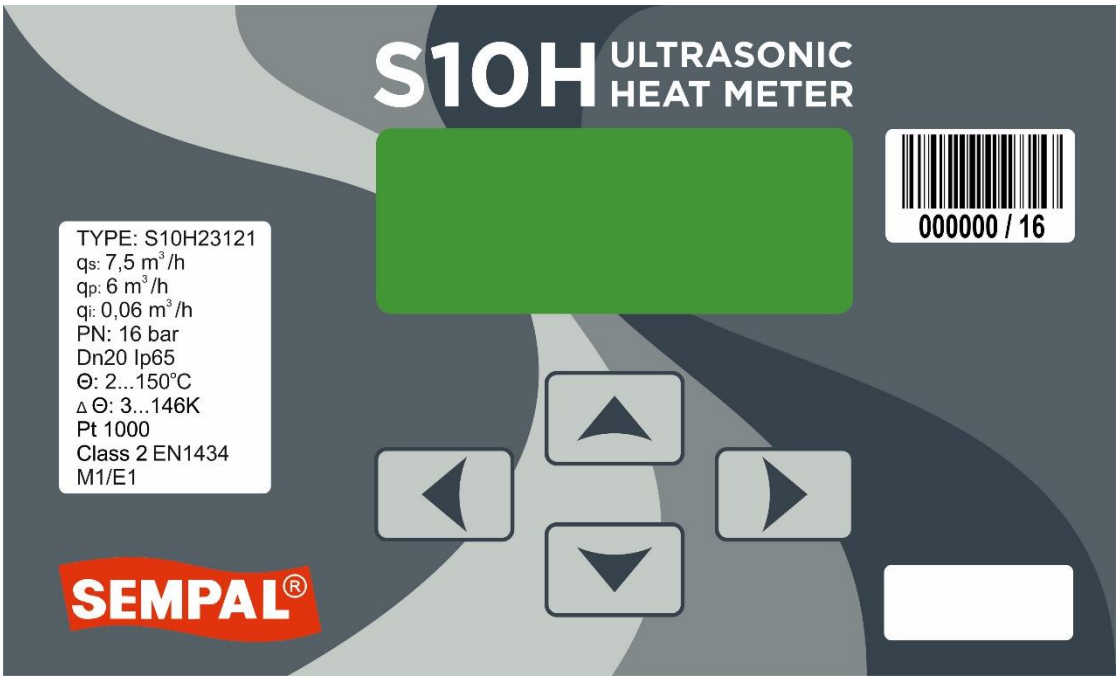
S10H Ultrasonic Heat meter

Battery powered



Operating Instructions
Part 1

Table of contents

Abbreviation list

OI – operating instructions.
FS – flow sensor unit.
FlS – ultrasonic flow sensor.
TS – temperature sensor.
RTD – resistive temperature detector.
DN – nominal diameter.
PN – nominal overpressure.
PC – personal computer.

General description

S10H heat meters (hereinafter referred to as meters) are hybrid or compact measuring instruments, which can be used as heat meters, cooling meter or combined heat/cooling meters based on the ultrasonic transit time measuring principle. The water is used as the heat (cool) - conveying liquid.
S10H meter consists of flow sensor, calculator and temperature sensor pair, which after verification must be treated as inseparable.
S10H meters should undergo the starting-up and adjustment works by qualified personnel during commissioning.
Manufacturer's guarantee (48 months since shipment) applies to the meters which were put into operation by the specialized companies having corresponding credentials from company-manufacturer. More detailed information is resulted in section 16 ‘Manufacturer’s Guarantee’.
A recalibration interval is no more than 4 years.
The quality system of “SEMPAL Co LTD” has been certified according to ISO 9001:2008, ISO 14001:2004, BS OHSAS 18001:2007.
If you have any questions about purchase, maintenance, operation and service of meters, contact us or our authorized regional representatives.

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1 Preface

These operating instructions (hereinafter referred to as OI) contains the following information: the assignment, field of application, performance capability and completeness, a principle of operation and a design, the method of installation and commissioning, the method of operation and maintenance service of meters.

While meters are in exploitation, it is necessary to be strictly guided by present OI.

2 Assignment

2.1 S10H heat meters are intended for measurement of heat consumption.

Meters also measure the volume, mass, temperature and overpressure of the heat-conveying liquid, water or fluids with solid particles of no more than 200 μm and residue mass of no more than 500 mg/l (hereinafter referred to as a heat-conveying liquid).

2.2 Meters depending on their configuration are applied for metering (including fiscal metering) of heat quantity (in closed or open heat supply systems) or water volume according to EN 1434. Functional features of meters' configurations are given in 3.1.

3 Technical specifications

3.1 Meters can have next **configurations** (see Annex B):

– 2, 2/1, 2/2 – heat meters for closed district heating system;

– 4, 7 – heat meters for open district heating system;

– 5 – heat meter in a closed district heating system with a check water meter on the return pipeline;

– 6 – heat meter for closed district heating system and independent water meter.

3.2 Meters in accordance with environmental conditions meet class C of EN 1434-1. The meters can work under the following conditions:

– atmospheric pressure can vary from 84.0 up to 106.7 kPa;

– relative air humidity is up to 95 %.

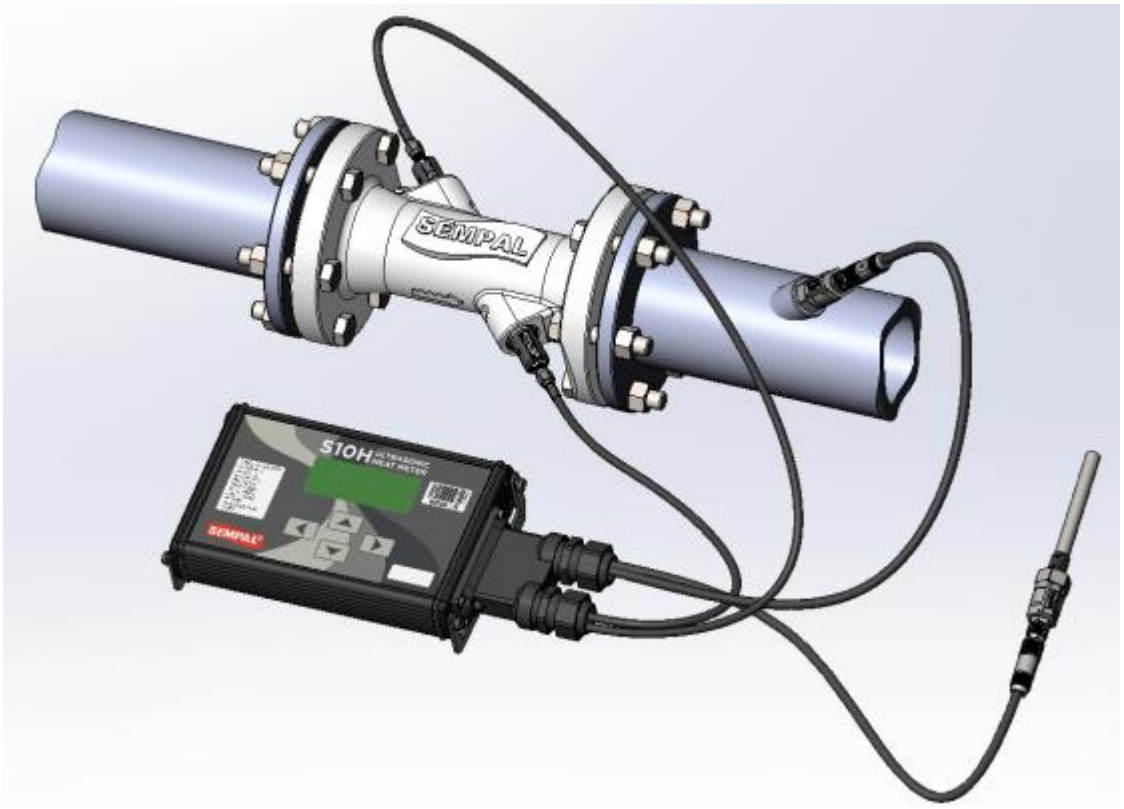
3.3 Meters of configurations 2, 2/1, 5 and 6 meets the requirements of EN 1434.

3.4 The meter consists of the following **functional units**:

– flow sensor unit with ultrasonic flow sensors (FS);

– temperature sensors (TS);

– calculator.



Distinctive functional features of meter configurations and basic functional units are represented in the table 3.1. (meters' configurations in details are given in the Annex B)

Table 3.1

Distinctive structural and functional features	Configuration						
	2	2/1	2/2	4	5	6	7
Number of FS	1	1	1	2	2	2	2
Number of RTD	2	2	1	2	2	3	3
Measurement of the temperature of the heat-conveying liquid in the return pipeline	+	+	–	+	+	+	+
Measurement of the temperature of cold water	–	–	–	–	–	–	+
Measurement of the volume of the heat-conveying liquid in the flow pipeline	+	–	+	+	+	+	+
Measurement of the volume of the heat-conveying liquid in the return pipeline	–	+	–	+	+	–	+
Measurement of the volume of water in the water supply system	–	–	–	–	–	+	–
Indication of heat-conveying liquid leak	–	–	–	+	+	–	+

Additionally the meter can have one or two overpressure sensors (further under the text - pressure sensors or PS), which are used for transformation of the water overpressure in a proportional electric signal with current from 4 up to 20 mA.

Metrological performance of pressure sensors corresponds to the individual order.

3.5 **Unit system**

Meters indicate the results of measurements in SI unit system (MW, GJ, MPa). The heat

power and heat quantity can be represented in CGS (GCal/h, GCal) unit system. Indication of measurement information is set in accordance with user's requirements.

3.6 **Measured quantities**

Measured results are displayed on 2-sectional LCD.

The first section has 8-bit 7-segment indicator with special symbols. The measuring data are always displayed in this section.

The second section has one row (on the top of the indicator) for displaying text information. This section is switched on only during operation with keyboard.

The calculator indicates the following quantities:

- heat quantity, GJ (GCal);
- heat power, MW (GCal/hour);
- volume (mass) of the heat-conveying liquid or water, m^3 (ton);
- volumetric (mass) flow of the heat-conveying liquid or water, m^3/h (ton/h);
- heat-conveying liquid temperature, C;
- overpressure of the heat-conveying liquid, MPa;
- work time and non-work time, h;
- current time (hours, minutes, seconds) and date.

3.7 **Archives**

The calculator provides storage of such archive data as measured values of heat quantity and volume (mass) of the heat-conveying liquid (water), work time and non-work time and also average measured temperatures:

per hour - during 70 preceding days (hourly archive);

per day - within 1 preceding year (daily archive).

All stored information and measurable parameters can be read by standard interface RS-232C.

Measurement information about heat quantity, heat-conveying liquid volume and, also, work time and non-work time is stored in nonvolatile meter's memory within 8 years with power off.

3.8 **Display**

The number of display digits:

- for heat quantity, volume (mass) of the heat-conveying liquid is 8;
- for heat power, volumetric (mass) flow rate of the heat-conveying liquid is 5;
- for heat-conveying liquid temperature is 5;
- for overpressure of the heat-conveying liquid is 3;
- for work time, non-work time, and current time is 7.

The minimum bit value of digital display while indicating:

- heat quantity can vary from 10^{-7} up to 1 GJ (GCal);
- volume (mass) of the heat-conveying liquid can vary from 10^{-7} up to 1 m^3 (from 10^{-7} up to 1 ton);

– volumetric (mass) flow rate of the heat-conveying liquid can vary from 0.001 up to 0.1 m^3/hour (from 0.001 up to 0.1 ton/hour);
– heat power - from 0.001 up to 0.1 MW (GCal/hour);
– heat-conveying liquid temperature is 0.01 C;
– overpressure of the heat-conveying liquid is 0.01 MPa;
– work time and non-work time can vary from 10^{-5} to 1 hour;
– current time is 1 sec.

3.9 **Meter data**

Meters provide measurements of heat quantity and volume (mass) of the heat-conveying liquid in ranges of volumetric flow rates and thermal power resulted in the table 3.2.

The table contains values of the lower limit of the flow rate (q_i), permanent flow rate (q_p), the upper limit of the flow rate (q_s), and the transitional flow rate (q_t).

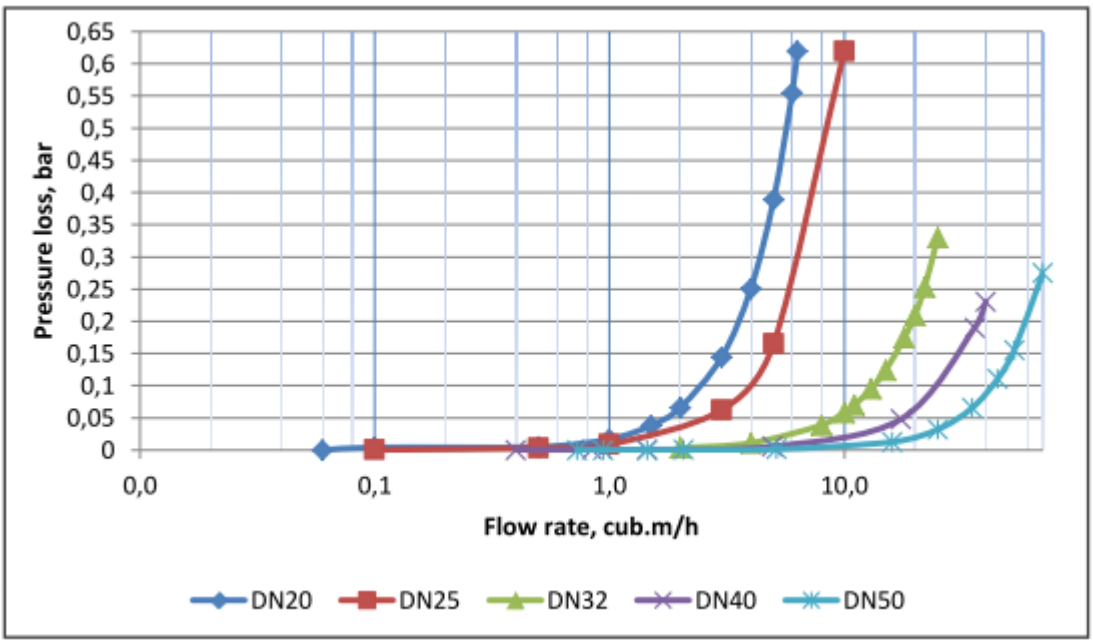
Table 3.2

Flow sensor unit DN	Nom flow q_p, m^3/h	Min flow q_i, m^3/h	Transit flow q_t, m^3/h	Max flow q_s, m^3/h
DN 20	6	0.06	0.12	7.5
DN 25	10	0.1	0.2	12.50
DN 32	22	0.25	0.60	31.25
DN 40	40	0.4	0.8	50
DN 50	60	0.6	1.2	75
DN 65	100	1.0	2.0	125
DN 80	150	1.5	3.0	187.5
DN 100	250	2.5	5.0	312.5
DN 125	400	4.5	8.8	500
DN 150	600	6.0	12	750
DN 200	1000	10.0	20	1250
DN 250	1500	15.0	30	1875
DN 300	2500	25.0	50	3125
DN 350	4000	40.0	80	5000
DN 400	6000	60.0	120	7500

The temperature of the heat-conveying liquid in flow and return pipelines can vary in a range from 2 ^{0}C up to 150 ^{0}C.

Meters provide measurement of heat quantity at temperature difference between the flow and return pipelines ($\Delta\Theta$) from 3 K up to 145 K.

Pressure loss on flow sensor units of DN20-DN50



The maximal pressure measured by the meter is 4 MPa.
The range of the electric signals from pressure transducer varies from 4 up to 20 mA.

Meters have output signal for data communication by standard interface RS-232C to connect to computer, modem, LAN, Internet. Connection to LAN and Internet is provided through extra adapters. Communication protocols depend on applied adapter (UDP, TCP/IP, http, …)

The maximal heat-conveying liquid overpressure inside flow sensor unit is 1.6 MPa (16 kgf/cm^2).

Protection class of calculator enclosure is IP 65.

Mean error-free work time for meters is not less than 50 000 hours, for calculators – 100 000 hours.

Total average meter life cycle is not less than 12 years.

3.10 **Power supply**

Meters' power supply is realized by built-in lithium battery of 3.6V. Battery lifecycle is 5-6 years. Battery replacement can be done directly on-site without meter shutdown.

WARNING! Meter is delivered with switched off battery.

While delivering by air transport the battery should be switched off and removed from the meter.

3.11 **Accuracy**

Permissible error limits while measuring the quantity of heat are:

– for accuracy class 1 – $\pm (2+0{,}01 \cdot q_p/q + 4 \cdot \Delta\Theta_{min}/\Delta\Theta)$ %;

– for accuracy class 2 – ± (3+0,02·q_p/q + 4·$\Delta\Theta_{min}/\Delta\Theta$) %;

where $\Delta\Theta$ is measured temperature difference of heat-conveying liquid in the flow and return pipes, °C.

Permissible flow rate measurement error limits while measuring volume and mass of heat-conveying liquid should be:

– ± (1+0.01·q_p/q) % for accuracy class 1;

– ± (2+0.02· q_p/q) % for accuracy class 2;

where q is measured flow rate value, m^3/h.

Limits of permissible absolute error for heat meters while measuring a heat-conveying liquid temperature are ±(0.2+0.002·$\Delta\Theta_{min}/\Delta\Theta$) °C, where $\Delta\Theta$ is numerical value of temperature difference, °C.

Limits of pressure measurement error:

– ± 0.5 % when pressure transducers from meter's set are used;

– $\pm\sqrt{0.2^2+\delta_{PT}^2}$ when customer's pressure transducers are used ,

where δ_{PT} is permissible error limit of customer's pressure transducer.

Specific coefficients of pressure transducer curve are entered into calculator's memory.

Limits of absolute meter error while measuring the work time and non-work time are ± 1 minute per 24 hours.

3.12 **Meter outputs**

The calculator has two passive pulse outputs. Pulse outputs meet to class OD in accordance with EN 1434-2.

Maximum switched voltage should be no more than 10 V while switched current is no more than 10 mA.

Maximum pulse-repetition frequency is 100 Hz while pulse duration is 4 ms ± 0.5 ms.

Pulse settings (set by user) are from 1 to 9999999 pulse/unit. Where «unit» is unit of measure for transformed physical quantity. The user can select from the following physical quantities: volume (pulse/m^3), mass (pulse/ton), heat quantity (pulse/GJ).

4 Package contents

4.1 The **meter complete delivery set** is represented in the table 4.1.

Table 4.1

Name and reference designation	Number	Additional information
S10H heat meter , including:	1 pcs.	Configuration and completeness in accordance with the order
1 S10H Calculator	1 pcs.	While in delivery the battery is switched off
2 Flow sensor unit (FS)	See additional information	Number, configuration and dimension-type in accordance with the order (see Annexes A, B)
3 Ultrasonic flow sensor with sealing ring (for DN20 are not delivered separately. Flow sensor unit of DN20 is delivered together with ultrasonic flow sensors)	See additional information	Number of FlS for one FS is defined by number of places for their installation in accordance with the order
4 Resistive temperature detector RTD or temperature sensor	See additional information	Number in accordance with the order
5 Overpressure sensors (PS)	See additional information	Number, type and completeness according to the order.
6 Connection cable (device cable)	1 pcs.	Number of communication lines and their length according to the order (see Annex A)
7 S10H. Heat meter Operating instructions	1 pcs.	
8 Packaging (set)	1 set	
9 Modem		In coordination with the customer while ordering the MDM unit
10 Data Reader		Special order
11 Adapter module MC-1		Special order
12 Protection enclosure		Special order
13 Reserve belongings		Completeness and number is ordered

4.2 Meter's configuration, FS type, connecting cables, number of communications channels and their length are specified while ordering. The format of meter's marking is given in Annex A.

