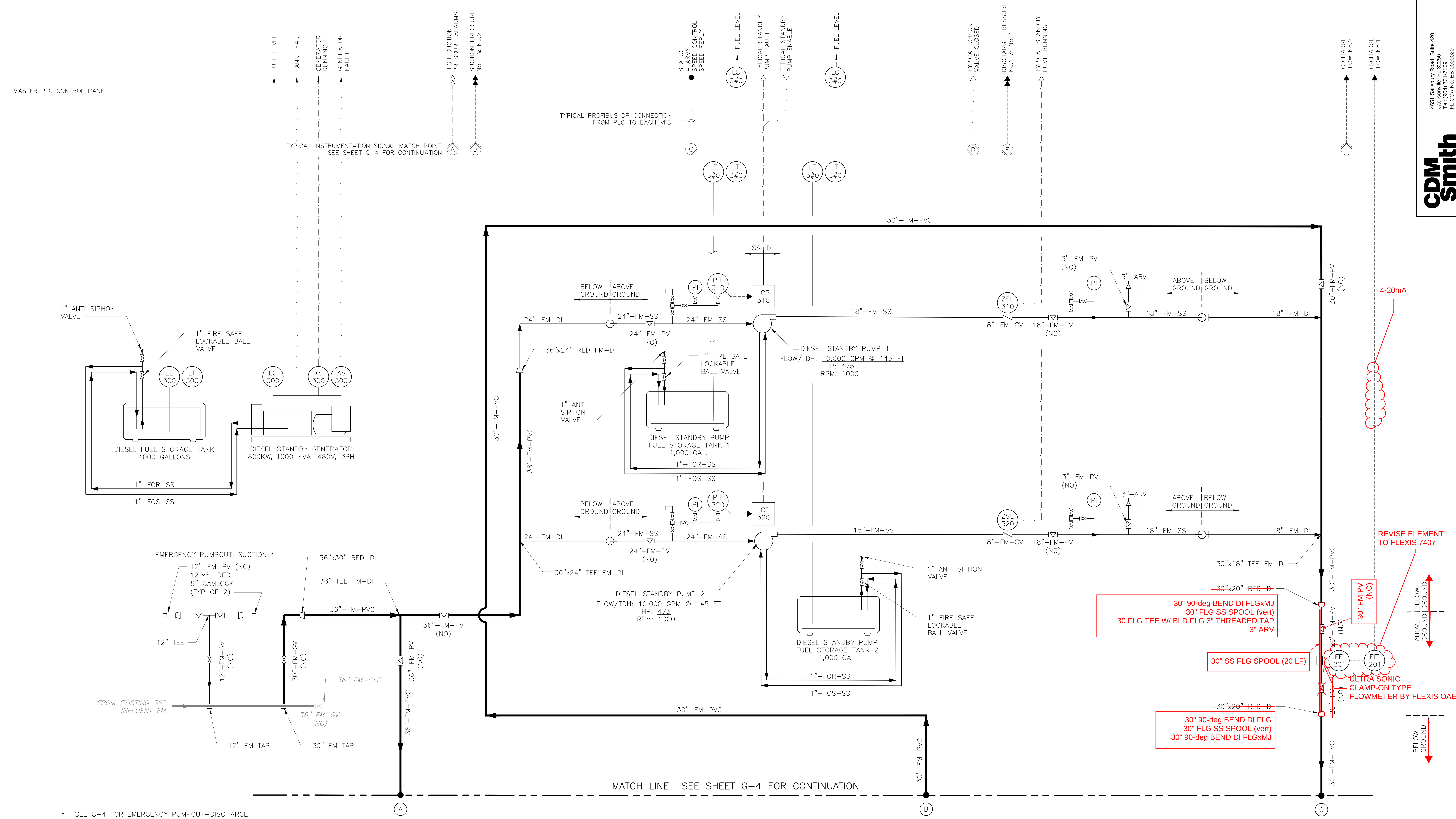

* SEE G-4 FOR EMERGENCY PUMPOUT-DISCHARGE.

NOTE:
1. SEE ELECTRICAL DRAWINGS FOR INSTRUMENTATION LEGEND AND ABBREVIATIONS.

CONTROL NARRATIVE:

A SUMMARY OF THE BASIC STATION OPERATION IS AS FOLLOWS: CONTROL OF ALL PUMPS WILL BE ON THE BASIS OF MAINTAINING A CONSTANT SUCTION PRESSURE OF 50-FT NGVD OR APPROXIMATELY 2 PSI ON THE SUCTION OF THE PUMPS. UNDER LOW FLOW CONDITIONS, (1,000 GPM TO 5,555 GPM) ONE OF THE JOCKEY PUMPS WILL BE OPERATING. WHEN FLOW BEGINS TO APPROACH THE HIGH END VALUE OF THE PUMP'S OPERATING RANGE, A PRIMARY BOOSTER PUMP WILL BE STARTED IN ORDER TO MAINTAIN THE SUCTION SET POINT, AND THE JOCKEY PUMP WILL BE STOPPED. THE LEAD JOCKEY PUMP DUTY WILL THEN ALTERNATE. AS FLOWS INCREASE AT THE STATION, THE PRIMARY BOOSTER PUMP SPEED WILL INCREASE TO THE MAXIMUM, AND AS REQUIRED TO MAINTAIN THE SET SUCTION PRESSURE, ADDITIONAL PRIMARY BOOSTER PUMPS WILL BE BROUGHT ON LINE MATCHING THE SPEED OF THE OPERATING PUMPS AND WORKING IN UNISON. AS FLOWS TEND TO DECREASE, THE PUMPS WILL BE SLOWED AND/OR STOPPED IN REVERSE ORDER TO MAINTAIN THE SUCTION SET POINT, WITH A JOCKEY PUMP RESTARTED TO HANDLE THE LOW FLOW CONDITION. THE LEAD PRIMARY BOOSTER PUMP SEQUENCE WILL THEN ROTATE. ON POWER FAIL, THE STANDBY GENERATOR WILL START AND ALL PUMP STATION LOADS WILL BE TRANSFERRED TO THE STANDBY GENERATOR, AND THE BOOSTER PUMP STATION WILL RESUME NORMAL OPERATIONS. ON HIGH SUCTION THE LEAD PUMP INITIALLY, AND AS SUCTION PRESSURE INCREASES, THE LAG AUXILIARY DIESEL PUMP WILL BE CALLED TO RUN. THE ENGINE SPEED GOVERNOR OF EACH DIESEL PUMP WILL PACE THE INFLUENT FLOW BASED ON MAINTAINING THE SUCTION PRESSURE SET POINT.

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DRAWN BY: A. NUNES
DATE: MAY 2019
CHECKED BY: E. STURTZ
DATE: MAY 2019

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JEA, BRADLEY ROAD
WASTEWATER BOOSTER PUMP STATION
PROCESS AND INSTRUMENTATION DIAGRAM 1 OF 2

PROJ. NO. 6103-108860
DATE: MAY 2019
SCALE: NTS

NO. SHEETS 79
SHEET NO. 4
DRAWING NO. G-3

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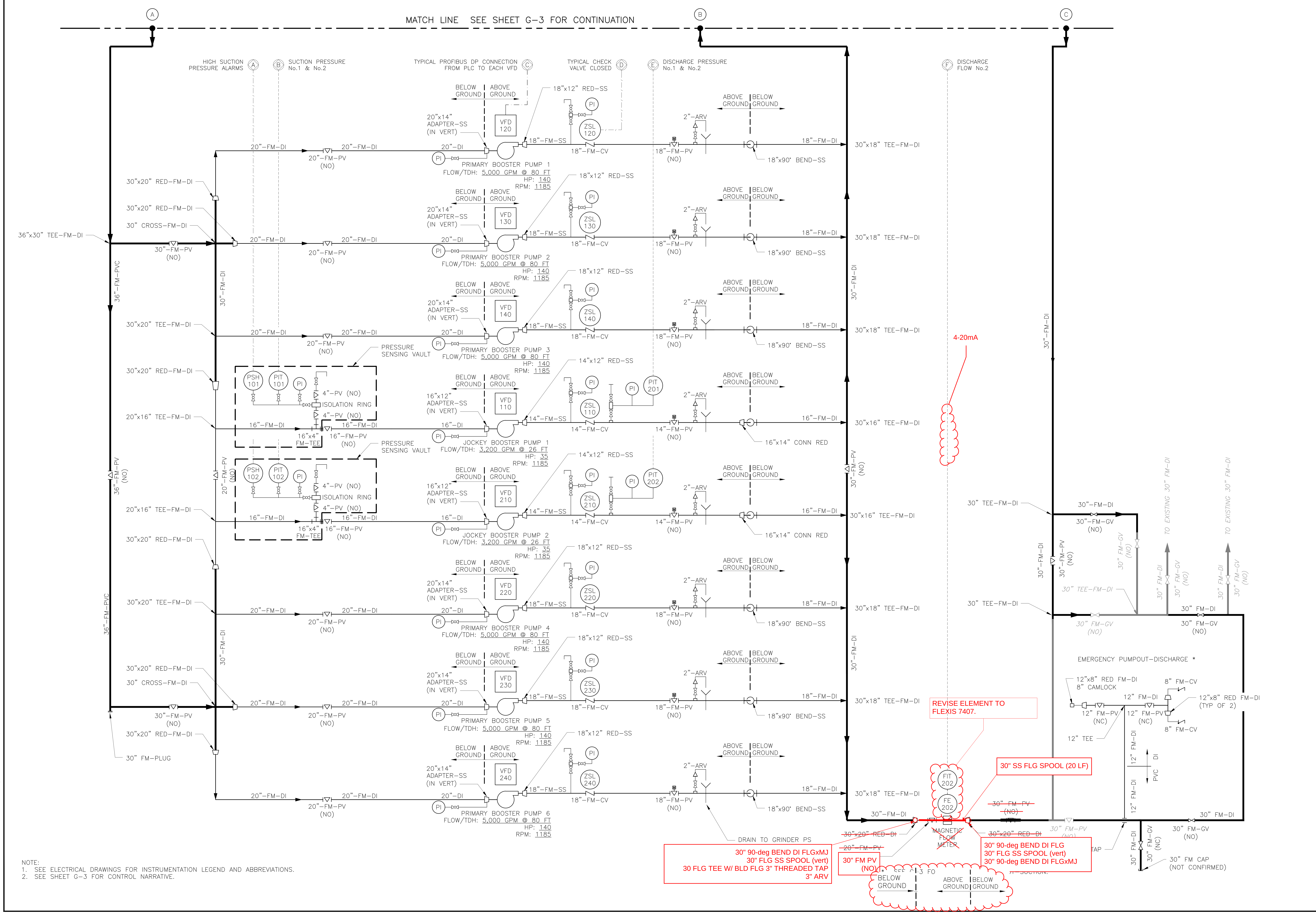

NOTE:
1. SEE ELECTRICAL DRAWINGS FOR INSTRUMENTATION LEGEND AND ABBREVIATIONS.
2. SEE SHEET G-3 FOR CONTROL NARRATIVE.

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JEA, BRADLEY ROAD
WASTEWATER BOOSTER PUMP STATION
PROCESS AND INSTRUMENTATION DIAGRAM 2 OF 2

PROJ. NO. 6103-108860
DATE: MAY 2019
SCALE: NTS
NO. SHEETS 79
SHEET NO. 5
DRAWING NO. G-4

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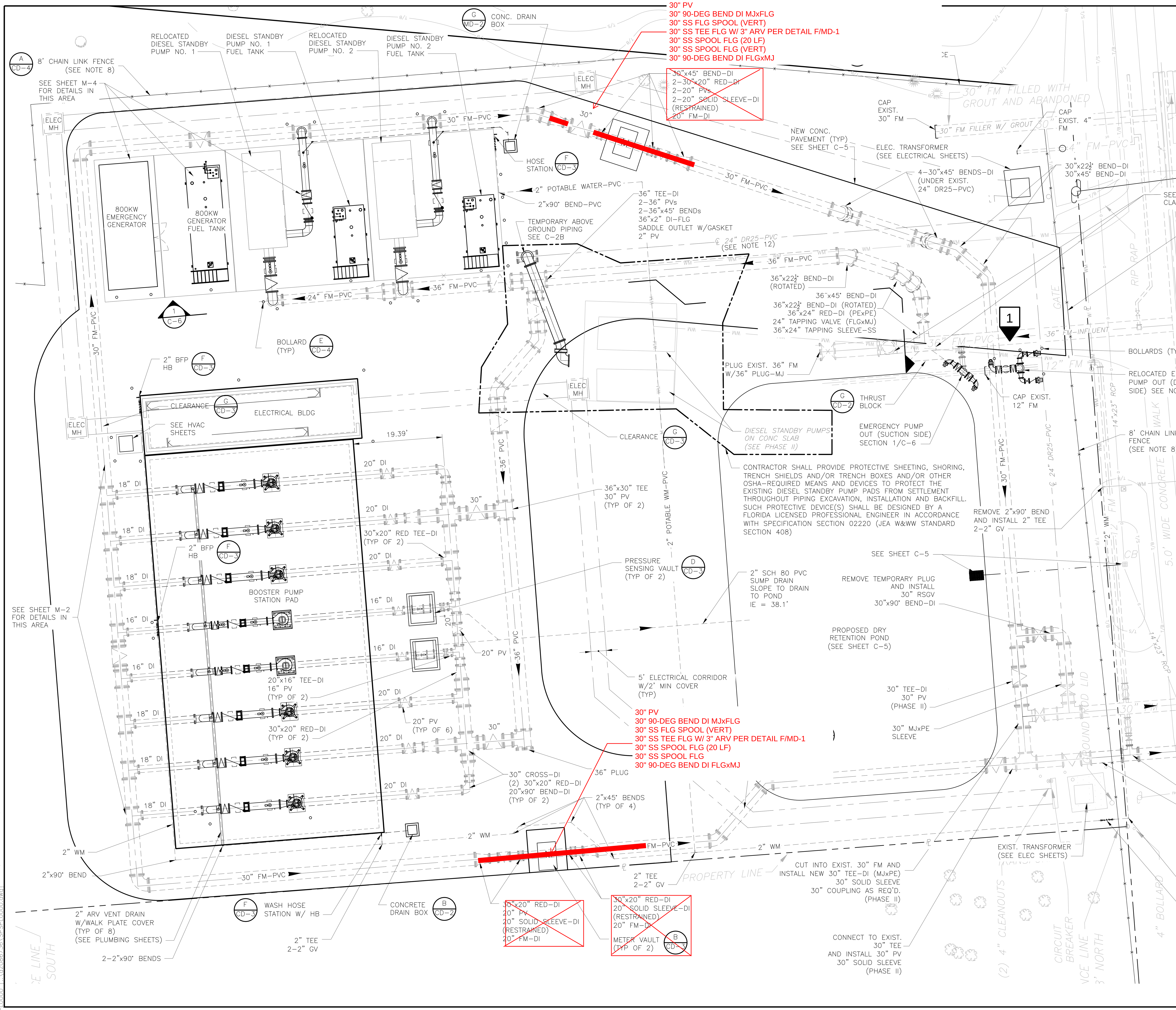

EMERGENCY PUMP OUT

PHOTO NO. 1

NTS

NOTES:

1. ALL BELOW GRADE PIPE, VALVES, JOINTS, AND FITTINGS SHALL BE RESTRAINED.
2. ALL ABOVE GRADE PIPING TO BE 316 SST. SEE MECHANICAL DRAWINGS FOR DETAILS.
3. ALL BELOW GRADE VALVES SHALL BE INSTALLED WITH VALVE BOXES PER JEA STANDARDS. ALL OTHER BELOW GRADE PIPING TO BE PVC. SEE MECHANICAL SHEETS FOR DETAILS.
4. REFERENCE SPECIFICATION 01014 FOR SEQUENCING OF CONSTRUCTION TO KEEP EXISTING PUMP STATION OPERATIONAL.
5. REFER TO SPECIFICATION SECTIONS 01014 AND 01465 FOR CONSTRUCTION SEQUENCING CONSTRAINTS AND EQUIPMENT TESTING AND STARTUP REQUIREMENTS.
6. CONTRACTOR TO PROVIDE TRENCH SHORING AND SUPPORT EXISTING UTILITIES AS NECESSARY TO PROTECT EXISTING PUMP STATION OPERATING SYSTEM.
7. ELECTRICAL CORRIDOR SHOWN FOR COORDINATION WITH PIPING. REFER TO ELECTRICAL DRAWINGS FOR ADDITIONAL ELECTRICAL INFORMATION.
8. ENTIRE PERIMETER FENCE TO BE REPLACED WITH NEW 8' CHAIN LINK FENCE.
9. REFER TO LANDSCAPE DRAWINGS FOR TREE DISPOSITION ALONG THE FENCE LINE.
10. SEE PLUMBING SHEETS FOR FUEL SYSTEM FOR FUEL TANKS.
11. CONTRACTOR SHALL POTHOLE AND VERIFY LOCATION AND ELEVATION OF ALL EXISTING PIPES AT POINTS OF CONNECTION AND FOR CROSSING PRIOR TO COMMENCING ORDER PIPE.
12. TEMPORARY 24" DIESEL PUMP CONNECTION AND EXIST. 24" DISCHARGE PIPE ℄ SHOWN TO CLARIFY CONSTRUCTION CONFLICTS. SEE SHEET C-6, C-2A AND C-2B. RELOCATE AND MODIFY AS SHOWN.
13. PLUG VALVE SEATS TO BE ORIENTED ON THE DOWNSTREAM END OF THE VALVE FOR ALL STATION SUCTION LINES, AND ON THE UPSTREAM END OF THE VALVE FOR ALL STATION DISCHARGE LINES. SEE SHEET C-7 FOR SUCTION AND DISCHARGE PIPE LIMITS AND FLOW DIRECTION.
14. ENGINEER TO FIELD LOCATE TWO ADDITIONAL BOLLARDS AT DIESEL PUMPS.

LEGEND:

1 PHOTO NUMBER AND DIRECTION

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DESIGNER: J. GOLDMAN DATE: MAY 2019
DRAWN BY: A. NUNES
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JEA, BRADLEY ROAD WASTEWATER BOOSTER PUMP STATION YARD PIPING PLAN

PROJ. NO. 6103-108860
DATE: MAY 2019
SCALE: 1" = 10'
NO. SHEETS 79
SHEET NO. 12
DRAWING NO. C-3

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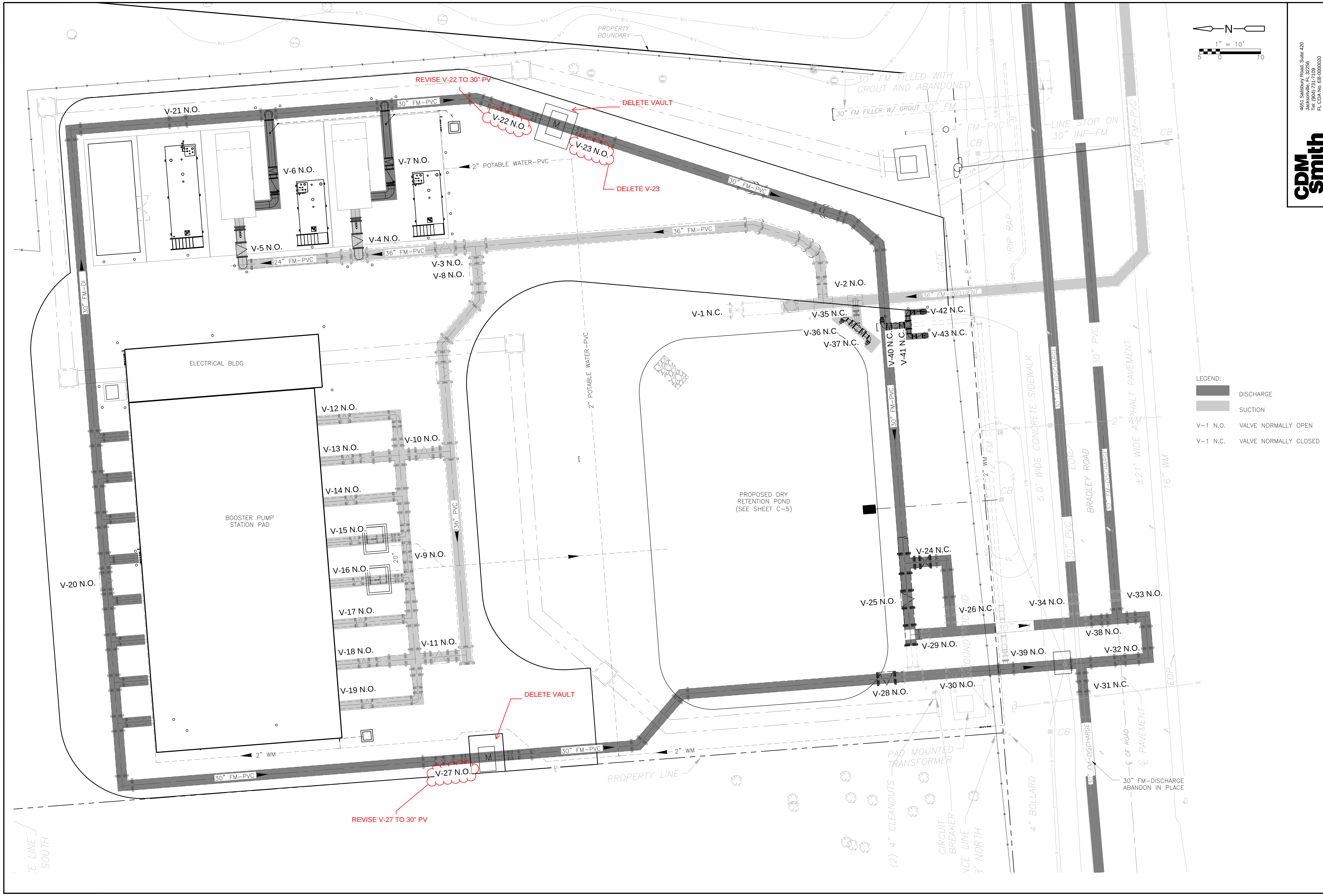

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JEA, BRADLEY ROAD WASTEWATER BOOSTER PUMP STATION YARD VALVE STATUS

PROJ. NO. 6103-108860
DATE: MAY 2019
SCALE: 1" = 10'

NO. SHEETS 79
SHEET NO. 16
DRAWING NO. C-7

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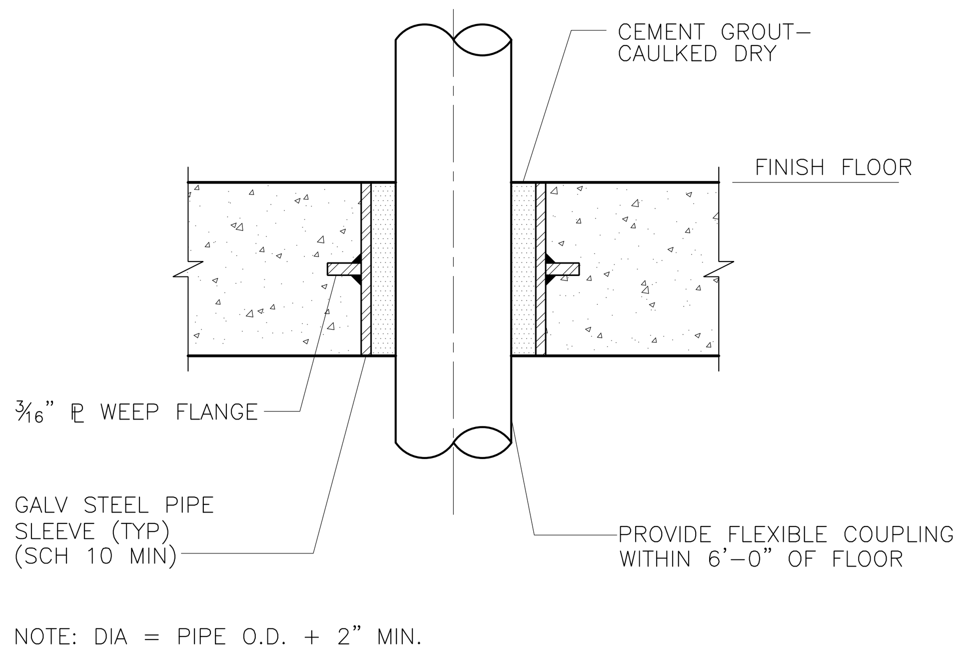
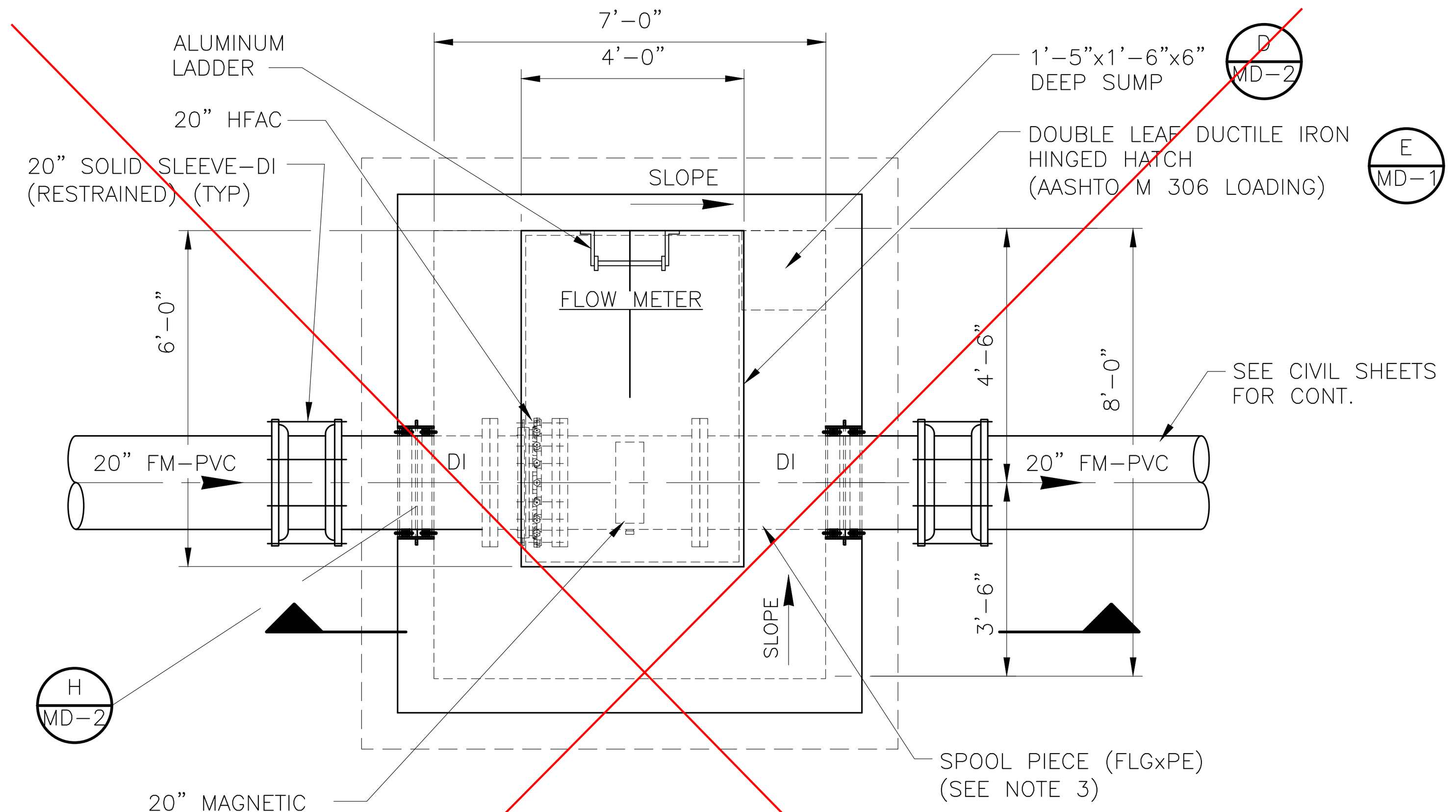


NOTE: DIA = PIPE O.D. + 2" MIN.

PIPE SLEEVE W/GROUT FLOOR PENETRATION

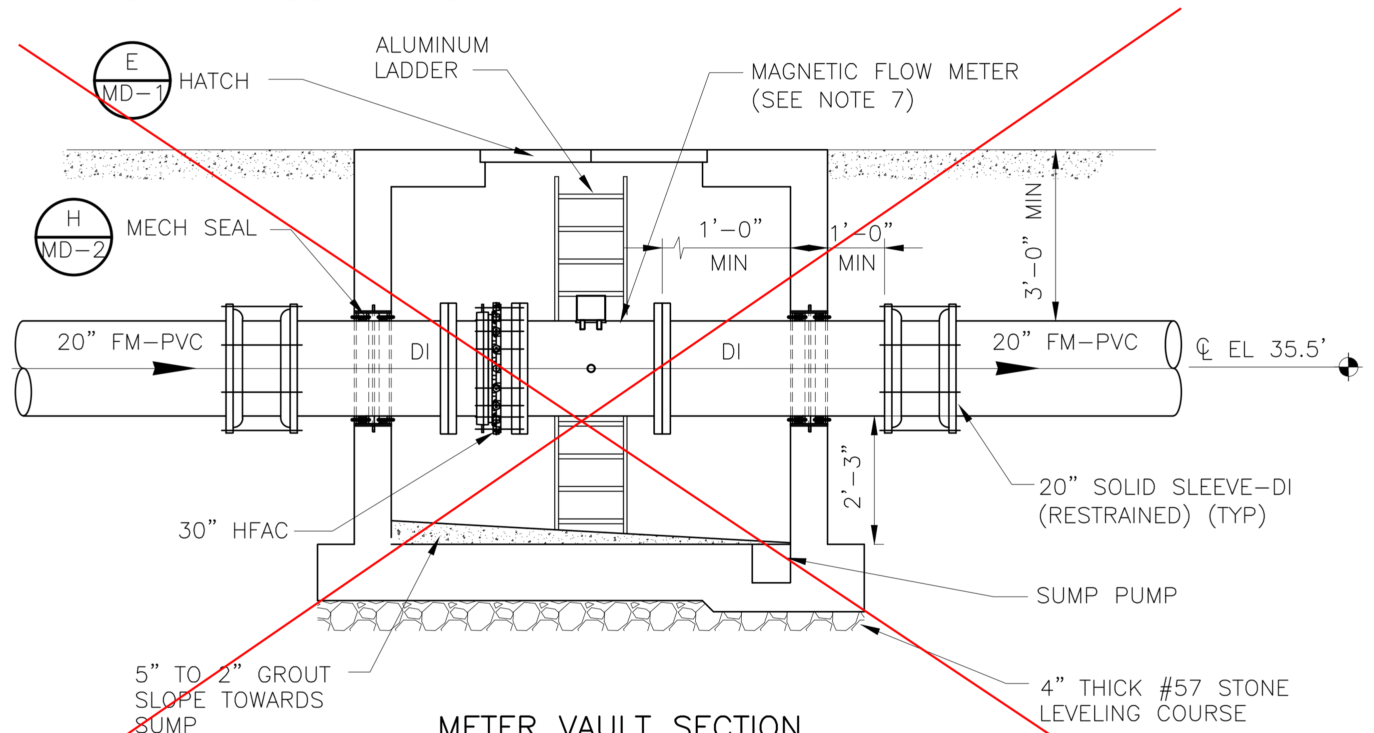
DETAIL A
NTS –



METER VAULT PLAN

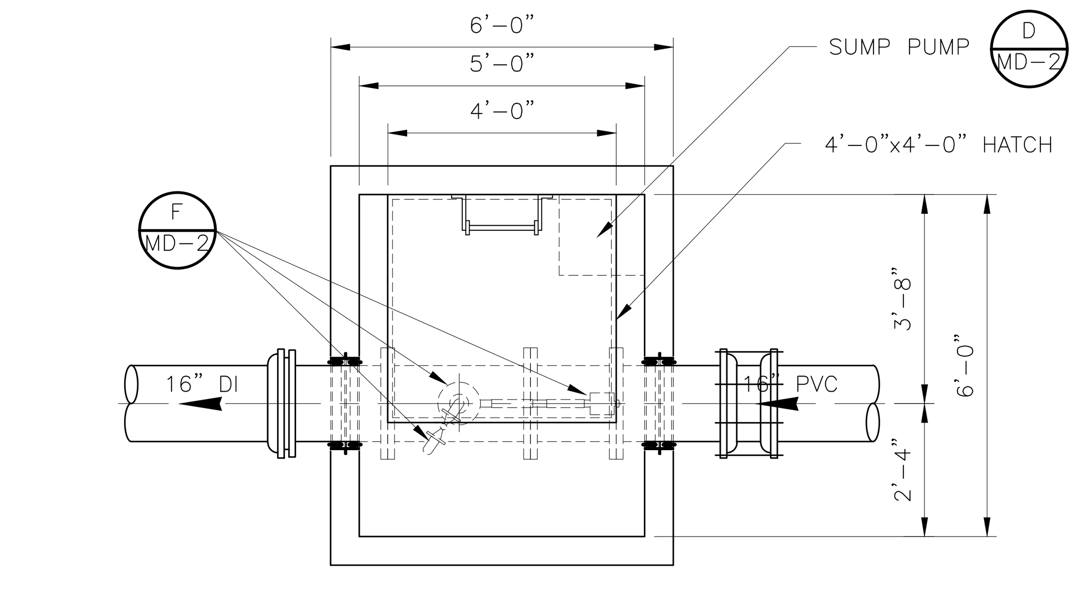
NOTES:

1. SEE ELECTRICAL SHEETS FOR CONDUIT PENETRATION REQUIREMENTS.
2. ROTATE THE ASSEMBLY 45° FACING THE ALUMINUM LADDER. (NOT ROTATED IN DRAWING FOR CLARITY).
3. CONTRACTOR TO CONFIRM REQUIRED SPOOL PIECE LAY LENGTH DIMENSION WITH FLOW METER MANUFACTURER.
4. CONTRACTOR TO CONFIRM FINAL GRADE AND MAIN ELEVATIONS.
5. ALL BELOW PIPING SHALL BE RESTRAINED.
6. MATCH GRADE IN CONCRETE PAVEMENT.
7. COORDINATE EXACT LOCATION AND INSTALLATION REQUIREMENTS OF MAGNETIC FLOW METER WITH MANUFACTURER.
8. ALL PIPE IN VAULT IS DI.
9. MINIMUM 5 PIPE DIAMETERS UPSTREAM OF FLOW METER TO VALVE.
10. CONTRACTOR TO PROVIDE A 20" FLGxFLG SPOOL PIECE OF EQUAL LENGTH OF METER TO OWNER.



METER VAULT SECTION

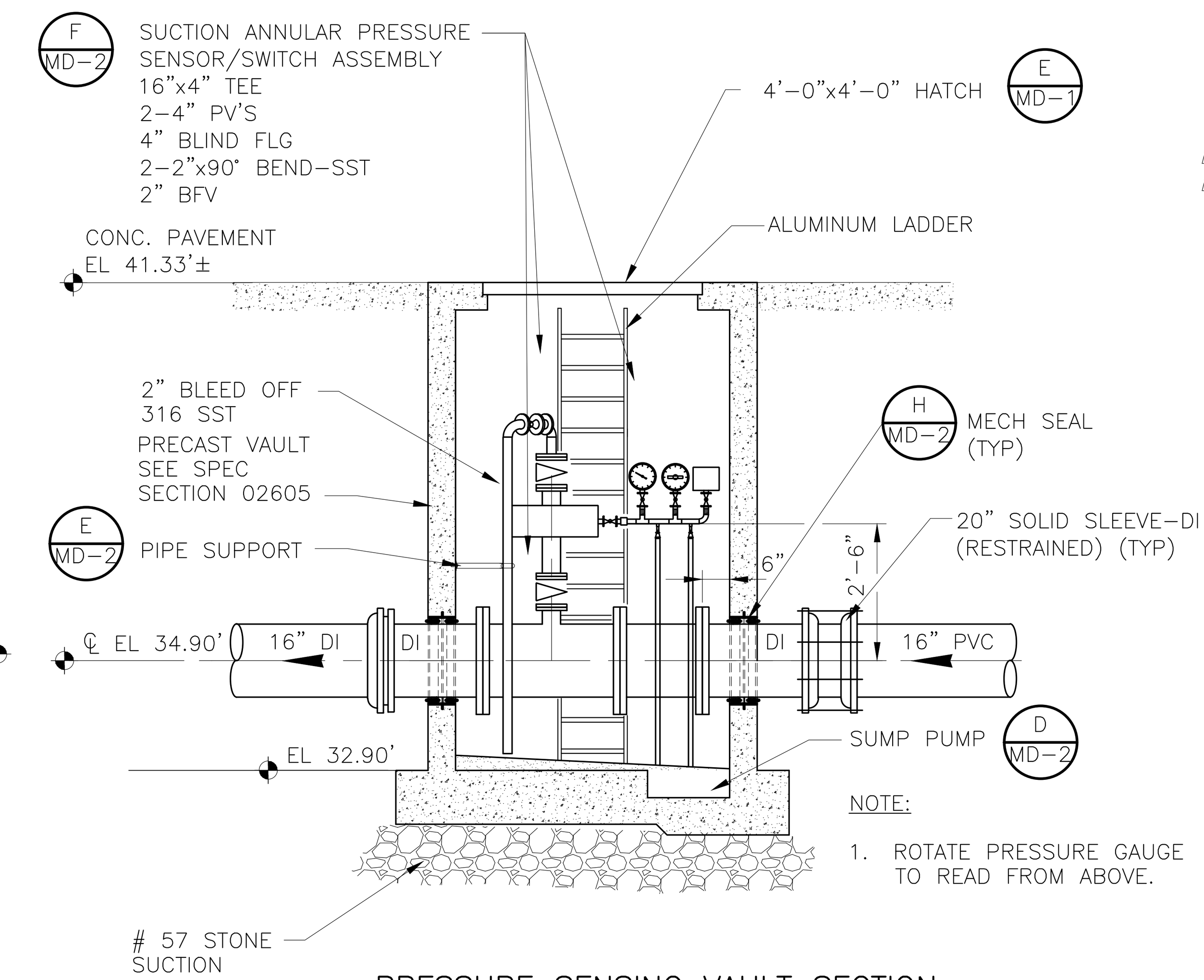
DETAIL B
NTS C–3



PRESSURE SENSING VAULT PLAN

NOTES:

1. SEE ELECTRICAL SHEETS FOR CONDUIT PENETRATION REQUIREMENTS.
2. SEE CIVIL SHEETS FORM ORIENTATION OF SUMP PUMP DISCHARGE.
3. ROTATE THE ASSEMBLY 45° FACING THE ALUMINUM LADDER. (NOT ROTATED IN DRAWING FOR CLARITY).
4. CONTRACTOR TO CONFIRM FINAL GRADE AND MAIN ELEVATIONS.
5. MATCH PAVEMENT ELEVATIONS.
6. ALL BELOW PIPING SHALL BE RESTRAINED.
7. ALL PIPE IN VAULT IS DI.

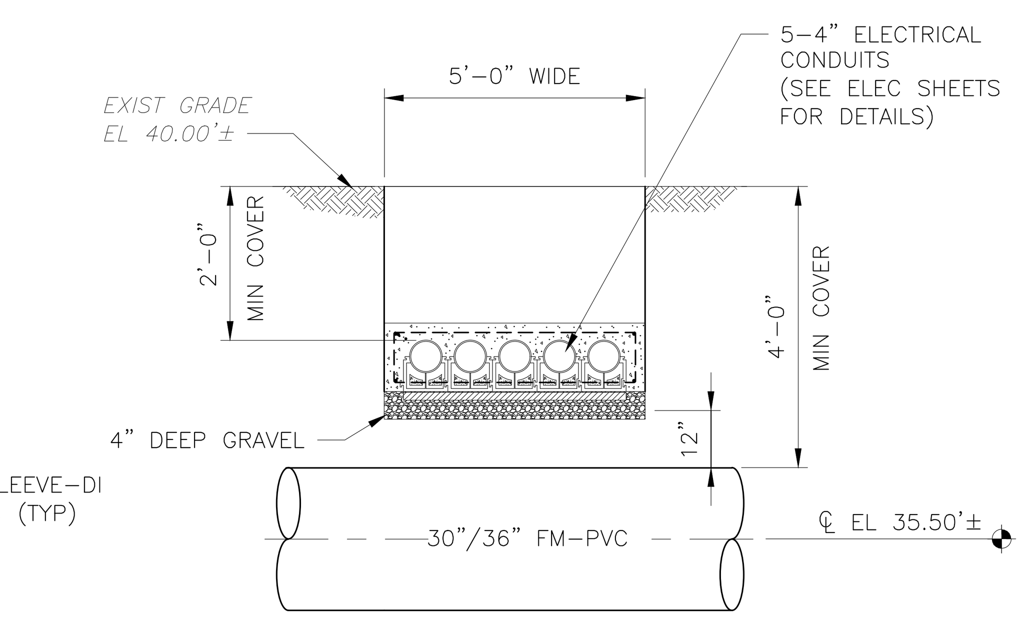


NOTE:

1. ROTATE PRESSURE GAUGE TO READ FROM ABOVE.

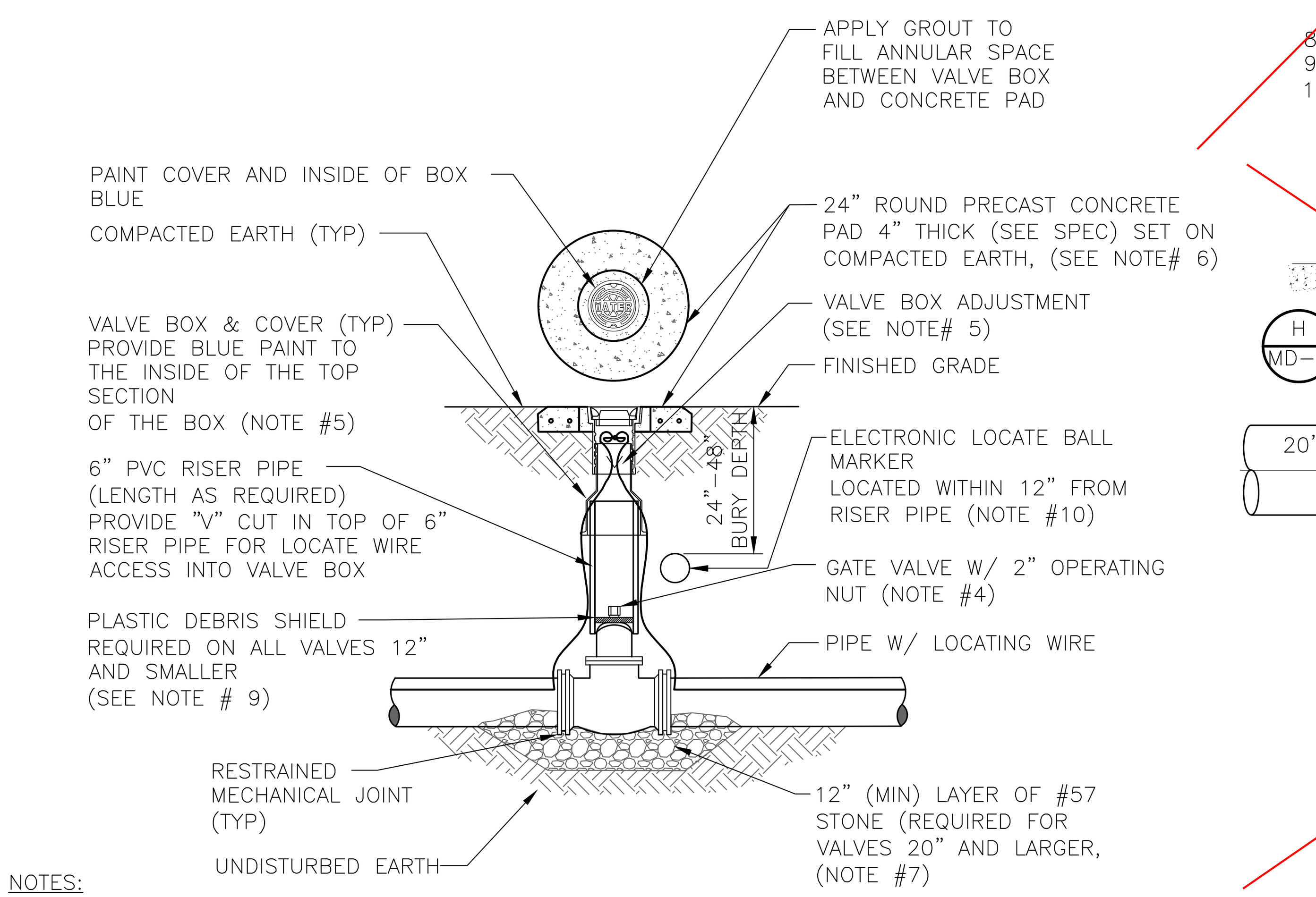
PRESSURE SENSING VAULT SECTION

DETAIL D
3/8" = 1'–0" C–3



FM AND ELECTRICAL CORRIDOR CLEARANCE DETAIL

DETAIL G
NTS C–3



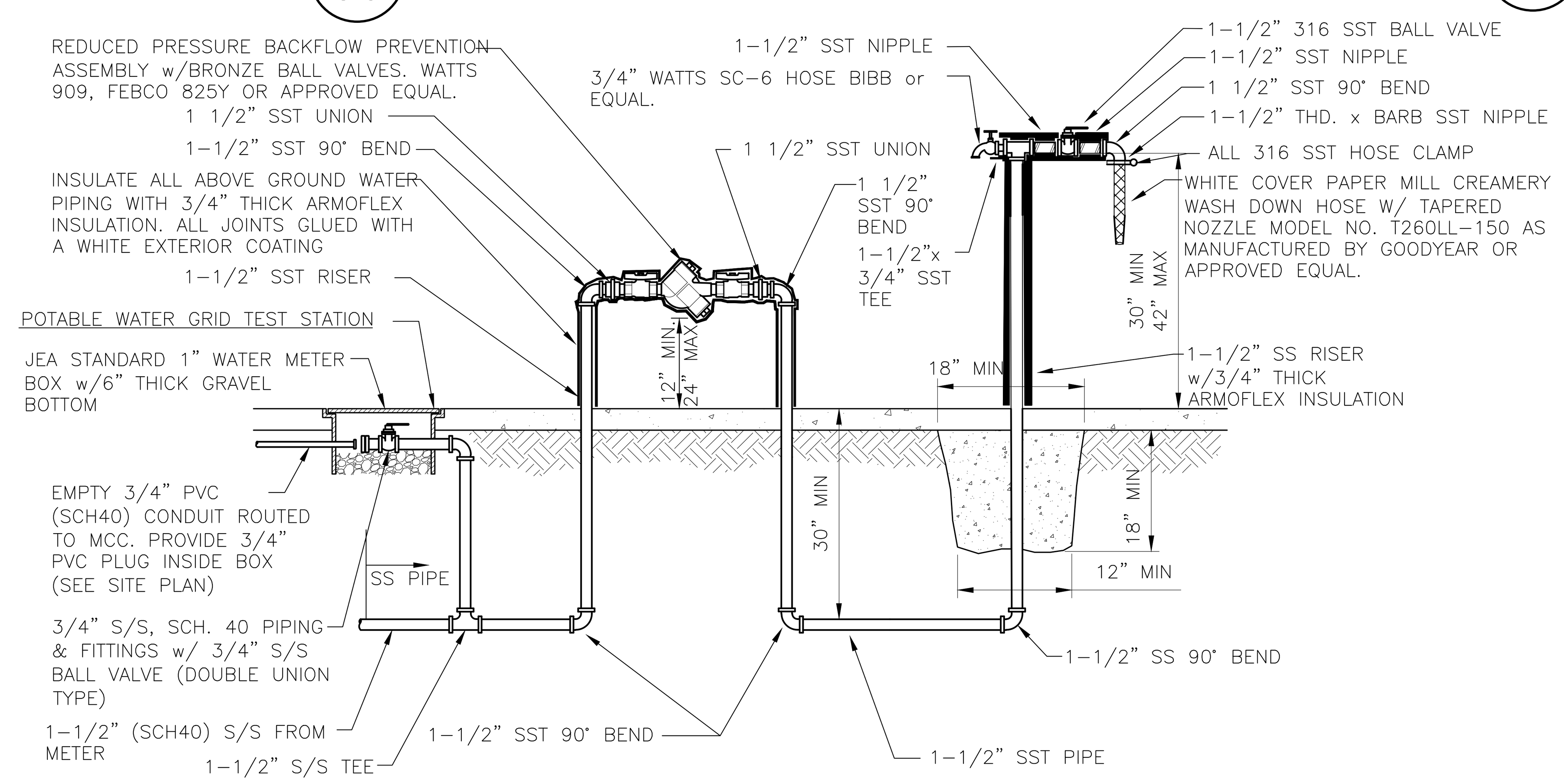
NOTES:

1. FOR UNPAVED LOCATIONS, A PRECAST CONCRETE VALVE PAD SHALL BE PROVIDED AND INSTALLED FLUSH WITH GRADE. CONCRETE PAD IS NOT REQUIRED FOR VALVE LOCATED IN THE ROADWAY, UNLESS SHOWN OR NOTED OTHERWISE.
2. LOCATING WIRE IS REQUIRED ON ALL PRESSURE PIPING (SEE DETAILW–44).
3. A "V" CUT SHALL BE CARVED IN THE CURB CLOSEST/ADJACENT TO ALL BELOW GRADE VALVES. THE "V" CUT IS TO BE PAINTED GREEN.
4. IN PAVED AREAS, INSTALL VALVE AT A DEPTH TO ALLOW A 12" MIN. DISTANCE BETWEEN THE VALVE COVER PLATE AND THE TOP OF THE VALVE OPERATING NUT. OUTSIDE OF PAVED AREAS (GRASS), INSTALL VALVE AT A DEPTH TO ALLOW A 6" MINIMUM DISTANCE BETWEEN THE VALVE COVER AND THE TOP OF THE VALVE OPERATING NUT. OPERATING NUT/STEM EXTENSION SHALL BE PROVIDED (WHERE APPLICABLE) SO THAT THE OPERATING NUT WILL BE NO MORE THAN 30 INCHES BELOW FINISHED GRADE.
5. FOR NEW CONSTRUCTION, THE VALVE BOX SHALL BE ADJUSTED TO MIDRANGE TO ALLOW FOR FUTURE BOX ADJUSTMENTS. ROUTE LOCATE WIRES THRU A "V" CUT IN THE TOP OF THE 6" PVC RISER PIPE FOR LOCATE WIRE ACCESS INTO VALVE BOX. THE LOCATE WIRES WITH A 12" LONG PIG–TAIL AT THE TOP SHALL BE CONNECTED TOGETHER WITH A WIRE NUT.
6. BRASS IDENTIFICATION TAG INDICATING "WATER", VALVE SIZE, DIRECTION AND TURNS TO OPEN & VALVE TYPE. PROVIDE A 1/4" HOLE IN BRASS TAG AND ATTACH TAG (TWIST WIRE AROUND TAG) TO THE END OF THE LOCATE WIRE. TAGS ARE NOT REQUIRED ON VALVES INSTALLED ON FIRE HYDRANT BRANCH LINES.
7. IN LIEU OF PRECAST CONCRETE PAD, A 6" THICK X 24" (ROUND OR SQUARE) POURED CONCRETE PAD W/2 – #4 REBAR AROUND PERIMETER, MAY BE USED.
8. GRAVEL SHALL BE PROVIDED UNDER ALL VALVES 20" AND LARGER. THE MINIMUM VERTICAL LIMIT OF GRAVEL IS 12" UNDER THE VALVE UP TO 1/3 THE OVERALL HEIGHT OF THE VALVE.
9. FOR VALVES 12 INCH AND SMALLER, PROVIDE A WHITE OR BLACK PLASTIC DEBRIS SHIELD WHICH INSTALLS BELOW THE OPERATING NUT. THIS SHIELD SHALL CENTER THE RISER PIPE BOX OVER THE OPERATING NUT AND MINIMIZE INFILTRATION. SHIELD SHALL BE BY AFC, BOXLOK OR APPROVED EQUAL.
10. ALL VALVES SHALL BE INSTALLED WITH AN ELECTRIC LOCATE MARKER. MARKER SHALL BE 4" DIA. COLOR CODED BALL MARKER (3M–1403XR FOR WATER AND 1408XR FOR RECLAIMED WATER).

WATER VALVE INSTALLATION DETAIL

JANUARY 2016 PLATE W-18

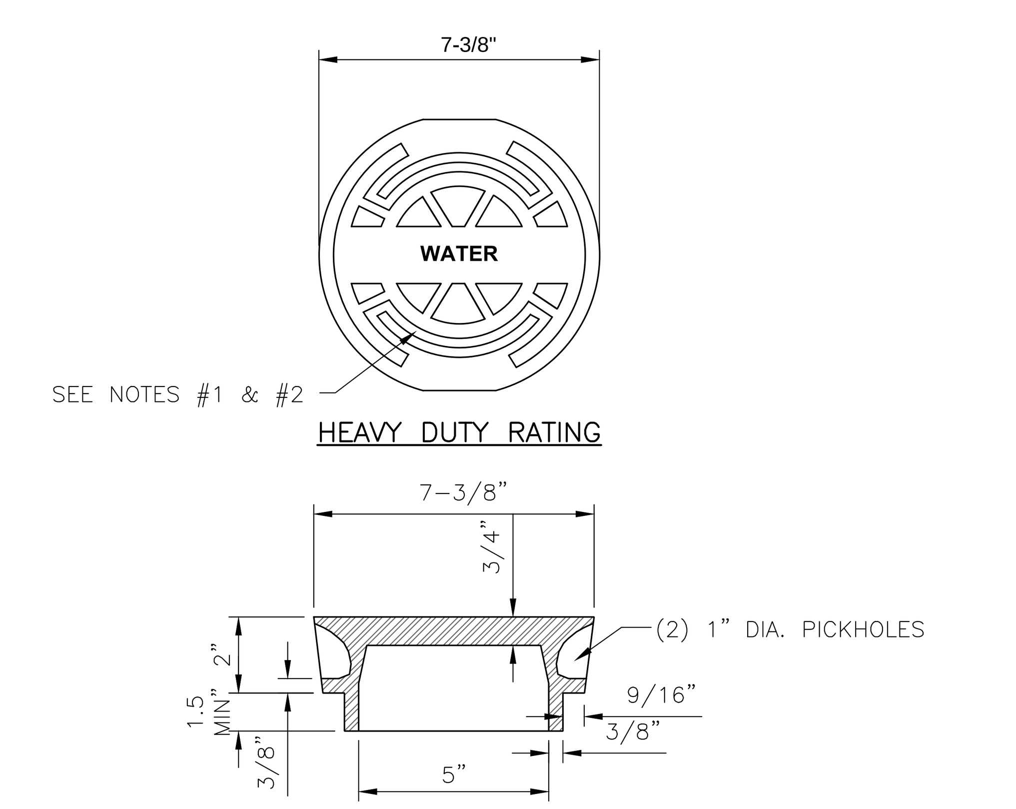
DETAIL E
NTS –



NOTE: ALL PIPING ABOVE AND UNDER CONCRETE SLAB SHALL BE 316 SST SCHEDULE 40.

HOSE STATION

DETAIL F
NTS C–3



SEE NOTES #1 & #2

HEAVY DUTY RATING

NOTES:

1. PAINT TOP OF THE COVER WITH ENAMEL PAINT (BLUE COLOR) FOR WATER.
2. LID WEIGHT: APPROX. 12 LBS.

WATER SYSTEM VALVE BOX COVER

JANUARY 2016 PLATE W-16

DETAIL J
N.T.S –

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CHECKED BY: E. STURTZ
DATE: MAY 2019

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JEA, BRADLEY ROAD
WASTEWATER BOOSTER PUMP STATION
STANDARD DETAILS

PROJ. NO. 6103-108860
DATE: MAY 2019
SCALE: NTS

NO. SHEETS 79
SHEET NO. 19
DRAWING NO. CD-3

ISSUED FOR BID - MAY 2019

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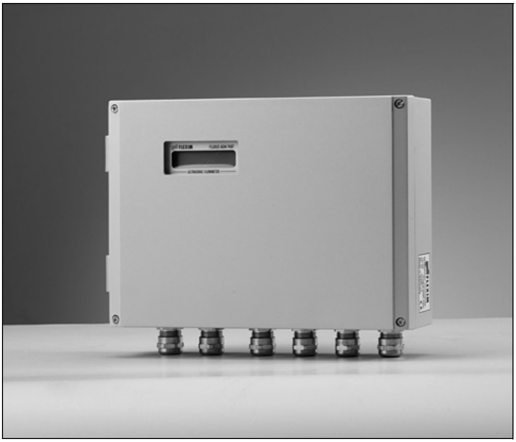
User Manual

UMFLUXUS_F7V4-0-2EN

Ultrasonic Flowmeter for Liquids

FLUXUS ADM 7407
FLUXUS ADM 7407 A2



FLUXUS ADM 7907

Firmware V5.xx

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E-mail: flexim@flexim.de
www.flexim.com

User manual for
FLUXUS ADM 7x07
UMFLUXUS_F7V4-0-2EN, 2011-03-16
Firmware V5.xx

Die Sprache, in der die Anzeigen auf dem Messumformer erscheinen, kann eingestellt werden (siehe Abschnitt 9.4).

