Ultrasonic heat/cold meter

SONOTHERM SN3070

CONTENT

1. APPLICATION

The meter system SONOTHERM SN3070 is intended for measurement of absolute heat/cold quantities (energy) transferred by water in closed-circle heating/cooling systems. It can be used as commercial meter to determine the heat/cold quantities used or transferred at heated/cooling premises, heat-exchanger stations or at heat/cold-generating plants. The system consists of a flow-measuring section (ultrasonic flow meter) and an electronic calorimeter including the necessary data processing and archiving facility.

2. MEASUREMENT PRINCIPLES

2.1. Measuring part of ultrasonic flow meter

The flow meter section is based on a single-channel "transit-time" impulse method where the flow rate of the measured liquid is determined from the flight time of ultrasonic signal between the sensor probes. The ultrasonic signal is sent and flow-rate measurements are performed in turns in and against the flow direction whereby the error due to non-symmetric positions of the ultrasonic probes is eliminated.

The ultrasonic signal propagation time in the flow direction in flow sensor UC 7.0 is defined by the equation

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

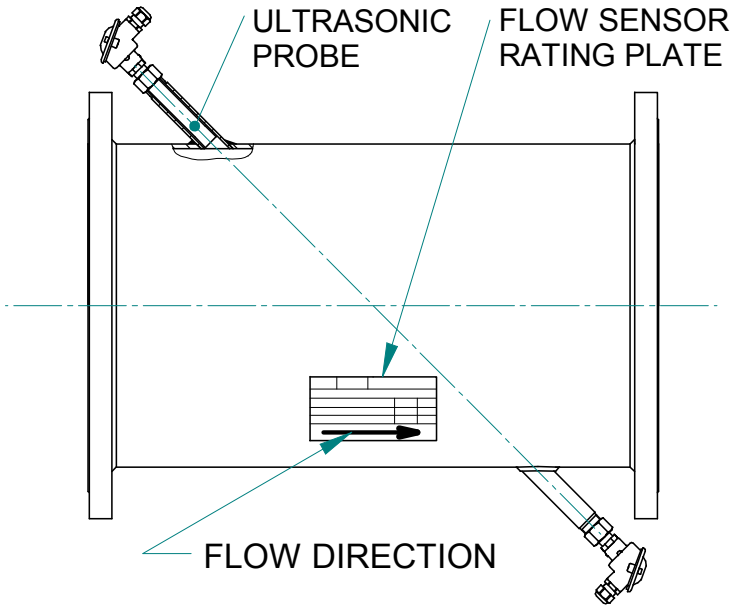


Fig. 1 - Dimensional sketch of the measuring part

where l - distance between the head parts of ultrasonic probes [m]
c - signal propagation speed in the given liquid [m/s]
v - flow speed of the measured liquid [m/s]
l_1 - aggregate thickness of bottom parts of both probes [m]
c_1 - signal propagation speed in the probe material [m/s]

When the ultrasonic signal travels in the direction against the flow, the expression for the signal propagation time t_2 differs from t_1 in that the flow speed is negative:

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

Parameters l_1 a c_1 are constants for the given sensor probe.

The ultrasonic signal propagation speed can be expressed as follows:

$v_1 = c + v \,.\, \cos\alpha$ for measurements in the flow direction

$v_2 = c - v \,.\, \cos\alpha$ for measurements against the flow direction

The difference between the ultrasonic signal propagation speeds in and against the flow direction is proportional to the liquid flow speed v [m/s].

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

The instantaneous flow rate can be determined using the equation:

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

where v - liquid flow speed [m/s]
s - sensor cross-section [m^2]
k(v) - correction coefficient (a function of the instantaneous liquid speed).
This coefficient modifies the resulting q with respect to the liquid flow speed profile in the sensor.

2.2. Measuring part of calorimeter

The calculation of the heat power value uses the following formula; it is assumed that the heat exchanger is absolutely tight and no heating water is being extracted from the heating system.

$$q_t = q_m \cdot \left[i_1(t_1) - i_2(t_2)\right] = q_v \cdot \rho(t) \cdot \left[i_1(t_1) - i_2(t_2)\right]$$

with the following instantaneous parameter values:

q_t	- heat power transferred by heating water	[J/h]
q_m	- mass flow rate of heating water	[t/h]
q_v	- volume flow rate of heating water	[m^3/h]
$i_1(t_1)$	- enthalpy of water in the feed piping	[J/kg]
$i_2(t_2)$	- enthalpy of water in the return piping	[J/kg]
$\rho(t)$	- specific density of heating water	[kg/m^3]
t	- water temperature at flow-rate measurement spot	[°C]
t_1	- water temperature (higher temperature of medium)	[°C]
t_2	- water temperature (lower temperature of medium)	[°C]

The quantity of heat transferred Q is defined as the integral over time of the instantaneous heat power values:

$$Q = \int_t q_t \, dt \qquad \left[J\right]$$

3. TECHNICAL DESCRIPTION

3.1. General description

The meter system SONOTHERM SN3070 determines the heat/cold quantity delivered or transferred by calculation in a calorimetric counter using data on the water volume passed through the ultrasonic flow meter and the water temperatures in the feed and return pipes.

Type designation of meter systems and their component parts:

System	Accessory electronic unit	Flow sensor
SN3070	MTU 2.00	UC 7.0

The quantity of heating/cooling water passed through the feed or return piping is measured by means of an ultrasonic flow meter. The water temperatures in the feed and return pipes are measured by two resistance platinum temperature sensors Pt 100 or Pt 500. These measured data are processed in a calorimetric counter with LCD display. The operator can select the data to be displayed using a multifunction control button (see the table defining the display codes in either *Operational* or *Testing modes* on page 16 – Chapter 7).

Electronic communication with the meter system is possible using either the M-Bus interface (EN 1434-4 standard) or the IR interface on the front panel. The M-Bus signals are connected to the meter terminal board.

In the cases of a line voltage failure, the ultrasonic flow meter will discontinue operation but not the calorimeter where a back-up battery will supply the necessary power. The calorimeter will thus save all hitherto measured data and record the period of power down time. The calorimetric counter also has specific diagnostic functions; it can identify thermometer failures (shorts or open circuits) or their combinations – see the error codes on page 19.

