Ultrasonic flowmeters

SONOELIS SE404x

SONOELIS SE406x

Contents

1 BASIC INFORMATION

1.1 Application

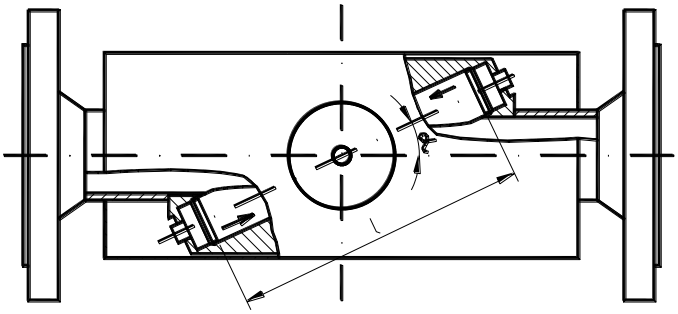
Ultrasonic flowmeters SONOELIS SE404x and SONOELIS SE406x are intended for measurements of instantaneous flow rate and aggregate flow volume passed through a fully flooded piping. If provided with a fluid temperature measurement device, they can also be used for measurement of mass flow rate.
The meter principle permits flow-rate measurement of any type of fluid including electrically non-conducting or aggressive liquids. The meter will thus find application in both water management systems and various industries including chemical industry.

1.2 Measurement principle

The meter uses the transit-time ultrasonic flow velocity measurement principle. The measured fluid shall permit passage of ultrasonic signals.

Ultrasonic impulses are sent in turns in and against the fluid flow direction. For the transit time of the ultrasonic signal sent in the fluid flow direction it holds:

$$t_1 = \frac{l}{c + v.\cos\alpha} + \frac{l_1}{c_1} \qquad (s)$$



where l is the distance between the face parts of the ultrasonic probes (m)
c is the signal propagation velocity in the measured fluid (m/s)
v is the fluid flow velocity (m/s)
l_1 is the aggregate thickness of the bottom parts of both probes (m)
c_1 is the signal propagation velocity in the probe material (m/s).

The only difference between the calculation formula for the transit time of the ultrasonic signal travelling against the fluid flow direction (t_2) and that for t_1 consists of the opposite sign of the fluid velocity:

$$t_2 = \frac{l}{c - v \cdot \cos\alpha} + \frac{l_1}{c_1} \qquad (s)$$

Parameters l_1 and c_1 are constants given by the probe design.

The ultrasonic signal propagation velocity can be expressed as follows:

$v_1 = c + v.\cos\alpha$ for the signal travelling in the fluid flow direction, and
$v_2 = c - v.\cos\alpha$ for the signal travelling against the fluid flow direction.

The difference between the velocities of the ultrasonic signal travelling in and against the fluid flow direction is proportional to the fluid flow velocity v (m/s).

$$v = \frac{v_1 - v_2}{2.\cos\alpha}$$

The magnitude of the instantaneous fluid flow volume can be determined using the formula:

$$q = v \cdot s \cdot k(v) \qquad \left(m^3/h\right)$$

where v is the fluid velocity (m/s),
s is the sensor flow cross-section (m^2), and
k(v) is a correction coefficient depending upon the instantaneous fluid flow velocity.

Coefficient k (v) modifies the measured flow rate value with respect to the fluid velocity profile inside the sensor.

1.3 Meter properties and functions

Ultrasonic flowmeters SONOELIS SE404x and SONOELIS SE406x are supplied in two optional configurations:

- Version ECONOMIC – converter alone
- Version COMFORT – converter plus display and control keyboard

Both meter versions can be provided with either single-ray or double-ray sensors.

ECONOMIC This basic meter version without display or keyboard works as a device converting a fluid flow into electric signals.

Standard meter design:

- Power supply 110 or 230 VAC
- One frequency output
- One impulse output

Enhanced design:

- Power supply 24 VDC
- One current output
- Communication interface RS-485
- One switching (two-state) output
- Fluid temperature measurement function

If the meter includes a fluid temperature measurement device, the outputs can provide information on flow rates in weight units.

COMFORT Added to the basic meter version are:

- LC display (visualisation of the measured values and meter parameters), and
- Four-button membrane keyboard facilitating meter parameter setting according to the customer requirements.

Flowmeter configurations

Meter version	Type designation			Converter functions
	Flowmeter	Converter	Sensor	
ECONOMIC	SE4041	UP 2.10	UC 3.0 – single ray	Basic configuration
	SE4061		UC 5.0 – double ray	
COMFORT	SE4045	UP 3.10	UC 3.0 – single ray	Basic configuration + LC display + keyboard
	SE4065		UC 5.0 – double ray	

Sensor UC 3.0 is a single-ray sensor including two ultrasonic probes, sensor UC 5.0 is a double-ray sensor including four ultrasonic probes.

The double-ray sensor makes possible more detailed scanning of the fluid velocity profile inside the meter sensor which, especially in cases of lower fluid flow velocities, ensures higher measurement precision.

1.4 Important user instructions

Ultrasonic flowmeters of the type series SONOELIS SE404x and SONOELIS SE406x are manufactured and tested in accordance with the applicable international directions and standards. To ensure successful meter commissioning and operation, the user shall observe all recommendations and instructions in the product manual.

1.4.1 Safety directions

- Prior to any meter manipulation, both the future meter user and installation staff shall read carefully and get well acquainted with the enclosed flowmeter documentation.
- The electric connections of the meter shall be made in strict observance of the relevant national directions and standards applicable to work with electrical equipment with special regard to health protection and labour safety.
- Meter installation, electric connections and commissioning shall be performed by duly qualified staff only.
- Make sure to observe all directions given in this manual concerning mechanical installation and electric connections, paying special attention to warning labels.
- In cases of suspected malfunction the customer shall not attempt to dismantle the meter assembly. Any meter repairs shall be reserved to the manufacturer or their duly authorised partners. The meter shall not be sent for repair without Representation of Meter Decontamination (see Part 17, ANNEXES).
- The key meter component parts are protected against unauthorised handling by manufacturing seals. Broken seals will imply loss of the rights to free warranty services.

1.4.2 Liabilities

ELIS PLZEŇ a. s. as a flowmeter manufacturer wish to supply their products in the best quality. All products developed by ELIS PLZEŇ a.s. are intellectual property of the company and subject to their copyright. This protection extends to any documentation supplied with the company products. Unless ELIS PLZEŇ a.s. have approved such conduct, no third person may amend or modify such documentation in any way. Any misuse of the above intellectual property is punishable.

The purpose of the documentation supplied with the product is to acquaint the customer with the product properties, its installation and application. The flowmeter user shall read thoroughly this manual and observe the manufacturer's directions contained herein. Such conduct will protect the customer against loss of the product warranty and prevent meter defects due to incorrect installation or use.

The flowmeter installation shall be reserved to a qualified firm with staff trained by ELIS PLZEŇ a.s. Such firm will be responsible for the correct meter installation and commissioning. ELIS PLZEŇ a.s. shall bear no liability for meter defects caused by its faulty installation, incorrect use or unprofessional parameter setting or programming.

ELIS PLZEŇ a. s. supply to the market a product certified for compliance with the valid standards where included in the delivery package is, apart from this manual on project design, product installation and service, a Representation on Compliance. The supplied product is subject to a warranty as stated in the order confirmation document or purchase contract.

Manual to products manufactured by ELIS PLZEŇ a.s. are subject to regular updating where the latest version of the manual is supplied with the product and can also be found on the Internet address www.elis.cz. ELIS PLZEŇ a.s. reserve to themselves the right to amend/update any pieces of the technical documentation to their proprietary products.

When placing an order, the buyer shall specify all required meter parameters, whereupon ELIS PLZEŇ a.s. as the seller will confirm the receipt of the order in writing and send it back to the buyer with their General Commercial Conditions. The meter supplies meet the requirements of the Czech Civil Code as amended. The product sent to the buyer is configured according to the confirmed order or the respective purchase contract. ELIS PLZEŇ a.s. shall not be liable for any design differences or meter parameters that have not been mutually specified and agreed.

Used in this manual for project design, product installation and service are the following symbols:

Warning: a faulty operation or incorrect setting may result in meter malfunction, damage or risk to health.

Supplementary information important for correct meter function or optional extension of the meter configuration.

1.5 Warranty

The flowmeters are subject to manufacturer's warranty as described in the valid commercial conditions of the seller. More detailed information on the warranty scope and conditions is contained in Part 14 hereof.

1.6 Certification

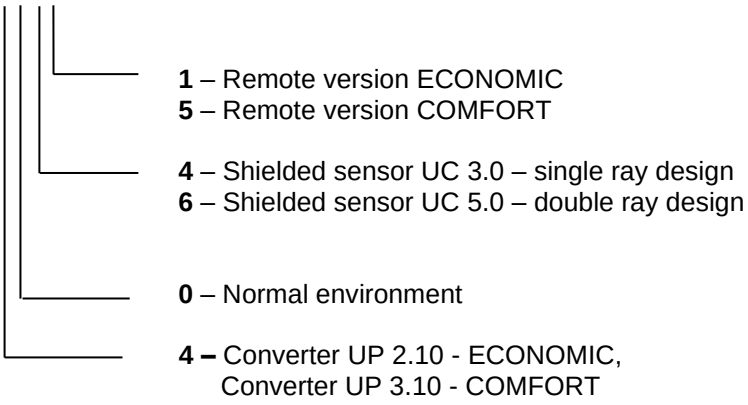
Ultrasonic flowmeters of the type series SONOELIS SE40xx have the following certificates (see Part 17, ANNEXES of this manual):

- **Representation on CE compliance**
- **MID certificate TCM 142-16/5353 issued for ultrasonic flowmeters (**SONOELIS SE4041.1 and SONOELIS SE4011.1)

2 METER IDENTIFICATION

2.1 Flowmeters SONOELIS SE404x and SONOELIS SE406x; type designation

SONOELIS SE40xx



2.2 Scope of delivery

2.2.1 SONOELIS SE404x and SONOELIS SE406x; remote versions

- Converter for SONOELIS SE404x or SONOELIS SE406x in configuration specified in the customer order.
- Ultrasonic probe UC 3.0 or UC 5.0 including coaxial cables.
- Manual: Ultrasonic Flowmeters SONOELIS SE404x and SONOELIS SE406x.

The product packaging meets the requirements on domestic and international transport; optional alternative packaging is available corresponding to the agreed product collection arrangement with the buyer.

2.3 Associated documents

- Meter calibration report – on request.

2.4 Meter rating plates

2.4.1 System rating plate

This plate is attached to the right side of converter box.

Remote meter version

FLOW METER	SE 404x		**SN/Year** 47950/20		**MANUFACTURER:** ELIS PLZEŇ a.s.		
TEMP. RANGE 0-150 °C		**TRANSMITTER** UP 2.10		**SN/Year** 12345/20			
CLASS EMC E	**ENVIROMENTAL CLASS** C		**COMM. ADDRESS.** 007		**SENSOR** UC 3.0 DN200/PN16		
MIN.	Q_1 0,5 **m³/h**		**FREQUENCE** 0-1 kHz			**SN/Year** 12345/20	
PERMAN.	Q_3 50 **m³/h**	**OUTPUT PULSE**	5 l/puls				
OVERLOAD	Q_4 50 **m³/h**		**CURRENT** 4-20 mA		**TEMP. SENSOR** Pt100		

Example of the system rating plate

2.4.2 Converter rating plate

This plate is attached to the left side of the converter box.

Remote meter version

ELIS PLZEŇ a.s.

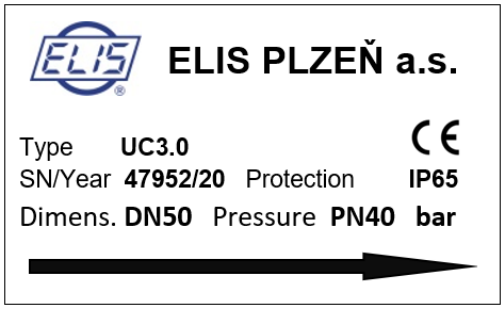
Type UP 2.10 **SN/Year** 47952/20
Supply Voltage 230 V
Protection IP 65 **Input Power** 15 W

Example of the converter rating plate

2.4.3 Sensor rating plate

This plate is located on the sensor body.

Remote meter version



Example of the sensor rating plate

3 METER DESIGN AND MATERIAL OPTIONS

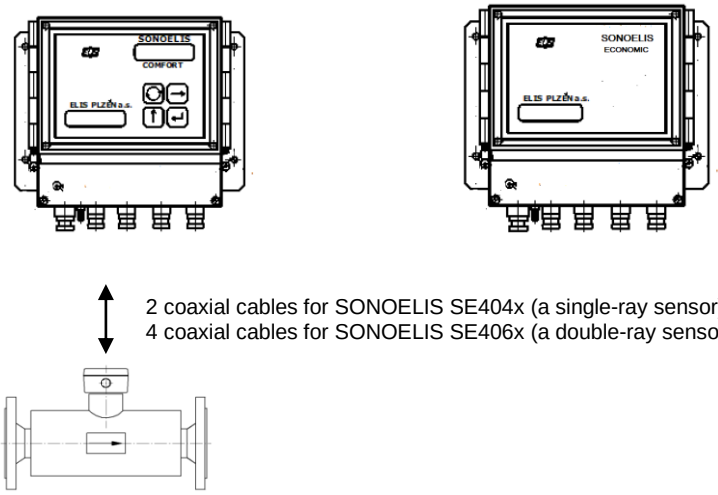
3.1 Remote meter version

If the meter design is described as “remote”, it means that the meter sensor and converter are physically separated. Electrically these units are interconnected by coaxial cables.
Flowmeters SONOELIS SE404x and SONOELIS SE406x are manufactured in two design versions:

- Version ECONOMIC – converter alone
- Version COMFORT – converter plus display and keyboard

The only visible difference between flowmeters SONOELIS SE404x (with a single-ray sensor) and SE406x (double-ray sensor) is in their connection cables.

Version COMFORT **Version ECONOMIC**



Sensor: UC 3.0 – single ray / UC 5.0 – double ray

Remote meter version including an IP 67 sensor
The meter sensor is supplied with two or four coaxial cables connected to the sensor terminal box. After the sensor on-site installation, these cables need be brought to the meter converter and their other ends connected to the appropriate sensor terminals.

Remote meter version including an IP 68 sensor
The coaxial cables (one or two pairs) are connected to the sensor terminal box in production whereby the box is filled with liquid insulation compound.

Sensor installation in piping
The meter sensors UC 3.0 (single ray) and UC 5.0 (double ray) are always provided with flanges. Unless required otherwise, the sensor will be supplied with flanges are according to standard ČSN EN 1092-1. The customer may select other types of flange such as flanges according to standards ANSI B16.5, BS 4504, JS B2210 or others.