The transmitter can be operated in the language of your choice (see section 9.4).

Il est possible de sélectionner la langue utilisée par le transmetteur à l'écran (voir section 9.4).

El caudalímetro puede ser manejado en el idioma de su elección (ver sec-- ción 9.4).

Table of Contents

Annex

1 Introduction

1.1 Regarding this Manual

This manual has been written for the personnel operating the ultrasonic flowmeter FLUXUS. It contains important information about the instrument, how to handle it correctly, and how to avoid damages.

Make sure you have read and understood this manual before using the instrument.

Attention!	Observe the Safety Instructions for the Use in Explosive Atmosphere (see document SIFLUXUS).

Read the safety Instructions carefully. Make sure you have read and understood this manual before using the instrument.

All reasonable effort has been made to ensure the correctness of the content of this user manual. However, If you find any erroneous information, please inform us. We will be grateful for any suggestions and comments regarding the concept and your experience working with the instrument.

This will ensure that we can further develop our products for the benefit of our customers and in the interest of technological progress. If you have any suggestions about improving the documentation and particularly this user manual, please let us know so that we can consider your comments for future reprints.

1.2 Safety Instructions

The user manual contains instructions that are marked as follows:

Note!	This text contains important information about the use of the flowmeter.

Attention!	This text contains important instructions which should be observed to avoid damage or destruction of the flowmeter. Proceed with special caution!

	This texts contains instructions according to directive 94/9/EC.

Observe these safety instructions!

1.3 Warranty

The FLUXUS flowmeter is guaranteed for the term and to the conditions specified in the sales contract provided the equipment has been used for the purpose for which it has been designed and operated according to the instructions given in this User Manual. Misuse of the FLUXUS will immediately revoke any warranty given or implied.

This includes:

- replacement of a component of FLUXUS with a component that was not approved by FLEXIM
- unsuitable or insufficient maintenance
- repair of FLUXUS by unauthorized personnel

FLEXIM assumes no responsibility for injury to the customer or third persons proximately caused by the material owing to defects in the product which were not predictable or for any indirect damages.

FLUXUS is a very reliable instrument. It is manufactured under strict quality control, using modern production techniques. If installed as recommended in an appropriate location, used cautiously and taken care of conscientiously, no troubles should appear.

If any problem appears which can not be solved with the help of this manual (see chapter 20), contact our sales office giving a precise description of the problem. Specify the type, serial number and firmware version of the flowmeter.

2 Handling

2.1 First Inspection

The flowmeter has already been tested thoroughly at the factory. At delivery, proceed to a visual control to make sure that no damage has occurred during transportation.

Check that the specifications of the flowmeter delivered correspond to the specifications given on the purchase order.

The type and the serial number of the transmitter are shown on the nameplate. The transducer type is printed on the transducers.

2.2 General Precautions

Attention!	Observe the Safety Instructions for the Use in Explosive Atmosphere (see document SIFLUXUS).

FLUXUS is a precision measuring instrument and must be handled with care. To obtain good measurement results and not damage the instrument, it is important that great attention is paid to the instructions given in this user manual, particularly to the following points:

- Protect the transmitter from shocks.
- The housing may only be opened by authorized personnel. The degree of protection of the transmitter FLUXUS ADM 7407 A2 and FLUXUS ADM 7407 will only be ensured if the front plate is tightly screwed to the housing.
- Keep the transducers clean. Manipulate the transducer cables with caution. Avoid excessive cable bend.
- Make sure to work under correct ambient and operating temperatures. The ambient temperature must be within the operating temperature range of the transmitter and the transducers (see annex B, section Technical Data).
- Observe the degree of protection (see annex B, section Technical Data).

2.3 Cleaning

- Clean the transmitter with a soft cloth. Do not use detergents.
- Remove traces of the coupling compound from the transducers with a soft paper towel.

3 Transmitter

3.1 Measurement Principle

The flow of the medium is measured by ultrasonic signals using the transit time difference method.

Ultrasonic signals are emitted by a transducer installed on one side of the pipe, reflected on the opposite side and finally received by a second transducer. The signals are emitted alternatively in and against the flow direction.

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

The transit time difference Δt is measured, allowing to determine the average flow velocity on the propagation path of the ultrasonic signals. A flow profile correction is then performed to obtain the area average of the flow velocity, which is proportional to the volumetric flow rate.

The received ultrasonic signals are tested for their usefulness for the measurement and the plausibility of the measured values is evaluated. The complete measuring procedure is controlled by the integrated microprocessors. Disturbance signals are eliminated.

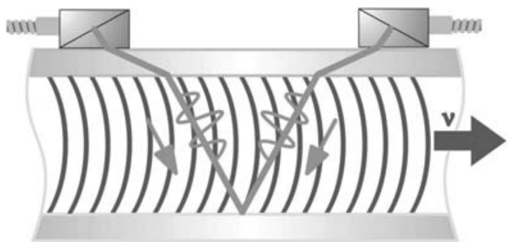


Fig. 3.1: Path of the ultrasonic signal

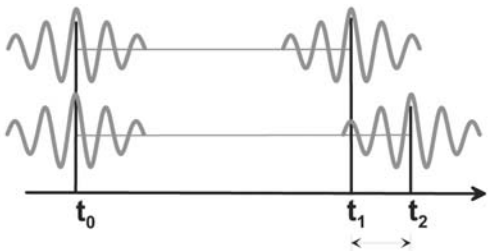


Fig. 3.2: Transit time difference Δt

3.2 Serial number

The type and the serial number are shown on the nameplate of the transmitter. When contacting FLEXIM, always have both numbers and the number of the firmware version at hand (see section 15.5).

3.3 Description of the Transmitter

Attention!	The degree of protection of the transmitter will only be ensured if the cable glands are firmly tightened and the housing is tightly screwed.

3.3.1 Design of FLUXUS ADM 7407 A2 and FLUXUS ADM 7407

The front plate has to be removed to access the command panel.

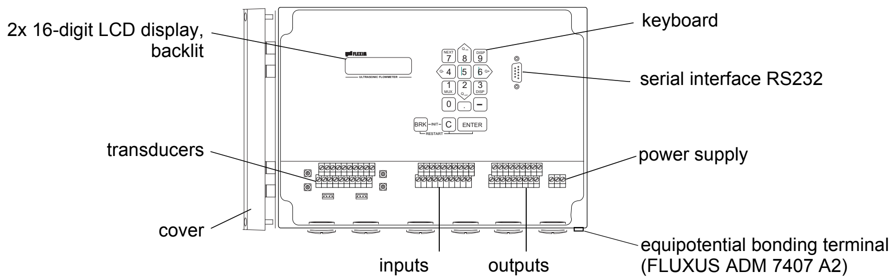


Fig. 3.3: Command panel of FLUXUS ADM 7407 A2 and FLUXUS ADM 7407

3.3.2 Design of FLUXUS ADM 7907

The transmitter is designed as a 19 " module (42 HP, 3 U).

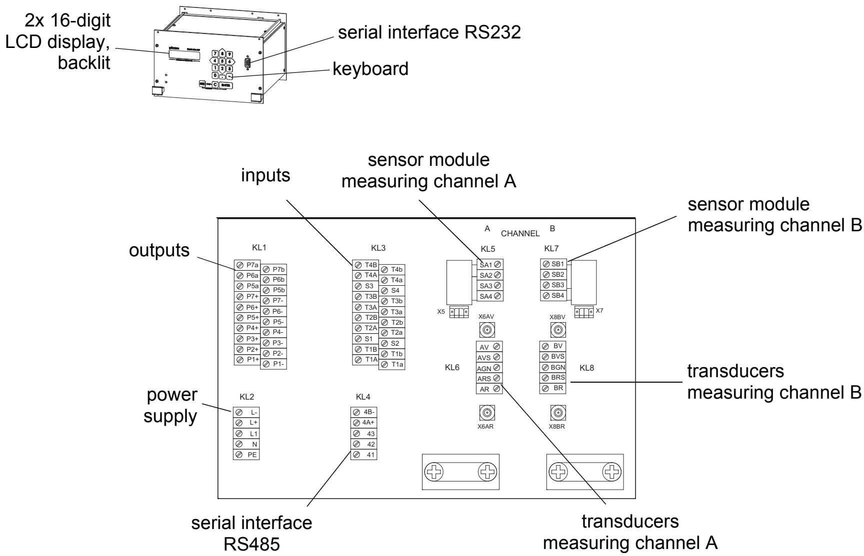


Fig. 3.4: Command panel and terminal board of FLUXUS ADM 7907

3.4 Keyboard

The keyboard consists of three function keys ENTER, BRK and C and ten numerical keys.

Several keys have double functions. They can be used for entering data and for navigating through scroll lists.

The arrow-shaped keys Q- 4, 6 Q+, QON 8 and 2 QOFF are used as cursor keys in the selection mode and for entering digits and letters in the input mode.

Table 3.1: General functions

ENTER	confirmation of selection or of entered value
BRK + C + ENTER	RESET: Press these three keys simultaneously to correct a malfunction. The reset has the same effect as restarting the transmitter. Stored data are not affected.
BRK	interruption of the measurement and selection of the main menu Be careful not to stop a current measurement by inadvertently pressing key BRK!

Table 3.2: Navigation

BRK	selection of the main menu
Q- 4 6 Q+	scroll to the left/right through a scroll list
QON 8 2 QOFF	scroll upwards/downwards through a scroll list
ENTER	confirmation of the selected menu item

Table 3.3: Input of digits

0 ... DISP 9	input of the digit shown on the key
LF –	sign for the input of negative values
LIGHT .	decimal marker
C	Delete values. After the value has been deleted, the previous value will be displayed.
ENTER	confirmation of input

Table 3.4: Input of text

Q- 4 6 Q+	positioning of the cursor
DISP 9	changing the currently selected character to an "A"
3 DISP	changing the currently selected character to a "Z"
5	changing between small and capital letters
QON 8 2 QOFF	selection of the precedent/next ASCII character
0	deleting the character and inserting a blank
NEXT 7 ... 1 MUX	Automatic scrolling up or down through the limited ASCII character set. The character changes every second. The scrolling is stopped by pressing any other key.
ENTER	finishing editing

Table 3.5: Cold start

BRK + C	INIT (cold start): Most parameters and settings are reset to the factory default values. Stored data is not affected. Keep the two keys pressed while switching the transmitter on until the main menu is displayed. A cold start during operation is executed as follows: • Press the keys BRK, C and ENTER simultaneously. A RESET is executed. • Release key ENTER only. Keep the keys BRK and C pressed until the main menu is displayed.

4 Selection of the Measuring Point

Attention!	Observe the Safety Instructions for the Use in Explosive Atmosphere (see document SIFLUXUS).

The correct selection of the measuring point is crucial for achieving reliable measurement results and a high measurement accuracy.

A measurement on a pipe is possible if

- the ultrasound propagates with a sufficiently high amplitude (see section 4.1)
- the flow profile is fully developed (see section 4.2)

The correct selection of the measuring point and thus, the correct transducer positioning guarantees that the sound signal will be received under optimum conditions and evaluated correctly.

Due to the variety of applications and the different factors that influence the measurement, there is no standard solution for the transducer positioning. The correct position of the transducers is influenced by the following factors:

- diameter, material, lining, wall thickness and form of the pipe
- medium
- gas bubbles in the medium

Avoid measuring points in the vicinity of deformations and defects of the pipe and in the vicinity of welds.

Avoid locations with deposit formation in the pipe.

The ambient temperature must be within the operating temperature range of the transducers (see annex B, section Technical Data).

Select the location of the transmitter within cable reach of the measuring point.

The ambient temperature at the location must be within the operating temperature range of the transmitter (see annex B, section Technical Data).

If the measuring point is within an explosive atmosphere, the danger zone and gases that may be present must be determined. The transducers and the transmitter must be appropriate for these conditions.

4.1 Acoustic Penetration

The pipe must be acoustically penetrable at the measuring point. The acoustic penetration is reached when pipe and medium do not attenuate the sound signal so strongly that it is completely absorbed before reaching the second transducer.

The attenuation in the pipe and in the medium depends on:

- kinematic viscosity of the medium
- proportion of gas bubbles and solids in the medium
- deposits on the inner pipe wall
- pipe material

The following requirements must be met at the measuring point:

- the pipe is always filled completely
- no material deposits in the pipe
- no bubbles accumulate

Note!	Even bubble-free media can form gas bubbles when the medium expands, e.g. before pumps and after great cross-section extensions.

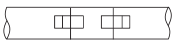
Observe the notes in Table 4.1.

Table 4.1: Recommended mounting position

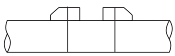
horizontal pipe

Select a measuring point where the transducers can be mounted on the side of the pipe, allowing the sound waves to propagate in the pipe horizontally. Thus, solid deposits on the bottom of the pipe or gas bubbles in the pipe's upper part will not influence the propagation of the signal.

correct :



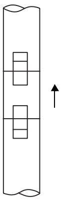
disadvantageous:



vertical pipe

Select the measuring point at a pipe location where the medium flows upward. The pipe must be completely filled.

correct :



disadvantageous:

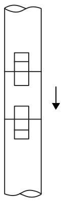
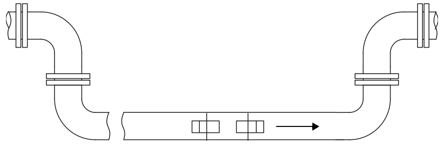


Table 4.1: Recommended mounting position

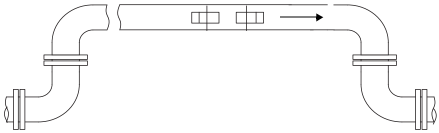
free inlet or outlet pipe section:

Select the measuring point at a pipe location where the pipe can not run empty.

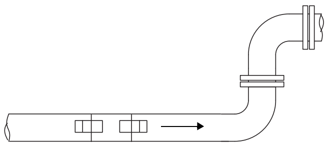
correct :



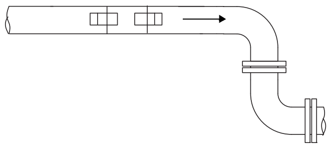
disadvantageous:



correct :



disadvantageous:



4.2 Undisturbed Flow Profile

Some flow elements (elbows, slide valves, valves, control valves, pumps, reducers, diffusers, etc.) distort the flow profile in their vicinity. The axisymmetrical flow profile needed for correct measurement is no longer given. A careful selection of the measuring point helps to reduce the impact of disturbance sources.

It is most important that the measuring point is chosen at a sufficient distance from any disturbance sources. Only then it can be assumed that the flow profile in the pipe is fully developed. However, measuring results can be obtained even if the recommended distance to disturbance sources can not be observed for practical reasons.

Recommended straight inlet and outlet pipe lengths for different types of flow disturbance sources are shown in the examples in Table 4.2.

Table 4.2: Recommended distance from disturbance sources
D = nominal pipe diameter at the measuring point, l = recommended distance

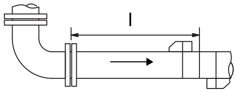
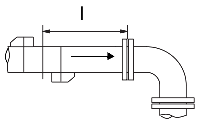
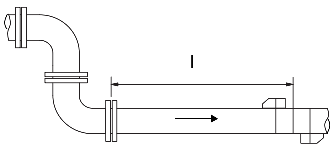
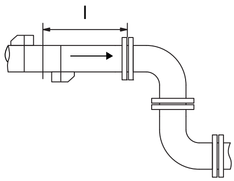
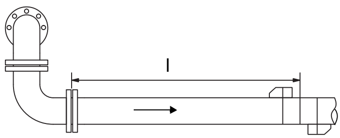
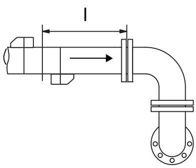
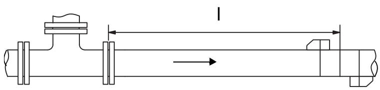
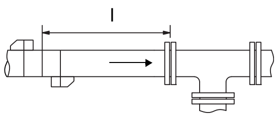
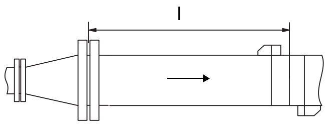
disturbance source: 90° elbow	
supply line: l ≥ 10 D	return line: l ≥ 5 D
	
disturbance source: 2x 90° elbows on same level	
supply line: l ≥ 25 D	return line: l ≥ 5 D
	
disturbance source: 2x 90° elbows on different level	
supply line: l ≥ 40 D	return line: l ≥ 5 D
	
disturbance source: T piece	
supply line: l ≥ 50 D	return line: l ≥ 10 D
	

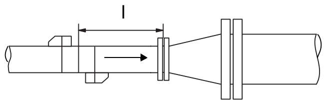
Table 4.2: Recommended distance from disturbance sources
D = nominal pipe diameter at the measuring point, l = recommended distance

disturbance source: diffuser

supply line: l ≥ 30 D

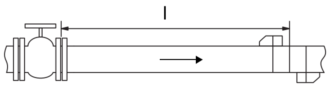


return line: l ≥ 5 D

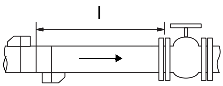


disturbance source: valve

supply line: l ≥ 40 D

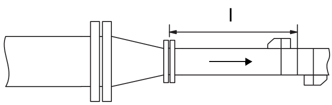


return line: l ≥ 10 D

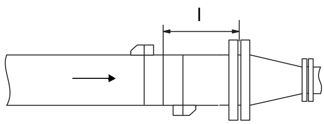


disturbance source: reducer

supply line: l ≥ 10 D

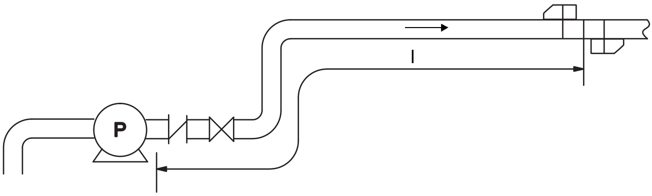


return line: l ≥ 5 D



disturbance source: pump

supply line: l ≥ 50 D



5 Installation of FLUXUS ADM 7407

Attention!	Observe the Safety Instructions for the Use in Explosive Atmosphere (see document SIFLUXUS).

5.1 Location

Select the measuring point according to the recommendations in chapter 4. The ambient temperature must be within the operating temperature range of the transducers (see annex B, section Technical Data).

Select the location of the transmitter within cable reach of the measuring point. The ambient temperature must be within the operating temperature range of the transmitter (see annex B, section Technical Data).

If the measuring point is within an explosive atmosphere, the danger zone and gases that may be present must be determined. The transducers and the transmitter must be appropriate for these conditions.

Attention!	Observe the Safety Instructions for the Use in Explosive Atmosphere (see document SIFLUXUS).

Attention!	The degree of protection of the transmitter will only be ensured if the cable glands are firmly tightened and the housings are tightly screwed.

5.2 Wall Installation

- Remove the front cover of the housing.
- At the chosen location, drill 4 holes in the wall (see Fig. 5.1).

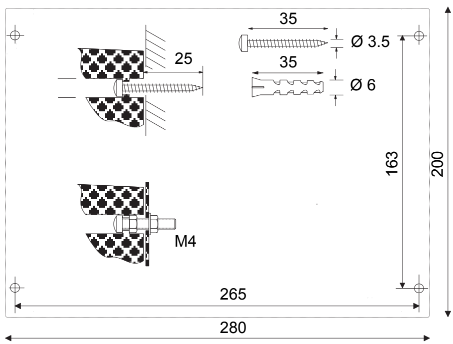


Fig. 5.1: Wall installation (dimensions in mm)

- Insert the dowels into the holes.
- Fix the housing to the wall with screws.

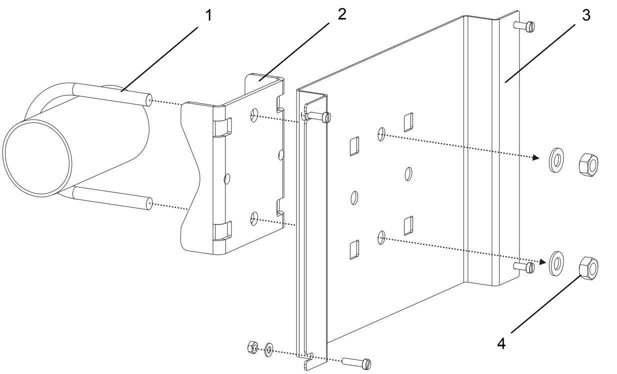
5.3 Pipe Installation

Installation on a 2 " pipe

- Fix the pipe mounting plate (2) to the pipe (see Fig. 5.2).
- Fix the instrument mounting plate (3) to the pipe mounting plate (2) with the nuts (4).
- Fix the bottom side of the housing to the instrument mounting plate (3).

Installation on a 2 " pipe:

The mounting kit is fixed to the pipe with tension straps (5) instead of the shackle (see Fig. 5.2). Push the tension straps through the holes of the instrument mounting plate (3).



1	shackle
2	pipe mounting plate
3	instrument mounting plate
4	nut
5	tension strap

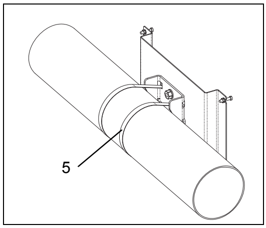


Fig. 5.2: Pipe installation set

5.4 Connection of the Transducers - Connection System TS

Note!	If transducers are replaced or added, the sensor module must also be replaced or added (see section 5.10).

It is recommended to run the cables from the measuring point to the transmitter before connecting the transducers to avoid load on the connectors.

Overview

5.4.1 Transducers - Direct Connection

For the connection of the transducers (ATEX Zone 1) see section 5.4.3.

Attention!	Observe the Safety Instructions for the Use in Explosive Atmosphere (see document SIFLUXUS).

- Remove the left blind plug for the connection of the transducers (see Fig. 5.3).
- Insert the transducer cable with the SMB connectors in the housing.

- Fix the transducer cable to the housing by tightening the cable gland.
- Connect the SMB connectors to the sockets of the transmitter (see Fig. 5.3 and Table 5.1).

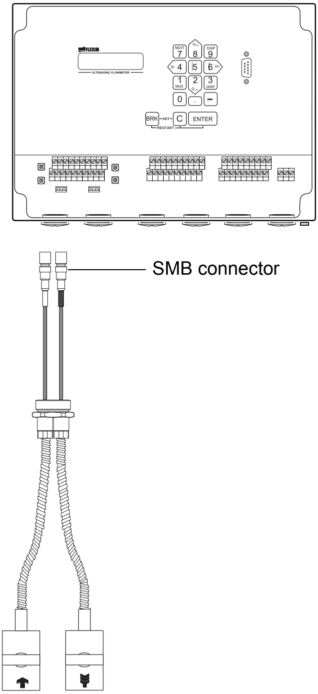


Fig. 5.3: Transducers - direct connection

Table 5.1: Terminal assignment

terminal	connection
X_AV	SMB connector (brown cable, marked white)
X_AR	SMB connector (brown cable, marked black)

5.4.2 Transducers - Connection via Junction Box

For the connection of the transducers (ATEX Zone 1) see section 5.4.4.

Attention!	Observe the Safety Instructions for the Use in Explosive Atmosphere (see document SIFLUXUS).

Attention!	The equipotential bonding terminals of the transducers and of the junction box must be connected to the same equipotential bonding system to prevent a potential difference from occurring.

Connection of the Extension Cable to the Transmitter

- Remove the left blind plug for the connection of the transducers (see Fig. 5.4).
- Open the cable gland of the extension cable. The compression part remains in the cap nut.
- Push the extension cable through the cap nut and the compression part.
- Prepare the extension cable with the cable gland. Cut the external shield and brush it back over the compression part.
- Screw the gasket ring side of the basic part in the housing.
- Insert the extension cable in the housing.

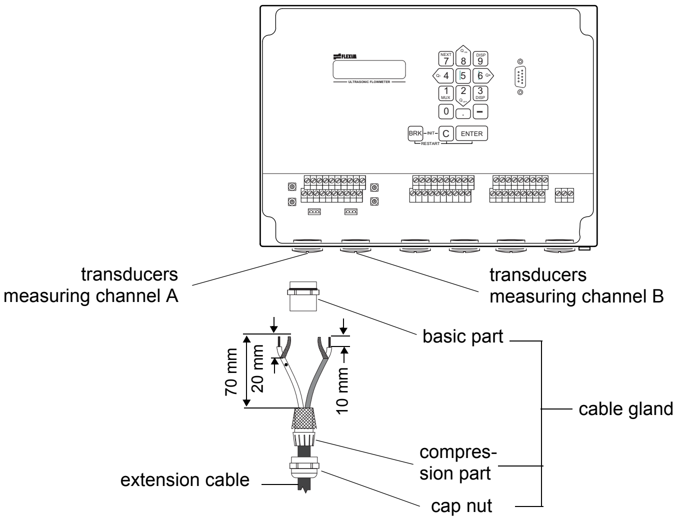


Fig. 5.4: Transducers - connection via junction box to the transmitter

Attention!	For good high frequency shielding, it is important to ensure good electrical contact between the external shield and the cap nut (and the housing).

- Fix the cable gland by screwing the cap nut on the basic part.
- Connect the leads to the terminals of the transmitter (see Fig. 5.4 and Table 5.2).

Table 5.2: Terminal assignment

terminal	connection
AV	white or marked cable (core)
AVS	white or marked cable (internal shield)
ARS	brown cable (internal shield)
AR	brown cable (core)

Connection of the Extension Cable to the Junction Box

Attention!	The external shield of the extension cable must not have electrical contact to the junction box. The extension cable must remain completely insulated up to the shield terminal of the junction box.

- Remove the blind plug from the junction box (see Fig. 5.5 or Fig. 5.6).
- Open the cable gland of the extension cable. The compression part remains in the cap nut.
- Push the extension cable through the cap nut, the compression part and the basic part of the cable gland.
- Insert the extension cable in the junction box.
- Prepare the extension cable with the cable gland. Cut the external shield and brush it back (see Fig. 5.5 or Fig. 5.6.
- Pull the extension cable back until the brushed back external shield is below the shield terminal of the junction box (see Fig. 5.7 or Fig. 5.8).
- Screw the gasket ring side of the basic part in the junction box.
- Fix the cable gland by screwing the cap nut on the basic part.
- Fix the extension cable and the external shield to the shield terminal of the junction box (see Fig. 5.7 or Fig. 5.8).
- Connect the leads to the terminals of the junction box (see Fig. 5.7 or Fig. 5.8 and Table 5.3).

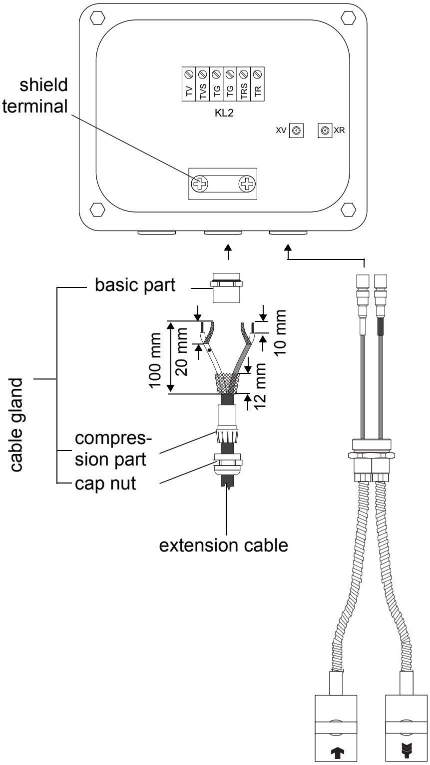


Fig. 5.5: Connection to junction box JB02, JB03

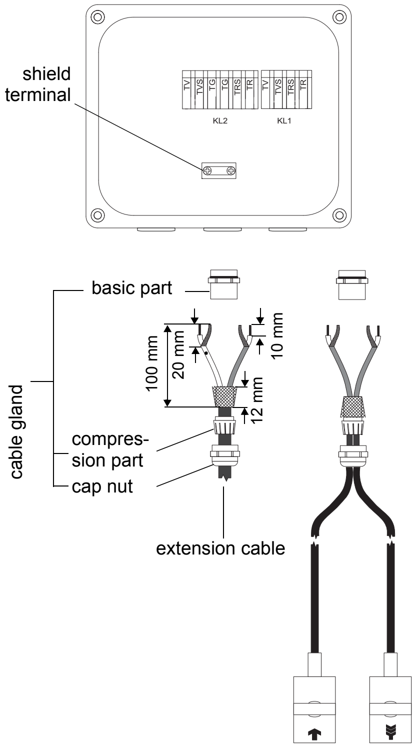


Fig. 5.6: Connection to junction box JBP2, JBP3

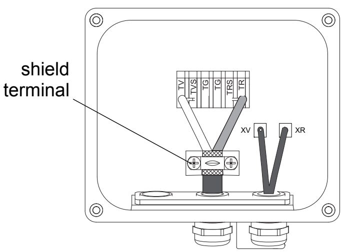


Fig. 5.7: Junction box JB02, JB03

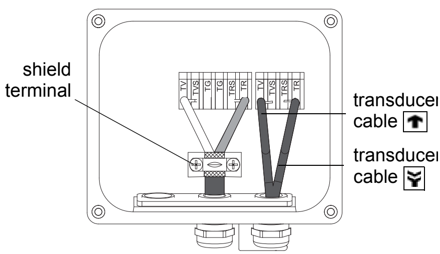


Fig. 5.8: Junction box JBP2, JBP3

Table 5.3: Terminal assignment

terminal	connection
TV	white or marked cable (core)
TVS	white or marked cable (internal shield)
TRS	brown cable (internal shield)
TR	brown cable (core)

Connection of the Transducer Cable to the Junction Box JB02, JB03

- Remove the blind plug from the junction box (see Fig. 5.7).
- Insert the transducer cable with the SMB connectors in the housing.
- Fix the transducer cable to the housing by tightening the cable gland.
- Connect the SMB connectors to the sockets of the junction box (see Fig. 5.7 and Table 5.4).

Table 5.4: Terminal assignment

terminal	connection
XV	SMB connector (brown cable, marked white)
XR	SMB connector (brown cable, marked black)

Connection of the Transducer Cable to the Junction Box JBP2, JBP3

- Remove the blind plug from the junction box (see Fig. 5.8).
- Open the cable gland of the transducer cable. The compression part remains in the cap nut.
- Push the transducer cable through the cap nut, the compression part and the basic part.
- Prepare the transducer cable with the cable gland. Cut the external shield and brush it back.
- Insert the transducer cable in the junction box.
- Screw the gasket ring side of the basic part in the junction box.
- Fix the cable gland by screwing the cap nut on the basic part.
- Connect the leads to the terminals of the junction box (see Fig. 5.8 and Table 5.5).

Table 5.5: Terminal assignment (KL1)

terminal	connection
TV	transducer ↑ (core)
TVS	transducer ↑ (internal shield)
TRS	transducer ↓ (internal shield)
TR	transducer ↓ (core)

5.4.3 Transducers (ATEX Zone 1) - Direct Connection

Attention!	Observe the Safety Instructions for the Use in Explosive Atmosphere (see document SIFLUXUS).

- Remove the left blind plug for the connection of the transducers (see Fig. 5.9).
- Open the cable gland of the transducer cable. The compression part remains in the cap nut.
- Push the two transducer cables through the cap nut and the compression part.

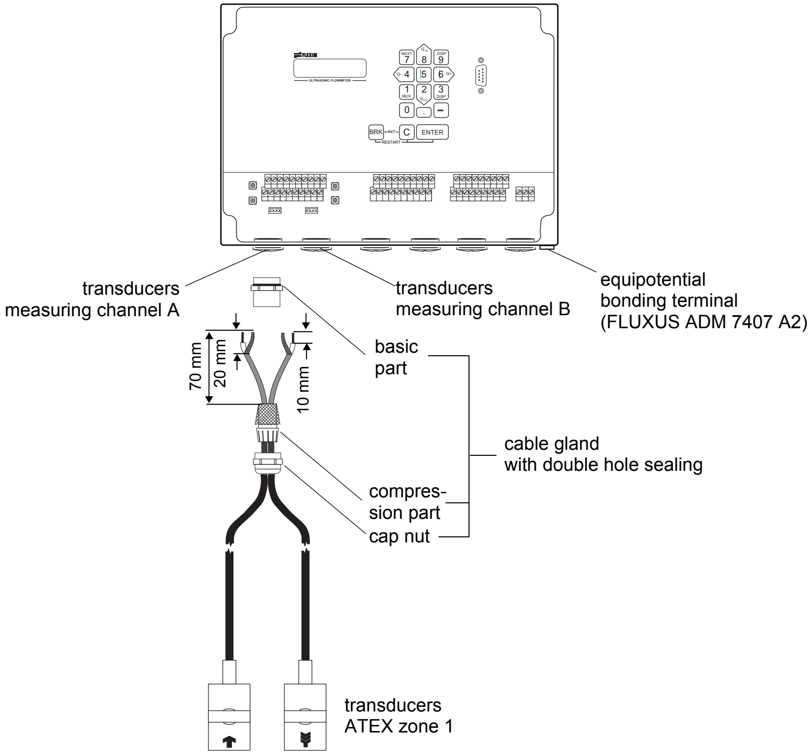


Fig. 5.9: Transducers (ATEX zone 1) - direct connection

Table 5.6: Terminal assignment

terminal	connection
AV	transducer ↑ (core)
AVS	transducer ↑ (internal shield)
ARS	transducer ↓ (internal shield)
AR	transducer ↓ (core)

- Prepare the transducer cables with the cable gland. Cut the external shield and brush it back over the compression part.
- Screw the gasket ring side of the basic part in the housing.
- Insert the transducer cable in the housing.

Attention!	For good high frequency shielding, it is important to ensure good electrical contact between the external shield and the cap nut (and the housing).

- Fix the cable gland by screwing the cap nut on the basic part.
- Connect the leads to the terminals of the transmitter (see Fig. 5.9 and Table 5.6).

5.4.4 Transducers (ATEX Zone 1) - Connection via Junction Box

Attention!	Observe the Safety Instructions for the Use in Explosive Atmosphere (see document SIFLUXUS).

Attention!	The equipotential bonding terminals of the transducers and of the junction box must be connected to the same equipotential bonding system to prevent a potential difference from occurring.

Connection of the Extension Cable to the Transmitter

- Remove the left blind plug for the connection of the transducers (see Fig. 5.10)).
- Open the cable gland of the extension cable. The compression part remains in the cap nut.
- Push the extension cable through the cap nut and the compression part.
- Prepare the extension cable with the cable gland. Cut the external shield and brush it back over the compression part.
- Screw the gasket ring side of the basic part in the housing.
- Insert the extension cable in the housing.

Attention!	For good high frequency shielding, it is important to ensure good electrical contact between the external shield and the cap nut (and the housing).

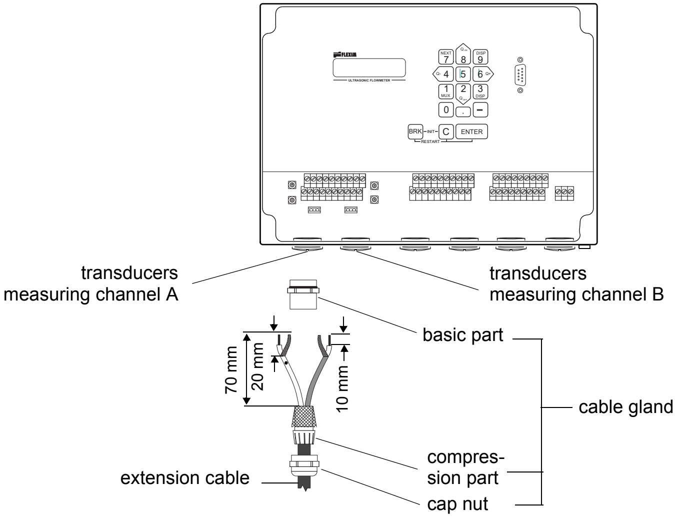


Fig. 5.10: Transducers (ATEX zone 1) - connection via junction box, connection of the extension cable to the transmitter

- Fix the cable gland by screwing the cap nut on the basic part.
- Connect the leads to the terminals of the transmitter (see Fig. 5.10 and Table 5.7).

Table 5.7: Terminal assignment

terminal	connection
AV	white or marked cable (core)
AVS	white or marked cable (internal shield)
ARS	brown cable (internal shield)
AR	brown cable (core)

Connection of the Extension Cable to the Junction Box

Attention!	The external shield of the extension cable must not have electrical contact to the junction box. The extension cable must remain completely insulated up to the shield terminal of the junction box.

- Remove the blind plug from the junction box (see Fig. 5.11).
- Open the cable gland of the extension cable. The compression part remains in the cap nut.
- Push the extension cable through the cap nut, the compression part and the basic part of the cable gland.

- Insert the extension cable in the junction box.
- Prepare the extension cable with the cable gland. Cut the external shield and brush it back.
- Pull the extension cable back until the brushed back external shield is below the shield terminal of the junction box (see Fig. 5.12).
- Screw the gasket ring side of the basic part in the junction box.
- Fix the cable gland by screwing the cap nut on the basic part.
- Fix the extension cable and the external shield to the shield terminal of the junction box (see Fig. 5.12).
- Connect the leads to the terminals of the junction box (see Fig. 5.12 and Table 5.8).

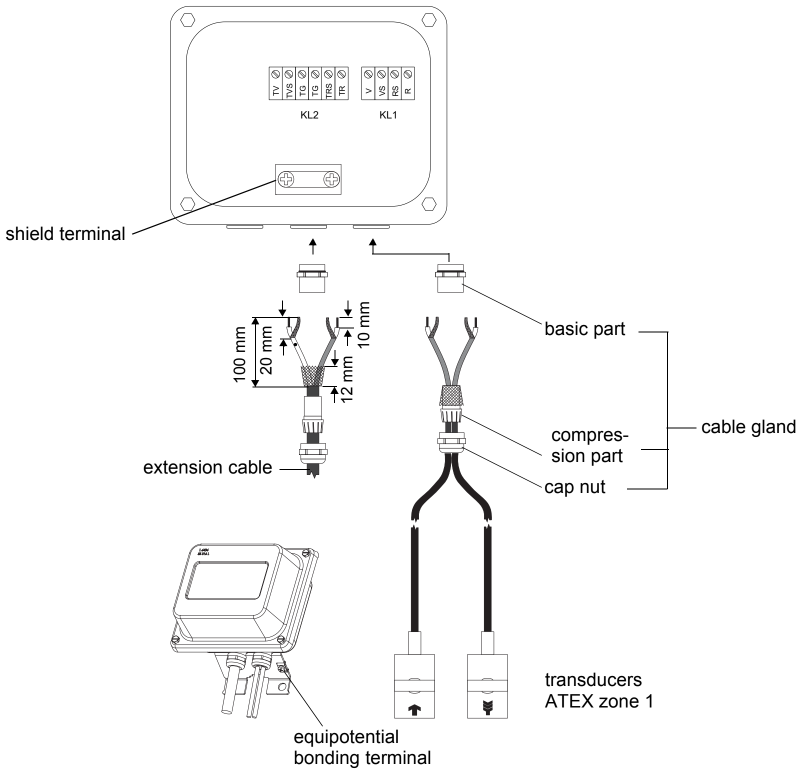


Fig. 5.11: Transducers (ATEX zone 1) - connection via junction box, connection of extension cable and transducer cable to the junction box

Table 5.8: Terminal assignment

terminal	connection
TV	white or marked cable (core)
TVS	white or marked cable (internal shield)
TRS	brown cable (internal shield)
TR	brown cable (core)

Connection of the Transducer Cable to the Junction Box

- Remove the blind plug from the junction box (see Fig. 5.11).
- Open the cable gland of the transducer cable. The compression part remains in the cap nut.
- Push the transducer cable through the cap nut, the compression part and the basic part.
- Prepare the transducer cable with the cable gland. Cut the external shield and brush it back.
- Insert the transducer cable in the junction box.
- Screw the gasket ring side of the basic part in the junction box.
- Fix the cable gland by screwing the cap nut on the basic part.
- Connect the leads to the terminals of the junction box (see Fig. 5.12 and Table 5.9).

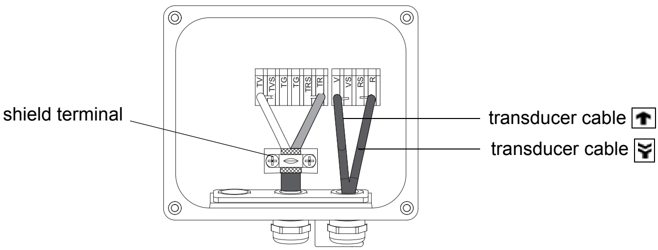


Fig. 5.12: Terminals for the connection of the extension cable and the transducer cable (ATEX zone 1)

Table 5.9: Terminal assignment

terminal	connection
V	transducer (core)
VS	transducer (internal shield)
RS	transducer (internal shield)
R	transducer (core)

5.5 Connection of the Transducers - Connection System AS

Attention!	Observe the Safety Instructions for the Use in Explosive Atmosphere (see document SIFLUXUS).

- Remove the left blind plug for the connection of the transducers (see Fig. 5.13).
- Insert the extension cable with the AMP-Quick and SMB connectors in the housing.
- Fix the extension cable to the housing by tightening the cable gland.
- Connect the AMP-Quick und SMB connectors to the sockets of the transmitter (see Fig. 5.13 and Table 5.10).

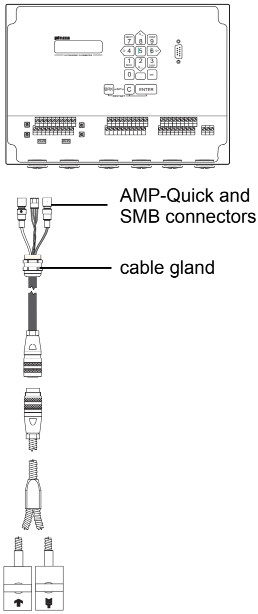


Fig. 5.13: Transducers - direct connection

Table 5.10: Terminal assignment

terminal	connection
X_AV	SMB connector (white or marked cable)
X_AR	SMB connector (brown cable)
X1	AMP-Quick connector

5.6 Connection of the Power Supply

Attention!	Observe the Safety Instructions for the Use in Explosive Atmosphere (see document SIFLUXUS).

Attention!	According to IEC 61010-1:2001, a switch has to be provided near the instrument in the building installation, easily accessible for the user and marked as a disconnection device for the instrument. If FLUXUS ADM 7407 A2 is used in explosive atmosphere, the switch should be installed outside the explosive atmosphere. If this is not possible, the switch should be installed in the least hazardous area.

Attention!	The degree of protection of the transmitter will only be guaranteed if the power cable fits firmly and tightly in the cable gland.

- Remove the right blind plug for the connection of the power supply (see Fig. 5.14).
- Prepare the power cable with an M20 cable gland.
- Push the power cable through the cap nut, the compression part and the basic part of the cable gland (see Fig. 5.15).
- Insert the power cable into the housing (see Fig. 5.14).
- Screw the gasket ring side of the basic part in the housing of the transmitter.

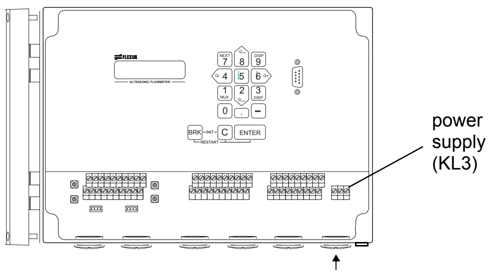


Fig. 5.14: Connection of the power supply.

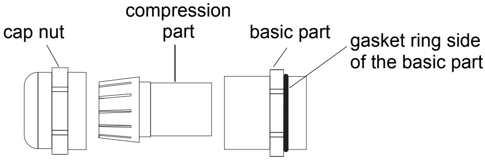


Fig. 5.15: Cable gland

- Fix the cable gland by screwing the cap nut on the basic part of the cable gland (see Fig. 5.15).
- Connect the leads to the terminals of terminal strip KL3 (see Fig. 5.14 and Table 5.11).

Table 5.11: Terminal assignment (power supply)

terminal	connection AC	connection DC
PE	earth	earth
N(-)	neutral	- DC
L(+)	phase 100...240 V AC, 50/60 Hz	+ DC
fuse	1 A, time-lag	1.6 A, time-lag

5.7 Connection of the Outputs

Attention!	Observe the Safety Instructions for the Use in Explosive Atmosphere (see document SIFLUXUS).

```
I1 active loop
Klemmen:P1+,P1-
```

Configure the outputs (see chapter 19). The terminals to be used for the connection of the output are displayed at the end of the configuration dialog (here: P1+ and P1- for the active current loop).

- Remove the second blind plug from the right for the connection of the outputs (see Fig. 5.16).
- Prepare the output cable with an M20 cable gland.
- Push the output cable through the cap nut, the compression part and the basic part of the cable gland (see Fig. 5.15).
- Insert the output cable into the housing.
- Screw the gasket ring side of the basic part in the housing of the transmitter.
- Fix the cable gland by screwing the cap nut on the basic part.
- Connect the leads to the terminal of terminal strip KL4 as displayed (see Fig. 5.16 and Table 5.12).
- Close the transmitter: Screw the front plate to the housing.

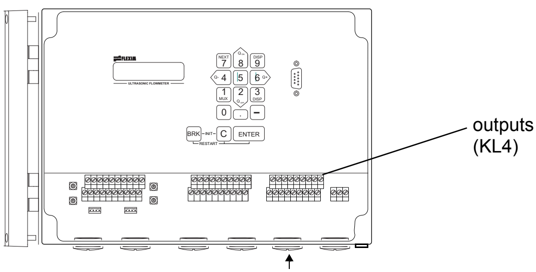
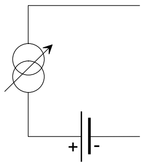
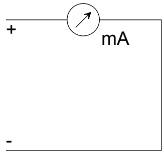
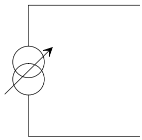
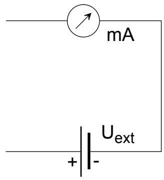
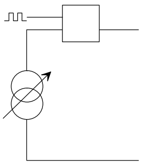
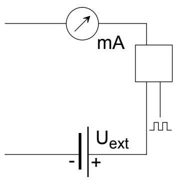
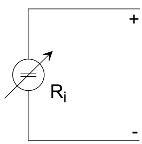
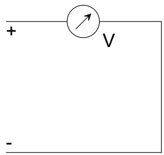
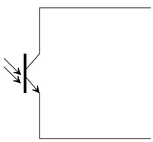
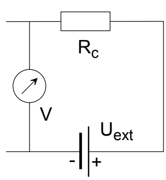


Fig. 5.16: Connection of the Outputs

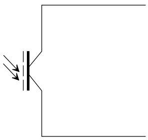
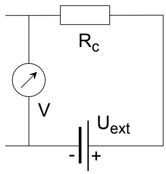
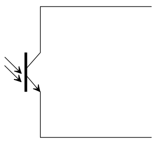
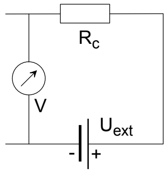
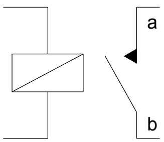
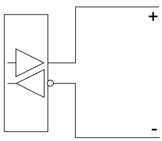
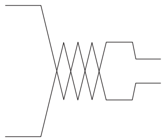
Table 5.12: Circuits of the outputs

output	transmitter internal circuit	 connection	external circuit	remark
active current loop		Px+ Px-		R_{ext} < 500 Ω
passive current loop		Px+ Px-		U_{ext} = 4...24 V U_{ext} > 0.021 A · R_{ext} [Ω] + 4 V example: U_{ext} = 12 V: R_{ext} = 0...380 Ω
HART (passive)		Px+ Px-		U_{ext} = 10...24 V
voltage output		Px+ Px-		R_i = 500 Ω R_{ext} > 2 MΩ If R_{ext} is lower, the accuracy is lower than specified.
frequency output		Px+ Px-		U_{ext} = 5...24 V R_c [kΩ] = U_{ext}/I_c [mA] I_c = 1...4 mA

The number, type and connections of the outputs are customized.

R_{ext} is the sum of all ohmic resistances in the circuit (e.g. resistance of the conductors, resistance of the amperemeter/voltmeter).

Table 5.12: Circuits of the outputs

output	transmitter		external circuit	remark
	internal circuit	connection		
binary output (optorelay)		Px+ Px-		U_{ext} ≤ 26 V I_c ≤ 100 mA
binary output (open collector)		Px+ Px-		U_{ext} = 5...24 V R_c [kΩ] = U_{ext}/I_c [mA] I_c = 1...4 mA
binary output (Reed relay)		Px+/Pxa Px-/Pxb		U_{max} = 48 V I_{max} = 0.25 A
RS485		A+ B- 101 (shield)		120 Ω termination resistor

The number, type and connections of the outputs are customized.

R_{ext} is the sum of all ohmic resistances in the circuit (e.g. resistance of the conductors, resistance of the amperemeter/voltmeter).

5.8 Connection of the Inputs

5.8.1 Connection of a Temperature Input

Attention!	Observe the Safety Instructions for the Use in Explosive Atmosphere (see document SIFLUXUS).

Temperature probes Pt100/Pt1000 (4-wire) can be connected to the inputs of the transmitter (optional) (see chapter 8).

For the assignment and the activation of the temperature inputs see chapter 18.

Table 5.13: Terminal assignment of the transmitter

terminal	connection with extension cable	connection without extension cable
Txa	red	red
TxA	gray	red/blue
Txb	blue	white/blue
TxB	white	white
Sx	Pt100/Pt1000 shield	Pt100/Pt1000 shield

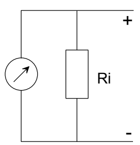
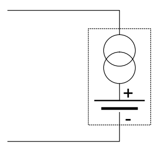
x = 1...4

5.8.2 Connection of a Current Input

Passive Current Input

An active current source or a passive current source with an external power supply can be connected to a passive current input.

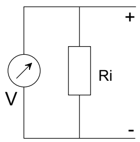
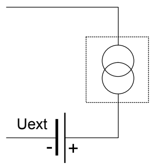
Table 5.14: Connection of an active current source

input	transmitter		external circuits	note
	internal circuits	connection		
passive current input		TxA TxB		max. permanent overcurrent: 100 mA

Attention!	The terminals Txa and Txb must not be connected.

If the polarity of the current source is inversed, only the sign of the measured current will change.

Table 5.15: Connection of a passive current source

input	transmitter		external circuits	note
	internal circuits	connection		
passive current input		TxA Txb		short circuit current: max. 100 mA

Attention!	The terminals Txa and TxB must not be connected.

An external voltage source U_{ext} is necessary. It must provide a current of min. 20 mA and

- supply sufficient power for the energy requirements of the passive current source and
- cover the voltage drop at the input resistor (1 V at 20 mA) and
- cover all other voltage drops (e.g. cable resistance) in the circuit

example: A passive current source (e.g. a pressure sensor) is to be connected to a passive current input.

Technical data of the pressure sensor:

U_S = 11...30 V DC
I_a = 4...20 mA ($I_{a\ max}$ = 22 mA)

U_{ext} required for the operation of the passive pressure sensor is:

$$\begin{aligned} U_{ext\ min} &= U_{S\ min} + I_{a\ max} \cdot R_i + I_{a\ max} \cdot R_c \\ &= 11\ \text{V} + 22\ \text{mA} \cdot 50\ \Omega + 20\ \text{mA} \cdot 2\ \Omega \\ &= 12.14\ \text{V} \end{aligned}$$

$$\begin{aligned} U_{ext\ max} &= U_{S\ max} \\ &= 30\ \text{V} \end{aligned}$$

U_S - operating voltage of the pressure sensor

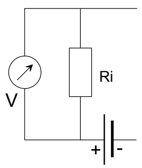
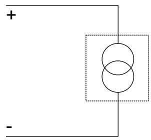
I_a - output current

R_i - input resistance

R_c - cable resistance

Active Current Input

Table 5.16: Connection of a passive current source

input	transmitter		external circuits	note
	internal circuits	**connection**		
active current input		TxA Txb		max. permanent over-current: 100 mA

At full load (20 mA), a voltage of 22.9 V DC is available for the supply of the passive current source.

Attention!	An active current source must not be connected to an active current input!

Attention!	The terminals Txa and TxB must not be connected.

Attention!	Observe the correct polarity to avoid damage of the current source. A permanent short circuit can lead to the destruction of the active current input.

5.9 Connection of the Serial Interface

Attention!	Observe the Safety Instructions for the Use in Explosive Atmosphere (see document SIFLUXUS).

The RS232 interface is located on the front plate of the transmitter (see Fig. 5.17). In order to connect the RS232 interface, the housing must be opened.

The transmitter can also be equipped with an RS485 interface (optional). It is connected as follows (see Fig. 5.17 and Table 5.17):

Table 5.17: Connection of the RS485 interface

terminal	connection
A+	A+
B-	B-
101	shield (optional)

For further information on the data transmission see chapter 13.

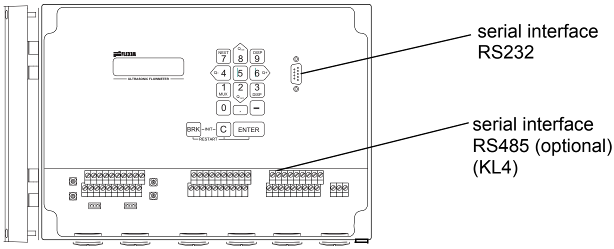


Fig. 5.17: Connection of the serial interface

5.10 Connection of the Sensor Module (SENSPROM)

Attention!	Observe the Safety Instructions for the Use in Explosive Atmosphere (see document SIFLUXUS).

The sensor module contains important transducer data for the operation of the transmitter with the transducers. It is connected to the corresponding terminals of the transmitter.

If transducers are replaced or added, the sensor module must also be replaced or added.

Note!	The serial numbers of the sensor module and the transducer must be identical. A wrong or incorrectly connected sensor module will lead to incorrect measured values or to a measurement failure.

- Stop the measurement.
- Insert the sensor module in the lower row of terminal strip KL1 (see Fig. 5.18). The slots SA1...SA4 are assigned to the transducers of measuring channel A, the slots SB1...SB4 are assigned to the transducers of measuring channel B.
- Edit the program branch `Parameter` once completely. Press ENTER until the main menu is displayed
- The measurement can be restarted afterwards.

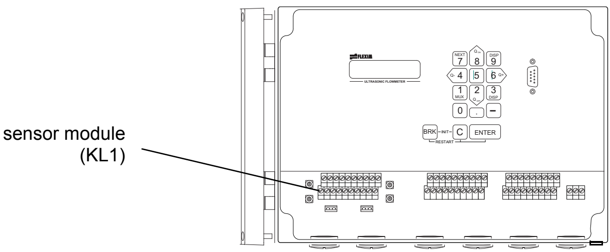


Fig. 5.18: Connection of the sensor module (SENSPROM)

6 Installation of FLUXUS ADM 7907

Attention!	Observe the Safety Instructions for the Use in Explosive Atmosphere (see document SIFLUXUS).

6.1 Location

Select the measuring point according to the recommendations in chapter 4. The ambient temperature must be within the operating temperature range of the transducers (see annex B, section Technical Data).

Select the location of the transmitter within cable reach of the measuring point. The ambient temperature must be within the operating temperature range of the transmitter (see annex B, section Technical Data).

If the measuring point is within an explosive atmosphere, the danger zone and gases that may be present must be determined. The transducers and the transmitter must be appropriate for these conditions.

Attention!	Observe the Safety Instructions for the Use in Explosive Atmosphere (see document SIFLUXUS).

6.2 Connection of the Transducers - Connection System TS

Note!	If transducers are replaced or added, the sensor module must also be replaced or added (see section 6.8).

It is recommended to run the cables from the measuring point to the transmitter before connecting the transducers to avoid load on the connectors.

Overview

6.2.1 Transducers - Connection via Junction Box

For the connection of the transducers (ATEX Zone 1) see section 6.2.2.

Attention!	Observe the Safety Instructions for the Use in Explosive Atmosphere (see document SIFLUXUS).

Attention!	The equipotential bonding terminals of the transducers and of the junction box must be connected to the same equipotential bonding system to prevent a potential difference from occurring.

Connection of the Extension Cable to the Transmitter

- Prepare the extension cable. Cut the external shield and brush it back.
- Push the extension cable through the shield terminal to terminal strip KL6 for measuring channel A and to terminal strip KL8 for measuring channel B (see Fig. 6.1).

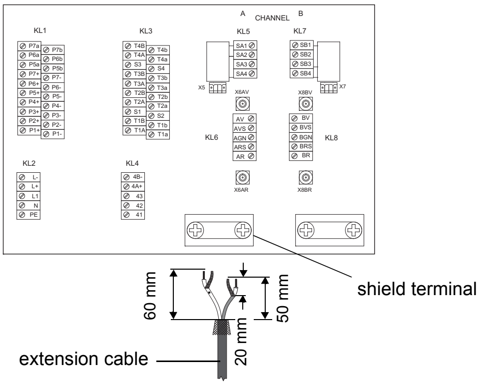


Fig. 6.1: Transducers - connection via junction box to the transmitter

- Pull the extension cable back until the brushed back external shield is below the shield terminal (see Fig. 6.1).
- Fix the extension cable and the external shield to the shield terminal.
- Connect the leads to the terminals of the transmitter (see Fig. 6.1 and Table 6.1).