3.2. Meter connection to heating system

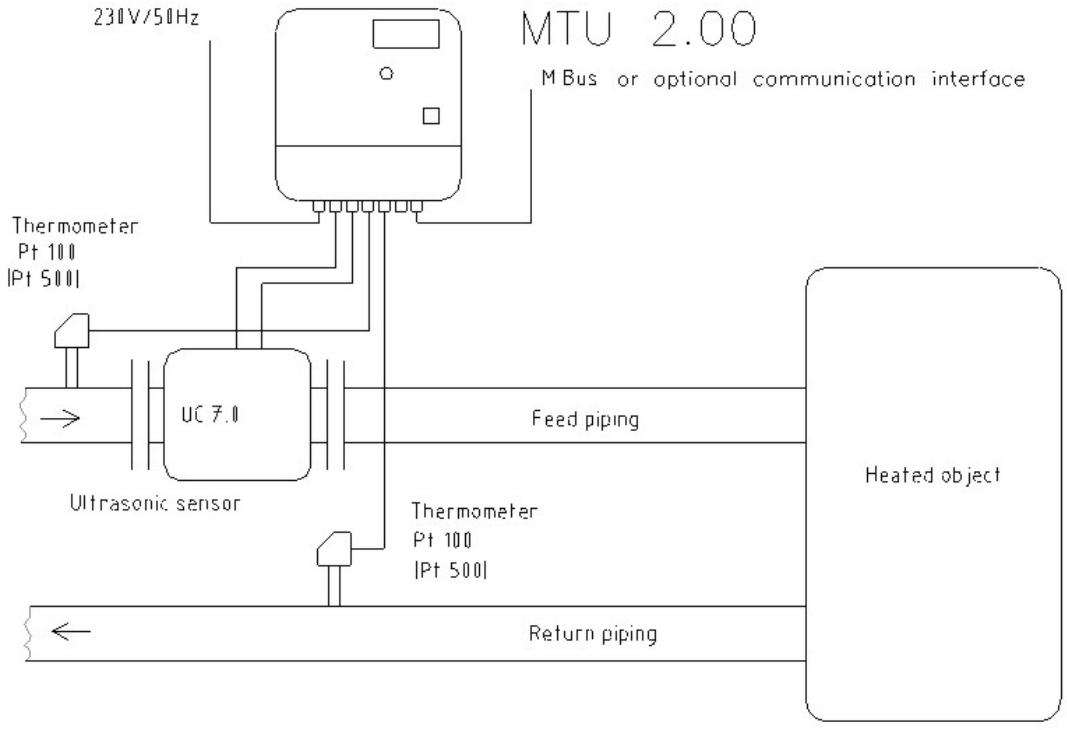


Fig. 2 - Meter connection to heating system

Cooling system: Thermometers for measuring of cold have to be connected to the piping by opposite way. Description of connection is in chapter 6.2.

3.3. Meter design

3.3.1. Ultrasonic sensor UC 7.0

The sensor body is a welded piece consisting of two end flanges to be connected to the piping, the main pipe section and two pipe branches holding the ultrasonic probes (see Fig. 1). In the standard sensor version the body is designed for operating pressure PN 10, made of high-quality steel and the flanges are according to standard ČSN EN 1092-1; the whole assembly is coated with powder epoxy paint KOMAXIT E 2310 of light grey hue (RAL 7035).

On special request, the sensor body can be supplied: - in a stainless-steel version
- with ANSI or JIS flanges
- in version for PN 16 or PN 25 (piping sizes up to DN 500)

Sensors for application in drinking-water supply systems are coated with powder epoxy paint KOMAXIT E 2110 of blue hue (RAL 5017).

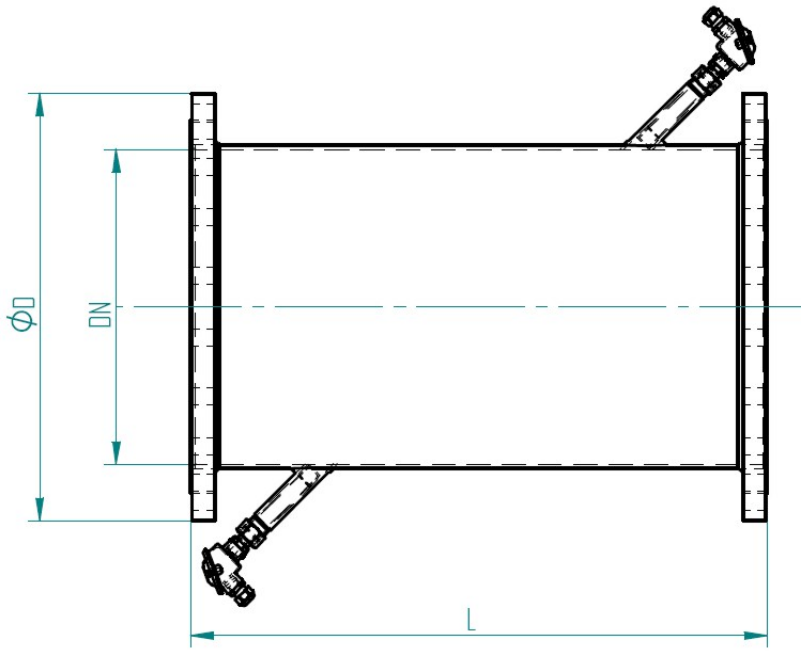


Fig. 3 - Dimensional sketch of the meter sensor

DN	200	250	300	350	400	450	500	600	700	800	1000	1200
NPS	8“	10“	12“	14“	16“	18“	20“	24“	28“	32“	40“	48“
L [mm]	600	650	700	750	800	850	900	700	800	850	1000	1150
D [mm]	340	395	445	505	565	615	670	780	895	1015	1230	1455
Weight [kg]	41,5	53,5	68	89	113	136	161	182	292	378	632	978

Table 1 - Sensor dimensions

3.3.2. Electronic to flow meter

The electronic accessory to the flow meter is housed in a plastic box with internal metal coating. The calorimetric counter, type MTU 2.00, is located in the same box. The ultrasonic sensor is connected to its electronic accessory by means of two coaxial cables of adequate length.

Regarding function, the electronic accessory to the flow meter can be divided into the following parts:

- circuits isolating the meter probes
- switches controlling the probe signals
- ultrasonic sender
- ultrasonic receiver including sensitivity-control circuitry
- interface circuits communicating with the data processing computer
- computer
- output circuits generating impulses for the calorimetric counter
- circuits of the serial communication line (the flow-meter setting)
- power source.

There is also an adaptive filter eliminating fast changes of instantaneous flow rate resulting from pulsation of the liquid flowing through the piping, actions of the flow-control elements and other disturbing events from outside the piping. In a flow meter of standard design, this filter causes a delay of several seconds of the sensor output data with respect to the actual flow rate in the sensor.

However, the electronic accessory of the ultrasonic flow meter can be modified so as to ensure a very fast response to the quickly changing mass flow data. This modification finds application in systems where instantaneous flow rate needs be measured and monitored as fast as possible, e.g. in heat exchanger and transfer stations where fast regulation processes take place.

3.3.3. Calorimeter

The electronic calorimetric counter is a modern microprocessor-based device used in combination with an ultrasonic flow meter to measure heat energy for commercial purposes. The calorimeter can process and store large quantities of data so that the user has detailed information on the current status of the measuring point as well as the measured data over long periods of time.