Description of design features for FS and also drawings, mounting dimensions are resulted in Annex L.

5 Structure and functioning of meters

5.1 Heat meter provides measurement of heat quantity measuring volumes, temperatures and pressures of heat-conveying liquid in flow and return pipes.

5.2 The principle of flow measurement of heat-conveying liquid is ultrasonic time-of-flight. The time for the sound to travel between a transmitter and a receiver is measured. The time difference is proportional to the average fluid velocity and flow rate correspondingly. The integrated momentary flow rate values give the information about heat-conveying liquid volume which has passed through FS. The heat-conveying liquid mass is calculated as a function of volume and density of the flow depending on its temperature.

5.3 Heat-conveying liquid temperature is measured by platinum resistive temperature detectors (temperature sensors) installed in appropriate pipes.

5.4 Flow rate measuring process is continuous. Flow rate measurement is occurred a few times per second and obtained data are stored. Reading of stored data is occurred 1 time per second to calculate the quantity of heat.

Measurement cycle for temperature and pressure is one time in 10 sec.

Every measurement cycle lasts for 1 sec and includes measurement of heat-conveying liquid parameters, as well as self-diagnostics of the meter.

5.5 Heat meters can be represented in the following configurations (see Annex B):

– 2 (or 2/0) – heat meter in a closed district heating system with measurement of temperatures in the flow and return pipes. Flow meter is installed in the flow pipe;

– 2/1 – heat meter in a closed district heating system with measurement of temperatures in the flow and return pipes. Flow meter is installed in the return pipe;

– 2/2 – heat meter in a closed district heating system with measurement of temperature in the flow pipe. The return pipe temperature is programmed. Flow meter is installed in the flow pipe;

– 4 – heat meter in an open district heating system. The cold water temperature is programmed;

– 5 – heat meter in a closed district heating system with a check water meter on the return pipeline. Water leak as a difference between flow rates in the flow and return pipes is indicated;

– 6 – heat meter in a closed district heating system and an independent water meter;

– 7 - heat meter in an open district heating system with a cold water pipeline. Cold water temperature is measured.

Next denotations are used in the expressions given below:

Q – heat quantity (J);

H – specific enthalpy (J/kg);

q_m – mass flow rate (kg/h);

t – time (h).

The specific enthalpy is a temperature and pressure function, therefore for increase of enthalpy calculation accuracy during meter commissioning the overpressure values for corresponding pipelines are entered in meter memory. In the case of malfunction of PS the heat quantity calculation is provided based on programmed pressure value.

When pressure sensors are included for delivery the user can set the pressure value obtained from one of the available PS to calculate a heat quantity.

Entered (measured) pressure values are displayed in records as P1, P2 and Pcold. So if the meter doesn't include PS then these values are entered. If the meter is supplied with PS, then measured values are recorded.

For configuration 4 the entered (not measured) cold temperature value is considered. Thus any change of cold water temperature is fixed in the event journal.

Entered value of cold water temperature can be changed from 0 up to 25.5 C with 0.1 ºC resolution. *If the value 0.0 ºC was entered the specific enthalpy value is identically equated to 0.*

Bringing into service meter configurations with the entered cold water temperature it is necessary to consider, that the heat quantity measured by a heat meter mismatches heat quantity which has been produced by the heat supplier. It is because the entered temperature of cold water is not equal to the valid temperature of cold water which changes in time. In this case at settlement with the heat supplier it can be demanded (depending on requirements of settlement rules between the supplier and the consumer) a corrective procedure according to applicable normative documents.

Schemes for sensors connection in different configurations are represented in Annex B.

5.5.1 **Closed heat supply system** (heat meter configurations **2, 5, 6**). Heat quantity calculation is carried out under formula:

$$Q = \int_t q_m \cdot (H_1 - H_2) \cdot dt \qquad (5.1)$$

where q_m is heat-conveying liquid flow rate in the flow pipeline, kg/h;
H_1 and H_2 are heat-conveying liquid specific enthalpies in flow and return pipes of the heat-exchange circuit, correspondingly, J/kg;
t is time, hour.

5.5.2 **Open heat supply system** (heat meter configurations 4 and 7):

$$Q = \int_t q_{m1} \cdot H_1 \cdot dt - \int_t q_{m2} \cdot H_2 \cdot dt - \int_t (q_{m1} - q_{m2}) \cdot H_{cold} \cdot dt \qquad (5.2)$$

where q_{m1} and q_{m2} are heat-conveying liquid mass flow rates in the flow and return pipelines, correspondingly, kg/h;
H1, H2 are heat-conveying liquid enthalpies in the flow and return pipelines, correspondingly, J/kg;
H_{cold} is cold water specific enthalpy.

In 4th configuration we don't measure cold water temperature, but enter it programmatically (this temperature is entered by user).

Meters of configurations 4 and 7 measure heat-conveying liquid flow rate in the flow and return pipelines and ***calculate*** flow rate difference. Meters of configurations 4 and 7 ***don't***

measure water leaks, water leak is ***calculated*** as flow rate difference in the flow and return pipelines.

5.6 The meter carries out calculation, recording in memory (archive) and further printout of average temperature values for heat quantity calculation per time t_0-t_1 as average-weighted values found under following formula:

$$\overline{\Theta}_{\int} = \frac{\int_{t_0}^{t_1} \Theta(t) \cdot q_m(t) \cdot dt}{\int_{t_0}^{t_1} q_m(t) \cdot dt} \qquad (5.3)$$

where $\Theta(t)$ is momentary (current) measured temperature values;
$q_m(t)$ is momentary (current) measured values of mass flow rate of the heat-conveying liquid (water).

For discrete in time measurements provided by meter every 1-2 sec, the following formula is valid:

$$\Theta_{W.AV} = \frac{\sum_i \Theta_i \cdot q_{mi}}{\sum_i q_{mi}} \qquad (5.4)$$

where Θ_{mi} and q_{mi} are the temperature and mass flow rate of heat-conveying liquid, correspondingly for i^{th} measurement.

In case of no flow rate of heat-conveying-liquid the temperature is calculated as arithmetic mean value for all measurable temperature values for specific time.

For temperatures, which are not taken in calculation of heat quantity, the arithmetic mean temperature value is calculated.

5.7 The meter carries out flow measurement in the range from $0.5q_i$ (q_{min}) till q_s (see table 3.2).

For all types of FS measurement errors are provided in a range [q_i (q_{min}); q_s], but in subranges [$0.5q_i$ (q_{min}); q_i (q_{min})[the mentioned measurement errors are not standardized, however device working capacity is kept, and the heat-conveying liquid mass storing and heat calculation are carried out.

While measuring instantaneous flow rate values $q < 0.5\ q_i$ (q_{min}) the device indicates 'zero-flow' message and mass storing $m=q\cdot\rho$ isn't carried out.

5.8 Measurement of the heat-conveying liquid (water) overpressure is carried out by calculator while measuring the current of electric signal from the pressure sensor. Overpressure values P_{op} (MPa), measured and displayed by the calculator, and current I_{in} (mA) on an input of pressure measuring channel (on the calculator input) are connected by a following ratio:

5.9
$$P_{op} = (I_{meas} - I_1) \cdot \frac{(P_2 - P_1)}{(I_2 - I_1)} + P_1 \qquad (5.5)$$

where P_1 and P_2 are pressure values in two points of pressure sensor characteristic (for example, minimal and maximum pressure);
I1 and I2 are correspondingly currents on the PS outputs in the above specified points;
I_{meas} is value of measured current on the output of PS.

5.10 While measuring time parameters the meter carries out measurement of following quantities: time of correct work (running or work time), time of incorrect work (time of errors), power on time, power off time (non-work or idle time), and also displays current (taking into account daylight saving) time.

Time of correct work (running time Trun or work time) – device operating time (power on, no error messages). Time of correct work on 1-st and 2-nd channels is displayed on the water meter indicator in a mode **«Indication of additional parameters»** (see Annex D).

Time of incorrect work (time of errors Terr) – device operating time (power on, there are error messages). **Terr** values are presented in printouts of stored data archives and error archives.

Power on time Tpower – total time when the device power supply voltage is on. It is indicated on the meter display in a mode **"Indication of additional parameters"** and also is presented in a daily archive printout.

Power off time (idle time Tidle or non-work time) – total time when the device power supply voltage is off. It is displayed on the meter indicator in a mode **« Indication of additional parameters»,** and also included in daily report.

Current date/time – current time (taking into account daylight saving). It is indicated on the meter display in a mode **"Indication of additional parameters".** Automatic switch to daylight saving time mode can be on/off.

Measurement, indication and registration of above-listed parameters are carried out in hours. In figure 5.1 the timing sheet is represented. It explains how time of correct work **Trun** and time of non-working condition **Tnw** for accounting period **Tacc** are resulted. During **Trun** authentic measurement of all parameters was made**,** during **Tnw** there was no registration of any parameter or there was no power supply voltage (battery disconnected).

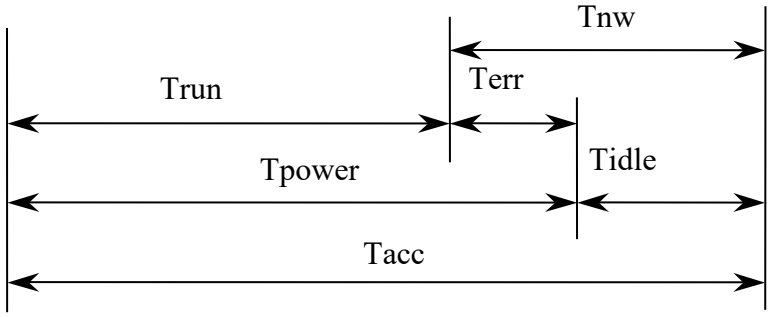


Figure 5.1

5.11 To connect to external devices RS-232C is applied. RxD, TxD, DTR, RTS lines are used.

5.12 Meters have a few separate sub-assemblies which connected between themselves. They are calculator, temperature sensors, flow sensor unit with ultrasonic flow sensors (FS), pressure sensors.

5.12.1 The calculator housing has four control buttons, the digital display, slots for connecting cables.

Heat meter control buttons are described in Annex D.

5.12.2 Heat meter's digital display has two sections. The first one contains a 8-bit 7-segment indicator and specific symbols. In this section the measuring data and units are displayed. The second section is a row for displaying text information. It is arranged in the upper part of indicator. This section is lightening if the user needs to see additional information and complete some kind of actions in device menu.

The basic working mode of the meter is displaying measuring data from main menu. At this time the second section is switched off.

5.12.3 FS is a spool piece with flanges and bushes for mounting ultrasonic flow sensors. FS sizes (linear and angular) have rigid tolerances to achieve required measuring accuracy and stability of operation. Sizes are resulted in the Annex L.

5.12.4 Temperature sensors are installed in pipelines in special thermometer pockets or bushes (in accordance with the order) on the flow and return pipes of heat-exchange circuit.

5.12.5 The length of connecting cables is determined according to a lay-out of meter components and can be within the limits:

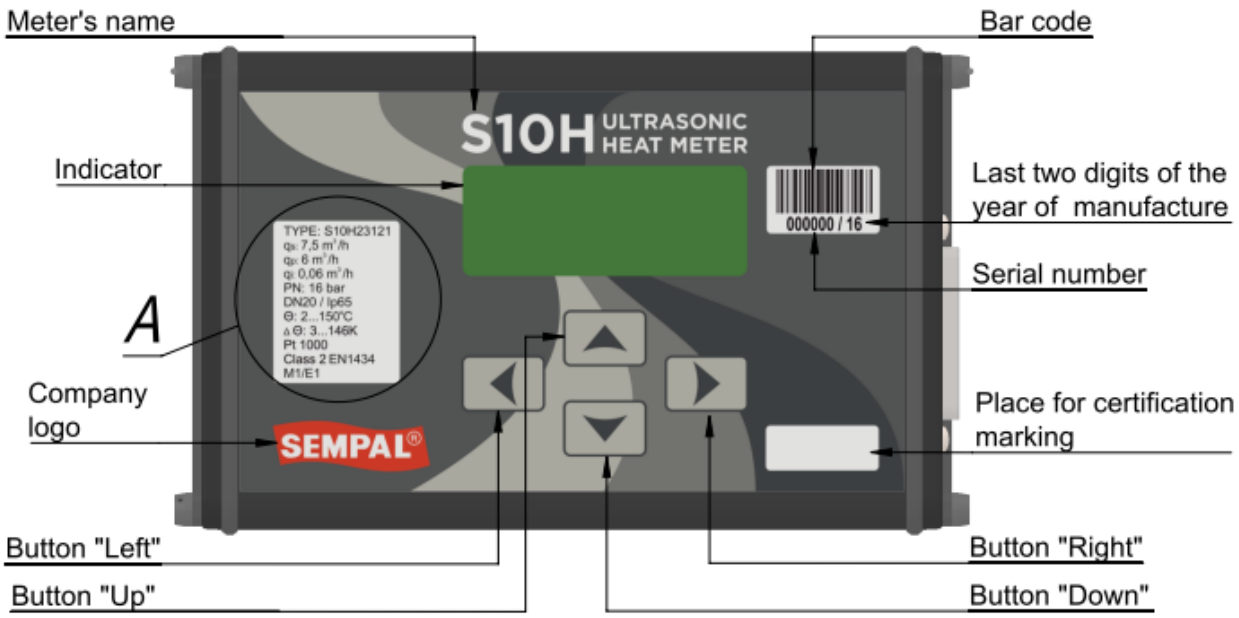
- from 2 to 10 m (max 30 m) for ultrasonic flow sensors,
- from 2 to 10 m (max 30 m) for temperature sensors,
- from 2 to 10 m (max 30 m) for pressure sensors,
- from 2 to 30 m (max 50 m) for RS-232 interface.

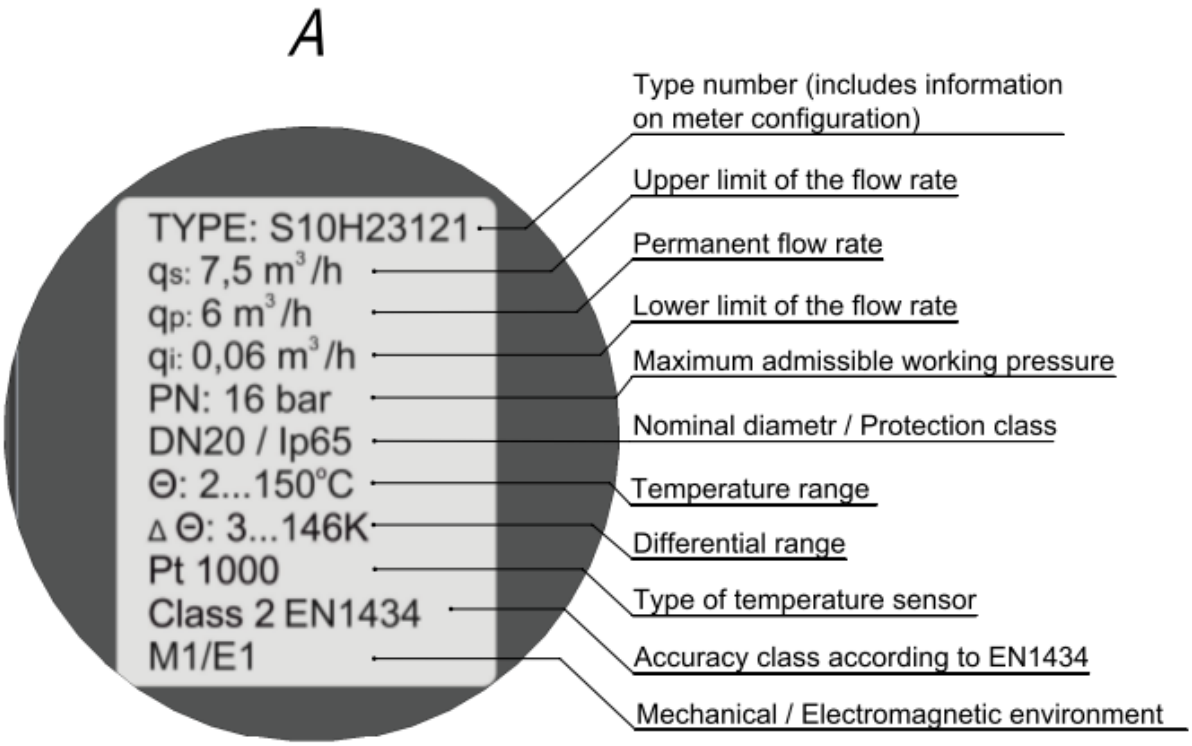
Extended cable length values in parentheses are possible only by additional agreement.

6 Marking and sealing

6.1 Marking

Meter marking on the calculator contains the following data:





On the flow sensor unit (see Annex L):
- nominal bore DN;
- flow direction arrow;
- maximum admissible working pressure PN.

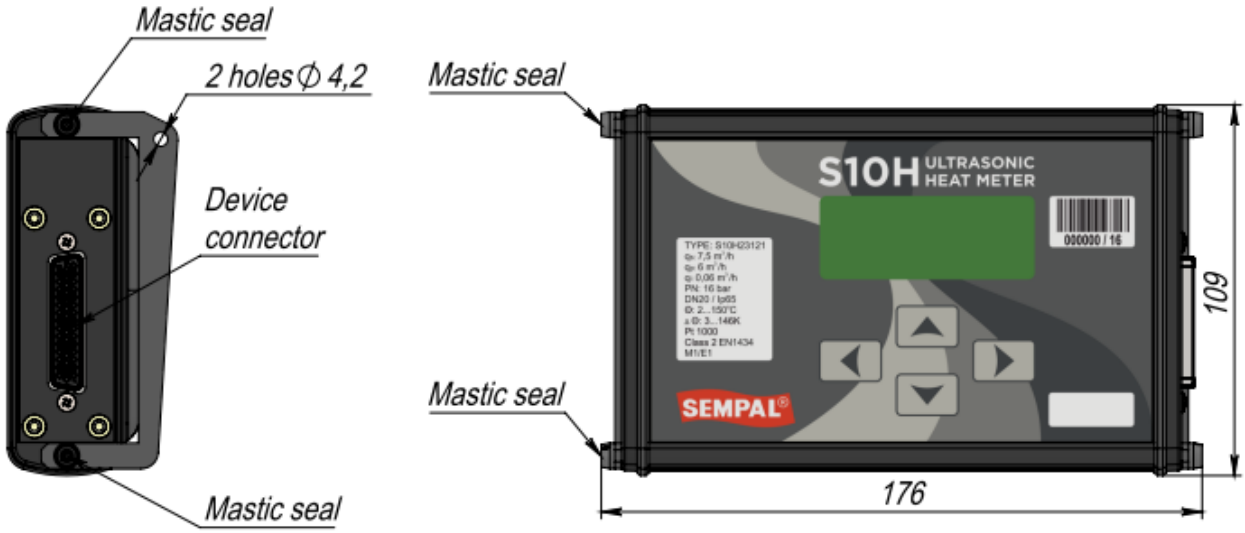
Serial numbers of RTD and FS are put on their bodies.