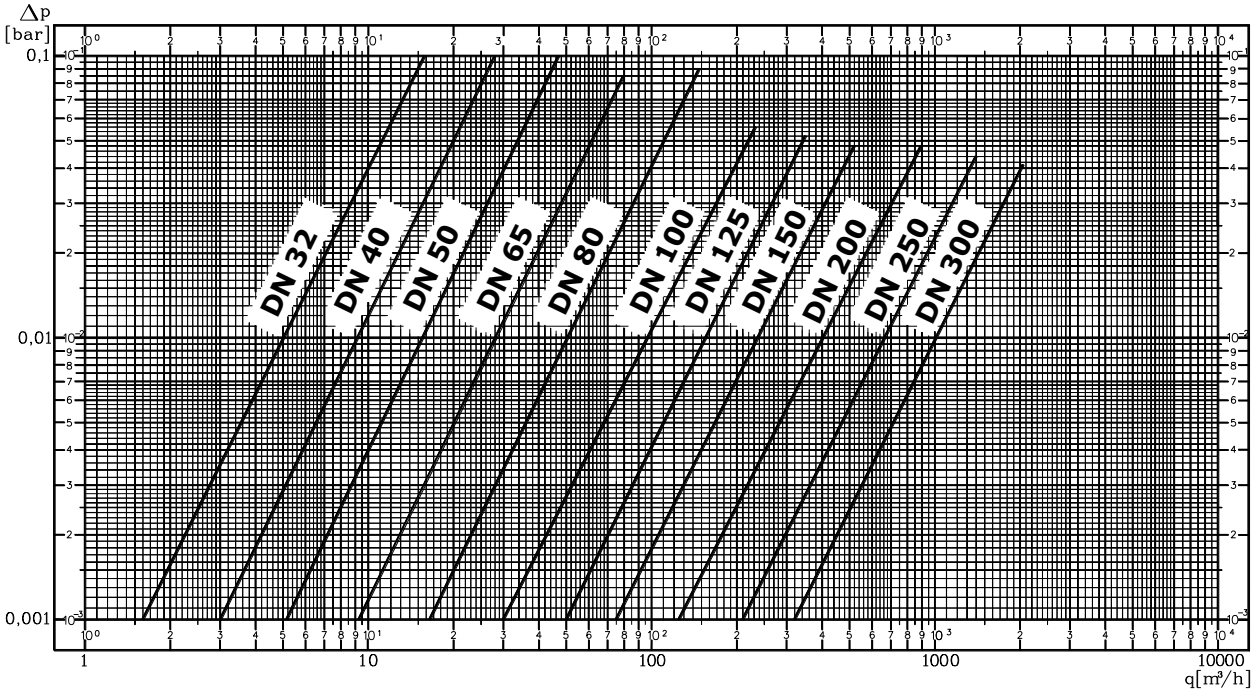
3.2 Operational pressure of the measured fluid

In the standard design version (with flanges according to standard ČSN EN 1092-1), ultrasonic meter sensors UC 3.0 and UC 5.0 of all available sizes can be used in piping systems PN16 and PN40.

3.3 Sensor dimensions

Ultrasonic flowmeters SONOELIS SE404x and SONOELIS SE406x are designed to make possible flow rate measurements with the fluid velocity in the range 0.1 to 10 m/s. In practical situations, it is best to maintain the fluid velocity inside the sensor between 0.5 and 5 m/s. With fluid velocity too low the relative measurement error tends to grow, while at extra high fluid velocities the risk of disturbing flow turbulences cannot be avoided.

Pressure loss in sensors UC 3.0 and UC 5.0



In cases where the operational fluid velocity in the given piping is low and the measurement error too high, it is possible to increase the fluid velocity in the sensor by using a reduction piece in the piping and a sensor of smaller diameter. The disadvantage of this solution is pressure loss on the piping reduction. Therefore, in practical situations the reduction is limited to nearest lower standard piping diameter.

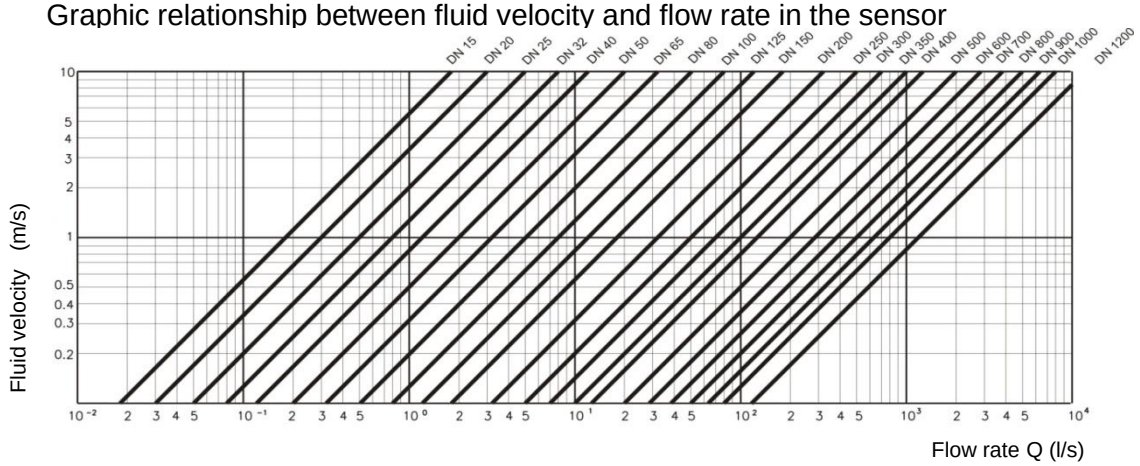
The fluid velocity ***v*** in piping can be calculated by the following formula:

$$v = \frac{0.0003536 \times Q}{DN^2} \qquad \text{(m/s, m}^3\text{/h, m)}$$

where

Q … the fluid flow rate (m³/h),
DN … the piping diameter (m)

Graphic relationship between fluid velocity and flow rate in the sensor



Limit flow rates for various sensor sizes

DN	NPS	(l/s)		(m^3/h)	
		Q_1	Q_4	Q_1	Q_4
32	1 ¼“	0.056	5.6	0.20	20
40	1 ½“	0.083	8.9	0.30	32
50	2“	0.139	13.9	0.50	50
65	2 ½“	0.222	22.2	0.80	80
80	3“	0.417	41.7	1.50	150
100	4“	0.667	66.7	2.40	240
125	5	0.972	97.2	3.50	350
150	6“	1.389	138.9	5.00	500
200	8“	2.500	250.0	9.00	900
250	10“	3.889	388.9	14.00	1 400
300	12“	5.556	555.6	20.00	2 000

Flow rate definition (according to standard EN ISO 4064-1 - OIML R 49):
Q_4… overload (maximum) flow rate
Q_1… minimum flow rate

Upon agreement with the manufacturer, flowmeters can be supplied with higher maximum flow rates than those shown in the table.

4 INSTALLATION

4.1 Delivery acceptance

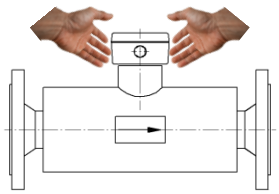
Upon meter delivery, the buyer shall check integrity of the product packaging and the good condition of the product itself.
The delivery scope shall be checked in reference to the order specifications, delivery note and meter rating plates.

In cases of delivery more than one meter at a time, due attention shall be paid to matching the correct sensors and converters (see the system rating plates).

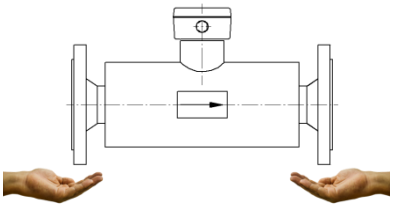
4.2 Meter handling

When lifting the meter, hold it by the flanges of transport eye, never by the connecting box.

The wrong grip



Recommended grip



To prevent irreparable meter damage during transport, do not place any auxiliary parts inside the sensor.

In meter handling or lifting, use textile slings only. Chains or steel cables might damage the meter. It is recommended to transfer the flowmeter to the installation site in the original transport package.

4.3 Storage

During meter storage prior to installation, it is necessary:

- to maintain the specified storage conditions regarding temperature and relative humidity of the ambient air,
- to ensure that the meter is not exposed to direct sunlight (risk of damage to the meter display).

It is recommended to store the meter in its transport packaging and remove the protective wrapping and casing only immediately prior to the meter installation.

4.4 Installation conditions

4.4.1 General rules

The general rules to be observed during the mechanical assembly and installation of the meter are:

- the protective wrapping and casing shall be removed only prior to the meter installation,
- the arrow on the sensor body shall point in the direction of the positive fluid flow,
- the fluid flow direction in a meter sensor installed in vertical piping shall be upwards,
- the flanges on the piping shall be strictly parallel,
- the internal diameters of the piping and seals shall correspond to that of the sensor,
- the sealing shall be correctly placed between the flanges and not extend into the flow profile,

- the piping supports at the meter input and output shall minimise the mechanical stresses on the sensor (vibration, tension, bend and others),
- no piping support or brace shall be placed directly under the meter sensor,
- the sensor shall be protected against direct sunshine,
- when choosing the meter installation place, make sure that the operators will have good access to the meter converter and all meter rating plates,
- the meter sensor shall always be fully flooded with the measured fluid with a minimum risk of fluid aeration.

Upon completion of the meter installation, make sure that no subsequent electric-arc welding work is done on the adjoining piping. Flanges must not be welded unto the piping ends with the meter sensor attached.

4.4.2 Straight piping sections

The meter installation place in the piping shall meet the requirements of standard EN ISO 4064-5 with the local conditions ensuring:

- stable fluid flow,
- stable fluid velocity profile,
- complete sensor flooding, and preventing
- the risk of cavitation and fluid foaming.

At the sensor input and output, there shall be straight piping sections of lengths specified as multiples of the inner piping diameter. In cases of bi-directional flow rate measurements, the conditions at the sensor input and output shall be the same.

It is desirable that no intermediate edge causing turbulence appears at the joint plane between the sensor and the adjacent piping section. The inner diameter of the piping connected to the meter sensor shall not be smaller and at the same time not greater than by 1% of the inner diameter of the sensor.

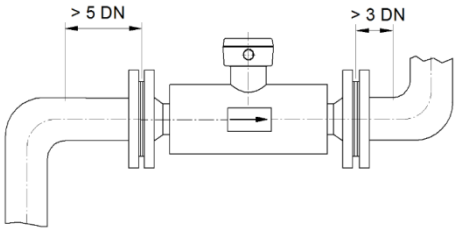
As a general rule it is recommended to install the flowmeter sensor before the flow disturbing elements in the piping.

The movement of the measured fluid in the piping shall be as smooth as possible. If the piping system includes a pump generating pressure impulses in the fluid flow (e.g. a pneumatic pump), a suitable hydraulic damper shall be used.

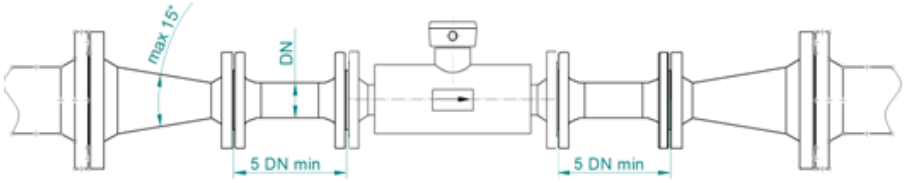
Sensor UC 3.0 (a single-ray sensor)
For sensor UC 3.0, the required lengths of straight piping sections at the input and output of the sensor are 5 DN and 3 DN, respectively. This rule applies in cases of simple flow-disturbing elements in the piping such as a 90°bend or taper.
For bi-directional flow rate measurement, the basic required lengths of straight piping sections at the sensor input and output are the same, namely 5 DN.
If there are more than one flow-disturbing element (such as bend or fitting) found near the meter sensor, the required lengths of straight piping sections shall be the respective multiple of the basic lengths.

Sensor UC 5.0 (a double-ray sensor)
If the same lengths of straight piping sections as required for sensor UC 3.0 are used, the application of sensor UC 5.0 will ensure higher precision of the flow rate measurements (see Section 9.3 below).

Basic required lengths of straight piping sections

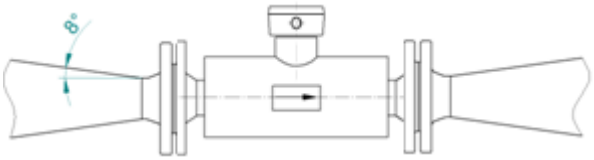


If the flowmeter size is smaller than that of the adjoining piping, it is necessary to use conical reduction pieces with apex angle not exceeding 15°.



With horizontal piping, eccentric reduction pieces should be used to prevent generation of air bubbles – see standard ČSN ISO 6817.

Tapered reduction pieces with slope angle up to 8° can be considered straight piping sections.

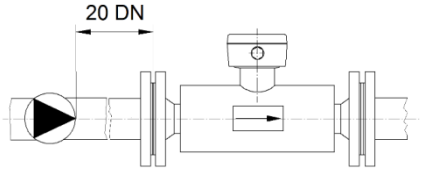


4.4.3 Pump operation effect limitation

To prevent pressure drop inside the sensor and related undesirable effects such as cavitation, generation of gas bubbles or fluid foaming, place the pump in the piping always at the sensor input side.

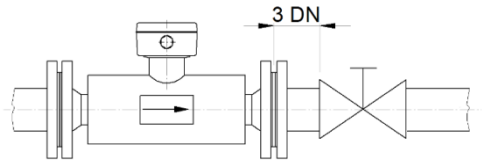
Pump placement at the sensor input side will suppress the cavitation effects and gas release from the measured fluid. Higher pressure in the piping system will keep the fluid under the saturated vapour pressure and so eliminate the cavitation effects.

The required length of straight piping section between the pump and meter sensor is at least 20 DN.

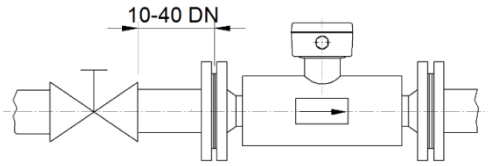


4.4.4 Limitation of the effects of closing and regulation fittings

To prevent negative effect on the fluid velocity profile in the sensor and cavitation, the closing and regulation fittings/valves should preferably be placed at the output side of the flowmeter. If it is so, the required length of straight piping section between the sensor and the nearest valve is 3 DN.

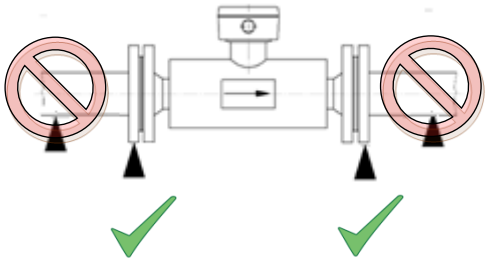


In cases where for technological reasons a full-flow fitting need be placed at the input side of the meter sensor, the recommended length of straight piping section is 10 DN. If such fitting is a regulation valve, the recommended length of straight piping section is 40 DN.