The counter input receives signals from the impulse sender of the flow meter and two temperature sensors. With each impulse from the flow meter received, the temperatures of the incoming and outgoing liquid are measured. The temperature data and flow meter impulses are stored in the internal memory circuits of the counter. The heat energy data are calculated using the data on the temperature difference, flow rate and the associated thermal coefficients; these data are integrated in the counter memory and their aggregate values shown on the counter display.

If the frequency of the output impulses from the flow meter is higher than 1Hz, the impulses (representing the flow volume passed through the meter) are cumulated and the heat measurements are taken once a second.

If the interval between impulses exceeds 60s, each 60s temperature readings are taken and shown on the counter display; but the heat measurement/calculation takes place only after the next impulse from the flow meter is received.

4. TECHNICAL SPECIFICATIONS

4.1. Rated inner diameters and limit flow rates for sensor UC 7.0

Using Table 2, select the correct sensor size with respect to the required measuring range.
The data in the Table are taken from standard ČSN EN 14154-1.

Rated piping diameter DN		200	250	300	350	400	450	500	600	700	800	1000	1200
Q_4 overload flow rate	m^3/h	1000	1200	1500	1800	2000	2300	2500	3000	3600	4100	5100	6100
	G/min	4403	5283	6604	7925	8806	10127	11007	13209	15850	18052	22455	26857
Q_3 permanent flow rate	m^3/h	800	960	1200	1440	1600	1840	2000	2400	2880	3280	4080	4880
	G/min	3522	4227	5283	6340	7045	8101	8806	10567	12680	14441	17964	21486
Q_2 transitional flow rate	m^3/h	16	19,2	24	28,8	32	36,8	40	48	57,6	65,6	81,6	97,6
	G/min	70,44	84,53	105,67	126,80	140,89	162,02	176,11	211,34	253,60	288,83	359,27	429,72
Q_1 minimum flow rate	m^3/h	10	12	15	18	20	23	25	30	36	41	51	61
	G/min	44,03	52,83	66,04	79,25	88,06	101,27	110,07	132,09	158,5	180,52	224,55	268,57
Q_{NEC} suppressed flow	m^3/h	2,3	3,6	5,1	7,0	9,1	11,5	14,2	15	18	20,5	25,5	30,5
	G/min	10,1	15,8	22,4	30,8	40,1	50,6	62,5	66,0	79,2	90,2	112,3	134,3
Pulse output constant k_i	l/imp	500	500	500	1000	1000	1000	2000	2000	5000	5000	10000	10000
	G/imp	100	200	200	200	200	500	500	500	500	1000	1000	1000

Table 2 - Ranges of measured values for given piping sizes

The threshold flow rate (Q_{NEC}) is the minimum flow rate at which the meter starts to indicate and process the fluid flow parameters. At the manufacturer's plant, Q_{NEC} is set at a value corresponding to the flow velocity of 20mm/s. On customer's request, the threshold flow rate can be set at any value within the range of Q_{NEC} = 0.1 ÷ 25% Q_4.

The maximum permitted error in fluid volume measurements at flow rates between Q_1 (including) and Q_2 (excluding) is: 5% irrespective of the fluid temperature.

The maximum permitted error in fluid volume measurements at flow rates between Q_2 (including) and Q_4 (including) is: 1% for the fluid temperature not exceeding 50°C, and
3% for the fluid temperature greater than 50°C.

4.2. Technical parameters of Ultrasonic heat/cold meter SONOTHERM SN3070

Piping I.D.	DN200 to DN1200
Rated pressure	PN 10, on request PN 16 or PN 25 for piping sizes DN200 to DN500
Measurement precision of flow meter	± 1% for flow rate Q > Q_2 (see Table 2) and fluid temperature up to 50°C
Fluid temperature	0 to +150°C
Ambient temperature	+5 to +50°C
Ambient relative humidity	not exceeding 80%
Storage temperature	-10 to 70 °C at relative humidity not exceeding 70 %
Temperature difference Δt	3 to 120 °C
Visual output via	LCD, 7 + 2 digits from zero to nine
Power source	90 to 260 V, 50/60 Hz
Back-up power source	Li battery 3 V (lifetime 5 years)
Power requirement	12VA
Line fuse	T 250mA, 250V
Protection against electric shock according to standard ČSN 332000-4-41	automatic disconnection from power source in the TN – S network
Protect. class; electronic unit	IP 65
Protect. class; sensor, probes	IP 54 (on request IP 68)
Outputs	M-Bus (standard EN 1434-4, IEC 870)
	IR opto coupler
Optional accessories	extended range of fluid temperature (up to +180°C)
	sensor protection class IP 68
	drinking-water meter version
	sensor flanges according to alternative standards (ANSI, JIS)

Table 3 - flow meter specifications

4.3. Communication

System SONOTHERM SN3070 is provided with communication interface M-Bus (standard EN1434-4) with the respective signals connected to the meter terminal board, and IR interface accessible via a window in the front panel. The measured data can be transferred using both interface systems.

4.4. Optional calorimeter accessories

On request, the calorimetric counter can be supplied with the following optional devices/functions:
- display with illuminated background

When using other optional devices, it should be noted that there are two free terminals available (marked as “rez.” – reserve) where any of the following signals can be connected:
- impulse output of the “heat energy” or “volume” signals (open-collector output, $U_{CE\ max}$ = 24 V, $I_{CE\ max}$ = 20 mA, impulse length 250 ms)
- impulse input – impulse counter for “hot water” or other signals (contact input, f_{max} = 12 Hz, impulse length 40 ms, max. voltage 3 V)
- communication interface SIOX-Bus (compatible with meters of the model series SWM 820, SWM 690 and other measuring systems based on such devices)
- alarm signal (open-collector output, $U_{CE\ max}$ = 24 V, $I_{CE\ max}$ = 20 mA, impulse length 250 ms).
- protection of sensor IP 67

5. METER APPLICATION DIRECTIONS AND RULES

5.1. Project design of systems including ultrasonic flow meters

In designing any project it is necessary to observe specific rules concerning placement of the meter sensors in piping so that the measuring precision would not be adversely affected. In the case of the meter sensor UC7.0, the required lengths of straight piping sections before and after the meter sensor are 5DN and 3DN, respectively (see Fig. 4, 5).