Table 6.1: Terminal assignment

terminal	connection
AV	white or marked cable (core)
AVS	white or marked cable (internal shield)
ARS	brown cable (internal shield)
AR	brown cable (core)

Connection of the Extension Cable to the Junction Box

Attention!	The external shield of the extension cable must not have electrical contact to the junction box. The extension cable must remain completely insulated up to the shield terminal of the junction box.

- Remove the blind plug from the junction box (see Fig. 6.2 or Fig. 6.3).
- Open the cable gland of the extension cable. The compression part remains in the cap nut.
- Push the extension cable through the cap nut, the compression part and the basic part of the cable gland.
- Insert the extension cable in the junction box.
- Prepare the extension cable with the cable gland. Cut the external shield and brush it back (see Fig. 6.2 or Fig. 6.3.)
- Pull the extension cable back until the brushed back external shield is below the shield terminal of the junction box (see Fig. 6.4 or Fig. 6.5).
- Screw the gasket ring side of the basic part in the junction box.
- Fix the cable gland by screwing the cap nut on the basic part.
- Fix the extension cable and the external shield to the shield terminal of the junction box (see Fig. 6.4 or Fig. 6.5).
- Connect the leads to the terminals of the junction box (see Fig. 6.4 or Fig. 6.5 and Table 6.2).

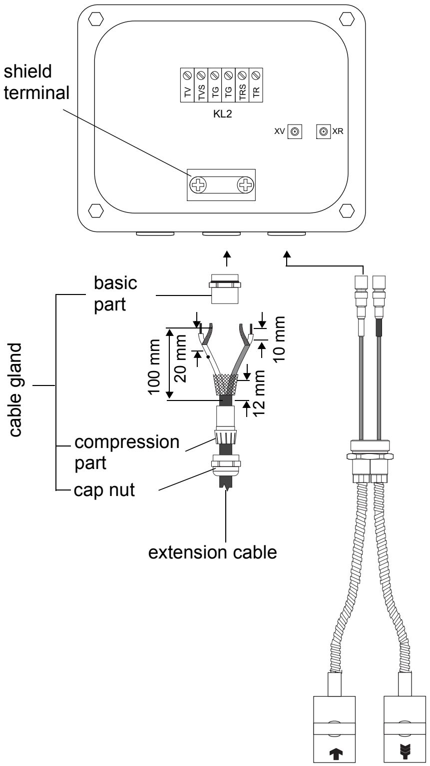


Fig. 6.2: Connection to junction box JB02, JB03

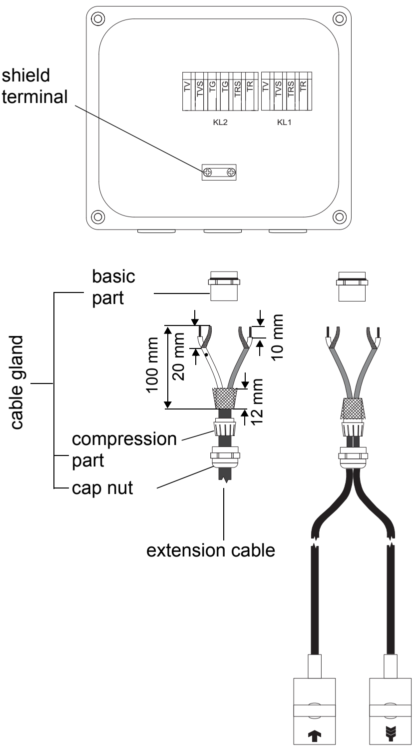


Fig. 6.3: Connection to junction box JBP2, JBP3

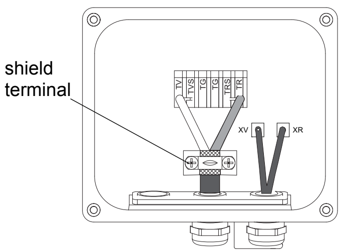


Fig. 6.4: Junction box JB02, JB03

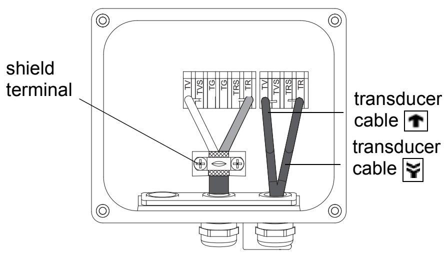


Fig. 6.5: Junction box JBP2, JBP3

Table 6.2: Terminal assignment

terminal	connection
TV	white or marked cable (core)
TVS	white or marked cable (internal shield)
TRS	brown cable (internal shield)
TR	brown cable (core)

Connection of the Transducer Cable to the Junction Box JB02, JB03

- Remove the blind plug from the junction box (see Fig. 6.4).
- Insert the transducer cable with the SMB connectors in the housing.
- Fix the transducer cable to the housing by tightening the cable gland.
- Connect the SMB connectors to the sockets of the junction box (see Fig. 6.4 and Table 6.3).

Table 6.3: Terminal assignment

terminal	connection
XV	SMB connector (brown cable, marked white)
XR	SMB connector (brown cable, marked black)

Connection of the Transducer Cable to the Junction Box JBP2, JBP3

- Remove the blind plug from the junction box (see Fig. 6.5).
- Open the cable gland of the transducer cable. The compression part remains in the cap nut.
- Push the transducer cable through the cap nut, the compression part and the basic part.
- Prepare the transducer cable with the cable gland. Cut the external shield and brush it back.
- Insert the transducer cable in the junction box.
- Screw the gasket ring side of the basic part in the junction box.
- Fix the cable gland by screwing the cap nut on the basic part.
- Connect the leads to the terminals of the junction box (see Fig. 6.5 and Table 6.4).

Table 6.4: Terminal assignment (KL1)

terminal	connection
TV	transducer ↑ (core)
TVS	transducer ↑ (internal shield)
TRS	transducer ↓ (internal shield)
TR	transducer ↓ (core)

6.2.2 Transducers (ATEX Zone 1) - Connection via Junction Box

Attention!	Observe the Safety Instructions for the Use in Explosive Atmosphere (see document SIFLUXUS).

Attention!	The equipotential bonding terminals of the transducers and of the junction box must be connected to the same equipotential bonding system to prevent a potential difference from occurring.

Connection of the Extension Cable to the Transmitter

- Prepare the extension cable. Cut the external shield and brush it back.
- Push the extension cable through the shield terminal to terminal strip KL6 for measuring channel A and to terminal strip KL8 for measuring channel B (see Fig. 6.6).
- Pull the extension cable back until the brushed back external shield is below the shield terminal (see Fig. 6.6).
- Fix the extension cable and the external shield to the shield terminal.
- Connect the leads to the terminals of the transmitter (see Fig. 6.6 and Table 6.5).

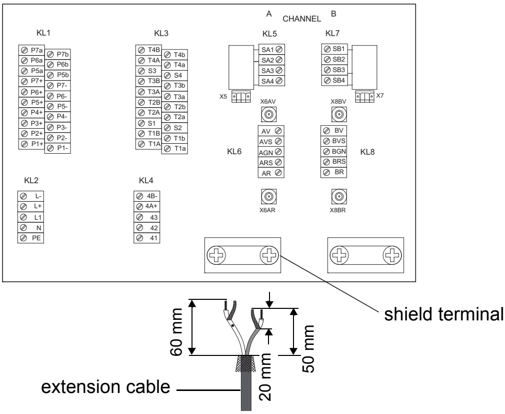


Fig. 6.6: Transducers (ATEX zone 1) - connection via junction box, connection of the extension cable to the transmitter

Table 6.5: Terminal assignment

terminal	connection
AV	white or marked cable (core)
AVS	white or marked cable (internal shield)
ARS	brown cable (internal shield)
AR	brown cable (core)

Connection of the Extension Cable to the Junction Box

Attention!	The external shield of the extension cable must not have electrical contact to the junction box. The extension cable must remain completely insulated up to the shield terminal of the junction box.

- Remove the blind plug from the junction box (see Fig. 6.7).
- Open the cable gland of the extension cable. The compression part remains in the cap nut.
- Push the extension cable through the cap nut, the compression part and the basic part of the cable gland.
- Insert the extension cable in the junction box.
- Prepare the extension cable with the cable gland. Cut the external shield and brush it back.

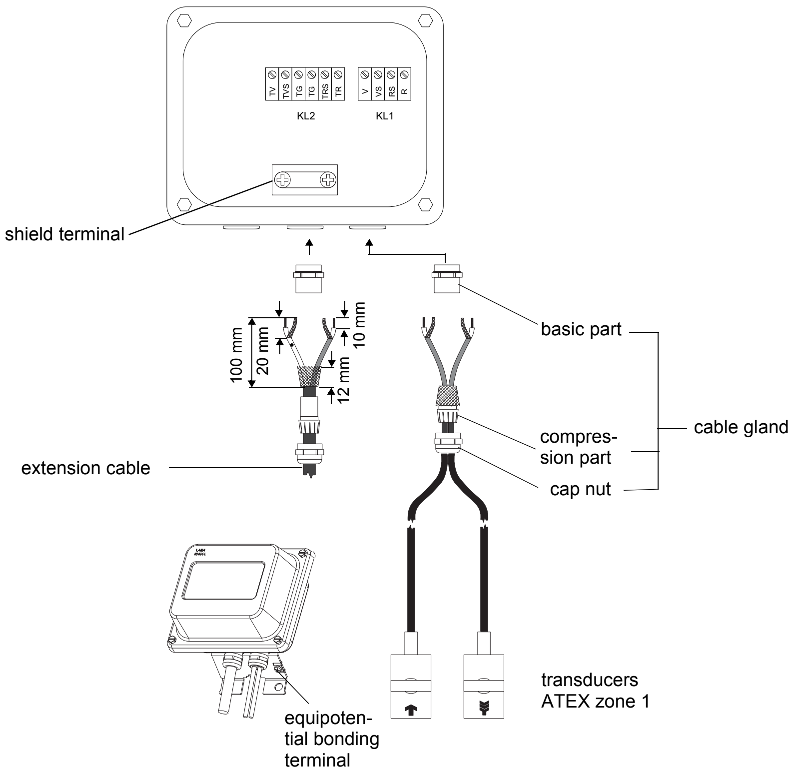


Fig. 6.7: Transducers (ATEX zone 1) - connection via junction box, connection of extension cable and transducer cable to the junction box

- Pull the extension cable back until the brushed back external shield is below the shield terminal of the junction box(see Fig. 6.8).
- Screw the gasket ring side of the basic part in the junction box.
- Fix the cable gland by screwing the cap nut on the basic part.
- Fix the extension cable and the external shield to the shield terminal of the junction box (see Fig. 6.8).
- Connect the leads to the terminals of the junction box (see Fig. 6.8 and Table 6.6).

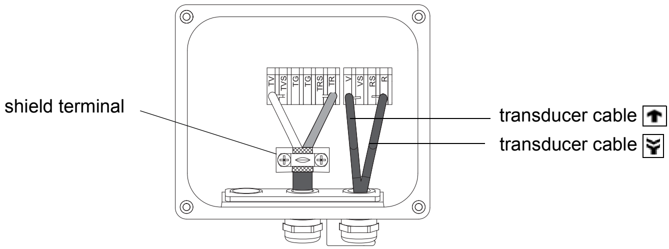


Fig. 6.8: Terminals for the connection of the extension cable and the transducer cable (ATEX zone 1)

Table 6.6: Terminal assignment

terminal	connection
TV	white or marked cable (core)
TVS	white or marked cable (internal shield)
TRS	brown cable (internal shield)
TR	brown cable (core)

Connection of the Transducer Cable to the Junction Box

- Remove the blind plug from the junction box (see Fig. 6.7).
- Open the cable gland of the transducer cable. The compression part remains in the cap nut.
- Push the transducer cable through the cap nut, the compression part and the basic part.
- Prepare the transducer cable with the cable gland. Cut the external shield and brush it back.
- Insert the transducer cable in the junction box.
- Screw the gasket ring side of the basic part in the junction box.
- Fix the cable gland by screwing the cap nut on the basic part.

- Connect the leads to the terminals of the junction box (see Fig. 6.8 and Table 6.7).

Table 6.7: Terminal assignment

terminal	connection
V	transducer ↑ (core)
VS	transducer ↑ (internal shield)
RS	transducer ↓ (internal shield)
R	transducer ↓ (core)

6.3 Connection of the Transducers - Connection System AS

Attention!	Observe the Safety Instructions for the Use in Explosive Atmosphere (see document SIFLUXUS).

- Open the cable gland of the extension cable (see Fig. 6.9).

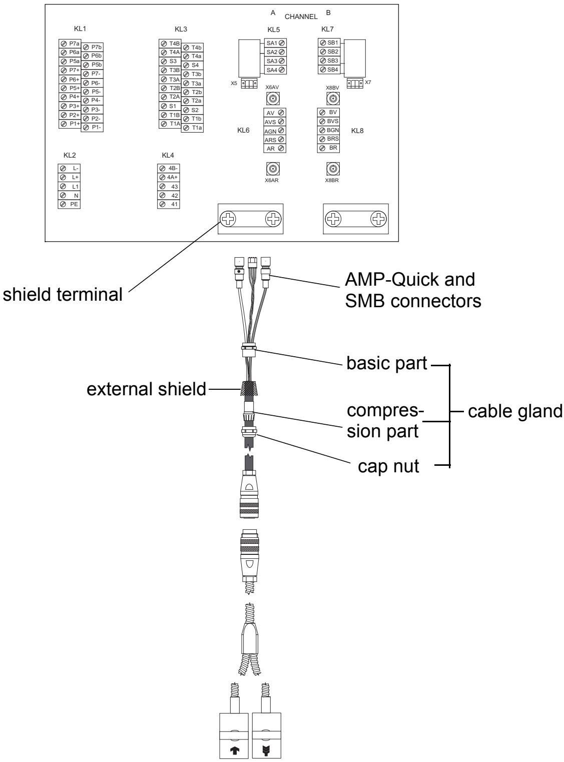


Fig. 6.9: Transducers - direct connection

- Push the basic part of the cable gland towards the AMP-Quick and SMB connectors, the cap nut and the compression part in the other direction.

Note!	Cap nut, compression part and basic part of the cable gland remain on the cable.

- Push the extension cable through the shield terminal to terminal strip KL6 for measuring channel A and to terminal strip KL8 for measuring channel B (see Fig. 6.9).
- Pull the extension cable back until the brushed back external shield is below the shield terminal (see Fig. 6.9).
- Fix the extension cable and the external shield to the shield terminal.
- Connect the AMP-Quick and SMB connectors to the sockets of the transmitter (see Fig. 6.9 and Table 6.8).

Table 6.8: Terminal assignment

terminal		connection
measuring channel A	measuring channel B	
X6AV	X8BV	SMB connector (white or marked cable)
X6AR	X8BR	SMB connector (brown cable)
X5	X7	AMP-Quick connector

6.4 Connection of the Power Supply

Attention!	According to IEC 61010-1:2001, a switch has to be provided near the instrument in the building installation, easily accessible for the user and marked as a disconnection device for the instrument.

- Connect the leads to the terminals of the power supply (see Fig. 6.10 and Table 6.9).

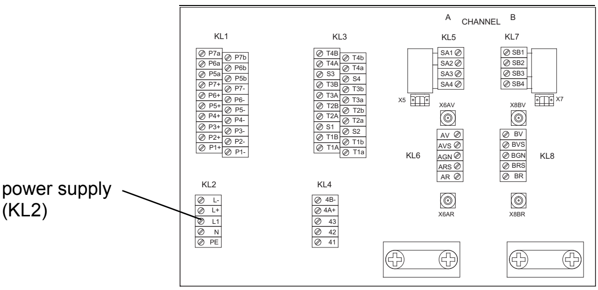


Fig. 6.10: Connection of the power supply

Table 6.9: Terminal assignment (power supply)

terminal	connection AC
PE	earth
N	neutral
L1	Phase 100...240 V AC, 50/60 Hz
fuse	1 A, time-lag

terminal	connection DC
PE	earth
L-	- DC
L+	+ DC
fuse	1.6 A, time-lag

6.5 Connection of the Outputs

```
I1 active loop
Klemmen:P1+,P1-
```

Configure the outputs (see chapter 19). The terminals to be used for the connection of the output are displayed at the end of the configuration dialog (here: P1+ and P1- for the active current loop).

- Connect the leads to the terminals of the outputs as displayed on the transmitter (see Fig. 6.11 and Table 6.10).

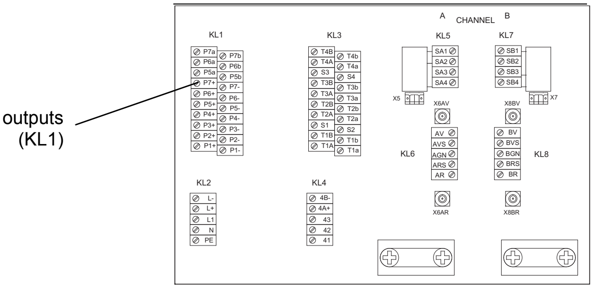
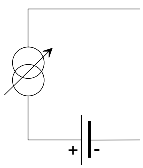
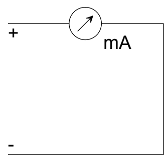


Fig. 6.11: Connection of the Outputs

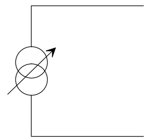
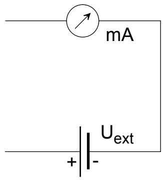
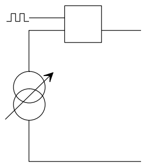
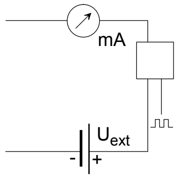
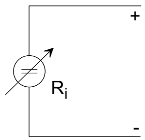
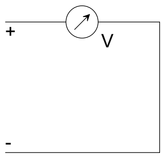
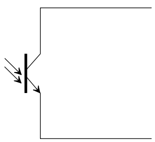
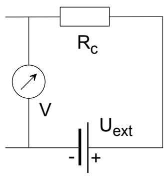
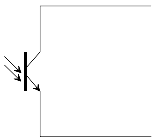
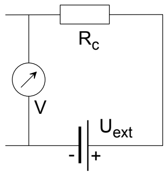
Table 6.10: Circuits of the outputs

output	transmitter internal circuit	transmitter connection	external circuit	remark
active current loop		Px+ Px-		R_{ext} < 500 Ω

The number, type and connections of the outputs are customized.

R_{ext} is the sum of all ohmic resistances in the circuit (e.g. resistance of the conductors, resistance of the amperemeter/voltmeter).

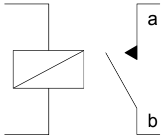
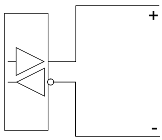
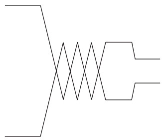
Table 6.10: Circuits of the outputs

output	transmitter internal circuit	transmitter connection	external circuit	remark
passive current loop		Px+ Px-		U_{ext} = 4...24 V U_{ext} > 0.021 A · R_{ext} [Ω] + 4 V example: U_{ext} = 12 V: R_{ext} = 0...380 Ω
HART (passive)		Px+ Px-		U_{ext} = 10...24 V
voltage output		Px+ Px-		R_i = 500 Ω R_{ext} > 2 MΩ If R_{ext} is lower, the accuracy is lower than specified.
frequency output		Px+ Px-		U_{ext} = 5...24 V R_c [kΩ] = U_{ext}/I_c [mA] I_c = 1...4 mA
binary output (open collector)		Px+ Px-		U_{ext} = 5...24 V R_c [kΩ] = U_{ext}/I_c [mA] I_c = 1...4 mA

The number, type and connections of the outputs are customized.

R_{ext} is the sum of all ohmic resistances in the circuit (e.g. resistance of the conductors, resistance of the amperemeter/voltmeter).

Table 6.10: Circuits of the outputs

output	transmitter		external circuit	remark
	internal circuit	connection		
binary output (Reed relay)		Px+/Pxa Px-/Pxb		U_{max} = 48 V I_{max} = 0.25 A
RS485		4A+ 4B- 43 (shield)		120 Ω termination resistor

The number, type and connections of the outputs are customized.

R_{ext} is the sum of all ohmic resistances in the circuit (e.g. resistance of the conductors, resistance of the amperemeter/voltmeter).

6.6 Connection of the Inputs

6.6.1 Connection of a Temperature Input

Temperature probes Pt100/Pt1000 (4-wire) can be connected to the inputs of the transmitter (optional) (see chapter 8).

For the assignment and the activation of the temperature inputs see chapter 18.

Table 6.11: Terminal assignment of the transmitter

terminal	connection with extension cable	connection without extension cable
Txa	red	red
TxA	gray	red/blue
Txb	blue	white/blue
TxB	white	white
Sx	Pt100/Pt1000 shield	Pt100/Pt1000 shield

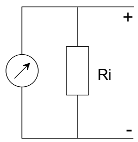
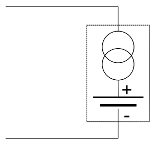
x = 1...4

6.6.2 Connection of a Current Input

Passive Current Input

An active current source or a passive current source with an external power supply can be connected to a passive current input.

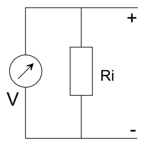
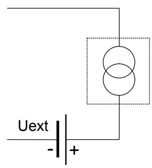
Table 6.12: Connection of an active current source

input	transmitter		external circuits	note
	internal circuits	connection		
passive current input		TxA TxB		max. permanent over-current: 100 mA

Attention!	The terminals Txa and Txb must not be connected.

If the polarity of the current source is inversed, only the sign of the measured current will change.

Table 6.13: Connection of a passive current source

input	transmitter		external circuits	note
	internal circuits	connection		
passive current input		TxA Txb		short circuit current: max. 100 mA

Attention!	The terminals Txa and TxB must not be connected.

An external voltage source U_{ext} is necessary. It must provide a current of min. 20 mA and

- supply sufficient power for the energy requirements of the passive current source and
- cover the voltage drop at the input resistor (1 V at 20 mA) and
- cover all other voltage drops (e.g. cable resistance) in the circuit

example: A passive current source (e.g. a pressure sensor) is to be connected to a passive current input.

Technical data of the pressure sensor:

U_S = 11...30 V DC
I_a = 4...20 mA ($I_{a\ max}$ = 22 mA)

U_{ext} required for the operation of the passive pressure sensor is:

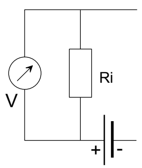
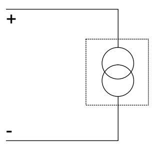
$$\begin{aligned} U_{ext\ min} &= U_{S\ min} + I_{a\ max} \cdot R_i + I_{a\ max} \cdot R_c \\ &= 11\ V + 22\ mA \cdot 50\ \Omega + 20\ mA \cdot 2\ \Omega \\ &= 12.14\ V \end{aligned}$$

$$\begin{aligned} U_{ext\ max} &= U_{S\ max} \\ &= 30\ V \end{aligned}$$

U_S - operating voltage of the pressure sensor
I_a - output current
R_i - input resistance
R_c - cable resistance

Active Current Input

Table 6.14: Connection of a passive current source

input	transmitter		external circuits	note
	internal circuits	connection		
active current input		TxA Txb		max. permanent overcurrent: 100 mA

At full load (20 mA), a voltage of 13.9 V DC is available for the supply of the passive current source.

Attention!	An active current source must not be connected to an active current input!

Attention!	The terminals Txa and TxB must not be connected.

Attention!	Observe the correct polarity to avoid damage of the current source. A permanent short circuit can lead to the destruction of the active current input.

6.7 Connection of the Serial Interface

The RS232 interface is located on the front plate of the transmitter (see Fig. 3.4).

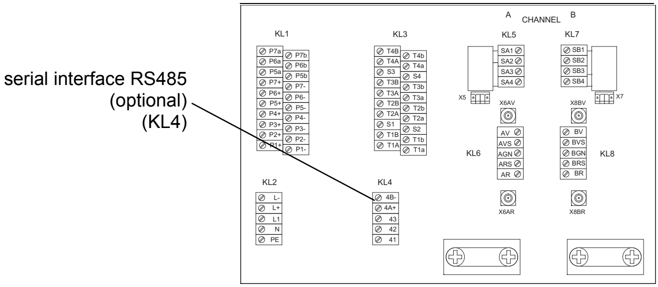


Fig. 6.12: Connection of the serial interface

The transmitter can also be equipped with an RS485 interface (optional). It is connected as follows (see Fig. 3.4 and Table 6.15):

Table 6.15: Terminal assignment

terminal	connection
4A+	RS485 A+
4B-	RS485 B-
43	RS485 (shield)

For further information on the data transmission see chapter 13.

6.8 Connection of the Sensor Module (SENSPROM)

The sensor module contains important transducer data for the operation of the transmitter with the transducers. It is connected to the corresponding terminals of the transmitter.

If transducers are replaced or added, the sensor module must also be replaced or added.

Note!	The serial numbers of the sensor module and the transducer must be identical. A wrong or incorrectly connected sensor module will lead to incorrect measured values or to a measurement failure.

- Disconnect the power supply from the transmitter.
- If the transducer cable has a 4-pole connector, connect it with socket X5 (terminal strip KL5) or X7 (terminal strip KL7) (see Fig. 6.13).
- Alternatively, connect the sensor module to the terminals of terminal strip KL5 or KL7 (see Fig. 6.13).

Attention!	The sensor module and the connector must not be connected at the same time.

- If the length of pre-assembled cables is reduced, it is not necessary to use the 4-pole connector. The data cables can be be connected directly to the terminals of terminal strip KL5 or KL7 (see Fig. 6.13 and Table 6.16).

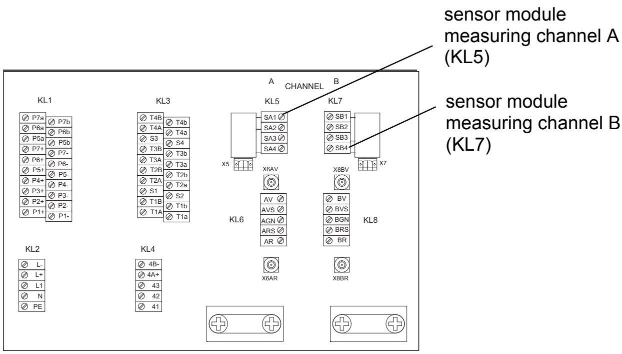


Fig. 6.13: Connection of the sensor module (SENSPROM)

Table 6.16: Terminals for the connection of the sensor module

terminal	connection
SA1	gray
SA2	
SA3	brown
SA4	green

7 Mounting the Transducers

- Before you start this chapter, read and follow the instruction in chapter 10.

Attention!	Observe the Safety Instructions for the Use in Explosive Atmosphere (see document SIFLUXUS).

The transducers will be fixed to the pipe by means of the supplied transducer mounting fixture.

Rust, paint or other deposits on the pipe will absorb the sound signal. A good acoustic contact between pipe and transducers is obtained as follows:

- Clean the pipe at the selected measuring point:
- Remove rust or loose paint. An existing paint layer on the pipe should be smoothed for a better measuring result.
- Use coupling foil or apply a bead of acoustic coupling compound along the center line onto the contact surface of the transducers.
- Observe that there must be no air pockets between the transducer contact surface and the pipe wall.
- Make sure that the transducer mounting fixture applies the necessary pressure on the transducers.

The transducers are mounted in such way that the engravings on the transducers form an arrow (see Fig. 7.1). The transducer cables show then in opposite directions.

For the determination of the flow direction with the help of the arrow see section 10.8.

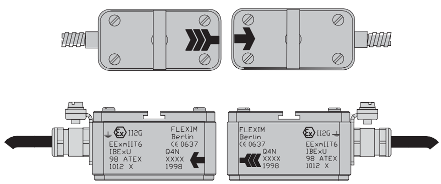


Fig. 7.1: Correct positioning of the transducers

Select the installation instructions that correspond to the supplied transducer mounting fixture.

- Variofix L: see section 7.1
- Variofix C: see section 7.2
- mounting shoe and clasp: see section 7.3

7.1 Mounting with Variofix L

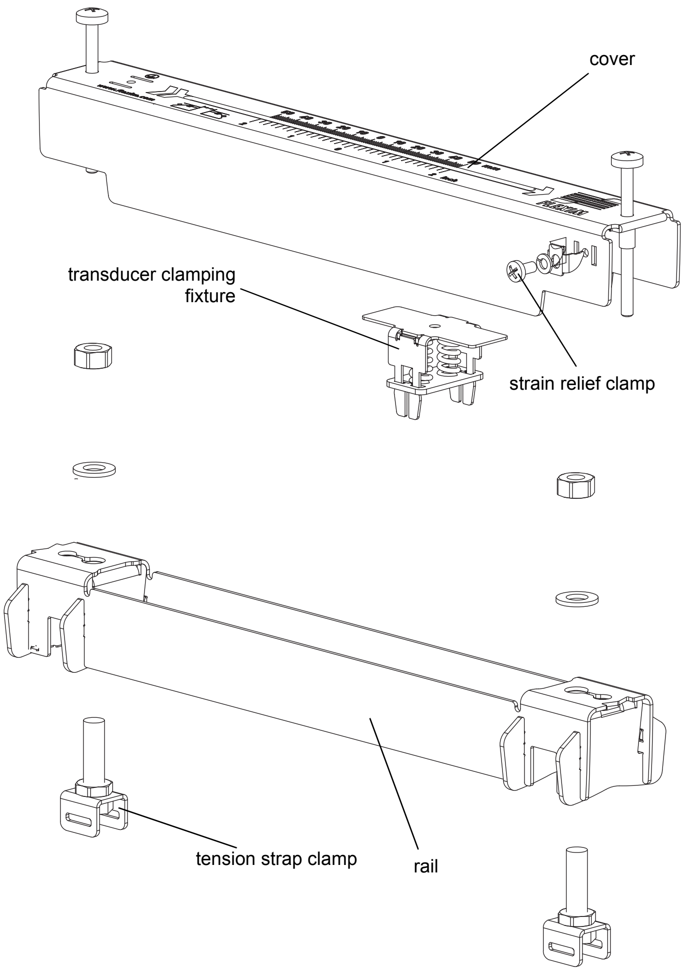


Fig. 7.2: Design of Variofix L

7.1.1 Mounting the Clasps

Select the installation instructions that correspond to the supplied clasp:

- for band clamp clasp see section 7.1.1.1
- for quick release clasp see section 7.1.1.2
- for ratchet clasp see section 7.1.1.3

7.1.1.1 Band Clamp Clasp

The clasp is fixed to the tension strap (see Fig. 7.3).

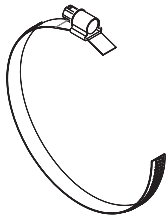


Fig. 7.3: Band clamp clasp with tension strap

7.1.1.2 Quick Release Clasp

The clasp is fixed to the tension strap (see Fig. 7.4).

Cut the tension straps to length (pipe circumference + 120 mm).

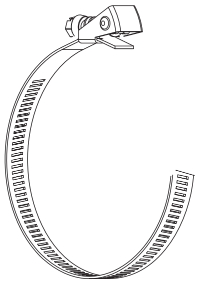


Fig. 7.4: Quick release clasp with tension strap

7.1.1.3 Ratchet clasp

- Cut the tension strap to length (pipe circumference + 120 mm).

Attention!	The edge of the tension strap is very sharp, leading to risk of injury. Remove the burr of the sharp edge.

- Insert approx. 10 cm of the tension strap through the parts (1) and (2) of the clasp (see Fig. 7.5 a).
- Bend the tension strap.
- Insert the tension strap in part (1) of the ratchet clasp (see Fig. 7.5 b).
- Tighten the tension strap.
- Repeat the steps for the second tension strap.

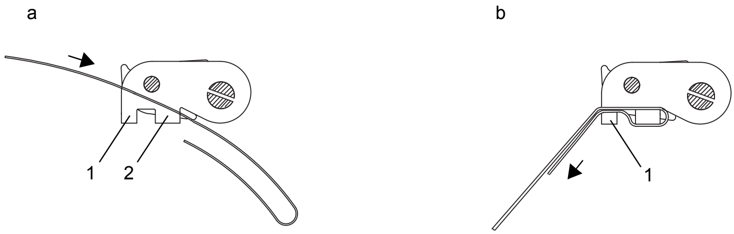


Fig. 7.5: Ratchet clasp with tension strap

7.1.2 Mounting the Tension Strap Clamp

Select the installation instructions that correspond to the supplied clasp:

- for band clamp clasp see section 7.1.2.1
- for quick release clasp see section 7.1.2.2
- for ratchet clasp see 7.1.2.3

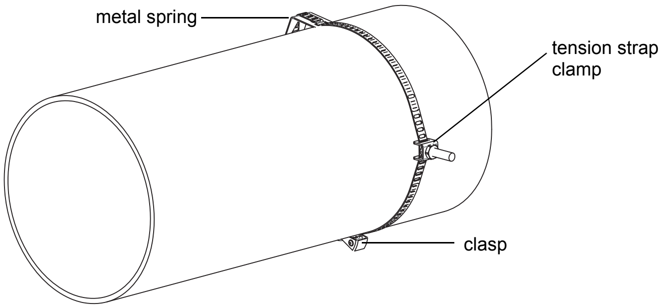


Fig. 7.6: Tension strap with tension strap clamp and metal spring on the pipe

7.1.2.1 Band Clamp Clasp

- Insert the tension strap in the tension strap clamp (see Fig. 7.7).
- Position the clasp and the tension strap clamp on the pipe (see Fig. 7.6). On horizontal pipes, mount the tension strap clamp on the side of the pipe, if possible.
- Place the tension strap around the pipe and insert it in the clasp (see Fig. 7.7).
- Tighten the tension strap.
- Tighten the screw of the clasp.

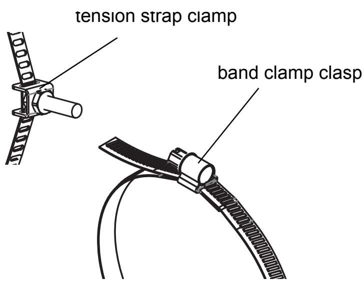


Fig. 7.7: Tension strap with band clamp clasp and tension strap clamp

7.1.2.2 Quick Release Clasp

- Insert the tension strap in the tension strap clamp and the metal spring (see Fig. 7.8).
- Position the clasp, the metal spring and the tension strap clamp on the pipe (see Fig. 7.6):
  - On horizontal pipes, mount the tension strap clamp on the side of the pipe, if possible.
  - Mount the metal spring on the opposite side of the tension strap clamp.
- Place the tension strap around the pipe and insert it in the clasp (see Fig. 7.8).
- Tighten the tension strap.
- Tighten the screw of the clasp.

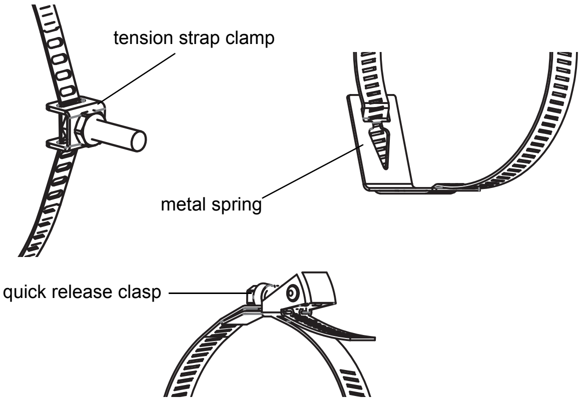


Fig. 7.8: Tension strap with quick release clasp, metal spring and tension strap clamp

7.1.2.3 Ratchet Clasp

- Insert the tension strap in the tension strap clamp and the metal spring (see Fig. 7.9). It is not necessary to mount the metal spring:
  - on steel pipes
  - on pipes with an outer pipe diameter < 80 mm or
  - on pipes that are not subjected to significant temperature fluctuations
- Position the clasp, the metal spring (if necessary) and the tension strap clamp on the pipe (see Fig. 7.6).
  - On horizontal pipes, mount the tension strap clamp on the side of the pipe, if possible.
  - Mount the metal spring on the opposite side of the tension strap clamp.

- Place the tension strap around the pipe and insert it in part (3) of the clasp (see Fig. 7.10).
- Tighten the tension strap.
- Cut off the protruding tension strap (see Fig. 7.11).

Attention!	The edge of the tension strap is very sharp, leading to risk of injury. Remove the burr of the sharp edge.

- Tighten the screw of the clasp.

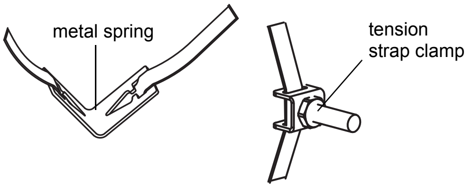


Fig. 7.9: Tension strap with tension strap clamp and metal spring

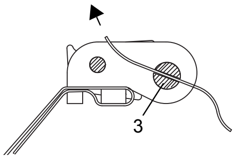


Fig. 7.10: Ratchet clasp with tension strap

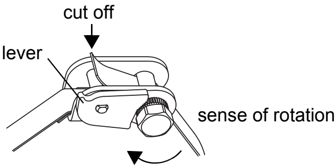


Fig. 7.11: Ratchet clasp with tension strap

7.1.3 Mounting the Rail

- Place the second tension strap clamp in the rail. Observe the orientation of the tension strap clamp (see Fig. 7.12).
- Tighten the nut of the tension strap clamp slightly.
- Screw the rail to the tension strap clamp that is fixed to the pipe (see Fig. 7.13).
- Tighten the nut of the tension strap clamp.

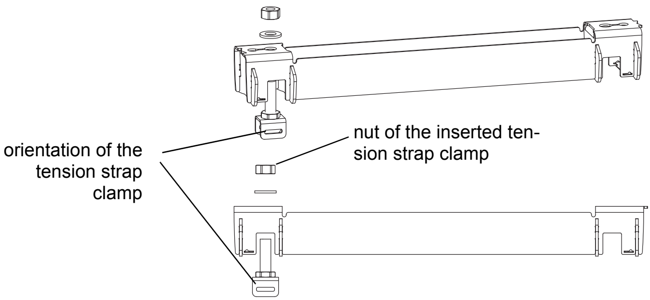


Fig. 7.12: Rail Variofix L

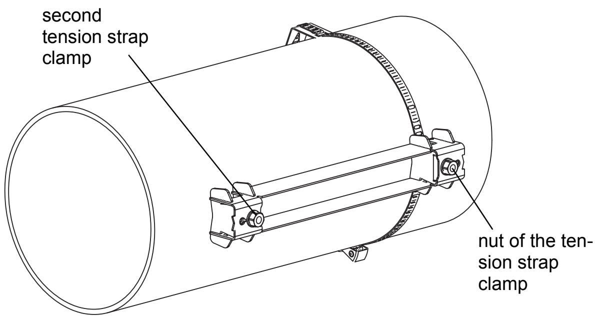


Fig. 7.13: Rail, mounted on one side of the pipe

Select the installation instructions that correspond to the supplied clasp:

- for band clamp clasp see section 7.1.3.1
- for quick release clasp see section 7.1.3.2
- for ratchet clasp see section 7.1.3.3

7.1.3.1 Band Clamp Clasp

- Insert the tension strap in the second tension strap clamp (see Fig. 7.15).
- Position the clasp and the tension strap clamp on the pipe:
- Place the tension strap around the pipe and insert it in the clasp (see Fig. 7.14).
- Tighten the tension strap.
- Tighten the screw of the clasp.
- Tighten the nut of the tension strap clamp (see Fig. 7.15).

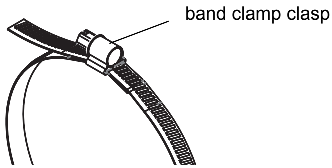


Fig. 7.14: Tension strap with band clamp clasp

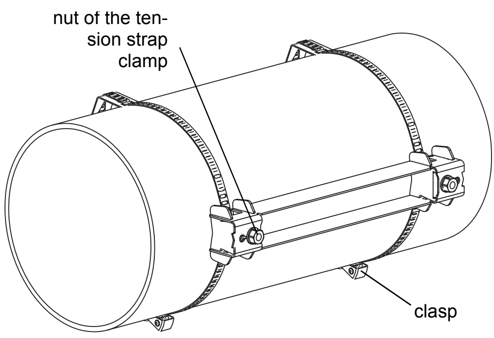


Fig. 7.15: Rail on the pipe

7.1.3.2 Quick Release Clasp

- Insert the tension strap in the second tension strap clamp and the metal spring (see Fig. 7.15 and Fig. 7.16).
- Position the clasp, the metal spring and the tension strap clamp on the pipe. Mount the metal spring on the opposite side of the tension strap clamp.
- Place the tension strap around the pipe and insert it in the clasp (see Fig. 7.16).
- Tighten the tension strap.
- Tighten the screw of the clasp.
- Tighten the nut of the tension strap clamp (see Fig. 7.15).

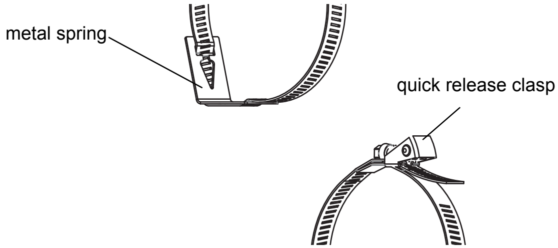


Fig. 7.16: Tension strap with quick release clasp and metal spring

7.1.3.3 Ratchet Clasp

- Insert the tension strap in the second tension strap clamp and the metal spring (see Fig. 7.15 and Fig. 7.17). It is not necessary to mount the metal spring:
  - on steel pipes
  - on pipes with an outer pipe diameter < 80 mm or
  - on pipes that are not subjected to significant temperature fluctuations
- Position the clasp, the metal spring (if necessary) and the tension strap clamp on the pipe. Mount the metal spring on the opposite side of the tension strap clamp, if necessary.

- Place the tension strap around the pipe and insert it in part (3) of the clasp (see Fig. 7.18).
- Tighten the tension strap.

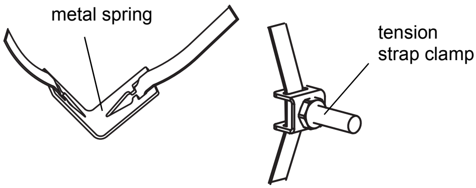


Fig. 7.17: Tension strap with the metal spring and the tension strap clamp

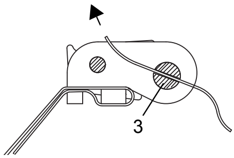


Fig. 7.18: Ratchet clasp with tension strap

- Cut off the protruding tension strap (see Fig. 7.19).

Attention!	The edge of the tension strap is very sharp, leading to risk of injury. Remove the burr of the sharp edge.

- Tighten the screw of the clasp.
- Tighten the nut of the tension strap clamp (see Fig. 7.15).

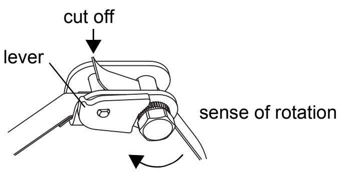


Fig. 7.19: Ratchet clasp with tension strap

Note!	To release the screw and the tension strap press the lever down (see Fig. 7.19).

7.1.4 Mounting the Transducers in the Cover

- Press the transducers firmly on the transducer clamping fixture in the cover until the transducers are firmly fixed in the cover. The transducer cables show in opposite directions (see Fig. 7.20).

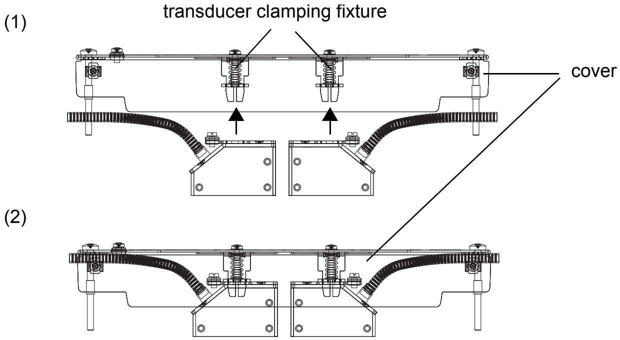


Fig. 7.20: Transducers in the cover

- Adjust the transducer distance recommended by the transmitter (see Fig. 7.21).
- Fix the transducer cables with the strain relief clamp to protect them from mechanical strain (see Fig. 7.21).
- Put coupling pads (or some coupling compound for a short-term installation) on the contact surface of the transducers. The coupling pads can be fixed to the contact surface with some coupling compound.

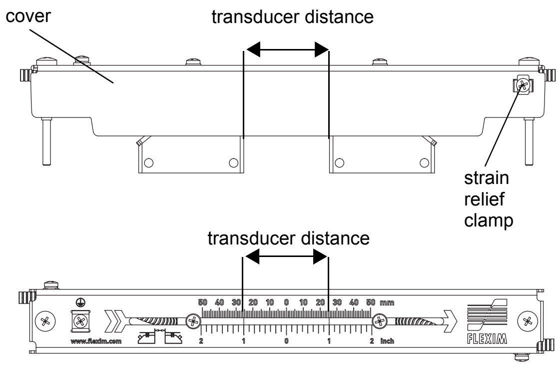


Fig. 7.21: Adjusting the transducer distance

Note!	If coupling pads are used: If the signal is not sufficient for a measurement, use the coupling compound instead of the coupling pads.

- Put the cover with the transducers on the rail.
- Correct the transducer distance, if necessary (see section 10.6.1 and section 10.6.2).

Note!	Observe that the coupling pads must remain on the contact surface of the transducers.

- Tighten the screws of the cover (see Fig. 7.22).

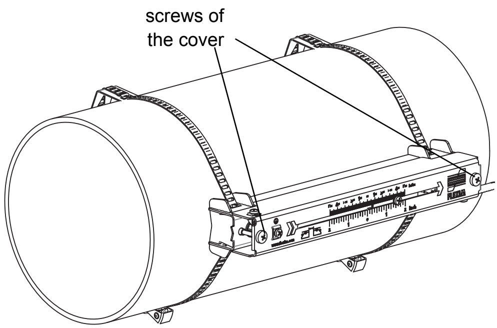


Fig. 7.22: Transducers with Variofix L on the pipe

7.2 Mounting with Variofix C

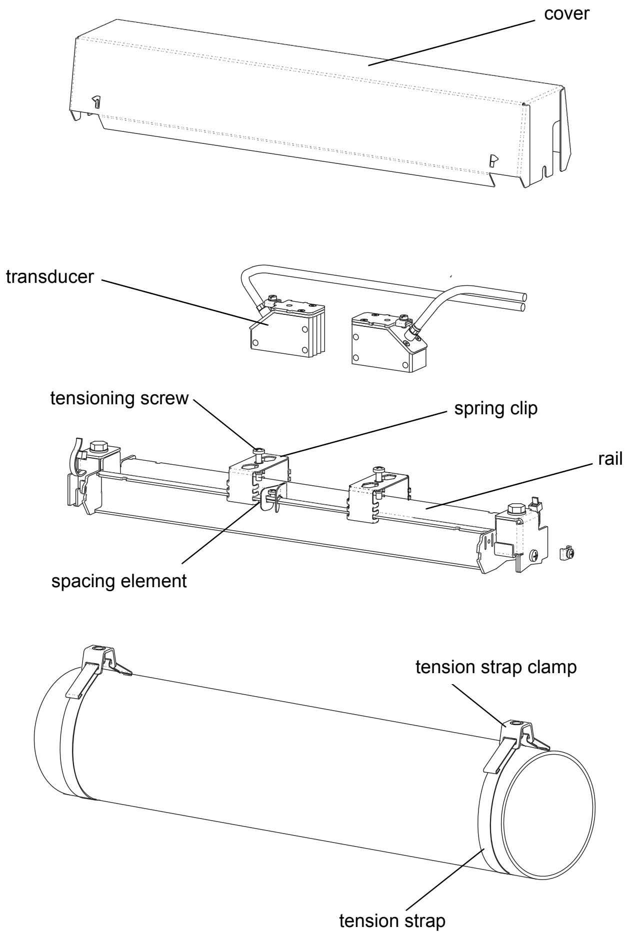


Fig. 7.23: Design of Variofix C with transducers (installation without clasp)

7.2.1 Installation of the Rail

Select the installation instructions that correspond to the supplied clasp:

- for the installation of the rail without a clasp see section 7.2.1.1
- for the installation of the rail with a ratchet clasp see section 7.2.1.2

7.2.1.1 Installation of the Rail Without a Clasp

- Cut the tension strap to length (pipe circumference + 120 mm).

Attention!	The edge of the tension strap is very sharp, leading to risk of injury. Remove the burr of the sharp edge.

- Insert approx. 10 cm of the tension strap in one of the slots of the tension strap clamp and bend it (see Fig. 7.24).
- If necessary, insert the long end of the tension strap in the metal spring (see Fig. 7.25). It is not necessary to mount the metal spring:
  - on steel pipes
  - on pipes with an outer pipe diameter < 80 mm or
  - on pipes that are not subjected to significant temperature fluctuations
- Place the tension strap around the pipe (see Fig. 7.26).
- Position the metal spring (if mounted) and the tension strap clamp:
  - On horizontal pipes, mount the tension strap clamp on the side of the pipe, if possible.
  - Mount the metal spring (if necessary) on the opposite side of the tension strap clamp.
- Insert the long end of the tension strap in the second slot of the tension strap clamp (see Fig. 7.26 a).
- Tighten the tension strap and bend it.

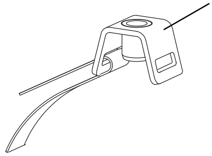


Fig. 7.24: Tension strap with tension strap clamp

- Bend both ends of the tension strap (see Fig. 7.26 b).
- Repeat the steps for the second tension strap.

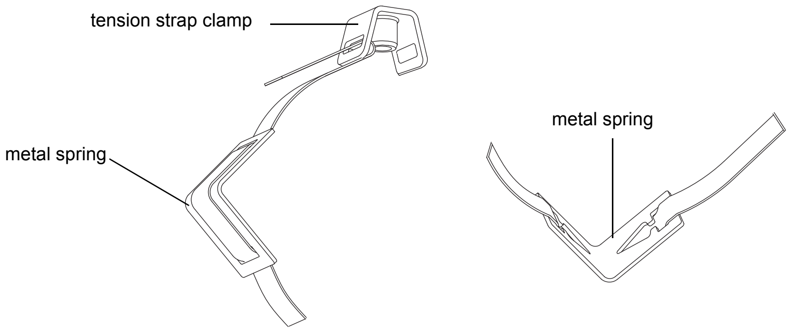


Fig. 7.25: Tension strap with the metal spring and the tension strap clamp

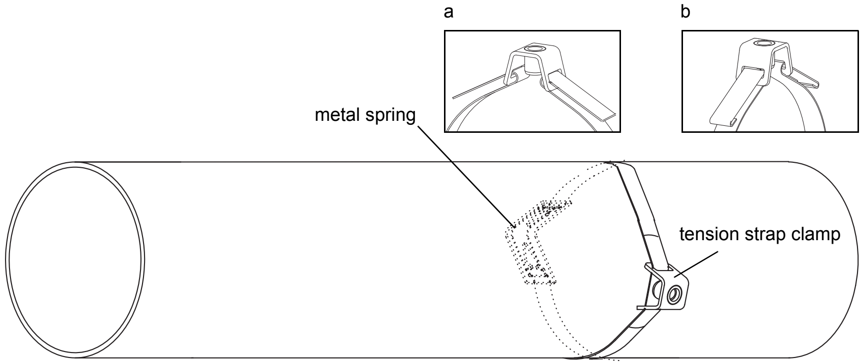


Fig. 7.26: Tension strap with the metal spring and the tension strap clamp on the pipe

- Put the rail on the tension strap clamps (see Fig. 7.27).
- Fix the rail to the tension strap clamps with the screws.
- Tighten the screws.

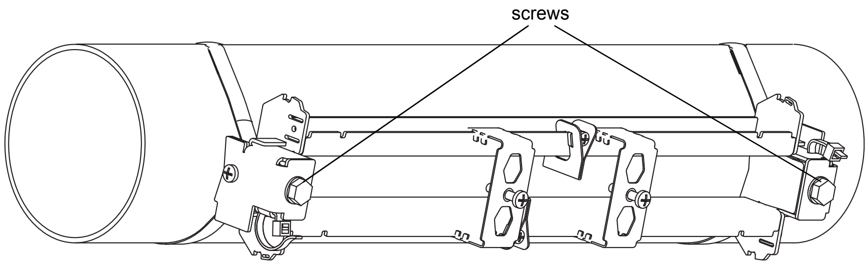


Fig. 7.27: Rail on the pipe

7.2.1.2 Installation of the Rail with the Ratchet Clasp

- Cut the tension strap to length (pipe circumference + 120 mm).

Attention!	The edge of the tension strap is very sharp, leading to risk of injury. Remove the burr of the sharp edge.

- Insert approx. 10 cm of the tension strap through parts (1) and (2) of the ratchet clasp (see Fig. 7.28 a).
- Bend the tension strap.
- Insert the tension strap in part (1) of the ratchet clasp (see Fig. 7.28 b).
- Tighten the tension strap.

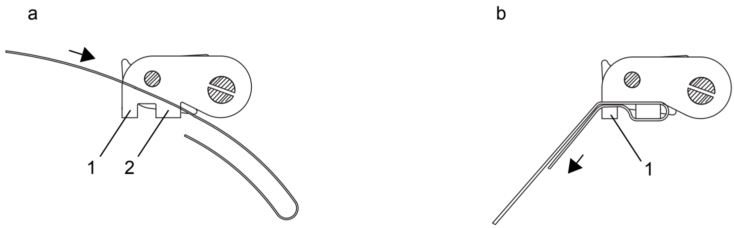


Fig. 7.28: Ratchet Clasp with tension strap

- Insert the long end of the tension strap in the tension strap clamp and the metal spring (see Fig. 7.29). It is not necessary to mount the metal spring:
  - on steel pipes
  - on pipes with an outer pipe diameter < 80 mm or
  - on pipes that are not subjected to significant temperature fluctuations
- Place the tension strap around the pipe (see Fig. 7.30).
- Position the metal spring (if mounted), the ratchet clasp and the tension strap clamp:
  - On horizontal pipes, mount the tension strap clamp on the side of the pipe, if possible.
  - Mount the metal spring (if necessary) on the opposite side of the tension strap clamp.
- Insert the long end of the tension strap in part (3) of the ratchet clasp (see Fig. 7.31).
- Tighten the tension strap.

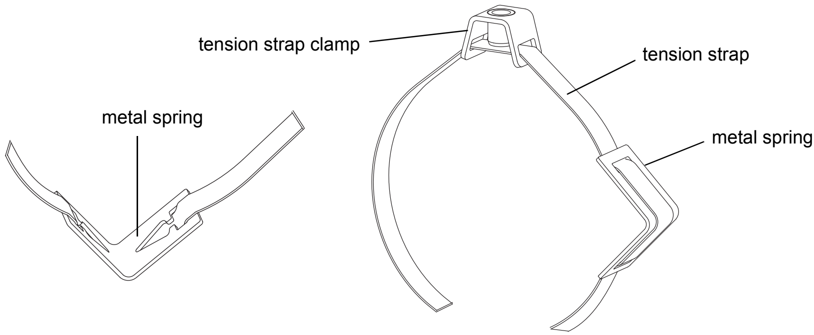


Fig. 7.29: Tension strap with the metal spring and the tension strap clamp

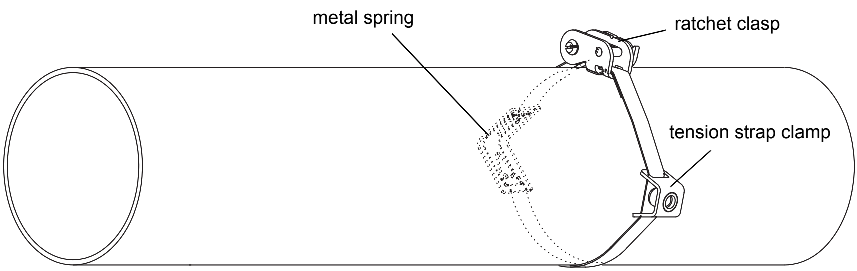


Fig. 7.30: Tension strap with the metal spring, the ratchet clasp and the tension strap clamp on the pipe

- Cut off the protruding tension strap (see Fig. 7.32).

Attention!	The edge of the tension strap is very sharp, leading to risk of injury. Remove the burr of the sharp edge.

- Tighten the screw of the ratchet clasp.
- Repeat the steps for the second tension strap.

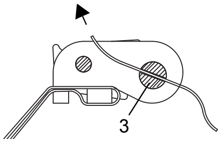


Fig. 7.31: Ratchet Clasp with tension strap

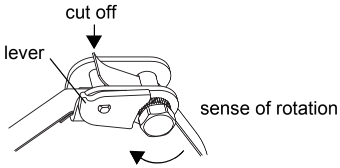


Fig. 7.32: Ratchet Clasp with tension strap

Note!	To release the screw and the tension strap press the lever down (see Fig. 7.32).