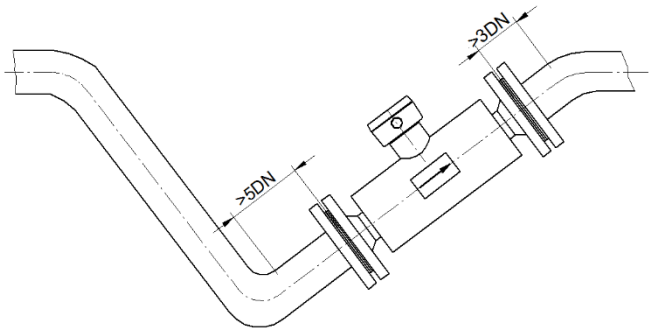
4.4.5 Limitation of the effects of vibration and other mechanical stresses

To prevent the action of mechanical stress and undesirable vibration, the piping sections at the sensor input and output shall be supported as near to the sensor as possible.



4.4.6 Sensor flooding

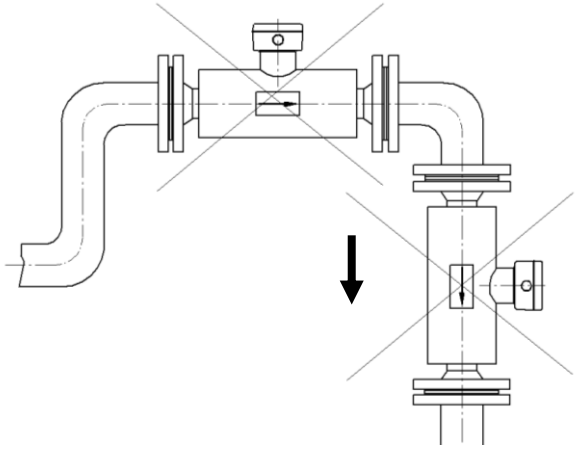
The meter sensor shall always be fully flooded with the measured fluid. In cases where such condition does not apply to the adjoining piping sections, the sensor position shall be such that its complete flooding is still achieved.



4.4.7 Incorrect meter placement

The meter sensor shall not be located at the top of the piping system or, in vertical position, with the fluid flow direction downwards, especially if the piping discharge point is near. Observance of this rule will prevent measurement errors due to higher concentration of air bubbles inside the sensor.

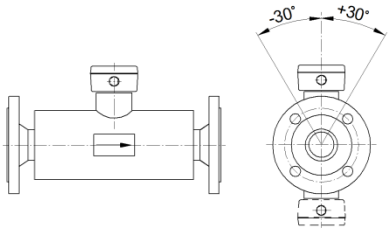
Unsuitable meter installation positions



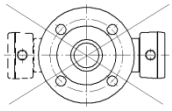
4.4.8 Sensor position

The flowmeter position in the piping can be both horizontal and vertical. However, the axis of the measurement rays in the sensor should be as close to horizontal position as possible and the fluid flow direction shall be upwards.

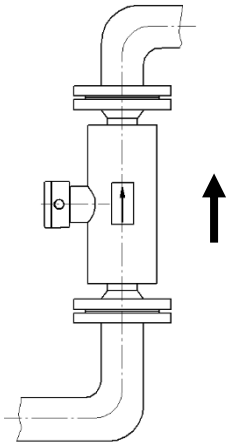
The permitted deviation from the ideal sensor position is ± 30° in both directions.



Unsuitable sensor position



In cases of vertical sensor position, the fluid flow direction shall always be upwards.



As component parts of fluids such as rape oil, mazut, caprolactam or some chemical compounds tend to separate, it is preferable to install the meter sensor in vertical position where the fluid flow ensures good mixing up and improves the fluid homogeneity.

The piping discharge point shall be found at least 2 DN above the meter position.

4.5 Thermal insulation

If a flowmeter is to be installed in a thermally insulated piping, thermal insulation is usually applied on the meter sensor too. In such a case, observe the following rules:

- thermal insulation is placed on the sensor only,
- the meter converter shall be protected against undesirable heating (by direct sunshine or thermal radiation from nearby equipment).

4.6 Flowmeter heating

In cases of flow rate measurements of fluids at sub-zero temperatures or at ambient temperatures near the limit on the permitted sub-zero fluid temperatures, the meter sensor may be thermally insulated and at the same time heated.

- The meter sensor can be heated electrically or using a heat-exchanger piping with a suitable heat-carrying medium.
- Recommended for electric heating is an AC-power system with a zero-switching regulation.

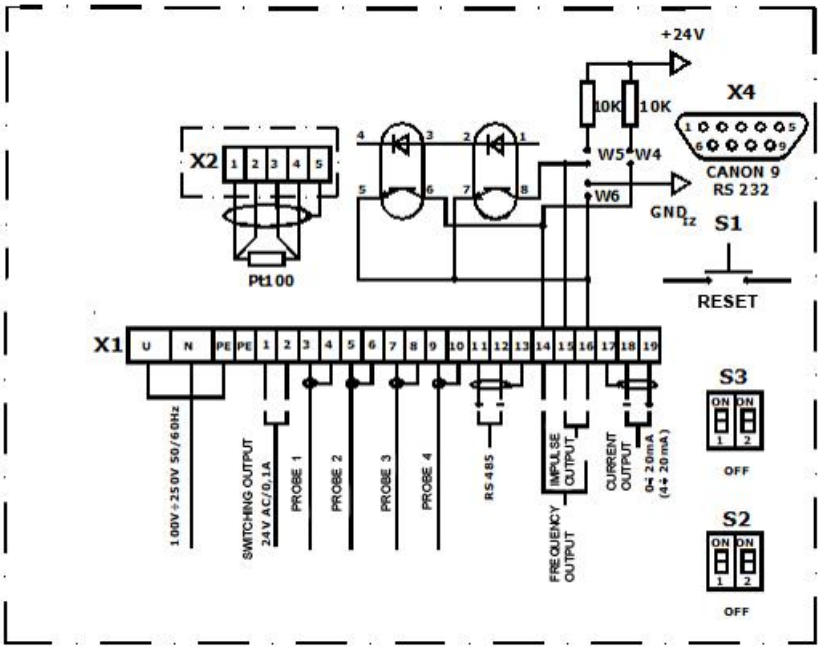
5 ELECTRICAL CONNECTIONS

5.1 Converter connection

Flowmeters SONOELIS SE404x.1 and SONOELIS SE406x.1 use the same converter terminal box.

5.1.1 Converter connectors and terminal box

Converter UP 2.10 – single ray
Converter UP 3.10 – double ray



Connector X4 Canon 9 RS 232 is reserved for manufacturing and servicing purposes. Terminal strip X2 is used to connect temperature sensor Pt100 (the enhanced flowmeter version).

Standard meter version

Terminal strip X1	AC power supply
U	110VAC (95 –132V), 50 – 60Hz 230VAC (184 – 250V), 50 – 60Hz
N	
PE	

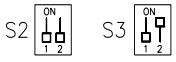
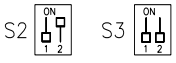
Enhanced meter version

Terminal strip X1	DC power supply
C (+)	24V DC (19.2 – 28.8V)
D (–)	
PE	

Output signals		
Terminal strip X1		**Function**
1	Switching output 24VAC, 0.1A	Status reporting
2		
11	+	RS-485 communication line
12	–	
13	Shielding	
14	+	Frequency output passive/active
15	+	Impulse output passive/active
16	GND	Common ground
17	Shielding	Current output, active 4–20mA (0–20mA)
18	–	
19	+	

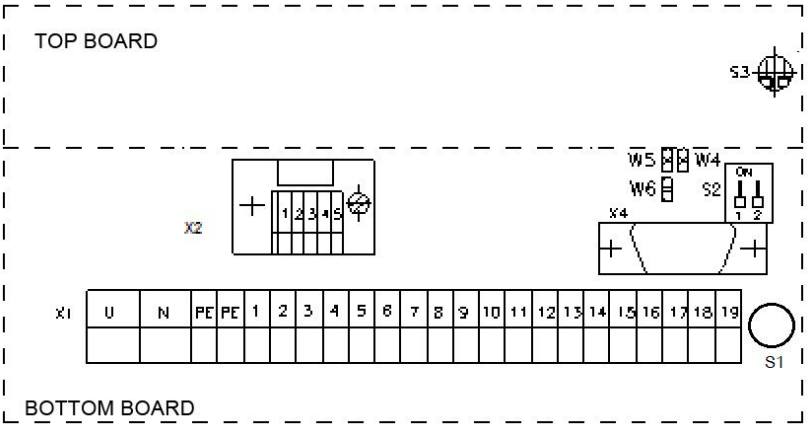
Switching and setting elements

- Jumpers W4, W5 and W6 are used to select active or passive operation mode of the frequency and impulse outputs.
  - Active frequency output: connected W4, W6
  - Active impulse output: connected W5, W6
  - Passive frequency output: disconnected W4, W6
  - Passive impulse output: disconnected W5, W6
- Push-button S1 is used to reset the aggregate volume data. It is found next to terminal strip X1.
- Switches S2 and S3 control the flowmeter operation and visualisation modes.

Flowmeter function	***Data on display***	***Switch configurations***
Operation	Instantaneous flow rate	
Operation	Instantaneous flow velocity	
Programming	EEPROM status	
Service	Service data	

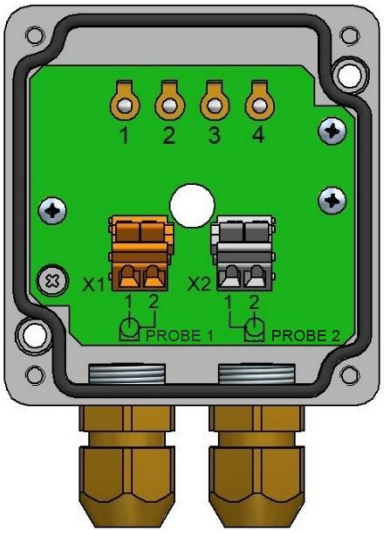
Functions **Programming** and **Service** are reserved to manufacturing and servicing purposes.

Switches S2, S3 and jumpers W4, W5, W6 on the bottom and top boards



5.2 Sensor connection box

5.2.1 Ultrasonic sensor UC 3.0 (single-ray version)

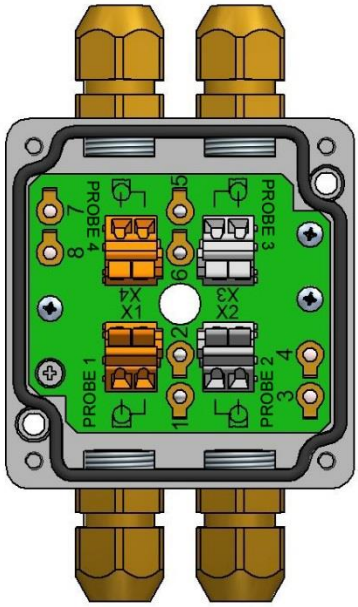


Terminal box of the UC 3.0 sensor

Single-ray version

Converter UP 2.10	Connections	Sensor UC 3.0		Ultrasonic probe
Terminal strip X1		Terminal strip	Terminal	
3	Conductor	X1	1	Probe 1
4	Shielding	X1	2	
5	Conductor	X2	1	Probe 2
6	Shielding	X2	2	

5.2.2 Ultrasonic sensor UC 5.0 (double-ray version)



Terminal box of the UC 5,0 sensor

Double-ray version

Converter UP 3.10	Connections	Sensor UC 5.0		Ultrasonic probe
Terminal strip X1		Terminal strip	Term.	
3	Conductor	X1	1	Probe 1
4	Shielding	X1	2	
5	Conductor	X2	1	Probe 2
6	Shielding	X2	2	
7	Conductor	X3	1	Probe 3
8	Shielding	X3	2	
9	Conductor	X4	1	Probe 4
10	Shielding	X4	2	

5.3 Sensor to converter connection cables

In operation, the meter sensor and converter are interconnected by coaxial cables.
To minimise induction interference through the connecting cables, the meter converter should be placed as close to the meter sensor as practicable.
Maximum distance between the meter sensor and converter: 100m with the difference in the cable lengths not exceeding 0.1m.

The cables are supplied with the flowmeter. The buyer shall specify the required cable length.

The flowmeter as supplied to the customer has been calibrated with the cables interconnecting the meter sensor and converter in place. The customer shall not modify or replace these cables. Any cable replacement shall be reserved to duly authorised service staff or the meter manufacturer.
The cable positions shall be fixed. Should any cable movement be permitted, the associated changes in capacitance might have detrimental effect on the measurement precision, especially at low fluid flow velocities.

5.4 Power supply and data communication cables

If used in normal operating environments, the cables need not meet any special requirements. Applied to the project design and meter installation can be procedures associated with standard electronic measurement and control equipment. Nevertheless, strict adherence is compulsory to the applicable national regulations and standards.

Shielded cables are required to connect the current output, Pt100 temperature sensor and the RS 485 communication line. **Shielding shall always be connected at one cable end only, at the side of the meter converter.**

Shielded cables are also recommended to be used for the connection of frequency and impulse outputs. **Here the shielding shall be connected at the cable end leading to the master data processing system.**

The flowmeter includes no power switch. Unless it is provided with line cable and plug, the meter installation shall be made complete with a separate power switch or circuit breaker (see clause 6.11.3.1 of standard ČSN EN 61010-1).
The protective conductor of the line cable connected to the PE terminal shall be longer than conductors L and N. Should the power cable be pulled from the cable bushing, the PE conductor shall be disconnected as the last.

5.5 Cable routes

To minimise electromagnetic interference, the cables from the meter sensor shall be laid at least 25cm away from the power cables to other electrical equipment.

The cable routes shall be chosen to prevent the risk of thermal degradation of the cable insulation due to nearness to hot technological equipment. All cables shall be led outside the thermal insulation on the piping. Cables in bushings shall be sealed tight and the bushing tightened using suitable tooling. Every cable shall be secured in position against incidental pulling from the bushing at a distance not exceeding 0.3m from the bushing.
When installing a cable into a bushing, make sure to form a “dripping loop” on the cable (the cable should extend about 30mm horizontally from the bushing and then a U-shaped loop aiming downwards should provide the desired draining effect).

5.6 Power supply specifications

Flowmeters SONOELIS SE404x and SONOELIS SE406x can be supplied in design versions with either AC or DC power supply:

AC 110V power supply
- 110VAC (95–132V), 50–60Hz, 15VA max.
- Internal fuse T 250mA / 250V

AC 230V power supply
- 230VAC (184–250V), 50–60Hz, 15VA max.
- Internal fuse T 250mA / 250V

DC power supply – the enhanced meter version
- 24VDC (19.2–28.8V), 15VA max.
- Internal fuse T 250mA / 250V

5.7 Input and output connections

5.7.1 Frequency output

Functions and parameters

- One frequency output: passive / active, insulated from the ground and other outputs
- Open collector: Umax = 30V, Imax = 20mA, common ground with impulse output
  - Active output: jumpers W4 and W6
  - Passive output: no jumpers
- Status at power failure: open
- Operational mode:
  - Frequency range: 0–10kHz, high-to-low ratio 1:1

In specific cases, the frequency output can be used in the so-called “uniform impulse” mode of operation. It is a special function where the frequency output generates low-frequency impulses with high-to-low ratio 1:1. Depending on the sensor dimension, assigned to each of these impulses is a specific “impulse number” ranging from 1 to 500 litres per second. The magnitude of the impulse number to be used in the “uniform impulse” mode of operation shall be agreed between the customer and meter manufacturer.
When selecting the “uniform impulse” mode of operation, the customer may not simultaneously utilise the current output (the current output signal would show incorrect data).