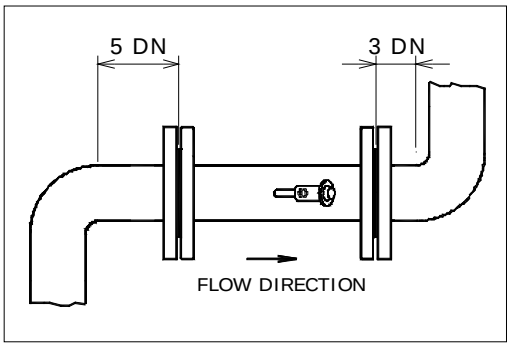


Fig. 4 - Minimum lengths of straight piping sections

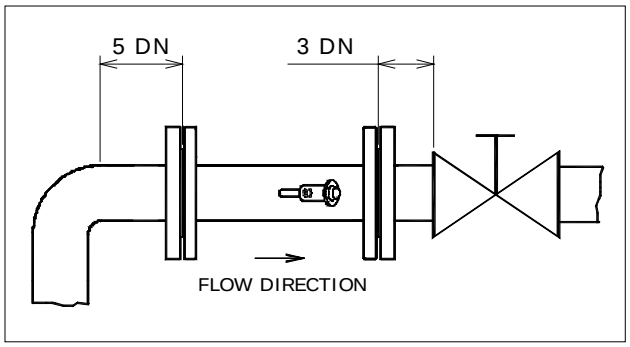


Fig. 5 - Minimum length of straight piping section at the input side of closing valve

If there is a pump near the meter sensor, it should be located at the distance of at least 20DN from the sensor output (see Fig. 6).

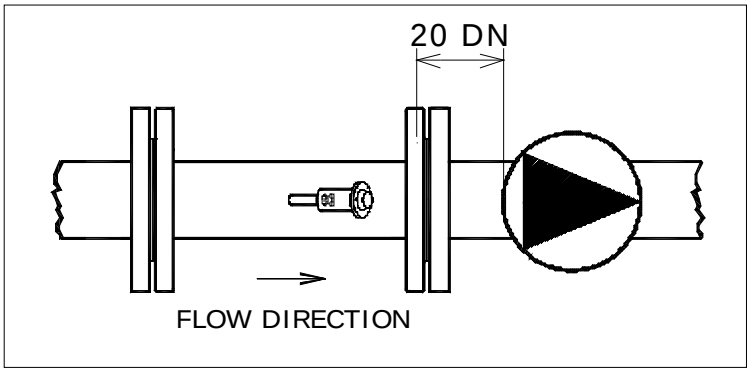


Fig. 6 - Minimum length of straight piping section before a pump

In cases where complete flooding of the piping cannot be guaranteed at all times, the meter sensor should be located so as to ensure meeting of this condition (see Fig. 7).

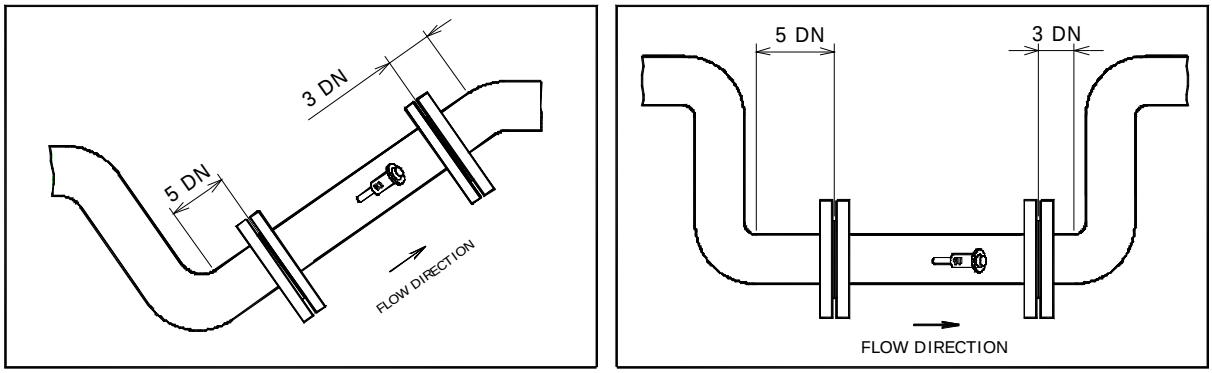


Fig. 7 - Sensor locations ensuring complete flooding at all times

If the sensor is to be fitted into a vertical piping section, the fluid flow direction in such section shall be upwards (see Fig. 8).

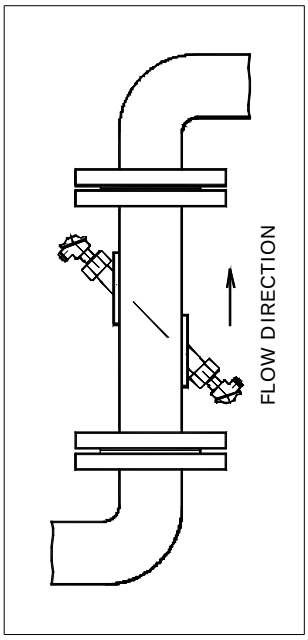


Fig. 8 - Sensor fitted into a vertical piping section

Errorless meter operation cannot be guaranteed unless the sensor is completely filled with the measured fluid at all times. Therefore the sensor should not be located at the highest piping sections or in vertical piping sections if the fluid flow direction is downwards, in particular in situations where there is a piping outlet into open reservoirs or tanks anywhere near (see Fig. 9).

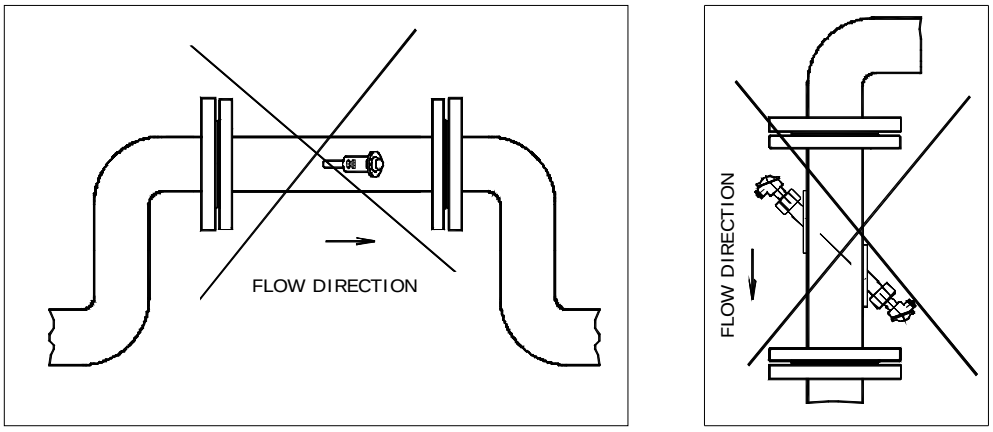


Fig. 9 - Examples of incorrect sensor placement

Another factor that may influence the meter function is the sensor angle position with respect to its longitudinal axis. Occasional air bubbles in the piping may get caught in the hollow welded-on probe holders where they would disrupt the measuring process. To effectively prevent this from occurring, the sensor probes should best be in the horizontal plane (see Fig. 10). If for any reason such position is not possible, the sensor body may be fitted in angular position where the probe plane and horizontal plane form an angle of not more than 30°.