- Put the rail on the tension strap clamps (see Fig. 7.33).
- Fix the rail to the tension strap clamps with the screws.
- Tighten the screws.

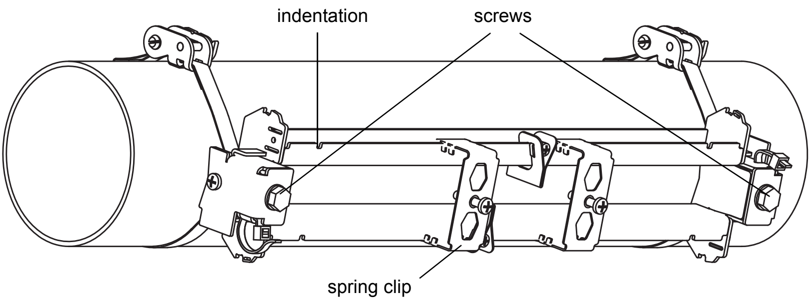


Fig. 7.33: Rail on the pipe

Note!	The spring clip can be removed from the rail or put on the rail over the indentations (see Fig. 7.33).

7.2.2 Mounting the Transducers

- Put coupling pads (or some coupling compound for a short-term installation) on the contact surface of the transducers. The coupling pads can be fixed to the contact surface of the transducers with some coupling compound.

Note!	If coupling pads are used: If the signal is not sufficient for a measurement, use the coupling compound instead of the coupling pads.

- Position the transducers on the rail in such way that the engravings on the transducers form an arrow. The transducer cables show in opposite directions (see Fig. 7.34).
- Adjust the transducer distance recommended by the transmitter (see section 10.6).

Note!	Observe that the coupling pads must remain on the contact surface of the transducers.

- Slide the spring clips on the transducers (see Fig. 7.35).
- Fix the transducers by tightening the tensioning screws slightly. The end of the screw must be rotated into the hole on the transducer (see Fig. 7.34).
- Correct the transducer distance, if necessary (see section 10.6.1 and section 10.6.2).
- Tighten the tensioning screw.
- Fix the spacing element on the rail to mark the transducer position (see Fig. 7.34).
- Fix the transducer cables with the cable tie to protect them from mechanical strain (see Fig. 7.35).
- Put the cover on the rail (see Fig. 7.36).
- Tighten the screws on both sides of the cover.

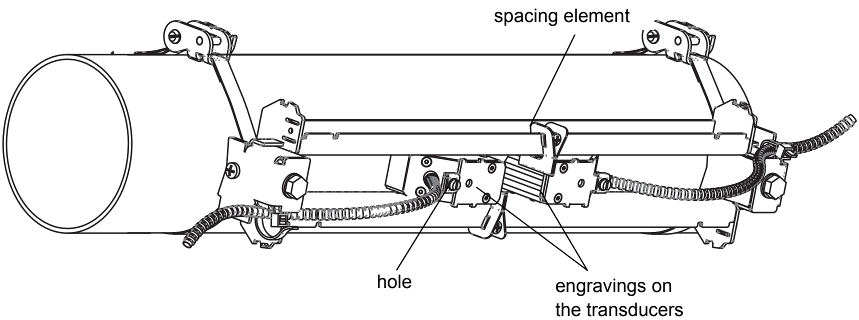


Fig. 7.34: Transducers in the rail (spring clip not shown)

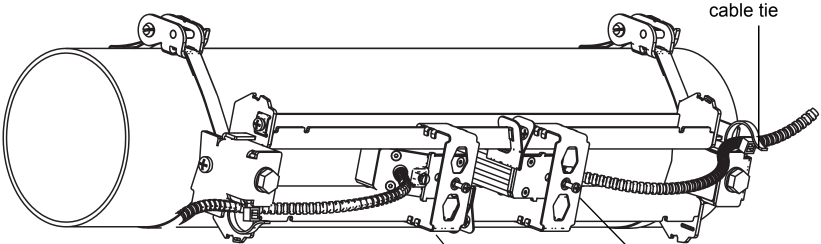


Fig. 7.35: Transducers in the rail

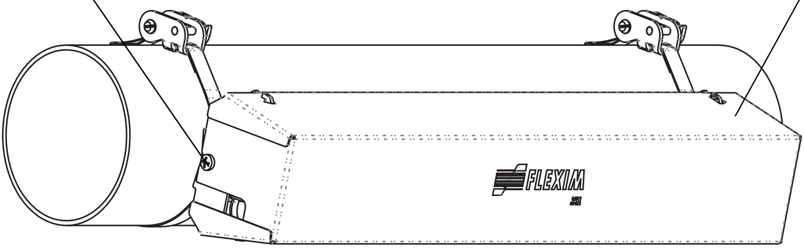


Fig. 7.36: Variofix C with transducer on the pipe

7.3 Mounting with Mounting Shoe and Band Clamp Clasp

- Push the tension strap through the groove on the top of the mounting shoe (see Fig. 7.37).
- Position the mounting shoe and the clasp on the pipe. On horizontal pipes, mount the mounting shoe on the side of the pipe, if possible.
- Place the tension strap around the pipe and insert it in the clasp.
- Tighten the tension strap.
- Tighten the screw of the clasp.

Note!	The clasp must be in contact completely with the pipe to ensure a good fixation.

- Repeat the steps for fixing the second mounting shoe. Adjust the displayed transducer distance between the inner edges of the mounting shoes by means of the measuring tape.
- Tighten the screws of the clasps.
- Push the transducers in the mounting shoes. Press the transducer firmly on the pipe. There should be no air pockets between transducer surface and pipe wall. Tighten the screw of the mounting shoe firmly.

Note!	When the transducers are mounted on a vertical pipe and the transmitter is placed lower than the transducers, the transducer cables should be fixed to the tension strap with a cable tie to protect them from mechanical strain.

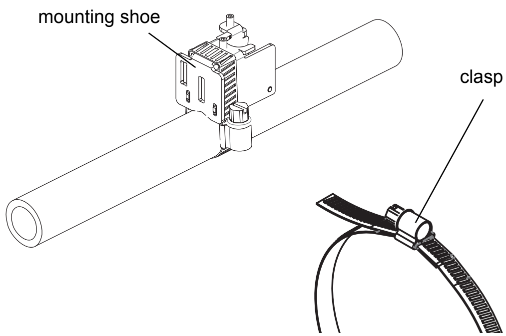


Fig. 7.37: Transducer in the mounting shoe, mounted with the tension strap and the clasp

8 Installation of the Temperature Probes (Optional)

Attention!	Observe the Safety Instructions for the Use in Explosive Atmosphere (see document SIFLUXUS).

8.1 Mounting the Temperature Probes

- Remove rust, insulation material and loose paint to get a good thermal contact.
- Clean the pipe.

Temperature Probe Pt100 (Response Time 8 s)

- Fix the protection plate and the isolation foam to the temperature probe (see Fig. 8.1 and Fig. 8.2).
- Apply a film of thermal conductivity paste (not supplied by FLEXIM) on the contact surface of the temperature probe.
- Take the spring end of the ball chain and insert the last ball in one of the slots on the top of the temperature probe.

Fig. 8.1: Temperature probe

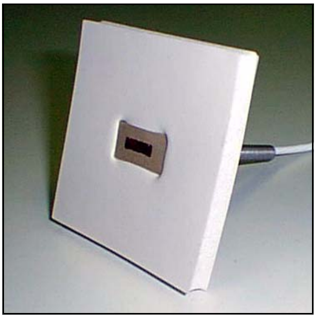


Fig. 8.2: Temperature probe with protection plate and isolation foam

- Place the chain around the pipe. Tighten the chain and insert it in the other slot of the temperature probe (see Fig. 8.3).

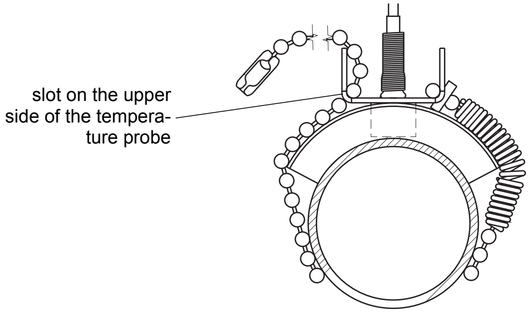


Fig. 8.3: Mounted temperature probe

8.2 Connection of the Temperature Probes

Attention!	Observe the Safety Instructions for the Use in Explosive Atmosphere (see document SIFLUXUS).

- Connect the temperature probes to temperature inputs of the transmitter.

Table 8.1: Terminal strip KL2 of the transmitter

terminal	connection of the temperature probe	connection of the extension cable
T1a...T4a	red	red
T1A...T4A	red/blue	gray
T1b...T4b	white/blue	blue
T1B...T4B	white	white
S1...S4	shield	shield

9 Start-up

9.1 Switching on

```
FLEXIM FLUXUS
ADM7XX7-XXXXXXX
```

As soon as the transmitter is connected to the power supply, the display indicates which transducer has been detected at which channel.

Afterwards, the serial number of the transmitter is displayed for a short time.

Data can not be entered while the serial number is displayed.

```
>PAR<mea opt sf
Parameter
```

After the initialization, the main menu is displayed in the selected language. The language of the display can be set (see section 9.4).

9.2 Displays

9.2.1 Main menu

```
>PAR<mea opt sf
Parameter
```

The main menu contains the following program branches:

- `par` (Parameter)
- `mea` (Measuring)
- `opt` (Output Options)
- `sf` (Special Function)

The selected program branch is displayed in capital letters between arrows. The complete designation of the selected program branch is displayed in the lower line.

Select a program branch by pressing key 4 and 6. Press ENTER.

Note!	By pressing key BRK, the measurement will be stopped and the main menu selected.

Note!	In this user manual, all program entries and keys are indicated with typewriter characters (`Parameter`). The menu items are separated from the main menu by a backslash "\".

9.2.2 Overview of the Program Branches

- **Program branch `Parameter`**
  input of the pipe and medium parameters
- **Program branch `Measuring`**
  processing of the steps for the measurement
- **Program branch `Output Options`**
  setting of the physical quantity, the unit of measurement and the parameters for the measured value output
- **Program branch `Special Funct.`**
  contains all functions that are not directly related to the measurement

For an overview of the program branches see figure below. For a detailed overview of the menu structure see annex A.

`Parameter` `>PAR<`	`Measuring` `>MEA<`	`Output Options` `>OPT<`	`Special Funct.` `>SF<`
selection of the measuring channel	selection of the measuring channel	selection of the measuring channel	system settings[1]
pipe parameters	measuring point number	physical quantity	instrument information
medium parameters	sound path	unit of measurement	print measured values
transducer type	transducer positioning	damping	delete measured values
extension cable	measurement	measured value output	program code
	consistency check		install material
			install medium

[1] `SYSTEM settings` contains the following menu items:
- `Dialogs/Menus`
- `Proc. inputs`
- `Measuring`
- `Proc. outputs`
- `Storing`
- `serial transmis.`
- `Miscellaneous`
- `Set Clock`
- `Libraries`

9.2.3 Navigation

A vertical arrow ⇳ will be displayed if the menu item contains a scroll list. The current list item will be displayed in the lower line.

```
Parameter        ⇳
for Channel     A:
```

Use key 8 and 2 to select a list item in the lower line. Press ENTER.

Some menu items contain a horizontal scroll list in the lower line. The selected list item is displayed in capital letters between arrows.

```
Lining
no           >YES<
```

Press key 4 and 6 to scroll through the lower line and select a list item. Press ENTER.

Some menu items contain a horizontal scroll list in the upper line. The selected list item is displayed in capital letters between arrows. The current value of the list item is displayed in the lower line.

```
R1=FUNC<typ mode
Function:      MAX
```

Press key 4 and 6 to scroll through the upper line and select a list item.

Press key 8 and 2 to scroll through the lower line and select a value for the selected list item.

Press ENTER.

9.3 HotCodes

A HotCode is a key sequence used to activate certain settings:

- language selection (see section 9.4)
- activating the SuperUser mode (see section 16)
- activating the FastFood mode (see section 12.6)
- manual input of the lower limit for the inner pipe diameter (see section 12.8)

A HotCode can be entered in the main menu after pressing key C. The HotCode will not be displayed during the input.

9.4 Language Selection

The transmitter can be operated in the languages listed below. The language can be selected with the following HotCodes:

Table 9.1: Language HotCodes

909031	Dutch
909033	French
909034	Spanish
909044	English
909049	German

Depending on the technical data of the transmitter, some of the languages might not be implemented.

When the last digit has been entered, the main menu will be displayed in the selected language.

The selected language remains activated when the transmitter is switched off and on again. After a cold start, the default language set by the manufacturer is activated.

9.5 Operation State Indication (FLUXUS ADM 7907)

The operation state is indicated by 2 LEDs .

Table 9.2: Operation State Indication (LED SIGNAL)

LED off	transmitter offline
LED lights green	signal quality of the measuring channel sufficient for a measurement
LED lights red	signal quality of the measuring channel not sufficient for a measurement

Table 9.3: Operation state indication (LED READY)

LED off	no measurement
LED lights yellow	measurement
LED flashes yellow	before a HotCode can be entered, key C must be pressed

9.6 Interruption of the Power Supply

As soon as the measurement begins, all current measuring parameters will be stored in a non-volatile cold start resistant EPROM. The operation of the transmitter will be interrupted if the power supply fails. All input data remain stored.

```
FLEXIM FLUXUS
ADM7XX7-XXXXXXXX
```

After the return of the power supply, the serial number is displayed for a few seconds.

The interrupted measurement is continued. All selected output options are still active. The measurement will not be continued after the return of the power supply if a cold start has been performed.

10 Basic Measurement

Attention!	Observe the Safety Instructions for the Use in Explosive Atmosphere (see document SIFLUXUS).

The pipe and medium parameters are entered for the selected measuring point (see chapter 4). The parameter ranges are limited by the technical characteristics of the transducers and of the transmitter.

Note!	During the parameter input, the transducers must be connected to the transmitter.

Note!	The parameters will only be stored when the program branch `Parameter` has been edited in its entirety.

10.1 Input of the Pipe Parameters

```
>PAR<mea opt sf
Parameter
```

Select the program branch `Parameter`. Press ENTER.

```
Parameter      ⇳
for Channel   A:
```

Select the channel for which the parameters are to be entered. Press ENTER.

This display will not be indicated if the transmitter has only one measuring channel.

10.1.1 Outer Pipe Diameter/Pipe Circumference

```
Outer Diameter
   100.0      mm
```

Enter the outer pipe diameter. Press ENTER.

```
Outer Diameter
1100.0   MAXIMAL
```

An error message will be displayed if the entered parameter is outside of the range. The limit will be displayed.

example: upper limit 1100 mm for the connected transducers and for a pipe wall thickness of 50 mm.

It is possible to enter the pipe circumference instead of the outer pipe diameter (see section 15.2.1).

If the input of the pipe circumference has been activated and `0` (zero) is entered for the `Outer Diameter`, the menu item `Pipe Circumfer.` will be displayed. If the pipe circumference is not to be entered, press key BRK to return to the main menu and start the parameter input again.

10.1.2 Pipe Wall Thickness

```
Wall Thickness
      3.0      mm
```

Enter the pipe wall thickness. Press ENTER.

Note!	The inner pipe diameter (= outer pipe diameter - 2x pipe wall thickness) is calculated internally. If the value is not within the inner pipe diameter range of the connected transducers, an error message will be displayed. It is possible to change the lower limit of the inner pipe diameter for a given transducer type (see section 12.8).

10.1.3 Pipe Material

The pipe material must be selected to be able to determine the sound velocity. The sound velocity for the materials in the scroll list are stored in the transmitter.

```
Pipe Material    ⇕
Carbon Steel
```

Select the pipe material.

If the medium is not in the scroll list, select `Other Material`. Press ENTER.

It can be specified which materials will be displayed in the scroll list (see section 14.5).

When the pipe material has been selected, the corresponding sound velocity is set automatically. If `Other Material` has been selected, the sound velocity must be entered.

```
c-Material
   3230.0     m/s
```

Enter the sound velocity of the pipe material. Press ENTER.

Note!	Enter the sound velocity of the material (i.e. longitudinal or transversal velocity) which is nearer to 2500 m/s.

For the sound velocity of some materials see annex C, Table C.1.

10.1.4 Pipe Lining

```
Lining
no            >YES<
```

If the pipe has an inner lining, select `yes`. Press ENTER.

If `no` is selected, the next parameter will be displayed (see section 10.1.5).

```
Lining             ⇕
Bitumen
```

Select the lining material.

If the material is not in the scroll list, select `Other Material`. Press ENTER.

It can be specified which materials will be displayed in the scroll list (see chapter 10.1.5).

If `Other Material` is selected, the sound velocity must be entered.

```
c-Material
   3200.0      m/s
```

Enter the sound velocity of the lining material. Press ENTER.

For the sound velocity of some materials see annex C, Table C.1.

```
Liner Thickness
      3.0       mm
```

Enter the thickness of the liner. Press ENTER.

Note!	The inner pipe diameter (= outer pipe diameter - 2x pipe wall thickness - 2x liner thickness) is calculated internally. If the value is not within the inner pipe diameter range of the connected transducers, an error message will be displayed. It is possible to change the lower limit of the inner pipe diameter for a given transducer type (see section 12.8).

10.1.5 Pipe Roughness

The flow profile of the medium is influenced by the roughness of the inner pipe wall. The roughness will be used for the calculation of the profile correction factor. As, in most cases, the pipe roughness can not be exactly determined, it has to be estimated.

For the roughness of some materials see annex C, Table C.2.

```
Roughness
      0.4       mm
```

Enter the roughness of the selected pipe or liner material.

Change the value according to the condition of the inner pipe wall. Press ENTER.

10.2 Input of the Medium Parameters

```
Medium            ⇕
Water
```

Select the medium from the scroll list.

If the medium is not in the scroll list, select `Other Medium`. Press ENTER.

It is possible to specify which media will be displayed in the scroll list (see section 14.5).

For the programmed parameters of common media see annex C, Table C.3.

If a medium is selected from the scroll list, the menu item for the input of the medium temperature is displayed directly (see section 10.2.4).

If `Other Material` is selected, the medium parameters must be entered first.

- min. and max. sound velocity
- kinematic viscosity
- density

10.2.1 Sound Velocity

The sound velocity of the medium is used for the calculation of the transducer distance at the beginning of the measurement. However, the sound velocity does affect the measuring result directly. Often, the exact value of the sound velocity for a medium is unknown. Therefore, a range of possible values for the sound velocity must be entered.

```
c-Medium
   1500.0    m/s
```

Enter the average sound velocity of the medium. Press ENTER.

This display will only be indicated if `Other Medium` has been selected.

```
c-Medium range
 auto     >USER<
```

Select `auto` or `user`. Press ENTER.

`auto`: The area around the average sound velocity is defined by the transmitter.

`user`: The area around the average sound velocity must be entered.

```
c-Medium=1500m/s
range   +-150m/s
```

Enter the area around the average sound velocity of the medium. Press ENTER.

This display will only be indicated if `user` has been selected.

10.2.2 Kinematic Viscosity

The kinematic viscosity affects the flow profile of the medium. The entered value and other parameters are used for the profile correction.

```
Kinem.Viscosity
    1.00   mm2/s
```

Enter the kinematic viscosity of the medium. Press ENTER.

This display will only be indicated if `Other Medium` has been selected

10.2.3 Density

The density is used to calculate the mass flow rate (product of the volumetric flow rate and the density).

Note!	If the mass flow rate is not measured, press ENTER. The other measuring results will not be affected.

```
Density
    1.00   g/cm3
```

Enter the operating density of the medium. Press ENTER.

This display will only be indicated if `Other Medium` has been selected.

10.2.4 Medium Temperature

The medium temperature is used for the interpolation of the sound velocity and for the calculation of the recommended transducer distance at the beginning of the measurement.

During the measurement, the medium temperature is used for the interpolation of the density and the viscosity of the medium.

The value entered here will be used for the calculations if the medium temperature is not measured and fed to an input of the transmitter.

```
Medium Temperat.
    20.0       C
```

Enter the medium temperature. The value must be within the operating temperature range of the transducers. Press ENTER.

10.2.5 Medium Pressure

The medium pressure is used for the interpolation of the sound velocity .

```
Fluid pressure
    1.00     bar
```

Enter the medium pressure. Press ENTER.

This display will only be indicated if `Special Funct.\SYSTEM settings\Dialogs/Menus\Fluid pressure` is activated.

10.3 Other Parameters

10.3.1 Transducer Parameters

If transducers are detected on a measuring channel, the parameter input finished. Press ENTER. The main menu will be displayed.

If no or special transducers are connected, the transducer parameters have to be entered.

```
Transducer Type ⇳
Standard
```

Select `Standard` to use the standard transducer parameters stored in the transmitter.

Select `Special Version` to enter the transducer parameters. The transducer parameters must be provided by the transducer manufacturer.

Press ENTER.

Note!	If standard transducer parameters are used, FLEXIM can not guarantee for the precision of the measured values. A measurement might even be impossible.

```
Transd. Data    1
   35.99
```

If `Special Version` has been selected, enter the 6 transducer parameters specified by the manufacturer. Press ENTER after each input.

10.3.2 Extension Cable

```
Additional cable
    65.0        m
```

If the transducer cable must be extended, enter the additional cable length (e.g. between the junction box and the transmitter). Press ENTER.

10.4 Selection of the Channels

The channels on which will be measured can be activated individually.

```
par>MEA<opt sf
Measuring
```

Select program branch `Measuring`. Press ENTER.

```
par>MEA<opt sf
NO DATA!
```

If this error message is displayed, the parameters are not complete. Enter the missing parameters in the program branch `Parameter`.

```
CHANN: >A< B Y Z
MEASUR  ✓  ✓ - .
```

The channels for the measurement can be activated and deactivated.

✓: the channel is active

–: the channel is not active

•: the channel can not be activated

This display will not be indicated if the transmitter has only one measuring channel.

Note!	A channel can not be activated if the parameters are not valid, e.g. if the parameters in the program branch `Parameter` of the channel are not complete.

- Select a channel with key 4 and 6.
- Press key 8 to activate or deactivate the selected channel. Press ENTER.

A deactivated channel will be ignored during the measurement. Its parameters will remain unchanged.

If the data logger or the serial interface is activated, the measuring point number must be entered:

```
A:Meas.Point No.:
xxx (↑↓←→)
```

Enter the measuring point number. Press ENTER.

If arrows are displayed in the lower line on the right, ASCII text can be entered. If no arrows are displayed, only digits, point and hyphen can be entered.

10.5 Defining the Number of Sound Paths

The number of transits of the ultrasonic waves through the medium depends on the placement of the transducers on the pipe.

If the number of transits is odd (diagonal mode), the transducers will be mounted on opposite sides of the pipe.

If the number of transits is even (reflection mode), the transducers will be mounted on the same side of the pipe.

A higher number of transits means increased accuracy of the measurement. However, the increased transit distance results in a higher attenuation of the signal.

The reflections on the opposite pipe wall and deposits on the inner pipe wall cause additional amplitude losses of the sound signal.

If the signal is attenuated strongly, e.g. by the medium, the pipe, deposits, etc., the number of sound paths must be set to 1 if necessary.

Note!	Exact positioning of the transducers is easier for an even number of transit paths (reflection mode) than for an odd number (diagonal mode).

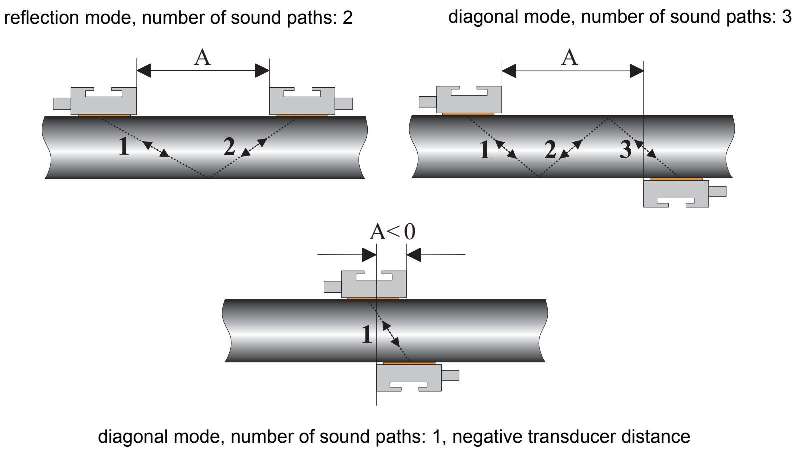


Fig. 10.1: Sound path and transducer distance (A)

```
A: Sound Path
        2      NUM
```

A value for the number of sound paths corresponding to the connected transducers and the entered parameters will be recommended. Change the value if necessary. Press ENTER.

10.6 Transducer Distance

```
Transd. Distance
A:54 mm Reflec
```

A value for the transducer distance is recommended. Fix the transducers (see chapter 7). Adjust the transducer distance.

Press ENTER.

A - measuring channel
Reflec - reflection mode
Diagon - diagonal mode

The transducer distance displayed here is the distance between the inner edges of the transducers.

In case of a measurement in diagonal mode on very small pipes, a negative transducer distance is possible (see Fig. 10.1).

Note!	The accuracy of the recommended transducer distance depends on the accuracy of the entered pipe and medium parameters.

10.6.1 Fine Adjustment of the Transducer Distance

```
Transd. Distance
A:     54    mm !
```

If the displayed transducer distance is adjusted, press ENTER.

The measuring for the positioning of the transducers is started.

```
S=■■■■■■
A:■<>■=54     mm!
```

The amplitude of the received signal is displayed by the bar graph S=.

If the LED of the measuring channel lights green, the signal is sufficient for a measurement (FLUXUS ADM 7907).

If the LED of the measuring channel lights red, the signal is not sufficient for a measurement (FLUXUS ADM 7907).

Shift a transducer slightly in the range of the recommended transducer distance

- FLUXUS ADM 7407: until the bar graph reaches its max. length (max. 6 squares)
- FLUXUS ADM 7907: until the LED of the measuring channel lights green.

```
S=■■■■■■
Q=■■■■■■■■■■■■
```

```
time=      94.0 µs
Q=■■■■■■■■■■■
```

The following can be displayed in the upper line with key DISP 9 and in the lower line with key 3 DISP:

- transducer distance
- bar graph Q= (signal quality), must have max. length
- transit time `time` in µs
- bar graph S= (signal amplitude)

If the signal is not sufficient for measurement, `Q= UNDEF` will be displayed.

In case of large deviations, check if the entered parameters are correct or repeat the measurement at a different point on the pipe.

```
Transd. Distance?
     53.9       mm
```

After the precise positioning of the transducers, the recommended transducer distance is displayed again.

Enter the actual (precise) transducer distance. Press ENTER.

Repeat the steps for all channels on which will be measured. The measurement will be started automatically afterwards.

10.6.2 Consistency Check

If a wide range for the sound velocity has been entered in the program branch `Parameter` or the exact parameters of the medium are not known, a consistency check is recommended.

The transducer distance can be displayed during measurement by scrolling with key DISP 9.

```
L=(50.0) 54.0  mm
    54.5    m3/h
```

The optimum transducer distance (here: 50.0 mm) is displayed in the upper line in parentheses, followed by the entered transducer distance (here: 54.0 mm). The latter value must correspond to the adjusted transducer distance. Press ENTER to optimize the transducer distance.

The optimum transducer distance is calculated on the basis of the measured sound velocity. It is therefore a better approximation than the first recommended value which had been calculated on the basis of the sound velocity range entered in the program branch `Parameter`.

If the difference between the optimum and the entered transducer distance is less than specified in Table 10.1, the measurement is consistent and the measured values are valid. The measurement can be continued.

If the difference is greater, adjust the transducer distance to the displayed optimum value. Afterwards, check the signal quality and the signal amplitude bar graph (see section 10.6.1). Press ENTER.

Table 10.1: Standard values for signal optimization

transducer frequency (third character of the technical type)	**difference between the optimum and the entered transducer distance [mm]**	
	shear wave transducer	**lamb wave transducer**
G	20	-50...+100
H	-	-35...+60
K	15	-25...+40
M	10	-10...+20
P	8	-6...+10
Q	6	-3...+5
S	3	-

```
Transd. Distance?
    50.0       mm
```

Enter the new adjusted transducer distance. Press ENTER.

```
L=(51.1) 50.0 mm
    54.5    m3/h
```

Scroll with key DISP 9 again until the transducer distance is displayed and check the difference between the optimum and the entered transducer distance. Repeat the steps if necessary.

Note!	Never change the transducer distance during the measurement without restarting the consistency check.

Repeat the steps for all channels on which a measurement is being made.

10.6.3 Value of the Sound Velocity

The sound velocity of the medium can be displayed during the measurement by pressing key 3 (DISP).

If an approximate range for the sound velocity has been entered in the program branch `Parameter` and the transducer distance has been optimized afterwards as described in section 10.6.2, it is recommended to write down the sound velocity for the next measurement. By doing this, it will not be necessary to repeat the fine adjustment.

Also write down the medium temperature because the sound velocity depends on the temperature. The value can be entered in the program branch `Parameter` or a user defined medium can be created for this sound velocity (see section 14.2 and 14.3).

10.7 Start of the Measurement

```
A:Volume Flow
   31.82    m3/h
```

The measured values are displayed in the lower line. Press ENTER to return to the fine adjustment of the transducer distance (see section 10.6.1).

If more than one measuring channel is available/activated, the transmitter works with an integrated measuring point multiplexer providing simultaneous measurement on the different measuring channels.

The flow is measured on one measuring channel for approx. 1 s, then the multiplexer switches to the next activated channel.

The time necessary for the measurement depends on the measuring conditions. E.g. if the measuring signal can not be detected immediately, the measurement might be > 1 s.

The outputs and the serial interface continuously receive the measured values of the corresponding channel. The results are displayed according to the actually selected output options. The default unit of measurement of the volumetric flow rate is m^3/h. For the selection of the values to be displayed and for the setting of the output options see chapter 11. For further measuring functions see chapter 12.

10.8 Detection of the Flow Direction

The flow direction in the pipe can be detected with the help of the displayed volumetric flow rate in conjunction with the arrow on the transducers:

- The medium flows in the direction of the arrow if the displayed volumetric flow rate is positive (e.g. 54.5 m^3/h).
- The medium flows against the direction of the arrow if the displayed volumetric flow rate is negative (e.g. -54.5 m^3/h).

10.9 Stopping the Measurement

The measurement will be interrupted by pressing key BRK if it is not protected by a program code (see section 12.9).

Note!	Be careful not to stop a current measurement by inadvertently pressing key BRK!

11 Displaying the Measured Values

The physical quantity is set in the program branch `Output Options` (see section 11.1).

During the measurement, the designation of the physical quantity is displayed in the upper line, the measured value in the lower line. The display can be adapted (see section 11.3).

11.1 Selection of the Physical Quantity and of the Unit of Measurement

The following physical quantities can be measured:

- **sound velocity**
- **flow velocity**: is calculated on the basis of the measured transit time difference
- **volumetric flow rate**: is calculated by multiplying the flow velocity by the cross-section of the pipe
- **mass flow rate**: is calculated by multiplying the volumetric flow rate by the operating density of the medium
- **heat flow (optional)**: is calculated on the basis of the volumetric flow rate, the measured temperatures of the supply and return lines, and the heat flow coefficients of the medium

The physical quantity is selected as follows:

```
par mea >OPT< sf
Output Options
```

Select the program branch `Output Options`. Press ENTER.

```
Output Options  ⇳
for Channel    A:
```

Select the channel for which the physical quantity is to be entered. Press ENTER.

This display will not be indicated, if the transmitter has only one measuring channel.

```
Physic. Quant.  ⇳
Volume Flow
```

Select the physical quantity in the scroll list. Press ENTER.

```
Volume in:      ⇳
m3/h
```

For the selected physical quantity (except for the sound velocity), a scroll list with the available units of measurement is displayed. The previously selected unit of measurement is displayed first.

Select the unit of measurement of the selected physical quantity. Press ENTER.

Press BRK to return to the main menu. The further menu items of the program branch `Output Options` are for the activation of the measured value output.

Note!	If the physical quantity or the unit of measurement is changed, the settings of the outputs will have to be checked (see chapter 19).

11.2 Toggling between the channels

If more than one channel is available/activated, the display for the measured values can be adapted as follows:

- AutoMux mode
  - all channels
  - only calculation channels
- HumanMux mode

Key 1 MUX toggles between the modes.

11.2.1 AutoMux Mode

In the AutoMux mode, the display and the measuring process are synchronized. The channel on which a measurement is being made is displayed in the upper line on the left.

The measured values are displayed as configured in the program branch `Output Options` (see section 11.1). When the multiplexer switches to the next channel, the display is updated.

```
A:Volume Flow
     54.5    m3/h
```

```
B:Flow Velocity
     1.25     m/s
```

The AutoMux mode is the default display mode. It is activated automatically after a cold start.

All Channels

The measured values of all channels (measuring and calculation channels) are displayed. The next active channel is displayed after min. 1.5 s.

Only Calculation Channels

Only the measured values of the calculation channels are displayed. The next active calculation channel is displayed after min. 1.5 s.

This mode can only be activated if at least 2 calculation channels are active.

11.2.2 HumanMux Mode

In the HumanMux mode, the measured values of one channel are displayed. The measurement on the other channels is continued, but not displayed.

```
B:Flow Velocity
     1.25     m/s
```

The selected channel is displayed left in the upper line.

Press key NEXT 7 to display the next activated channel. The measured values of the selected channel will be displayed as configured in the program branch `Output Options` (see section 11.1).

11.3 Adjustment of the Display

During the measurement, the display can be adapted as to display two measured values simultaneously (one in each line of the display). This does not affect totalizing, storing of measured values, measured value output, etc.

The following information can be displayed in the upper line:

- designation of the physical quantity
- totalizer values, if activated
- temperatures assigned to the channel and their difference if the temperature is measured
- date and time at which the data logger will be full
- measuring mode
- transducer distance
- alarm state indication if it is activated (see section 19.7.5) and if alarm outputs are activated (see section 19.6).

The following information can be displayed in the lower line:

- flow velocity
- sound velocity
- mass flow rate
- volumetric flow rate
- heat flow

Press key 9 (DISP) during the measurement to change the display in the upper line, press key 3 (DISP) to change the display in the lower line.

```
A:Flow Velocity
*    2.47     m/s
```

The character * indicates that the displayed value (here: flow velocity) is not the selected physical quantity.

11.4 Status Line

Important data on the ongoing measurement are displayed in the status line. The quality and precision of the ongoing measurement can be estimated.

```
A: S3 Q9 c✓ RT F↓
```

Press key 9 (DISP) during the measurement to scroll through the upper line to the status line.

	value	explanation
S		**signal amplitude**
	0 … 9	< 5 % … ≥ 90 %

Q		**signal quality**
	0	< 5 %
	…	…
	9	≥ 90 %
c		**sound velocity** comparison of the measured and the expected sound velocity of the medium. The expected sound velocity is calculated on the basis of the medium parameters (medium selected in the program branch `Parameter`, temperature dependency, pressure dependency).
	√	ok, is equal to the expected value
	↑	> 20 % of the expected value
	↓	< 20 % of the expected value
	?	unknown, can not be measured
R		**flow profile** information about the flow profile based on the Reynolds number
	T	fully turbulent flow profile
	L	fully laminar flow profile
	↕	the flow is in the transition range between laminar and turbulent flow
	?	unknown, can not be calculated
F		**flow velocity** comparison of the measured flow velocity with the flow limits of the system
	√	ok, the flow velocity is not in the critical range
	↑	the flow velocity is higher than the current limit
	↓	the flow velocity is lower than the current cut-off flow (even if it is not set to zero)
	0	the flow velocity is in the offset range of the measuring method
	?	unknown, can not be measured

11.5 Transducer distance

```
L=(51.2) 50.8 mm
     54.5    m3/h
```

By pressing key DISP 9 during the measurement, it is possible to scroll to the display of the transducer distance.

The optimum transducer distance (here: 51.2 mm) is displayed in parentheses in the upper line, followed by the entered transducer distance (here: 50.8 mm).

The optimum transducer distance might change during the measurement (e.g. due to temperature fluctuations).

A deviation from the optimum transducer distance (here: -0.4 mm) is compensated internally.

Note!	Never change the transducer distance during the measurement!

12 Advanced Measuring Functions

12.1 Damping Factor

Each displayed measured value is a floating average of all measured values of the last x seconds, with x being the damping factor. A damping factor of 1 s means that the measured values are not averaged because the measuring rate is approx. 1/s. The default value of 10 s is appropriate for normal flow conditions.

Strongly fluctuating values caused by high flow dynamics require a higher damping factor.

Select the program branch `Output Options`. Press ENTER until the menu item `Damping` is displayed.

```
Damping
      10        s
```

Enter the damping factor. Press ENTER.

Press BRK to return to the main menu.

12.2 Totalizers

Heat quantity, total volume or total mass of the medium at the measuring point can be determined.

There are two totalizers, one for the positive flow direction, one for the negative flow direction.

The unit of measurement used for totalizing corresponds to the heat, volume or mass unit selected for the physical quantity.

The value of a totalizer consists of max. 11 digits, including max. 4 decimal places. For the adjustment of the number of decimal places see section 16.6.

```
A:Volume Flow
    54.5    m3/h
```

To activate the totalizers, press key Q_{ON} 8 during the measurement (see Table 12.1).

```
A:   32.5      m3
     54.5    m3/h
```

The value of the totalizer will be displayed in the upper line (here: the volume which has passed through the pipe at the measuring point in the positive flow direction after the activation of the totalizers).

Table 12.1: Keys for display of the totalizers

activation	press key 8 (Q_{ON}) once during the measurement
deactivation	press key 2 (Q_{OFF}) three times during the measurement
display of the totalizer for the positive flow direction	press key 6 (Q+) during the measurement
display of the totalizer for the negative flow direction	press key 4 (Q-) during the measurement
reset of the totalizers to zero	press key 8 (Q_{ON}) three times during measurement

```
A:NO COUNTING   !
      3.5     m/s
```

This error message will be displayed if the totalizers of a measuring channel used for measuring the flow velocity are to be activated. The flow velocity can not be totalized.

Note!	The totalizers can only be activated for the measuring channel whose measured values are displayed at the moment.

Note!	The pressing of a key will only influence the totalizers if the totalizer is displayed in the upper line.

12.2.1 Storing the Values of the Totalizers

During the Heat Flow Measurement

During the heat flow measurement, it is possible to output and store the values of the heat quantity totalizer and of the volume totalizer. Select `Special Funct.\SYSTEM settings\Measuring\heat+flow quant.`.

```
heat+flow quant.
off         >ON<
```

Select on to store and output the values of the heat quantity totalizer and the volume totalizer during the heat flow measurement.

Press ENTER.

When the Measurement Is Stopped

The behavior of the totalizers when the measurement is stopped or after a RESET of the transmitter is set in `Special Funct.\SYSTEM settings`\Measuring\`Quantity recall`.

```
Quantity recall
off         >ON<
```

If on is selected, the values of the totalizers will be stored and used for the next measurement.

If `off` is selected, the totalizers will be reset to zero.

Selection of the Totalizers for Storing

It is possible to store only the value of the totalizer that is currently displayed or one value for each flow direction. Select `Special Funct.\SYSTEM settings\Storing\Quantity Storage`.

```
Quantity Storage
one        >BOTH<
```

If `one` is selected, only the value of the totalizer that is currently displayed will be stored.

If `both` is selected, the values of the totalizers totalizer for both flow directions will be stored.

Press ENTER.

12.2.2 Overflow of the Totalizers

The overflow behavior of the totalizers can be set:

Without overflow:

- The value of the totalizer increases to the internal limit of 10^{38}.
- if necessary, the values will be displayed as exponential numbers (±1.00000E10). The totalizer can only be reset to zero manually.

With overflow:

- The totalizer will be reset to zero automatically when ±9999999999 is reached.

Select `Special Funct.\SYSTEM settings\Measuring\Quant. wrapping`.

```
Quant. wrapping
off          >ON<
```

Select `on` to work with overflow. Select `off` to work without overflow. Press ENTER.

Independently of the setting, the totalizers can be reset to zero manually.

Note!	The overflow of a totalizer influences all output channels, e.g. data logger, online output. The output of the sum of both totalizers (the throughput ΣQ) via an output will not be valid after the first overflow (wrapping) of one of the corresponding totalizers. To signalize the overflow of a totalizer, an alarm output with the switching condition `QUANT.` and the type `HOLD` must be activated.

12.3 Upper Limit of the Flow Velocity

Single outliers caused by heavily disturbed surroundings can appear among the measured values of the flow velocity. If the outliers are not ignored, they will affect all derived physical quantities, which will then be unsuitable for the integration (e.g. pulse outputs).

It is possible to ignore all measured flow velocities higher than a upper limit. These measured values will be marked as outliers.

The upper limit of the flow velocity is set in `Special Funct.\SYSTEM settings\Measuring\Velocity limit`.

```
Velocity limit
      0.0     m/s
```

Enter 0 (zero) to switch off the checking for outliers.

Enter a limit > 0 to switch on the checking for outliers. The measured flow velocity will then be compared to the entered upper limit.

Press ENTER.

If the flow velocity is higher than the upper limit,

- the flow velocity will be marked as invalid. The physical quantity can not be determined.
- the LED of the measuring channel will light red (FLUXUS ADM 7907)
- "!" will be displayed after the unit of measurement (in case of a normal error, "?" is displayed)

Note!	If the upper limit is too low, a measurement might be impossible because most of the measured values will be marked as "invalid".

12.4 Cut-Off Flow

The cut-off flow is a lower limit for the flow velocity. All measured flow velocities that are lower than the limit and their derived values are set to zero.

The cut-off flow can depend on the flow direction or not. The cut-off flow is set in `Special Funct.\SYSTEM settings\Measuring\Cut-off Flow`.

```
Cut-off Flow
absolut    >SIGN<
```

Select sign to define a cut-off flow in dependence on the flow direction. Two independent limits are set for the positive and negative flow directions.

Select absolut to define a cut-off flow independently of the flow direction. A limit is set for the absolute value of the flow velocity.

Press ENTER.

```
Cut-off Flow
factory    >USER<
```

Select factory to use the default limit of 2.5 cm/s (0.025 m/s) for the cut-off flow.

Select user to enter the cut-off flow.

Press ENTER.

If Cut-off Flow\sign and user are selected, two values will have to be entered:

```
+Cut-off Flow
      2.5    cm/s
```

Enter the cut-off flow. Press ENTER.

All positive values of the flow velocity that are lower than this limit will be set to zero.

```
-Cut-off Flow
     -2.5    cm/s
```

Enter the cut-off flow. Press ENTER.

All negative values of the flow velocity greater than this limit will be set to zero.

If Cut-off Flow\absolut and user is selected, only one value will have to be entered:

```
Cut-off Flow
      2.5    cm/s
```

Enter the cut-off flow. Press ENTER.

The absolute values of all flow velocity values that are lower than this limit will be set to zero.

12.5 Uncorrected Flow Velocity

For special applications, the uncorrected flow velocity might be of interest.

The profile correction for the flow velocity is activated in Special Funct.\SYSTEM settings\Measuring\Flow Velocity.

```
Flow Velocity
>NORMAL<  uncorr.
```

Select normal to display and output the flow velocity with profile correction.

Select uncorr. to display the flow velocity without profile correction. Press ENTER.

```
A:PROFILE CORR.
>NO<          yes
```

If uncorr. is selected, it has to be confirmed each time the program branch Measuring is selected if the profile correction is to be used.

```
A:FLOW VELOCITY
     2.60     m/s
```

If no is selected, the profile correction will be switched off.

All physical quantities will be calculated with the uncorrected flow velocity.

During the measurement, the designation of the physical quantity will be displayed in capital letters to indicate that the value is uncorrected.

Press ENTER.

```
A:PROFILE CORR.
NO          >YES<
```

If `yes` is selected, the uncorrected flow velocity will only be used if the flow velocity is selected as the physical quantity in the program branch `Output Options`.

All other physical quantities (volumetric flow rate, mass flow rate, etc.) will be determined with the corrected flow velocity.

During the measurement, the designation of the physical quantity will be displayed in capital letters to indicate that the value is uncorrected.

Press ENTER.

```
A:Flow Velocity
*U   54.5     m/s
```

In both cases, the corrected flow velocity can also be displayed.

Scroll with key 3 (DISP) until the flow velocity is displayed. The uncorrected flow velocity is marked with `U`.

Uncorrected flow velocities transmitted to a PC are marked with `uncorr.`.

12.6 Measurement of Transient Processes (FastFood Mode)

The FastFood mode enables the measurement of flows with high dynamics.

A continuous adaptation to changing measuring conditions which takes place in the normal measuring mode is only partially realized in the FastFood mode.

- The sound velocity of the medium is not measured. Instead, the sound velocity stored in the internal database is used, taking into account the medium temperature entered in the program branch `Parameter` (or the measured temperature if the medium temperature is measured).
- A change of measuring channel is not possible.
- The inputs and outputs can still be used.
- The measured values are stored as usual.

The FastFood mode has to be enabled and activated.

12.6.1 Enabling/Disabling the FastFood Mode

Press key C. Enter HotCode 007022 has been switched on.

```
Enable FastFood
no          >YES<
```

Select `yes` to enable the FastFood Mode, no to disable it.

12.6.2 Storage Rate of the FastFood Mode

```
Storage Rate
      70      ms
```

If the FastFood mode is enabled, a `Storage Rate` in ms will have to be entered in the program branch `Output Options`.

Press ENTER.

12.6.3 Activation/Deactivation of the FastFood Mode

If the FastFood mode is enabled and a measurement is started, the normal measuring mode will still be running (i.e. multi-channel measurement with permanent adaptation to the measuring conditions). If the data logger is activated, the measured values will not be stored.

```
A:Volume Flow
    54.5    m3/h
```

Press key 0 to activate/deactivate the FastFood mode for the measuring channel currently displayed.

```
A:Mode=FastFood
    54.5    m3/h
```

Scroll with key DISP 9 in the upper line until the activated measuring mode A:Mode=FastFood or A:Mode=TransTime is displayed.

If the data logger is activated, a new data set will be created and storing of measured values will be started. If the FastFood mode is deactivated or if the measurement is interrupted, the storing will be stopped.

Note!	The values of the current measuring data set will be deleted if the FastFood mode is deactivated and activated again without interrupting the measurement. The values of the current measuring data set will be kept if the measurement is interrupted before the FastFood mode is activated again. A new measuring data set is created when the next measurement is started.

12.7 Calculation Channels

Note!	Calculation channels are only available if the transmitter has more than one measuring channel.

In addition to the ultrasonic measuring channels, the transmitter has two virtual calculation channels Y and Z. The measured values of the measuring channels A and B can be used for calculations by the calculation channels.

The result of the calculation is the measured value of the selected calculation channel. This measured value is equivalent to the measured values of a measuring channel. All operations with the measured values of a measuring channel (totalizing, online output, storing, outputs, etc.) can also be done with the values of a calculation channel.

12.7.1 Characteristics of the Calculation Channels

In the program branch `Parameter`, the measuring channels to be used for the calculation and the calculation function have to be entered.

A calculation channel can not be attenuated. The damping factor has to be set separately for each of the two measuring channels.

Two cut-off flow values for each calculation channel can be defined. The cut-off flow is not based on the flow velocity as for measuring channels. Instead, it is defined in the unit of measurement of the physical quantity selected for the calculation channel. During the measurement, the calculated values are compared to the cut-off flow values and set to zero if necessary.

A calculation channel provides valid measured values if at least one measuring channel provides valid measured values.

12.7.2 Parameterization of a Calculation Channel

```
Parameter        ⇳
for Channel     Y:
```

Select a calculation channel (Y or Z) in the program branch `Parameter`. Press ENTER.

```
Calculation:
Y= A - B
```

The current calculation function is displayed. Press ENTER to edit the function.

```
>CH1< funct ch2 ⇳
  A     -    B
```

Three scroll lists are displayed in the upper line:

- selection of the first measuring channel (`ch1`)
- selection of the calculation function (`funct`)
- selecton of the second measuring channel (`ch2`)

Select a scroll list with key 4 or 6.

The list items are displayed in the lower line.

Scroll with key 8 and 2 through the scroll list. All measuring channels and their absolute values can be used as input channels for the calculation.

The following calculation functions are available:

- `-`: `Y = ch1 - ch2`
- `+`: `Y = ch1 + ch2`
- `(+)/2`: `Y = (ch1 + ch2)/2`
- `|-|`: `Y = |ch1 - ch2|`

Press ENTER.

12.7.3 Output Options for a Calculation Channel

```
Output Options  ⇳
for Channel    Y:
```

Select a calculation channel in the program branch `Output Options`. Press ENTER.

```
Physic. Quant.  ⇳
Mass Flow
```

Select the physical quantity to be calculated. Press ENTER.

Make sure that the physical quantity selected for the calculation channel can be calculated from the physical quantities of the selected measuring channels. Possible combinations are shown in Table 12.2.

Table 12.2: Physical quantity of the calculation channel

physical quantity of the calculation channel	possible physical quantity of the first measuring channel (CH1)				possible physical quantity of the second measuring channel (CH2)			
	flow velocity	volumetric flow rate	mass flow rate	heat flow	flow velocity	volumetric flow rate	mass flow rate	heat flow
flow velocity	x	x	x	x	x	x	x	x
volumetric flow rate		x	x	x		x	x	x
mass flow rate		x	x	x		x	x	x
heat flow				x				x

example 1: The difference of the volume flow rates of the channels A and B is to be calculated.

The physical quantity of channel A and B can be the volumetric flow rate or the mass flow rate, but not the flow velocity. The physical quantities of the two measuring channels do not need to be identical (channel A = mass flow rate, channel B = volumetric flow rate).

example 2: To determine the heat flow difference, the physical quantity of the two input channels must be the heat flow.

```
Mass in:          ⇳
kg/h
```

Select the unit of measurement. Press ENTER.

Two cut-off flow values for each calculation channel can be defined. They are defined in the unit of measurement of the physical quantity selected for the calculation channel.

```
+Cut-off Flow
     1.00    kg/h
```

All positive calculated values that are lower than the limit will be set to 0.

```
-Cut-off Flow
    -2.00    kg/h
```

All negative calculated values that are greater than the limit will be set to 0.

```
Store Meas.Data
>NO<          yes
```

The data logger can be activated/deactivated. Press ENTER.

12.7.4 Measuring with Calculation Channels

```
par >MEA< opt sf
Measuring
```

Select program branch `Measuring`. Press ENTER.

```
CHANN: A B >Y< Z
MEASUR ✓ ✓ ✓  .
```

Activate the necessary channels. Calculation channels are activated or deactivated in the same way as the measuring channels. Press ENTER.

```
WARNING! CHANNEL
       B:INACTIV!
```

If a measuring channel that is needed for an activated calculation channel has not been activated, a warning will be displayed. Press ENTER.

Position the transducers for all activated measuring channels. The measurement will be started automatically.

```
Y:Flow Velocity
   53.41     m/s
```

If a calculation channel is activated, the HumanMux mode (see section 11.2.2) will be selected at the beginning of the measurement and the values of the calculation channel will be displayed.

If the AutoMux mode is selected, the measured values of the measuring channels, but not the measured values of the calculation channels, will be displayed alternately.

```
Y:  A - B
   53.41     m/s
```

Press key 9 (DISP) to display the calculation function.

Press key 7 (NEXT) to display the measured values of the different channels.

12.8 Change of the Limit for the Inner Pipe Diameter

It is possible to change the lower limit of the inner pipe diameter for a given transducer type.

Press key C.Enter HotCode 071001.

```
DNmin Q-Sensor
      15      mm
```

Enter the lower limit of the inner pipe diameter of the displayed transducer type. Press ENTER to select the next transducer type.

Note!	If a transducer is used below its recommended inner pipe diameter, a measurement might be impossible.

12.9 Program Code

An ongoing measurement can be protected from an inadvertent intervention by a program code.

If a program code has been defined, it will be requested when there is an intervention in the measurement (a command or key BRK).

If a program code is active, the message `Program code active` will be displayed for a few seconds when a key is pressed.

To execute a command, it is sufficient to enter the first three digits of the program code (= access code).

To stop an ongoing measurement, the complete program code has to be entered (= break code).

The input of a program code is interrupted with key C.

Note!	Do not forget the program code!

```
Special Funct.  ⇕
set program code
```

Select `Special Funct.\set program code`.

```
Program code
------
```

Enter a program code with max. 6 digits. Press ENTER.

```
INVALID CODE !
909049
```

An error message will be displayed if a reserved number has been entered (e.g. a HotCode for language selection).

A program code will remain valid as long as:

- no other valid program code is entered or
- the program code is not deactivated.

12.9.1 Intervention in the Measurement

To stop a measurement when it is protected by a program code, press key C and enter the program code. If the entered program code is correct, the measurement will be interrupted and the main menu will be selected.

Deactivation of the Program Code

```
Program code
------
```

Select `Special Funct.\set program code`.

The program code is deleted by entering "`------`". Press ENTER.

If the character "`-`" is entered less than six times, this character sequence will be used as the new program code.

13 Storing and Output of Measured Values

Attention!	Observe the Safety Instructions for the Use in Explosive Atmosphere (see document SIFLUXUS).

Storing

The following data can be stored:

- date
- time
- measuring point number
- pipe parameters
- medium parameters
- transducer parameters
- sound path (reflection or diagonal mode)
- transducer distance
- damping factor
- storage rate
- physical quantity
- unit of measurement
- measured values
- totalizer values

In order to store the measured data, the data logger must be activated (see section 13.1.1).

The available data logger memory can be displayed (see section 13.5).

The storing of each measured value will be signaled acoustically. This signal can be deactivated (see section 13.4.6).

Online Output

During the measurement, the measured values will be transmitted directly to a PC (see section 13.2.3).

Offline Output

The measured values will be stored in the transmitter and later transmitted to a PC (see section 13.2.4).

13.1 Data Logger

13.1.1 Activation/Deactivation of the Data Logger

```
Output Options  ⇳
for Channel    A:
```

Select in the program branch `Output Options` the channel for which the data logger is to be activated. Press ENTER.

This display will not be indicated if the transmitter has only one measuring channel.

```
Store Meas.Data
no          >YES<
```

Press ENTER until the menu item `Store Meas.Data` is displayed.

Select `yes` to activate the data logger. Press ENTER.

13.1.2 Setting the Storage Rate

The storage rate is the frequency at which the measured values are output or stored. The storage rate will be set separately for each measuring channel.

If the storage rate is not set, the storage rate previously selected will be used.

The storage interval should be at least equal to the number of activated measuring channels, e.g. the storage interval of a channel should be min 2 s if 2 measuring channels are activated.

```
Storage Rate    ⇳
Once per 10 sec.
```

Select a storage rate or `EXTRA`. Press ENTER.

This display will only be indicated if `Store Meas.Data` and/or `Serial Output` are activated.

```
Storage Rate
        1       s
```

If `EXTRA` has been selected, enter the storage rate. Press ENTER.

13.1.3 Measuring Point Number

At the beginning of the measurement, the measuring point must be identified by

- an ASCII text (e.g. MS.PK20!)
- digits, including point, hyphen (e.g. 18.05-06).

The input mode is set in the program branch `Special Funct.` (see section 15.2.3).

```
A:Meas.Point No.:
     xxx (↑↓←→)
```

Enter the measuring point number. Press ENTER.

If arrows are displayed, ASCII text can be entered. If no arrows are displayed, only digits, point and hyphen can be entered.

The measuring point number and the parameters will be stored together with the measured values.

13.1.4 Measurement

```
DATA MEMORY
OVERFLOW!
```

If `Output Options\Store Meas.Data` has been activated and `Special Funct.\SYSTEM settings\Ringbuffer` is deactivated, this error message will be displayed as soon as the data logger is full. Press ENTER.

If no other measured value output has been activated, the measurement will be stopped.

If another measured value output has been activated, the measurement will be continued. Only the storing of the measured values will be stopped. The error message will be displayed periodically.

13.2 Output of the Measured Values

Attention!	Observe the Safety Instructions for the Use in Explosive Atmosphere (see document SIFLUXUS).

The measured values can be output via the serial interface. For the connection of the serial interface to the transmitter see section .

13.2.1 RS232 Interface

In order to connect the RS232 interface, the housing must be opened.

- output of the measured values in ASCII format
- transmission of the stored measured values by means of the program FluxData in binary format

13.2.2 RS485 Interface (Optional)

- output of the measured values in ASCII format
- transmission of the measured values via a bus protocol (transmitter as Modbus slave)

Note!	It is recommended to use the RS485 interface for the online output. The RS232 interface should only be used if the transmitter does not have an RS485 interface.

13.2.3 Online Output

The measured values are transmitted via the serial interface to a PC directly during the measurement. If the data logger is activated, the measured values will also be stored.

- Select the program branch `Output Options`. Press ENTER.
- Select the channel for which the online output is to be activated. Press ENTER until the menu item `Serial Output` is displayed.

```
Serial Output
no         >YES<
```

Select `yes` to activate the online output. Press ENTER.

- Set the storage rate (see section 13.1.2).

The measuring point number will be requested when the measurement is started (see section 13.1.3).