Connections to terminal strip X1		
Output	Terminal	
Frequency	14	+
	16	−

The frequency output signal quality depends on capacitance of the connecting cable. The adverse effect of the cable capacitance should be taken in account especially in cases where the output signal of frequency up to 10kHz needs be transferred over long distances.

Connection to the frequency output shall be made by a shielded cable.
The shielding shall be connected at the cable end leading to the master data processing system.

5.7.2 Impulse output

Functions and parameters

- One impulse output: passive / active, insulated from the ground and other outputs
- Open collector: Umax = 30V, Imax = 20mA, common ground with the frequency output
  - Active output: jumpers W5 and W6
  - Passive output: no jumpers
- Status at power failure: open
- Operational mode:
  - Impulses: maximum frequency 10 Hz
    impulse number selectable from the range 0.1 to 10,000 litres per impulse
    impulse length 50ms

The standard impulse number setting shall meet the condition $f_{imp} < 10Hz$.

Sensor size	DN	32	40	50	65	80	100	125	150	200	250	300
Imp. number	l/imp	1	1	5	5	5	10	10	50	50	50	100

Upon customer's request, other than the impulse numbers shown in the above table can be set in the manufacturing plant (including impulse numbers outside the standard values). More information can be found in Part 15, ORDER NUMBER.

Impulse number determination for impulse output frequencies <10Hz:

1. Impulse number calculation for f = 10Hz:

   Impulse number = Q_4 /36 (litres per impulse or m^3 per hour)

2. The calculated value will be rounded up to the nearest higher value from the standard series or to the value specified by the customer. This procedure will ensure that the impulse output frequency will not exceed the limit of 10Hz.

Connections to terminal strip X1		
Output	Terminal	
Impulse	15	+
	16	−

Connection to the impulse output shall be made by a shielded cable.
The shielding shall be connected at the cable end leading to the master data processing system.

5.7.3 Current output 4–20mA (0–20mA)

Functions and parameters

- One current output: active, insulated from the ground and out outputs
  Umax = 24V
- Current range: 4–20mA (0–20mA) corresponding to flow rates 0 to Q_4

Measured flow parameters:

- Volume flow rate
- Relative volume flow rate (in per cent of the overload flow rate Q_4)
- Mass flow rate (T)
- Relative mass flow rate (in per cent of the overload flow rate Q_4) (T)
- Volume (resulting/aggregate fluid volume)
- Volume + (fluid volume passed through the meter in positive direction) (O)
- Volume - (fluid volume passed through the meter in negative direction) (O)
- Mass (resulting/aggregate fluid mass) (T)
- Mass + (fluid weight passed through the meter in positive direction) (T), (O)
- Mass − (fluid weight passed through the meter in negative direction) (T), (O)
- Temperature (T)
- Density (T)
- Sound propagation velocity
- Fluid flow velocity in the sensor flange plane

Comment: Quantities "T" are measured and the measured data displayed only if the flowmeter assembly includes a thermometer; quantities "O" are measured and the measured data displayed only if the meter has been set for measurements in both fluid flow directions.

In cases of bidirectional measurement, a switching output is used to identify the fluid flow direction.

Connections to terminal strip X1		
Output	Terminal	
Current 4–20mA (0–20mA)	17	Shielding
	18	−
	19	+

Connection to the current output shall be made by a shielded cable.
The shielding shall be connected at the cable end leading to the meter converter.

5.7.4 Switching output

Functions and parameters

- One switching output: passive, insulated from the ground and other outputs
- Optotriac: Umax = 24VAC, Imax = 100mA
- Operational status: OFF or ON, depending on the meter setting
- Status at power failure: open
- Output setting options:
  In cases of single-direction measurement, the switching output can be set at OFF or ON for the following meter conditions:
  - Indication of measured values exceeding the volume flow rate limit value,
  - Indication of measured values exceeding the mass flow rate limit value,
  - Indication of measured values exceeding the specified fluid volume value,
  - Indication of measured values exceeding the specified fluid mass value,
  - Indication of measured values exceeding the specified temperature limit value,
  - Indication of flowmeter defect.

If the flowmeter configuration is for bidirectional measurement, the switching output function is reserved for the fluid flow direction indication.

Connections to terminal strip X1	
Output	Terminal
Switching	1
	2

The external power source for the switching output shall be of the AC type.

5.7.5 Fluid temperature measurement

Input: temperature sensor PT100
Connections: 4 wires

Connections to terminal strip X2		
Thermometer		Terminal
PT100	Lead A	1
		2
	Lead B	3
		4
	Shielding	5

Connections to the thermometer shall be made by shielded cables.
The shielding shall be connected at the cable end leading to the meter converter.

5.7.6 Communication interface RS-485

In enhanced meter versions, ultrasonic flowmeters SONOELIS SE404x and SONOELIS SE406x can be provided with an insulated serial line RS-485.

Recommended cable type: JYTY – AL, laminated foil 2Dx1 mm^2
Connections:

Terminal strip X1	Line conductors
11	+
12	–
PE	Shielding

Line parameters:
Transmission speed: 4,800 Bd
Data bits: 8
Stop bit: 1
Parity: Selectable for each data transmission direction.

Interface RS-485 makes possible communication between the flowmeter and master control system regarding collection and transmission of data such as:

- Instantaneous fluid volume and mass flow rate,
- Aggregate volume or mass of the fluid passed through the meter sensor,
- Power failure time,
- Meter failure time,
- Measurement time,
- Counter resetting information (volume, time),
- Information on fluid temperature and density.

RS-485 communication conditions:

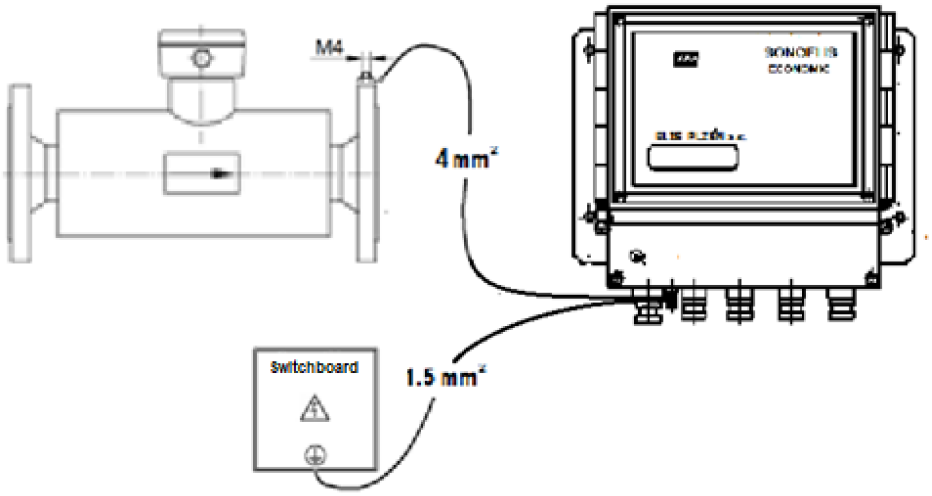
- Meter call frequency: maximum one call per ten seconds
- In cases of unsuccessful meter call (no reply): repeated call no sooner than after five seconds
- At each call, only one service can be required

While the communication is in progress, the system test is being carried out. This test may be accompanied by a short display flash. Such flash does not indicate any system defect.

The ELIS RS-485 communication protocol is described in manufacturer's manual:
Es 90452K/a Ultrasonic flowmeters SONOELIS SEXXXX, Communication Protocol RS-485

5.8 Grounding, potential equalisation

The grounding bolts on the meter sensor and converter shall be connected by a Cu wire of minimum cross-section of 4mm^2. At the same time, connect the grounding point on the converter with that on the power switchboard using a Cu wire of minimum cross-section 1.5mm^2.



These interconnections shall not be simultaneously used for potential equalisation of other equipment.

6 METER COMMISSIONING

6.1 Check on electrical connections

Prior to meter energising, make sure that:

- the line voltage complies with the specifications on the meter rating plate,
- the power network is provided with suitable protection devices,
- all terminals and electric contacts are properly tightened,
- the installation cables are:
  - free of any visible signs of damage,
  - connected to the correct terminals both in the meter and the cooperating master control system
  - secured against excessive stress (pulling from the bushings), and
- the required interconnections and the meter connection to the reference potential have been made according to the manual specifications.

6.2 Check on other installation details

To attain the equipment IP class referred to in Part 8, TECHNICAL DATA, make sure that:

- the installation cables are of the size corresponding to the cable bushing dimensions,
- dripping loops have been formed on the connecting cables,
- in the given meter position, no cable outlets or bushings aim upwards,
- all covers and lids on the meter boxes have been properly tightened.

After each service action check:

- the condition and integrity of all sealing elements and surfaces,
- tighten all cable bushings and box lids/covers with suitable tooling.

6.3 Check on the meter installation site

The flowmeter has been supplied calibrated, tested for correct operation and with parameters set according to the customer specifications.
Prior to the meter commissioning make sure that the meter has been installed in observance of the conditions in Section 4.4 above and that the adjacent technological equipment cannot adversely affect the meter operation by, among others:

- excessive external heating,
- thermal stress on the cable insulation,
- piping vibration or mechanical shock.

6.4 Check on the operating conditions

Prior filling the fluid piping with the meter installed make sure that the fluid parameters (temperature and pressure) will not exceed the limit values specified on the meter rating plate and that no risk to health or life of the operators may arise.

7 FLOWMETER OPERATION AND CONTROL

7.1 The ECONOMIC meter version

The converter of the SONOELIS SE404x or SONOELIS SE406x flowmeter in the ECONOMIC version has no display or keyboard and its functions are limited to conversion of the fluid flow parameters to electric signals.
About ten seconds after connecting to the power source, the meter will assume the measuring mode of operation with the frequency, impulse and current outputs activated. The output parameters have been set at the manufacturing plant according to the customer specifications.

7.2 The COMFORT meter version

Compared to the ECONOMIC version, the SONOELIS SE404x and SONOELIS SE406x flowmeters in the COMFORT design version are provided with two-line LC displays and four-button control keyboards. About ten seconds after connecting to the power source, the meter functions will be in operational condition whereby the following greeting text will appear on the display for about three seconds:

Flowmeter by
E L I S

7.2.1 Display

Shown on the display are the meter operational conditions and measured data values in configuration specified by the customer/user.
Upon connecting to the power supply, the meter will automatically assume the data display mode of operation with the so-called “selected quantity” displayed.

7.2.1.1 *Meter status information*

The last sign on the second display line is used to indicate the current meter status:

I	Meter electronic system initiation
+	Measurement in positive flow direction
-	Measurement in negative flow direction
C	Measured value calculations, output signal generation and data visualisation
W	Waiting
T	Data communication – sending mode

Under normal meter operation, the above symbols appear in turns on the display.
In cases of meter failure due to:

- sensor defect,
- sensor cable defect,
- air bubble or
- mechanical particle in the fluid piping,

the last sign appearing on the first display line will be “R” while the signs “I” and “+” will appear in turns at the end of the second display line.

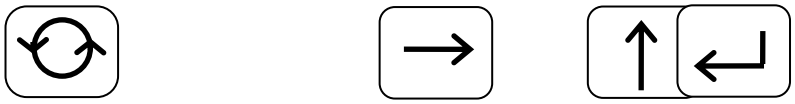
Should the electronic system of the meter fail, this alternating appearance of characters on the second display line will cease.

7.2.1.2 *Display functions*

Visualised on the meter display can be up to three measured quantities.
The first display line shows the instantaneous value of the volume or mass flow rate.
The second display line shows in turns the aggregate value of the fluid volume passed through the meter sensor (or the corresponding fluid weight) and the measured fluid temperature (provided the meter configuration makes temperature measurement possible).
The data alternation frequency can be set. The duration of the data appearance on the display depends on the number of measurement cycles.

7.2.2 Control pushbuttons

Using the converter keyboard, the user may, within the limitations of the user control menu, control, set and modify the flowmeter functions to adjust them to the current needs and character of the plant technology.



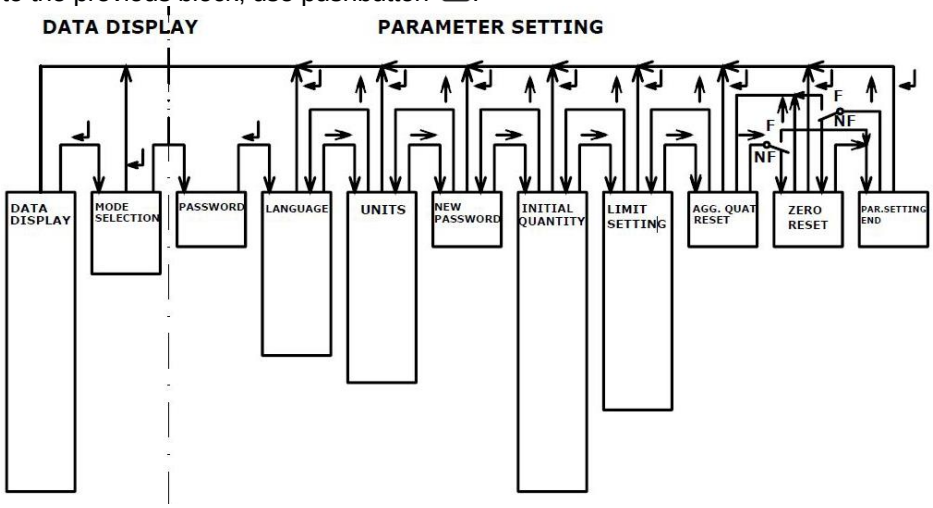
Pushbutton functions

- Item selection from the offered options (a cyclic function)
  Sign selection (+/−, decimal point, points in calendar date, colon in time information).
- Move to the previous menu block (to the left)
  Setting numeric values 0–9 (a cyclic function)
- Move to the next menu block (to the right)
  Move of the position for the setting of numeric values
- Confirmation of the current operation

Pushbutton control actions do not interfere with the meter measurement functions.

Schematic diagram of the meter control menu

The meter can be run in one of the two basic operational modes: the DATA DISPLAY and PARAMETER SETTING modes. To switch from one mode to the other and to move among individual function blocks use the pushbutton shown at the given interface position in the schematic diagram shown below. For example, to move from the LANGUAGE SELECTION to the UNIT SELECTION blocks, use pushbutton →. To return to the previous block, use pushbutton ↑.



Function block ZERO SETTING is available in technological meters only (the software switch in the NF position). In commercial meters (the switch in the F position) this block is not available.

7.2.3 Review of measured quantities

Volume flow rate		
Relative volume flow rate (in per cent of the overload flow rate Q_4)		
Mass flow rate	(T)	
Relative mass flow rate (in per cent of the overload flow rate Q_4)	(T)	
Volume (the resulting/aggregate volume)		
Volume + (passed through the meter sensor in positive direction)	(O)	
Volume - (passed through the meter sensor in negative direction)	(O)	
Mass (the resulting/aggregate mass/weight)		(T)
Mass + (passed through the meter sensor in positive direction)	(T), (O)	
Mass - (passed through the meter sensor in negative direction)	(T), (O)	
Temperature	(T)	
Density	(T)	
Sound propagation velocity		
Fluid flow velocity in the sensor flange plane		
Beginning of operational interval (date and time of the summary value resetting)		
Operation time		
Failure time		
Power failure time		
Calendar date		
Time		

Comment:
Quantities designated (T) are measured and the measured data displayed provided the meter configuration includes a thermometer; quantities designated (O) are measured and the measured data displayed provided the meter has been set for bidirectional measurements.