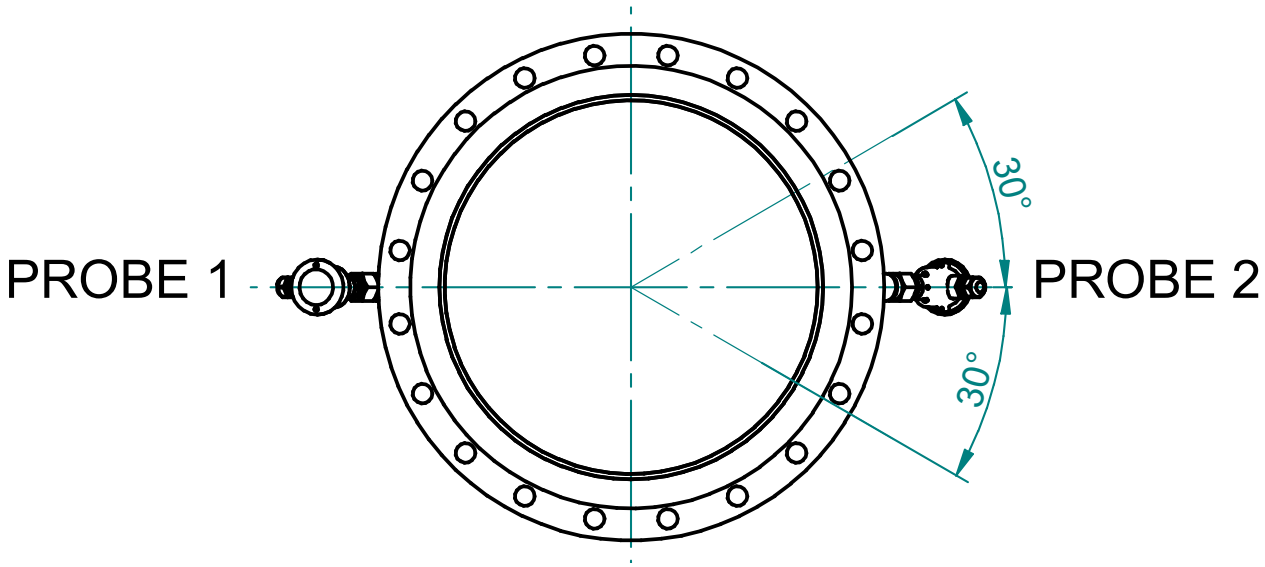


Fig. 10 - Permitted range of the meter sensor rotation with respect to its longitudinal axis.

5.2. Data processing electronic unit

In the cases of a commercial meter application, the data-processing electronic unit shall have an independent power supply line 230V, 50Hz with an over current circuit breaker (the recommended rating 6A) that can be sealed in the ON position. Arrangements should be made so that the power supply can only be disconnected by duly authorised staff. The recommended type of power supply cable is CYKY 3 x 1,5mm^2, outer diameter 10.5mm.

5.3. Resistance temperature sensor

The water temperature measurements can be made using thermometers including resistance temperature sensors Pt 100 or Pt 500, provided such thermometers have been type-tested and approved for use in Czech Republic. The thermometers used in commercial heat meters shall comply with the requirements in Code 505/1990 Coll., be type-approved, metrological verified by the National Metrological Centre and be supplied in pairs with the temperature reading differences over the whole range of measured temperatures not exceeding 0.05°C. Each temperature sensor shall be connected by two wires.

Temperature sensors Pt 100 and Pt 500

Maximum length of connecting wires: 2.5m for wire cross-section 0.22mm^2
5.0m for wire cross-section 0.50mm^2
7.5m for wire cross-section 0.75mm^2.

Maximum current loading: 4μA RMS (for sensor Pt 100).

6. METER ASSEMBLY AND INSTALLATION RULES

The meter assembly and installation work shall be done in strict observance of the directions and principles listed in this Manual.

To prevent electric interference, the power cables shall be led at least 25cm away from all signal cables associated with the flow meter (i.e. the coaxial cables connecting sensor UC 7.0, the cables from temperature sensors, M-Bus interface signal cables and all input and output impulse signal cables). Should any signal cables need be extended, the connections shall be done by soldering and the soldered joints shall be protected from climatic or mechanical stresses by placing in a suitable installation box. All cables shall be led outside the thermal insulation layers on the water piping. The temperature sensors shall be connected by shielded conductors. The shields shall be connected to the earth potential on one side only, on the terminal board X10 of the electronic accessory.

Sensor must be grounded properly. For grounding use a conductor with minimum cross section area 4 mm^2 and connect the conductor to grounding bolts of evaluation electronic and flow sensor (see figure here below).

Earthing connection between the MTU 2.00 electronic unit and the flow sensor.