13.2.4 Offline Output

The measured values will be transmitted from the data logger of the transmitter via the serial interface:

- to a PC by means of the program FluxData or
- to a terminal program in ASCII format

Offline Output by Means of the Program FluxData

Settings in the transmitter:

```
par mea opt >SF<
Special Funct.
```

Press BRK to select the main menu.

Further settings in the transmitter are not necessary.

settings in the program FluxData:

- Start the program FluxData on the PC.
- In the program FluxData, open the menu "Options" and select "Serial interface". Select the Default protocol and the serial port of the PC that the transmitter is connected to (e.g. COM1 in Fig. 13.1). Click on OK.

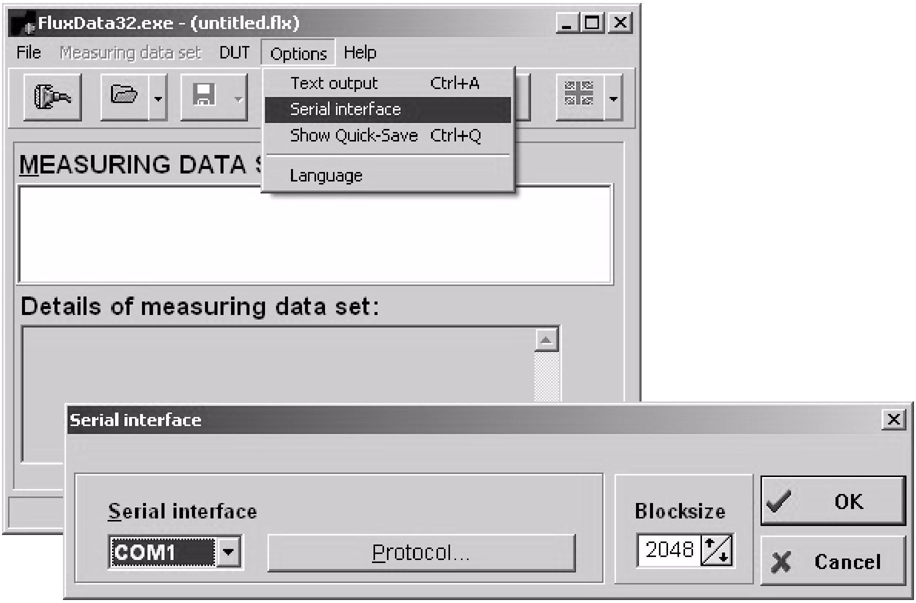


Fig. 13.1: Selection of the serial interface

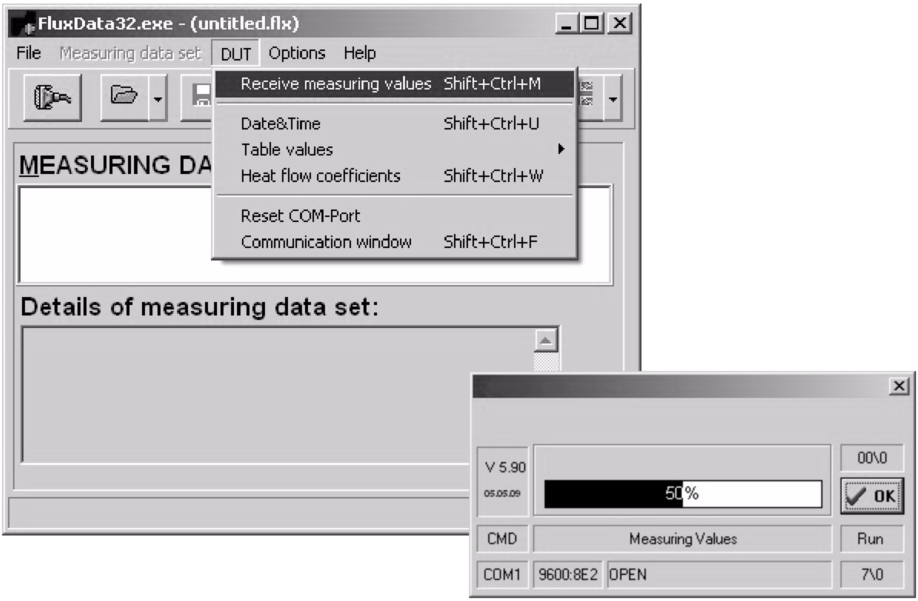


Fig. 13.2: Receive measured values

- In the program FluxData, open the menu "DUT" and select "Receive Measuring values" (see Fig. 13.3). The received measuring data sets will be displayed (see Fig. 13.3).

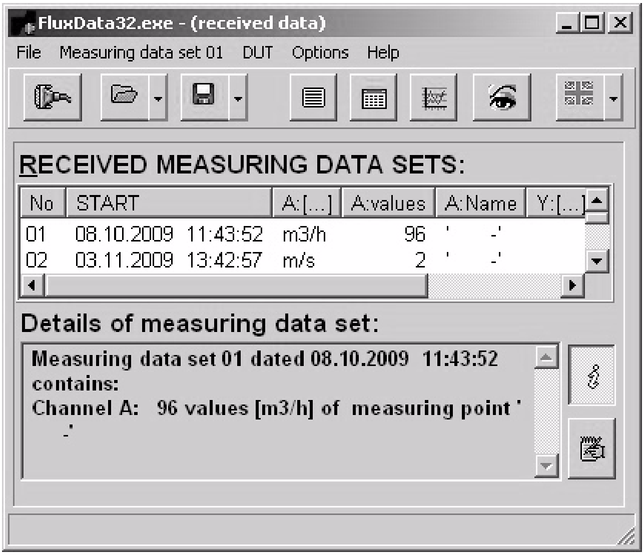


Fig. 13.3: Display of the received measuring data sets

Offline Output to a Terminal Program

```
Special Funct.  ⇳
Print Meas.Val.
```

Select `Special Funct.\Print Meas.Val.`. Press ENTER.

```
NO VALUES        !
Print Meas.Val.
```

This error message will be displayed if no measured values are stored. Press ENTER.

Connect the transmitter to a PC with a serial interface. Press ENTER to transmit the stored measured values.

```
Send Header    01
................
```

The display indicates that the measured values are being transmitted.

```
SERIAL ERROR     !
Print Meas.Val.
```

This error message will be displayed if an error has occurred during the serial transmission. Press ENTER. Check the connections and make sure that the PC is ready to receive data.

```
■■■■■■■
................
```

The progress of the data transfer is displayed by a bar graph.

13.2.5 Data Format

The header is transmitted at the beginning of the measurement. The first 4 lines contain general information about the transmitter and the measurement. The following lines contain the configuration parameters that are output for each channel in a data block.

example:

```
\DEVICE             :ADM7XX7-XXXXXXXX
\MODE               : ONLINE
\CHAN               : 1 (A:)
DATE                : 2011-01-09
TIME                : 19:56:52
Par.Record
Meas.Point No.:     : A:F5050
Pipe
 Outer Diameter     : 60.3 mm
 Wall Thickness     : 5.5 mm
 Roughness          : 0.1 mm
 Pipe Material      : Carbon Steel
 Lining             : WITHOUT LINING
Medium              : Water
 Medium Temperat.   : 38 C
 Fluid pressure     : 1.00 bar
Transducer Type     : xxx
Sound Path          : 3 NUM
Transd. Distance    : -15.6 mm
Damping             : 20 s
Full-Scale Val.     : 4.50 m3/h
Physic. Quant.      : Volume Flow
Unit Of Measure     : [m3/h]/[m3]
```

The line `\DATA` will be transmitted next, followed once by the column titles (see Table 13.1) for the corresponding channel. The measured values are transmitted afterwards.

example:

```
\DATA
A:;\*MEASURE;     Q_POS;       Q_NEG;
B:;\*MEASURE;     Q_POS;       Q_NEG;
```

In every storage interval, one data line per activated measuring channel is transmitted. The line "???" will be transmitted if there are no measured values available for the storage interval.

example: With a storage interval of 1 s, 10 lines "???" will be transmitted if the measurement has been restarted after a 10 s interruption for the positioning of the transducers.

The following data columns can be transmitted:

Table 13.1: Format of the serial output

column title	column format	contents
*MEASURE	###000000.00	the physical quantity selected in `Output Options`
Q_POS	+00000000.00	totalizer value for the positive flow direction
Q_NEG	-00000000.00	totalizer value for the negative flow direction
FQ_POS		value of the totalizer for the positive flow direction (if the heat flow has been selected as the physical quantity)
FQ_NEG		the value of the totalizer for the negative flow direction (if the heat flow has been selected as the physical quantity)
T1	###000.0	temperature `T1` (= supply temperature if the heat flow has been selected as the physical quantity)
T2	###000.0	temperature `T2` (= return temperature if the heat flow has been selected as the physical quantity)
...		designation for other inputs
SSPEED		sound velocity of the medium
KNZ		concentration in mass percent
AMP		signal amplitude

Online Output

Columns will be created for all quantities that appear during the measurement. The columns Q_POS and Q_NEG will remain empty if the totalizers are deactivated.

As the totalizers can not be activated for the physical quantity flow velocity, these columns will not be created.

Offline Output

During the offline output, columns will only be created if at least one measured value is stored in the data set. The columns Q_POS and Q_NEG will not be created if the totalizers are deactivated.

Transmission Parameters

- the transmitter sends CRLF-terminated ASCII
- max. line length: 255 digits
- RS232: 9600 bits/s, 8 data bits, even parity, 2 stop bits, protocol (RTS/CTS)
- RS485: 9600 bits/s, 8 data bits, even parity, 1 stop bit

The settings for the RS485 interface can be changed in the program branch `Special Funct.\SYSTEM settings\Network`. These displays will not be indicated if the transmitter does not have an RS485 interface.

```
SYSTEM settings ⇕
Network
```

Select `Special Funct.\SYSTEM settings\Network` to change the settings of the transmission parameters.

```
Device address:
       0     ADR
```

Press ENTER to confirm the instrument address in the network.

```
Serial protocol
default   >SETUP<
```

Select `default` to display the default transmission parameters.

Select `setup` to change the transmission parameters. Press ENTER.

```
>BAUD< parity  st
1200   EVEN     1
```

Set the transmission parameters in the 3 scroll lists. Press ENTER.

- `baud`: baud rate
- `parity`: parity
- `st`: number of stop bits

13.2.6 Settings of the Serial Output

Some formatting settings for the serial output can be set in `Special Funct.\SYSTEM settings\serial transmis.`

```
SER:kill spaces
off          >ON<
```

Select on if the space characters are not to be transmitted. Press ENTER.

The file size will be considerably smaller (shorter transmission time).

```
SER:decimalpoint
'.'          >','<
```

Select the decimal marker to be used for floating-point numbers (point or comma). Press ENTER.

```
SER:col-separat.
';'        >'TAB'<
```

Select the character to be used to separate columns (semicolon or tabulator). Press ENTER.

This setting depends on the PC program used.

```
Send Offline via
RS232     >RS485<
```

Select the serial interface for the offline output.

This display will only be indicated if the transmitter has an RS485 interface.

13.3 Deleting the Measured Values

```
Special Funct.  ⇳
Delete Meas.Val.
```

Select `Special Funct.\Delete Meas.Val.`. Press ENTER.

```
Really Delete?
no         >YES<
```

Select `yes` or `no`. Press ENTER.

13.4 Settings for the Data Logger

Select `Special Funct.\SYSTEM settings\Storing`. The following menu items are available:

- ring buffer
- storage mode
- storing of the totalizer values
- storing of the signal amplitude
- storing of the sound velocity
- storing of the concentration
- acoustic signal during the storing

13.4.1 Ring Buffer

The setting of `Ringbuffer` affects the storing of measured values as soon as the data logger is full:

```
Ringbuffer
off         >ON<
```

Select the behavior of the ring buffer. Press ENTER. If `on` has been selected, the available data logger memory will be halved. The oldest measured values will be overwritten. If `off` has been selected, the storing of measured values will be stopped.

13.4.2 Storage Mode

```
Storage mode
>SAMPLE<  average
```

Select the storage mode. Press ENTER.

If `sample` has been selected, the displayed measured value will be used for storing and online output. If `average` is selected, the average of all values measured during a storage interval will be used for storing and online output.

Note!	The storage mode does not affect the continuously working interfaces (e.g. current output, voltage output). If `average` has been selected, all primary physical quantities will be averaged, i.e. also the measured temperatures if the corresponding measuring channel is activated.

Note!	If no average could be calculated over the complete storage interval while `average` was activated, the value will be marked as invalid. The ASCII file will contain "???" instead of invalid average values and the corresponding physical quantity and "?UNDEF" instead of invalid temperatures. There will be no indication as to how many currently measured values a valid average consists of.

13.4.3 Storing of the Totalizers

It is possible to store only the value of the currently displayed totalizer or one value for each flow direction.

Select `Special Funct.\SYSTEM settings\Storing\Quantity Storage`.

```
Quantity Storage
one       >BOTH<
```

Select `one` to store only the displayed totalizer.

Select `both` to store the totalizers of both flow directions.

Press ENTER.

Note!	The totalizers will only be stored if they are activated and the data logger is activated. The storing of a totalizer reduces the total number of measured values to be stored by approx. two thirds.

example: In the program branch `Special Funct.`, It is displayed that 10 000 additional measured values can be stored. If the totalizers are activated and only one totalizer is being stored, 3 333 data fields will be available for storing. If both totalizers are stored, 2 000 data fields will be available for storing.

13.4.4 Storing of the Signal Amplitude

Select `Special Funct.\SYSTEM settings\Storing\Store Amplitude`.

```
Store Amplitude
off          >ON<
```

If `on` is selected and the data logger is activated, the amplitude of the measured signal will be stored together with the measured values. Press ENTER.

13.4.5 Storing the Sound Velocity of the Medium

Select `Special Funct.\SYSTEM settings\Storing\Store c-Medium`.

```
Store c-Medium
off          >ON<
```

If on is selected and the data logger is activated, the sound velocity of the medium will be stored together with the measured values. Press ENTER.

13.4.6 Acoustic Signal

Per default, an acoustic signal will be emitted every time a measured value is stored or transmitted to a PC or printer. The signal can be deactivated in `Special Funct.\SYSTEM settings\Storing\Beep on storage`.

```
Beep on storage
>on<          off
```

Select `off` to deactivate the acoustic signal, on to activate it. Press ENTER.

13.5 Available Data Logger Memory

```
FULL= 26.01/07:39
    54.5    m3/h
```

The time on which the memory will be full can be displayed during the measurement.

Scroll through the displays of the upper line with key 9 (DISP) during the measurement.

Max. 100 measuring data sets can be stored. The number of measuring data sets depends on the total number of measured values stored in the previous measuring data sets.

If the data logger is empty and a measurement is started with one physical quantity on one measuring channel without storing the totalizer, approx. 100 000 measured values can be stored. The available data logger memory can be displayed:

```
Special Funct.  ⇕
Instrum. Inform.
```

Select `Special Funct.\Instrum. Inform.`. Press ENTER.

```
ADM 7XX7-XXXXXXXX
Free:       18327
```

The type and the serial number of the transmitter will be displayed in the upper line.

The available data logger memory will be displayed in the lower line (here: 18 327 additional measured values can be stored). Press key BRK twice to return to the main menu.

14 Libraries

The internal material database of the transmitter contains parameters for pipe and lining materials as well as for media. It can be extended with user defined materials or media. User defined materials and media will always be displayed in the scroll lists of the program branch `Parameter`.

User defined materials and media can be stored in an integrated coefficient memory (user area). The coefficient memory has to be partitioned first (see section 14.1).

The properties of user defined materials or media can be entered as follows:

- as constants without the extended library (see section 14.2)
- as constants or temperature and pressure dependent functions by means of the extended library (see section 14.3)

The material and media scroll lists displayed in the program branch `Parameter` can be arranged (see section 14.5). Shorter scroll lists make working more efficient.

14.1 Partitioning of the Coefficient Memory

The coefficient memory can be divided into parts for the following material data:

- material properties:
  - transversal and longitudinal sound velocity
  - typical roughness
- medium properties:
  - min. and max. sound velocity
  - kinematic viscosity
  - density
- heat flow coefficients (additional medium property)
- steam coefficients (additional medium property)

For the max. number of data sets for each category of these material data see Table 14.1.

Table 14.1: Capacity of the coefficient memory

	max. number of data sets	occupancy of the coefficient memory in %
materials	13	97
media	13	97
heat flow coefficients	29	98
steam coefficients	19	95

```
Libraries          ⇳
Format USER-AREA
```

Select `Special Funct.\SYSTEM settings\ Libraries\Format USER-AREA`. Press ENTER.

```
MAXIMAL:       13!
Materials:      15
```

This error message will be displayed if the entered number of data sets for a category of material data exceeds the capacity of the coefficient memory.

```
Format USER-AREA
Materials:      03
```

Enter the number of the user defined materials. Press ENTER.

```
Format USER-AREA
Media:          03
```

Enter the number of the user defined media. Press ENTER.

```
Format USER-AREA
Heat-Coeffs:    00
```

Enter the number of user defined data sets for the heat flow coefficients. Press ENTER.

Heat flow coefficients can only be entered if the transmitter has temperature inputs.

```
Format USER-AREA
Steam-Coeffs:   00
```

Enter the number of user defined data sets for the steam coefficients. Press ENTER.

Steam coefficients can only be entered if the transmitter has temperature inputs.

```
USER AREA:
      52%    used
```

The occupancy of the coefficient memory is displayed for a few seconds.

```
Format NOW?
no           >YES<
```

Select `yes` to start the partitioning. Press ENTER.

```
FORMATTING ...
■■■■■■■  ...
```

The coefficient memory will partitioned accordingly. This procedure takes a few seconds.

```
Libraries         ⇳
Format USER-AREA
```

After the partitioning, `Format USER-AREA` is displayed again.

14.1.1 Data Retention during Formatting of the Coefficient Memory

When the coefficient memory is repartitioned, max. 8 data sets of each type can be retained.

example 1: The number of user defined materials is reduced from 5 to 3. The data sets #01 to #03 are retained. . The data sets #04 and #05 are deleted.

example 2: The number of user defined materials is increased from 5 to 6. All 5 data sets are kept.

14.2 Input of Material/Medium Properties without the Extended Library

To enter the material/medium properties as constants, the extended library must be deactivated.

```
Libraries          ⇳
Extended Library
```

Select `Special Funct.\SYSTEM settings\Libraries\Extended Library`. Press ENTER.

```
Extended Library
>OFF<            on
```

Select `off` to deactivate the extended library. Press ENTER.

The properties of a user defined material/medium can be entered now.

The input of a material or a medium is almost identical. Therefore, displays for a medium will only be shown and described in case of differences.

```
Special Funct.     ⇳
Install Material
```

Select `Special Funct.\Install Material` or Install Medium. Press ENTER.

```
USER Material
NOT FORMATTED !
```

This error message will be displayed if the coefficient memory does not contain an area for user defined materials/media.

Partition the coefficient memory accordingly (see section 14.1).

```
Install Material
>EDIT<      delete
```

Select `edit`. Press ENTER.

```
USER Material      ⇳
#01:--not used--
```

Select a user defined material/medium. Press ENTER.

```
EDIT TEXT (↑↓←→)
USER MATERIAL    1
```

Change the designation of the material/medium.

The default name for a user defined material/medium is `USER MATERIAL N` or `USER Medium N` with `N` being an integer.

Note!	95 ASCII characters (letters, capital letters, numbers, special characters [!? " + - ( ) > < % * etc.]) are available for the designation of materials/media. A designation can have max. 16 characters. The input of text is described in section 3.4.

Material Properties

```
c-Material
   1590.0      m/s
```

Enter the sound velocity of the material. Press ENTER.

For the sound velocity of some materials see annex C, Table C.1.

```
Roughness
      0.4       mm
```

Enter the roughness of the material. Press ENTER.

For the typical roughness of some materials see annex C, Table C.2.

Medium Properties

```
c-Medium       MIN
   1400.0      m/s
```

```
c-Medium       MAX
   1550.0      m/s
```

Enter the min. and max. sound velocity of the medium. Press ENTER.

```
Kinem.Viscosity
     1.01    mm2/s
```

Enter the kinematic viscosity of the medium. Press ENTER.

```
Density
     1.00    g/cm3
```

Enter the density of the medium. Press ENTER.

14.3 Extended Library

14.3.1 Introduction

If the extended library is activated, it is possible to enter material and medium properties as a function of the temperature or of the pressure and additional medium properties (heat flow coefficients, steam coefficients and concentration coefficients). These data can be entered into the transmitter directly or by means of the program FluxKoef.

Table 14.2: Material and medium properties that can be stored

property	property is necessary for...
material property	
transversal sound velocity	flow measurement
longitudinal sound velocity	flow measurement
type of sound wave	flow measurement
typical roughness	profile correction of the flow velocity
medium property	
sound velocity	start of measurement
viscosity	profile correction of the flow velocity
density	calculation of mass flow rate
additional properties of a medium	
heat flow coefficients	heat flow measurement
steam coefficients	heat flow measurement with steam in supply line

Enter only the properties needed for the measuring task.

example: The density of a medium is unknown. If the mass flow rate is not measured, any constant value can be entered as the density.

The measurement of the flow velocity and of the volumetric flow rate will not be affected. However, the value of the mass flow rate will be wrong.

The dependency of the material/medium properties from the temperature and pressure can be described

- as constants
- as linear function
- with polynomials of grade 1 to 4
- with customized interpolation functions.

In most cases, constants or a linear function are sufficient.

If e.g. the temperature fluctuations at the measuring point are low compared to the temperature dependency of the material properties, the linearization or the complete neglect of the temperature dependency will not result in a considerable additional measuring error.

If, however, the process conditions fluctuate strongly and the medium properties depend strongly on the temperature (e.g. viscosity of a hydraulic oil), polynomials or customized interpolation functions should be used. Contact FLEXIM to find the best solution for the measuring task.

Customized Interpolation Functions

Some dependencies are only approximated insufficiently by polynomials. A number of customized interpolation functions `Basics: Y=F(X,Z)` are available to interpolate multidimensional dependencies y = f(T, p). Contact FLEXIM for more information.

14.3.2 Activation of the Extended Library

```
Extended Library
off         >ON<
```

Select `Special Funct.\SYSTEM settings\ Libraries\Extended Library`. Press ENTER.

Select on to activate the extended library. Press ENTER.

14.3.3 Input of Material/Medium Properties

The properties of a user defined material/medium can be entered now.

The input of a material or a medium is almost identical. Therefore, the displays for a medium will only be shown and described in case of differences.

```
Special Funct.  ⇳
Install Material
```

Select `Special Funct.\Install Material` or `Install Medium`. Press ENTER.

```
USER Material
NOT FORMATTED !
```

An error message will be displayed if the coefficient memory does not contain an area for user defined materials/ media.

Partition the coefficient memory accordingly (see section 14.1).

```
Edit Material   ⇳
Basics:Y=m*X +n
```

Select the function for the temperature or pressure dependency of the material/medium properties:

`Y=const.`: constants

`Y=M*X+N`: linear function of the temperature

`Y=Polynom`: $y = k_0 + k_1 \cdot x + k_2 \cdot x^2 + k_3 \cdot x^3 + k_4 \cdot x^4$

`Y=F(X,Z)`: customized interpolation function (only for experienced users or after consultation with FLEXIM)

`go back`: return to the precedent menu item

```
USER Material   ⇳
#01:--not used--
```

Select a user defined material/medium.

```
USER MATERIAL    2
>EDIT<     delete
```

Select `edit` to edit the material/medium properties or `delete` to delete the material/medium and to return to the scroll list `Edit Material` or `Edit Medium`.

This display will only be indicated if an already existing material/medium has been selected.

```
#2: Input Name:
USER MATERIAL    2
```

Enter the designation of the material/medium. Press ENTER.

The default name for a user defined material/medium is `USER MATERIAL N` or `USER Medium N` with `N` being an integer.

Material Properties

Enter the material's:

- transversal sound velocity
- longitudinal sound velocity

1...5 values depending on the selected function must be entered. Press ENTER after each input.

If an already defined material is edited, for each property there will be a request whether it is to be edited. Select `yes` or `no`. Press ENTER. Change the values, if necessary.

```
Default soundsp.
long.   >TRANS.<
```

Select the type of sound wave to be used for the flow measurement. Press ENTER.

For most materials, a transversal sound wave must be selected.

```
Roughness
      0.4       mm
```

Enter the typical roughness of the material. Press ENTER.

```
Save changes
no          >YES<
```

Select `yes` to store the entered properties or `no` to quit the menu item without storing. Press ENTER.

Medium Properties

Enter the medium's:

- longitudinal sound velocity
- kinematic viscosity
- density

Depending on the selected function, 1...5 values must be entered. Press ENTER after each input.

If an already defined medium is edited, for each property of some of the functions there will be a request whether it is to be edited. Select `yes` or `no`. Press ENTER. Change the values, if necessary.

```
Save changes
no          >YES<
```

Select `yes` to store the entered properties, `no` to quit the menu item without storing. Press ENTER.

14.3.4 Input of Heat Flow Coefficients

Note!	The heat flow coefficients can also be edited with the programs FluxData and FluxKoef.

Note!	The entered coefficients will not be checked. Absurd values can result in wrong measured values or in permanent system errors.

Select `Special Funct.\Install Medium`. Press ENTER.

```
Edit Medium     ⇳
Heat-flow coeffs
```

Select `Heat-flow coeffs`. Press ENTER.

```
Heat-flow coeffs
NOT FORMATTED !
```

This error message will be displayed if the coefficient memory does not contain an area for the heat flow coefficients.

Partition the coefficient memory accordingly (see section 14.1).

```
Heat-Coeffs for ⇳
Beer
```

Select the medium for which the heat flow coefficients have to be entered.

User defined media will be displayed first, followed by the media of the internal database.

```
Select index   ⇕
02(--not used--)
```

Select an index for storing the heat flow coefficients of the selected medium. Press ENTER.

If the coefficient memory is partitioned in such way that heat flow coefficients for two media can be entered, indices 01 and 02 are available.

```
Heat-flow coeffs
          0.0 a0
```

Enter the 10 heat flow coefficients: a0...a4, r0...r4. Press ENTER after each input.

```
Heat-flow coeffs
Save?  no   >YES<
```

Select `yes` to store the heat flow coefficients. Press ENTER.

14.3.5 Input of the Steam Coefficients

Use the program FluxKoef (optional).

Note!	The entered coefficients will not be checked. Absurd values can result in wrong measured values or in permanent system errors.

14.4 Deleting a User Defined Material/Medium

To delete a user defined material/medium, proceed as follows:

Select `Special Funct.\Install Material` or `Install Medium`. Press ENTER.

If the extended library is activated, press ENTER until the request for deleting is displayed.

```
Install Material
edit    >DELETE<
```

Select `delete`. Press ENTER.

```
USER Material
#01: Polystyrol
```

Select the material/medium to be deleted. Press ENTER.

```
Really Delete?
no          >YES<
```

Select `yes` or `no`. Press ENTER.

14.5 Arrangement of the Material/Medium Scroll List

The materials and media to be displayed in the program branch `Parameter` are arranged in the material scroll list and in the medium scroll list.

Note!	User defined materials/media will always be displayed in the scroll lists of the program branch `Parameter`.

```
SYSTEM settings ⇕
Libraries
```

Select `Special Funct.\SYSTEM settings\Libraries`. Press ENTER.

```
Libraries       ⇕
Material list
```

Select `Material list` to edit the material scroll list or `Medium list` to edit the medium scroll list.

Select `go back` to return to `SYSTEM settings`. Press ENTER.

```
Material list
factory   >USER<
```

Select `factory` if all materials/media of the internal database are to be displayed in the scroll list. An already existing scroll list will not be deleted but only deactivated.

Select `user` to activate the user defined scroll list. Press ENTER.

```
Material list   ⇕
>Show list
```

If `user` has been selected, the material or medium scroll list can be edited (see section 14.5.1...14.5.3).

```
Material list   ⇕
>End of Edit
```

Select `End of Edit` to stop editing. Press ENTER.

```
Save List       ?
no         >YES<
```

Select `yes` to store all changes of the scroll list or `no` to quit the menu item without storing. Press ENTER.

Note!	If the material/medium scroll list is quit by pressing key BRK before storing, all changes will be lost.

14.5.1 Displaying a Scroll List

```
Material list   ⇕
>Show list
```

Select `Show list`. Press ENTER to display the scroll list as in the program branch `Parameter`.

```
Current list=   ⇳
Other Material
```

The current scroll list is displayed in the lower line.

Press ENTER to return to the scroll list `Material list` or `Medium list`.

14.5.2 Adding a Material/Medium to the Scroll List

```
Material list   ⇳
>Add Material
```

Select `Add Material` or `Add Medium` to add a material/medium to the scroll list. Press ENTER.

```
>Add Material   ⇳
Stainless Steel
```

All materials/media that are not contained in the current scroll list will be displayed in the lower line.

Select the material/medium. Press ENTER. The material/medium will be added to the scroll list.

Note!	The materials/media are displayed in the order in which they have been added.

14.5.3 Adding all Materials/Media to the Scroll List

```
Material list   ⇳
>Add all
```

Select `Add all` to add all materials/media of the database to the current scroll list. Press ENTER.

14.5.4 Removing a Material/Medium from the Scroll List

```
Material list   ⇳
>Remove Material
```

Select `Remove Material` or `Remove Medium` to remove a material/medium from the scroll list. Press ENTER.

```
>Remove Material⇳
Stainless Steel
```

All materials/media of the current scroll list will be displayed in the lower line.

Select the material/medium. Press ENTER. The material/medium will be removed from the scroll list.

Note!	User defined materials/media will always be displayed in the scroll lists of the program branch `Parameter`. They can not be removed.

14.5.5 Removing all Materials/Media from the Scroll List

```
Material list   ⇳
>Remove all
```

Select `Remove all` to remove all materials/media from the scroll list. Press ENTER. User defined materials/media will not be removed.

15 Settings

15.1 Time and Date

The transmitter has a battery-powered clock. Measured values are automatically stored with the date and time.

15.1.1 Time

```
SYSTEM settings ⇳
Set Clock
```

Select `Special Funct.\SYSTEM settings\Set Clock`. Press ENTER.

```
TIME          11:00
ok            >NEW<
```

The current time is displayed. Select `ok` to confirm the time or `new` to set the time. Press ENTER.

```
TIME          11:00
Set Time          !
```

Select the digit to be edited with key 4 and 6.

Edit the selected digit with key 8 and 2. Press ENTER.

```
TIME          11:11
>OK<            new
```

The new time is displayed. Select `ok` to confirm the time or `new` to set the time again. Press ENTER.

15.1.2 Date

After the time has been set, `DATE` is displayed.

```
DATE 2011-01-25
ok            >NEW<
```

Select `ok` to confirm the date or `new` to set the date. Press ENTER.

```
DATE  2011-01-25
Set Date          !
```

Select the digit to be edited with key 4 and 6.

Edit the selected digit with key 8 and 2. Press ENTER.

```
DATE  2011-01-26
>OK<            new
```

The new date is displayed. Select `ok` to confirm the date or `new` to set the date again. Press ENTER.

15.2 Dialogs and Menus

```
SYSTEM settings ⇳
Dialogs/Menus
```

Select `Special Funct.\SYSTEM settings\Dialogs/Menus`. Press ENTER.

Note!	The settings of the menu item `Dialogs/Menus` will be stored at the end of the dialog. If the menu item is quit before the end of the dialog, the settings will not be effective.

15.2.1 Pipe circumference

```
Pipe Circumfer.
off         >ON<
```

Select on if the pipe circumference is to be entered instead of the pipe diameter in the program branch `Parameter`. Press ENTER.

```
Outer Diameter
   100.0      mm
```

If on has been selected for `Pipe Circumfer.`, the outer pipe diameter will nevertheless be requested in the program branch `Parameter`.

To select the menu item `Pipe Circumfer.`, enter `0` (zero). Press ENTER.

```
Pipe Circumfer.
   314.2      mm
```

The value displayed in `Pipe Circumfer.` is calculated on the basis of the last displayed value of the outer pipe diameter.

example: 100 mm * π = 314.2 mm

```
Pipe Circumfer.
     180      mm
```

Enter the pipe circumference. The limits for the pipe circumference are calculated on the basis of the limits for the outer pipe diameter.

```
Outer Diameter
    57.3      mm
```

During the next scroll through the program branch `Parameter`, the outer pipe diameter that corresponds to the entered pipe circumference will be displayed.

example: 180 mm : π = 57.3 mm

Note!	The pipe circumference is only edited temporarily. When the transmitter switches back to the display of the pipe circumference (internal recalculation), slight rounding errors may occur.

example: entered pipe circumference: 100 mm
displayed outer pipe diameter: 31.8 mm

When the transmitter switches back to the display of the pipe circumference, 99.9 mm will be displayed.

15.2.2 Medium Pressure

The dependency of the properties of a medium on the pressure can be taken into account.

.

```
Fluid pressure
off          >ON<
```

If on has been selected, the medium pressure will be requested in the program branch `Parameter`.

If `off` has been selected, 1 bar will be used for all calculations.

Note!	For documentation purposes, it is useful to enter the medium pressure, even if the transmitter contains no pressure-dependent characteristic curves.

15.2.3 Measuring Point Number

```
Meas. Point No.:
(1234)  >(↑↓←→)<
```

Select `1234` if the measuring point is to be identified only by numbers, point and dash.

Select ↑↓←→ if the measuring point is to be identified by the ASCII editor.

15.2.4 Transducer Distance

```
Transd. Distance
auto        >USER<
```

recommended setting: `user`

- `user` will be selected if the measuring point is always the same.
- `auto` can be selected if the measuring point changes often.

```
Transd. Distance?
   (50.8)  50.0 mm
```

In the program branch `Measuring`, the recommended transducer distance will be displayed in parentheses, followed by the entered transducer distance if the recommended and the entered transducer distance are not identical.

```
Transd. Distance?
     50.8       mm
```

During transducer positioning in the program branch `Measuring`

- only the entered transducer distance will be displayed if `Transd. Distance = user` has been selected and the recommended and the entered transducer distances are identical
- only the recommended transducer distance will be displayed if `Transd. Distance = auto` has been selected.

15.2.5 Steam in the Supply Line

```
Steam in inlet
off           >ON<
```

Select on if the medium in the supply line can be vaporous during the heat flow measurement (see section 17.5). In this case, the supply pressure will have to be entered in the program branch `Parameter`.

15.2.6 Temperature Correction

```
Corr.Offset
off           >ON<
```

Select on to enable the input of a temperature correction for each temperature input (see section 18.5).

15.2.7 Error Value Delay

The error value delay is the time after which an error value will be sent to an output if no valid measured values are available.

```
Error-val. delay
damping    >EDIT<
```

Select `edit` to enter an error value delay. Select `damping` if the damping factor is to be used as the error value delay.

For further information on the behavior of missing measured values see section 19.1.2 and 19.2.

15.2.8 Alarm State Indication

```
SHOW RELAIS STAT
off           >ON<
```

Select on to display the alarm state during the measurement.

Fur further information on the alarm outputs see section 19.6.

15.2.9 Preferred Units

It is possible to set the preferred units for the length, temperature and pressure:

```
Length unit
>[mm]<    [inch]
```

Select `mm` or `inch` as the preferred unit for the length. Press ENTER.

```
Temperature
>[°C]<      [°F]
```

Select `°C` or `°F` as the preferred unit for the temperature. Press ENTER.

```
Pressure
>[bar]<    [psi]
```

Select `bar` or `psi` as the preferred unit for the pressure. Press ENTER.

15.2.10 Setting for the Medium Pressure

It is possible to set whether the absolute or the relative pressure will be used:

```
Pressure absolut
 off         >ON<
```

Select on or `off`. Press ENTER.

If on has been selected, the absolute pressure p_a will be displayed/input/output.

If `off` has been selected, the relative pressure p_g will be displayed/input/output.

$p_g = p_a - 1.01$ bar

```
Fluid pressure
     1.00  bar(a)
```

The pressure and its unit of measurement will e.g. be displayed in the program branch `Parameter`. It will be followed by the selected pressure, indicated in parentheses.

a - absolute pressure
g - relative pressure

Note!	All changes will be stored now at the end of the dialog.

15.3 Measurement Settings

```
SYSTEM settings ⇳
Measuring
```

Select `Special Funct.\SYSTEM settings\Measuring`. Press ENTER.

Note!	The settings of the menu item `Measuring` will be stored at the end of the dialog. If the menu item is quit before the end of the dialog, the settings will not be effective.

```
WaveInjector
off           >ON<
```

This menu item will only be displayed if a WaveInjector is in the scope of supply (see user manual of the WaveInjector).

```
Compare c-fluid
no           >YES<
```

Select `yes` if the measured sound velocity is to be compared to the theoretical or expected value. The difference

$\Delta c = c_{mea} - c_{stored}$

between the two sound velocities will be displayed during the measurement. c_{stored} is the sound velocity stored in the database.

Press key DISP 9 during the measurement to scroll to the display of Δc.

```
Flow Velocity
>NORMAL<  uncorr.
```

Select `normal` to display and output the profile corrected flow values, `uncorr.` to display and output the flow values without flow profile correction. Press ENTER.

Fur further information see section 12.5.

```
Cut-off Flow
absolut    >SIGN<
```

```
Cut-off Flow
factory    >USER<
```

A lower limit for the flow velocity can be entered (see section 12.4).

```
Velocity limit
     24.0     m/s
```

An upper limit for the flow velocity can be entered (see section 12.3).

Enter `0` (zero) to deactivate the flow velocity check.

```
Heat Quantity
>[J]<        [Wh]
```

The heat quantity is the totalizer of the heat flow. Select the unit of measurement for the heat flow (`J` or `Wh`).

```
heat+flow quant.
off          >ON<
```

Select on to store and output the values of the heat quantity totalizer and the volume totalizer during the heat flow measurement.

```
Quant. wrapping
off          >ON<
```

Select the overflow behavior of the totalizers (see section 12.2.2).

```
Quantity recall
off          >ON<
```

Select `on` to keep the previous totalizer values after a restart of the measurement.

Select `off` to reset the totalizers to zero after a restart of the measurement.

```
Turbulence mode
off          >ON<
```

The activation of the turbulence mode can improve the signal quality if the flow is highly turbulent (e.g. in the vicinity of an elbow or valve). An SNR value of min. 6 dB is required during the measurement.

Note!	All changes will be stored now at the end of the dialog.

15.4 Setting the Contrast

```
SYSTEM settings ⇕
Miscellaneous
```

Select `Special Funct.\SYSTEM settings\ Miscellaneous` to set the contrast of the display of the transmitter. Press ENTER.

```
 SETUP DISPLAY
←   CONTRAST   →
```

The contrast of the display is adjusted with the following keys:

6 (Q+) to increase the contrast

(Q-) 4 to decrease the contrast

2 (Q_{OFF}) = min. contrast

5 = medium contrast

(Q_{ON}) 8 = max. contrast

Note!	After a cold start, the display will be reset to medium contrast.

15.5 Instrument Information

```
Special Funct.  ⇕
Instrum. Inform.
```

Select `Special Funct.\Instrum. Inform.` to display information about the transmitter. Press ENTER.

```
ADM7XX7-XXXXXXXX
Free:      18327
```

The type and the serial number of the transmitter will be displayed in the upper line.

The available data logger memory will be displayed in the lower line (here: 18 327 additional measured values can be stored).

Press ENTER.

```
ADM7XX7-XXXXXXXX
V x.xx   dd.mm.yy
```

The type and the serial number of the transmitter will be displayed in the upper line.

The firmware version of the transmitter with date is displayed in the lower line.

Press ENTER.

16 SuperUser-Mode

The SuperUser mode offers the possibility of an advanced analysis of the signal and the measured values as well as the definition of additional parameters adapted to the measuring point, in order to achieve better measuring values or during experimental work. Features of the SuperUser mode are:

- Defaults will not be observed.
- There are no plausibility checks when parameters are being entered.
- There is no check whether the entered parameters are within the limits determined by the laws of physics and technical data.
- The cut-off flow is not active.
- A value for the number of sound paths must be entered.
- Some menu items that are not visible in the normal the normal mode are displayed.

Attention!	The SuperUser mode is intended for experienced users with advanced application knowledge. The parameters can affect the normal measuring mode and lead to wrong measuring values or to a failure of the measurement when a new measuring point is set up.

16.1 Activating/Deactivating

Press key C. Enter HotCode 071049 .

```
SUPERUSER MODE
*IS ACTIVE NOW*
```

It is displayed that the SuperUser mode is activated. Press ENTER. The main menu will be displayed.

Press key C. Enter HotCode 071049 again to deactivate the SuperUser mode.

```
SUPERUSER MODE
IS PASSIVE NOW
```

It is displayed that the SuperUser mode is deactivated. Press ENTER. The main menu will be displayed.

16.2 Transducer Parameters

Attention!	Some of the defined parameters are still active after the deactivation of the SuperUser mode.

In the SuperUser mode, the menu item `Transducer Type` will be displayed at the end of the parameter input, even if the transducers are detected by the transmitter.

```
Transducer Type ⇳
Q2E-314
```

Press ENTER.

or

```
Transducer Type ⇕
Special Version
```

Select `Special Version` to enter the transducer parameters. Press ENTER.

```
Transd. Data    1
   35.99
```

If `Special Version` has been selected, the transducer parameters must be entered.

The transducer parameters must be provided by the transducer manufacturer. Press ENTER after each input.

16.3 Defining the Flow Parameters

In the SuperUser mode, it is possible to define some flow parameters (profile bounds, correction of the flow velocity) for the specific application or measuring point.

```
Measuring       ⇕
Calibration
```

Select `Special Funct.`\\`SYSTEM settings`\\Measuring\\`Calibration`. Press ENTER.

```
Calibrat. data ⇕
for Channel    A:
```

Select the measuring channel for which the flow parameters are to be defined. Press ENTER.

16.3.1 Profile Bounds

```
A:Profile bounds
 factory   >USER<
```

Select `user` if the profile bounds are to be defined. If `factory` is selected, the default profile bounds will be used and the menu item `Calibration` will be displayed (see section 16.3.2).

Press ENTER.

```
Laminar flow
if R*<          0
```

Enter the max. Reynolds number at which the flow is laminar. The entered number will be rounded to the hundreds. Enter `0` (zero) to use the default value.

range: 0...25 500
default: 1 000

Press ENTER.

```
Turbulent flow
if R*>          0
```

Enter the min. Reynolds number at which the flow is turbulent. The entered number will be rounded to the hundreds. Enter `0` (zero) to use the default value.

range: 0...25 500
default: 3 000

Press ENTER.

```
A:Calibration ?
>OFF<          on
```

A request is displayed if an additional correction of the flow velocity is to be defined. Select on to define the correction data, `off` to work without correction of the flow velocity and return to the menu item `SYSTEM settings`.

For the definition of the correction of the flow velocity see section 16.3.2.

example: profile bound for the laminar flow: 1 500
profile bound for the turbulent flow: 2 500

At Reynolds numbers < 1 500, the flow during the measurement is regarded as laminar for the calculation of the physical quantity. At Reynolds numbers > 2 500, the flow is regarded as turbulent. The range 1 500...2 500 is the transition range between laminar and turbulent flow.

Attention!	The defined profile bounds are still active after the deactivation of the SuperUser mode.

16.3.2 Correction of the Flow Velocity

After the profile bounds have been defined (see section 16.3.1), it is possible to define a correction of the flow velocity.

$v_{cor} = m \cdot v + n$

with

- v - measured flow velocity
- m - slope, range: -2.000...+2.000
- n - offset, range: -12.7...+12.7 cm/s
- v_{cor} - corrected flow velocity

All quantities derived from the flow velocity will be calculated with the corrected flow velocity. The correction data will be transmitted to the PC or printer during the online or offline output.

Note!	During the measurement, it will not be displayed that the correction of the flow velocity is active.

```
A:Calibration ?
off          >ON<
```

Select on to define the correction data, `off` to work without correction of the flow velocity and return to the menu item `SYSTEM settings`.

```
A:Slope=
     1.00
```

If on has been selected, enter the slope. If `0.0` is entered, the correction will be deactivated.

range: -2.000...+2.000

Press ENTER.

```
A:Offset=
      0.0    cm/s
```

Enter the offset. Enter `0` (zero) to work without an offset.

range: -12.7...+12.7 cm/s

Press ENTER.

example 1: Slope: 1.1
Offset: -10.0 cm/s = -0.1 m/s

If a flow velocity v = 5 m/s is measured, before the calculation of the derived quantities, it will be corrected as follows:

v_{cor} = 1.1 · 5 m/s - 0.1 m/s = 5.4 m/s

example 2: Slope: -1.0
Offset: 0.0

Only the sign of the measured values is changed.

Note!	The correction data will only be stored when a measurement is started. If the transmitter is switched off without starting a measurement, the entered correction data will be lost.

Attention!	The correction of the flow velocity is still active after the deactivation of the SuperUser mode.

16.4 Limit of the Signal Amplification

In order to prevent disturbing and/or pipe wall signals (e.g. if the pipe has run empty) from being interpreted as useful signals, it is possible to define a max. signal amplification. If the signal amplification is greater than the max. signal amplification,

- the flow velocity will be marked as invalid. The physical quantity can not be determined.
- the LED of the measuring channel will light red
- a hash symbol "#" will be displayed after the unit of measurement (in case of a normal error, "?" is displayed).

Select `Special Funct./SYSTEM settings/Measuring/Miscellaneous`. Press ENTER until the menu item `Gain threshold` is displayed.

```
A: Gain threshold
Fail if >   90 dB
```

Enter for each measuring channel the max. signal amplification. Enter `0` (zero) if no limit of the signal amplification is to be used.

range: 0...255

Press ENTER.

Attention!	The limit of the signal amplification is still active after the deactivation of the SuperUser mode.

16.5 Upper Limit of the Sound Velocity

When the plausibility of the signal is evaluated, it will be checked if the sound velocity is within a defined range. The upper limit used for the evaluation is the greater of the following values:

- fixed upper value, default: 1 848 m/s
- value of the sound velocity curve of the medium at the operating point plus offset, default offset: 300 m/s

In the SuperUser mode, the values can be defined for media that are not contained in the data set of the transmitter. Select `Special Funct.\SYSTEM settings\Measuring\Miscellaneous`. Press ENTER until the menu item `Bad soundspeed` is displayed.

```
A: Bad soundspeed
thresh.  2007 m/s
```

Enter for each measuring channel the fixed upper level of the sound velocity. Enter `0` (zero) to use the default value.

range: 0...3 000 m/s
default: 1 848 m/s

Press ENTER.

```
A: Bad soundspeed
offset:  +321 m/s
```

Enter for each measuring channel the offset. Enter `0` (zero) to use the default value.

rangeich: 0...900 m/s
default: 300 m/s

Press ENTER.

example: fixed upper value of the sound velocity `thresh.`: 2 007 m/s
`offset:` 600 m/s
value of the sound velocity curve at the operating point: 1 546 m/s

As 1 546 m/s + 600 m/s = 2 146 m/s is greater than the fixed upper value 2 007, this value will be used as the upper limit of the sound velocity when the plausibility of the signal is evaluated.

```
GAIN=91dB
SS=1038/2146 m/s
```

It is possible to display the valid range for the sound velocity (SS=) in the lower line during the measurement. The second value (here: 2 146 m/s) is the upper limit at the operating point.

Attention!	The defined upper limit of the sound velocity is still active after the deactivation of the SuperUser mode.

16.6 Number of Decimal Places of the Totalizers

The values of the totalizers can be displayed with up to 11 places, e.g. 74890046.03. In the SuperUser mode, it is possible to define the number of decimal places.

Select `Special Funct.\SYSTEM settings\Measuring\Miscellaneous`. Press ENTER until the menu item `Total digits` is displayed.

```
Total digits    ⇳
Automatic
```

Select one of the following list items.

`Automatic`: dynamic adjustment
`Fixed to x digit`: x decimal places (range: 0...4)

Press ENTER.

`Total digits = Automatic`

The number of decimal places will be adjusted dynamically. Low values will first be displayed with 3 decimal places. With greater values, the number of decimal places will be reduced.

max. value	display
$< 10^6$	±0.00 ... ±999999.999
$< 10^7$	±1000000.00 ... ±9999999.99
$< 10^8$	±10000000.0 ... ±99999999.9
$< 10^{10}$	±1000000000 ... ±9999999999

`Total digits = Fixed to x digit`

The number of decimal points is constant. The max value of the totalizer is reduced with each additional decimal place.

decimal places	max. value	max. display
0	$< 10^{10}$	±9999999999
1	$< 10^8$	±99999999.9
2	$< 10^7$	±9999999.99
3	$< 10^6$	±999999.999
4	$< 10^5$	±99999.9999

Note!	The number of decimal places and the max. value defined here only affect the display of the totalizers.

For setting the behavior of the totalizers when the max. value is reached see section 12.2.2.

16.7 Temperature-Based Heat Flow Cut-Off

With the temperature-based heat flow cut-off, all measured temperature differences between the supply and return line that are lower than a defined value are set to zero. The heat flow is also set to zero. The value of the heat quantity totalizer remains unchanged.

Select `Special Funct.\SYSTEM settings\Measuring\Miscellaneous`. Press ENTER until the menu item `Thermal low cut` is displayed.

```
Thermal low cut
off           >ON<
```

Select on to activate the temperature-based heat flow cut-off, `off` to deactivate it. Press ENTER.

```
Thermal flow ->0
if |dT|<   0.0 C
```

If on has been selected, enter the limit of the temperature difference. All temperature differences between the supply and return line that are lower than this value will be set to zero. Enter `0` (zero) to work without the temperature-based heat flow cut-off.

range: 0...5.0 °C

Press ENTER.

16.8 Manual Reset of the Totalizers

If the manual reset of the totalizers is activated, the totalizers can be reset to zero during the measurement by pressing key C three times, even if a program code is activated.

Select `Special Funct.\SYSTEM settings\Measuring\Miscellaneous`. Press ENTER until the menu item `3xC clear totals` is displayed.

```
3xC clear totals
off           >ON<
```

Select on to activate the manual reset of the totalizers, `off` to deactivate it. Press ENTER.

Note!	The manual reset of the totalizers is still active after the deactivation of the SuperUser mode.

16.9 Display of the Sum of the Totalizers

The sum of the totalizers for the two flow directions can be displayed in the upper line during the measurement.

Select `Special Funct.\SYSTEM settings\Measuring\Miscellaneous`. Press ENTER until the menu item `Show ΣQ` is displayed.

```
Show ΣQ
off           >ON<
```

Select `on` to activate the display of the sum of the totalizers, `off` to deactivate it. Press ENTER.

```
ΣQ          13.2 m3
```

If the display of the sum of the totalizers is activated, the sum `ΣQ` can be displayed in the upper line during the measurement.

16.10 Display During the Measurement

In the SuperUser mode, the following information can be displayed during the measurement besides the normal information (see section 11.3):

- absolute transit time of the measuring signal
- sound velocity
- Reynolds number
- variance of the measuring signal
- range of the sound velocity
- signal amplification
- SCNR value

17 Heat Flow and Heat Quantity

If the transmitter has the optional heat quantity measurement and two temperature inputs, the heat flow and the heat quantity can be measured.

17.1 Measuring Setup

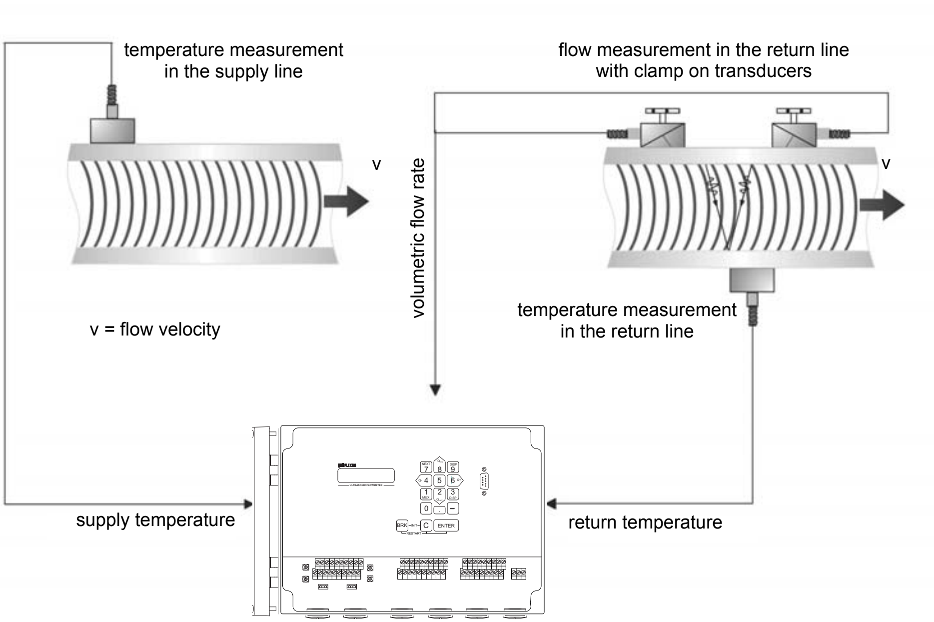


Fig. 17.1: Measurement of heat flow and heat quantity

One temperature probe is fixed on each the supply and the return line (see chapter 8).

The transducers for the flow measurement are fixed on the return line (see section 10.6). The return temperature is the temperature at the measuring point.

17.2 Calculation of the Heat Flow and the Heat Quantity

The following physical quantities are used for the calculation:

- supply temperature
- return temperature (medium temperature)
- volumetric flow rate in the return line
- density, temperature and pressure of the medium

Note!	If the supply or return temperature is known and constant during the whole measurement, this temperature can be entered in the transmitter and the corresponding temperature probe does not need to be connected.

10 medium-dependent heat flow coefficients are needed for the heat flow measurement. The heat flow coefficients of some media are stored in the internal database of the transmitter. The heat flow coefficients of the other media must be entered before the start of the measurement.

A temperature correction value (offset) can be defined for each temperature input (see section 18.5).

If the supply pressure is constant or can be measured with an additional input, the heat flow and the heat quantity can be determined for a medium that is vaporous in the supply line (see section 17.5).

17.3 Settings

- Configure the temperature inputs in `Special Funct.\SYSTEM settings\Proc. inputs` (see section 18.1).
- If necessary, enter the heat flow coefficients of the medium (see section 14.3.4).
- Select program branch `Output Options`.

```
Output Options  ⇕
for Channel    A:
```

Select the measuring channel on which the heat flow is to be measured (the channel to which the temperature inputs have been assigned). Press ENTER.

This display will not be indicated if the transmitter has only one measuring channel.

```
Physic. Quant.  ⇕
Heatflow
```

Select `Heatflow` as the physical quantity. Press ENTER.

- Select `Special Funct.\SYSTEM settings\Measuring`. Press ENTER until the list item `Heat Quantity` is displayed.

```
Heat Quantity
>[J]<       [Wh]
```

Select the unit of measurement (`J` or `Wh`). Press ENTER.

```
heat+flow quant.
off         >ON<
```

Select on to output both the volume totalizer and the heat quantity totalizer.

17.4 Measurement

Start the measurement as usual.

```
Heatflow
*INVALID MEDIUM*
```

If no heat flow coefficients are available for the selected medium, an error message will be displayed.

```
T1=  90.2      C
T2=  70.4      C
```

The two temperature inputs are checked and the measured temperatures are displayed. Press ENTER.

```
T1=?UNDEF        C
T2=  70.4        C
```

If a temperature can not be measured (the temperature probe is not connected or is defective), the error message ?UNDEF will be displayed.

```
A:T1 manualFIX
      0.0        C
```

If `Fixed input val.` has been selected during the configuration of the temperature input, the value has to be entered now.

Enter the medium temperature. Press ENTER.

Note!	A fixed temperature should be entered if e.g. the temperature can only be measured with difficulties on the supply line but the supply temperature is known and constant.

```
A:T1 manualFIX
     10.0        C
```

For simulations, it is possible to enter the supply and return temperatures as constants.

In this case, do not connect the temperature probes to the transmitter. The temperatures must be entered.

```
A:Heatflow
      0.0       kW
```

As soon as all necessary values are entered, the measured heat flow will be displayed.

If the heat quantity is also to be measured, the heat quantity totalizer will have to be activated (see section 12.2).

17.5 Steam in the Supply Line

If the supply pressure is constant or can be measured with an additional input, the heat flow and the heat quantity can be determined for a medium that is vaporous in the supply line.

The state of aggregation of the medium will be determined by means of the supply pressure and the supply temperature.

Note!	The measurement of the volumetric flow rate, and thus of the heat flow, is only possible when the medium is liquid in the return line.

The steam coefficients of water and ammonia are stored in the internal database of the transmitter. The steam coefficients of the other media must be entered with the program FluxKoef.

17.5.1 Activation/Deactivation

```
SYSTEM settings ⇕
Dialogs/Menus
```

Select `Special Funct.\SYSTEM settings\Dialogs/Menus\Steam in inlet`.

```
Steam in inlet
off          >ON<
```

Select on to activate `Steam in inlet`. The state of aggregation of the medium will be determined by means of the supply pressure and the supply temperature.

Select `off` to activate `Steam in inlet`. The medium is always assumed to be liquid in the supply line.

```
Inlet pressure
    10.0     bar
```

If `Steam in inlet` is activated, the supply pressure must be entered in the program branch `Parameter`.