6.2 **Sealing**

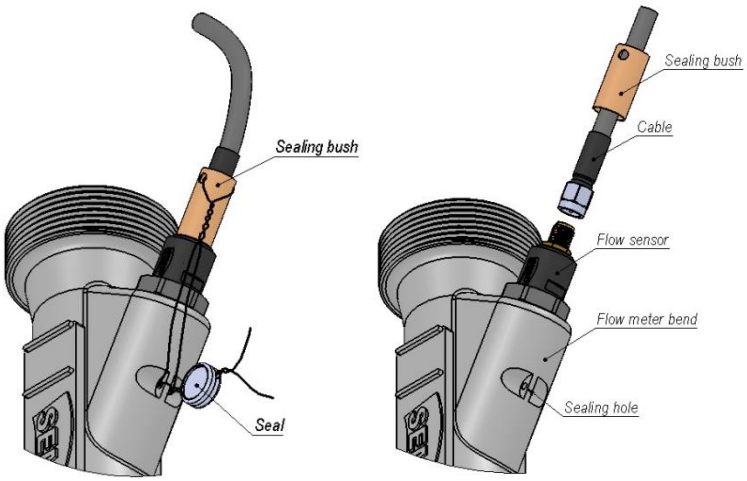
Meter components are sealed up to prevent a non-authorized access to adjustment of meter's readings.

The calculator is sealed up by two mastic seals. Seals are put on fixing screws on lateral covers. For mastic fixing sealing cups are provided under screw heads.
For realization of additional sealing by means of a lead seal, the screws with holes in heads on lateral covers are stipulated. On customer's demand the replacement of these screws by additional sealing cups is possible.
Marking of connecting cables are put on labels, located near corresponding connectors.

Sealing of calculator



Sealing of flow sensors



7 Packing and marking

7.1 Marking of transport container has specific instructions "CAUTIOUSLY FRAGILE", “PROTECT FROM MOISTURE”, "TOP".

7.2 Meter components are packed into the boxes in accordance with drawings of manufacturer.

In coordination with the customer FS delivery without transport container or in customer’s container is possible.

8 Disposal

The meters should be disassembled as follows:

lithium D-cells – approved utilization;

printed circuits (without LC display) – metal recovery of PCB scrap;

LC display (glass and liquid crystals) – approved processing of LC display;

calculator case (aluminum alloy) – metal recovery;

cables for flow sensors and temperature sensors (copper with PVC mantle) – cable recovery;

plastic parts – plastic recovery;

packing – cardboard recycling

9 Installation

9.1 Unpacking and degreasing

Unpacking and degreasing of meters are carried out after their being indoors within 2 hours, while ambient temperature varies from 10 up to 30 C and relative humidity is no more than 80 %.

To make unpacking, please follow the instructions:

- open packing boxes;
- take a package with the calculator and operational documentation;
- check up completeness of meters in accordance with the order;
- take meter components from packing boxes, make an external survey and be convinced that there is no mechanical damages, coating infringements and isolation of connecting cables.

Battery installation into calculator should be done as follows:

- Screw off four screws, which fix a cover of battery module;
- connect a battery to a calculator board in accordance with the figure 12.1;
- carefully put a battery into a module, battery cable should be located right inside a module;
- close a cover of module and tighten it up by screws.

Wait for appearance of a notice “battery” on the indicator.

Set current time. Procedure to set time is described in Annex D.

9.2 Installation requirements

9.2.1 Installation of meter components is carried out in accordance with chosen configuration, necessity of application of the additional equipment, and also parameters of district heating system.

Schematic circuits for meter installation depending on its configuration are given in Annex B.

9.2.2 **Climatic conditions** in a room, where meter components are installed should be as follows:

1) In a place for FS and TS installation:

– ambient temperature can vary from –40 °C up to +70 °C;

– ambient humidity is up to 95 %, while temperature is 35 °C;

2) In a place for calculator installation:

– ambient temperature can vary from 5 °C up to 55 C;

– ambient humidity is up to 93 % while temperature is 25 °C.

Climatic conditions in a place for installation of the additional equipment should meet the conditions specified in the operational documentation for this equipment.

9.2.3 Protection of places for FS and TS installation from direct ingress of moisture, dirt, oils and aggressive liquids should be provided.

The content of acid and alkali fume in air of premises, where meter components are installed, should be within the limits of sanitary rules.

For outdoor FS installation it is recommended to provide protection (canopy) against direct ingress of atmospheric precipitates on ultrasonic flow sensors.

FS installation in places with possible short-term water flooding is allowed while observing following protection measures for FS and entrance cables:

– the lining of cables should be made in protective waterproof pipes, which are resistant to influence of an environment (including the increased temperature);

– area for connection of protective pipes to ultrasonic flow sensors or RTD should be protected from water influence by means of tight clutch, profile sealants or other ways recommended by the manufacturer of protective pipes.

9.3 Requirements to FS installation and arrangement

FS is installed into a pipeline.

FS installation place should be as much as possible moved away from sources of vibrations, jolting, electromagnetic interferences (electromotors, pumps, compressors, etc.). No electric voltage relative to a protective contour of grounding in the place, where FS should be installed.

The distance between flow sensor unit and an installation area for the calculator should be minimal and not exceed 10 m. It is possible to increase the distance up to 20 m by agreement with the manufacturer.

In all cases it is necessary to provide full filling of flow measurement section with water otherwise meters stop functioning, and malfunction (see chapter 13 of OI) would be diagnosed.

Flow measurement sections can be installed in vertical position, however submission of the heat-conveying liquid thus should be carried out in a direction bottom-top for providing FS with water filling.

Heat meter operation in special conditions (incomplete filling of FS with the heat-conveying liquid or polluted heat-conveying liquid) determines its location as resulted in figure 9.1. In this case complete water filling of FS is guaranteed. The most polluted pipeline section appears in a place below FS.

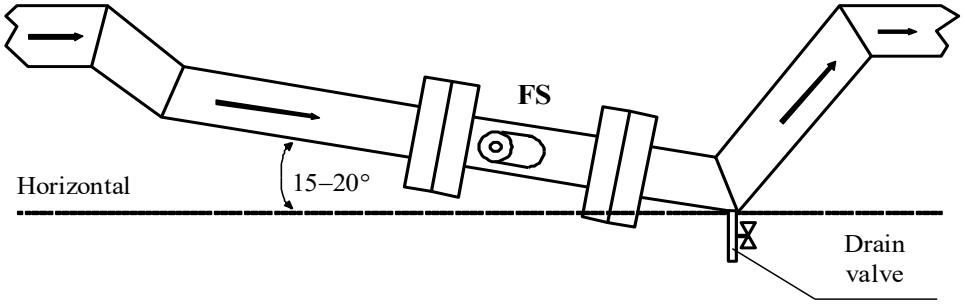


Figure 9.1

To remove heat-conveying liquid from the bottom part of the pipeline (see Figure 9.1), it is possible to provide the drain valve.

While installing the meter, **please, pay attention** to the following requirements:

– the pipeline section chosen for flow sensor unit installation, should be located in horizontal plane (a deviation from a horizontal within the limits of ± 20 °).

– bushes for flow sensors are also arranged in horizontal plane with a deviation from a horizontal line no more than ± 20 °.

9.4 Installation of meter componentry

9.4.1 FS installation

9.4.1.1 FS is spool piece type of an ultrasonic flow meter.

9.4.1.2 Delivery sets with FS of DN20, DN25, DN32, DN40 include special pipe branches (nipples), which are welded to straight sections of the pipe during installation.

For other FS the straight sections are included in delivery set according to customer's request.

Pipe branch with sleeve nut included in delivery sets is a part of straight section and applied for further welding to pipeline to create required distance of straight section.

The axis of a branch pipe and straight section should be a uniform coaxial line without significant jogs and bends. Transition 'jump' from a branch pipe to a pipe should not exceed ± 2.5% from DN value to aside.

9.4.1.3 While installing FS of DN20 and DN25 (FS connection to welded pipe branches with sleeve nut) its position should be fixed (to prevent a revolution) by a screw driver S = 30 mm, which is based on special faces of FS (see figure in Annex L).

It is strongly prohibited to apply another FS componentry to prevent FS revolution (PS connectors, FS body, faces with marking).

For tightening a sleeve nut the screw driver S = 41 mm should be applied.

9.4.1.4 While connecting flow meter's flange to the pipe, the flange bore can be reamed to external pipe diameter with the least allowable tolerances. The schemes for flange welding are given in Fig. 9.2 and Fig. 9.3.

Flange mounting to the pipeline should be carried out without metal sagging on the internal pipe surface. Otherwise change of velocity profile can lead to additional meter error.

After flow meter installation the flange painting should be done.

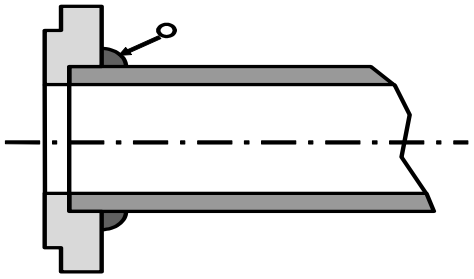


Figure 9.2

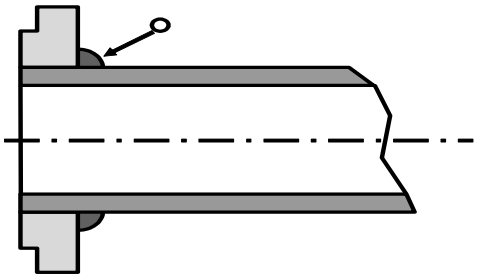


Figure 9.3

WARNING!

Please avoid welding of flanges to the pipeline if FS has been installed! It can lead to flow meter damage because of overheating.

9.4.2 **Installation of flow sensors**

9.4.2.1 The order for installation of flow sensors FlS listed below is applied for FS of DN 32… DN400.

FS of DN20 and DN25 is delivered with installed and sealed flow sensors, their dismantling can be done only at manufacturing company.

9.4.2.2 After installation of flow sensor unit ultrasonic flow sensors should be installed as follows:

– clean internal surfaces of bushes from dust and dirt if necessary;

– for protection of fixing nut and flow sensor materials from diffusion with material of FS it is necessary to grease a bush thread and a lateral cylindrical surface of ultrasonic flow sensors with graphite greasing;

– flow sensors effective area (edge) should be cleaned from greasing;

– insert ultrasonic flow sensors in bushes (pipe-bends) of flow sensor unit. Marking is put on sensor cable outputs. So flow sensors with marks “11” (or “21” for the second flow measuring channel) should be inserted **in first (according to flow direction)** FS bush, FlS with marks “12” (or “22” for the second flow measurement channel) should be inserted in second (according to flow direction) FS bush;

– at tightening of flow sensor’s fixing nut the force put to a wrench should be equal to 40 … 45 N·m and provide a ‘zero’ gap between FS surface and flow sensor ring surface outside of its sealing gasket. For flow sensors installed in FS of DN32 the force is 18 … 20 N·m.

WARNING!

Ultrasonic flow sensors contain piezoceramic elements and thin-walled design elements, which have the increased fragility and do not permit shock and excessive compressing loads.

That is why

IT IS FORBIDDEN:

– to swap around flow sensors for different channels;

– to drop ultrasonic flow sensors or to knock on them at transportation and installation;

– to carry out mounting and dismantling of FS with installed ultrasonic flow sensors;

– to accomplish metalwork or welding works on the pipeline closely to FS with the installed ultrasonic flow sensors;

– to exceed the mentioned above force for tightening of ultrasonic flow sensors;

– to dismount stuck to FS flow sensors, while turning them in bushes during regular service.

9.4.3 Installation of temperature sensors

Temperature sensors can be installed in two ways:

– by screw-driving in bushes (lugs) of the first type welded into the pipeline for direct contact of the TS with the heat-conveying liquid;

– by screw-driving in protective sleeves, which, in turn, are screwed in bushes (lugs) of the second type. The last ones are welded into the pipeline for contact with the heat-conveying liquid via a protective thermal pocket.

Choosing a way of TS (RTD) installation in the pipeline it is necessary to consider, that to obtain a maximal accuracy of temperature measurement the sensitive element of RTD should be arranged as close as possible to an axis of the pipeline. There are three types of RTD with length of 58, 80, 150 mm (type 4, 2, 3 correspondingly) and variants of their angular installation in accordance with specified requirement irrespective of pipeline diameter. The inclination angle and depth of RTD immersing is provided with use of bushes (lugs), the design of which depends on pipeline DN. Recommended variants of RTD depending on FS type are given in tables 9.2 and 9.3. Variants of RTD installation in protective sleeves and without it are given in figures 9.4, 9.5.

Warning! Applying lugs with inclination 45 or 60 °, it is necessary to provide a contact of water with the bottom part of RTD, where thermosensitive element is located.

The installation place for each RTD included in delivery set is given on the meter's scheme for installation (see the Annex B). The RTD which measures temperature of the water should be installed close to FS. The distance between the RTD and the calculator should not exceed 10 m.

The RTD can be installed on the upstream or downstream sections of FS, but installation on the downstream section is preferable. While installing the RTD after FS, the distance between the bush and FS should be not less than 5 DN and at installation before FS - not less than 10 DN.

After bush welding, it is necessary to process its thread by tap M10x1.5 or M16x1.5 (depending on bush type).

While installing the RTD with inclination 45° or 60°, it is necessary to drill 10 mm hole (16 mm for a protective sleeve) and to saw it up to a necessary oval depending on thickness of a pipe wall (see figure 9.4, 9.5).

The sealing surface of the bush should be protected from splashes of the fused metal during welding.

Before application of sealing gasket (fluoroplastic ring) a sealing surface of the bush should be greased.

While screwing the RTD in the bush, the force put to a wrench of 200 mm length, should be no more than 5 kg and provide hermetic seal. The deformation of fluoroplastic gasket in the gap between sealing surfaces of RTD and the bush is not permitted.

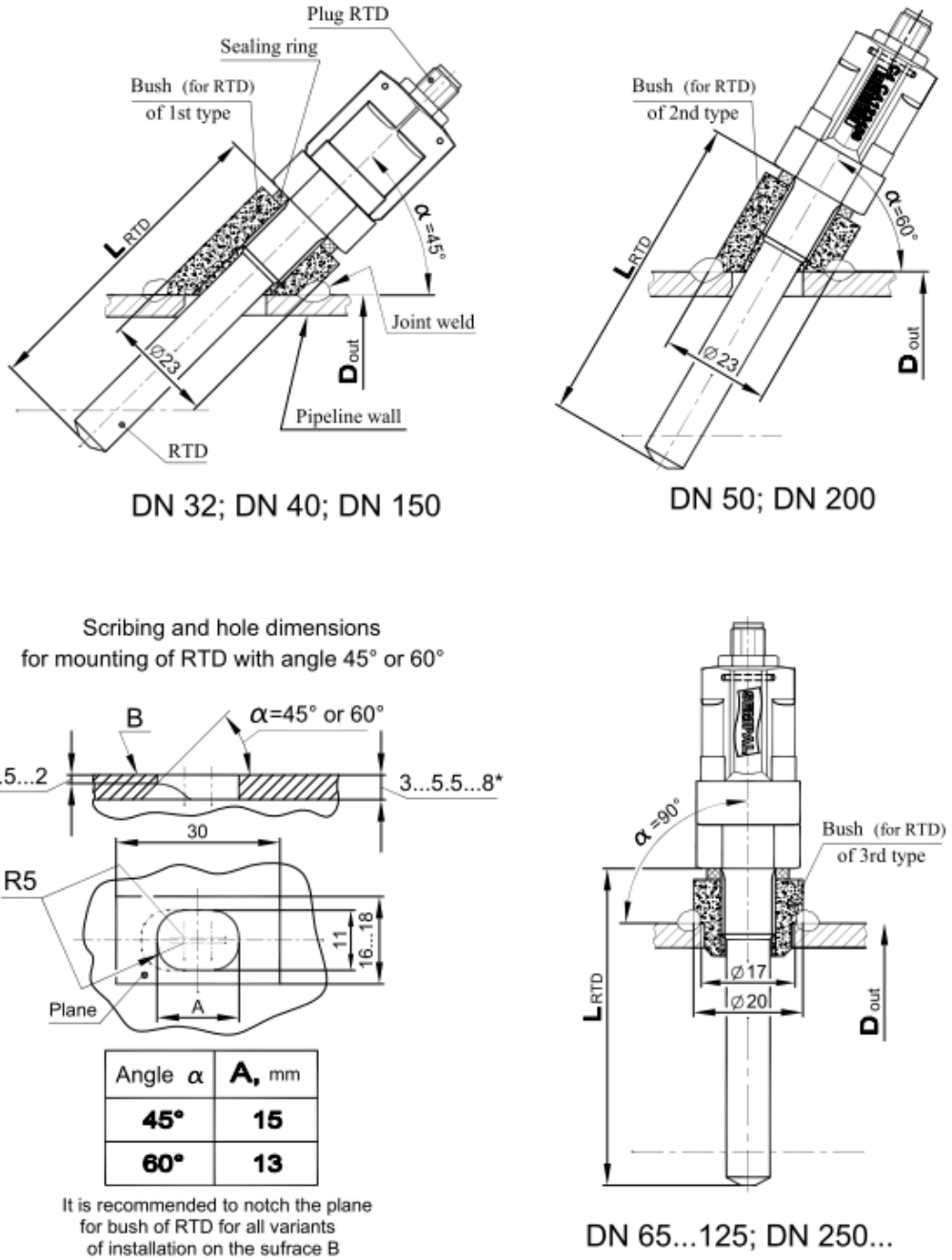
Before screwing the RTD in the thermal pocket it is necessary to be convinced of cleanliness of a thermal pocket and to fill it on 1/8 of volume with high-temperature silicon lubricant of any type.