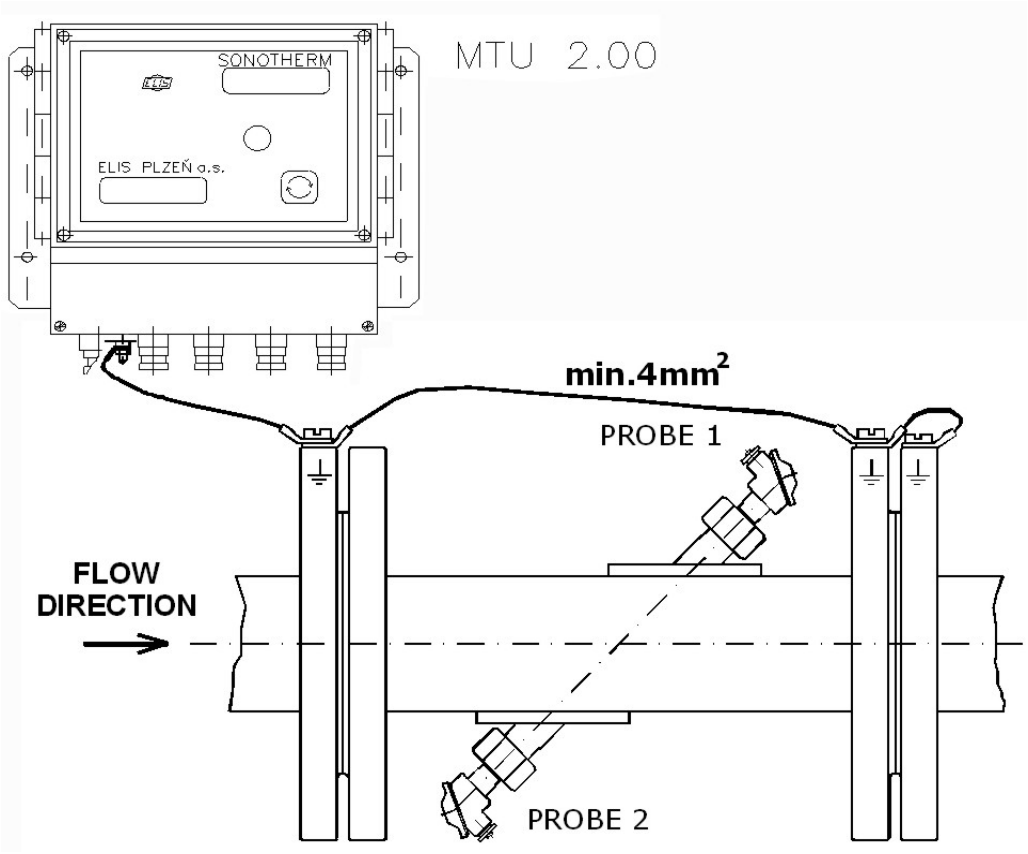


Fig. 11 - Earthing connection between the MTU 2.00 electronic unit and the flow sensor.

6.1. Data processing electronic unit MTU 2.00

The electronic unit shall be mounted in a perpendicular position on a wall or support plate by means of an assembly frame. The electrical connections between the electronic unit and the flow sensor UC 7.0 shall be done as described in Section 6.2 below. The difference in lengths of the connecting coaxial cables shall not be greater than 0.1m.

6.2. Electrical connections

Use the schematic drawing below to connect the MTU 2.00 electronic unit to the flow sensor probes. Pay particular attention to the probe 1 and 2 positions with respect to the flow direction.

Schematic drawing of electrical connections between MTU 2.00 and associated devices

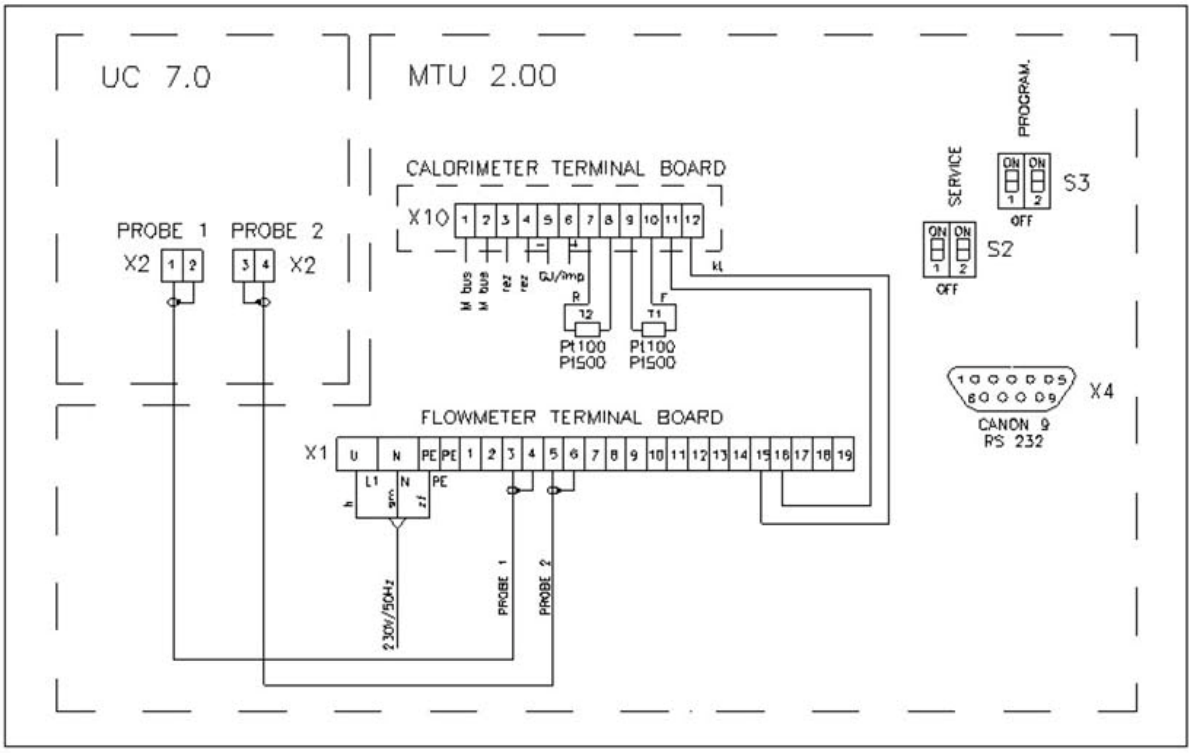


Fig. 12 - Electrical connections

Heating system:

T1 - thermometer in the feed piping (higher temperature, F)

T2 – thermometer in the return piping (lower temperature, R)

Cooling system:

T1 - thermometer in the return piping (higher temperature, R)

T2 – thermometer in the feed piping (lower temperature, F)

Connection of thermometers Pt100 and Pt500 is identical.

Connector CANON 9 for RS 232 shall be used only for meter servicing purposes.

6.3. Ultrasonic sensor UC 7.0

The ultrasonic flow sensor shall be mounted directly on the piping, with the thermal insulation removed. The connecting coaxial cables shall not be attached to the hot-water piping.

When installing the sensor into the piping, make sure that the inner sensor space be completely filled with water at all times. During measurement, water shall not leave the sensor space nor air be allowed to enter it.

If the sensor is mounted in a vertical position, the only permitted water flow direction is upwards. Disregarding the meter installation principles listed in Section 5 may result in measurement errors.

6.4. Mechanical connections

The ultrasonic sensor shall be fitted into the fluid piping by means of flanges ensuring exact match with the respective counter-flanges on the piping ends (see the specifications on the flange circumference). Unless required otherwise, the sensor shall be supplied with flanges according to standard ČSN EN 1092-1 (the alternative solutions are ANSI or JIS flanges).

The box housing the electronic accessory can be mounted onto a vertical support plate using four bolts of diameter 5 mm.

7. OPERATIONAL START AND METER CONTROL

7.1. Flow metering section

As soon as the flow sensor has been installed in the piping and the electrical connections between the sensor and its electronic unit have been made, the system can be connected to power. Within a short time the flow meter starts its measuring functions.
Connector X4 is reserved for calibration purposes, parameter setting in production and servicing.

Ultrasonic sensor UC 7.0 is connected to the associated data processing unit by means of two coaxial cables (see the respective schematic diagram).

If the system is used as a standard meter, switch S3 located under the box lid provided with the official mark and one half of switch S2 are used in production and for metrological purposes. The functions of the remaining half of switch S2 are described in the following table.