7.2.4 Measurement quantity units

The units in which the measured quantities are to be displayed shall be specified by the customer in the meter order form.

Volume flow rate	Mass flow rate	Volume		Mass	
m^3/h	t/h	1,000	m^3	1,000	t
m^3/min	t/min		m^3		t
m^3/s	t/s		l		kg
l/h	kg/h	1,000	bbl	1,000	ton
l/min	kg/min		bbl		ton
l/s	kg/s	1,000	ft^3		lb
bbl/h	ton/h		ft^3		
bbl/min	ton/min	1,000	gal		
bbl/s	ton/s		gal		
ft^3/h	lb/h				
ft^3/min	lb/min				
ft^3/s	lb/s				
gal/h					
gal/min					
gal/s					

Temperature	Density	Velocity
°C	t/m^3	m/s
°F	kg/m^3	ft/s
	g/cm^3	
	ton/m^3	
	lb/ft^3	

Unit names

Unit	Name
bbl	US barrel (fluid)
ft	foot
gal	US gallon
ton	US tonne
lb	pound
m^3	cubic metre
l	litre

Unit	Name
s	second
min	minute
h	hour
°C	degree Centigrade
°F	degree Fahrenheit
t	tonne
kg	kilogram

7.2.5 Unit conversion constants

Volume flow rate	1 m^3/h =	0.01666667 m^3/min 0.0002777778 m^3/s 1,000 l/h 16.66667 l/min 0.2777778 l/s 6.289387 bbl/h 0.1048231 bbl/min 0.001747052 bbl/s 35.31467 ft^3/h 0.5885778 ft^3/min 0.009809630 ft^3/s 264.1708 gal/h 4.402846 gal/min 0.07338077 gal/s
Mass flow rate	1 t/h =	1.102311 ton/h 0.01837185 ton/min 0.0003061975 ton/s 2,204.623 lb/h 36.74371 lb/min 0.6123952 lb/s
Volume	1 m^3 =	6.289387 bbl 35.31467 ft^3 264.1708 gal
Mass/weight	1 t =	1.102311 tonne 2,204.623 lb
Density	1 t/m^3 =	1.102311 ton/m^3 62.42797 lb/ft^3
Temperature	t_F =	32 + 1.8 t_c
Velocity	1m/s =	3.280840 ft/s

7.2.6 Data display mode

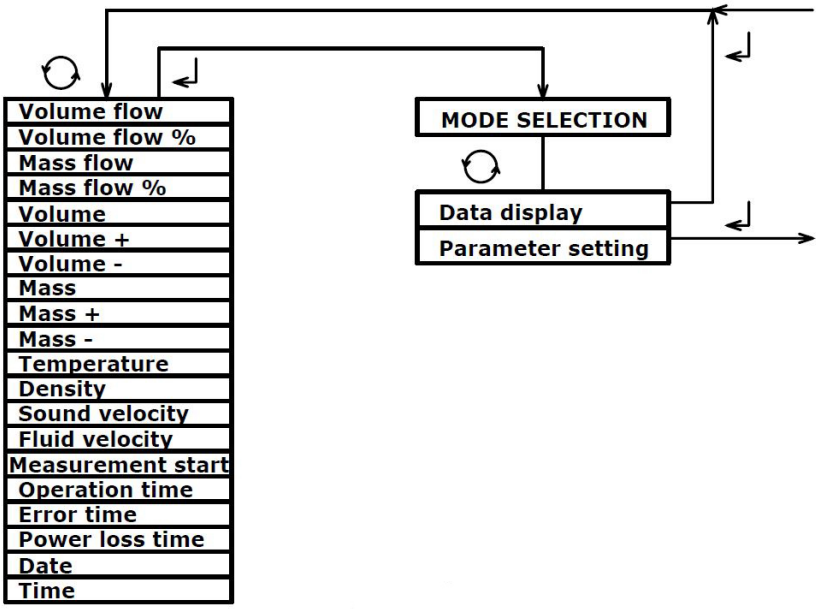
The list of measured quantities included in Section 7.2.3 applies to the enhanced meter design version. In the data display mode of operation, each of these quantities can be selected to be visualised. The first display line shows the quantity name in one of the seven optional languages (Czech, English, German, Russian, Spanish, Italian and French), the second line the quantity value and the associated measurement unit.

Upon meter energising, the data display mode is automatically selected with the initial quantity value shown on the display.

Use pushbutton ⟲ to display the next item on the list of the measured quantities. Unless the same button is activated within five minutes again, the display will automatically return to visualising the initial quantity.

Use pushbutton ↵ in the DATA DISPLAY block to move to the MODE SELECTION block where the required mode can be selected by pushbutton ⟲. Upon confirmation of this selection by pushbutton ↵, the meter will enter the selected mode.

Data display mode of operation



7.2.6.1 *Volume flow rate*

The instantaneous volume flow rate value is displayed in the form of three- or four-digit number (as specified by the manufacturer with respect to the type of meter application). If the meter has been set for bidirectional measurement, the sign of plus or minus will appear before the number. The positive sign indicates fluid flow in the direction of the arrow on the meter sensor, the negative sign the opposite flow direction.

7.2.6.2 *Relative volume flow rate*

The figure on the display is the volume flow rate value in per cent of the overload flow rate Q_4.

7.2.6.3 *Mass flow rate*

Provided the flowmeter configuration includes a thermometer and the relationship between the fluid density and temperature is known, displayed is the mass flow rate under similar conditions as described in Section 7.2.5.1. If no thermometer has been installed, this display mode selection by pushbutton ⟲ will be automatically skipped.

7.2.6.4 *Relative mass flow rate*
See the comments in Section 7.2.5.2.

7.2.6.5 *Volume*
The displayed quantity is the aggregate flow volume passed through the meter sensor from the beginning of the current operational interval. The start of an operational interval is given by actuation of the S1 resetting pushbutton or receipt via the RS-485 communication line of the resetting command from the master control system or by actuation of the meter keyboard pushbuttons as described in Section 7.2.6.7 below.

The basic resolution in volume display is 0.01 litre. The displayed figure may have up to seven valid digits. Should the volume value exceed the seven-digit format, is will be displayed in the form of E^n (n =1,2 … 9). The maximum value that may appear on the display is $2.8x10^9$ m^3.
In cases of bidirectional measurement, the volume value is equal to the difference between the fluid volumes passed through the meter sensor in the positive and negative directions (the “resulting volume”). The resulting volume will then be denoted as “plus” or “minus”.

7.2.6.6 *Volume +*
This quantity will only be displayed if the meter has been set for bidirectional measurement. Volume + is the fluid volume passed through the meter sensor in the direction of the arrow on the sensor body. Regarding the format and scope of the displayed values, see Section 7.2.5.5.

7.2.6.7 *Volume –*
See Section 7.2.5.6., but for the opposite fluid flow direction.

7.2.6.8 *Mass*
See Section 7.2.5.5, but for fluid mass display. The basic resolution in mass display is 0.01 kg.

7.2.6.9 *Mass +*
See the comments in Section 7.2.5.6.

7.2.6.10 *Mass –*
See Section 7.2.5.7.

7.2.6.11 *Temperature*
Temperature may only be displayed if the flowmeter configuration includes a thermometer. The measurement resolution is 0.1°C.

7.2.6.12 *Density*
Fluid density may only be displayed if the flowmeter configuration includes a thermometer.

7.2.6.13 *Sound propagation velocity*
Displayed is the acoustic signal propagation velocity in the measured fluid.

7.2.6.14 *Fluid flow velocity*
Displayed is the flow velocity of the measured fluid in the sensor flange plane.

7.2.6.15 *Beginning of operational interval*
The calendar date, hour and minute of the beginning of the recent operational interval (the latest resetting of the aggregate measured values).

7.2.6.16 *Operation time*
The period in hours, minutes and seconds elapsed since the recent beginning of the operational interval during which the flowmeter performed measurements without any defects.

7.2.6.17 *Failure time*

The period in hours, minutes and seconds elapsed since the beginning of the recent operational interval during which the flowmeter has been energised but did not perform measurements due to a defect.

7.2.6.18 *Power failure*

The period in hours, minutes and seconds elapsed since the beginning of the recent operational interval during which the meter was not energised.

7.2.6.19 *Calendar date*

Information on the current calendar date.

7.2.6.20 *Time*

Information on the current time of the day.

7.2.7 Parameter setting mode

Upon entering the parameter setting mode (as described in Section 7.2.2.), the meter will ask the operator for the password consisting of a four-digit number.

7.2.7.1 *Password entry*

The top display line will display the legend:

PASSWORD

In the first position on the bottom display line will appear the number of 0. By repeated actuation of pushbutton ↑ increase the number always by one; after 9 will follow 0 again. After selecting the correct number in the first position, move to the second position by actuating pushbutton → where 0 will appear. Repeat the procedure until the correct password. i.e. combination of four numbers appears on the bottom display line.

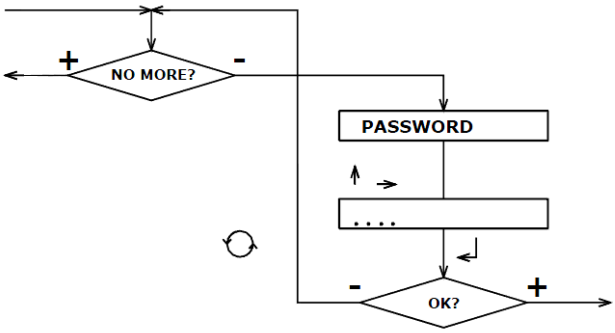
Confirm the complete password by actuating pushbutton ↵. Provided the correct passwords has been entered, the system will move to the LANGUAGE SELECTION block. If the password is wrong, the system will require a new password entry.

After three unsuccessful attempts at password entry the system will switch to the data display mode and will not permit any more attempts at entering the parameter setting mode. To have a chance to enter the parameter setting mode in such situation, the operator must switch the meter power off and on again.

Should the user forget their password, it is possible to use the manufacturer's password (0200). The procedure of entering the manufacturer's password is as follows: switch off the meter power supply, actuate pushbutton ↵, actuate and hold in depressed position pushbutton ↵ white switching on the power supply again.

Upon entering the parameter setting mode, the user may change their password using the procedure described in Section 7.2.6.4.

Password check


+
NO MORE?
-
PASSWORD
....
-
OK?
+

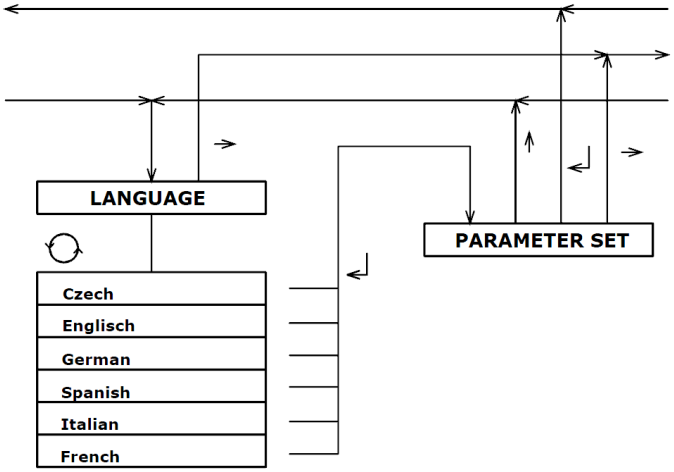
7.2.7.2 *Language selection*

The user may choose any of the seven communication languages stored in the meter memory. The language selection is the very first step following successful password entry and opening of the parameter setting mode of operation. The top display line will then read

LANGUAGE SELECTION

in the previously chosen communication language. The initial language setting will be Czech or the language specified by the customer in their order documentation. Shown on the bottom display line will be the language name, e.g. Czech. Actuate repeatedly pushbutton ⟲ to select the desired language and confirm your selection by pushbutton ↵. The message on the display will then confirm the selection in the recently specified language.

Language selection procedure



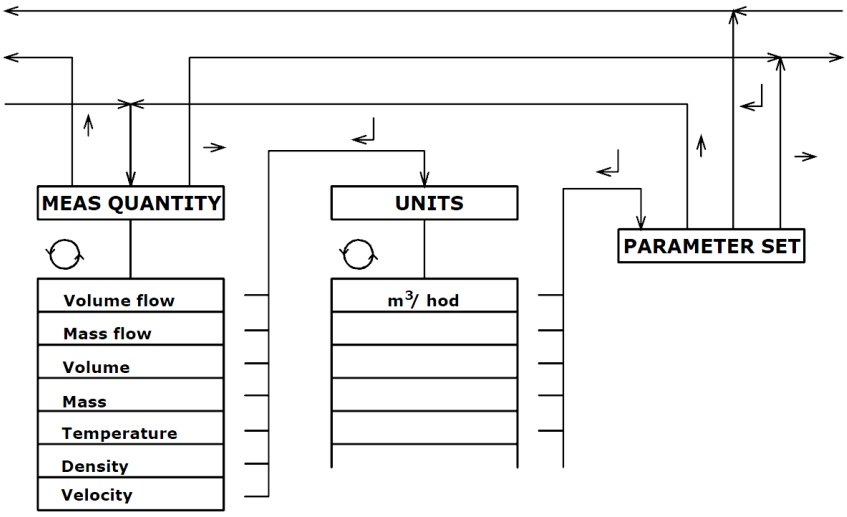
7.2.7.3 *Unit selection*

The unit selection procedure makes it possible to assign to each measured quantity the physical unit in which the measured values are to be displayed.
The top display line will first read

UNIT SELECTION

with the quantity name shown on the bottom line. Use pushbutton ⟲ to select the desired quantity. Upon actuating pushbutton ↵ the quantity name will move to the top line while on the bottom line will appear one of the relevant measuring units. Select the required unit by pushbutton ⟲ and confirm your selection by actuating pushbutton ↵. Using ↑ select another measured quantity or move on to the next step in meter parameter setting by actuating pushbutton →.

Unit selection procedure

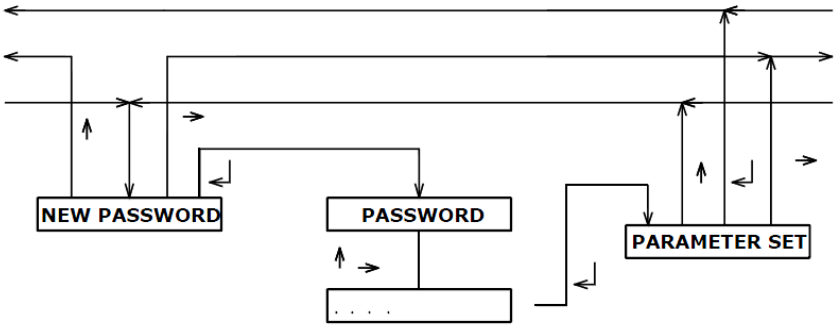


7.2.7.4 *New password*

NEW PASSWORD

The user may change the password needed to enter the parameter setting mode at any time. Upon actuating pushbutton ↵ the meter will invite the user to define the new password. In the first digital position on the bottom line will appear "0". Proceed with the password number setting as described in Section 7.2.6.1. above. Confirm your selection by pushbutton ↵ whereby the word DONE will appear on the display. From that moment on the parameter setting mode may only be entered with the new password.