Table 9.1

DN, mm	Configuration of RTD, nominal length (L_{RTD}, mm), type	Configuration variants for bushes of first type (internal thread of bushes is M10x1.5)	Angle of inclination
32	L_{RTD}=58; type 4	1	45°
50		2	60°
65		3	90°
80			
100	L_{RTD}=80; type 2		
125			45°
150	L_{RTD}=150; type 3	1	60°

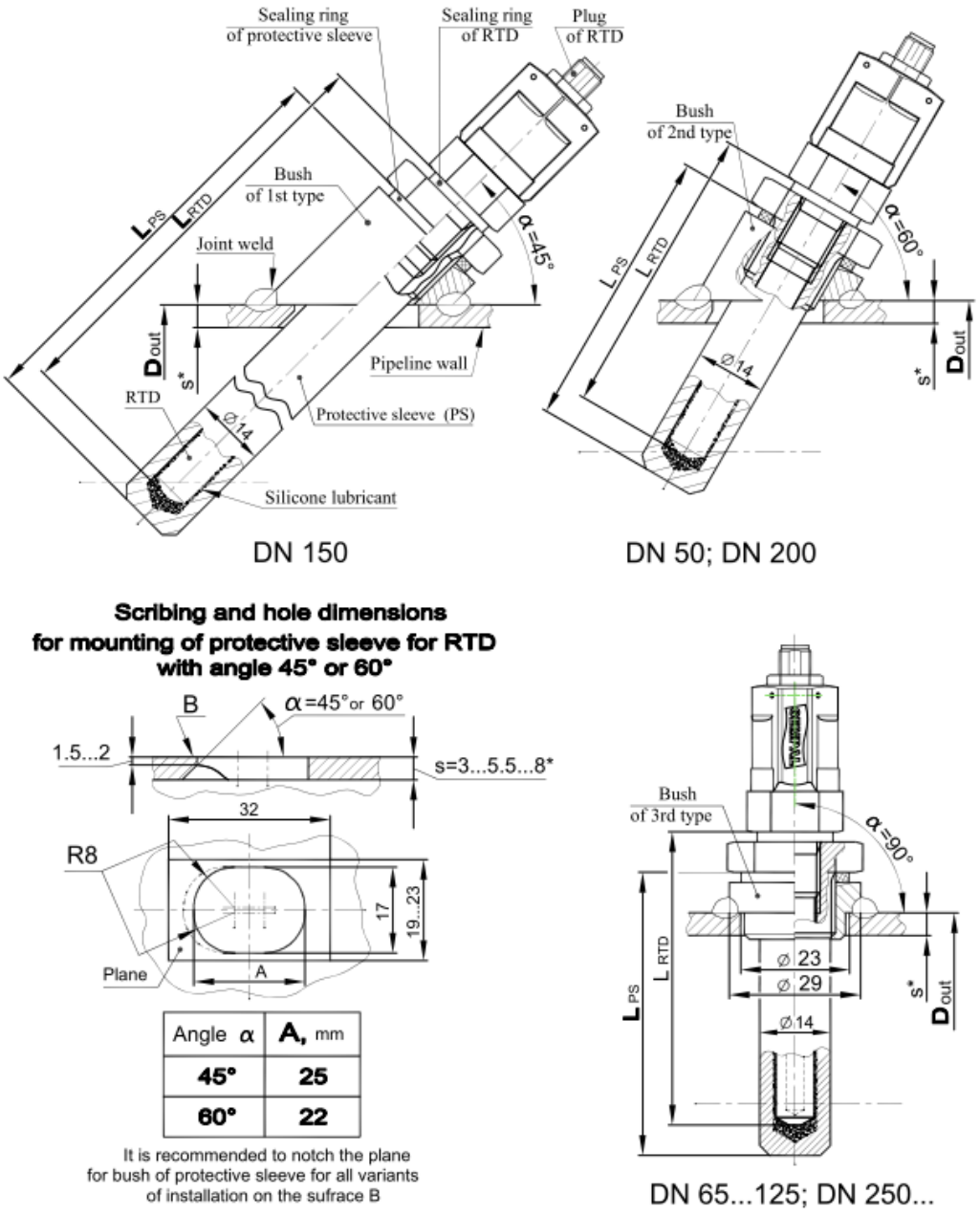
Table 9.2

DN, mm	Configuration of thermal pocket, nominal length (L_{PS}), mm; nominal length of RTD (L_{RTD}), mm	Configuration variants for bushes of second type (internal thread of bushes is M16x1.5)	Angle of inclination
50	(type 4) L_{PS}=56; L_{RTD}= 58	5	60°
65		6	90°
80			
100	(type 2) L_{PS}=78.5; L_{RTD}= 80		
125			
150	(type 3) L_{PS}=148; L_{RTD}= 150	4	45°



Notices. 1. For pipelines of DN 32...DN 150 position of thermo-sensitive element RTD is optimised relatively water and gas standard pipes.
2. It is necessary to mount a reamer at installation of PRTD-S on pipelines with nominal diameter under DN-32.

Figure 9.4 Installation of temperature sensors (RTD) of type 2, 3, and 4 without protective sleeve



Notices. 1. It is necessary to mount an extender at installation of RTD on pipelines with nominal diameter under DN 50.

Figure 9.5 Installation of temperature sensors (RTD) of type 2, 3 and 4 with protective sleeve

9.4.4 Mounting of the calculator

The calculator can be fixed in horizontal position (on the table, stand or shelf) or in vertical position (on the wall or in device enclosure).

For fixing of the calculator special accessories in delivery complete set are provided. The scheme for fixing is given in the Annex C.

9.4.5 Cabling

After installation of all meter components their bond by means of connecting cables from the delivery complete set is made in following sequence:

1) cabling;
2) cable connection to the calculator, temperature sensors and ultrasonic flow sensors.

Cabling is carried out under following requirements:

– cable mounting should exclude a possibility of its contact with pipelines and other elements if their temperature is below a minus 40 ^{0}C or above 70 ^{0}C;

– cable protection against mechanical damages should be carried out by cable grooming in pipes, hoses, ducts, etc. Cable grooming for one meter in one protective housing is permitted;

– cable grooming of two and more meters should be provided in protective housings separated from each other on a distance not less than 5 cm for prevention of mutual electromagnetic inductions;

– after cable grooming it is necessary to make their connection to meter components considering marks of cables.

The rest of the cable should be left in device enclosure.

WARNING!

- **Grooming of connecting cables near power supply lines or in their protective housings (housings of power lines) is forbidden.**

Cable connection to the calculator and to all sensors should be carried out as follows: while defining 'switch' positions on connectors, **plug connectors accurately, without appreciable effort. Mutual rotation is not permitted**; **after all a sleeve nut should be twisted** to prevent possible crumpling (bend, fracture) of contact items (pins) at partial lengthwise coupling.

While connecting sensors it is necessary to strictly follow the marks on device cable and flow sensor cable outputs.

In Table 9.4 marking on communications channels has been adjusted with marking on flow sensor cable outputs (for 1-path flow meters).

Table 9.3

Cable function (connected unit)	Marking on device cable	Marking on flow sensor cable outlets	
		Marking	Arrangement
Flow sensor 1 of channel 1	A11	11	First downstream
Flow sensor 2 of channel 1	A12	12	Second downstream
Flow sensor 1 of channel 2	A21	21	First downstream

Flow sensor 2 of channel 2	A22	22	Second downstream

In Table 9.4 marking on communications channels of device cable is given to connect temperature sensors, pressure sensors and peripheral devices.

Table 9.4

Cable function (connected unit)	Marking on device cable	Cable function (connected unit)	Marking on device cable
TS1	B1	PS1	C1
TS2	B2	PS2	C2
TS3	B3	RS232	D1
		Pulse outputs	D4

Circuitry of device cable are given in the Annex F.

CAUTION! IT IS FORBIDDEN:

1 To break the procedure of cable connection according to marking in tables 9.3 – 9.4.

2 To swap RTD of temperature sensors TS1, TS2, TS3 (see the Annex B) and pressure sensors PS1 and PS2.

3 To increase or shorten the length of cables of ultrasonic flow sensors.

4 To apply FS, RTD, ultrasonic flow sensors and calculators from different delivery sets.

5 Cable twisting, kinking and sharp bends is not permitted while connecting to flow sensor.

CAUTION!!!

If it was required to make welding during device commissioning, the meter should be switched off and device cable should be disconnected from the calculator housing. Otherwise the meter can be damaged.

10 Setting-up Procedures

10.1 While meters work with supplementary devices (PC), these devices should be connected to meters strictly according to maintenance documentation.

10.2 For comfortable work with the meter (after its purchase and before installation) and for check of meter working capacity together with ultrasonic flow sensors it is necessary:

1) Assemble a flow sensor unit with rubber gasket (thickness of 1-2 mm) and technological cap at the end face, install it vertically, fix flow sensors, and completely fill FS with water.

2) Check up all items in **«Indication of main parameters»** mode, check up all items in **"Check"** mode and also it is obligatory to provide zero setting in **"Setup"** mode to correctly repeat this operation while installing device on the object (the description of operating modes is also given in Chapter 11).

10.3 **While installing device on the real object** it is necessary to fill with water the pipeline with installed flow sensor unit. Run through FS the heat-conveying liquid (water) with increased volumetric flow rate during 10 minutes. Be convinced of no leakage in places, where meter components are installed, and no error messages on the digital display of the calculator. The list of these messages is resulted in Chapter 13

10.4 Accomplish mentioned hereinafter actions in **«Setup»** mode.

To login in **"Setup"** mode see the order of menu access in **"Setup"** mode described in item Annex D.

In **"Setup"** mode:

– set hydraulic zero for the channel of volume measurement;

– set a proper archiving format for the data;

– set «Metering» mode. At this time reset of all meter parameters for certain calculating channel would be done.

For zero setting following actions should be done:

– zero setting should be carried out not earlier than in 10 minutes after battery installation.

– cut off a heat-conveying liquid flow, but FS should remain completely filled with heat-conveying liquid.

– provide zero setting according to “Setup” menu item.

In case of failure or wrong zero setting the measurement error increases and can exceed permissible value. Reset of device readings at its commissioning is blocked, if setting of hydraulic zero was not successfully completed. Detailed information about zero setting is given in Annex M **“How to set hydraulic zero”.**

If during meter startup its commissioning was not provided, a proper warning will be displayed.

After ending of the above-stated operations meters are ready for functioning.

WARNING!

– While in service it is forbidden to disconnect sensors, to change arrangement of sensors (to prevent such not authorized actions **a mechanical socket sealing** of all flow sensors, TS,

PS is stipulated), to switch off the calculator, to install meters on the pipeline with incomplete (partial) water filling of FS or on the pipeline supplying the water in steam condition. In all above-stated cases the water meter will register failure operating time, which is subtracted from the time of water volume measurement. Power off time (time with disconnected battery) isn't considered during failure operating and would be displayed in a mode **«Indication of additional parameters»**.

– If the water was cut off for a long time (repair of the system, etc.) and it had led to occurrence of stagnations in the pipeline (drains, a rust, bubbles, etc.) it is recommended to set the "Stop" mode and to provide the guaranteed absence of the water in a flow sensor unit.

– Scum on internal FS walls reduces the real FS diameter and can lead to overestimation of water flow rate readings. Therefore it is necessary to provide maintenance service of meter (see Chapter 12).

During each operation cycle (1 - 2 seconds) the heat meter carries out self-diagnostics of a technical condition by several criteria. In case of flow sensor unit failures, breakage of flow (temperature) sensor cables, absence of the heat-conveying liquid, etc., storage of integral parameters (heat-conveying liquid volume and mass, and non-failure operating time) is discontinued and the error message is appeared (see Chapter 13).

11 The operating procedure

11.1 Requirements to the personnel.

The maintenance personnel should be completely acquainted with present OI.

11.2 **Structure of the menu** of control of the meter.

Control of the meter (a readout and specification of operating mode and meter parameters) is carried out by means of proper menu item selection.

Items of Menu are displayed in the top row of meter indicator.

Use of the menu (switching of items) allows to get the information about measured parameters values, parameters of the meter and also to carry out meter verification.

Selection of menu items and changing (input, setting) of parameters is carried out by pressing buttons on the calculator. Sequence of operations to select the certain menu item and to input parameter value or to select a parameter from the list is given in the Annex D.

All measured quantities, meter parameters and commands for meter control are combined in some sections - **modes of control** of the meter.

Some service modes ('Setup', 'Verification') are protected from non-authorized access by the password.

The meter modes are given in the Annex D.

11.2.1 'Indication of main parameters' Mode.

The device switches to '**Indication of main parameters'** mode after battery installation, after device set-up in **'Setup' mode**, after ending of work in **service** modes (**'Check'**, **'Verification'**), and also at automatic returning to '**Indication of main parameters'** mode if buttons are inactive.

Depending on meter configuration the proper measured parameters, which meet to a given configuration, are displayed on the calculator indicator.

In this mode error messages are shown on display.

Meter has three *metering* mode:

– "**Out of metering**" – this is initial mode. In this mode it is possible setup some parameters in "Setup" menu. This mode indicated by periodically display text "**no rSt**";

– "**Metering**" mode. This is main mode. There is no additional indication for this mode.

– "**Stopped**" mode. This mode can be activated, when no heat-conveying liquid in pipe for long period, etc. In this mode no data are placed in archive and no errors indicated.

11.2.2 'Errors' mode.

The menu of this mode is appeared only if some errors in device functioning take place. This mode is used for presentation of complete (not only code, but text) information about running errors. It is possible to see all registered to this moment errors.

Doesn't have impact on measuring process.

11.2.3 'Indication of additional parameters' Mode.

This mode is intended for displaying of minor (rarely viewed) measuring magnitudes. Doesn't have impact on measuring process.

While working in '**Indication of main parameters'** and '**Indication of additional parameters'** modes in worst-case situations **the code and explanation** of the failure is displayed (see Chapter 13).

11.2.4 'Check' Mode.

'Check' mode is intended for indication of parameters which should be checked. **'Check' mode** doesn't interrupt measuring process and can be used either by auditor or by user. In particular, in this mode counters of entries into 'Setup' and 'Verification' modes are displayed.

11.2.5 'Setup' mode.

'Setup' mode is used by consumer during meter commissioning for hydraulic zero setting in volume measurement channels, input of necessary parameters (pressure, cold water temperature, etc.), and also for choosing an appropriate mode.

It should be considered that while metering 'Verification' mode is blocked. In addition, those items of 'Setup' mode which should be unchangeable during process of measurement are also blocked.

11.2.6 'Verification' Mode.

'Verification' Mode is used to evaluate measuring errors and calculating errors of basic meter performance, and also to check correctness of their indication.

'Verification' Mode is used for automation of heat meter performance verification in case of regular verification. Verification is conducted only by authorized personnel.

11.2.7 'Limit prolongation' Mode.

It is intended for password entering if time limit prolongation is needed.

11.2.8 Password entering.

Entry into service modes **'Setup' and 'Verification'** is permitted only after entering the proper passwords **to avoid non-authorized access** to parameters saved in calculator memory. To run a proper mode in the menu password is requested.

The manufacturer set the following **standard passwords for service modes** (see table 11.1) at device shipment:

Table 11.1

MODE	STANDARD PASSWORD
'Setup'	25205757

On customer's demand the manufacturer can set **INDIVIDUAL PASSWORDS** for service modes that is equivalent to additional **ELECTRONIC SEALING** of the calculating unit and provides inaccessibility of unauthorized users to saved up measuring information.

The password is represented by 8-digit integer number to get access to one of service modes.

Symbols «-» on the indicator mark bits for entering password digits.

Non-masked (open) value of an input digit is displayed only in that bit, in which input of its values (editing) is provided.

While entering a password, press the button "To the right" to move the cursor on one bit to the right. It allows to change any bits of the password.

Pressing buttons «Up» and «Down» leads to a change in the digit value.

Pressing the button «To the left» means ending of password entering.

If during 2 minutes there was no pressing a button the meter switches from 'Enter password' mode to 'Indication of main parameters' mode.

On figure 11.1 the way to run 'Setup' mode is given.

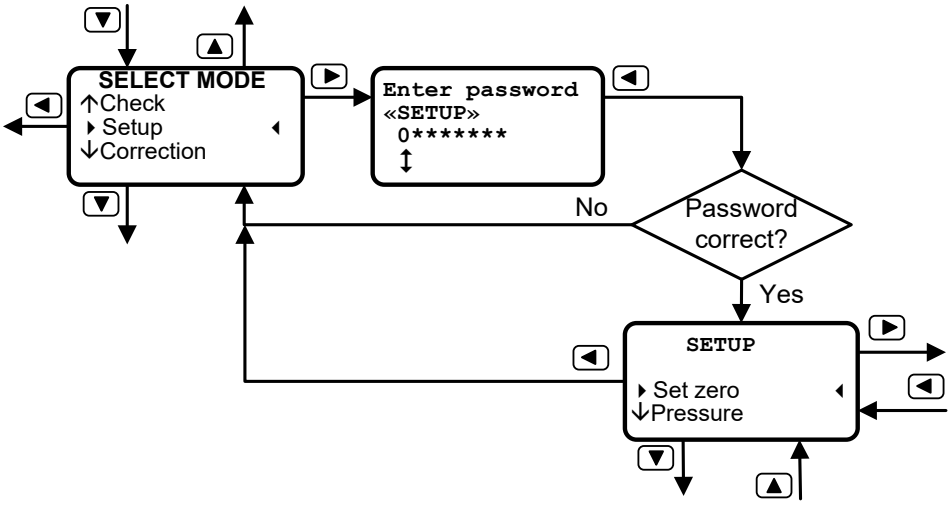

SELECT MODE
↑Check
Setup
↓Correction
Enter password
«SETUP»
0*******
No
Password
correct?
Yes
SETUP
Set zero
↓Pressure

Figure 11.1

12 Servicing

12.1 The Instruction to the representative of inspecting service

12.1.1 The S10H heat meter is protected from consumer intervention as well as intervention of heat supply organization. Any changes of a heat meter parameters can be carried out only in **'Setup' and 'Verification' service** modes. To except a non-authorized access into device functioning process and prevent possible attempts to change any device constants (calibration factors of RTD Kdl and Krc, flow rate conversion ratio, geometrical parameters of a flow meter), the fact of login or running through these modes is fixed in the **'Check'** mode. **The opportunity to check inputs in the specified modes** is equivalent to a mechanical sealing (i.e. it substitutes mastic seals, branded labels, etc.), so it is **electronic way of sealing of the calculator**. Therefore the basic attention should be paid to the number of entries into **service** modes. Difference of this number from the recorded one at the moment of device commissioning (release date according to the certificate) should be considered as damaging of the seal installed by inspecting organization. The possibility of mechanical sealing of the calculating unit with the use of sealing cups with holes on device case is stipulated. So, the fact of intervention in device functioning should be registered by analysis of event journal. All user's actions, which lead to change in device readings are dated in the event journal. If the event journal has a record about entering into service mode, but no records about meter parameters changing, it means that the user logged in and immediately logged out without changing meter parameters and performance.

12.1.2 It is necessary to consider, that heat meter commissioning begins with **reset** (zeroing) of its integrated indications (accumulated measuring data) on setting metering mode to "Metering". Reset of indications also should be carried out after meter repair or verification.

12.1.3 Difference between power on time and time of correct work means that a water meter operated incorrectly (switching-off, breakage or short circuit of sensor cables, absence of the water, etc.). Therefore sealing of flow sensors or their connectors is not obligatory. However, the possibility of mechanical sealing for flow sensors and their connectors with a use of proper holes in clamping nuts of FlS and connector housings is stipulated.

12.1.4 To except a non-authorized influence on RTD parameters and so on temperature measurement accuracy it is necessary to mechanically seal up the temperature sensor using a hole in RTD housing.

12.2 Maintenance service is carried out by the representative of service organization. During servicing it is necessary to carry out the security measures.

12.3 Battery replacement.

Battery resource is indicated in 'Check' menu and also included in current status report. Battery replacement (lithium battery, voltage 3.6 V) should be carried out sooner or later depending on meter operation.

Battery replacement can be done without breaking of measuring process or with breaking when verification is needed. Battery should be ordered only at manufacturing company. Installation of other type batteries is forbidden.