Switches S3 and S2: setting combinations		
Measurement mode	S2:1 in position OFF S2:2 in position OFF	S3:2 in position OFF
Servicing mode	S2:2 in position ON	S3:2 in position OFF
Programming mode	S2:2 in position OFF	S3:2 in position ON

Table 4 - Switches S3 and S2

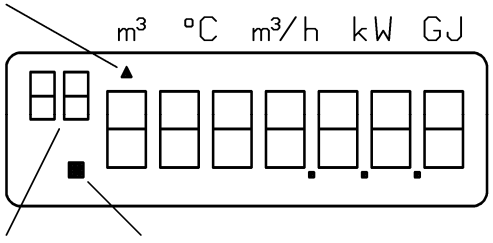
7.2. Calorimetric section

As soon as the temperature sensors have been installed and electrically connected, the calorimeter functions can be tested using the respective display code table.

Upon delivery, the calorimeter will be set at the “transport mode” where no measurements are performed and only the real time function is operative. With the transport mode selected, the display shows the word “no” in the upper left corner. To select the “operation mode”, depress the display push-button and hold in the depressed position for about 5s.

7.3. Displayed data and information

The upper-line symbol identifies the measured quantity displayed.



Data and information measured/transferred

* Accumulated (heat/cold) energy
* Quantity of impulses at both additional impulse inputs (optional solution on customer order)
* Error code and duration of actual error
* Instantaneous power
* Instantaneous flow rate
* Input temperature
* Output temperature
* Temperature difference
* Operational period
* Meter number
* Production series number
* Real time and function date
* Litres per impulse parameter
* Flow meter location (feed or return piping)
* Readings on the selected date when the following data are stored in the system memory
    - calendar date
    - accumulated energy
    - accumulated flow volume measured by flow meter
    - accumulated flow volume used in energy calculations
    - accumulated number of impulses at impulse inputs (optional meter configuration)
    - error code (if any) of error occurring at the time of data storage action
* Accumulated flow volume measured by flow meter
* Accumulated flow volume used in energy calculations
* Total period of error duration
* Previous error code – error type and duration
* Up to 37 monthly memory registers where each register contains the same type of data as those listed under „Readings on the selected date“
* Recommended battery replacement date

Display codes on the system LCD in the “operating” and “testing” modes of operation

DISPLAY CODE	DISPLAYED DATA OR INFORMATION	FORMAT
10	**Operating mode** Accumulated energy	
11	Accumulated flow volume measured by flow meter	
12	LCD test	
13	Impulse register 1 – accumulated value (on customer order)	
14	Impulse register 2 – accumulated value (on customer order)	
15	Error code	
16	Error duration – total time of actual error	Minutes
20	Instantaneous power	
21	Instantaneous flow rate	
22	Input temperature (T1)	
23	Output temperature (T2)	
24	Temperature difference (T)	
30	**Readings on selected data** (Date of memory storage)	RRMMDD
31	Accumulated energy	
32	Accumulated flow volume measured by flow meter	
33	Accumulated flow volume used in energy calculations	
34	Impulse register 1 – accumulated value	
35	Impulse register 2 – accumulated value	
36	Error code (any error existing on date of data memory storage)	
37	Total error time (if any)	Minutes
40	**Regular monthly readings** – date of data memory storage	RRMMDD
41	Accumulated energy	
42	Accumulated flow volume measured by flow meter	
43	Accumulated flow volume used in energy calculations	
44	Impulse register 1 – accumulated value	
45	Impulse register 2 – accumulated value	
46	Error code (any error existing on date of data memory storage)	
47	Total period of error duration (if any)	Minutes
50	Meter operation time	Hours
51	Actual date	RRMMDD
52	Actual time	HHMM
53	Recommended battery replacement date	RRMMDD
60	Communication address	
AX	Meter number	
BX	Production series number	
63	Flow meter impulse input setting – litres per impulse	Litres/impulse
64	Flow meter location in piping branch T2 (L) or T1 (H)	L,H
70	Accumulated flow volume used in energy calculations	
71	Last recorded and communicated value of accumulated energy	
72	Time of last communication	Hour
73	Error duration – total period of actual error duration	Minutes
74	Previous error code	
75	Total period of previous error duration	Minutes

Table 5 - Display codes

To switch over between code groups, depress the push-button and hold it depressed for longer time. To switch from one code to the next within a code group depress the push-button shortly.
Display format explanation:
RRMMDD RR ... last two digits of year, MM ... month, DD ... day in the month
HHMM HH ... hours, MM ... minutes

Comments/explanations:

1) The calorimetric counter has two registers to store data on accumulated flow volume; register 11 contains data on the total accumulated flow volume passed through the flow meter, register 70 contains data on the accumulated flow volume used in heat value calculations. Differences in the data stored in these registers can help identify errors in the temperature sensors whose signals are used for energy calculations.

2) To display the next reading on specified date, depress the push-button until you arrive at change of date. After passing through display code 37, the last reading on specified date will be displayed. Then depress the push-button to return to the normal display mode.

3) To display the next monthly reading on specified date, depress the push-button until you arrive at change of date. After passing through display code 47, the last monthly reading on specified date will be displayed. Then depress the push-button to return to the normal display mode.

4) The right character (X) in the display code AX is a supplementary number to the meter number.

5) The right character (X) in the display mode BX is a supplementary number to the production series number.

Error code

There are available three error display modes:
- in display code “15” ... actual error
- in display code “36” ... error existing at the time of data reading and storage
- in display code “46” ... error existing at the time of regular monthly reading.

Error codes

Error code	Type of error
0001	**Output thermometer (T2), open circuit**
0002	**Output thermometer (T2), short circuit**
0003	Errors 0001 + 0002 *
0004	**Input thermometer (T1), open circuit**
0005	Errors 0001 + 0004
0006	Errors 0002 + 0004
0007	Errors 0001 + 0002 + 0004 *
0008	**Input thermometer (T1), short circuit**
0009	Errors 0001 + 0008
000A	Errors 0002 + 0008
000b	Errors 0001 + 0002 + 0008 *
000c	Errors 0004 + 0008 *
000d	Errors 0001 + 0004 + 0008 *
000e	Errors 0002 + 0004 + 0008 *
000F	Errors 0001 + 0002 + 0004 + 0008 *
0010	Electronic unit (error in EEPROM)
0011 - 001F	Combination of error 0010 and any above error(s)
0020	Electronic unit (error in “Inter-Bus”)
0021 - 003F	Combination of error 0020 and any above error(s)
0040	**Low flow rate**
0041 - 007F	Combination of error 0040 and any above error(s)
0080	**Power supply failure - line voltage 230V or bus power**
0081 - 00FF	Combination of error 0080 and any above error(s)
0100	**Recommended battery replacement date not observed**
0101 - 01FF	Combination of error 0100 and any above error(s)

Table 6 - Error codes

The most frequent errors in the table are printed in bold type. The remaining errors may occur only rarely. Errors marked with "*" will not occur if the electronic accessory works correctly.