New password definition procedure

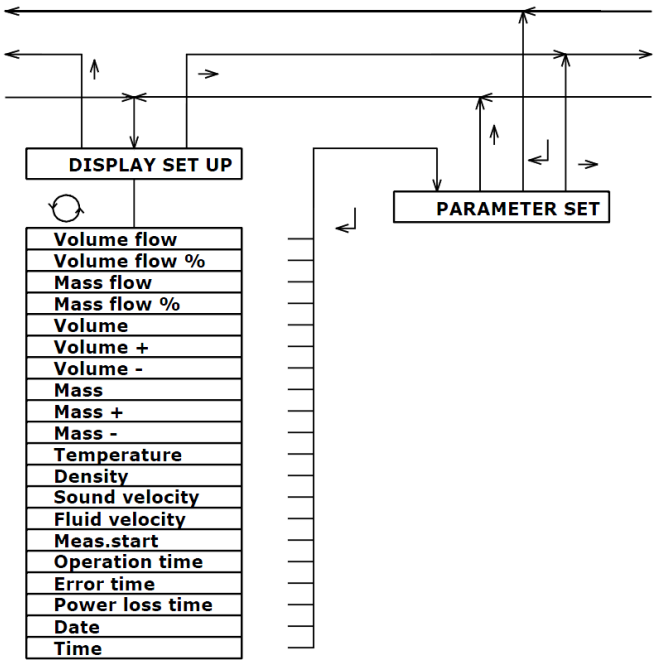


7.2.7.5 *Selection of the initial measured quantity*

INITIAL QUANTITY

Shown on the bottom display line will be a quantity name. Using pushbutton ⟲ select the desired initial quantity and confirm your selection by pushbutton ↵. The display will then show the word DONE.

Initial quantity selection procedure



7.2.7.6 *Parameter setting*

PARAMETER SETTING

Select the parameter by pushbutton ⟲ and confirm your selection by ↵. The parameter name will then move to the top display line with the most recently set measuring unit shown on the bottom line (excepting calendar date and time). This measuring unit will always be the same as that selected for the respective measured quantity. For example, if volume flow rate is displayed in litres per second, then the limit volume flow rate will also be set in litres per second. If the meter has been set for mass flow rate measurement and the measured data are displayed in tons, the impulse number will also be set in tons.
Upon actuating pushbutton →, the legend on the bottom display line will be replaced by “0”. Use pushbuttons ↑ and → to set the desired number where pushbutton ⟲ is reserved for insertion of special signs (the decimal point in numbers and point and colon with calendar date and time).

Setting of days of the week:

0 – Sunday
1 – Monday
2 – Tuesday
3 – Wednesday
4 – Thursday
5 – Friday
6 – Saturday

A decimal number shall have no more than seven digits. The date and time information shall include initial zeroes (for example the date 3 July 2001 shall be written as 03.07.01, the time 9h 7min as 09:07:00).

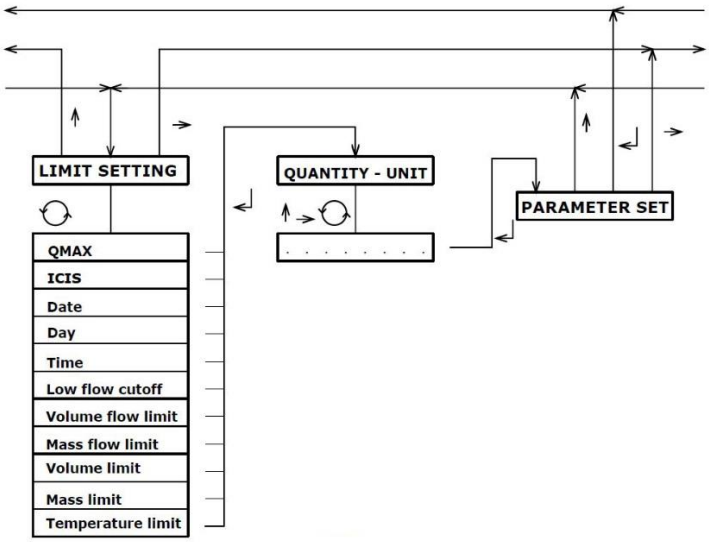
The parameter setting shall be confirmed by pushbutton ↵. In cases of commercial meters, overload flow rate Q4, impulse number or meter insensitivity parameter cannot be set by the user (this setting is reserved to an authorised testing laboratory). The setting of these parameters will not be included among the meter specifications.

Review of meter parameters:

Qmax	maximum flow rate (overload flow rate Q_4 in given measurement units)
ICIS	impulse number specifying flow volume or mass (in given measurement units) per one impulse at the impulse output
Date	current calendar date
Day	current day of the week
Time	current time
Insensitivity	flow rate value in per cent of the overload flow rate Q_4 below which the meter displays zero flow rate value and the zero values are also indicated at the meter outputs
Limit vol.f.r.	The limit volume flow rate is the flow rate value at which the switching output is actuated (provided such output has been assigned to this measured quantity)
Limit m. f.r.	The limit mass flow rate with similar function as that described for the limit volume flow rate
Volume limit	The limit flow volume value with similar function as that described for the previous three parameters
Mass limit	The limit flow mass, see the previous four parameters
Temp. limit	The limit temperature, see the previous five parameters

All meter parameters shall be set in measurement units selected using the procedure described in Section 7.2.6.3. Should alternative measurement units be selected, the parameters values need be redefined to prevent meter malfunction.

Parameter setting procedure


LIMIT SETTING
QUANTITY - UNIT
PARAMETER SET
QMAX
ICIS
Date
Day
Time
Low flow cutoff
Volume flow limit
Mass flow limit
Volume limit
Mass limit
Temperature limit

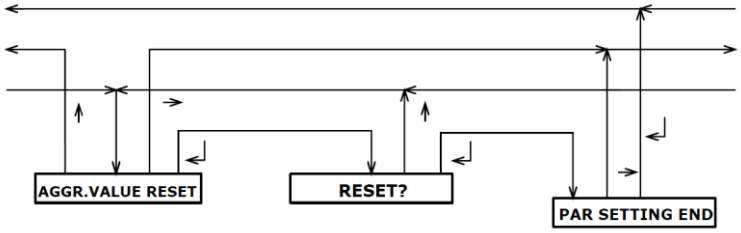
Resetting of aggregate quantities

Upon entering this block, the words REGISTER RESETTING will appear on the display. You may skip this function be actuating pushbutton ⊡. For resetting of the summation registers, use pushbutton ↵. The meter will then ask:

RESETTING DESIRED?

By pushbutton ↑ you may return to the beginning of this procedure without any resetting action performed. To continue with resetting, actuate pushbutton ↵. Resetting concerns all aggregate flow values (both volume and mass), time periods (operation and failure times, power supply failure period), while the beginning of a new operation period (calendar date, hour and minute) will be defined where the completion of these operations will be reported on the meter display by the message of COMPLETED.

Summation register resetting



7.2.7.7 *Zero setting*

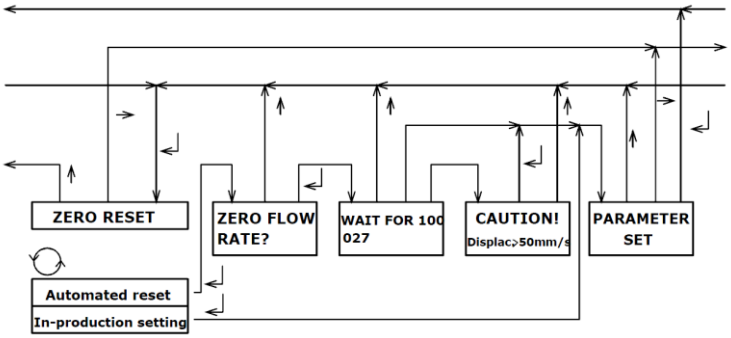
Prior to leaving the manufacturing plant, the correct setting of each flowmeter is carefully checked. One of the parameters set in production is the meter zero. It means that at zero flow rate (zero fluid flow velocity through the meter sensor) the measured flow rate (flow velocity) is zero. The zero setting (i.e. zero shift) is expressed in mm/s. The zero shift determined in the manufacturing plant is referred to as production setting and its value is stored in the meter memory.
The ageing of the meter component parts and other conditions during the meter operation may result in a slight shift of the meter zero. Its ready correction can be done by the zero-setting block.

The zero-setting procedure should be reserved to extraordinary situations where the user suspects incorrect measurement in the realm low flow rates. The setting procedure requires that zero flow rate through the meter sensor can be maintained. Make sure to check tightness of the closing valves in the piping.

Upon entering the zero-setting block, the meter will offer the options of production and automatic setting. The selection is done by pushbutton ⟲, confirmation by pushbutton ↵. In the production setting option, the zero shift value determined in the manufacturing plant is selected.
In the automatic zero setting mode, the meter will first ask if the fluid flow rate is really zero (the essential condition for successful zero setting). If it is not, you may return to the beginning of the process by actuating pushbutton ↑. Upon confirmation by pushbutton ↵ the meter will display the instruction WAIT FOR 100. The setting procedure requires 100 measuring cycles. The current cycle number is shown on the bottom display line.
After 100 measuring cycles the zero shift will be determined. Provided it does not exceed 50 mm/s, the measured value will be stored and the display will report DONE. Should the shift be greater than 50 mm/s, a message to this effect will appear on the meter display.
The latter situation is rather improbable, and it is recommended to make sure again that no fluid is passing through the meter sensor. Use pushbutton ↑ to return to the beginning of the process and pushbutton ↵ to start the zero setting procedure again.

The ZERO SETTING block is only available in technological meters (not in commercial ones).

Zero setting procedure



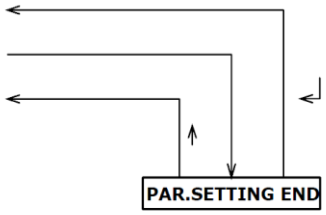
7.2.7.8 *End of parameter setting exercise*

At the end of the chain of parameter setting blocks you arrive at

SETTING COMPLETED

By actuating pushbutton ↵ the system will move to the data display mode of operation. Should you wish to return to any of the setting operations, actuate pushbutton ↑ to return to the previous block.

End of parameter setting



7.2.8 Automated test

The automated meter test is only available in the COMFORT meter version. This test is reserved to extraordinary situations where the meter does not work although apparently all required operational conditions have been met.
Prior to running the test make sure to check

- the meter converter and sensor connection,
- power supply connection,
- complete sensor flooding and
- arrange for zero fluid flow rate.

Start the test by switching off the power supply, then actuate pushbutton S1 (volume resetting) and, holding pushbutton S1 depressed, switch the power supply on again. Upon releasing the pushbutton, the following message will appear on the meter display:

TEST
SENSOR FULL?

If this is the case, i.e. the meter sensor is complete flooded, activate shortly pushbutton S1 again. The display will then read:

LIQUID
DOES NOT FLOW?

If you are sure that the fluid flow rate is really zero, activate shortly pushbutton S1 again. This action will start the test of the ultrasonic signal passability through the measure fluid in direction 1:

TEST
UTS THROUGH 1

If the test result is satisfactory, message “OK” will appear on the display for about four seconds whereby the passability test in the opposite fluid flow direction will be started:

TEST
UTS THROUGH 2

After successful completion of this partial test the test process continues with the display of the amplification values related to the ultrasonic signal passed in both direction, for example:

UTS THROUGHPUT
D1 = 4,56 D2 = 4,55

These values are of informative nature only. Under normal circumstances the values should be between 4.00 and 4.00, and their difference not exceed 0.10.
After about 4s the system will start measurement of the ultrasonic signal propagation velocity.
The top display line will read:

UTS RATE

After the measurement taking about 1s the measured value will be shown on the bottom display line, for example:

1510,6 m/s

If the measured value lies within limits specified by the manufacturer for the given liquid, the display message will read:

RATE LIMITS OK
END OF TEST

After another 4s the meter will commence normal operational measurements.

Should the test indicate a passability error, the message on the meter display will have “ER” instead of “OK”. Then, after 4s, the automated probe cleaning process will start and continue for five minutes. During that time, the display will read:

CLEAN.UTSP 5 MIN
1111111……..

The numbers on the bottom display line show the progress of the cleaning process. During each minute, one “1”, “2”, “3” etc. is added every four seconds so that the line will eventually fill up with 15 identical numbers at the end of each of the five minutes. With the probe cleaning process completed, another signal passability test will be carried out. If its result is still negative, shown on the meter display will be the following message:

DEFECT
END OF TEST

The flowmeter will have to be dismantled from its installation place and either sent for repair to the manufacturer or a serviceman invited to come and check the meter condition on site.

If an error is indicated in velocity measurement, i.e. the measured velocity value lies outside physically possible limits (VUTS < 900 m/s, VUTS > 1700 m/s), the probe cleaning process will be started (unless it has been already done) and the ultrasonic signal velocity measurement repeated. Should the result still be negative, the following message will appear on the display:

DEFECT
END OF TEST

and the test series will be ended.

If the measured velocity value lies outside the specified limits but inside those physically possible, the display message will read:

UTS RATE LIMITS
ADJUSTMENT

whereby the specified velocity limits will automatically be adjusted with respect to the measured velocity value. The meter display will then show the following message:

RATE LIMITS OK
END OF TEST

and the meter will after 4s switch to the normal measurement mode.

Should the meter in this situation still not work properly, the test sequence can be repeated. A failure to restore satisfactory meter performance even then will necessitate removal of the meter from operation and communication with the manufacturer regarding meter service or repair action.