Enter the supply pressure. Press ENTER.

Note!	The menu item `Steam in inlet` will always be displayed independently of the selected physical quantity. However, the supply pressure will only be used for the heat flow measurement.

17.5.2 Displays

During the heat flow measurement, the calculated state of aggregation can be displayed in the upper line by pressing key DISP 9 .

```
supply=LIQUID
   426.23      kW
```

This message will be displayed if the medium in the supply line is completely liquid.

```
supply=STEAM
  9565.23      kW
```

This message will be displayed if the medium in the supply line is completely vaporous.

```
supply=BOILING!
  7895.78      kW
```

This message will be displayed if the medium in the supply line is in the phase transition (critical range).

In this case, an exact measurement of the heat flow is not possible because the proportion of the medium in liquid phase in the supply line must be known in order to calculate the enthalpy of the supply.

The critical range of water of is ±3 °C around the boiling temperature. For this range, the heat flow is calculated with the steam saturation enthalpy.

```
HEATFLOW
  7895.78      kW
```

If the medium is in the critical range, the physical quantity will be displayed in capital letters.

18 Inputs

External transducers can be connected to the inputs (optional) to measure the following physical quantities:

- temperature
- density
- pressure
- kinematic viscosity
- dynamic viscosity

The values of the current, voltage, and temperature inputs can be used by all measuring channels.

An input must be assigned to a measuring channel (see section 18.1 and 18.3) and activated (see section 18.4) before it can be used for the measurement and for the storing of measured values.

Note!	If a new input module has been installed, the transmitter must be restarted (RESET) in order for the new inputs to be identified.

```
SYSTEM settings ⇳
Proc. inputs
```

Select `Special Funct.\SYSTEM settings\Proc. inputs`.

Depending on the configuration of the transmitter, one or several of the following list items will be displayed:

Table 18.1: List items for `Proc. inputs`

list item	function
`Link temperature`	assigning of the temperature inputs to the measuring channels
`Link other inp.`	assigning of other inputs to the measuring channels
`PT100/PT1000`	selection of a temperature probe
`...go back`	return to the precedent menu item

18.1 Assigning the Temperature Inputs to the Measuring Channels

18.1.1 Temperature Inputs and the Heat Flow Measurement

For the heat flow measurement, the supply and return temperature must be assigned to the corresponding measuring channel as `T-Inlet` and `T-Fluid/Outle` (see section 18.1.2). These temperatures are usually measured, but can also be entered as constants.

With the configuration in Table 18.2, two independent heat flow measurements can be made simultaneously. The temperature measured by T2 can not be used for the heat flow measurement on measuring channel B, but can be displayed and output.

Note!	The physical quantity `Heatflow` will only be displayed in the program branch `Output Options` of a measuring channel if a supply and return temperature have been assigned to this channel.

Table 18.2: Example of a configuration of the temperature inputs for the heat flow measurement

	temperature input
measuring channel A	
supply temperature	T1
return temperature	T2
heat quantity measurement	possible
measuring channel B	
supply temperature	constant value
return temperature	T4
heat quantity measurement	possible

18.1.2 Assignment of the Temperature Inputs

```
SYSTEM settings ⇕
Proc. inputs
```

Select `Special Funct.\SYSTEM settings\ Proc. inputs`. Press ENTER.

```
Proc. inputs    ⇕
Link temperature
```

Select the list item `Link temperature`.

```
A:T-Inlet       ⇕
Input T1
```

Select the temperature input to be assigned to measuring channel A as the supply temperature.

Select the list item `Fixed input val.` if the temperature is to be entered manually before the measurement.

Select the list item `No measuring` if no supply temperature is to be assigned to measuring channel A.

Press ENTER.

Select the list items for `T-Fluid/Outle`, `T(3)` and `T(4)` of measuring channel A and the other activated channels accordingly. Press ENTER after each input.

Note!	The configuration of a measuring channel will be stored when the next channel is selected. The configuration dialog of a channel must be finished to store the changes.

18.2 Selection of the Temperature Probe

```
SYSTEM settings ⇕
Proc. inputs
```

Select `Special Funct.\SYSTEM settings\Proc. inputs`. Press ENTER.

```
Proc. inputs    ⇕
PT100 / PT1000
```

Select the list item `PT100/PT1000`.

```
Input T1        ⇕
>PT100<    pt1000
```

Select the temperature probe.

If necessary, select the temperature probe for `Input T2`...`T4` accordingly.

18.3 Assignment of Other Inputs to the Measuring Channels

```
SYSTEM settings ⇕
Proc. inputs
```

Select `Special Funct.\SYSTEM settings\Proc. inputs`. Press ENTER.

```
Proc. inputs    ⇕
Link other inp.
```

Select the list item `Link other inp.`.

```
A:ext.Input(1)
Input I1
```

Select the first input to be assigned to measuring channel A. Only the installed inputs are displayed in the scroll list.

Select the list item `No measuring` if no input is to be assigned to measuring channel A.

Press ENTER.

Select the list items for `ext.Input(2)`...`(4)` of measuring channel A and the other activated channels accordingly.

Note!	The configuration of a measuring channel will be stored when the next channel is selected. The configuration dialog of a channel has to be finished to store the changes.

18.4 Activation of the Inputs

The activation of the inputs in program branch `Output Options` will only be displayed if the transmitter has inputs of the corresponding type and they have been assigned to a measuring channel.

18.4.1 Activation of the Temperature Inputs

Note!	If `Heatflow` has been selected as the physical quantity, the corresponding temperature inputs will be activated automatically. The steps described below are only necessary if the measured temperatures are to be displayed or output.

Temperature inputs must be activated if the measured temperatures are to be displayed, stored and/or output or if the measured temperature is to be used for the interpolation of the viscosity and the density of the medium.

```
Temperature    T1
no          >YES<
```

Select in the program branch `Output Options` the channel for which a temperature input has to be activated.

The temperature inputs assigned to the channel will be displayed one after another. Select `yes` for the temperature inputs that are to be activated.

Note!	The total number of measured values that can be stored will be reduced if a temperature input is activated.

18.4.2 Activation of Other Inputs

Attention!	Observe the correct polarity to avoid damaging the current source. A permanent short circuit can lead to the destruction of the current input.

Inputs must be activated if the measured values are to be displayed, stored and/or output together with the other measured values.

```
Input          I1
no          >YES<
```

In the program branch `Output Options`, select the channel for which an input is to be activated.

The inputs assigned to the channel will be displayed one after another. Select `yes` for the inputs that are to be activated.

Note!	The total number of measured values that can be stored will be reduced if an input is activated.

18.5 Temperature Correction

A temperature correction value (offset) can be set for each temperature input. If a correction value has been defined, it will be added automatically to the measured temperature. This function is useful if e.g.:

- the characteristic curves of the two temperature probes differ considerably from each other.
- a known and constant temperature gradient exists between the measured temperature and the actual temperature.

18.5.1 Activating/Deactivating the Temperature Correction

The temperature correction can be activated/deactivated in program branch `Special Funct.\SYSTEM settings\Dialogs/Menus`.

```
Tx Corr.Offset
off          >ON<
```

Select on to activate the temperature correction, `off` to deactivate it.

Note!	If `off` is selected, the temperature correction will be deactivated for all inputs. However, the entered correction values for each temperature input will be stored and displayed again when the temperature correction is activated again.

18.5.2 Input of the Temperature Correction

During the flow transducer positioning, the correction values will be requested for each input which has been activated and where the temperature can be measured.

```
T1 Corr.Offset
      0.3        C
```

Enter the offset for the temperature input.

Press ENTER.

Note!	Only measured temperatures can be corrected. In order to adjust the zero point, the same reference temperature is measured with the two temperature probes. The difference between the two measured temperatures is entered as the offset for one of the temperature inputs. The difference can also be distributed between the offsets of the two channels. The display of the temperature difference T1-T2 does not indicate if one or both temperatures are constant or if the values have been corrected.

```
T1= 90.5 C (COR)
      0.0       kW
```

During the measurement, a corrected temperature value is marked by `cor`.

19 Outputs

If the transmitter is equipped with outputs, they have to be installed and activated before they can be used:

- assign a measuring channel (source channel) to the output (if the transmitter has more than one measuring channel)
- assign the physical quantity (source item) to be transmitted to the output by the source channel, and the properties of the signal
- define the behavior of the output in case no valid measured values are available
- activate of the installed output in the program branch `Output Options`

19.1 Installation of an Output

All outputs are installed in `Special Funct.\SYSTEM settings\Proc. outputs`.

Note!	The configuration of an output will be stored at the end of the dialog. If the dialog is quit by pressing key BRK, the changes will not be stored.

`SYSTEM settings ⇕` `Proc. outputs`	Select `Special Funct.\SYSTEM settings\Proc. outputs`. Press ENTER.
`Install Output ⇕` `Current I1`	Select the output to be installed. Press ENTER. The scroll list contains all available outputs. A tick ✓ after a list item indicates that this output has already been installed.
`I1 enable` `no >YES<`	This display will be indicated if the output has not been installed yet. Select `yes`. Press ENTER.
`I1 disable` `>NO< yes`	If the output has already been installed, select no to reconfigure it or `yes` to uninstall the output and to return to the previous menu item to select another output. Press ENTER.
`I1 Source chan. ⇕` `Channel A:`	Select in the scroll list the measuring channel to be assigned to the output as the source channel. Press ENTER. This display will not be indicated, if the transmitter has only one measuring channel or only one measuring channel is active.

```
I1 Source item   ⇳
Measuring value
```

Select the physical quantity (source item) to be transmitted from the source channel to the output.

If a binary output is configured, only the list items `Limit` and `Impuls` will be displayed.

The source items and their scroll lists are shown in Table 19.1.

Table 19.1: Configuration of the outputs

source item	list item	output
`Measuring value`	`actual measure`	physical quantity selected in the program branch `Output Options`
	`Flow`	flow, independently of the physical quantity selected in the program branch `Output Options`
	`Heatflow`	heat flow, independently of the physical quantity selected in the program branch `Output Options`
`Quantity`	`Q+`	totalizer for the positive flow direction
	* `actual measure`	totalizer for the physical quantity selected in the program branch `Output Options`
	* `Flow`	flow totalizer
	* `Heatflow`	totalizer for the heat flow
	`Q-`	totalizer for the negative flow direction
	* `actual measure`	totalizer for the physical quantity selected in the program branch `Output Options`
	* `Flow`	flow totalizer
	* `Heatflow`	totalizer for the heat flow
	`ΣQ`	sum of the totalizers (positive and negative flow direction)
	* `actual measure`	totalizer for the physical quantity selected in the program branch `Output Options`
	* `Flow`	flow totalizer
	* `Heatflow`	totalizer for the heat flow
`Limit`	`R1`	limit message (alarm output R1)
	`R2`	limit message (alarm output R2)
	`R3`	limit message (alarm output R3)
`Temperature`		Is only available if a temperature input has been assigned to the channel.
	`T-Inlet (T1)`	supply temperature for the heat flow measurement
	`T-Outlet (T2)`	return temperature for the heat flow measurement
	`T(3)=EINGANG T3`	further temperature input
	`T(4)=INPUT T4`	further temperature input
	`TV(=T1)-TR(=T2)`	difference between supply and return temperature
	`TV(=T1)-T3`	difference between supply temperature and T(3)
	`TR(=T2)-T3`	difference between return temperature and T(3)
	`TV(=T1)-T4`	difference between supply temperature and T(4)
	`TR(=T2)-T4`	difference between return temperature and T(4)
	`T3-T4`	difference between T(3) and T(4)

Table 19.1: Configuration of the outputs

source item	list item	output
Impuls	from abs(x) from x > 0 from x < 0	pulse without sign consideration pulse for positive measured values pulse for negative measured values
Miscellaneous	c-Medium Signal	sound velocity of the medium signal amplitude of a measuring channel

19.1.1 Output Range

```
I1 Output range ⇕
   4/20 mA
```

When configuring an analog output, the output range will be defined now. Select a list item or `other range...` to enter the output range manually.

```
I1 Output MIN   ⇕
    10.0      mA
```

If `other range...` has been selected, enter the values `Output MIN` and `Output MAX`. Press ENTER after each input.

```
I1 Output MAX   ⇕
    11.0      mA
```

```
I1 Output MAX   ⇕
     12.0 MINIMAL
```

This error message will be displayed if the output range is not min. 10 % of the max. output range. The next possible value will be displayed. Repeat the input.

example: $I_{MAX} - I_{MIN} \geq 2$ mA for a 4…20 mA current output

19.1.2 Error Output

In the following dialog, an error value can be defined which is to be output if the source item can not be measured e.g. if there are gas bubbles in the medium.

Table 19.2: Error output

error value	result
Minimum	output of the lower limit of the output range
Hold last value	output of the last measured value
Maximum	output of the upper limit of the output range
Other value...	The value must be entered manually. It must be within the limits of the output.

example: source item: volumetric flow rate
output: current output
output range: 4…20 mA
error value delay t_d (see section 19.2): > 0

The volumetric flow rate can not be measured during the time interval $t_0...t_1$ (see Fig. 19.1). The error value will be output.

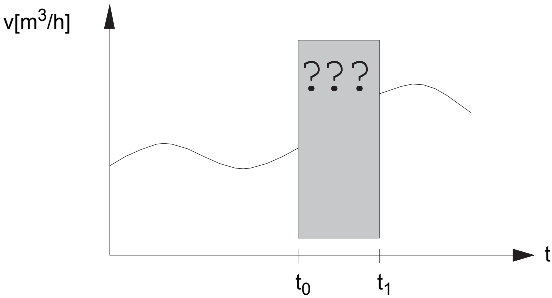


Fig. 19.1: Error output

Table 19.3: Examples for the error output

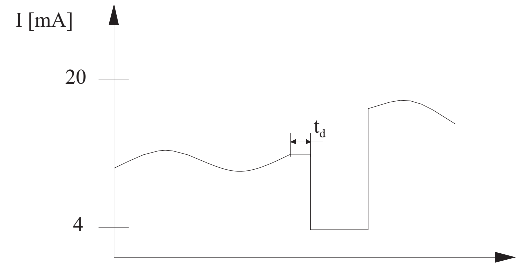
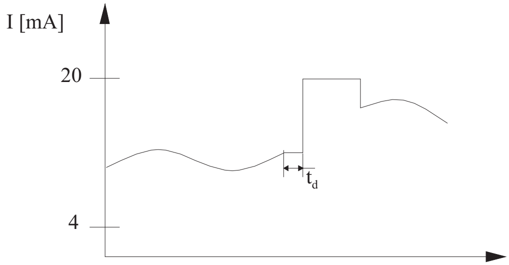
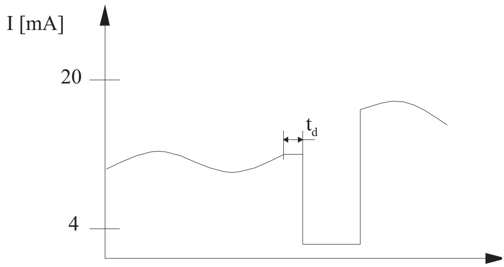
list item for the error output	output signal
`Error-value ⇳` `Minimum (4.0mA)`	
`Error-value ⇳` `Hold last value`	

Table 19.3: Examples for the error output

list item for the error output	output signal
`Error-value ⇳` `Maximum (20.0mA)`	

`Error-value ⇳`
`Other value...`
error output = 2 mA
	

```
Error-value      ⇳
Minimum (4.0mA)
```

Select a list item for the error output. Press ENTER.

```
Error-value
      3.5       mA
```

If `Other value` has been selected, enter an error value. It has to be within the limits of the output.

Press ENTER.

Note!	The settings will be stored at the end of the dialog.

```
I1 active loop
Terminal:P1+,P1-
```

The terminals for the connection of the output are displayed (here: `P1+` and `P1-` for the active current loop).

Press ENTER.

19.1.3 Function Test

The function of the installed output can now be tested. Connect a multimeter to the installed output.

Test of the Analog Outputs

```
I1:Output Test
        4      mA
```

The current output is tested in the display. Enter a test value. It has to be within the output range. Press ENTER.

```
I1=   4.0 mA
Again? no   >YES<
```

If the multimeter displays the entered value, the output functions correctly.

Select `yes` to repeat the test, `no` to return to `SYSTEM settings`. Press ENTER.

Test of the Binary Outputs

```
B1:Output Test ⇕
Reed-Relay OFF
```

Select `Reed-Relay OFF` or `Open collect OFF` in the scroll list `Output Test` to test the de-energized state of the output. Press ENTER. Measure the resistance at the output. The value has to be high ohmic.

```
B1=OFF
AGAIN? no   >YES<
```

Select `yes`. Press ENTER.

```
B1:Output Test ⇕
Reed-Relay ON
```

Select `Reed-Relay ON` or `Open collect. ON` in the scroll list `Output Test` to test the energized state of the output. Press ENTER. Measure the resistance at the output. The value has to be low ohmic.

```
B1=ON
AGAIN? no   >YES<
```

Select `yes` to repeat the test, `no` to return to `SYSTEM settings`. Press ENTER.

19.2 Error Value Delay

The error value delay is the time interval after which the error value will be transmitted to the output in case no valid measured values are available. The error value delay can be entered in the program branch `Output Options` if this menu item has been previously activated in the program branch `Special Funct.`. If the error value delay is not entered, the damping factor will be used.

```
Error-val. delay
>DAMPING<    edit
```

Select `Special Funct.\SYSTEM settings\Dialogs/Menus\Error-val. delay`.

Select `Damping` if the damping factor is to be used as the error value delay. Select `edit` to activate the menu item Error-val. delay in the program branch `Output Options`.

```
Error-val. delay
      10        s
```

From now on, the error value delay can be entered in the program branch `Output Options`.

19.3 Activation of an Analog Output

Note!	An output can only be activated in the program branch `Output Options` if it has been previously installed.

```
Output Options  ⇳
for Channel    A:
```

In the program branch `Output Options`, select the channel for which an output is to be activated. Press ENTER.

This display will not be indicated, if the transmitter has only one measuring channel.

```
Current Loop
I1: no      >YES<
```

Press ENTER until `Current Loop` is displayed. Select `yes` to activate the output. Press ENTER.

19.3.1 Measuring Range of the Analog Outputs

After an analog output has been activated in the program branch `Output Options`, the measuring range of the source item must be entered.

```
Meas.Values
>ABSOLUT<    sign
```

Select `sign` if the sign of the measured values is to be considered for the output.

Select `absolut` if the sign is not to be considered.

```
Zero-Scale Val.
     0.00    m3/h
```

Enter the lowest expected measured value. The unit of measurement of the source item will be displayed.

`Zero-Scale Val.` is the measured value that corresponds to the lower limit of the output range as defined in section 19.1.1.

```
Full-Scale Val.
   300.00    m3/h
```

Enter the highest expected measured value.

`Full-Scale Val.` is the measured value tha corresponds to the upper limit of the output range as defined in section 19.1.1.

example: output: current output
output range: 4…20 mA
`Zero-Scale Val.`: 0 m^3/h
`Full-Scale Val.`: 300 m^3/h

volumetric flow rate = 0 m^3/h, corresponds to 4 mA
volumetric flow rate = 300 m^3/h, corresponds to 20 mA

19.3.2 Function Test

The function of the installed output can now be tested. Connect a multimeter to the installed output.

```
I1: Test output ?
 no         >YES<
```

Select `yes` to activate the output. Press ENTER.

```
I1: Test value =
     5.00   m3/h
```

Enter a test value. The value must be indicated on the connected multimeter. Press ENTER.

```
I1: Test output ?
 no         >YES<
```

Select `yes` to repeat the test. Press ENTER.

19.4 Configuration of a Frequency Output as a Pulse Output

A frequency output sends a signal with a frequency that depends on the volume flow rate. The frequency output can be configured in such way that the source item can be totalized by using each period of the output signal as the increment.

Installation of a frequency output (optional):

```
Install Output ⇳
Frequency F1
```

Select `Frequency F1` in `Special Funct.\SYSTEM settings\Proc. outputs`. Press ENTER.

```
F1 enable
 no         >YES<
```

Select `yes` if the output has not been installed. Press ENTER.

or

```
F1 disable
>NO<          yes
```

Select `no` if the output has already been installed. Press ENTER.

```
F1 Source chan.⇳
Channel A:
```

Select in the scroll list the measuring channel to be assigned to the output as the source channel. Press ENTER.

```
F1 Source item ⇳
Measuring value
```

Select in the scroll list `Measuring value` (but not `Impuls`!). Press ENTER.

```
Setup as pulse ?
 no        >YES<
```

If `Measuring value` has been selected and the source item can be totalized, a request will be indicated whether the frequency output is to be configured as a pulse output. Select `yes`. Press ENTER.

```
F1 Output MAX
      1.0    kHz
```

Enter the upper limit of the frequency. Press ENTER.

The lower limit of the frequency and the error value will be set automatically to 0.5 Hz.

Activation of the output:

```
Output Options ⇳
for Channel   A:
```

In the program branch `Output Options`, select the channel for which the input is to be activated. Press ENTER.

This display will not be indicated if the transmitter has only one measuring channel.

```
Frequency Output
F1: no     >YES<
```

Select `yes` to activate the output. Press ENTER.

```
Pulses per unit:
     1000    /m3
```

Enter the number of pulses that is to be assigned to the unit of measurement of the totalizer. Press ENTER.

Example: 1000 pulses correspond to 1 m^3 of the totalized medium.

```
INFO: max flow=
   3600.0   m3/h
```

The max. flow depending on the upper limit of the frequency and pulse value is indicated. Press ENTER.

19.5 Activation of a Binary Output as a Pulse Output

A pulse output is an integrating output which emits a pulse when the volume or the mass of the medium which has passed the measuring point reaches a given value (`Pulse Value`). The integrated quantity is the selected physical quantity. Integration is restarted as soon as a pulse is emitted.

Note!	The menu item `Pulse Output` will only be indicated in the program branch `Output Options` if a pulse output has been installed.

```
Output Options  ⇳
for Channel    A:
```

Select in the program branch `Output Options` the channel for which a pulse output is be activated. Press ENTER.

This display will not be indicated if the transmitter has only one measuring channel.

```
Pulse Output
B1: no      >YES<
```

Select yes to activate the output. Press ENTER.

```
Pulse Output
NO COUNTING     !
```

This error message will be displayed if the flow velocity has been selected as the physical quantity.

The use of the pulse output is not possible in this case because integrating the flow velocity does not result in a reasonable value.

```
Pulse Value
     0.01      m3
```

Enter the pulse value. The unit of measurement will be displayed according to the current physical quantity.

When the totalized physical quantity reaches the pulse value, a pulse will be emitted.

```
Pulse Width
      100      ms
```

Enter the pulse width.

The range of possible pulse widths depends on the specification of the instrument (e.g. counter, PLC) that is to be connected to the output.

The max. flow that the pulse output can work with will be displayed now. This value is calculated on the basis of the entered pulse value and pulse width.

If the flow exceeds this value, the pulse output will not function properly. In this case, the pulse value and the pulse width must be adapted to the flow conditions. Press ENTER.

19.6 Activation of a Binary Output as an Alarm Output

Note!	The menu item `Alarm Output` will only be displayed in the program branch `Output Options` if an alarm output has been installed.

Max. 3 alarm outputs R1, R2, R3 per channel operating independently of each other can be configured. The alarm outputs can be used to output information on the current measurement or to start and stop pumps, motors, etc.

19.6.1 Alarm Properties

The switching condition, the holding behavior and the switching function of an alarm output can be defined.

Table 19.4: Alarm properties

alarm property	setting	description
`func` (switching condition)	`MAX`	The alarm will switch if the measured value exceeds the upper limit.
	`MIN`	The alarm will switch if the measured value falls below the lower limit.
	`+→- -→+`	The alarm will switch if the flow direction changes (sign change of measured value).
	`QUANT.`	The alarm will switch if totalizing is activated and the totalizer reaches the limit.
	`ERROR`	The alarm will switch if a measurement is not possible.
	`OFF`	The alarm is switched off.
`typ` (holding behaviour)	`NON-HOLD`	If the switching condition is not true anymore, the alarm will return to the idle state after approx. 1 s.
	`HOLD`	The alarm remains activated even if the switching condition is not true anymore.
`mode` (switching function)	`NO Cont.`	The alarm is energized if the switching condition is true and de-energized if idle.
	`NC Cont.`	The alarm is de-energized if the switching condition is true and energized if idle.

Note!	If no measurement is made, all alarms will be de-energized, independently of the programmed switching function.

```
Output Options ⇳
for Channel  A:
```

Select in the program branch `Output Options` the channel for which an alarm output is to be activated. Press ENTER.

This display will not be indicated if the transmitter has only one measuring channel.

```
Alarm Output
no        >YES<
```

Select `yes` to activate the alarm output. Press ENTER.

```
R1=FUNC<typ mode
Function:    MAX
```

Three scroll lists will be displayed:

- `func`: switching condition
- `typ`: holding behaviour
- `mode`: switching function

Press key 4 and 6 to select a scroll list in the upper line. Press key 8 and 2 to select a list item in the lower line.

Press ENTER to store the settings.

19.6.2 Setting the Limits

If the switching condition `MAX` or `MIN` has been selected in the scroll list `func`, the limit of the output will have to be defined:

```
R1 Input:          ⇳
Volume Flow
```

Select in the scroll list `Input` the physical quantity to be used for the comparison. The following list items are available:

- selected physical quantity
- signal amplitude
- sound velocity of the medium

Press ENTER.

```
High Limit:
   -10.00    m3/h
```

switching condition: `MAX`

Enter the upper limit. Press ENTER.

The alarm will switch if the measured value exceeds the limit.

```
Low Limit:
   -10.00    m3/h
```

switching condition: `MIN`

Enter the lower limit. Press ENTER.

The alarm will switch if the measured value falls below the limit.

example 1: `High Limit:`: -10 m^3/h

volumetric flow rate = -9.9 m^3/h
the limit is exceeded, the alarm switches

volumetric flow rate = -11 m^3/h
the limit is not exceeded, the alarm does not switch

example 2: `Low Limit:`: -10 m^3/h

volumetric flow rate = -11 m^3/h
the measured value is below the limit, the alarm switches

volumetric flow rate = -9.9 m^3/h
the measured value is not below the limit, the alarm does not switch

If the switching condition `QUANT.` has been selected in the scroll list `func`, the limit of the output will have to be defined:

```
Quantity Limit:
     1.00      m3
```

switching condition: `QUANT.`

Enter the limit of the totalizer. Press ENTER.

The alarm will switch if the measured value reaches the limit.

A positive limit will be compared to the totalizer value for the positive flow direction.

A negative limit will be compared to the totalizer value for the negative flow direction.

The comparison will also take place if the totalizer of the other flow direction is displayed.

Note!	The unit of measurement of the limit corresponds to the unit of measurement of the selected physical quantity. If the unit of measurement of the physical quantity is changed, the limit has to be converted and entered again.

example 1: physical quantity: volumetric flow rate in m^3/h
`Quantity Limit:`: 1 m^3

example 2: physical quantity. volumetric flow rate in m^3/h
`Low Limit:`:60 m^3/h

The unit of measurement of the physical quantity is changed to m^3/min. The new limit to be entered is 1 m^3/min.

19.6.3 Defining the Hysteresis

A hysteresis can be defined for the alarm output R1 to prevent a constant triggering of the alarm due to small fluctuations of the measured values around the limit.

The hysteresis is a symmetrical range around the limit. The alarm will be activated if the measured values exceed the upper limit and deactivated if the measured values fall below the lower limit.

example: `High Limit:`: 30 m^3/h
`Hysterese`: 1 m^3/h

The alarm will be triggered at values > 30.5 m^3/h and deactivated at values < 29.5 m^3/h.

```
R1 Hysterese:
     1.00    m3/h
```

switching condition: `MIN` or `MAX`

Enter the value for `Hysterese`.

or

Enter 0 (zero) to work without a hysteresis.

Press ENTER.

19.7 Behavior of the Alarm Outputs

19.7.1 Apparent Switching Delay

Measured values and totalizer values will be displayed rounded to two decimal places. The limits, however, will be compared to the non-rounded measured values. This might cause an apparent switching delay when the measured value changes marginally (less than two decimal places). In this case, the switching accuracy of the output is greater than the accuracy of the display.

19.7.2 Reset and Initialization of the Alarms

After a cold start, all alarm outputs will be initialized as follows:

Table 19.5: Alarm state after a cold start

func	OFF
typ	NON-HOLD
mode	NO Cont.
Limit	0.00

Press key C three times during the measurement to set all alarm outputs to the idle state. Alarm outputs whose switching condition is still met will be activated again after 1 s. This function is used to reset alarm outputs of the type HOLD if the switching condition is not met anymore.

By pressing key BRK, the measurement will be stopped and the main menu selected. All alarm outputs will be de-energized, independently of the programmed idle state.

19.7.3 Alarm Outputs during Transducer Positioning

At the beginning of the transducer positioning (bar graph display), all alarm outputs switch back to the programmed idle state.

If the bar graph is selected during measurement, all alarm outputs will switch back to the programmed idle state.

An alarm output of the type HOLD that has been activated during the previous measurement will remain in the idle state after the transducer positioning if the switching condition is not met anymore.

Switching of the alarms into the idle state will not be displayed.

19.7.4 Alarm Outputs during Measurement

An alarm output with switching condition MAX or MIN will be updated max. once per second to avoid humming (i.e. fluctuation of the measured values around the value of the switching condition).

An alarm output of the type NON-HOLD will be activated if the switching condition is met. It will be deactivated if the switching condition is not met anymore. The alarm will remain activated min. 1 s even if the switching condition is met for a shorter period of time.

Alarm outputs with the switching condition QUANT. will be activated if the limit is reached.

Alarm outputs with the switching condition ERROR will only be activated after several unsuccessful measuring attempts. Therefore, typical short-term disturbances of the measurement (e.g. switching on of a pump) will not activate the alarm.

Alarm outputs with the switching condition +→- -→+ and of the type NON-HOLD will be activated with each change of the flow direction for approx. 1 s (see Fig. 19.2).

Alarm outputs with the switching condition +→- -→+ and of the type HOLD will be active after the first change of the flow direction. They can be switched back by pressing key C three times (see Fig. 19.2).

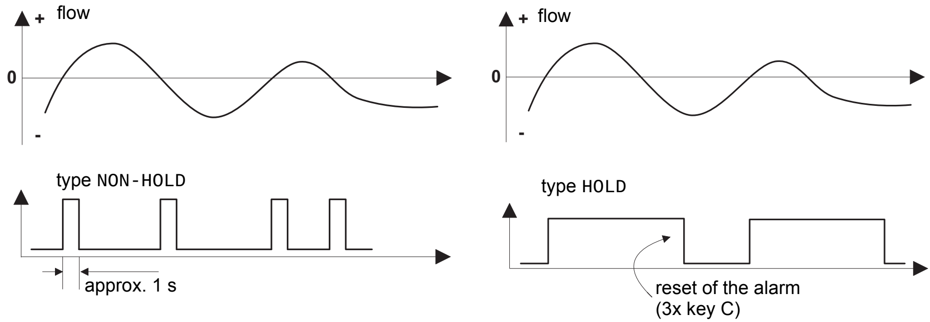


Fig. 19.2: Behavior of a relay when the flow direction changes

If there is an internal adaptation to changing measuring conditions, e.g. to a considerable rise of the medium temperature, the alarm will not switch. Alarm outputs with the switching condition OFF will be set automatically to the switching function NO Cont..

19.7.5 Alarm State Indication

Note!	There is no visual or acoustic indication of alarm output switching.

The alarm state can be displayed during the measurement. This function is activated in Special Funct.\SYSTEM settings\Dialogs/Menus.

```
SHOW RELAIS STAT
off          >ON<
```

Select the menu item SHOW RELAIS STAT. Select on to activate the alarm state indication.

Scroll during the measurement with key 9 until the alarm state is displayed in the upper line.

RX = □ □ □ □, with □ being a pictogram as shown in Table 19.6.

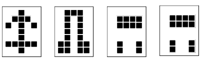
example: R1 = 

Table 19.6: Pictograms for the alarm state indication

	no.		`func` (switching condition)	`typ` (holding behavior)	`mode` (switching function)	current state
R		=				
	1		`OFF`	`NON-HOLD`	`NO Cont.`	closed
	2		`MAX`	`HOLD`	`NC Cont.`	open
	3		`MIN`			
			`+→- -→+`			
			`QUANT.`			
			`ERROR`			

19.8 Deactivation of the Outputs

If the programmed outputs are no longer required, they can be deactivated. The configuration of a deactivated output is stored and will be available if the output is activated again.

```
Alarm Output
>NO<          yes
```

Select no in `Output Options\Alarm Output` to deactivate an output. Press ENTER.

20 Troubleshooting

If any problem appears which can not be solved with the help of this manual, contact our sales office and give a precise description of the problem. Specify the type, the serial number and the firmware version of the transmitter.

Calibration

FLUXUS is a very reliable instrument. It is manufactured under strict quality control, using modern production techniques. If installed as recommended in an appropriate location, used cautiously and taken care of conscientiously, no troubles should appear. The transmitter has been calibrated at the factory and, usually, a re-calibration of the transmitter will not be necessary. A re-calibration is recommended if

- the contact surface of the transducers shows visible wear or
- the transducers were used for a prolonged period of time at a high temperature (several months >130 °C for normal transducers or > 200 °C for high temperature transducers).

The transmitter has to be sent to FLEXIM for recalibration under reference conditions.

The display does not work at all or fails regularly

Make sure that the correct voltage is available at the terminals. The voltage is indicated on the metal plate below the outer right terminal. If the power supply is ok, the transducers or an internal component of the transmitter are defective. The transducers and the transmitter have to be sent to FLEXIM for repair.

The message SYSTEM ERROR is displayed

Press key BRK to return to the main menu.

If this message is displayed repeatedly, write down the number in the lower line. Track down the situations when the error is displayed. Contact FLEXIM.

The transmitter does not react when key BRK is pressed during the measurement

A program code has been defined. Press key C and enter the program code.

The backlight of the display does not work, but all other functions are available.

The backlight is defective. This problem does not affect the other functions of the display. Send the transmitter to FLEXIM for repair.

Date and time are wrong, the measured values are deleted when the transmitter is switched off

The data backup battery has to be replaced. Send the transmitter to FLEXIM.

An output does not work

Make sure that the outputs are configured correctly. Check the function of the output as described in section 19.1.3. If the output is defective, contact FLEXIM.

A measurement is impossible or the measured values substantially differ from the expected values

see section 20.1.

The values of the totalizer are wrong

see section 20.6.

20.1 Problems with the Measurement

A measurement is impossible because no signal is received. A question mark is displayed in the lower line on the right

- Check if the entered parameters are correct, especially the outer pipe diameter, the pipe wall thickness and the sound velocity of the medium. (Typical errors: The circumference or the radius was entered instead of the diameter. The inner pipe diameter was entered instead of the outer pipe diameter.)
- Make sure that the recommended transducer distance was adjusted when mounting the transducers.
- Make sure that an appropriate measuring point has been selected (see section 20.2).
- Try to establish better acoustic contact between the pipe and the transducers (see section 20.3).
- Enter a lower value for the number of sound paths. The signal attenuation might be too high due to a high medium viscosity or deposits on the inner pipe wall (see section 20.4).

The measuring signal is received but no measured values can be obtained

- An exclamation mark "!" in the lower line on the right indicates that the defined upper limit of the flow velocity is exceeded and, therefore, the measured values are marked as invalid. The limit must be adapted to the measuring conditions or the check must be deactivated (see section 12.3).
- If no exclamation mark "!" is displayed, a measurement at the selected measuring point is not possible.

Loss of signal during the measurement

- If the pipe had run empty: Was there no measuring signal afterwards? Contact FLEXIM.
- Wait briefly until acoustic contact is reestablished. The measurement can be interrupted by a temporarily higher proportion of gas bubbles and solids in the medium.

The measured values substantially differ from the expected values

- Wrong measured values are often caused by wrong parameters. Make sure that the entered parameters are correct for the measuring point.
- If the parameters are correct, see section 20.5 for the description of typical situations in which wrong measured values are obtained.

20.2 Selection of the Measuring Point

- Make sure that the recommended min. distance to any disturbance source is observed (see chapter 4, Table 4.2).
- Avoid measuring points with deposit formation in the pipe.
- Avoid measuring points in the vicinity of deformations and defects on the pipe and in the vicinity of welds.
- Measure the temperature at the measuring point and make sure that the transducers are suitable for this temperature.
- Make sure that the outer pipe diameter is within the measuring range of the transducers.
- When measuring on a horizontal pipe, the transducers must be mounted on the side of the pipes.
- A vertical pipe must always be filled at the measuring point and the medium should flow upward.
- No gas bubbles should form (even bubble-free media can form gas bubbles when the medium expands, e.g. upstream of pumps and downstream of great cross-section enlargements).

Note!	If the temperature fluctuates at the measuring point, it is especially important that the inner hooks of the clasp engage in the tension strip. Otherwise, the contact pressure of the transducers will be insufficient at low temperatures.

Note!	If the temperature fluctuates widely, it is recommended to use FLEXIM clasps with springs to fix the transducers. Contact FLEXIM.

20.3 Maximum Acoustic Contact

Observe the instructions in chapter 7.

20.4 Application Specific Problems

The entered sound velocity of the medium is wrong

The entered sound velocity is used to calculate the transducer distance and is therefore very important for the transducer positioning. The sound velocities stored in the transmitter only serve as orientation.

The entered pipe roughness is not appropriate

Check the entered value. The state of the pipe should be taken into account.

Measurements on porous pipe materials (e.g. concrete or cast iron) are only possible under certain conditions

Contact FLEXIM.

The pipe liner may cause problems during the measurement if it is not firmly attached to the inner pipe wall or consists of an acoustically absorbing material

Try measuring on a liner free section of the pipe.

Highly viscous media strongly attenuate the ultrasonic signal

Measurements on media with a viscosity > 1000 mm^2/s are only possible under certain conditions.

A higher proportion of gas bubblesor solids in the medium scatter and absorb the ultrasonic signal and therefore attenuate the measuring signal

A measurements is impossible if the value is ≥ 10 %. If the proportion is high, but < 10 %, a measurement is only possible under certain conditions.

The flow is in the transition range between laminar and turbulent flow where flow measurement is difficult

Calculate the Reynolds number of the flow at the measuring point with the program FluxFlow (free download: www.flexim.com). Contact FLEXIM.

20.5 Large Deviations of the Measured Values

The entered sound velocity of the medium is wrong

A wrong sound velocity can result in the ultrasonic signal that is reflected directly on the pipe wall being mistaken for the measuring signal that has passed through the medium. The flow calculated on the basis of the wrong signal by the transmitter is very small or fluctuates around zero.

There is gas in the pipe

If there is gas in the pipe, the measured flow will always be too high becuse both the gas volume and the liquid volume are measured.

The defined upper limit of the flow velocity is too low

All measured flow velocities that are greater than the upper limit will be ignored and marked as invalid. All quantities derived from the flow velocity will also be marked as invalid. If several correct measured values are ignored, the totalizer values will be too low.

The entered cut-off flow is too high

All flow velocities below the cut-off flow are set to zero. All derived quantities are also set to zero. The cut-off flow (default: 2.5 cm/s) has to be set to a low value in order to be able to measure at low flow velocities.

The entered pipe roughness is not appropriate

The flow velocity to be measured is outside the measuring range of the transmitter

The measuring point is not appropriate

Select another measuring point to check whether the results are better. Because pipes are never rotationally symmetric, the flow profile is affected. Change the transducer position according to the pipe deformation.

20.6 Problems with the Totalizers

The values of the totalizer are too high

See `Special Function\SYSTEM settings\Measuring\Quantity recall`. If this menu item is activated, the values of the totalizer will be stored. The totalizer will continue with this value at the start of the next measurement.

The values of the totalizer are too low

One of the totalizers has reached the upper limit and has to be reset to zero manually.

The sum of the totalizers is not correct

See `Special Function\SYSTEM settings\Measuring\Quant. wrapping`. The sum of both totalizers (throughput) transmitted via an output is not valid after the overflow (wrapping) of one of the totalizers.

A Menu Structure

		cold start resistant
Program Branch Parameter		
>PAR< mea opt sf Parameter	main menu: selection of the program branch Parameter	
Parameter ⇳ for Channel A:	selection of a measuring channel (A, B) or of a calculation channel (Y, Z) This display will not be indicated if the transmitter has only one measuring channel.	
When a measuring channel is selected (A, B)		
Outer Diameter 100.0 mm	input of the outer pipe diameter	
Pipe Circumfer. 314.2 mm	input of the pipe circumference This display will only be indicated if Special Funct.\SYSTEM settings\Dialogs/Menus\Pipe Circumfer. is activated and Outer Diameter = 0 has been entered.	
Wall Thickness 3.0 mm	input of the pipe wall thickness range: depends on the connected transducers default: 3 mm	
Pipe Material ⇳ Carbon Steel	selection of the pipe material	
c-Material 3230.0 m/s	input of the sound velocity of the pipe material range: 600...6553.5 m/s This display will only be indicated if Other Material has been selected.	
Lining no >YES<	selection whether the pipe is lined	

		cold start resistant
Lining ⇳ Bitumen	selection of the lining material This display will only be indicated if `Lining = yes` has been selected.	
c-Material 3200.0 m/s	input of the sound velocity of the lining material range: 600...6553.5 m/s This display will only be indicated if `Other Material` has been selected.	
Liner Thickness 3.0 mm	input of the liner thickness default: 3 mm	
Roughness 0.4 mm	input of the roughness of the inner pipe wall range: 0...5 mm default: 0.1 mm (for steel as pipe material)	
Medium ⇳ Water	selection of the medium	
c-Medium MIN 1400.0 m/s	input of the min. sound velocity of the medium range: 500...3500 m/s This display will only be indicated if `Other Medium` has been selected.	
c-Medium MAX 1550.0 m/s	input of the max. sound velocity of the medium This display will only be indicated if `Other Medium` has been selected.	
Kinem.Viscosity 1.00 mm2/s	input of the kinematic viscosity of the medium range: 0.01...30 000 mm^2/s This display will only be indicated if `Other Medium` has been selected.	

		cold start resistant
`Density` `1.00 g/cm3`	input of the operating density of the medium range: 0.01...20 g/cm^3 This display will only be indicated if `Other Medium` has been selected.	
`Medium Temperat.` `20.0 C`	input of the medium temperature default: 20 °C	
`Fluid pressure` `1.00 bar`	input of the medium pressure range: 1...600 bar This display will only be indicated if `Special Funct.\SYSTEM settings\Dialogs/Menus\Fluid pressure` is activated.	
`Transducer Type ⇳` `Standard`	selection of the transducer type This display will only be indicated if no or special transducers are connected.	
`Additional cable` `65.0 m`	input of the length of an extension cable	
When a calculation channel is selected (Y, Z) Calculation channels will only be available if the transmitter has more than one measuring channel.		
`Calculation:` `Y= A - B`	display of the current calculation function	
`>CH1< funct ch2 ⇳` `A - B`	selection of the calculation function	
Program Branch `Measuring`		
`par >MEA< opt sf` `Measuring`	main menu: selection of the program branch `Measuring`	

		cold start resistant
`CHANN: >A< B Y Z` `MEASUR ✓ ✓ - .`	activation of the channels This display will not be indicated if the transmitter has only one measuring channel.	
`A:Meas.Point No.:` `xxx (↑↓←→)`	input of the measuring point number This display will only be indicated if `Output Options\Store Meas.Data` and/or `Serial Output` are activated.	
`A:PROFILE CORR.` `>NO< yes`	activating/deactivating the flow profile correction This display will only be indicated if `Special Funct.\SYSTEM settings\Measuring\Flow Velocity` = `uncorr.` has been selected.	
`A: Sound Path` `2 NUM`	input of the number of sound paths	
`Transd. Distance` `A:54 mm Reflex`	display of the transducer distance to be adjusted between the inner edges of the transducers	
Program Branch `Output Options`		
`par mea >OPT< sf` `Output Options`	main menu: selection of the program branch `Output Options`	
`Output Options ⇳` `for Channel A:`	selection of the channel whose output options are to be defined	
`Physic. Quant. ⇳` `Volume Flow`	selection of the physical quantity	
`Volume in: ⇳` `m3/h`	selection of the unit of measurement for the physical quantity	

		cold start resistant
`Temperature T1` `no >YES<`	activation of a temperature input This display will only be indicated if the temperature input T1 has been assigned to the channel in `Special Funct.\SYSTEM settings\Proc. inputs\Link temperature`.	
`INPUT I1` `no >YES<`	activation of a current input for an external temperature measurement This display will only be indicated if the input I1 has been assigned to the channel in `Special Funct.\SYSTEM settings\ Proc. inputs\Link other inp.`.	
`Damping` `10 s`	input of the duration over which a floating average of the measured values has to be determined range: 1...100 s	
`Store Meas.Data` `no >YES<`	activation of the data logger	
`Serial Output` `no >YES<`	activation of the measured value output to a PC or a printer via the serial interface	
`Storage Rate ⇕` `Once per 10 sec.`	selection of the storage rate for storing measured values in the data logger This display will only be indicated if `Output Options\Store Meas.Data` and/or `Serial Output` are activated.	
`Storage Rate` `1 s`	Input of the storage rate if `Storage Rate` = EXTRA has been selected range: 1...43 200 s (= 12 h)	
Current Loop		
`Current Loop` `I1: no >YES<`	activation of a current output This display will only be indicated if the current output has been installed in `Special Funct.\SYSTEM settings\Proc. outputs`.	

		cold start resistant
`Meas.Values` `>ABSOLUT<    sign`	selection whether the sign of the measured values is to be considered for the output This display will only be indicated if `Current Loop` is activated.	

`Zero-Scale Val.`
`     0.00    m3/h`
 	
`Full-Scale Val.`
`   300.00    m3/h`
	input of the lowest/highest measured value to be expected for the current output
	The values are assigned to the lower/upper limit of the output range.
	These displays will only be indicated if `Current Loop` is activated.	

`Error-val. delay` `       10       s`	input of the error value delay, i.e. of the time interval after which the value entered for the error output will be transmitted to the output if no valid measured values are available This display will only be indicated if `Special Funct.\SYSTEM settings\Dialogs/Menus\Error-val. delay` = `EDIT` has been selected.	
Pulse Output		
`Pulse Output` `B1: no      >YES<`	Activation of a Pulse Output This display will only be indicated if a pulse output has been installed in `Special Funct.\SYSTEM settings\Dialogs/Menus\Proc. outputs`.	
`Pulse Value` `     0.01      m3`	input of the pulse value (value of the totalizer at which a pulse will be emitted) This display will only be indicated if `Pulse Output` is activated.	
`Pulse Width` `      100      ms`	input of the pulse width range: 1 or 80...1000 ms This display will only be indicated if `Pulse Output` is activated.	

	cold start resistant
Alarm Output	

Display	Description
`Alarm Output` `no >YES<`	activation of an alarm output This display will only be indicated if an alarm output has been installed in `Special Funct.\SYSTEM settings\Proc. outputs`.
`R1=FUNC<typ mode` `Function: MAX`	Selection of the switching condition (`func`), the holding behavior (`typ`) and the switching function (`mode`) of the alarm output. This display will only be indicated if `Alarm Output` is activated.
`R1 Input: ⇳` `Volume Flow`	selection of the physical quantity to be monitored This display will only be indicated for R1 if `Alarm Output` is activated.
`High Limit:` `-10.00 m3/h`	input of the upper limit of the physical quantity to be monitored This display will only be indicated if `Alarm Output` has been activated and `MAX` has been selected as the switching condition.
`Low Limit:` `-10.00 m3/h`	input of the lower limit of the physical quantity to be monitored This display will only be indicated if `Alarm Output` has been activated and `MIN` has been selected as the switching condition.
`Quantity Limit:` `1.00 m3`	input of the limit for the totalizer of the physical quantity to be monitored This display will only be indicated if `Alarm Output` has been activated and `QUANT.` has been selected as the switching condition.
`R1 Hysterese:` `1.00 m3/h`	input of the hysteresis for the lower or upper limit This display will only be indicated if `Alarm Output` has been activated and `MIN` or `MAX` has been selected as the switching condition.

	cold start resistant
Program Branch `Special Funct.`	
`par mea opt >SF<` `Special Funct.` — main menu: selection of the program branch `Special Funct.`	
`SYSTEM settings`	
`Special Funct. ⇕` `SYSTEM settings` — selection of `Special Funct.\SYSTEM settings`	
`SYSTEM settings\Set Clock`	
`SYSTEM settings ⇕` `Set Clock` — selection of the displays for the input of the date and the time	
`SYSTEM settings\Libraries`	
`SYSTEM settings ⇕` `Libraries` — selection of the displays for the management of the material and medium scroll lists	
`SYSTEM settings\Libraries\Material list`	
`Libraries ⇕` `Material list` — selection of the displays for the arrangement of the material scroll list (pipe and lining materials)	
`SYSTEM settings\Libraries\Medium list`	
`Libraries ⇕` `Medium list` — selection of the displays for the arrangement of the medium scroll list	
`SYSTEM settings\Libraries\Format USER-AREA`	
`Libraries ⇕` `Format USER-AREA` — selection of the displays for the partitioning of the coefficient memory for the storing of user defined material and medium properties	

		cold start resistant
`Format USER-AREA` `Materials:     03`	input of the number of user defined materials	
`Format USER-AREA` `Media:         03`	input of the number of user defined media	
`Format USER-AREA` `Heat-Coeffs:   00`	input of the number of user defined data sets for the heat flow coefficients	
`Format USER-AREA` `Steam-Coeffs:  00`	input of the number of user defined data sets for the steam coefficients	
`USER AREA:` `      52%    used`	display of the occupancy of the coefficient memory	
`Format NOW?` `no          >YES<`	confirmation of the selected partition	
`FORMATTING ...` `■■■■■■■  ...`	the coefficient memory is being partitioned	
SYSTEM settings\Libraries\Extended Library		
`Libraries       ⇳` `Extended Library`	selection of the displays for the activation of the extended library	
`Extended Library` `off          >ON<`	activation of the extended library	
SYSTEM settings\Dialogs/Menus		
`SYSTEM settings ⇳` `Dialogs/Menus`	selection of the displays for the activation/deactivation or setting of the menu items in the other program branches	

		cold start resistant
`Pipe Circumfer.` `off >ON<`	activation of the menu item for the input of the pipe circumference in the program branch `Parameter`	x
`Fluid pressure` `off >ON<`	activation of the menu item for the input of the medium pressure in the program branch `Parameter`	
`Meas.Point No.:` `(1234) >(↑↓←→)<`	selection of the input mode for the measuring point number in the program branch `Measuring`: `(1234)`: digits, point, hyphen `(↑↓←→)`: ASCII editor	
`Transd. Distance` `auto >USER<`	setting for the display for the input of the transducer distance in the program branch `Measuring`: • `user`: only the entered transducer distance will be displayed if the recommended and the entered transducer distances are identical • `auto`: only the recommended transducer distance will be displayed recommended setting: `user`	
`Steam in inlet` `off >ON<`	activation of the menu item for the input of the supply pressure in the program branch `Parameter` for a heat flow measurement in a medium that can be a liquid or a gas in the supply line	x
`Tx Corr.Offset` `off >ON<`	activation of the menu item for the input of a correction value (offset) for each temperature input in the program branch `Measuring`	
`Error-val. delay` `damping >EDIT<`	selection of the error value delay • `damping`: The damping factor will be used. • `edit`: The menu item for the input of the error value delay in the program branch `Output Options` will be activated.	x
`SHOW RELAIS STAT` `off >ON<`	activation of the display of the alarm state during the measurement	x

	cold start resistant
SYSTEM settings\Proc. inputs	
`SYSTEM settings ⇳` `Proc. inputs` — selection of the displays for the setting of the inputs of the transmitter	
`Proc. inputs ⇳` `Link temperature` — assignment of temperature inputs and other inputs to the measuring channels	
SYSTEM settings\Measuring	
`SYSTEM settings ⇳` `Measuring` — selection of the displays for the settings of the measurement	
`WaveInjector` `off >ON<` — activation of the WaveInjector (optional)	
`Compare c-fluid` `no >YES<` — activation of the display for the difference between the measured and the expected sound velocity of a selected reference medium during the measurement	
`Flow Velocity` `normal >UNCORR.<` — selection whether the flow velocity is displayed and transmitted with or without profile correction	x
`Cut-off Flow` `absolut >SIGN<` — selection of the input of a lower limit for the flow velocity: • `absolut`: independent of the flow direction • `sign`: dependent on the flow direction	x
`Cut-off Flow` `factory >USER<` — activation of the input of a lower limit of the flow velocity: • `factory`: the default limit of 2.5 cm/s will be used • `user`: input of a limit	

		cold start resistant
`+Cut-off Flow` `      2.5    cm/s`	input of the cut-off flow for positive measured values range: 0...12.7 cm/s (0.127 m/s), default: 2.5 cm/s (0.025 m/s) This display will only be indicated if `Cut-off Flow` = `sign` and `Cut-off Flow` = `user` has been selected.	
`-Cut-off Flow` `     -2.5    cm/s`	Input of the cut-off flow for negative measured values range: -12.7...0 cm/s default: -2.5 cm/s This display will only be indicated if `Cut-off Flow` = `sign` und `Cut-off Flow` = `user` has been selected.	
`Cut-off Flow` `      2.5    cm/s`	Input of the cut-off flow for the absolute value of the measured values range: 0...12.7 cm/s default: 2.5 cm/s This display will only be indicated if `Cut-off Flow` = `absolut` und `Cut-off Flow` = `user` has been selected.	
`Velocity limit` `      0.0     m/s`	input of an upper limit of the flow velocity range: 0.1...25.5 m/s All measured values that are greater than the limit will be marked as outliers. Input of 0 (zero) switches off the detection for outliers.	x
`Heat Quantity` `>[J]<        [Wh]`	selection of the unit of measurement for the heat quantity	x
`heat+flow quant.` `off          >ON<`	activation of the output and storing of the heat quantity totalizer values during the heat flow measurement	x

		cold start resistant
`Quant. wrapping` `off >ON<`	activation of the overflow of the totalizers	x
`Quantity recall` `off >ON<`	activation of the taking-over of the totalizer values after a restart of the measurement	x
`SYSTEM settings\Proc. outputs`		
`SYSTEM settings ⇳` `Proc. outputs`	selection of the displays for the setting of the outputs of the transmitter	
`Install Output ⇳` `Current I1`	selection of the output to be installed	
`SYSTEM settings\Storing`		
`SYSTEM settings ⇳` `Storing`	selection of the displays for the storing of measured values in the data logger	
`Ringbuffer` `off >ON<`	setting of the overflow behavior of the data logger	x
`Storage mode` `sample >AVERAGE<`	selection of the sample mode • `sample`: storing and online output of the displayed measured value • `average`: storing and online output of the average of all measured values of a storage interval	x
`Quantity Storage` `one >BOTH<`	setting of the storing behavior of the totalizers • `one`: the value of the totalizer that is currently displayed will be stored • `both`: one value for each flow direction will be stored	x

		cold start resistant
Store Amplitude off >ON<	activation of the storing of the signal amplitude The value will only be stored if the data logger is activated.	x
Store c-Medium off >ON<	activation of the storing of the sound velocity of the medium The value will only be stored if the data logger is activated.	x
Beep on storage >ON< off	activation of an acoustic signal every time a measured value is stored or transmitted	x
SYSTEM settings\Serial transmis.		
SYSTEM settings ⇳ serial transmis.	selection of the displays for the formatting of the serial transmission of measured values	
SER:kill spaces off >ON<	activation of the serial transmission with/without blanks	
SER:decimalpoint '.' >','<	selection of the decimal marker for floating point numbers	
SER:col-separat. ';' >'TAB'<	selection of the character for column separation	
Send Offline via RS232 >RS485<	selection of the serial interface default: RS232 This display will only be indicated if the transmitter has an RS485 interface.	
SYSTEM settings\Network		
SYSTEM settings ⇳ Network	change of the settings of the transmission parameters	

	cold start resistant
`Device address:` `         0      ADR` — input of the instrument address	
`Serial protocol` `default   >SETUP<` — confirmation or change of the transmission parameters	
`>BAUD< parity  st` `1200   EVEN      1` — change of the baud rate, parity or number of stop bits	
SYSTEM settings\Miscellaneous	
`SYSTEM settings ⇳` `Miscellaneous` — selection of the display for the setting of the contrast	
`SETUP DISPLAY` `←   CONTRAST   →` — setting of the contrast of the display	
Instrum. Inform.	
`Special Funct.  ⇳` `Instrum. Inform.` — selection of the displays for information about the transmitter	
`ADM7XX7-XXXXXXXX` `Free:        18327` — display of the type, serial number and available data logger capacity	
`ADM7XX7-XXXXXXXX` `V x.xx   dd.mm.yy` — display of the type, serial number and firmware version with the date (dd - day, mm - month, yy - year)	
Print Meas.Val.	
`Special Funct.  ⇳` `Print Meas.Val.` — selection of the displays for the transmission of stored measured values to a PC	

	cold start resistant
``Send Header    01`` ``................`` — start of the transmission of measured values This display will only be indicated if the data logger contains measured values and the transmitter is connected to a PC via a serial cable.	
``■■■■■■`` ``................`` — display of the data transmission progress	
Delete Meas.Val.	
``Special Funct.  ⇳`` ``Delete Meas.Val.`` — selection of the displays for the deleting of stored measured values	
``Really Delete?`` ``no          >YES<`` — confirmation for the deleting of measured values This display will only be indicated if measured values are stored in the data logger.	
Install Material	
``Special Funct.  ⇳`` ``Install Material`` — selection of the displays for the input of the pipe and lining materials	
Install Material with Special Funct.\SYSTEM settings\Libraries\Extended Library = off	
``Install Material`` ``>EDIT<     delete`` — selection whether a user defined material is to be edited or deleted	
``USER Material   ⇳`` ``#01:--not used--`` — selection of a user defined material	
``EDIT TEXT (↑↓←→)`` ``USER MATERIAL   1`` — input of a designation for the selected material	
``c-Material`` ``  1590.0     m/s`` — input of the sound velocity of the material range: 600...6553.5 m/s	

		cold start resistant
`Roughness` `0.4 mm`	input of the roughness of the material	
Install Material with Special Funct.\SYSTEM settings\ Libraries\Extended Library = on		
`Edit Material ⇳` `Basics:Y=m*X +n`	selection of the function for the temperature and pressure dependency of the material properties	
`USER Material ⇳` `#01:--not used--`	selection of a user defined material	
`USER Material 2` `>EDIT< delete`	selection whether the user defined material is to be edited or deleted This display will only be indicated if the selected material already exists.	
`#2: Input Name:` `USER MATERIAL 2`	input of a designation for the selected material	
`T-SOUNDSP.` `1500.0 m/s`	input of the constants for the transversal sound velocity of the material The number of constants depends on the function selected above.	
`L-SOUNDSP.` `1500.0 m/s`	input of the constants for the longitudinal sound velocity of the material The number of constants depends on the function selected above.	
`Default soundsp.` `long. >TRANS.<`	selection of the sound wave type for the flow measurement	
`Roughness` `0.4 mm`	input of the roughness of the material	

		cold start resistant
Save changes no >YES<	confirmation that the changes are to be stored This display will only be indicated if a new material has been entered or the properties of an existing material have been changed.	
Install Medium		
Special Funct. ⇳ Install Medium	selection of the displays for the input of media	
Install Medium with Special Funct.\SYSTEM settings\Libraries\Extended Library = off		
Install Medium >EDIT< delete	selection whether a user defined medium is to be edited or deleted	
USER Medium ⇳ #01:--not used--	selection of a user defined medium	
EDIT TEXT (↑↓←→) USER MEDIUM 1	input of a designation for the selected medium	
c-Medium MIN 1400.0 m/s	input of the min. sound velocity of the medium range: 800...3500 m/s	
c-Medium MAX 1550.0 m/s	input of the max. sound velocity of the medium	
Kinem.Viscosity 1.01 mm2/s	input of the kinematic viscosity of the medium range: 0.01...30 000.00 mm^2/s	
Density 1.00 g/cm3	input of the operating density of the medium	

	cold start resistant

Install Medium with Special Funct.\SYSTEM settings\Libraries\Extended Library = on