Instantaneous values

Instantaneous power value (display code 20) and instantaneous flow rate (display code 21) are calculated only subsequently. If the impulses from the flow meter arrive in intervals longer than 4 seconds, the values of instantaneous power and flow rate are calculated after each new impulse. If this interval is shorter than 4 seconds, the impulses are cumulated and the instantaneous value calculations are carried out every 4 seconds.

8. WARRANTY AND POST-WARRANTY SERVICES

8.1. Warranty services

Warranty services are understood to be repairs of products executed free of charge during the contractually agreed warranty period. Such repairs can either be performed at the manufacturer's plant or at that of any authorised partner of the manufacturer.

Warranty repair is understood to be repair of any product defects due to faulty materials, parts or product design, executed free of charge within a period agreed between the customer/user and the meter manufacturer.

Should any meter defect be proved irreparable due to the above reasons, the manufacturer shall replace it by a new faultless product of the same type.

Warranty services can only be performed by the manufacturer (ELIS PLZEN a.s.) or a duly authorised service centre or a product distributor who have received valid authorisation in writing and have been trained in the necessary skills by the manufacturer.

Warranty services shall not be applicable to:

- products with damaged company or metrological seals
- defects due to incorrect product assembly and/or installation
- defects due to incorrect product application
- product theft or pilferage
- defects due to force majeure circumstances

Any requirement regarding warranty services shall be made known to the manufacturer in writing (using E-mail, fax or registered letter). Should the manufacturer not acknowledge the user's warranty claim as justified, it shall inform the user accordingly in writing and invoice to the same the repair costs involved. In the cases of any warranty repairs performed on standard meters, the meter parameters shall consequently be verified at the respective National Metrological Centre.

8.2. Post-warranty services

Post-warranty services are understood to be repairs of any and all product defects originating after the mutually agreed warranty period. Such repair, whether performed at the manufacturer's plant or elsewhere, as directed by the customer, shall be invoiced to the customer who shall be obliged to pay the invoiced sums. In the cases of post-warranty repairs of standard meters, the meter parameters shall consequently be verified at the respective National Metrological Centre. Any requirement regarding post-warranty services shall be made known to the manufacturer in writing (using E-mail, fax or registered letter).

9. TESTING

On every product, the manufacturer performs a detailed inspection of the product completeness and quality in reference to the respective quality assurance standards. Following this inspection the product is subject to tests performed in compliance with the agreed test specifications. Prior to release from the test station, every product is subject to a test run over a minimum period of 15 hours.

10. CALIBRATION AND VERIFICATION

In the cases of standard meters, the manufacturer shall provide for primary verification of the correct design of the flow meter and calorimetric sections at the Authorized Metrological Centre. The ultrasonic flow meter is tested and metrological verified at three specified operational modes within the required flow rate range. On customer's request and/or in the cases of higher precision requirements, the calibration measurements can be performed at as many as 9 modes within the measuring range.

Important notice:
It is recommended that the calibration measurements and verification of the flow meter section of SONOTHERM SN3070 at a certified testing centre be performed on a test stand in a continuous mode of operation.

11. ORDERING

In ordering a product, the customer shall use the enclosed Product Order Form.

12. PACKING

The product packing shall ensure safe domestic and international transport, taking into account the delivery conditions agreed to with the customer. The packing shall comply with the internal standards of the manufacturer (ELIS PLZEN a. s.).

13. PRODUCT ACCEPTANCE

Upon delivery, the goods shall be checked for completeness with respect to the delivery note and subject to visual inspection. A typical scope of delivery includes a complete system SONOTHERM SN3070, operation and maintenance manuals, product compliance certificate and delivery note.

14. WARRANTY CONDITIONS

Unless agreed within the commercial contract otherwise, the standard product warranty period is 12 months from the date of sale. Within the warranty period all product defects due to material and/or part faults shall be repaired free of charge. The warranty period shall be extended by the time the product was inoperative due to a warranty repair. Warranty shall not be applicable to any product defects due to incorrect system assembly and/or installation, intentional damage, pilferage, theft or any faults due to circumstances classified as force majeure.

15. RATING PLATES

Flow sensor label

ELIS PLZEŇ a. s.					
TYPE		S/N			
DIMENSION DN		m		kg	
PROTEC.		PRESS.PN		MPa	
LIQUID TEMPERATURE		0 ÷ 150		°C	
MEDIUM FLOW DIRECT.		→		CE	

Electronic unit label

ELIS PLZEŇ a. s.			
TYPE		S/N	
SUPPLY VOLTAGE	230 V/50 Hz		
INPUT POWER	6 W		
PROTECTION	IP 65		

System label

SYSTEM LABEL	SN3070	SERIES NUMBER:				CE
CERTIFICATE No.		COM. ADRESS		CLASS OF ACCURACY		
NOMINAL HEAT/COLD RATE	°C	MEASURED SYSTEM		TEMP. SENSOR		
NOMINAL HEAT/COLD DIFFERENCE	°C	Q_{max} OF FLOW METER	m^3/h	FLOW SENSOR		
MINIMUM HEAT/COLD DIFFERENCE	°C	PLACING OF FLOW METER	piping	PROD. No.		

ELIS PLZEŇ a.s. **Product order form** **SN3070**

Project:	
Measurement location:	
Project item:	

Required type of system			
Parameter to be specified		Parameter value	Units
Minimum flow rate			m^3/hour
Maximum flow rate			m^3/hour
Type of measured liquid			–
Temperature range of measured liquid			°C
Rated pressure of measured liquid		16 40 *	–
Rated inner diameter of sensor UC 7.0		DN	Chapter 4.1
Length of cables to sensor UC 7.0			m
Placing of flow meter		Feed piping (F) Return piping (R)	–
Communication via M-Bus		Yes No *	–
M-Bus communication address (range 1 to 250)		Yes No *	–
Optional accessories required		Yes No *	Chapter 4.4
	Display with illuminated background	Yes No *	–
	Stainless version of sensor UC 7.0	Yes No *	–
	Impulse output - energy	Yes No *	GJ/imp
	Impulse output - volume	Yes No *	m^3/imp
	Impulse input	Yes No * imp. number	–
	Communication via SIOX-Bus	Yes No *	–
	Alarm signal	Yes No *	–
	Counter flanges, packing and connecting parts and materials	Yes No *	(Enclose detailed specification)
	Flow meter verification in more than three operational modes within the measuring range	Yes No *	-
Customer address			
Company identification number			
Bank contact			
Contact person			
Telephone		Fax	

Table 7 - Product order form

Comment: The response time of the accessory electronic unit (if required in any particular application) can be modified on agreement with the customer. The standard meter configuration includes an adaptive filter.

* Cross out if inapplicable

Manufacturer's address:

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