8 TECHNICAL DATA

Basic meter parameters	
Measurement principle	Fluid flow velocity measurement by ultrasonic signals, the transit time method
Fluid flow velocity measurement scope	0.1–10 m/s
Rated piping sizes	Standard sizes: DN32 to DN300 for SE404x (1-ray meter version) DN40 to DN300 for SE406x (2-ray meter version) Special: NPS 1¼“ to 12“
Meter design	Remote version
Ultrasonic probe material	Stainless steel, grade 1.4571
Meter sensor design	Flange-type: UC 3.0 (DN32 to DN300) UC 5.0 (DN40 to DN300)
Construction materials	Converter box: plastic Sensor connection box: die casting, Al alloy Sensor: measuring pipe – stainless steel 1.4301 Flanges and sensor housing: standard version – carbon steel enhanced – stainless steel 1.4301
Surface finish	Sensor connection box: powder paint Flanges and sensor housing: standard version – powder paint
Power supply	**Standard meter version:** Line voltage AC 110V • 110VAC (95–132V), 50–60Hz, 15VA max. • Internal fuse T250mA / 250V Line voltage AC 230V • 230VAC (184–250V), 50–60Hz, 15VA max. • Internal fuse T250 mA / 250V **Enhanced meter version:** • 24VDC (19.2–28.8V), 15VA max. • Internal fuse T250mA / 250V

Back-up battery	Li battery 3 V (lifetime 5 years)
Operating environment	Free of explosion risk
EMC-environment class	A,B,C/E1,E2
Protection class	Converter: IP 65 Sensor: standard meter version IP 67, enhanced version IP 68
Pressure loss	See Section 3.3, Sensor dimensions
Start-up time	30 minutes

Functions and properties	
Meter display	Two-line alphanumeric LC display (2 x16 characters)
Control panel	4-button keyboard
Languages	Czech, English, German, Russian, Spanish, Italian, French
Measurement units	Metric US GB
Functions	Single / bidirectional measurements of: • volume flow rate • fluid volume passed through the meter sensor • fluid temperature • physical properties of fluid Communication with external devices
Zero insensitivity	Adjustable within the range of 0.1 to 25% Q_4
Status following power failure	Summation registers: status unchanged Meter configuration and parameters: unchanged Frequency/impulse/switching outputs: open

Process parameters	
Fluid temperature	Standard meter version 0°C to +150°C Enhanced version −20°C to +180°C
Pressure class	PN 16 / Class 150 PN 40 / Class 300
Solid particle content	≤ 2%
Gas content	≤ 5%

Measurement precision	
Reference conditions	See Part 9, CALIBRATION
Measurement precision at reference conditions	Standard meter version: according to standard ČSN EN ISO 4064-1 • class 2 for temperature class T30 • class 3 for temperature classes T50, T90 and T130 Enhanced meter version: to be agreed with the manufacturer

Ambient conditions	
Operational temperature **Relative humidity**	Standard range: +5°C to +55°C 80% max.
Storage temperature	−10°C to +70°C at relative humidity not exceeding 70%

Outputs	
One current output 4–20mA (0–20mA)	Active, insulated from the ground and other outputs
One frequency output	Passive, insulated from the ground and other outputs U_{extmax} = 30V, Imax = 20mA Active, insulated from the ground and other outputs U = 24V, Common GND with impulse output Open collector Frequency range 0–10kHz, high-to-low ratio 1:1

One impulse output	Passive: insulated from the ground and other outputs U_{extmax} = 30V, Imax = 20mA Active: insulated from the ground and other outputs U = 24V, Common GND with frequency output Open collector Impulses: maximum frequency 10Hz impulse length 50ms impulse number range 0.1 to 10,000 litres per impulse
One switching output	Passive: insulated from the ground and other outputs Umax = 30VAC, Imax = 100mA
Communication interface	RS-485, insulated from the ground and other outputs

Cables	
Power supply	Standard cables used with measurement and regulation equipment
Data transfer cables	Twisted pair, shielded
Connecting cables for remote meter version	Coaxial cables supplied with the meter: 2 pcs SONOELIS SE404x, 4 pcs SONOELIS SE406x Standard length: 6m Maximum length: 100m
RS-485 communication cable	JYTY – AL, laminated foil 2Dx1mm^2,
Cable bushings	Remote meter version: • Converter: UP 2.10 (1 measuring ray) 1 x PG 9, 5 x PG 7 UP 3.10 (2 measuring rays) 1 x PG 9, 7 x PG 7 • Sensor connection box (UC 3.0): 2 x PG 9 • Sensor connection box (UC 5.0): 4 x PG 9

9 CALIBRATION

9.1 General

The flowmeter is supplied from the manufacturing plant with its functions verified, calibrated and parameters set according to the customer requirements.
The measurement precision of flowmeters in standard design version is guaranteed in accordance with international standard ČSN EN ISO 4064-1: Water meters for cold drinking water and hot water.

Unless agreed otherwise with the customer, the flowmeters are calibrated using the frequency output 0–1kHz.
Upon special request and agreement with the meter manufacturer, the calibration procedure may be carried out using other types of output, i.e. impulse or current outputs.
The guaranteed meter precision parameters are always related to the type of electric output used for the meter calibration. The remaining two uncalibrated outputs are recommended to be employed in applications with the measurement precision lower by 1-2% than that of the calibrated output.

In on-site verification or comparison measurements or metrological verification tests shall always be selected the electric output used in the initial meter calibration at the manufacturing plant. During these tests, it is also necessary to strictly maintain the specified reference conditions.

In all precision verification tests special attention shall be paid to the connection of the hydraulic meter part (the meter sensor) to the hydraulic circuit in the test stand. The connecting elements, whether flanges, fittings or connection pieces required in food-processing plants, shall be of exactly the same type, size and manufacturing standard as used on the meter sensor so that no hydraulic disturbance would appear at the connection zones that might adversely affect the meter measurement precision.

9.2 Reference conditions

Measured fluid: water, temperature 22°C ±4K
Ambient temperature: 22°C ±2K
Straight piping sections: ≥ 10 DN at the input and 5 DN at the output of the meter
Fluid pressure at the meter output: min. 1 bar
Temperature stabilisation time: > 30 min
The meter sensor shall be correctly centred, with the power supply and grounding as specified in the meter manual

9.3 Measurement precision

9.3.1 Flowmeters SONOELIS SE404x and SE406x; standard measurement precision requirements

The basic parameters of flowmeters SONOELIS SE404x and SONOELIS SE406x are given by standard EN ISO 4064-1 (OIML R 49).

Fluid flow rate definitions:
Q_4… overload (maximum) flow rate,
Q_3… rated/operational flow rate,
Q_2… minimum flow rate for specified measurement precision,
Q_1… minimum flow rate,
Q_{NEC}… threshold flow rate sensitivity value of the meter sensor,

Where it holds:

$$\frac{Q_4}{Q_3} = 1.25 \qquad \frac{Q_2}{Q_1} = 1.6$$

Flow rate values for various sensor dimensions according to standard ČSN EN ISO4064-1
Flowmeters SONOELIS SE404x and SONOELIS SE406x

Rated sensor diameter	Overload flow rate (m^3/h)	Regular flow rate (m^3/h)	Transition flow rate (m^3/h)	Minimum flow rate (m^3/h)	Threshold sensor insensitivity* (m^3/h)
DN	Q4	Q3	Q2	Q1	Q_{NEC}
32	20	16.0	0.32	020	0.07
40	32	25.6	0.51	0.30	0.09
50	50	40.0	0.80	0.50	0.14
65	80	64.0	1.30	0.80	0.22
80	150	120.0	2.40	1.50	0.37
100	240	192.0	3.84	2.40	0.60
125	350	280.0	5.60	3.50	0.90
150	500	400.0	8.00	5.00	1.20
200	900	720.0	14.40	9.00	2.20
250	1 400	1 120.0	22.40	14.00	3.50
300	2 000	1 600.0	32.00	20.00	5.00

When used as component parts of heat meters, ultrasonic flowmeters SONOELIS SE404x and SONOELIS SE406x have the flow rate values determined in reference to standard ČSN EN 1434.

Flow rate values for various sensor dimensions according to ČSN EN 1434
Flowmeters SONOELIS SE404x a SONOELIS SE406x

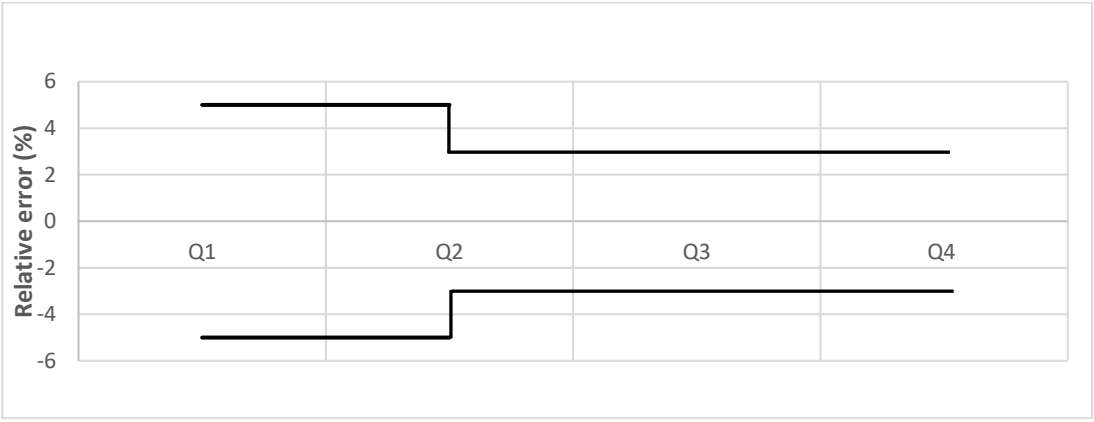
Rated sensor diameter	Maximum flow rate (m^3/h)	Regular flow rate (m^3/h)	Minimum flow rate (m^3/h)	Threshold sensor insensitivity* (m^3/h)
DN	q_s	q_p	q_{min}	q_{NEC}
32	20	10	0.2	0.07
40	32	16	0.32	0.09
50	50	25	0.5	0.14
65	80	40	0.8	0.22
80	150	75	1.5	0.37
100	240	120	2.4	0.60
125	350	175	3.5	0.90
150	500	250	5	1.20
200	900	450	9	2.20
250	1 400	700	14	3.50
300	2 000	1 000	20	5.00

where
- q_s is maximum flow rate
- q_p is rated operational flow rate
- q_i is minimum flow rate
- q_{NEC} is insensitivity in flow rate measurement

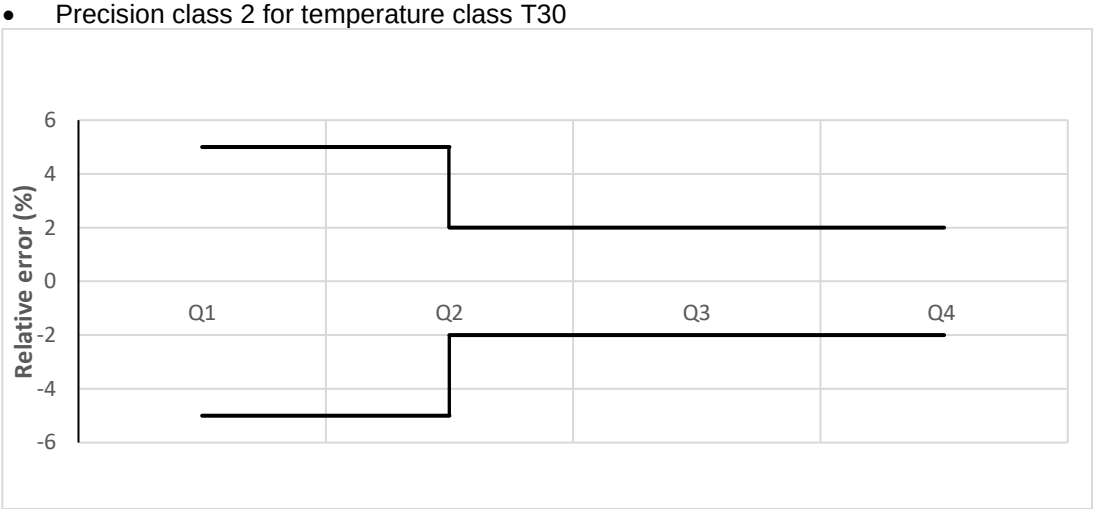
The flow rate value at which the meter starts to take in and evaluate the data on the fluid passing through the meter sensor.is set at the manufacturing plant equal to q_{NEC}/Q_{NEC} (corresponding to the fluid flow velocity of 20 mm/s). Upon the customer request, this production setting can be changed to anything between q_{NEC}/Q_{NEC} = 0.1 and 25% of q_s/Q_4.

In the cases of standard meter version, the relative error of ultrasonic flowmeters SONOELIS SE404x and SONOELIS SE406x is determined through three-point calibration and meets the requirements of standard ČSN EN ISO 4064-1 (OIML R49):

- Precision class 3 for temperature classes T50, T90 and T130



- Precision class 2 for temperature class T30



9.3.2 Enhanced meter precision

Higher flowmeter precision can be achieved through calibration in more than three points.

Ultrasonic flowmeter SONOELIS SE404x (1 measuring ray**)**
Precision ± 1% for flow rates Q > Q_2 and the fluid temperature not exceeding 50°C

Ultrasonic flowmeter SONOELIS SE406x (2 measuring rays)
Precision 0.5% for flow rates Q > Q_2 and the fluid temperature not exceeding 50°C

The meter precision is specified for the zero flow rate setting and reference conditions.
Upon agreement, the manufacturer can supply flowmeters with other than standard precision.

10 METER DESIGN DETAILS

10.1 Converter

The transmitter of the flow meter is built into a plastic box with IP 65 protection. The box is mounted on a steel plate, which allows the transmitter to be mounted on the wall using 4 screws with a maximum ø 5 mm. The box lid bears information about the flowmeter type designation and the manufacturer's name and trademark.
The system rating plate is located on the right side of the box, the transmitter plate is located on the left.
In the lower part of the box, is a connection terminal box under the removable cover.
Depending on the meter design version (ECONOMIC or COMFORT), the converter box lid is either compact or provided with a display and meter control keyboard.
The two-line display is of the backlighted LC-type, the membrane keyboard includes four pushbuttons.

Upon opening the box, accessible only are

- the connection terminal strip,
- meter configuration jumpers and switches,
- volume resetting pushbutton and
- an RS-232 CANON connector (reserved for the manufacturing and servicing purposes).

The connecting cables shall be brought to the terminal strip through plastic bushings (1 x PG 9 and 5 x PG 7, or 1 x PG 9 and 7 x PG 7).
Located next to the cable bushings is the PE terminal to be used for grounding and protection by potential equalisation.
Regarding the converter terminal connections, see Part 5, ELECTRICAL CONNECTIONS.

10.2 Sensor

As to external design and dimensions for installation with the same piping sizes, there is no difference between the single-ray (UC 3.0) and double-ray (UC 5.0) sensors, only the terminal box is adapted to facilitate connections of two or four cables.

The sensor is essentially a weldment consisting of internal tube with welded-on pieces for ultrasonic probes, flanges and external housing. The internal tube is made of alloy steel, the flanges and cover of carbon or alloy steel.
Sensor UC 3.0 includes two ultrasonic probes.
Sensor UC 5.0 includes four ultrasonic probes.

Attached to the sensor housing is a connection box with a terminal strip. The box is provided with two or four PG 9 bushings and a special valve preventing air humidity condensation inside the box.

Unless specified otherwise, the meter sensor is provided with flanges according to standard ČSN EN 1092-1. Upon agreement with the manufacturer, other types of flange may be used or flanges of all-stainless-steel design.

The sensor parts made of carbon steel and the connection box are provided with a powder paint finish of hue RAL 7035 or other colour according to the customer specifications.

The standard sensor protection class is IP 67. In cases of optional protection class IP 68 the connecting cables are fixed in position on the terminal board and the whole connection box is packaged with insulation compound.

Attached to the sensor body are the sensor rating plate and arrow showing the positive direction of the fluid flow.
Regarding the terminal connections of the ultrasonic sensors, see Part 5, ELECTRICAL CONNECTIONS.