The order of battery replacement:

– run 'Setup' mode, 'Battery replacement' item;

– after confirmation of replacement, meter switches to battery replacement mode and «battEry» is indicated on the meter display. Being in this mode meter stops measuring process and wait for battery replacement;

– unscrew four screws that fix the cover of battery slot on the back side of the meter, remove the battery and disconnect it from the meter;

– install the new battery, put it in the slot so, that the wire should not be bent by slot cover;

– close the cover of battery slot and screw the four screws to provide tightening of the slot gasket;

– press «To the right» button on the meter keyboard. Meter switches from battery replacement mode to measuring process.

Time of starting and ending of battery replacement is recorded in the event journal and time period of replacement is identified as meter non-work time.

Warning!

After switching off the old battery the new one should be switched on in 5 minutes. Otherwise meter stops metering and resets current time. This also will be registered in the event journal.

If after entering battery replacement mode procedure is not completed within 10 minutes, the meter switches to a regular measurement mode.

The order of battery replacement is represented in Figure 12.1.

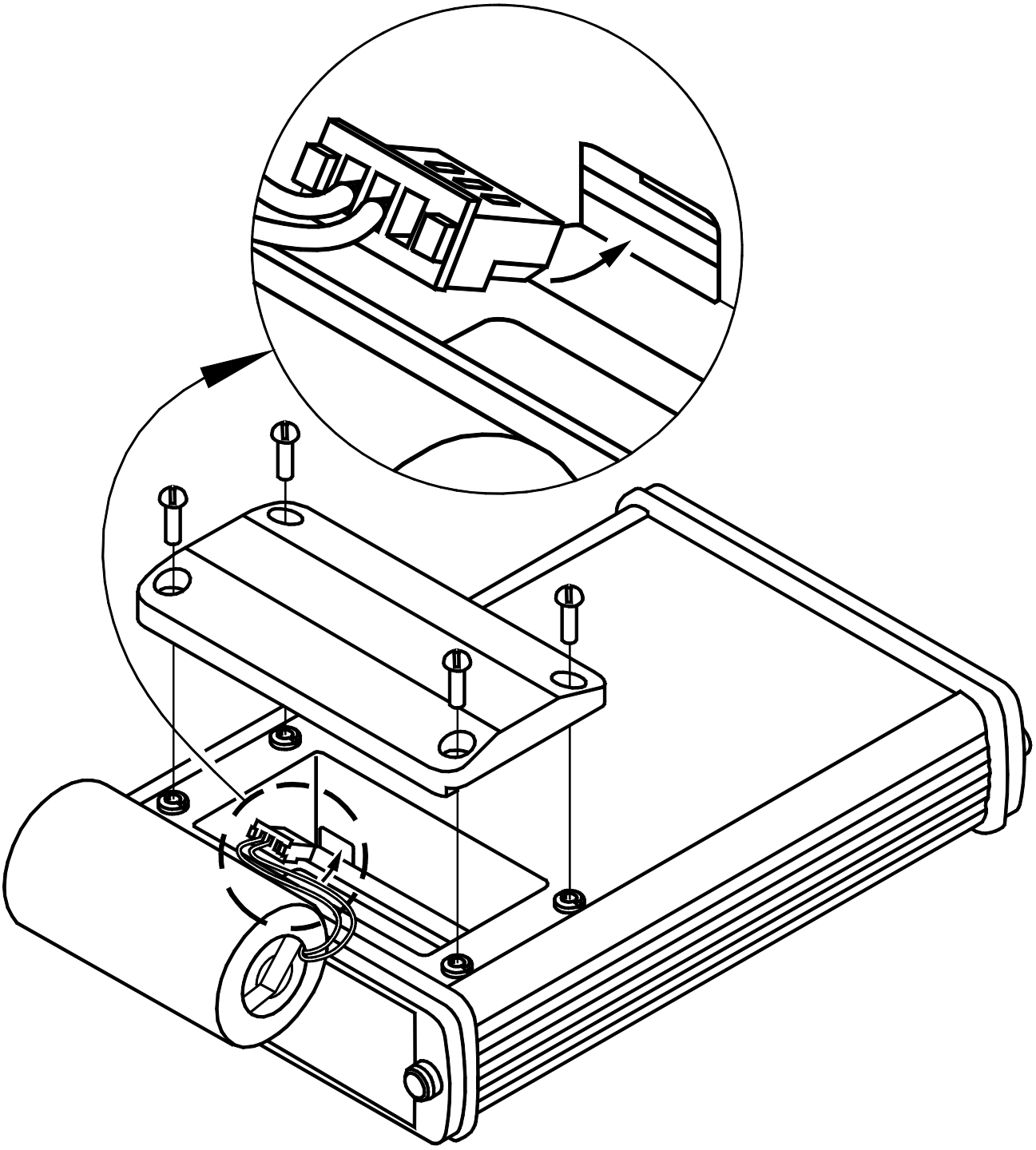


Figure 12.1

12.4 There are two types of maintenance for meters: #1 and #2.

12.4.1 **Maintenance #1** is carried out on a meter operation place once in six months and includes visual check and check of working capacity.

Check visually:

- no leak in places of meter installation;
- reliability of contact joints;
- no mechanical damages on plastic details;
- safe isolation of connecting cables;
- measuring data output in accordance with items 11.2.1.

At the end of the heating season it is recommended to clean of flow sensor surfaces using washing-up liquids, weak solutions of alkalis or acids (without mechanical cleaning). If water meter was out of service for a long period of time it is recommended to switch the meter into 'Stop' mode and provide the guaranteed absence of the water in a flow measurement section.

12.4.2 **Maintenance #2** is carried out before regular verification of meters.

Following operations should be carried out:

- operations, provided by maintenance #1;
- visual check of precipitation on the inner surface of flow measurement section (FS);
- dismantling and cleaning of FS according to item 12.5.1 and dismantling and cleaning of RTD if severe precipitation has been detected.

Dismounting and cleaning of FS of DN20 should be carried out only at manufacturing company or in authorized labs for verification.

Dismounting and cleaning of FS is carried out in the following way:

- to dismount ultrasonic flow sensors (except for FS of DN20);
- to dismount FS from the pipeline (if possible);
- to carry out visual check of FS and, if necessary, to clean mechanically its inner surface from precipitation;
- to wash out inner FS surface by a synthetic washing-up liquid of any type and then by water.

12.5 Meters (calculator, ultrasonic FlS, temperature sensors, flow measurement sections) undergo a verification after maintenance #2. Recalibration interval is no more than 4 years.

FS of DN20 should undergo verification procedure with undamaged seals on FlS.

13 Typical faultiness and methods of their elimination

While in operation, the meter constantly checks both the working capacity of its units and the working capacity of sensors (flow sensors, temperature sensors, etc.) connected to the meter.

Diagnosed errors are subdivided into groups according to a priority (importance for realization of correct measurement). The group number is less, the error importance is more. The error code includes its number and number of the measurement channel, in which there was an error.

Displayed error looks on the indicator as follows (example):

Er 1_3_1

Here 1_3_1 is error code, which consists of group number (first digit), error number (second digit) and measurement channel number (third digit). In this case measurement channel number is a number of temperature sensor. Simultaneously only one error can be displayed on the indicator. To view all errors it is recommended to use 'Errors' mode.

13.1 System errors.

As mentioned above, the lower number of errors, the higher its priority. Without priorities, there are system errors - errors of internal hardware of the meter, which generally preclude the operation of the meter. If there are such errors, no parameter is measured and accumulation of any parameters is not provided. Such errors are displayed on the indicator as follows (example):

«SYSErr02»

Number means an error type. System errors are registered in the event journal with some text decoding, if possible.

In case of system error the meter should be delivered to manufacturer for repair.

13.2 Error group «0».

In group «0» following errors are included:

– «**0_1_0**» - The error of flow rate measurement. Flow rate measurement in both channels is impossible.

– «**0_2_0**» - Error of ADC. Temperature measurement in all channels is impossible.

– «**0_3_0**» - The error of calibration of temperature sensor. Calibration parameters have been distorted somehow.

– «**0_4_0**» - The error of calibration of pressure sensor. Calibration parameters have been distorted somehow.

–

13.3 Error group «1».

This group includes errors referring to temperature measurement (the sign «x» specifies number of the channel):

– «**1_1_x**» - break of TSx.

– «**1_2_x**» - fault of TSx.

– «**1_3_x**» - TSx is failed. Resistance of mentioned TS is out of specified limits

– «**1_4_x**» - The error of incorrect coefficients for TSx, while calibrating coefficients are entered manually.

– «**1_5_x**» - TSx is below the tolerance. Measured temperature value is below permissible minimum (below -50 °C).

– «**1_6_x**» - TSx is over the tolerance. Measured temperature value is above permissible maximum (over +150 °C).

If TS with an error is involved into flow rate measurement process, then all measurements in the proper flow measurement channel would be canceled. If TS is used for heat quantity calculation then heat quantity is not determined.

13.4 Error group «**2**».

This group includes flow rate measurement errors referring to one of applied pair of flow sensors (one of enabled chords for sound propagation).

– «**2_1_x**» - the error of flow sensors in beam «x». This error can be caused by following reasons:

– failure of flow sensors;

– failure of flow sensors' cable – breakdown or fault;

– no water in FS.

13.5 Error group «**3**».

This group includes errors referring to flow rate measurement. If multi-beam flow meter is applied the error in measurement along one of sound paths not necessary leads to flow measurement error of flow meter.

– «**3_1_x**» - measurement by FSx. Flow measurement in mentioned FS is impossible.

– «**3_2_x**» - temperature of FSx. Because of malfunction of TS, which measures temperature in specified FS, a flow rate measurement is impossible. This error always takes place with an error of measurement by TS. This error is displayed (and is brought in error archive) to define interrelation between a temperature measurement error and a flow rate measurement error.

– «**3_3_x**» - high velocity in FSx. The volumetric flow rate in mentioned FS exceeds maximum value for this FS type more than twice.

If the error has been registered in the flow measurement channel, which is used for heat quantity calculations then heat quantity is not calculated.

13.6 Error group «**4**».

Errors of this group refer to heat quantity calculation (sign «x» specifies the number of the channel). Here the errors in temperature ratios, which are necessary for heat quantity calculation, are analyzed:

– «**4_1_x**» - $t_{ret} > t_{flow} + 2.5$ °C. The temperature of the return pipeline exceeds the temperature of flow pipeline more than on 2.5 °C. Heat quantity calculation is impossible. If temperature excess is in a range: 0 up to 2.5 °C, a temperature difference is accepted equal to 0, and the error is not registered

– «**4_2_x**» - $t_{cw} > t_{flow} + 2.5$ °C. The temperature of cold water exceeds water temperature in flow pipeline more than on 2.5 °C. Heat quantity calculation is impossible. If temperature excess is in a range: 0 up to 2.5 °C, a temperature difference is accepted equal to 0, and the error is not registered.

– «**4_3_x**» - $t_{cw} > t_{ret} + 2.5$ °C. The temperature of cold water exceeds water temperature in return pipeline more than on 2.5 °C. Heat quantity calculation is impossible. If excess is in a range: 0 up to 2.5 °C, a temperature difference is accepted equal to 0, and the error is not registered.

– «**4_4_x**» - the error of pressure measurement in flow pipeline. It is registered only if measured pressure is considered in heat calculation process.

– «**4_5_x**» - the error of pressure measurement in return pipeline. It is registered only if measured pressure is considered in heat calculation process.

– «**4_6_x**» - the error of cold water pressure measurement. It is registered only if measured pressure is considered in heat calculation process.

These errors don't affect flow rate and temperature measurements.

13.7 Error group «**6**».

– This group includes the errors of pressure measurement (the sign «x» specifies number of the channel):

– «**6_1_x**» - PSx is below the tolerance. Measured pressure is below zero. It can be caused by object conditions (underpressure), or with breakage of certain PS.

– «**6_2_x**» - PSx is over the tolerance. Measured pressure is above 20 kgf/cm^2. It can be explained by the fact of increased pressure on the object and faultiness of PS.

– «**6_3_x**» - PSx parameters are incorrect.

Pressure measurement errors don't affect flow rate and temperature measurements.

In hourly and daily archive printouts there is a value of error appearance duration (Terr). This value includes errors referred to flow measurement channel and errors which lead to impossibility of flow rate measurement. Errors of a flow meter and errors of temperature measurement are included here.

Printouts have a field 'Error types', in which presence of certain error type is displayed. In total up to four various types of errors can be displayed within an hour and up to 8 types of errors can be displayed within a day. The error is displayed on printout only if its duration exceeds 1 minute.

Errors are displayed by letters of the Latin alphabet. The certain letter meets to each type of errors:

A – system errors (error group 0);
B – temperature measurement errors (error group 1);
C – flow rate measurement errors (error group 3);
D – flow rate measurement errors (error group 2);
E – heat calculation errors (error group 4);
F – pressure measurement errors (error group 6);

For example, record 'BD' means, that there were errors of group 1 and group 2. More detailed information on these errors can be taken in the error archive printout.

In error archive printout the error code in the above described format and duration of this error in hours are mentioned. Within one hour up to 4 polytypic errors can be registered (in archive) and for a day - up to 8 polytypic errors can be registered. If the number of errors is

more than it was mentioned, than the most significant errors are stored. For example, the error of one TS can cause some more other errors, so only error of TS will be displayed.

The list of certain faultinesses and methods of their elimination are resulted in table 13.1.

Table 13.1.

Appearance of faultiness	Possible reason	Method of elimination
1. There is no indication on the indicator	The battery is completely discharged or not installed.	Replace (install) the battery.
2. The meter does not react on button pressing	The calculator is faulty	Provide a repair of the calculator

The notice: A repair of the calculator should be provided by specialized manufacturing division.

14 Storing

14.1 Heat meter storing can be made in heated or unheated storehouses.

Meter life cycle:

– in heated storehouse is no more than 10 years;

– in unheated storehouse is no more than 5 years.

14.2 Storage conditions for meters:

1) in heated storehouse:

– ambient temperature can vary from 0 up to 50 °C;

– relative air humidity is up to 80 %, while temperature is 30 °C and below without moisture condensation;

2) in unheated storehouse:

– ambient temperature can vary from minus 5 °C up to 50 °C;

– relative air humidity is up to 95 %, while temperature is 35 °C and below without moisture condensation.

14.3 At long-term storage in unheated storehouse meters should be placed in an additional cover from a polyethylene film.

15 Transportation

15.1 Meters can be transported by all modes of transport. Their packing should provide protection against direct influence of atmospheric precipitation.

While transporting by air transport, meters in packing should be placed in hermetically compartments.

15.2 Transportation conditions:

– ambient temperature:

– for calculator can vary from minus 20 °C up to 50 °C;

– for FS can vary from minus 50 °C up to 70 °C;

– relative air humidity is up to 98 %, while temperature is 35 °C;

– transport jolty with acceleration 30 m/sec^2 , while frequency varies from 80 up to 120 beats per minute.

15.3 Meters are steady against influence of sinusoidal vibrations, while frequencies vary from 5 up to 35 Hz with amplitude up to 0.35 mm.

15.4 Throwing of meters during delivering and unloading it is not permitted.

FS and packing box with the calculator should be fixed to except accidental moving at shipment in vehicle.

16 Guarantee of manufacturer

16.1 Manufacturer guarantees that produced heat meters meet to all requirements of their specifications within 48 months from the moment of shipment if the consumer observes the following conditions:

– installation, starting-up and adjustment of the heat meter is made by the organization, which has the manufacturer’s sanction;

– conditions of service, transportation and storage meet to requirements in Chapters 8-11, 14 and 15 of present OI.

16.2 Guarantees are extended on defects of meter components in delivery complete set in case of manufacturing defects, defects of materials and componentry.

16.3 Guarantees provide replacement of defective componentry and check of meter working capacity by manufacturer.

16.4 Faulty device should be delivered to the manufacturer for testing and repair.

16.5 Unsealing of the calculating unit (breaking of seals) before its returning to the manufacturer is not allowed.

16.6 Guarantees do not provide expenses indemnification for dismantle, return and repeated installation of the device, and also any secondary losses caused by malfunction.

16.7 In case of malfunction identification during a warranty period the consumer should report unsatisfactory condition of the equipment to manufacturer:

SEMPAL Co. LTD
LLC FIRM "SEMPAL Co LTD",
11, René Descartes str., Kiev, Ukraine, 03062

Тел.: +38 (044) 3371188, (044) 3551188
+38 (098) 1638888, (050) 1428888.
http://www.sempal.com

16.8 Do not put in claims to a heat meter in following cases:

– installation, starting-up and adjustment have been carried out by organization without manufacturer's license on carrying out of such works;

– damage of seals on the calculating unit;

– the expiration of a warranty period;

– violation of service, storage and transportation regulations stipulated by the operational documentation.

16.9 After ending of a warranty period or loss of the right on warranty service the manufacturer makes repair of heat meters according to a tariff.

Annex A
Meter designation

Example of designation: **« S10H – 2 – 4 – FS50/FS50n – 4b45p/4/0 – 3/5 – 3/5/0 – 3/5 – 1/2»**

Interpretation:

S10H -	**2 –**	**4 –**	**FS50/FS50n –**	**4b45p/4/0 –**	**3/5 –**
Heat meter name	Accuracy class	Configuration	Types of FS. “ n” - delivery without flanges	Types of applied RTD (0 – RTD isn’ t applied) “ b” with digit –angle of inclination of the bush, “ p” – if there is a thermometer pocket	Cable length up to corresponding FS, m

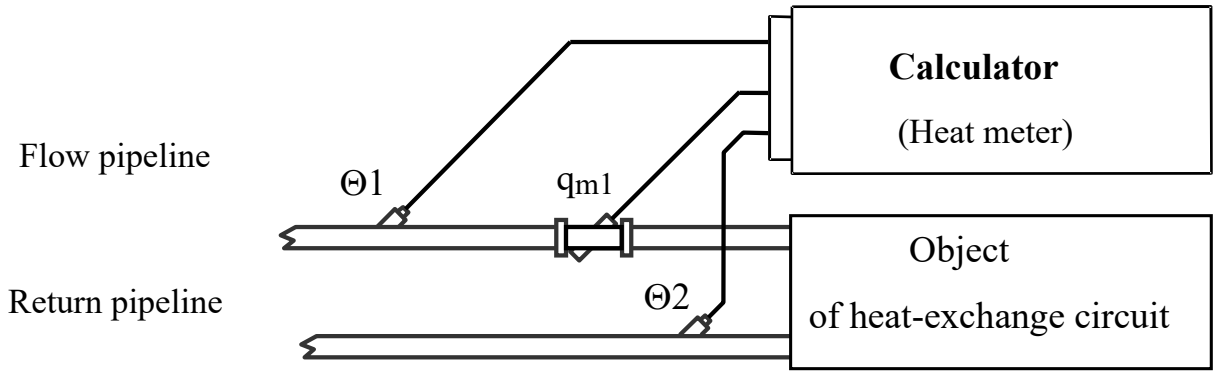
3/5/0 –	**3/5/1 –**	**1/2**
Cable length up to corresponding RTD, m	Cable length up to PS, m, and number of PS for delivery (3^{d} digit)	Cable length RS232C / pulse output cable, m

Annex B
Schematic circuits for meter installations
in different configurations

In listed below formulas there are following notations:

Q is heat quantity (J);
h is specific enthalpy (J/kg);
q_m is mass flow rate (kg/h);
t is time (h).