Edit Medium ⇕ Basics:Y=m*X +n	selection of the function for the temperature and pressure dependency of the medium properties
USER Medium ⇕ #01:--not used--	selection of a user defined medium
USER MEDIUM 2 >EDIT< delete	selection whether the user defined medium is to be edited or deleted This display will only be indicated if the selected medium already exists.
#2: Input Name: USER MEDIUM 2	input of a designation for the selected medium
SOUNDSPEED 1500.0 m/s	input of the constants for the longitudinal sound velocity of the medium The number of constants depends on the function selected above.
VISCOSITY 1.0 mm2/s	input of the kinematic viscosity of the medium
DENSITY 1.0 g/cm3	input of the operating density of the medium
Save changes no >YES<	confirmation that the changes are to be stored This display will only be indicated if a new medium has been entered or the properties of an existing medium have been changed.

	cold start resistant
After the input of HotCode 071001	x
`DNmin Q-Sensor` `15 mm` — input of the lower limit of the inner pipe diameter for the displayed transducer type range: 3...63 mm	

B Technical Data

Flow Transmitter

FLUXUS	**ADM 7407**	**ADM 7407 A2**	**ADM 7907**
design	standard field device	field device for ATEX zone 2	19 " module
measurement			
measuring principle	transit time difference correlation principle, automatic NoiseTrek selection for measurements with high gaseous or solid content		
flow velocity	0.01...25 m/s		
repeatability	0.15 % of reading ±0.01 m/s		
medium	all acoustically conductive liquids with < 10 % gaseous or solid content by volume (transit time difference principle)		
temperature compensation	corresponding to the recommendations in ANSI/ASME MFC-5M-1985		
accuracy[1]			
with standard calibration	±1.6 % of reading ±0.01 m/s		
with extended calibration (optional)	±1.2 % of reading ±0.01 m/s		
with field calibration[2]	±0.5 % of reading ±0.01 m/s		
flow transmitter			
power supply	100...240 V/50...60 Hz or 20...32 V DC		
power consumption	< 15 W		
number of flow measuring channels	1, optional: 2		
signal damping	0...100 s, adjustable		
measuring cycle (1 channel)	100...1000 Hz		
response time	1 s (1 channel), optional: 70 ms		
housing material	aluminum, powder coated		aluminum
degree of protection according to EN 60529	IP 65	IP 65	IP 20
dimensions	see dimensional drawing		42HP x 3U (without back panel) see dimensional drawing
weight	2.8 kg		1.7 kg
fixation	wall mounting, optional: 2 " pipe mounting		19 " rack mounting
operating temperature	-20...+60 °C		
display	2 x 16 characters, dot matrix, backlit		
menu language	English, German, French, Dutch, Spanish		

[1] for transit time difference principle, reference conditions and v > 0.15 m/s

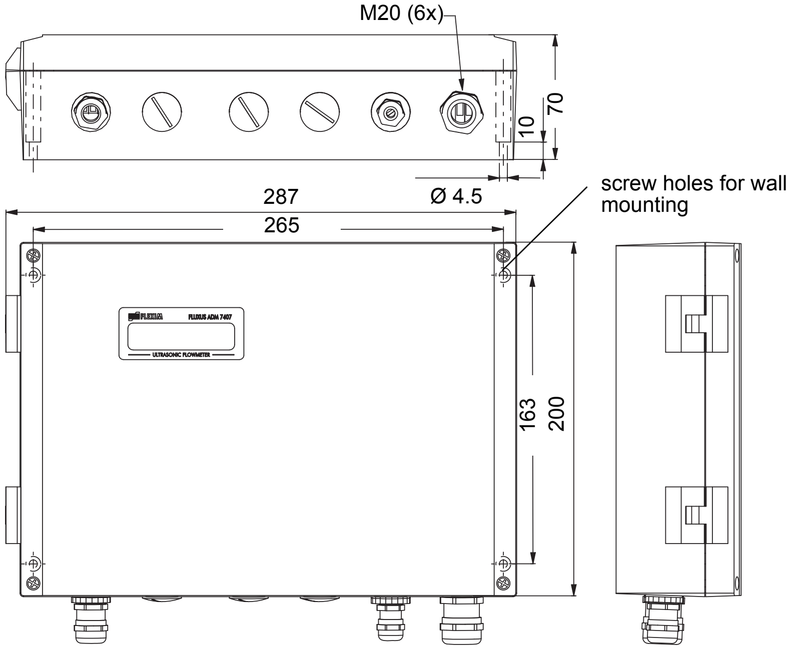
[2] reference uncertainty < 0.2 %

FLUXUS	ADM 7407	ADM 7407 A2	ADM 7907
explosion protection			
ATEX zone	-	2	-
ATEX marking	-	CE Ex II3G Ex nA II T4 T_a -20...+60 °C II3D Ex tD A22 IP65 T100 °C	-
measuring functions			
physical quantities	volumetric flow rate, mass flow rate, flow velocity, heat flow (if temperature inputs are installed)		
totalizers	volume, mass, optional: heat quantity		
calculation functions	average, difference, sum		
diagnostic functions	sound velocity, signal amplitude, SNR, SCNR, standard deviation of amplitudes and transit times		
data logger			
loggable values	all physical quantities, totalized values and diagnostic values		
capacity	> 100 000 measured values		
communication			
interface	- process integration: optional: RS485 (Modbus, sender) or HART - diagnosis: RS232		
serial data kit (optional)			
software (all Windows™ versions)	- FluxData: download of measured data, graphical presentation, conversion to other formats (e.g. for Excel™) - FluxKoef: creating medium data sets		
cable	RS232		
adapter	RS232 - USB		

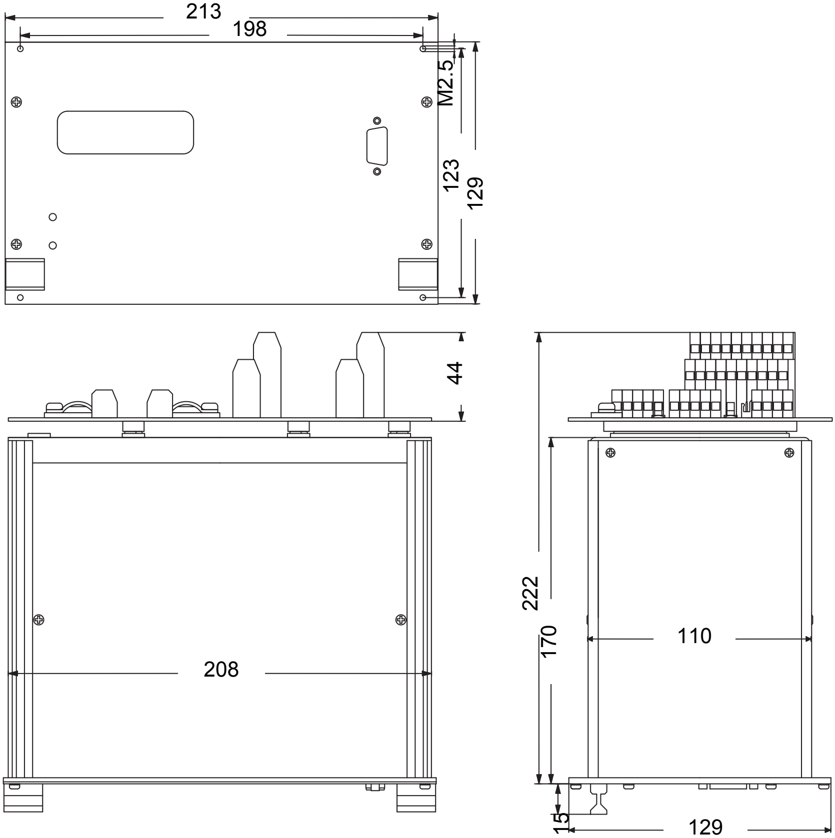
FLUXUS	ADM 7407	ADM 7407 A2	ADM 7907
outputs (optional)			
	The outputs are galvanically isolated from the transmitter.		
number	on request		
	current output		
current output - range - accuracy - active output - passive output	 0/4...20 mA 0.1 % of reading ±15 μA R_{ext} < 500 Ω U_{ext} = 4...24 V, dependent on R_{ext}, R_{ext} < 1 kΩ		
current output I1 in HART mode - range - passive output	 4...20 mA U_{ext} = 10...24 V		
	voltage output		
range accuracy internal resistance	0...1 V or 0...10 V 0...1 V: 0.1 % of reading ±1 mV 0...10 V: 0.1 % of reading ±10 mV R_i = 500 Ω		
	frequency output		
range open collector	0...1 kHz or 0...5 kHz 24 V/4 mA		
	binary output		
Reed relay open collector optorelay	- - 26 V/100 mA		48 V/0.25 A 24 V/4 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...1000 units 1...1000 ms		 0.01...1000 units 80...1000 ms
inputs (optional)			
	The inputs are galvanically isolated from the transmitter.		
number	max. 4, on request		
	temperature input		
designation connection range resolution accuracy	Pt100/Pt1000 4-wire -150...+560 °C 0.01 K ±0.01 % of reading ±0.03 K		
	current input		
accuracy active input - range passive input - range	0.1 % of reading ±10 μA U_i = 24 V, R_i = 50 Ω, P_i < 0.5 W, not short circuit proof 0...20 mA R_i = 50 Ω, P_i < 0.3 W -20...+20 mA		
	voltage input		
range accuracy internal resistance	0...1 V 0.1 % of reading ±1 mV R_i = 1 MΩ		

Dimensions

FLUXUS ADM 7407

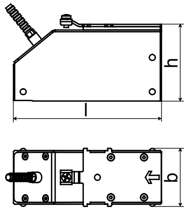
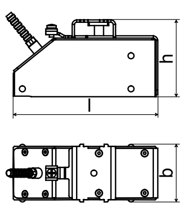


FLUXUS ADM 7907



in mm

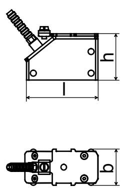
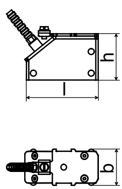
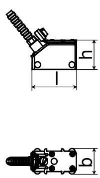
Shear Wave Transducers (zone 1)

technical type		CDG1N81	CDK1N81
order code		FSG-NA1TS FSG-NA1TS/OS FSG-NI1TS FSG-NI1TS/OS	FSK-NA1TS FSK-NA1TS/OS FSK-NI1TS FSK-NI1TS/OS
transducer frequency	MHz	0.2	0.5
inner pipe diameter d			
min. extended	mm	400	100
min. recommended	mm	500	200
max. recommended	mm	6500	3600
max. extended	mm	6500	6500
pipe wall thickness			
min.	mm	-	-
max.	mm	-	-
material			
housing		PEEK with stainless steel cap 304 (1.4301), option OS: 316L (1.4404)	PEEK with stainless steel cap 304 (1.4301), option OS: 316L (1.4404)
contact surface		PEEK	PEEK
degree of protection according to EN 60529		IP 65	IP 65
transducer cable			
type		1699	1699
length	m	5	5
dimensions			
length l	mm	129.5	126.5
width b	mm	51	51
height h	mm	67	67.5
dimensional drawing			
operating temperature			
min.	°C	-40	-40
max.	°C	+130	+130
temperature compensation		x	x

technical type			CDG1N81	CDK1N81
explosion protection				
ATEX / IEC Ex	transducer ATEX		FSG-NA1TS FSG-NA1TS/OS	FSK-NA1TS FSK-NA1TS/OS
	transducer IEC Ex		FSG-NI1TS FSG-NI1TS/OS	FSK-NI1TS FSK-NI1TS/OS
	zone		1	1
	explosion protection temperature			
	min.	°C	-55	-55
	max.	°C	+180	+180
	marking		CE 0637 Ex II2G II2D Ex eq II T6...T3 Ex tD A21 IP65 TX	CE 0637 Ex II2G II2D Ex eq II T6...T3 Ex tD A21 IP65 TX
	certification ATEX		IBExU07ATEX1168 X	IBExU07ATEX1168 X
	certification IEC Ex		IECEx IBE08.0007 X	IECEx IBE08.0007 X
	type of protection		gas: increased safety, powder filling dust: protection by enclosure	gas: increased safety, powder filling dust: protection by enclosure
	necessary transducer mounting fixture		Variofix L or Variofix C	Variofix L or Variofix C

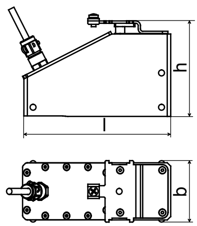
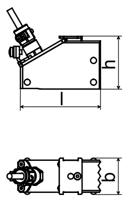
Transducers

Shear Wave Transducers (zone 1)

technical type		CDM2N81	CDP2N81	CDQ2N81
order code		FSM-NA1TS FSM-NA1TS/OS FSM-NI1TS FSM-NI1TS/OS	FSP-NA1TS FSP-NA1TS/OS FSP-NI1TS FSP-NI1TS/OS	FSQ-NA1TS FSQ-NA1TS/OS FSQ-NI1TS FSQ-NI1TS/OS
transducer frequency	MHz	1	2	4
inner pipe diameter d				
min. extended	mm	50	25	10
min. recom-mended	mm	100	50	25
max. recom-mended	mm	2000	200	150
max. extended	mm	3400	600	400
pipe wall thickness				
min.	mm	-	-	-
max.	mm	-	-	-
material				
housing		PEEK with stainless steel cap 304 (1.4301), option OS: 316L (1.4404)	PEEK with stainless steel cap 304 (1.4301), option OS: 316L (1.4404)	PEEK with stainless steel cap 304 (1.4301), option OS: 316L (1.4404)
contact surface		PEEK	PEEK	PEEK
degree of protec-tion according to EN 60529		IP 65	IP 65	IP 65
transducer cable				
type		1699	1699	1699
length	m	4	4	3
dimensions				
length l	mm	62.5	62.5	39
width b	mm	32	32	22
height h	mm	40.5	40.5	25.5
dimensional drawing				
operating temperature				
min.	°C	-40	-40	-40
max.	°C	+130	+130	+130
temperature compensation		x	x	x

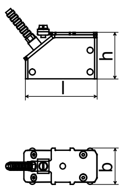
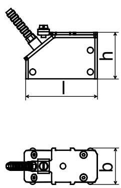
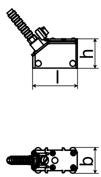
technical type			CDM2N81	CDP2N81	CDQ2N81
explosion protection					
ATEX / IEC Ex	transducer ATEX		FSM-NA1TS FSM-NA1TS/OS	FSP-NA1TS FSP-NA1TS/OS	FSQ-NA1TS FSQ-NA1TS/OS
	transducer IEC Ex		FSM-NI1TS FSM-NI1TS/OS	FSP-NI1TS FSP-NI1TS/OS	FSQ-NI1TS FSQ-NI1TS/OS
	zone		1	1	1
	explosion protection temperature				
	min.	°C	-55	-55	-55
	max.	°C	+180	+180	+180
	marking		CE 0637 Ex II2G II2D Ex eq II T6...T3 Ex tD A21 IP65 TX	CE 0637 Ex II2G II2D Ex eq II T6...T3 Ex tD A21 IP65 TX	CE 0637 Ex II2G II2D Ex eq II T6...T3 Ex tD A21 IP65 TX
	certification ATEX		IBExU07ATEX1168 X	IBExU07ATEX1168 X	IBExU07ATEX1168 X
	certification IEC Ex		IECEx IBE08.0007 X	IECEx IBE08.0007 X	IECEx IBE08.0007 X
	type of protection		gas: increased safety, powder filling dust: protection by enclosure	gas: increased safety, powder filling dust: protection by enclosure	gas: increased safety, powder filling dust: protection by enclosure
	necessary transducer mounting fixture		Variofix L or Variofix C	Variofix L or Variofix C	Variofix L or Variofix C

Shear Wave Transducers (zone 1, IP 68)

technical type		CDG1LI1	CDK1LI1	CDM2LI1	CDP2LI1
order code		**FSG-NA1TS/ IP68 FSG-NI1TS/IP68**	**FSK-NA1TS/ IP68 FSK-NI1TS/IP68**	**FSM-NA1TS/ IP68 FSM-NI1TS/IP68**	**FSP-NA1TS/ IP68 FSP-NI1TS/IP68**
transducer frequency	MHz	0.2	0.5	1	2
inner pipe diameter d					
min. extended	mm	400	100	50	25
min. recom-mended	mm	500	200	100	50
max. recom-mended	mm	6500	3600	2000	200
max. extended	mm	6500	6500	3400	600
pipe wall thickness					
min.	mm	-	-	-	-
max.	mm	-	-	-	-
material					
housing		PEEK with stain-less steel cap 316Ti (1.4571)	PEEK with stain-less steel cap 316Ti (1.4571)	PEEK with stain-less steel cap 316Ti (1.4571)	PEEK with stain-less steel cap 316Ti (1.4571)
contact surface		PEEK	PEEK	PEEK	PEEK
degree of protec-tion according to EN 60529		IP 68	IP 68	IP 68	IP 68
transducer cable					
type		2550	2550	2550	2550
length	m	12	12	12	12
dimensions					
length l	mm	128.5	128.5	70	70
width b	mm	54	54	32	32
height h	mm	83.5	83.5	46	46
dimensional drawing					
operating temperature					
min.	°C	-40	-40	-40	-40
max.	°C	+100	+100	+100	+100
temperature compensation		x	x	x	x

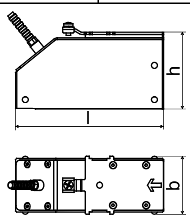
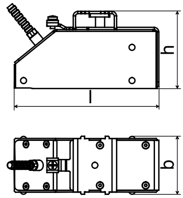
technical type			CDG1LI1	CDK1LI1	CDM2LI1	CDP2LI1
explosion protection						
ATEX / IEC Ex	transducer ATEX		FSG-NA1TS/ IP68	FSK-NA1TS/ IP68	FSM-NA1TS/ IP68	FSP-NA1TS/ IP68
	transducer IEC Ex		FSG-NI1TS/IP68	FSK-NI1TS/IP68	FSM-NI1TS/IP68	FSP-NI1TS/IP68
	zone		1	1	1	1
	explosion protection temperature					
	min.	°C	-55	-55	-55	-55
	max.	°C	+180	+180	+180	+180
	marking		CE 0637 Ex II2G II2D Ex q II T6...T3 Ex tD A21 IP68 TX	CE 0637 Ex II2G II2D Ex q II T6...T3 Ex tD A21 IP68 TX	CE 0637 Ex II2G II2D Ex q II T6...T3 Ex tD A21 IP68 TX	CE 0637 Ex II2G II2D Ex q II T6...T3 Ex tD A21 IP68 TX
	certification ATEX		IBExU07 ATEX1168 X	IBExU07 ATEX1168 X	IBExU07 ATEX1168 X	IBExU07 ATEX1168 X
	certification IEC Ex		IECEx IBE08.0007 X	IECEx IBE08.0007 X	IECEx IBE08.0007 X	IECEx IBE08.0007 X
	type of protection		gas: powder filling dust: protection by enclosure	gas: powder filling dust: protection by enclosure	gas: powder filling dust: protection by enclosure	gas: powder filling dust: protection by enclosure
	necessary transducer mounting fixture		Variofix L or Variofix C	Variofix L or Variofix C	Variofix L or Variofix C	Variofix L or Variofix C

Shear Wave Transducers (zone 1, extended temperature range)

technical type		CDM2E85	CDP2E85	CDQ2E85
order code		**FSM-EA1TS FSM-EA1TS/OS FSM-EI1TS FSM-EI1TS/OS**	**FSP-EA1TS FSP-EA1TS/OS FSP-EI1TS FSP-EI1TS/OS**	**FSQ-EA1TS FSQ-EA1TS/OS FSQ-EI1TS FSQ-EI1TS/OS**
transducer frequency	MHz	1	2	4
inner pipe diameter d				
min. extended	mm	50	25	10
min. recom-mended	mm	100	50	25
max. recom-mended	mm	2000	200	150
max. extended	mm	3400	600	400
pipe wall thickness				
min.	mm	-	-	-
max.	mm	-	-	-
material				
housing		PI with stainless steel cap 304 (1.4301), option OS: 316L (1.4404)	PI with stainless steel cap 304 (1.4301), option OS: 316L (1.4404)	PI with stainless steel cap 304 (1.4301), option OS: 316L (1.4404)
contact surface		PI	PI	PI
degree of protec-tion according to EN 60529		IP 56	IP 56	IP 56
transducer cable				
type		6111	6111	6111
length	m	4	4	3
dimensions				
length l	mm	62.5	62.5	39
width b	mm	32	32	22
height h	mm	40.5	40.5	25.5
dimensional drawing				
operating temperature				
min.	°C	-30	-30	-30
max.	°C	+200	+200	+200
temperature compensation		x	x	x

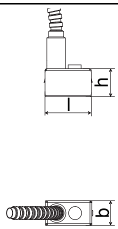
technical type			CDM2E85	CDP2E85	CDQ2E85
explosion protection					
ATEX / IEC Ex	transducer ATEX		FSM-EA1TS FSM-EA1TS/OS	FSP-EA1TS FSP-EA1TS/OS	FSQ-EA1TS FSQ-EA1TS/OS
	transducer IEC Ex		FSM-EI1TS FSM-EI1TS/OS	FSP-EI1TS FSP-EI1TS/OS	FSQ-EI1TS FSQ-EI1TS/OS
	zone		1/2 (gas/dust)	1/2 (gas/dust)	1/2 (gas/dust)
	explosion protection temperature				
	min.	°C	-45	-45	-45
	max.	°C	+225	+225	+225
	marking		CE 0637 Ex II2G II3D Ex eq II T6...T2 Ex tD A22 IP56 TX	CE 0637 Ex II2G II3D Ex eq II T6...T2 Ex tD A22 IP56 TX	CE 0637 Ex II2G II3D Ex eq II T6...T2 Ex tD A22 IP56 TX
	certification ATEX		IBExU07ATEX1168 X	IBExU07ATEX1168 X	IBExU07ATEX1168 X
	certification IEC Ex		IECEx IBE08.0007 X	IECEx IBE08.0007 X	IECEx IBE08.0007 X
	type of protection		gas: increased safety, powder filling dust: protection by enclosure	gas: increased safety, powder filling dust: protection by enclosure	gas: increased safety, powder filling dust: protection by enclosure
	necessary transducer mounting fixture		Variofix L or Variofix C	Variofix L or Variofix C	Variofix L or Variofix C

Shear Wave Transducers (ATEX zone 2, FM or without explosion protection)

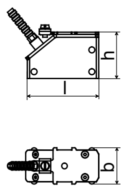
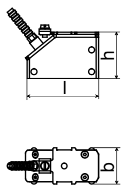
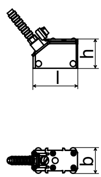
technical type		CDG1N52	CLG1N52	CDK1N52	CLK1N52
order code		**FSG-NA2TS FSG-NA2TS/OS FSG-NF2TS FSG-NF2TS/OS FSG-NNNTS FSG-NNNTS/OS**	**FSG-NA2TS/LC FSG-NA2TS /LC/OS FSG-NF2TS/LC FSG-NF2TS/ LC/OS FSG-NNNTS/LC FSG-NNNTS/ LC/OS**	**FSK-NA2TS FSK-NA2TS/OS FSK-NF2TS FSK-NF2TS/OS FSK-NNNTS FSK-NNNTS/OS**	**FSK-NA2TS/LC FSK-NA2TS/ LC/OS FSK-NF2TS/LC FSK-NF2TS/ LC/OS FSK-NNNTS/LC FSK-NNNTS/ LC/OS**
transducer frequency	MHz	0.2	0.2	0.5	0.5
inner pipe diameter d					
min. extended min. recom-mended max. recom-mended max. extended	mm mm mm mm	400 500 6500 6500	400 500 6500 6500	100 200 3600 6500	100 200 3600 6500
pipe wall thickness					
min. max.	mm mm	- -	- -	- -	- -
material					
housing contact surface		PEEK with stain-less steel cap 304 (1.4301), option OS: 316L (1.4404) PEEK	PEEK with stain-less steel cap 304 (1.4301), option OS: 316L (1.4404) PEEK	PEEK with stain-less steel cap 304 (1.4301), option OS: 316L (1.4404) PEEK	PEEK with stain-less steel cap 304 (1.4301), option OS: 316L (1.4404) PEEK
degree of protec-tion according to EN 60529		IP 67	IP 67	IP 67	IP 67
transducer cable					
type length	 m	1699 5	1699 9	1699 5	1699 9
dimensions					
length l width b height h	mm mm mm	129.5 51 67	129.5 51 67	126.5 51 67.5	126.5 47 55.9
dimensional drawing					
operating temperature					
min. max.	°C °C	-40 +130	-40 +130	-40 +130	-40 +130
temperature compensation		x	x	x	x

technical type			CDG1N52	CLG1N52	CDK1N52	CLK1N52
explosion protection						
ATEX	transducer		FSG-NA2TS FSG-NA2TS/OS	FSG-NA2TS/LC FSG-NA2TS/ LC/OS	FSK-NA2TS FSK-NA2TS/OS	FSK-NA2TS/LC FSK-NA2TS/ LC/OS
	zone		2	2	2	2
	explosion protection temperature					
	min. max.	°C °C	-55 +190	-55 +190	-55 +190	-55 +190
	marking		II3G Ex nA II T6...T3 Ta -55...+190 °C II3D Ex tD A22 IP67 TX	II3G Ex nA II T6...T3 Ta -55...+190 °C II3D Ex tD A22 IP67 TX	II3G Ex nA II T6...T3 Ta -55...+190 °C II3D Ex tD A22 IP67 TX	II3G Ex nA II T6...T3 Ta -55...+190 °C II3D Ex tD A22 IP67 TX
	certification		-	-	-	-
	type of protection		gas: non sparking dust: protection by enclosure	gas: non sparking dust: protection by enclosure	gas: non sparking dust: protection by enclosure	gas: non sparking dust: protection by enclosure
	necessary transducer mounting fixture		Variofix L or Variofix C	Variofix L or Variofix C	Variofix L or Variofix C	Variofix L or Variofix C
FM	transducer		FSG-NF2TS FSG-NF2TS/OS	FSG-NF2TS/LC FSG-NF2TS/ LC/OS	FSK-NF2TS FSK-NF2TS/OS	FSK-NF2TS/LC FSK-NF2TS/ LC/OS
	explosion protection temperature					
	min. max.	°C °C	-40 +125	-40 +125	-40 +125	-40 +125
	marking		NI/Cl. I,II,III/ Div. 2 /GP A,B,C,D,E,F,G/ Temp. Codes dwg 3860	NI/Cl. I,II,III/ Div. 2 /GP A,B,C,D,E,F,G/ Temp. Codes dwg 3860	NI/Cl. I,II,III/ Div. 2 /GP A,B,C,D,E,F,G/ Temp. Codes dwg 3860	NI/Cl. I,II,III/ Div. 2 /GP A,B,C,D,E,F,G/ Temp. Codes dwg 3860
	type of protection		non incendive	non incendive	non incendive	non incendive

Shear Wave Transducers (ATEX zone 2, FM or without explosion protection)

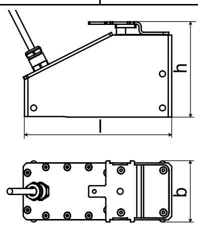
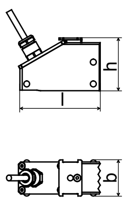
technical type		CDS1N52
order code		**FSS-NF2TS** **FSS-NNNTS**
transducer frequency	MHz	8
inner pipe diameter d		
min. extended	mm	6
min. recommended	mm	10
max. recommended	mm	70
max. extended	mm	70
pipe wall thickness		
min.	mm	-
max.	mm	-
material		
housing		stainless steel 304 (1.4301)
contact surface		PEI
degree of protection according to EN 60529		IP 65
transducer cable		
type		1699
length	m	2
dimensions		
length l	mm	25
width b	mm	13
height h	mm	17
dimensional drawing		
operating temperature		
min.	°C	-30
max.	°C	+130
temperature compensation		x
explosion protection		
FM		
transducer		FSS-NF2TS
explosion protection temperature		
min.	°C	-40
max.	°C	+125
marking		NI/Cl. I,II,III/Div. 2 / GP A,B,C,D,E,F,G/ Temp. Codes dwg 3860
type of protection		non incendive

Shear Wave Transducers (ATEX zone 2, FM or without explosion protection)

technical type		CDM2N52	CDP2N52	CDQ2N52
order code		**FSM-NA2TS** **FSM-NA2TS/OS** **FSM-NF2TS** **FSM-NF2TS/OS** **FSM-NNNTS** **FSM-NNNTS/OS**	**FSP-NA2TS** **FSP-NA2TS/OS** **FSP-NF2TS** **FSP-NF2TS/OS** **FSP-NNNTS** **FSP-NNNTS/OS**	**FSQ-NA2TS** **FSQ-NA2TS/OS** **FSQ-NF2TS** **FSQ-NF2TS/OS** **FSQ-NNNTS** **FSQ-NNNTS/OS**
transducer frequency	MHz	1	2	4
inner pipe diameter d				
min. extended	mm	50	25	10
min. recom-mended	mm	100	50	25
max. recom-mended	mm	2000	200	150
max. extended	mm	3400	600	400
pipe wall thickness				
min.	mm	-	-	-
max.	mm	-	-	-
material				
housing		PEEK with stainless steel cap 304 (1.4301), option OS: 316L (1.4404)	PEEK with stainless steel cap 304 (1.4301), option OS: 316L (1.4404)	PEEK with stainless steel cap 304 (1.4301), option OS: 316L (1.4404)
contact surface		PEEK	PEEK	PEEK
degree of protec-tion according to EN 60529		IP 67	IP 65	IP 65
transducer cable				
type		1699	1699	1699
length	m	4	4	3
dimensions				
length l	mm	62.5	62.5	39
width b	mm	32	32	22
height h	mm	40.5	40.5	25.5
dimensional drawing				
operating temperature				
min.	°C	-40	-40	-40
max.	°C	+130	+130	+130
temperature compensation		x	x	x

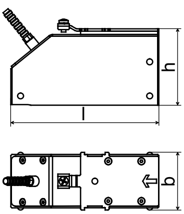
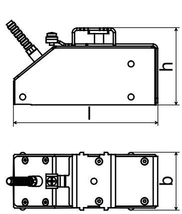
	technical type		CDM2N52	CDP2N52	CDQ2N52
explosion protection					
ATEX	transducer		FSM-NA2TS FSM-NA2TS/OS	FSP-NA2TS FSP-NA2TS/OS	FSQ-NA2TS FSQ-NA2TS/OS
ATEX	zone		2	2	2
ATEX	**explosion protection temperature**				
ATEX	min. max.	°C °C	-55 +190	-55 +190	-55 +190
ATEX	marking		II3G Ex nA II T6...T3 Ta -55...+190 °C II3D Ex tD A22 IP67 TX	II3G Ex nA II T6...T3 Ta -55...+190 °C II3D Ex tD A22 IP67 TX	II3G Ex nA II T6...T3 Ta -55...+190 °C II3D Ex tD A22 IP67 TX
ATEX	certification		-	-	-
ATEX	type of protection		gas: non sparking dust: protection by enclosure	gas: non sparking dust: protection by enclosure	gas: non sparking dust: protection by enclosure
ATEX	necessary transducer mounting fixture		Variofix L or Variofix C	Variofix L or Variofix C	Variofix L or Variofix C
FM	transducer		FSM-NF2TS FSM-NF2TS/OS	FSP-NF2TS FSP-NF2TS/OS	FSQ-NF2TS FSQ-NF2TS/OS
FM	**explosion protection temperature**				
FM	min. max.	°C °C	-55 +190	-55 +190	-55 +190
FM	marking		NI/Cl. I,II,III/ Div. 2 / GP A,B,C,D,E,F,G/ Temp. Codes dwg 3860	NI/Cl. I,II,III/ Div. 2 / GP A,B,C,D,E,F,G/ Temp. Codes dwg 3860	NI/Cl. I,II,III/ Div. 2 / GP A,B,C,D,E,F,G/ Temp. Codes dwg 3860
FM	type of protection		non incendive	non incendive	non incendive

Shear Wave Transducers (ATEX zone 2 or without explosion protection, IP 68)

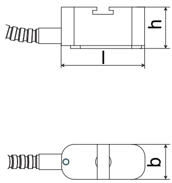
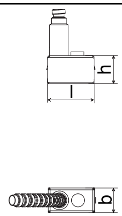
technical type		CDG1LI8	CDK1LI8	CDM2LI8	CDP2LI8
order code		**FSG-NA2TS/ IP68 FSG-NNNTS/ IP68**	**FSK-NA2TS/ IP68 FSK-NNNTS/ IP68**	**FSM-NA2TS/ IP68 FSM-NNNTS/ IP68**	**FSP-NA2TS/ IP68 FSP-NNNTS/ IP68**
transducer frequency	MHz	0.2	0.5	1	2
inner pipe diameter d					
min. extended	mm	400	100	50	25
min. recom-mended	mm	500	200	100	50
max. recom-mended	mm	6500	3600	2000	200
max. extended	mm	6500	6500	3400	600
pipe wall thickness					
min.	mm	-	-	-	-
max.	mm	-	-	-	-
material					
housing		PEEK with stain-less steel cap 316Ti (1.4571)	PEEK with stain-less steel cap 316Ti (1.4571)	PEEK with stain-less steel cap 316Ti (1.4571)	PEEK with stain-less steel cap 316Ti (1.4571)
contact surface		PEEK	PEEK	PEEK	PEEK
degree of protec-tion according to EN 60529		IP 68	IP 68	IP 68	IP 68
transducer cable					
type		2550	2550	2550	2550
length	m	12	12	12	12
dimensions					
length l	mm	128.5	128.5	70	70
width b	mm	54	54	32	32
height h	mm	83.5	83.5	46	46
dimensional drawing					
operating temperature					
min.	°C	-40	-40	-40	-40
max.	°C	+100	+100	+100	+100
temperature compensation		x	x	x	x

<table>
<tr><td colspan="2">technical type</td><td></td><td>CDG1LI8</td><td>CDK1LI8</td><td>CDM2LI8</td><td>CDP2LI8</td></tr>
<tr><td colspan="7">explosion protection</td></tr>
<tr><td rowspan="9">ATEX</td><td>transducer</td><td></td><td>FSG-NA2TS/
IP68</td><td>FSK-NA2TS/
IP68</td><td>FSM-NA2TS/
IP68</td><td>FSP-NA2TS/
IP68</td></tr>
<tr><td>zone</td><td></td><td>2</td><td>2</td><td>2</td><td>2</td></tr>
<tr><td colspan="6">explosion protection temperature</td></tr>
<tr><td>min.</td><td>°C</td><td>-40</td><td>-40</td><td>-40</td><td>-40</td></tr>
<tr><td>max.</td><td>°C</td><td>+90</td><td>+90</td><td>+90</td><td>+90</td></tr>
<tr><td>marking</td><td></td><td>CE Ex
II3G Ex nA II
T6...T5
Ta -40...+90 °C
II3D Ex tD A22
IP68 TX</td><td>CE Ex
II3GEx nA II
T6...T5
Ta -40...+90 °C
II3D Ex tD A22
IP68 TX</td><td>CE Ex
II3G Ex nA II
T6...T5
Ta -40...+90 °C
II3D Ex tD A22
IP68 TX</td><td>CE Ex
II3G Ex nA II
T6...T5
Ta -40...+90 °C
II3D Ex tD A22
IP68 TX</td></tr>
<tr><td>certification</td><td></td><td>-</td><td>-</td><td>-</td><td>-</td></tr>
<tr><td>type of protection</td><td></td><td>gas: non sparking
dust: protection by enclosure</td><td>gas: non sparking
dust: protection by enclosure</td><td>gas: non sparking
dust: protection by enclosure</td><td>gas: non sparking
dust: protection by enclosure</td></tr>
<tr><td>necessary transducer mounting fixture</td><td></td><td>Variofix L or
Variofix C</td><td>Variofix L or
Variofix C</td><td>Variofix L or
Variofix C</td><td>Variofix L or
Variofix C</td></tr>
</table>

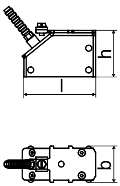
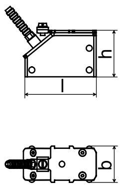
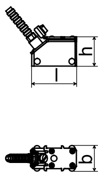
Shear Wave Transducers (connection system AS, without explosion protection)

technical type		CDG1NZ7	CLG1NZ7	CDK1NZ7	CLK1NZ7
order code		**FSG-NNNAS**	**FSG-NNNAS/LC**	**FSK-NNNAS**	**FSK-NNNAS/LC**
transducer frequency	MHz	0.2	0.2	0.5	0.5
inner pipe diameter d					
min. extended	mm	400	400	100	100
min. recom-mended	mm	500	500	200	200
max. recom-mended	mm	6500	6500	3600	3600
max. extended	mm	6500	6500	6500	6500
pipe wall thickness					
min.	mm	-	-	-	-
max.	mm	-	-	-	-
material					
housing		PEEK with stain-less steel cap 304 (1.4301)	PEEK with stain-less steel cap 304 (1.4301)	PEEK with stain-less steel cap 304 (1.4301)	PEEK with stain-less steel cap 304 (1.4301)
contact surface		PEEK	PEEK	PEEK	PEEK
degree of protec-tion according to EN 60529		IP 67	IP 67	IP 67	IP 67
transducer cable					
type		1699	1699	1699	1699
length	m	5	9	5	9
dimensions					
length l	mm	129.5	129.5	126.5	126.5
width b	mm	51	51	51	51
height h	mm	67	67	67.5	67.5
dimensional drawing					
operating temperature					
min.	°C	-40	-40	-40	-40
max.	°C	+130	+130	+130	+130
temperature compensation		x	x	x	x

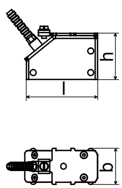
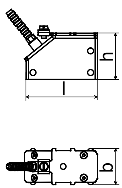
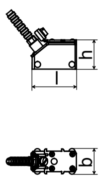
Shear Wave Transducers (connection system AS, without explosion protection)

technical type		CDQ1NZ7	CDS1NZ7
order code		**FSQ-NNNNL**	**FSS-NNNAS**
transducer frequency	MHz	4	8
inner pipe diameter d			
min. extended	mm	10	6
min. recommended	mm	25	10
max. recommended	mm	150	70
max. extended	mm	400	70
pipe wall thickness			
min.	mm	-	-
max.	mm	-	-
material			
housing		stainless steel 304 (1.4301)	stainless steel 304 (1.4301)
contact surface		PEEK	PEI
degree of protection according to EN 60529		IP 67	IP 65
transducer cable			
type		1699	1699
length	m	3	2
dimensions			
length l	mm	42.5	25
width b	mm	18	13
height h	mm	21.5	17
dimensional drawing			
operating temperature			
min.	°C	-40	-30
max.	°C	+130	+130
temperature compensation		x	x

Shear Wave Transducers (connection system AS, without explosion protection)

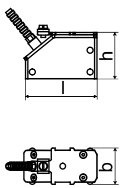
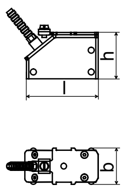
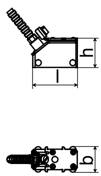
technical type		CDM2NZ7	CDP2NZ7	CDQ2NZ7
order code		**FSM-NNNAS**	**FSP-NNNAS**	**FSQ-NNNAS**
transducer frequency	MHz	1	2	4
inner pipe diameter d				
min. extended	mm	50	25	10
min. recom-mended	mm	100	50	25
max. recom-mended	mm	2000	200	150
max. extended	mm	3400	600	400
pipe wall thickness				
min.	mm	-	-	-
max.	mm	-	-	-
material				
housing		PEEK with stainless steel cap 304 (1.4301)	PEEK with stainless steel cap 304 (1.4301)	PEEK with stainless steel cap 304 (1.4301)
contact surface		PEEK	PEEK	PEEK
degree of protec-tion according to EN 60529		IP 67	IP 67	IP 67
transducer cable				
type		1699	1699	1699
length	m	4	4	3
dimensions				
length l	mm	62.5	62.5	39
width b	mm	32	32	22
height h	mm	40.5	40.5	25.5
dimensional drawing				
operating temperature				
min.	°C	-40	-40	-40
max.	°C	+130	+130	+130
temperature compensation		x	x	x

Shear Wave Transducers (extended temperature range, ATEX zone 2, FM or without explosion protection)

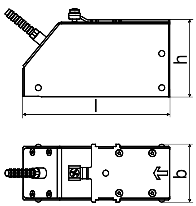
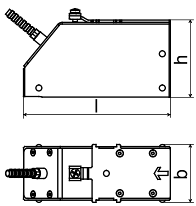
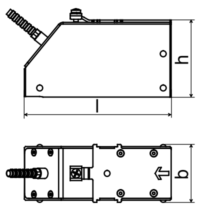
technical type		CDM2E52	CDP2E52	CDQ2E52
order code		**FSM-EA2TS** **FSM-EA2TS/OS** **FSM-EF2TS** **FSM-EF2TS/OS** **FSM-ENNTS** **FSM-ENNTS/OS**	**FSP-EA2TS** **FSP-EA2TS/OS** **FSP-EF2TS** **FSP-EF2TS/OS** **FSP-ENNTS** **FSP-ENNTS/OS**	**FSQ-EA2TS** **FSQ-EA2TS/OS** **FSQ-EF2TS** **FSQ-EF2TS/OS** **FSQ-ENNTS** **FSQ-ENNTS/OS**
transducer frequency	MHz	1	2	4
inner pipe diameter d				
min. extended	mm	50	25	10
min. recom-mended	mm	100	50	25
max. recom-mended	mm	2000	200	150
max. extended	mm	3400	600	400
pipe wall thickness				
min.	mm	-	-	-
max.	mm	-	-	-
material				
housing		PI with stainless steel cap 304 (1.4301), option OS: 316L (1.4404)	PI with stainless steel cap 304 (1.4301), option OS: 316L (1.4404)	PI with stainless steel cap 304 (1.4301), option OS: 316L (1.4404)
contact surface		PI	PI	PI
degree of protec-tion according to EN 60529		IP 56	IP 56	IP 56
transducer cable				
type		6111	6111	6111
length	m	4	4	3
dimensions				
length l	mm	62.5	62.5	39
width b	mm	32	32	22
height h	mm	40.5	40.5	25.5
dimensional drawing				
operating temperature				
min.	°C	-30	-30	-30
max.	°C	+200	+200	+200
temperature compensation		x	x	x

technical type			CDM2E52	CDP2E52	CDQ2E52
explosion protection					
ATEX	transducer		FSM-EA2TS FSM-EA2TS/OS	FSP-EA2TS FSP-EA2TS/OS	FSQ-EA2TS FSQ-EA2TS/OS
ATEX	zone		2	2	2
ATEX	**explosion protection temperature**				
ATEX	min.	°C	-45	-45	-45
ATEX	max.	°C	+235	+235	+235
ATEX	marking		II3G Ex nA II T6...T2 Ta -45...+235 °C II3D Ex tD A22 IP56 TX	II3G Ex nA II T6...T2 Ta -45...+235 °C II3D Ex tD A22 IP56 TX	II3G Ex nA II T6...T2 Ta -45...+235 °C II3D Ex tD A22 IP56 TX
ATEX	certification		-	-	-
ATEX	type of protection		gas: non sparking dust: protection by enclosure	gas: non sparking dust: protection by enclosure	gas: non sparking dust: protection by enclosure
ATEX	necessary transducer mounting fixture		Variofix L or Variofix C	Variofix L or Variofix C	Variofix L or Variofix C
FM	transducer		FSM-EF2TS FSM-EF2TS/OS	FSP-EF2TS FSP-EF2TS/OS	FSQ-EF2TS FSQ-EF2TS/OS
FM	**explosion protection temperature**				
FM	min.	°C	-45	-45	-45
FM	max.	°C	+235	+235	+235
FM	marking		NI/Cl. I,II,III/ Div. 2 / GP A,B,C,D,E,F,G/ Temp. Codes dwg 3860	NI/Cl. I,II,III/ Div. 2 / GP A,B,C,D,E,F,G/ Temp. Codes dwg 3860	NI/Cl. I,II,III/ Div. 2 / GP A,B,C,D,E,F,G/ Temp. Codes dwg 3860
FM	type of protection		non incendive	non incendive	non incendive

Shear Wave Transducers (extended temperature range, without explosion protection, connection system AS)

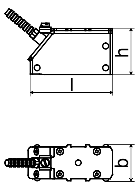
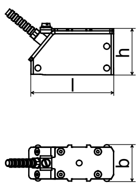
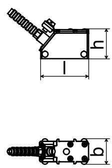
technical type		CDM2EZ7	CDP2EZ7	CDQ2EZ7
order code		**FSM-ENNAS**	**FSP-ENNAS**	**FSQ-ENNAS**
transducer frequency	MHz	1	2	4
inner pipe diameter d				
min. extended	mm	50	25	10
min. recom-mended	mm	100	50	25
max. recom-mended	mm	2000	200	150
max. extended	mm	3400	600	400
pipe wall thickness				
min.	mm	-	-	-
max.	mm	-	-	-
material				
housing		PI with stainless steel cap 304 (1.4301)	PI with stainless steel cap 304 (1.4301)	PI with stainless steel cap 304 (1.4301)
contact surface		PI	PI	PI
degree of protec-tion according to EN 60529		IP 65	IP 65	IP 65
transducer cable				
type		6111	6111	6111
length	m	4	4	3
dimensions				
length l	mm	62.5	62.5	39
width b	mm	32	32	22
height h	mm	40.5	40.5	25.5
dimensional drawing				
operating temperature				
min.	°C	-30	-30	-30
max.	°C	+200	+200	+200
temperature compensation		x	x	x

Lamb Wave Transducers (zone 1)

technical type		CRG1N83	CRH1N83	CRK1N83
order code		**FLG-NA1TS** **FLG-NA1TS/OS** **FLG-NI1TS** **FLG-NI1TS/OS**	**FLH-NA1TS** **FLH-NA1TS/OS** **FLH-NI1TS** **FLH-NI1TS/OS**	**FLK-NA1TS** **FLK-NA1TS/OS** **FLK-NI1TS** **FLK-NI1TS/OS**
transducer frequency	MHz	0.2	0.3	0.5
inner pipe diameter d				
min. extended	mm	500	400	220
min. recom-mended	mm	600	450	250
max. recom-mended	mm	5000	3500	2100
max. extended	mm	6500	5000	4500
pipe wall thickness				
min.	mm	14	9	5
max.	mm	27	18	11
material				
housing		PPSU with stainless steel cap 304 (1.4301), option OS: 316L (1.4404)	PPSU with stainless steel cap 304 (1.4301), option OS: 316L (1.4404)	PPSU with stainless steel cap 304 (1.4301), option OS: 316L (1.4404)
contact surface		PPSU	PPSU	PPSU
degree of protec-tion according to EN 60529		IP 65	IP 65	IP 65
transducer cable				
type		1699	1699	1699
length	m	5	5	5
dimensions				
length l	mm	128.5	128.5	128.5
width b	mm	51	51	51
height h	mm	67.5	67.5	67.5
dimensional drawing				
operating temperature				
min.	°C	-40	-40	-40
max.	°C	+170	+170	+170
temperature compensation		x	x	x

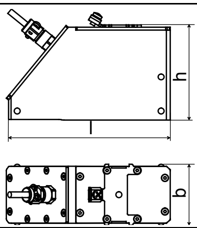
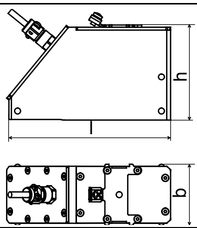
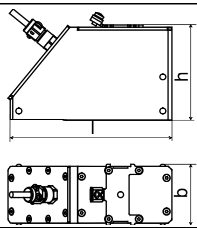
technical type			CRG1N83	CRH1N83	CRK1N83
explosion protection					
ATEX / IEC Ex	transducer ATEX		FLG-NA1TS FLG-NA1TS/OS	FLH-NA1TS FLH-NA1TS/OS	FLK-NA1TS FLK-NA1TS/OS
	transducer IEC Ex		FLG-NI1TS FLG-NI1TS/OS	FLH-NI1TS FLH-NI1TS/OS	FLK-NI1TS FLK-NI1TS/OS
	zone		1	1	1
	explosion protection temperature				
	min.	°C	-55	-55	-55
	max.	°C	+140	+140	+140
	marking		CE 0637 Ex II2G II2D Ex eq II T6...T3 Ex tD A21 IP65 TX	CE 0637 Ex II2G II2D Ex eq II T6...T3 Ex tD A21 IP65 TX	CE 0637 Ex II2G II2D Ex eq II T6...T3 Ex tD A21 IP65 TX
	certification ATEX		IBExU07ATEX1168 X	IBExU07ATEX1168 X	IBExU07ATEX1168 X
	certification IEC Ex		IECEx IBE08.0007 X	IECEx IBE08.0007 X	IECEx IBE08.0007 X
	type of protection		gas: increased safety, powder filling dust: protection by enclosure	gas: increased safety, powder filling dust: protection by enclosure	gas: increased safety, powder filling dust: protection by enclosure
	necessary transducer mounting fixture		Variofix L or Variofix C	Variofix L or Variofix C	Variofix L or Variofix C

Lamb Wave Transducers (Zone 1)

technical type		CRM1N83	CRP1N83	CRQ1N83
order code		**FLM-NA1TS** **FLM-NA1TS/OS** **FLM-NI1TS** **FLM-NI1TS/OS**	**FLP-NA1TS** **FLP-NA1TS/OS** **FLP-NI1TS** **FLP-NI1TS/OS**	**FLQ-NA1TS** **FLQ-NA1TS/OS** **FLQ-NI1TS** **FLQ-NI1TS/OS**
transducer frequency	MHz	1	2	4
inner pipe diameter d				
min. extended	mm	70	40	10
min. recom-mended	mm	120	60	25
max. recom-mended	mm	1000	400	100
max. extended	mm	2000	1000	400
pipe wall thickness				
min.	mm	3	1	0.5
max.	mm	5	3	1
material				
housing		PPSU with stainless steel cap 304 (1.4301), option OS: 316L (1.4404)	PPSU with stainless steel cap 304 (1.4301), option OS: 316L (1.4404)	PPSU with stainless steel cap 304 (1.4301), option OS: 316L (1.4404)
contact surface		PPSU	PPSU	PPSU
degree of protec-tion according to EN 60529		IP 65	IP 65	IP 65
transducer cable				
type		1699	1699	1699
length	m	4	4	3
dimensions				
length l	mm	74	74	42
width b	mm	32	32	22
height h	mm	40.5	40.5	25.5
dimensional drawing				
operating temperature				
min.	°C	-40	-40	-40
max.	°C	+170	+170	+170
temperature compensation		x	x	x

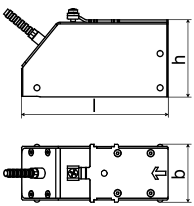
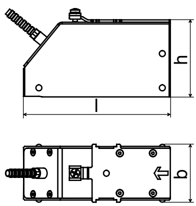
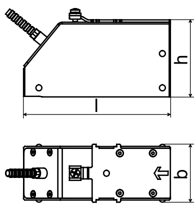
technical type			CRM1N83	CRP1N83	CRQ1N83
explosion protection					
ATEX / IEC Ex	transducer ATEX		FLM-NA1TS FLM-NA1TS/OS	FLP-NA1TS FLP-NA1TS/OS	FLQ-NA1TS FLQ-NA1TS/OS
	transducer IEC Ex		FLM-NI1TS FLM-NI1TS/OS	FLP-NI1TS FLP-NI1TS/OS	FLQ-NI1TS FLQ-NI1TS/OS
	zone		1	1	1
	explosion protection temperature				
	min.	°C	-55	-55	-55
	max.	°C	+140	+140	+140
	marking		CE 0637 Ex II2G II2D Ex eq II T6...T3 Ex tD A21 IP65 TX	CE 0637 Ex II2G II2D Ex eq II T6...T3 Ex tD A21 IP65 TX	CE 0637 Ex II2G II2D Ex eq II T6...T3 Ex tD A21 IP65 TX
	certification ATEX		IBExU07ATEX1168 X	IBExU07ATEX1168 X	IBExU07ATEX1168 X
	certification IEC Ex		IECEx IBE08.0007 X	IECEx IBE08.0007 X	IECEx IBE08.0007 X
	type of protection		gas: increased safety, powder filling dust: protection by enclosure	gas: increased safety, powder filling dust: protection by enclosure	gas: increased safety, powder filling dust: protection by enclosure
	necessary transducer mounting fixture		Variofix L or Variofix C	Variofix L or Variofix C	Variofix L or Variofix C

Lamb Wave Transducers (zone 1, IP 68)

technical type		CRG1LI3	CRH1LI3	CRK1LI3
order code		**FLG-NA1TS/IP68**	**FLH-NA1TS/IP68**	**FLK-NA1TS/IP68**
transducer frequency	MHz	0.2	0.3	0.5
inner pipe diameter d				
min. extended	mm	500	400	220
min. recommended	mm	600	450	250
max. recommended	mm	5000	3500	2100
max. extended	mm	6500	5000	4500
pipe wall thickness				
min.	mm	14	9	5
max.	mm	27	18	11
material				
housing		PPSU with stainless steel cap 316Ti (1.4571)	PPSU with stainless steel cap 316Ti (1.4571)	PPSU with stainless steel cap 316Ti (1.4571)
contact surface		PPSU	PPSU	PPSU
degree of protection according to EN 60529		IP 68	IP 68	IP 68
transducer cable				
type		2550	2550	2550
length	m	12	12	12
dimensions				
length l	mm	143.5	143.5	143.5
width b	mm	54	54	54
height h	mm	83.5	83.5	83.5
dimensional drawing				
operating temperature				
min.	°C	-40	-40	-40
max.	°C	+100	+100	+100
temperature compensation		x	x	x