10.3 Bushing dimensions

Remote meter version

- Converter: UP 2.10 (1 measuring ray) 1 x PG 9, 5 x PG 7
  UP 3.10 (2 measuring rays) 1 x PG 9, 7 x PG 7
- Sensor connection box: UC 3.0 - 2 bushings PG 9
  UC 5.0 - 4 bushings PG 9

10.4 Meter seals

Ultrasonic flowmeters of the type series SONOELIS SE404x and SONOELIS SE406x are supplied to the customers calibrated, tested as to their functions and with parameters set according to the customer specifications. Upon completion of all manufacturing and testing operations, the meters are provided with seals.

Technological meters

- Two manufacturing seals are placed on the lid of meter converter.
- Another manufacturing seal is placed on the lid of the sensor connection box.

Broken manufacturing seals will render void the user's right to warranty services, i.e. free-of-charge meter repairs within the agreed warranty period.

Commercial meters

The metrologically verified meters used for commercial purposes are provided with official verification seals.

Seal positions

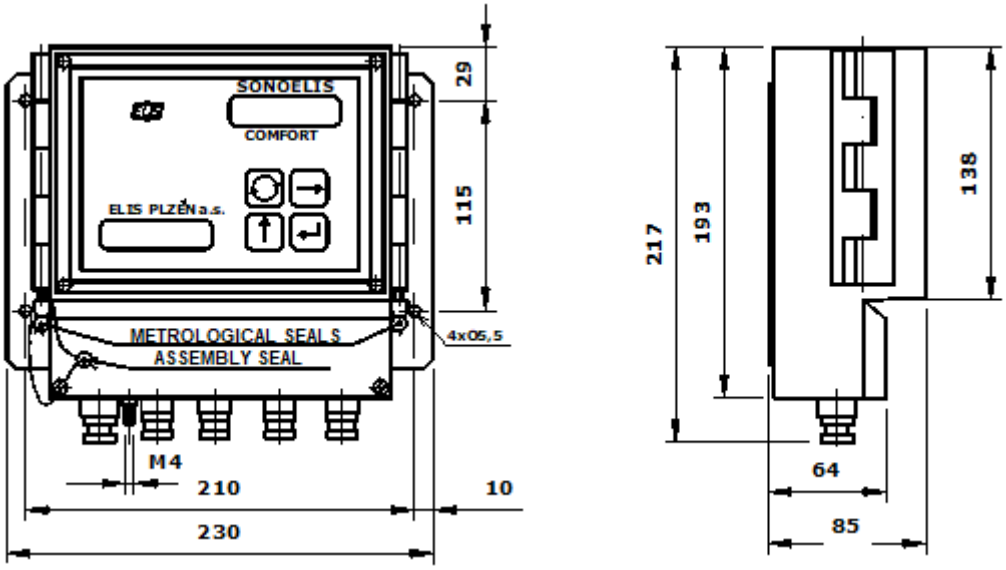
- The system type plate (located on the right side of the converter box) is fixed in position by means of two unremovable sticks-on labels bearing the official verification mark.
- The metal sheet cover protecting the electronic system of the meter against unauthorised access is secured in position by means of two seals with the imprints of an official mark.
- The connection box lid of sensor is secured in closed position by means of unremovable stick-on labels bearing the official verification mark.

Upon the meter installation in the plant technology, the assembly organisation staff will secure the terminal cover in closed position by means of two assembly seals with the imprints of an official mark.

10.5 Meter size and weight

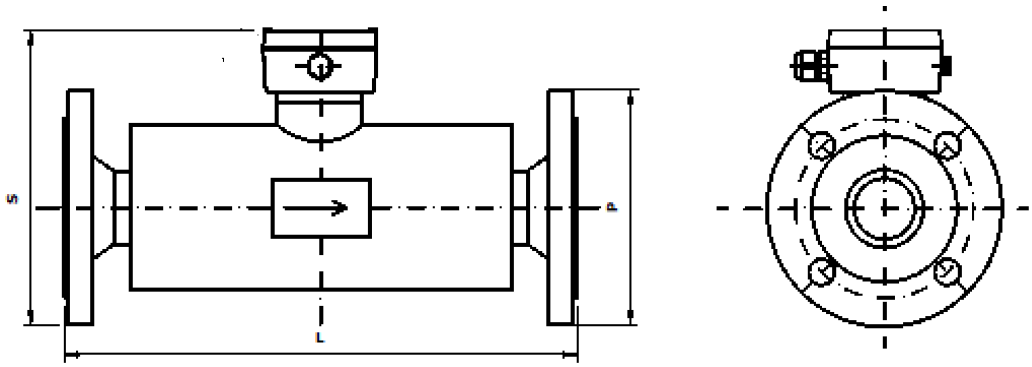
10.5.1 Converter

10.5.1.1 *Converter of the remote meter version (COMFORT AND ECONOMIC)*



Converter weight: approximately 1.5kg

10.5.2 Sensor



10.5.2.1 *Flanges ČSN EN 1092-1*

Sensors UC 3.0 and UC 5.0 **Flanges ČSN EN 1092-1**

Rated inner diameter	Rated pressure	ø P (mm)	S (mm)	L (mm)
DN32	PN16 PN40	140	181	360
DN40	PN16 PN40	150	191	360
DN50	PN16 PN40	165	206	360
DN65	PN16 PN40	185	220	360
DN80	PN16 PN40	200	237	360
DN100	PN16	220	256	360
	PN40	235	263	
DN125	PN16	250	285	360
	PN40	270	296	
DN150	PN16	285	314	360
	PN40	300	321	
DN200	PN16	340	361	450
	PN40	375	379	
DN250	PN16	405	419	450
	PN40	450	441	
DN300	PN16	460	471	450
	PN40	515	499	

Flanges ČSN EN 1092-1

Rated inner diameter	Ultrasonic sensor weight * (kg)			
	Sensor UC 3.0		Sensor UC 5.0	
	PN 16	PN 40	PN 16	PN 40
DN32	9	9	-	-
DN40	9	9	9	9
DN50	11	11	11	11
DN65	12	12	12	12
DN80	15	15	15	15
DN100	17	17	17	17
DN125	18	20	18	20
DN150	19	21	19	21
DN200	28	37	28	37
DN250	45	70	45	70
DN300	58	84	58	84

Comment: * The weight data are of informative nature only

10.5.2.2 *Flanges ASME B16.5*

Sensors UC 3.0 and UC 5.0 **Flanges ASME B16.5**

Rated inner diameter	Rated pressure	ø P	S	L
1 1/4 "	Class 150	115	181	360
1 1/2 "	Class 150	125	191	360
2 "	Class 150	150	206	360
2 1/2 "	Class 150	180	220	360
3 "	Class 150	190	237	360
4 "	Class 150	230	256	360
	Class 300	255	263	
5 "	Class 150	255	285	360
	Class 300	280	296	
6 "	Class 150	280	314	360
	Class 300	300	321	
8 "	Class 150	345	361	450
	Class 300	380	379	
10 "	Class 150	405	419	450
	Class 300	445	441	
12 "	Class 150	485	471	450
	Class 300	520	499	

11 FLOWMETER DEFECTS

Prior to any meter handling, installation or operation it is necessary that the user or the service company staff carefully read the meter documentation.

Any meter repairs are reserved to the manufacturer or the duly authorised service centre.

Meter repairs may only be performed by:

- Operators trained with the manufacturer for work with flowmeters of the type series SONOELIS SE404x and SONOELIS SE406x,
- Staff duly qualified for work with electronic equipment and measuring devices and trained for work on electrical equipment of rated voltage up to 1,000V according to Czech Regulation No 50/1978 Coll. or the corresponding national standard.
- In performing the meter service activities, the operators shall observe the national regulations and standards related to work on electrical equipment with special regard to labour safety and health protection.

The manufacturer shall not be liable for any product damage caused by the user or service provider.

12 MAINTENANCE

Flowmeters SONOELIS SE404x and SONOELIS SE406x do not need any special maintenance. During regular inspections it is recommended to check the tightness of cable bushings and grounding terminals and check the external meter parts for signs of mechanical damage.

Converter
The powder-paint finish of the converter box surface can be cleaned using standard cleaning agents and procedures applicable to maintenance of measuring devices.

Avoid application of abrasive cleaning agents for cleaning of the viewing window or rubber seals.

Sensor
External surfaces of the meter sensor can be cleaned using standard procedures applicable to maintenance of measuring devices. Regarding the piping system maintenance, it is not permitted to clean the internal sensor parts using the PIGS method (a mechanical cleaning process) as such procedure involves a risk of the ultrasonic probe damage. If the sensor is removed for maintenance from its position in the piping, clean only the input and output leading parts by a cleaning agent with degreasing and abrasive effects (e.g. a liquid cleaning cream).

13 SERVICE

General principles
Prior to sending the meter for maintenance or repair to the authorised service centre or the manufacturer, make sure the meter is thoroughly decontaminated.

Representation on decontamination
In accordance with the valid regulations regarding environment conservation, labour safety and health protection, the meter user shall enclose to their request for meter repair a representation in writing on the meter decontamination. A model form of such representation is shown in Part 17, ANNEXES.

Any costs of the meter decontamination incurred at the manufacturing plant will be charged to the customer.

A meter that cannot be decontaminated shall not be sent to the service provider.

14 WARRANTY

14.1 Warranty services

Warranty services primarily consist of product repairs performed free of charge within the agreed warranty period either at the manufacturing plant or the premises of an authorised manufacturer's partner.

Warranty repairs are all product repairs performed free of charge within the agreed warranty period in cases where the product defect originated due to defective material, product part or deficient workmanship.
Should the product defect originated due to any of the above reasons prove irreparable, the customer shall receive a new product free of charge.
Warranty repair actions are reserved to the manufacturer, duly authorised service centres or authorised product distributors. Such authorisation may obtain third parties based on a written certificate and upon thorough training of the service staff in the manufacturing plant.

Exempted from the warranty service/repair liability shall be:

- products with broken manufacturing or metrological seals,
- defects caused by incorrect meter assembly or installation procedures,
- defects due to errors in electrical connections or product installation,
- defects due to incorrect meter application,
- defects due to mechanical damage,
- defects due to the action of force majeure or natural disaster,
- products lost or stolen.

A requirement for warranty repair shall be sent to the product manufacturer in writing (by E-mail fax or registered letter).
Should the manufacturer resolve that the required repair cannot be acknowledged as a warranty repair, this fact will be communicated to the customer in writing and the repair costs will be invoiced to them.

14.2 Post-warranty services

Post-warranty service is understood to cover any and all product defects and repair actions originating and performed after the end of the agreed warranty period. All such repairs (whether performed at the manufacturer's plant or elsewhere as required by the customer) shall be invoiced by the service provider to the customer and paid by the latter.
A requirement for post-warranty repair shall be sent to the product manufacturer in writing (by E-mail fax or registered letter).

15 ORDER NUMBER

The form for the order number definition can be found at the manufacturer's web site:

http://www.elis.cz

as the **Specification table for ultrasonic flowmeter SONOELIS SE40xx**.

- In filling out the table the customer shall adhere to the instructions contained in Part 3, METER DESIGN AND MATERIAL OPTIONS.
- In reference to standard ČSN EN ISO 4065-1, the value of Q used in setting the meter output parameters is defined as q_s/Q_4.

16 RELATED DOCUMENTATION AND STANDARDS

Standards

ČSN EN ISO 4064-1	Water meters for cold drinking water and hot water
ČSN EN 1434-1	Heat meters
ČSN EN 1092-1	Flanges and flange connections
ASME B16.5	Pipe Flanges and Flanged Fittings
ČSN EN 13480	Metal industrial piping
ČSN EN 61010-1	Safety requirements concerning electric measuring, control and laboratory equipment
ČSN EN 60664-1	Low voltage equipment insulation co-ordination

Product manual

Es 90452K/a	Ultrasonic flowmeters SONOELIS SEXXXX, communication protocol RS485

17 ANNEXES

17.1 Representation on decontamination

REPRESENTATION ON DECONTAMINATION

CUSTOMER		**ADDRESS**		
		Name	Telephone	
FLOWMETER TYPE		Delivery date	Delivery note	
Production series number				
MEASURED FLUID				
FLUID PROPERTIES AND ASSOCIATED RISKS				
Toxic		Biologically hazardous		
Corrosive		Risk of burns		
Flammable		Detrimental to environment		
Other risks				
The flowmeter sensor cavities have been emptied and cleaned out				
Fluid traces have been removed from the external meter surfaces				
Residual contamination	Yes			
	No			
WHEN WORKING WITH THE METER, USE:				
Safety gloves				
Safety glasses				
Protective shield				
Respirator				
Protective clothing				
Laboratory hood				
Special safety measures:				
This is to confirm that the flowmeter has been properly decontaminated. If the above safety and protective equipment are used, the flowmeter handling will constitute no risk to health or environment.				
Date	Place	Signature		

17.2 EU conformity representation

EU PROHLÁŠENÍ O SHODĚ

Firma ELIS PLZEŇ a.s. Luční 425/15
301 00 Plzeň
Česká republika
IČO: 25210068

Název: ULTRAZVUKOVÝ PRŮTOKOMĚR

Typ: SONOELIS SE40XX

Výrobní číslo:

Funkce a určení: výrobek je určen k použití jako pracovní měřidlo pro měření okamžitého průtoku a celkového protekléhо množství vody a technických kapalin.

Tímto prohlašujeme na svou výhradní odpovědnost, že výše uvedený výrobek splňuje požadavky nařízení vlády č. 117/2016 Sb.

Použité normy, na jejichž základě se prohlašuje shoda:

NV č. 117/2016 Sb., 2014/30/EU
ČSN EN 61000-4-2, ed.2:2009
ČSN EN 61000-4-3, ed.3:2006+A1+A2+Z1
ČSN EN 61000-4-4, ed.3:2013
ČSN EN 61000-4-5, ed.2:2007+Z1
ČSN EN 61000-4-6, ed.4:2014+Z1
ČSN EN 61000-4-8, ed.2:2010
ČSN EN 61000-4-11, ed.2: 2005
ČSN EN 55011, ed.3:2010

Pro prohlášení shody bylo použito protokolů o zkoušce EMC, čísla protokolů 15-34 vydaných Elektrotechnickou laboratoří č. 1090 FEL ZČU v Plzni

V Plzni dne: 21. 04. 2021

Jméno: Petr Mareška
Funkce: výrobní ředitel

Podpis:

strana 1 z 1

Es90010H/d
2.10.2019

ELIS PLZEŇ a.s.
LUČNÍ 425/15
301 00 PLZEŇ
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FAX: +420 377 517 722
e-mail: sales@elis.cz
http://www.elis.cz

IČO: 25210068
DIČ: CZ25210068

ELIS PLZEŇ a.s. je zapsaná v OR, vedeném KS v Plzni, oddíl B, vložka 631. Datum zápisu 19.5.1997

17.3 MID certificate

Manufacturer's address and contact information:

ELIS PLZEŇ a. s.
Luční 425/15
301 00 Plzeň
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Tel.: +420/377 517 711
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