Configuration 2

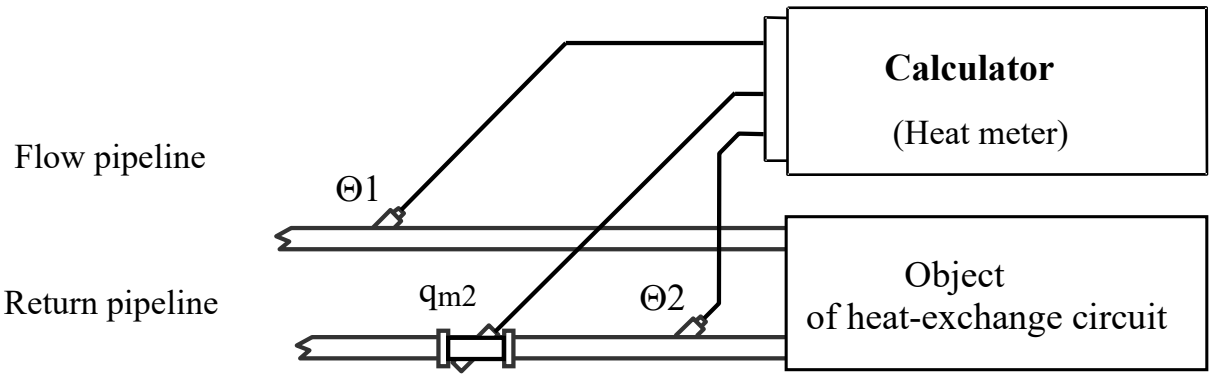


$$Q = \int_t q_{m1} \cdot (h_1 - h_2) \cdot dt$$

Heat meter in a closed district heating system

Figure B.1

Configuration 2/1

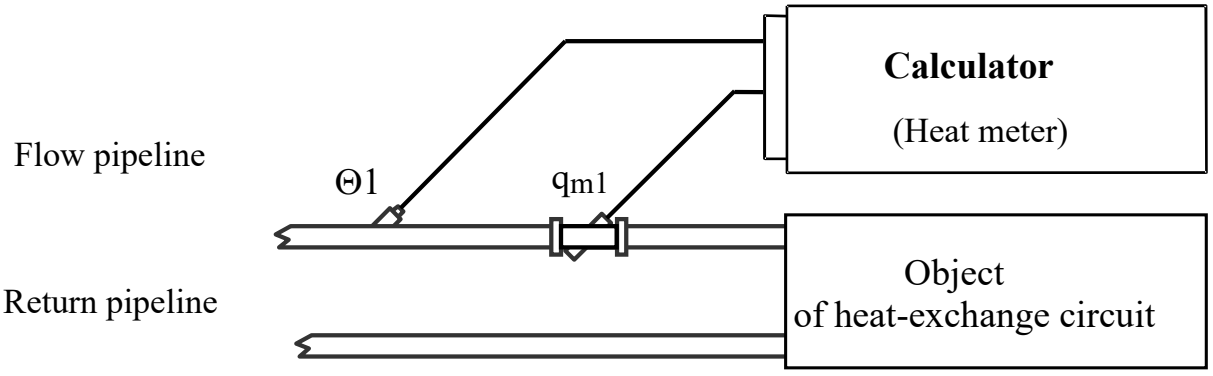


$$Q = \int_t q_{m2} \cdot (h_1 - h_2) \cdot dt$$

Heat meter in a closed district heating system

Figure B.2

Configuration 2/2

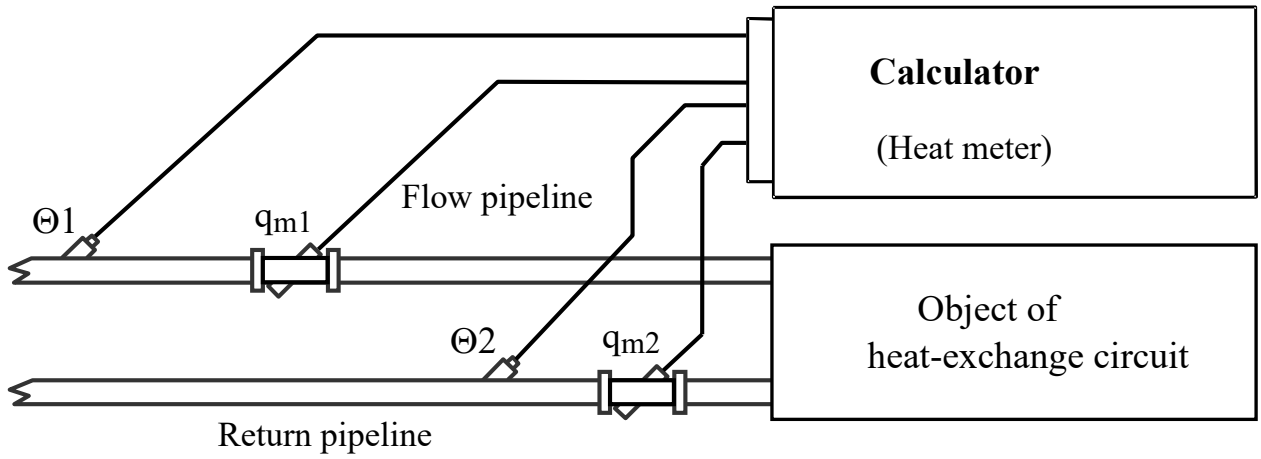


$$Q = \int_t q_{m1} \cdot (h_1 - h_2) \cdot dt$$

Heat meter in a closed district heating system
The return pipe temperature is programmed

Figure B.3

Configuration 4



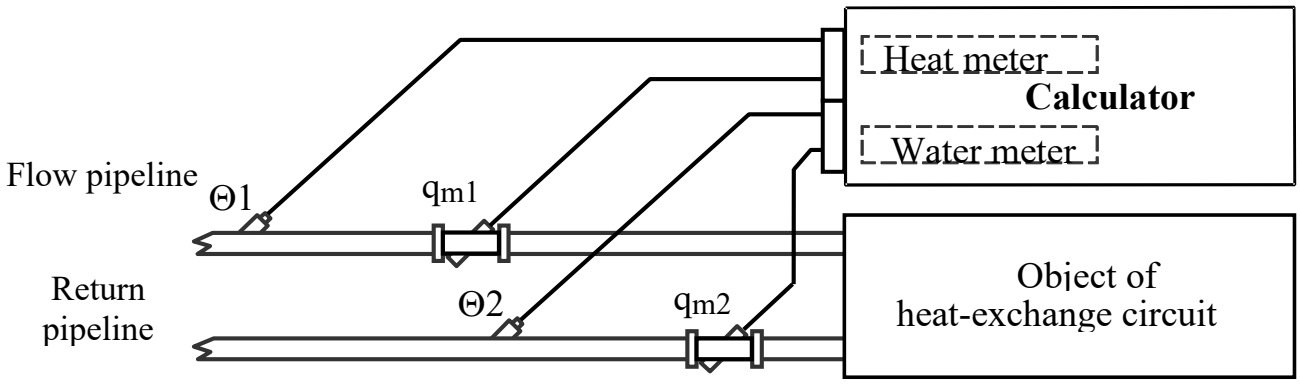
$$Q = \int_t q_{ml} \cdot (h_1 - h_2) \cdot dt + \int_t (q_{ml} - q_{m2}) \cdot (h_2 - h_{cold}) \cdot dt$$

Heat meter in an open district heating system without a cold water pipeline

(Cold water temperature Θ_{cold} is programmed)

Figure B.4

Configuration 5



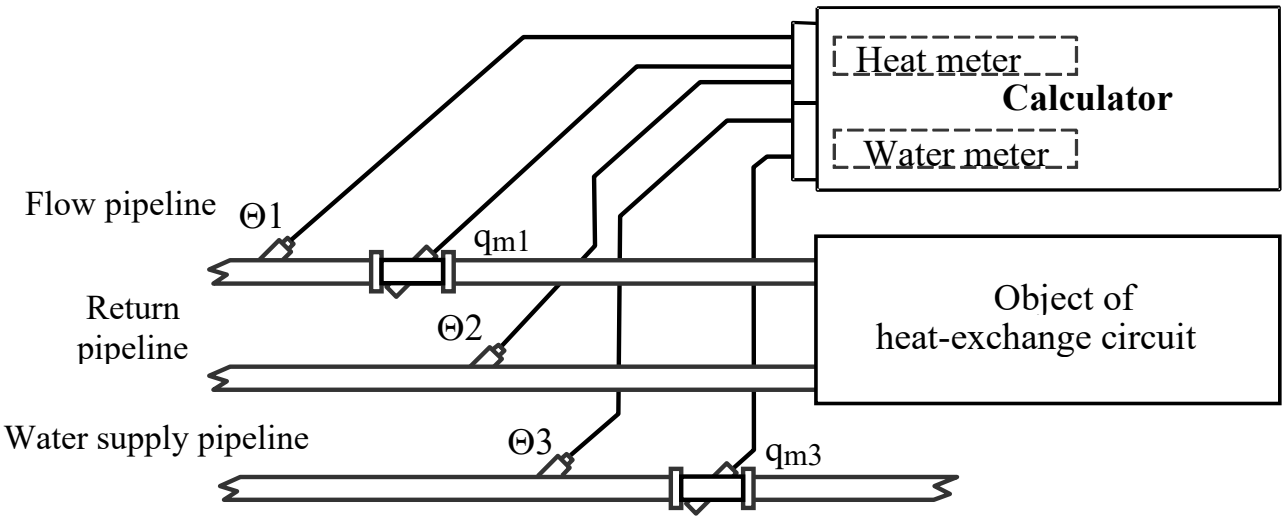
$$Q = \int_t q_{ml} \cdot (h_1 - h_2) \cdot dt$$

Heat meter in a closed district heating system with a check water meter on the return pipeline

(Basic function is heat quantity measurement, additional function is measurement of heat-conveying liquid volume in the return pipeline)

Figure B.5

Configuration 6



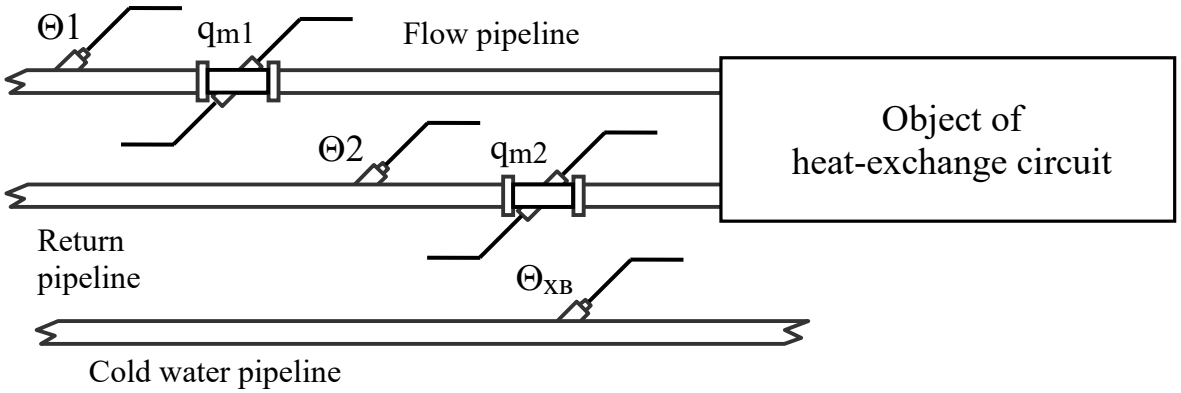
$$Q = \int_t q_{m1} \cdot (h_1 - h_2) \cdot dt$$

Heat meter in a closed district heating system and independent water meter

Basic function is heat quantity measurement, additional function is measurement of water in water supply pipeline.

Figure B.6

Configuration 7



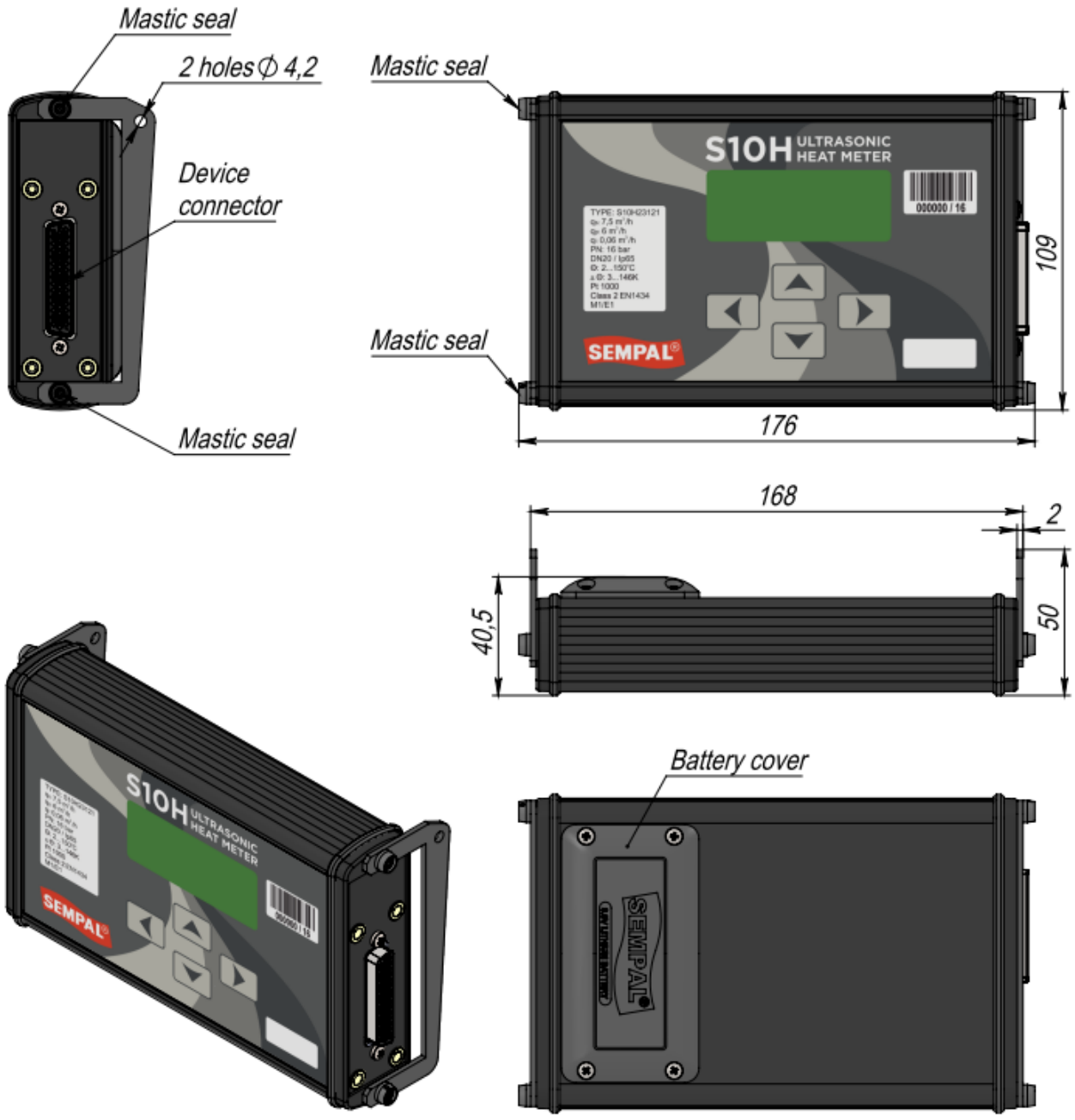
$$Q = \int_t q_{m1} \cdot (h_1 - h_2) \cdot dt + \int_t \left(q_{m1} - q_{m2}\right) \cdot (h_2 - h_{хв}) \cdot dt$$

Heat meter in an open district heating system with cold water supply pipeline

(Basic function is heat quantity measurement, cold water temperature is measured)

Figure B.7

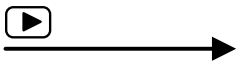
Annex C
Overall and connecting dimensions of calculator



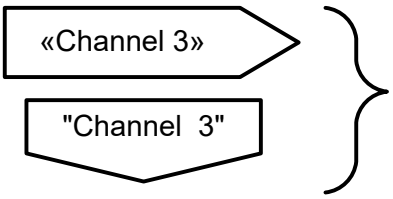
Reference designation

These buttons have the following functions:

▶ - «Right», ▲ - «Up», ▼ - «Down», ◀ - «Left»



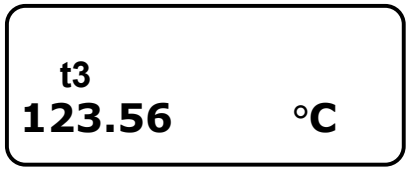
Move to next item if corresponding button has been pressed («Right» in the case)



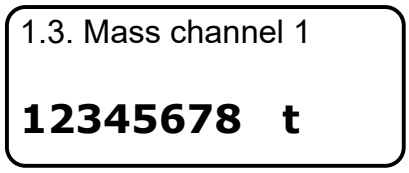
See continuation on the next page with corresponding title

Menu item denoted as (★) are indicated only for corresponding meter configuration.

Indication of menu item



Indicator in basic work mode.
The type of parameter and its dimension are displayed.



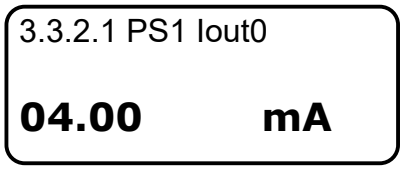
Indicator in menu item select mode.
Top line shows number of menu item and its name.
Bottom line can be used to display value of indicated parameter.

Editing of parameter can be done in three following steps:
- indication of parameter current value;
- editing the parameter. To start editing press “Right” button;
- indication of the result after ending of editing process.

After pressing the button “Right” edited symbol begins to blink.

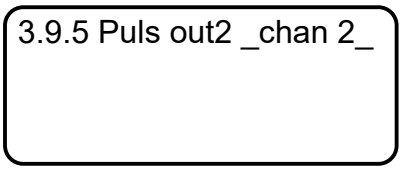
There are two editing modes:
- editing of digital value;
- select an item from the list.

Editing of digital value



Edited digit blinks. Change of digit is provided by buttons “Up” and “Down”. Move to the next digit is provided by button “Right”. After reaching the last right digit the cursor moves to the first digit. Ending of editing occurs at pressing “Left” button. After that blinking is stopped and saved parameter value is displayed. If number with floating point are edited the final number may differ from entered number on one lower order bit. It can be explained by way of internal data representation.

Selection of the variant



Selecting menu item for change of parameter from the list of available values in the top row (right side) the current parameter value put into symbols “_” is indicated. After pressing “Right” button these symbols are changed to «◗ ◖» what means the beginning of editing. Change of parameter value is provided by “Up” and “Down” buttons. End of editing is occurred by “Left” button. After that entered value is displayed.

If parameter shouldn’t be edited (for example, “Enter” button has been pressed by mistake) editing can be interrupted and parameter would be in initial condition. For this purpose “Right” and “Left” buttons should be pressed simultaneously.