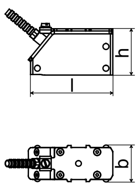
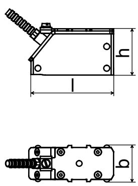
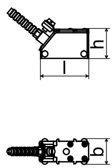
technical type			CRG1LI3	CRH1LI3	CRK1LI3
explosion protection					
ATEX	transducer		FLG-NA1TS/IP68	FLH-NA1TS/IP68	FLK-NA1TS/IP68
	zone		1	1	1
	explosion protection temperature				
	min. max.	°C °C	-55 +140	-55 +140	-55 +140
	marking		CE 0637 Ex II2G II2D Ex q II T6...T3 Ex tD A21 IP68 TX	CE 0637 Ex II2G II2D Ex q II T6...T3 Ex tD A21 IP68 TX	CE 0637 Ex II2G II2D Ex q II T6...T3 Ex tD A21 IP68 TX
	certification		IBExU07ATEX1168 X	IBExU07ATEX1168 X	IBExU07ATEX1168 X
	type of protection		gas: powder filling dust: protection by enclosure	gas: powder filling dust: protection by enclosure	gas: powder filling dust: protection by enclosure
	necessary transducer mounting fixture		Variofix L or Variofix C	Variofix L or Variofix C	Variofix L or Variofix C

Lamb Wave Transducers (ATEX zone 2, FM or without explosion protection)

technical type		CRG1N52	CRH1N52	CRK1N52
order code		**FLG-NA2TS** **FLG-NA2TS/OS** **FLG-NF2TS** **FLG-NF2TS/OS** **FLG-NNNTS** **FLG-NNNTS/OS**	**FLH-NA2TS** **FLH-NA2TS/OS** **FLH-NF2TS** **FLH-NF2TS/OS** **FLH-NNNTS** **FLH-NNNTS/OS**	**FLK-NA2TS** **FLK-NA2TS/OS** **FLK-NF2TS** **FLK-NF2TS/OS** **FLK-NNNTS** **FLK-NNNTS/OS**
transducer frequency	MHz	0.2	0.3	0.5
inner pipe diameter d				
min. extended	mm	500	400	220
min. recom-mended	mm	600	450	250
max. recom-mended	mm	5000	3500	2100
max. extended	mm	6500	5000	4500
pipe wall thickness				
min.	mm	14	9	5
max.	mm	27	18	11
material				
housing		PPSU with stainless steel cap 304 (1.4301), option OS: 316L (1.4404)	PPSU with stainless steel cap 304 (1.4301), option OS: 316L (1.4404)	PPSU with stainless steel cap 304 (1.4301), option OS: 316L (1.4404)
contact surface		PPSU	PPSU	PPSU
degree of protec-tion according to EN 60529		IP 67	IP 67	IP 67
transducer cable				
type		1699	1699	1699
length	m	5	5	5
dimensions				
length l	mm	128.5	128.5	128.5
width b	mm	51	51	51
height h	mm	67.5	67.5	67.5
dimensional drawing				
operating temperature				
min.	°C	-40	-40	-40
max.	°C	+170	+170	+170
temperature compensation		x	x	x

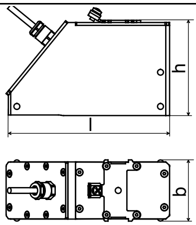
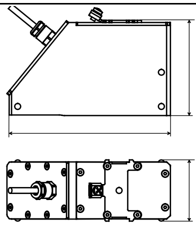
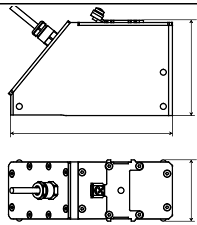
technical type			CRG1N52	CRH1N52	CRK1N52
explosion protection					
ATEX	transducer		FLG-NA2TS FLG-NA2TS/OS	FLH-NA2TS FLH-NA2TS/OS	FLK-NA2TS FLK-NA2TS/OS
	zone		2	2	2
	explosion protection temperature				
	min. max.	°C °C	-55 +150	-55 +150	-55 +150
	marking		II3G Ex nA II T6...T3 Ta -55...+150 °C II3D Ex tD A22 IP67 TX	II3G Ex nA II T6...T3 Ta -55...+150 °C II3D Ex tD A22 IP67 TX	II3G Ex nA II T6...T3 Ta -55...+150 °C II3D Ex tD A22 IP67 TX
	certification		-	-	-
	type of protection		gas: non sparking dust: protection by enclosure	gas: non sparking dust: protection by enclosure	gas: non sparking dust: protection by enclosure
	necessary transducer mounting fixture		Variofix L or Variofix C	Variofix L or Variofix C	Variofix L or Variofix C
FM	transducer		FLG-NF2TS FLG-NF2TS/OS	FLH-NF2TS FLH-NF2TS/OS	FLK-NF2TS FLK-NF2TS/OS
	explosion protection temperature				
	min. max.	°C °C	-40 +165	-40 +165	-40 +165
	marking		NI/Cl. I,II,III/ Div. 2 / GP A,B,C,D,E,F,G/ Temp. Codes dwg 3860	NI/Cl. I,II,III/ Div. 2 / GP A,B,C,D,E,F,G/ Temp. Codes dwg 3860	NI/Cl. I,II,III/ Div. 2 / GP A,B,C,D,E,F,G/ Temp. Codes dwg 3860
	type of protection		non incendive	non incendive	non incendive

Lamb Wave Transducers (ATEX zone 2, FM or without explosion protection)

technical type		CRM1N52	CRP1N52	CRQ1N52
order code		**FLM-NA2TS FLM-NA2TS/OS FLM-NF2TS FLM-NF2TS/OS FLM-NNNTS FLM-NNNTS/OS**	**FLP-NA2TS FLP-NA2TS/OS FLP-NF2TS FLP-NF2TS/OS FLP-NNNTS FLP-NNNTS/OS**	**FLQ-NA2TS FLQ-NA2TS/OS FLQ-NF2TS FLQ-NF2TS/OS FLQ-NNNTS FLQ-NNNTS/OS**
transducer frequency	MHz	1	2	4
inner pipe diameter d				
min. extended	mm	70	40	10
min. recom-mended	mm	120	60	25
max. recom-mended	mm	1000	400	100
max. extended	mm	2000	1000	400
pipe wall thickness				
min.	mm	3	1	0.5
max.	mm	5	3	1
material				
housing		PPSU with stainless steel cap 304 (1.4301), option OS: 316L (1.4404)	PPSU with stainless steel cap 304 (1.4301), option OS: 316L (1.4404)	PPSU with stainless steel cap 304 (1.4301), option OS: 316L (1.4404)
contact surface		PPSU	PPSU	PPSU
degree of protec-tion according to EN 60529		IP 65	IP 65	IP 65
transducer cable				
type		1699	1699	1699
length	m	4	4	3
dimensions				
length l	mm	74	74	42
width b	mm	32	32	22
height h	mm	40.5	40.5	25.5
dimensional drawing				
operating temperature				
min.	°C	-40	-40	-40
max.	°C	+170	+170	+170
temperature compensation		x	x	x

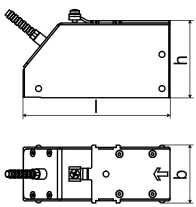
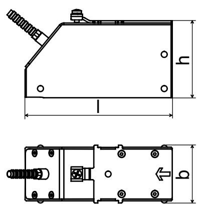
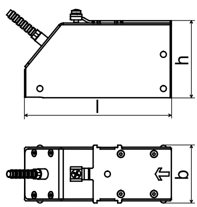
	technical type		CRM1N52	CRP1N52	CRQ1N52
explosion protection					
ATEX	transducer		FLM-NA2TS FLM-NA2TS/OS	FLP-NA2TS FLP-NA2TS/OS	FLQ-NA2TS FLQ-NA2TS/OS
ATEX	zone		2	2	2
ATEX	**explosion protection temperature**				
ATEX	min. max.	°C °C	-55 +150	-55 +150	-55 +150
ATEX	marking		II3G Ex nA II T6...T3 Ta -55...+150 °C II3D Ex tD A22 IP67 TX	II3G Ex nA II T6...T3 Ta -55...+150 °C II3D Ex tD A22 IP67 TX	II3G Ex nA II T6...T3 Ta -55...+150 °C II3D Ex tD A22 IP67 TX
ATEX	certification		-	-	-
ATEX	type of protection		gas: non sparking dust: protection by enclosure	gas: non sparking dust: protection by enclosure	gas: non sparking dust: protection by enclosure
ATEX	necessary transducer mounting fixture		Variofix L or Variofix C	Variofix L or Variofix C	Variofix L or Variofix C
FM	transducer		FLM-NF2TS FLM-NF2TS/OS	FLP-NF2TS FLP-NF2TS/OS	FLQ-NF2TS FLQ-NF2TS/OS
FM	**explosion protection temperature**				
FM	min. max.	°C °C	-55 +165	-55 +165	-55 +165
FM	marking		NI/Cl. I,II,III/Div. 2 / GP A,B,C,D,E,F,G/ Temp. Codes dwg 3860	NI/Cl. I,II,III/Div. 2 / GP A,B,C,D,E,F,G/ Temp. Codes dwg 3860	NI/Cl. I,II,III/Div. 2 / GP A,B,C,D,E,F,G/ Temp. Codes dwg 3860
FM	type of protection		non incendive	non incendive	non incendive

Lamb Wave Transducers (ATEX zone 2 or without explosion protection, IP 68)

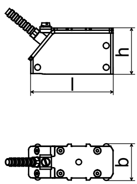
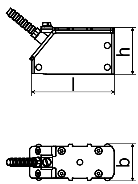
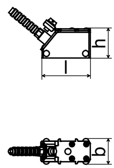
technical type		CRG1LI8	CRH1LI8	CRK1LI8
order code		**FLG-NA2TS/IP68** **FLG-NNNTS/IP68**	**FLH-NA2TS/IP68** **FLH-NNNTS/IP68**	**FLK-NA2TS/IP68** **FLK-NNNTS/IP68**
transducer frequency	MHz	0.2	0.3	0.5
inner pipe diameter d				
min. extended	mm	500	400	220
min. recom-mended	mm	600	450	250
max. recom-mended	mm	5000	3500	2100
max. extended	mm	6500	5000	4500
pipe wall thickness				
min.	mm	14	9	5
max.	mm	27	18	11
material				
housing		PPSU with stainless steel cap 316Ti (1.4571)	PPSU with stainless steel cap 316Ti (1.4571)	PPSU with stainless steel cap 316Ti (1.4571)
contact surface		PPSU	PPSU	PPSU
degree of protec-tion according to EN 60529		IP 68	IP 68	IP 68
transducer cable				
type		2550	2550	2550
length	m	12	12	12
dimensions				
length l	mm	143.5	143.5	143.5
width b	mm	54	54	54
height h	mm	83.5	83.5	83.5
dimensional drawing				
operating temperature				
min.	°C	-40	-40	-40
max.	°C	+100	+100	+100
temperature compensation		x	x	x

technical type			CRG1LI8	CRH1LI8	CRK1LI8
explosion protection					
ATEX	transducer		FLG-NA2TS/IP68	FLH-NA2TS/IP68	FLK-NA2TS/IP68
	zone		2	2	2
	explosion protection temperature				
	min. max.	°C °C	-40 +90	-40 +90	-40 +90
	marking		CE Ex II3G Ex nA II T6...T5 Ta -40...+90 °C II3D Ex tD A22 IP68 TX	CE Ex II3G Ex nA II T6...T5 Ta -40...+90 °C II3D Ex tD A22 IP68 TX	CE Ex II3G Ex nA II T6...T5 Ta -40...+90 °C II3D Ex tD A22 IP68 TX
	certification		-	-	-
	type of protection		gas: non sparking dust: protection by enclosure	gas: non sparking dust: protection by enclosure	gas: non sparking dust: protection by enclosure
	necessary transducer mounting fixture		Variofix L or Variofix C	Variofix L or Variofix C	Variofix L or Variofix C

Lamb Wave Transducers (without explosion protection, connection system AS)

technical type		CRG1NC3	CRH1NC3	CRK1NC3
order code		**FLG-NNNAS**	**FLH-NNNAS**	**FLK-NNNAS**
transducer frequency	MHz	0.2	0.3	0.5
inner pipe diameter d				
min. extended	mm	500	400	220
min. recom-mended	mm	600	450	250
max. recom-mended	mm	5000	3500	2100
max. extended	mm	6500	5000	4500
pipe wall thickness				
min.	mm	14	9	5
max.	mm	27	18	11
material				
housing		PPSU with stainless steel cap 304 (1.4301)	PPSU with stainless steel cap 304 (1.4301)	PPSU with stainless steel cap 304 (1.4301)
contact surface		PPSU	PPSU	PPSU
degree of protec-tion according to EN 60529		IP 65	IP 65	IP 65
transducer cable				
type		1699	1699	1699
length	m	5	5	5
dimensions				
length l	mm	128.5	128.5	128.5
width b	mm	51	51	51
height h	mm	67.5	67.5	67.5
dimensional drawing				
operating temperature				
min.	°C	-40	-40	-40
max.	°C	+170	+170	+170
temperature compensation		x	x	x

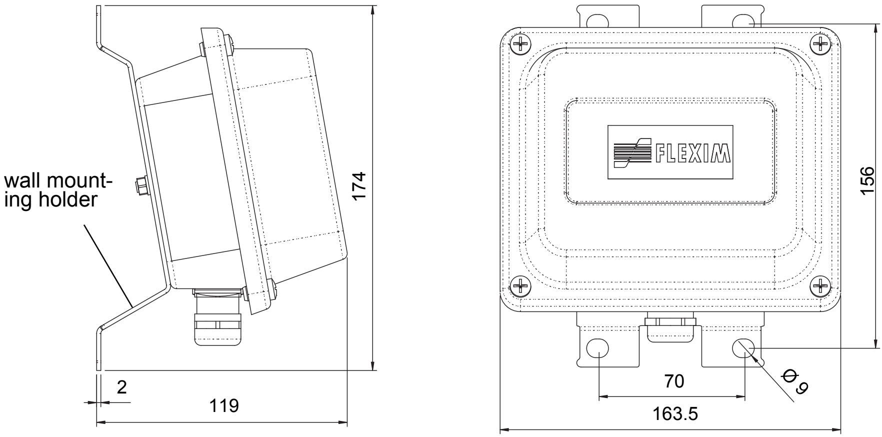
Lamb Wave Transducers (without explosion protection, connection system AS)

technical type		CRM1NC3	CRP1NC3	CRQ1NC3
order code		**FLM-NNNAS**	**FLP-NNNAS**	**FLQ-NNNAS**
transducer frequency	MHz	1	2	4
inner pipe diameter d				
min. extended	mm	70	40	10
min. recom-mended	mm	120	60	25
max. recom-mended	mm	1000	400	100
max. extended	mm	2000	1000	400
pipe wall thickness				
min.	mm	3	1	0.5
max.	mm	5	3	1
material				
housing		PPSU with stainless steel cap 304 (1.4301)	PPSU with stainless steel cap 304 (1.4301)	PPSU with stainless steel cap 304 (1.4301)
contact surface		PPSU	PPSU	PPSU
degree of protec-tion according to EN 60529		IP 65	IP 65	IP 65
transducer cable				
type		1699	1699	1699
length	m	4	4	3
dimensions				
length l	mm	74	74	42
width b	mm	32	32	22
height h	mm	40.5	40.5	25.5
dimensional drawing				
operating temperature				
min.	°C	-40	-40	-40
max.	°C	+170	+170	+170
temperature compensation		x	x	x

Junction Box

technical type		JB01S4E3M	JB02	JB03	JBP2	JBP3
dimensions		see dimensional drawing	see dimensional drawing	see dimensional drawing	see dimensional drawing	see dimensional drawing
fixation		wall mounting optional: 2 " pipe mounting	wall mounting optional: 2 " pipe mounting	wall mounting optional: 2 " pipe mounting	wall mounting optional: 2 " pipe mounting	wall mounting optional: 2 " pipe mounting
material						
housing		stainless steel 316L (1.4404)	stainless steel 304 (1.4301) option OS: 316L (1.4404)	stainless steel 304 (1.4301) option OS: 316L (1.4404)	stainless steel 316L (1.4404)	stainless steel 316L (1.4404)
gasket		silicone	silicone	silicone	silicone	silicone
degree of protection according to EN 60529		IP 67	IP 67	IP 67	IP 67	IP 67
cable gland		M20	M20	M20	M20	M20
operating temperature						
min.	°C	-40	-40	-40	-40	-40
max.	°C	+80	+80	+80	+80	+80
explosion protection						
ATEX / IECEx zone		1	2	-	2	-
marking		CE 0637 Ex II2G II2D Ex e mb II (T6)...T4 Ta -40...+(70)80 °C Ex tD A21 IP67 T 100 °C	CE Ex I3G Ex nA II T6...T4 T_a -40...+80 °C II3D Ex tD A22 IP67 T 100 °C	-	CE Ex II3G Ex nA II T6...T4 T_a -40...+80 °C II3D Ex tD A22 IP67 T 100 °C	-
certification ATEX		IBExU06ATE X1161	-	-	-	-
certification IEC Ex		IECEx IBE08.0006	-	-	-	-
type of protection		junction box: increased safety decoupled network: encapsulation	non sparking, protection by enclosure	-	non sparking, protection by enclosure	-

Dimensions

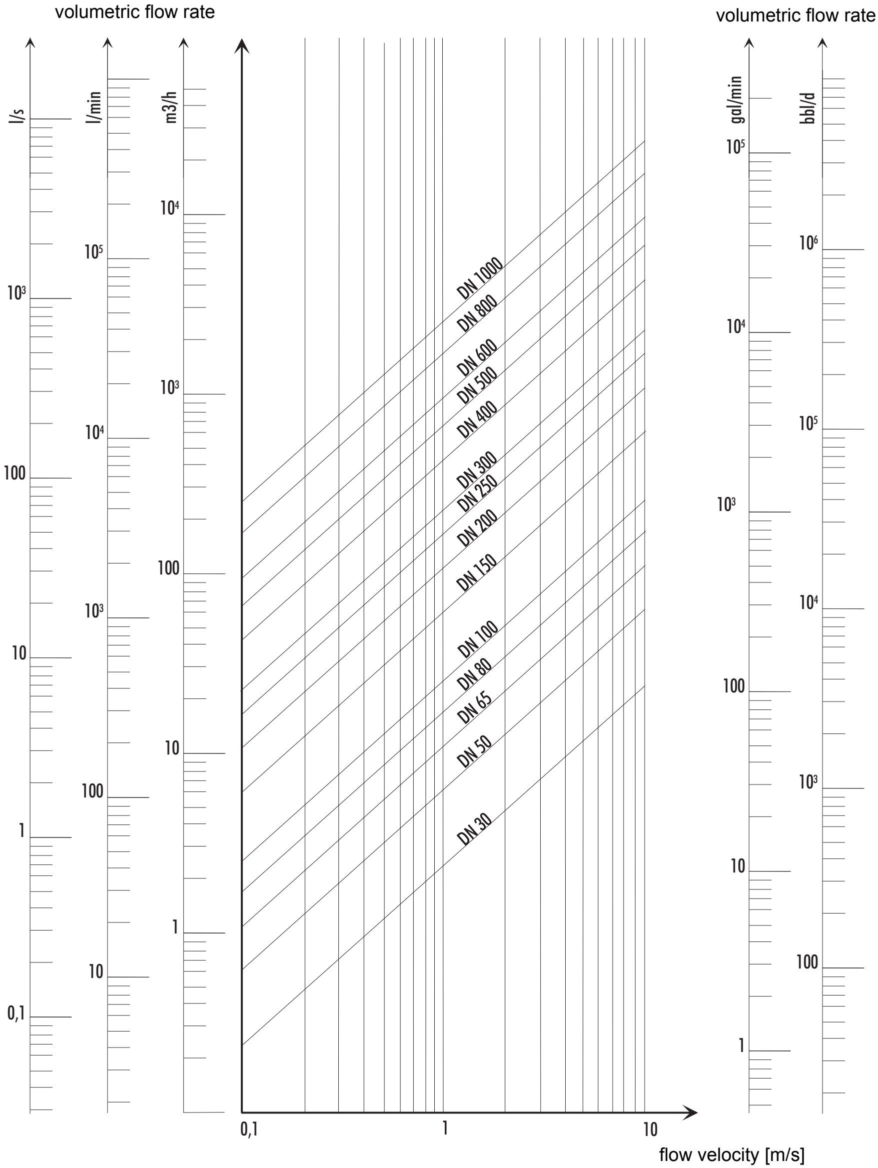


Units of Measurement

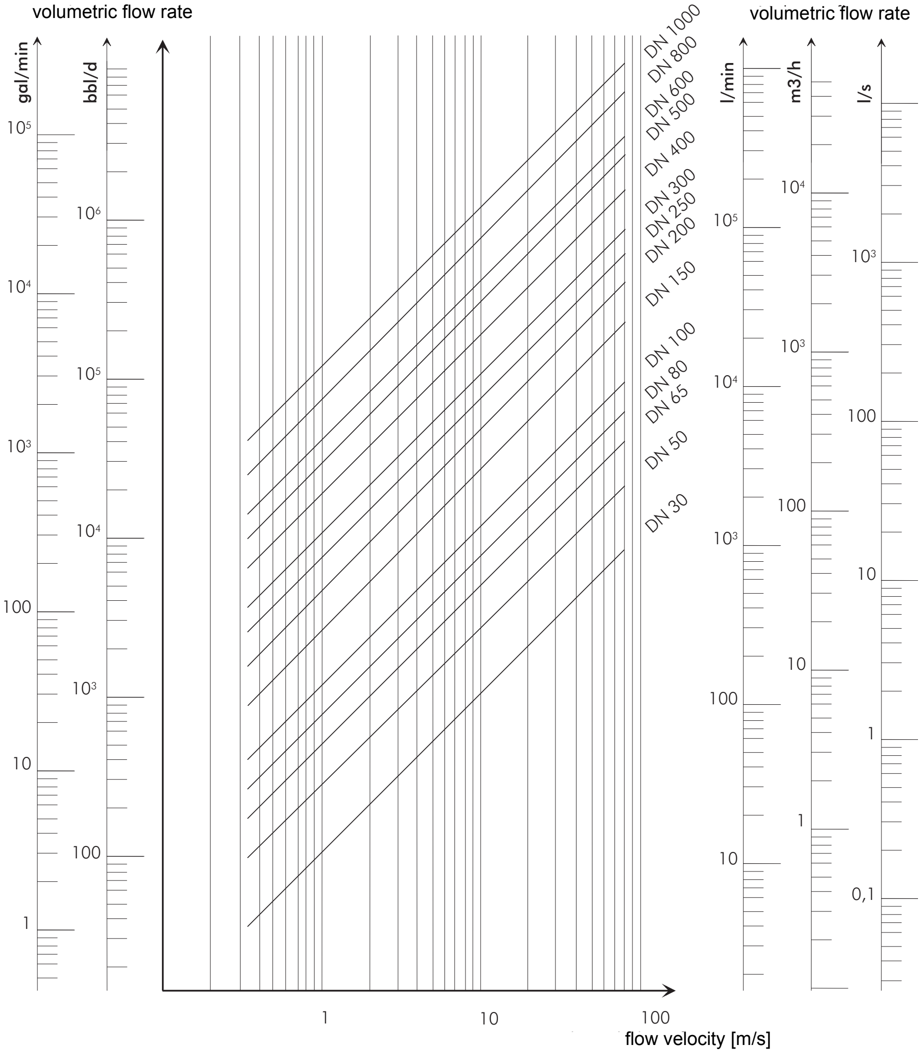
volumetric flow rate	flow velocity	mass flow rate	totalizers volume	totalizers mass	sound velocity	heat quantity	heat flow
m^3/d	m/s	kg/h	m^3	g	m/s	J	kW
m^3/h	cm/s	kg/min	l	kg		Wh	
m^3/min	inch/s	g/s	gal	t			
m^3/s	fps	t/d					
ml/min		t/h					
l/h		lb/d					
l/min		lb/h					
l/s		lb/min					
hl/h		lb/s					
hl/min							
hl/s							
Ml/d							
bbl/d							
bbl/h							
bbl/m							
USgpd							
USgph							
USgpm							
USgps							
MGD							
CFD							
CFH							
CFM							
CFS							

1 US gallon = 3.78 l
1 barrel = 42 US gallons = 158.76 l

Flow Nomogram (metrical)



Flow Nomogram (imperial)



C Reference

The following tables provide assistance for the user. The accuracy of the data depends on the composition, the temperature and the manufacturing process of the material. FLEXIM does not assume liability for any inaccuracies.

Table C.1: Sound Velocity of Selected Pipe and Lining Materials at 20 °C

The values of some of these materials are stored in the internal database of the transmitter. Column c_{flow} shows the sound velocity (longitudinal or transversal) used for the flow measurement.

material	c_{trans} [m/s]	c_{long} [m/s]	c_{flow}	material	c_{trans} [m/s]	c_{long} [m/s]	c_{flow}
aluminum	3 100	6 300	trans	platinum	1 670		trans
asbestos cement	2 200		trans	polyethylene	925		trans
lead	700	2 200	trans	polystyrene	1 150		trans
bitumen	2 500		trans	PP	2 600		trans
brass	2 100	4 300	trans	PVC		2 395	long
carbon steel	3 230	5 800	trans	PVC (hard)	948		trans
copper	2 260	4 700	trans	PVDF	760	2 050	long
Cu-Ni-Fe	2 510		trans	quartz glass	3 515		trans
ductile iron	2 650		trans	rubber	1 900	2 400	trans
glass	3 400	4 700	trans	silver	1 590		trans
grey cast iron	2 650	4 600	trans	Sintimid		2 472	long
PE		1 950	long	stainless steel	3 230	5 790	trans
Perspex	1 250	2 730	long	Teka PEEK		2 537	long
PFA		1 185	long	Tekason		2 230	long
plastics	1 120	2 000	long	titanium	3 067	5 955	trans

The sound velocity depends on the composition and the manufacturing process of the material.

The sound velocity of alloys and cast materials fluctuates strongly. The values only serve as an orientation.

Table C.2: Typical Roughnesses of Pipes

The values are based on experience and measurements.

material	absolute roughness [mm]
drawn pipes of non-ferrous metal, glass, plastics and light metal	0…0.0015
drawn steel pipes	0.01…0.05
fine-planed, polished surface	max. 0.01
planed surface	0.01…0.04
rough-planed surface	0.05…0.1
welded steel pipes, new	0.05…0.1
after long use, cleaned	0.15…0.2
moderately rusted, slightly encrusted	max. 0.4
heavily encrusted	max. 3
cast iron pipes:	
bitumen lining	> 0.12
new, without lining	0.25…1
rusted	1…1.5
encrusted	1.5…3

Table C.3: Typical Properties of Selected Media at 20 °C and 1 bar

medium	sound velocity [m/s]	kinematic viscosity [mm^2/s]	density [g/cm^3]
acetone	1 190	0.4	0.7300
ammonia (NH_3)	1 386	0.2	0.6130
gasoline	1 295	0.7	0.8800
beer	1 482	1.0	0.9980
BP Transcal LT	1 365	20.1	0.8760
BP Transcal N	1 365	94.3	0.8760
diesel	1 210	7.1	0.8260
ethanol	1 402	1.5	0.7950
hydrofluoric acid 50 %	1 221	1.0	0.9980
hydrofluoric acid 80 %	777	1.0	0.9980
glycol	1 665	18.6	1.1100
20 % glycol/H_2O	1 655	1.7	1.0280
30 % glycol/H_2O	1 672	2.2	1.0440
40 % glycol/H_2O	1 688	3.3	1.0600
50 % glycol/H_2O	1 705	4.1	1.0750
ISO VG 100	1 487	314.2	0.8690
ISO VG 150	1 487	539.0	0.8690
ISO VG 22	1 487	50.2	0.8690
ISO VG 220	1 487	811.1	0.8690
ISO VG 32	1 487	78.0	0.8690
ISO VG 46	1 487	126.7	0.8730
ISO VG 68	1 487	201.8	0.8750
methanol	1 119	0.7	0.7930
milk	1 482	5.0	1.0000
Mobiltherm 594	1 365	7.5	0.8730
Mobiltherm 603	1 365	55.2	0.8590
NaOH 10 %	1 762	2.5	1.1140
NaOH 20 %	2 061	4.5	1.2230
paraffin 248	1 468	195.1	0.8450
R134 Freon	522	0.2	1.2400
R22 Freon	558	0.1	1.2130
crude oil, light	1 163	14.0	0.8130
crude oil, heavy	1 370	639.5	0.9220
sulphuric acid 30 %	1 526	1.4	1.1770
sulphuric acid 80 %	1 538	13.0	1.7950
sulphuric acid 96 %	1 366	11.5	1.8350
juice	1 482	1.0	0.9980
hydrochloric acid 25 %	1 504	1.0	1.1180
hydrochloric acid 37 %	1 511	1.0	1.1880
sea water	1 522	1.0	1.0240
Shell Thermina B	1 365	89.3	0.8630
silicone oil	1 019	14 746.6	0.9660
SKYDROL 500-B4	1 387	21.9	1.0570
SKYDROL 500-LD4	1 387	21.9	1.0570
Water	1 482	1.0	0.9990

Table C.4: Properties of Water at 1 bar and at Saturation Pressure

medium temperature [°C]	medium pressure [bar]	density [kg/m^3]	specific heat capacity* [kJ/kg/K-1]
0	1	999.8	4.218
10	1	999.7	4.192
20	1	998.3	4.182
30	1	995.7	4.178
40	1	992.3	4.178
50	1	988.0	4.181
60	1	983.2	4.184
70	1	977.7	4.190
80	1	971.6	4.196
90	1	965.2	4.205
100	1.013	958.1	4.216
120	1.985	942.9	4.245
140	3.614	925.8	4.285
160	6.181	907.3	4.339
180	10.027	886.9	4.408
200	15.55	864.7	4.497
220	23.20	840.3	4.613
240	33.48	813.6	4.769
260	46.94	784.0	4.983
280	64.20	750.5	5.29
300	85.93	712.2	5.762
320	112.89	666.9	6.565
340	146.05	610.2	8.233
360	186.75	527.5	14.58
374.15	221.20	315.5	∞

* at constant pressure

Table C.5: Chemical Resistance of Autotex

Autotex (keyboard) is resistant according to DIN 42115, part 2 against the following chemicals for a contact time of more than 24 h without visible changes:

- ethanol
- cyclohexanol
- diacetone alcohol
- glycol
- isopropanol
- glycerine
- methanol
- triacetin
- Dowandol DRM/PM
- acetone
- methyl-ethyl-ketone
- Dioxan
- cyclohexanone
- MIBK
- isophorone
- ammonia < 40 %
- soda lye < 40 %
- potassium hydroxide < 30 %
- alcalicarbonate
- bichromate
- potassium hexacyanoferrates
- acetonitrile
- sodium bisulfate
- formaldehyde 37…42 %
- acetaldehyde
- aliphatic hydrocarbons
- Toluol
- Xylol
- diluent (white spirit)
- formic acid < 50 %
- acetic acid < 50 %
- phosphoric acid < 30 %
- hydrochloric acid < 36 %
- nitric acid < 10 %
- trichloroacetic acid < 50 %
- sulphuric acid < 10 %
- drilling emulsion
- diesel oil
- varnish
- paraffin oil
- castor oil
- silicone oil
- turpentine oil substitute
- Dccon
- plane fuel
- gasoline
- Water
- saltwater
- 1,1,1-trichlorethane
- ethyl acetate
- diethyl ether
- N-butyl acetate
- amyl acetate
- butylcellosolve
- ether
- chlornatron < 20 %
- hydrogen peroxide < 25 %
- potash soft soap
- detergent
- tensides
- softener
- iron chloride ($FeCl_2$)
- iron chloride ($FeCl_3$)
- dibutyl phthalate
- dioctyl phthalate
- sodium carbonate

Autotex is resistant according to DIN 42115, part 2 to acetic acid for a contact time <1 h without visible damage.

Autotex is not resistant to following chemicals:

- concentrated mineral acids
- concentrated alkaline solutions
- high pressure steam > 100 °C
- benzyl alcohol
- methylene chloride

D Certificates

CE

FLEXIM

Declaration of conformity

We,

FLEXIM Flexible Industriemesstechnik GmbH
Wolfener Str. 36
12681 Berlin
Germany,

declare under our sole responsibility that the ultrasonic flowmeters

FLUXUS G704 A2, FLUXUS ADM 7407 A2

to which this declaration relates are in conformity with the following EC directives:

EMC Directive 2004/108/EC for Electromagnetic Compatibility

Low Voltage Directive 2006/95/EC for Electrical Safety

Directive 94/9/EC - Safety Requirements for Control Systems and Equipment for Use in Explosive Atmospheres according to annex VIII

The ultrasonic flowmeters are in conformity with the following European Standards:

Class	Standard	Description
EMC Directive	EN 61326-1:2006	Electrical equipment for measurement, control and laboratory use - EMC requirements - General requirements
- Immunity	EN 61326-1	Electrical equipment for continuous, unattended operation
	EN 61000-4-2:1995 +A1:1998+A2:2001	Testing and measurement techniques - Electrostatic discharge immunity test
	EN 61000-4-3:2003	Testing and measurement techniques - Radiated, radio-frequency, electromagnetic field immunity test
	EN 61000-4-4:2005	Testing and measurement techniques - Electrical fast transient/burst immunity test
	EN 61000-4-5:2007	Testing and measurement techniques - Surge immunity test
	EN 61000-4-6:2002	Testing and measurement techniques - Immunity to conducted disturbances, induced by radio-frequency fields
	EN 61000-4-11:2005	Testing and measurement techniques - Voltage dips, short interruptions and voltage variations immunity tests
- Emission	EN 61326-1:2007	Electrical equipment Class A
Low Voltage Directive	EN 61010-1:2002	Safety requirements for electrical equipment for measurement, control, and laboratory use - General requirements
- Isolation		Pollution degree 2
		Overvoltage category 2
		Safety class 1

(continuation on verso)

FLEXIM Flexible Industriemesstechnik GmbH · Wolfener Straße 36 · 12681 Berlin
Tel. +49 (0)30 93 66 76 60 · Fax +49 (0)30 93 66 76 80

Class	Standard	Description
ATEX95	EN 60079-0:2006	Electrical apparatus for explosive gas atmospheres - General requirements
	EN 60079-15:2005	Electrical apparatus for explosive gas atmospheres - Construction, test and marking of type of protection "n" electrical apparatus
	EN 61241-0:2006	Electrical apparatus for use in the presence of combustible dust - General requirements
	EN 61241-1:2004	Electrical apparatus for use in the presence of combustible dust - Protection by enclosures "tD"

The ultrasonic flowmeters have to be marked as follows:

⟨Ex⟩ II3G Ex nA II T4 Ta -20...+60°C

⟨Ex⟩ II3D Ex tD A22 IP65 T 100°C

The installation, operating and safety instructions have to be observed!

Berlin, 2009-09-23

Dipl.-Ing. Jens Hilpert
Managing Director

FLEXIM Flexible Industriemesstechnik GmbH · Wolfener Straße 36 · 12681 Berlin
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CE

FLEXIM

Declaration of conformity

We

FLEXIM Flexible Industriemesstechnik GmbH
Wolfener Str. 36
12681 Berlin
Germany,

declare under our sole responsibility that the ultrasonic flowmeters

FLUXUS ADM 7207, FLUXUS ADM 7407, FLUXUS ADM 7807, FLUXUS ADM 7907, FLUXUS G704, FLUXUS G709

to which this declaration relates are in conformity with the EC directives

EMC Directive 2004/108/EC for Electromagnetic Compatibility
Low Voltage Directive 2006/95/EC for Electrical Safety.

The ultrasonic flowmeters are in conformity with the following European Standards:

Class	Standard	Description
EMC Directive	EN 61326-1:2006	Electrical equipment for measurement, control and laboratory use - EMC requirements
- Immunity	EN 61326-1	Electrical equipment for continuous, unattended operation
	EN 61000-4-2:1995 +A1:1998+A2:2001	Testing and measurement techniques; Electrostatic Discharge Immunity
	EN 61000-4-3:2003	Testing and measurement techniques; RF Field Immunity
	EN 61000-4-4:2005	Testing and measurement techniques; Electrical Fast Transient / Burst Immunity
	EN 61000-4-5:2007	Testing and measurement techniques; Surge Immunity Test
	EN 61000-4-6:2002	Testing and measurement techniques; RF Conducted Immunity
	EN 61000-4-11:2005	Testing and measurement techniques; AC Mains Voltage Dips and Interruption Immunity
- Emission	EN 61326-1:2007	Electrical equipment Class A
Low Voltage Directive	EN 61010-1:2002	Safety requirements for electrical equipment for measurement, control and laboratory use
- Isolation		Pollution degree 2
		Overvoltage category 2
		Safety class 1

The installation, operating and safety instructions have to be observed!

Berlin, 03/02/2009

i.A. Sudaus

Dipl.-Ing. Jens Hilpert
Managing Director

FLEXIM Flexible Industriemesstechnik GmbH · Wolfener Straße 36 · 12681 Berlin
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FLEXIM

Declaration of conformity

We,

FLEXIM Flexible Industriemesstechnik GmbH

Wolfener Str. 36

12681 Berlin

Germany,

declare under our sole responsibility that the junction box

JB01SaE3b

is in conformity with the following EC directives:

Directive 94/9/EC - Safety Requirements for Control Systems and Equipment for Use in Explosive Atmospheres.

The junction box mentioned above is in conformity with the following European Standards:

Class	Standard	Description
ATEX95	EN 60079-0:2004	Electrical apparatus for explosive gas atmospheres - General requirements
	EN 60079-7:2003	Electrical apparatus for explosive gas atmospheres - Increased safety "e"
	EN 60079-18:2004	Electrical apparatus for explosive gas atmospheres - Construction, test and marking of type of protection encapsulation "m" electrical apparatus
	EN 61241-0:2006	Electrical apparatus for use in the presence of combustible dust - General requirements
	EN 61241-1:2004	Electrical apparatus for use in the presence of combustible dust - Protection by enclosures "tD"

The conformity with the directive 94/9/EC was certificated in the following documents of the notified body IBExU Institut für Sicherheitstechnik GmbH (ID No. 0637):

Document type	Object	Document number
EC Type examination certificate	Junction box JB01SaE3b	IBExU06ATEX1161

FLEXIM Flexible Industriemesstechnik GmbH · Wolfener Straße 36 · 12681 Berlin
Tel. +49 (0)30 93 66 76 60 · Fax +49 (0)30 93 66 76 80

FLEXIM GmbH has a quality assurance system which complies to annex IV of the directive 94/9/EC.
The quality assurance system was certified by the notified body
IBExU Institut für Sicherheitstechnik GmbH (ID No. 0637):

Document type	Description	Document number
Declaration	Acknowledgement of the quality assurance system	IBExU11ATEX Q001

The marking of the junction box includes the following:

CE 0637 Ex II2G II2D

Ex e mb II (T6)...T4 Ta -40...+(70)80 °C

Ex tD A21 IP67 T 100 °C

The installation, operating and safety instructions have to be observed!

Berlin, 2011-03-16

Dipl.-Ing. Jens Hilpert
Managing Director

FLEXIM Flexible Industriemesstechnik GmbH · Wolfener Straße 36 · 12681 Berlin
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FLEXIM

Declaration of conformity

We,

FLEXIM Flexible Industriemesstechnik GmbH
Wolfener Str. 36
12681 Berlin
Germany,

declare under our sole responsibility that the junction boxes

JB02, JBT2 and JBP2

conform to the requirements for use in explosive atmosphere
according to annex VIII of the

Directive 94/9/EC - Safety Requirements for Control Systems and Equipment for Use in Explosive Atmospheres.

The junction boxes mentioned above are in conformity with the following European Standards:

Class	Standard	Description
ATEX95	EN 60079-0:2006	Electrical apparatus for explosive gas atmospheres - General requirements
	EN 60079-15:2005	Electrical apparatus for explosive gas atmospheres - Construction, test and marking of type of protection "n" electrical apparatus
	EN 61241-0:2006	Electrical apparatus for use in the presence of combustible dust - General requirements
	EN 61241-1:2004	Electrical apparatus for use in the presence of combustible dust - Protection by enclosures "tD"

The junction boxes have to be marked as follows:

Ex II3G Ex nA II T6...T4 Ta -40...+80 °C

Ex II3D Ex tD A22 IP67 T 100 °C

The installation, operating and safety instructions have to be observed!

Berlin, 2009-09-23

Dipl.-Ing. Jens Hilpert
Managing Director

KEJBX2V1-1EN.doc

Declaration of conformity

We,

FLEXIM Flexible Industriemesstechnik GmbH

Wolfener Str. 36

12681 Berlin

Germany,

declare under our sole responsibility that the transducers

****K1N31, **K1N41, **G1N31, **G1N41, **K1N33, **K1N43, **G1N33, **G1N43, **H1N33, **H1N43, **M2N41, **P2N41, **M1N43, **P1N43, **M2E45, **P2E45**

are in conformity with the following EC directives:

Directive 94/9/EC - Safety Requirements for Control Systems and Equipment for Use in Explosive Atmospheres.

The transducers mentioned above are in conformity with the following European Standards:

Class	Standard	Description
ATEX95	EN 60079-0:2006	Electrical apparatus for explosive gas atmospheres - General requirements
	EN 60079-5:2007	Explosive atmospheres - Equipment protection by powder filling "q"
	EN 61241-0:2006	Electrical apparatus for use in the presence of combustible dust - General requirements
	EN 61241-1:2004	Electrical apparatus for use in the presence of combustible dust - Protection by enclosures "tD"

The conformity with the directive 94/9/EC was certificated in the following documents of the notified body IBExU Institut für Sicherheitstechnik GmbH (ID No. 0637):

Document type	Object	Document number
EC Type examination certificate	**K1N31, **K1N41, **G1N31, **G1N41, **K1N33, **K1N43, **G1N33, **G1N43, **H1N33, **H1N43, **M2N41, **P2N41, **M1N43, **P1N43, **M2E45, **P2E45	IBExU04ATEX1011 X

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FLEXIM Flexible Industriemesstechnik GmbH · Wolfener Straße 36 · 12681 Berlin
Tel. +49 (0)30 93 66 76 60 · Fax +49 (0)30 93 66 76 80

FLEXIM GmbH has a quality assurance system which complies to annex IV of the directive 94/9/EC.
The quality assurance system was certified by the notified body
IBExU Institut für Sicherheitstechnik GmbH (ID No. 0637):

Document type	Description	Document number
Declaration	Acknowledgement of the quality assurance system	IBExU11ATEX Q001

The marking of the transducers includes the following:

CE 0637 Ex
II2G Ex q II T6...T3 or T2
II2D Ex tD A21 IP65 TX

The installation, operating and safety instructions have to be observed!

Berlin, 2011-03-16

Dipl.-Ing. Jens Hilpert
Managing Director

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FLEXIM

Declaration of conformity

We,

FLEXIM Flexible Industriemesstechnik GmbH

Wolfener Str. 36

12681 Berlin

Germany,

declare under our sole responsibility that the transducers

****K1N71, **K1N81, **G1N71, **G1N81, **K1N73, **K1N83, **G1N73, **G1N83, **H1N73, **H1N83, **M2N81, **P2N81, **Q2N81, **M1N83, **P1N83, **Q1N83**

are in conformity with the following EC directives:

Directive 94/9/EC - Safety Requirements for Control Systems and Equipment for Use in Explosive Atmospheres.

The transducers mentioned above are in conformity with the following European Standards:

Class	Standard	Description
ATEX95	EN 60079-0:2006	Electrical apparatus for explosive gas atmospheres - General requirements
	EN 60079-5:2007	Explosive atmospheres - Equipment protection by powder filling "q"
	EN 60079-7:2007	Explosive atmospheres - Equipment protection by increased safety "e"
	EN 61241-0:2006	Electrical apparatus for use in the presence of combustible dust - General requirements
	EN 61241-1:2004	Electrical apparatus for use in the presence of combustible dust - Protection by enclosures "tD"

The conformity with the directive 94/9/EC was certificated in the following documents of the notified body IBExU Institut für Sicherheitstechnik GmbH (ID No. 0637):

Document type	Object	Document number
EC Type examination certificate	**K1N71, **K1N81, **G1N71, **G1N81, **K1N73, **K1N83, **G1N73, **G1N83, **H1N73, **H1N83, **M2N81, **P2N81, **Q2N81, **M1N83, **P1N83, **Q1N83	IBExU07ATEX1168 X

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FLEXIM Flexible Industriemesstechnik GmbH · Wolfener Straße 36 · 12681 Berlin
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FLEXIM GmbH has a quality assurance system which complies to annex IV of the directive 94/9/EC.
The quality assurance system was certified by the notified body
IBExU Institut für Sicherheitstechnik GmbH (ID No. 0637):

Document type	Description	Document number
Declaration	Acknowledgement of the quality assurance system	IBExU11ATEX Q001

The marking of the transducers includes the following:

CE 0637 Ex II2G II2D
Ex eq II T6...T3
Ex tD A21 IP65 TX

The installation, operating and safety instructions have to be observed!

Berlin, 2011-03-16

Dipl.-Ing. Jens Hilpert
Managing Director

FLEXIM Flexible Industriemesstechnik GmbH · Wolfener Straße 36 · 12681 Berlin
Tel. +49 (0)30 93 66 76 60 · Fax +49 (0)30 93 66 76 80

CE

FLEXIM

Declaration of conformity

We,

FLEXIM Flexible Industriemesstechnik GmbH

Wolfener Str. 36

12681 Berlin

Germany,

declare under our sole responsibility that the transducers

****K1LI1, **G1LI1, **M2LI1, **P2LI1, **K1LI3, **H1LI3, **G1LI3**

are in conformity with the following EC directives:

Directive 94/9/EC - Safety Requirements for Control Systems and Equipment for Use in Explosive Atmospheres.

The transducers mentioned above are in conformity with the following European Standards:

Class	Standard	Description
ATEX95	EN 60079-0:2006	Electrical apparatus for explosive gas atmospheres - General requirements
	EN 60079-5:2007	Explosive atmospheres - Equipment protection by powder filling "q"
	EN 61241-0:2006	Electrical apparatus for use in the presence of combustible dust - General requirements
	EN 61241-1:2004	Electrical apparatus for use in the presence of combustible dust - Protection by enclosures "tD"

The conformity with the directive 94/9/EC was certificated in the following documents of the notified body IBExU Institut für Sicherheitstechnik GmbH (ID No. 0637):

Document type	Object	Document number
EC Type examination certificate	**K1LI1, **G1LI1, **M2LI1, **P2LI1, **K1LI3, **H1LI3, **G1LI3	IBExU07ATEX1168 X

(continuation on verso)

FLEXIM Flexible Industriemesstechnik GmbH · Wolfener Straße 36 · 12681 Berlin
Tel. +49 (0)30 93 66 76 60 · Fax +49 (0)30 93 66 76 80

FLEXIM GmbH has a quality assurance system which complies to annex IV of the directive 94/9/EC.
The quality assurance system was certified by the notified body
IBExU Institut für Sicherheitstechnik GmbH (ID No. 0637):

Document type	Description	Document number
Declaration	Acknowledgement of the quality assurance system	IBExU11ATEX Q001

Test conditions for IP 68:	3 months at 2 bar (20 m) at 20 °C

The marking of the transducers includes the following:

CE 0637 Ex II2G II2D

Ex q II T6...T3

Ex tD A21 IP68 TX

The installation, operating and safety instructions have to be observed!

Berlin, 2011-03-16

Dipl.-Ing. Jens Hilpert
Managing Director

FLEXIM Flexible Industriemesstechnik GmbH · Wolfener Straße 36 · 12681 Berlin
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CE

FLEXIM

Declaration of conformity

We,

FLEXIM Flexible Industriemesstechnik GmbH

Wolfener Str. 36

12681 Berlin

Germany,

declare under our sole responsibility that the transducers

****M2E85, **P2E85, **Q2E85**

are in conformity with the following EC directives:

Directive 94/9/EC - Safety Requirements for Control Systems and Equipment for Use in Explosive Atmospheres.

The transducers mentioned above are in conformity with the following European Standards:

Class	Standard	Description
ATEX95	EN 60079-0:2006	Electrical apparatus for explosive gas atmospheres - General requirements
	EN 60079-5:2007	Explosive atmospheres - Equipment protection by powder filling "q"
	EN 60079-7:2007	Explosive atmospheres - Equipment protection by increased safety "e"
	EN 61241-0:2006	Electrical apparatus for use in the presence of combustible dust - General requirements
	EN 61241-1:2004	Electrical apparatus for use in the presence of combustible dust - Protection by enclosures "tD"

The conformity with the directive 94/9/EC was certificated in the following documents of the notified body IBExU Institut für Sicherheitstechnik GmbH (ID No. 0637):

Document type	Object	Document number
EC Type examination certificate	**M2E85, **P2E85, **Q2E85	IBExU07ATEX1168 X

(continuation on verso)

FLEXIM Flexible Industriemesstechnik GmbH · Wolfener Straße 36 · 12681 Berlin
Tel. +49 (0)30 93 66 76 60 · Fax +49 (0)30 93 66 76 80

FLEXIM GmbH has a quality assurance system which complies to annex IV of the directive 94/9/EC.
The quality assurance system was certified by the notified body
IBExU Institut für Sicherheitstechnik GmbH (ID No. 0637):

Document type	Description	Document number
Declaration	Acknowledgement of the quality assurance system	IBExU11ATEX Q001

The marking of the transducers includes the following:

CE 0637 Ex II2G II3D
Ex eq II T6...T2
Ex tD A22 IP56 TX

The installation, operating and safety instructions have to be observed!

Berlin, 2011-03-16

Dipl.-Ing. Jens Hilpert
Managing Director

FLEXIM Flexible Industriemesstechnik GmbH · Wolfener Straße 36 · 12681 Berlin
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CE

FLEXIM

Declaration of conformity

We,

FLEXIM Flexible Industriemesstechnik GmbH
Wolfener Str. 36
12681 Berlin
Germany,

declare under our sole responsibility that the transducers

CDM1N52, CDP1N52

conform to the requirements for use in explosive atmosphere according to appendix VIII of the

Directive 94/9/EC - Safety Requirements for Control Systems and Equipment for Use in Explosive Atmospheres.

The transducers mentioned above are in conformity with the following European Standards:

Class	Standard	Description
ATEX95	EN 60079-0:2006	Electrical apparatus for explosive gas atmospheres - General requirements
	EN 60079-15:2005	Electrical apparatus for explosive gas atmospheres Construction, test and marking of type of protection "n" electrical apparatus
	EN 61241-0:2006	Electrical apparatus for use in the presence of combustible dust-General requirements
	EN 61241-1:2004	Electrical apparatus for use in the presence of combustible dust-Protection by enclosures "tD"

The transducers have to be marked as follows:

Ex II3G Ex nA II T6...T4 Ta -20°C...130°C

Ex II3D Ex tD A22 IP67 TX

The operating and safety instructions have to be observed!

Berlin, 23/04/2008

Dipl.-Ing. Jens Hilpert
Managing Director

CE

FLEXIM

Declaration of conformity

We,

FLEXIM Flexible Industriemesstechnik GmbH
Wolfener Str. 36
12681 Berlin
Germany,

declare under our sole responsibility that the transducers

***DG1N52, *DK1N52, *DM2N52, *DP2N52, *DQ2N52**

conform to the requirements for use in explosive atmosphere according to appendix VIII of the

Directive 94/9/EC - Safety Requirements for Control Systems and Equipment for Use in Explosive Atmospheres.

The transducers mentioned above are in conformity with the following European Standards:

Class	Standard	Description
ATEX95	EN 60079-0:2006	Electrical apparatus for explosive gas atmospheres - General requirements
	EN 60079-15:2005	Electrical apparatus for explosive gas atmospheres Construction, test and marking of type of protection "n" electrical apparatus
	EN 61241-0:2006	Electrical apparatus for use in the presence of combustible dust-General requirements
	EN 61241-1:2004	Electrical apparatus for use in the presence of combustible dust-Protection by enclosures "tD"

The transducers have to be marked as follows:

Ex II3G Ex nA II T6...T3 Ta -55...+190 °C

Ex II3D Ex tD A22 IP67 TX

The operating and safety instructions have to be observed!

Berlin, 2009-11-20

Dipl.-Ing. Jens Hilpert
Managing Director

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FLEXIM

Declaration of conformity

We,

FLEXIM Flexible Industriemesstechnik GmbH
Wolfener Str. 36
12681 Berlin
Germany,

declare under our sole responsibility that the transducers

CLG1N52, CLK1N52, *LQ2N52

conform to the requirements for use in explosive atmosphere according to appendix VIII of the

Directive 94/9/EC - Safety Requirements for Control Systems and Equipment for Use in Explosive Atmospheres.

The transducers mentioned above are in conformity with the following European Standards:

Class	Standard	Description
ATEX95	EN 60079-0:2006	Electrical apparatus for explosive gas atmospheres - General requirements
	EN 60079-15:2005	Electrical apparatus for explosive gas atmospheres Construction, test and marking of type of protection "n" electrical apparatus
	EN 61241-0:2006	Electrical apparatus for use in the presence of combustible dust-General requirements
	EN 61241-1:2004	Electrical apparatus for use in the presence of combustible dust-Protection by enclosures "tD"

The transducers have to be marked as follows:

Ex II3G Ex nA II T6...T3 Ta -55...+190 °C

Ex II3D Ex tD A22 IP67 TX

The operating and safety instructions have to be observed!

Berlin, 2009-11-20

Dipl.-Ing. Jens Hilpert
Managing Director

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CE

FLEXIM

Declaration of conformity

We,

FLEXIM Flexible Industriemesstechnik GmbH
Wolfener Str. 36
12681 Berlin
Germany,

declare under our sole responsibility that the transducers

****M2E52, **P2E52, **Q2E52**

conform to the requirements for use in explosive atmosphere according to appendix VIII of the

Directive 94/9/EC - Safety Requirements for Control Systems and Equipment for Use in Explosive Atmospheres.

The transducers mentioned above are in conformity with the following European Standards:

Class	Standard	Description
ATEX95	EN 60079-0:2006	Electrical apparatus for explosive gas atmospheres - General requirements
	EN 60079-15:2005	Electrical apparatus for explosive gas atmospheres Construction, test and marking of type of protection "n" electrical apparatus
	EN 61241-0:2006	Electrical apparatus for use in the presence of combustible dust- General requirements
	EN 61241-1:2004	Electrical apparatus for use in the presence of combustible dust- Protection by enclosures "tD"

The transducers have to be marked as follows:

Ex II3G Ex nA II T6...T2 Ta -45...+235 °C

Ex II3D Ex tD A22 IP56 TX

The operating and safety instructions have to be observed!

Berlin, 2009-06-25

Dipl.-Ing. Jens Hilpert
Managing Director

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CE

FLEXIM

Declaration of conformity

We,

FLEXIM Flexible Industriemesstechnik GmbH
Wolfener Str. 36
12681 Berlin
Germany,

declare under our sole responsibility that the transducers

****K1LI8, *RH1LI8, **G1LI8, **M2LI8, **P2LI8**

conform to the requirements for use in explosive atmosphere according to appendix VIII of the

Directive 94/9/EC - Safety Requirements for Control Systems and Equipment for Use in Explosive Atmospheres.

The transducers mentioned above are in conformity with the following European Standards:

Class	Standard	Description
ATEX95	EN 60079-0:2006	Electrical apparatus for explosive gas atmospheres - General requirements
	EN 60079-15:2005	Electrical apparatus for explosive gas atmospheres Construction, test and marking of type of protection "n" electrical apparatus
	EN 61241-0:2006	Electrical apparatus for use in the presence of combustible dust- General requirements
	EN 61241-1:2004	Electrical apparatus for use in the presence of combustible dust- Protection by enclosures "tD"

The transducers have to be marked as follows:

⟨Ex⟩ II3G Ex nA II T6...T5 Ta -40...+90 °C

⟨Ex⟩ II3D Ex tD A22 IP68 TX

The operating and safety instructions have to be observed!

Berlin, 11/03/2009

Dipl.-Ing. Jens Hilpert
Managing Director

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FLEXIM

Declaration of conformity

We,

FLEXIM Flexible Industriemesstechnik GmbH
Wolfener Str. 36
12681 Berlin
Germany,

declare under our sole responsibility that the transducers

CRK1N52, CTK1N52, CRH1N52, CTH1N52, CRG1N52, CTG1N52, CRM1N52, CTM1N52, CRP1N52, CRQ1N52

conform to the requirements for use in explosive atmosphere according to appendix VIII of the

Directive 94/9/EC - Safety Requirements for Control Systems and Equipment for Use in Explosive Atmospheres.

The transducers mentioned above are in conformity with the following European Standards:

Class	Standard	Description
ATEX95	EN 60079-0:2006	Electrical apparatus for explosive gas atmospheres - General requirements
	EN 60079-15:2005	Electrical apparatus for explosive gas atmospheres Construction, test and marking of type of protection "n" electrical apparatus
	EN 61241-0:2006	Electrical apparatus for use in the presence of combustible dust-General requirements
	EN 61241-1:2004	Electrical apparatus for use in the presence of combustible dust-Protection by enclosures "tD"

The transducers have to be marked as follows:

Ex II3G Ex nA II T6...T3 Ta -55...+150 °C

Ex II3D Ex tD A22 IP67 TX

The operating and safety instructions have to be observed!

Berlin, 17/10/2008

Dipl.-Ing. Jens Hilpert
Managing Director

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