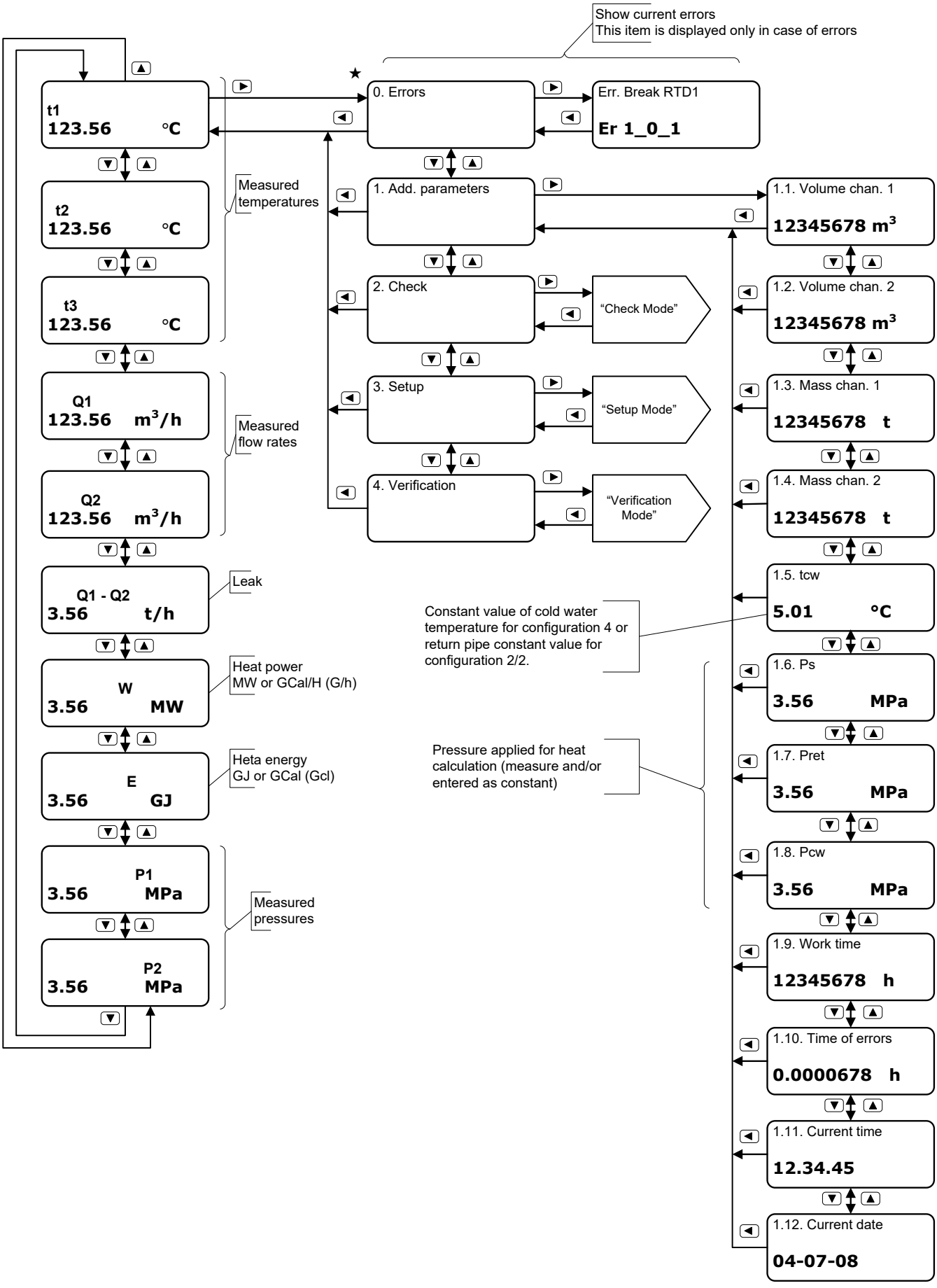
Notes:

1. Holding any button for more than 0.5 sec will result in autorepeat of that button with the rate of 3 times per second.

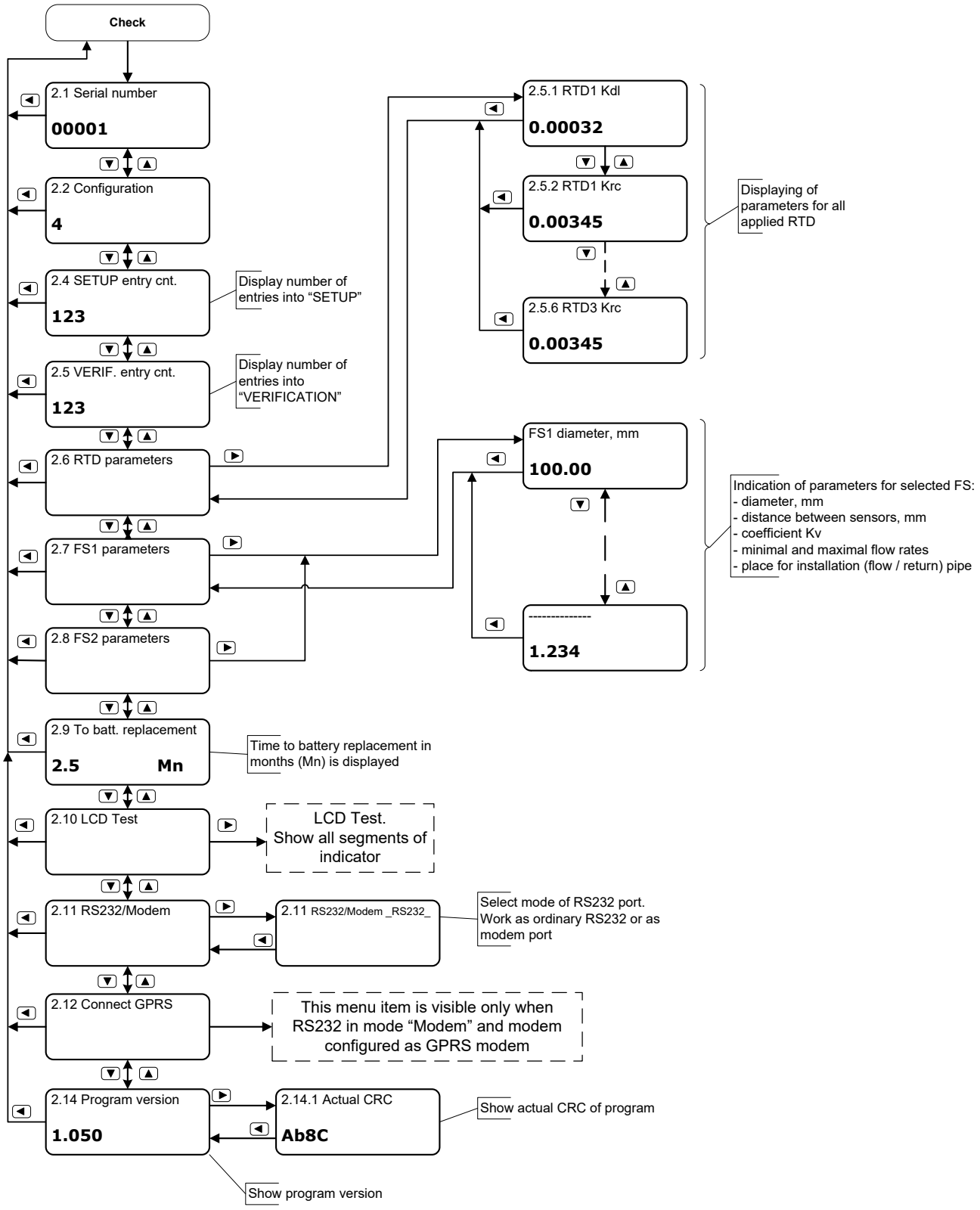
If there was no pressing buttons in 2 min, the meter switches from selection mode or password entry to “Indication of main parameters” mode.

2. If entered an invalid parameter, the meter displays an error message. Pressing any button clear error message and returns to previous menu.

‘Indication of main parameters’ mode

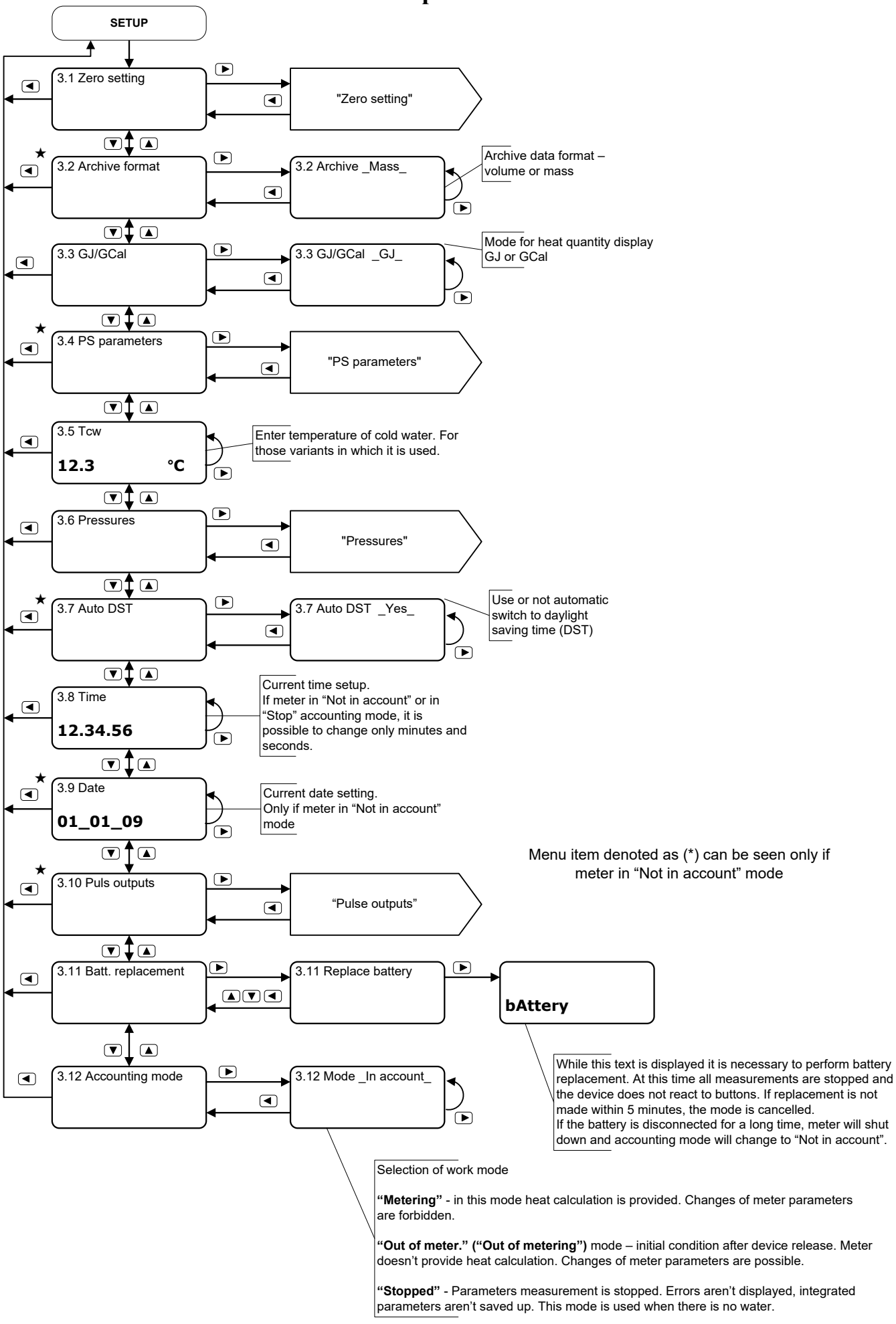


‘Check’ mode

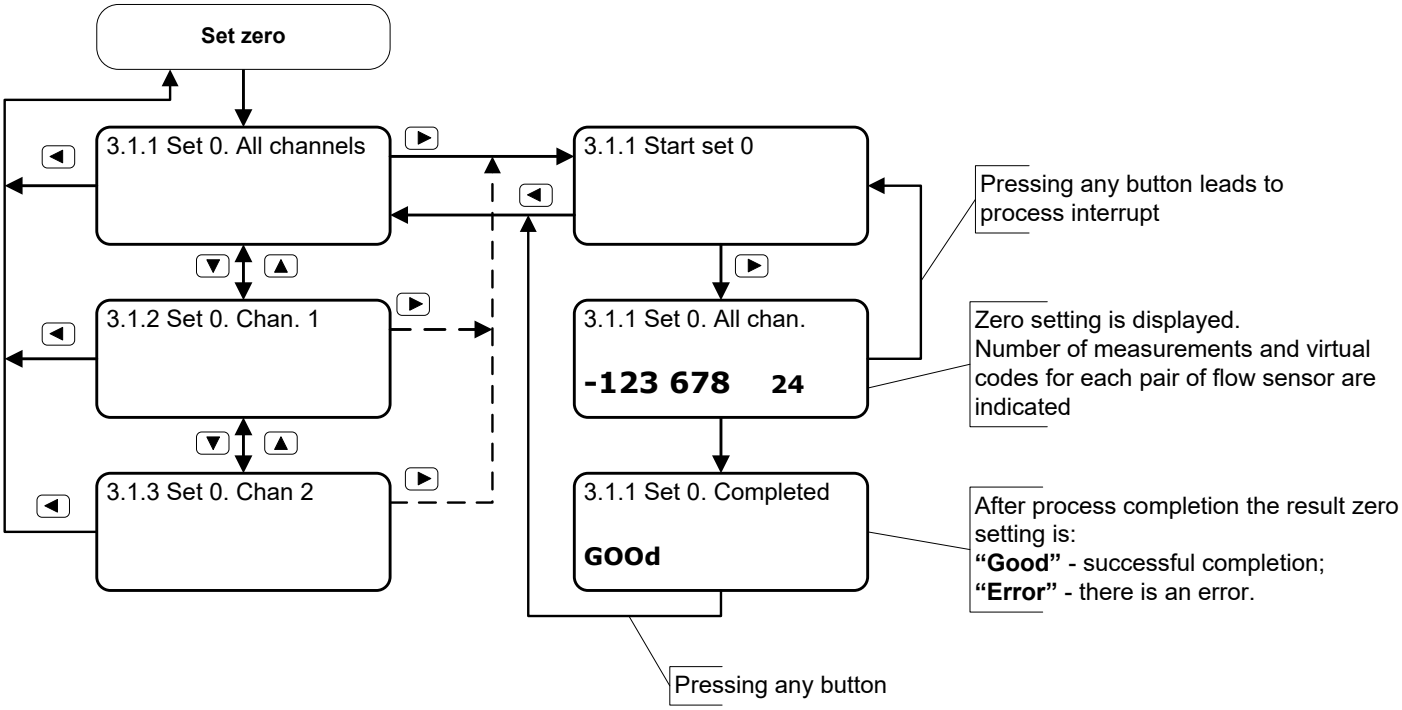

Check
2.1 Serial number
00001
2.2 Configuration
4
2.4 SETUP entry cnt.
123
Display number of entries into “SETUP”
2.5 VERIF. entry cnt.
123
Display number of entries into “VERIFICATION”
2.6 RTD parameters
2.7 FS1 parameters
2.8 FS2 parameters
2.9 To batt. replacement
2.5 Mn
Time to battery replacement in months (Mn) is displayed
2.10 LCD Test
LCD Test.
Show all segments of indicator
2.11 RS232/Modem
2.11 RS232/Modem _RS232_
Select mode of RS232 port.
Work as ordinary RS232 or as modem port
2.12 Connect GPRS
This menu item is visible only when RS232 in mode “Modem” and modem configured as GPRS modem
2.14 Program version
1.050
2.14.1 Actual CRC
Ab8C
Show actual CRC of program
Show program version
2.5.1 RTD1 Kdl
0.00032
2.5.2 RTD1 Krc
0.00345
2.5.6 RTD3 Krc
0.00345
Displaying of parameters for all applied RTD
FS1 diameter, mm
100.00

1.234
Indication of parameters for selected FS:
- diameter, mm
- distance between sensors, mm
- coefficient Kv
- minimal and maximal flow rates
- place for installation (flow / return) pipe

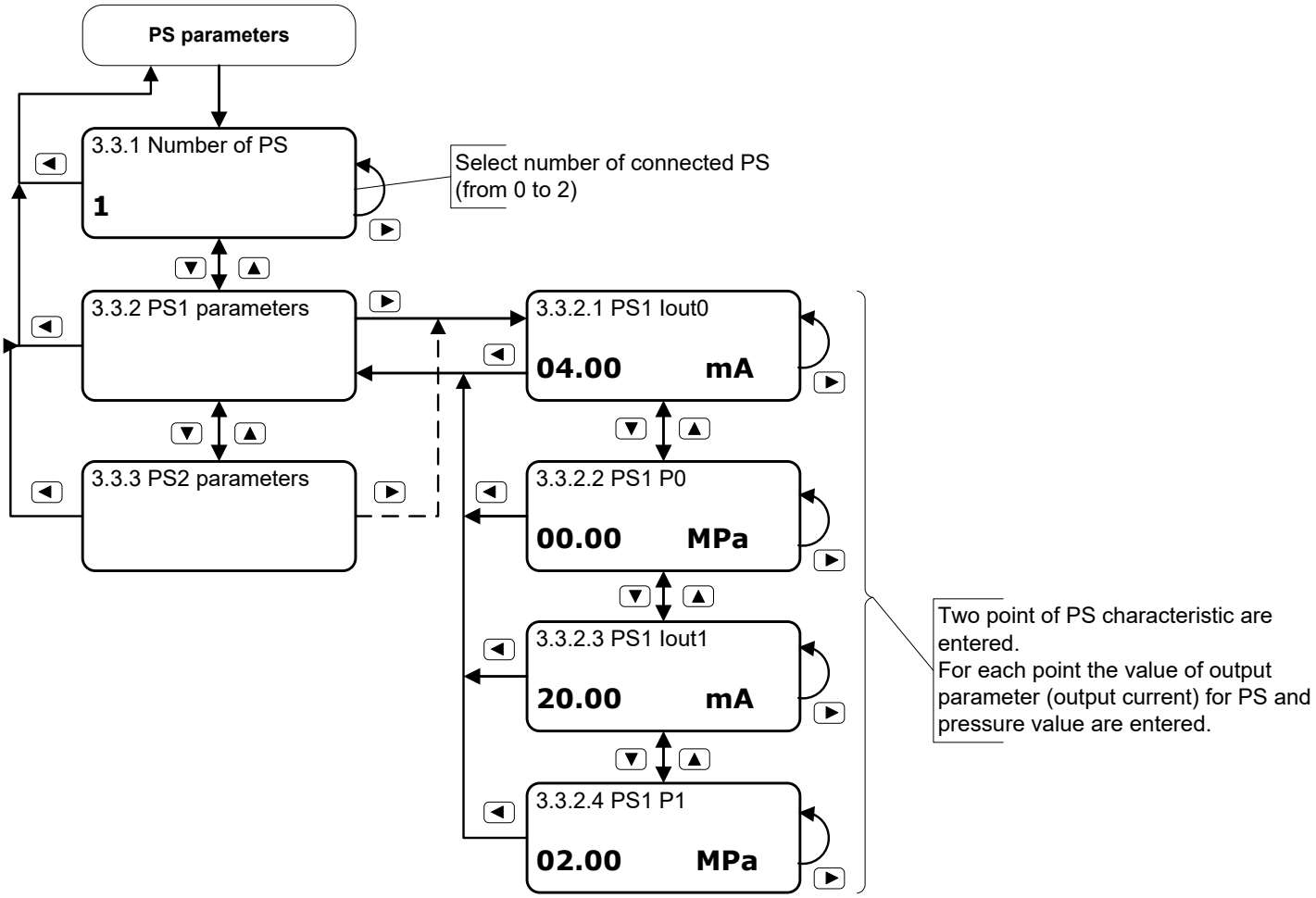
‘Setup’ mode


SETUP
3.1 Zero setting
"Zero setting"
3.2 Archive format
3.2 Archive _Mass_
Archive data format – volume or mass
3.3 GJ/GCal
3.3 GJ/GCal _GJ_
Mode for heat quantity display GJ or GCal
3.4 PS parameters
"PS parameters"
3.5 Tcw
12.3 °C
Enter temperature of cold water. For those variants in which it is used.
3.6 Pressures
"Pressures"
3.7 Auto DST
3.7 Auto DST _Yes_
Use or not automatic switch to daylight saving time (DST)
3.8 Time
12.34.56
Current time setup. If meter in “Not in account” or in “Stop” accounting mode, it is possible to change only minutes and seconds.
3.9 Date
01_01_09
Current date setting. Only if meter in “Not in account” mode
Menu item denoted as (*) can be seen only if meter in “Not in account” mode
3.10 Puls outputs
“Pulse outputs”
3.11 Batt. replacement
3.11 Replace battery
bAttery
While this text is displayed it is necessary to perform battery replacement. At this time all measurements are stopped and the device does not react to buttons. If replacement is not made within 5 minutes, the mode is cancelled. If the battery is disconnected for a long time, meter will shut down and accounting mode will change to “Not in account”.
3.12 Accounting mode
3.12 Mode _In account_
Selection of work mode
“Metering” - in this mode heat calculation is provided. Changes of meter parameters are forbidden.
“Out of meter.” (“Out of metering”) mode – initial condition after device release. Meter doesn’t provide heat calculation. Changes of meter parameters are possible.
“Stopped” - Parameters measurement is stopped. Errors aren’t displayed, integrated parameters aren’t saved up. This mode is used when there is no water.

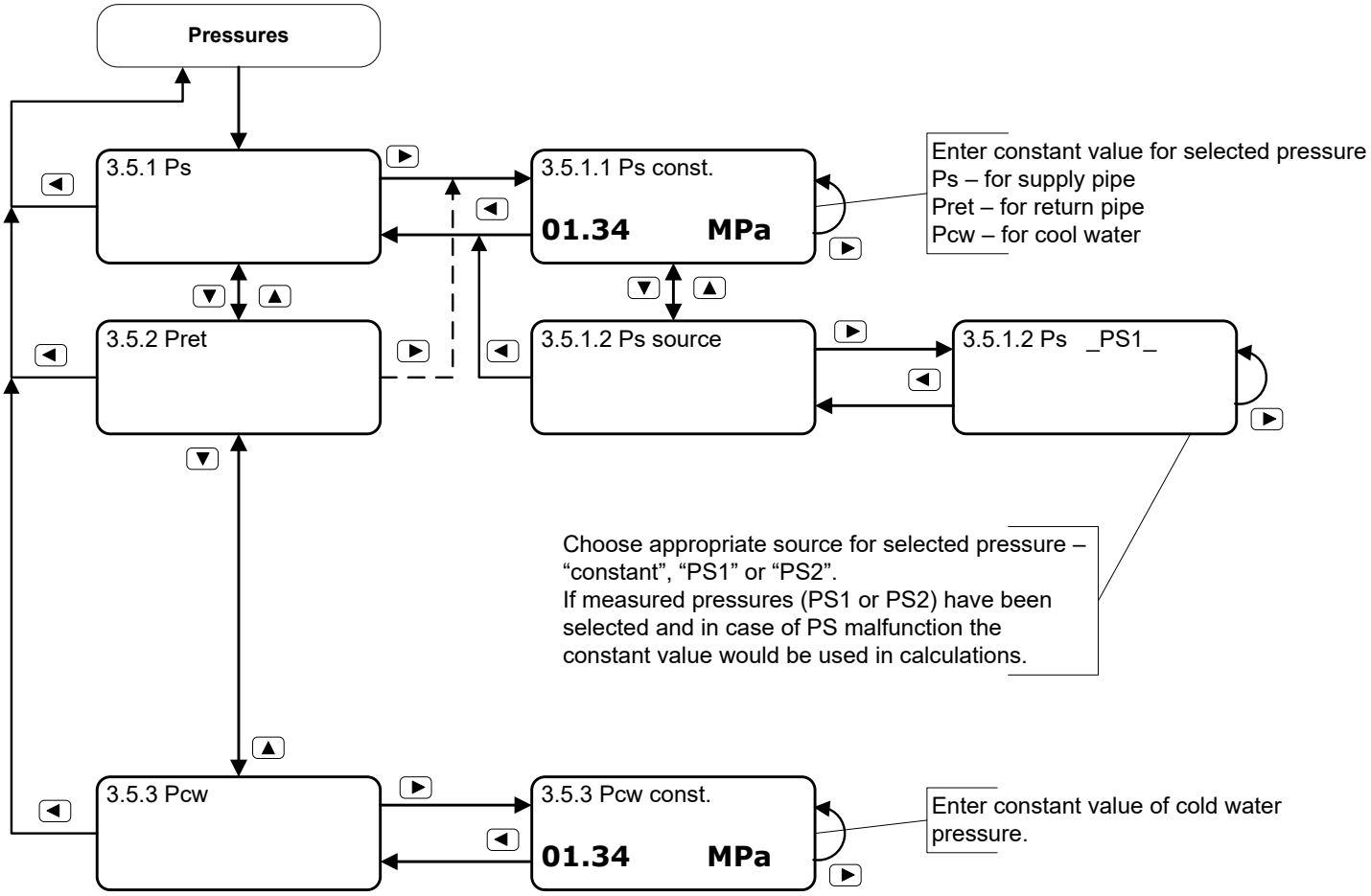
‘Setup / Set zero’ mode



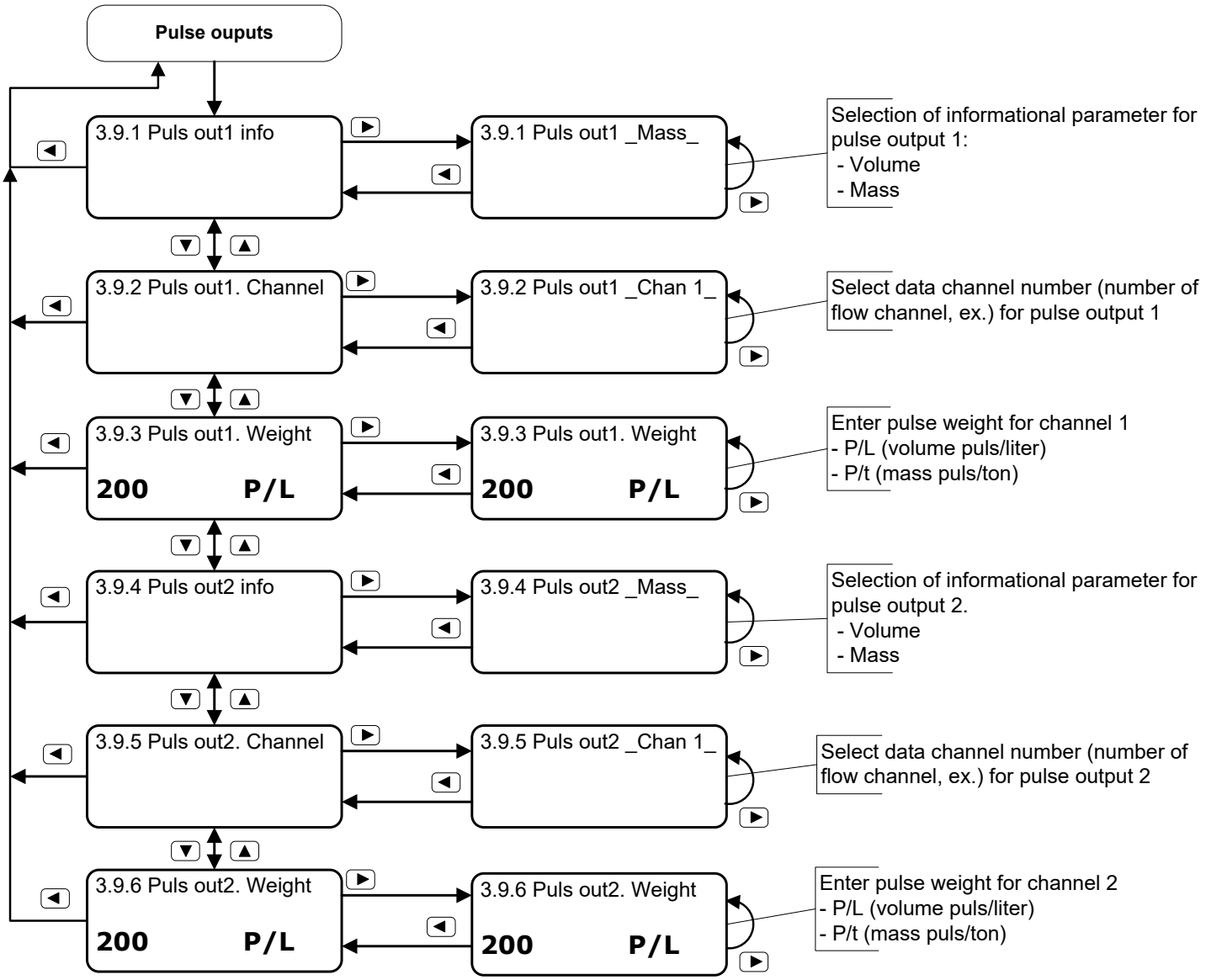
‘Setup / PS parameters’ mode



‘Setup/Pressures’ mode



’Setup / Pulse outputs’ mode



Annex E

Examples of reports created by “Sempal Device Manager” software

Hourly report example

Daily report example

Hour	Twork h	Temperature, °C			Flow rate, m3			Heat, GCal	Pressure, kgf/cm2			Terr, h	Errors type	Notes	Temperature, °C		
		ts	tret	tcw	V1	V2	dV		Ps	Pret	Pcw				t1	t2	t3
08	0.27	50.96	46.14	24.93	2.560	1.779	0.780	0.02974	5.10	4.08	1.02	0.00			50.96	46.14	24.93
09	1.00	51.24	46.19	24.47	9.762	7.152	2.609	0.10449	5.10	4.08	1.02	0.00			51.24	46.19	24.47
10	1.00	57.83	49.08	25.10	9.599	7.920	1.679	0.12175	5.10	4.08	1.02	0.00			57.83	49.08	25.10
11	1.00	61.05	53.46	25.76	9.534	8.350	1.184	0.10264	5.10	4.08	1.02	0.00			61.05	53.46	25.76
12	1.00	61.62	54.06	25.75	9.555	8.299	1.256	0.10512	5.10	4.08	1.02	0.00			61.62	54.06	25.75
13	1.00	62.28	54.64	25.76	9.901	8.157	1.744	0.12302	5.10	4.08	1.02	0.00			62.28	54.64	25.76
14	1.00	62.87	55.21	25.79	9.840	8.361	1.479	0.11601	5.10	4.08	1.02	0.00			62.87	55.21	25.79
15	1.00	63.05	55.37	25.83	9.771	8.388	1.383	0.11296	5.10	4.08	1.02	0.00			63.05	55.37	25.83
16	1.00	62.89	55.37	25.87	9.687	8.561	1.126	0.10326	5.10	4.08	1.02	0.00			62.89	55.37	25.87
17	1.00	62.41	55.18	25.84	9.661	8.272	1.389	0.10784	5.10	4.08	1.02	0.00			62.41	55.18	25.84
18	1.00	61.65	54.48	25.64	9.682	7.690	1.992	0.12402	5.10	4.08	1.02	0.00			61.65	54.48	25.64
19	1.00	61.25	54.11	25.20	9.666	7.801	1.865	0.12017	5.10	4.08	1.02	0.00			61.25	54.11	25.20
20	1.00	61.01	53.71	24.04	9.437	7.623	1.814	0.11983	5.10	4.08	1.02	0.00			61.01	53.71	24.04
21	1.00	61.00	53.44	23.43	9.559	6.737	2.822	0.15382	5.10	4.08	1.02	0.00			61.00	53.44	23.43
22	1.00	61.18	53.42	22.79	9.440	6.987	2.453	0.14512	5.10	4.08	1.02	0.00			61.18	53.42	22.79
23	1.00	61.60	54.00	23.22	9.718	7.642	2.076	0.13479	5.10	4.08	1.02	0.00			61.60	54.00	23.22
	15.25	60.69	53.41	24.96	147.371	119.721	27.650	1.82458	5.10	4.08	1.02	0.00			60.69	53.41	24.96

BILL of
heat consuming from **29/06/2010** to **29/06/2010**

page 1 of 1

Organization: _____

Address: _____

Account: _____

Conventional data:

heating: _____ **ventilation:** _____

Date	Twork h	Temperature, °C			Flow rate, m3			Heat, GCal	Pressure, kgf/cm2			Terr, h	Errors type	Temperature, °C		
		ts	trev	tcw	V1	V2	dV		Ps	Prev	Pcw			t1	t2	t3
29/06/2010	15.25	60.69	53.41	24.96	147.371	119.721	27.650	1.82458	5.10	4.08	1.02	0.00		60.69	53.41	24.96
	15.25	60.69	53.41	24.96	147.371	119.721	27.650	1.82458	5.10	4.08	1.02	0.00		60.69	53.41	24.96

Measurement system used in report (SI or SGS) chosen by user in “Setup” mode menu.

Errors report example

Hourly data of errors for meter S/N 54 from 15/01/2010 to 28/01/2010.

page 1 of 1

Date	Error code and duration in hour
15/01/2010	
18:00	1_1_1 = 0.12 1_1_2 = 0.12 3_1_1 = 0.12 3_1_2 = 0.12
16/01/2010	
10:00	1_1_1 = 0.49 1_1_2 = 0.49 3_1_1 = 0.51 3_1_2 = 0.51
11:00	1_1_1 = 1.00 1_1_2 = 1.00 3_1_1 = 1.00 3_1_2 = 1.00
12:00	1_1_1 = 1.00 1_1_2 = 1.00 3_1_1 = 1.00 3_1_2 = 1.00
13:00	1_1_1 = 1.00 1_1_2 = 1.00 3_1_1 = 1.00 3_1_2 = 1.00
14:00	1_1_1 = 1.00 1_1_2 = 1.00 3_1_1 = 1.00 3_1_2 = 1.00
15:00	1_1_1 = 1.00 1_1_2 = 1.00 3_1_1 = 1.00 3_1_2 = 1.00
16:00	1_1_1 = 1.00 1_1_2 = 1.00 3_1_1 = 1.00 3_1_2 = 1.00
17:00	1_1_1 = 0.63 1_1_2 = 0.63 3_1_1 = 0.62 3_1_2 = 0.62

Journal report example

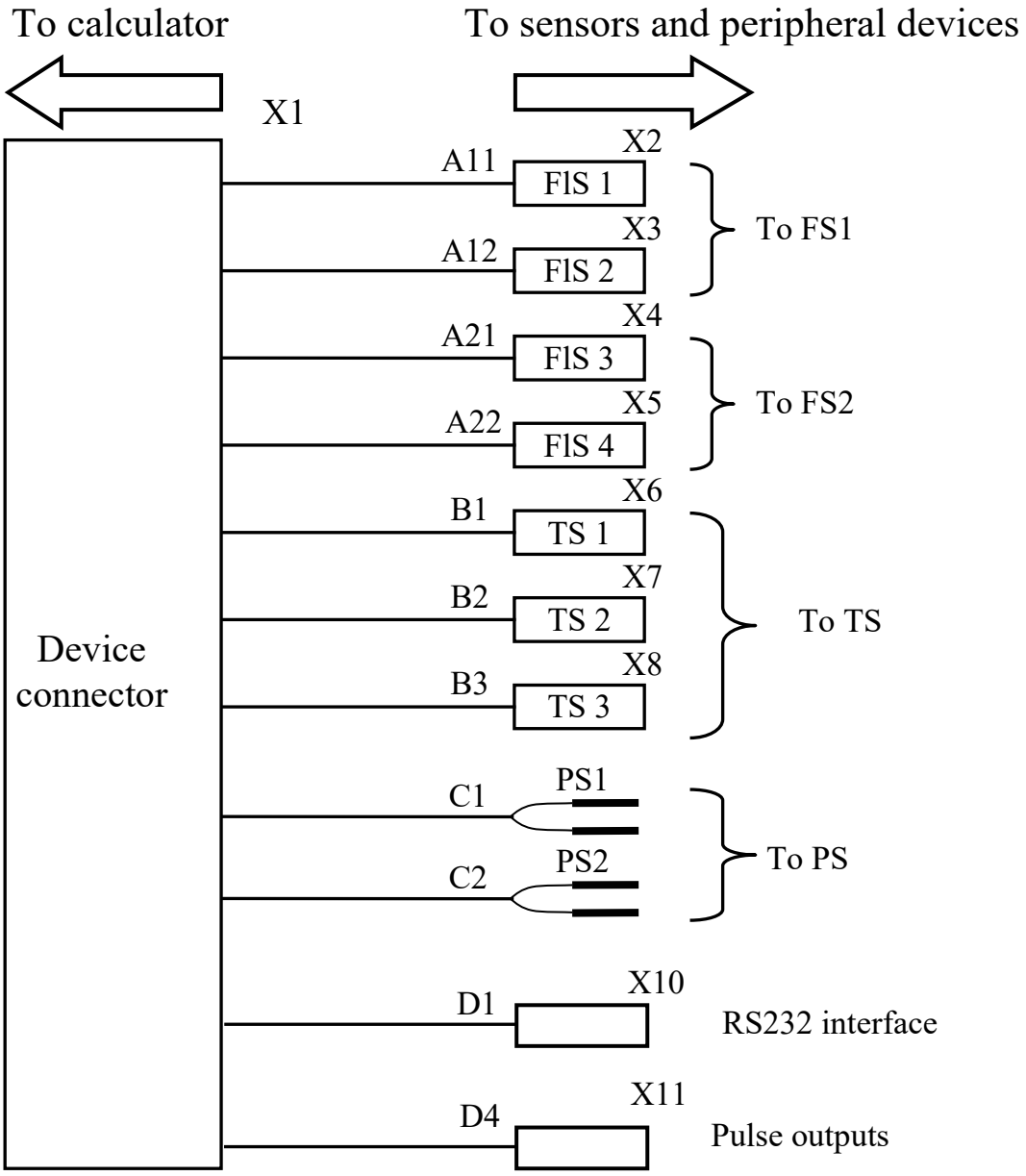
Event journal for meter S/N 00050

с 29/06/2010 по 29/06/2010

Pos.	Date	Journal record
1	29/06/2010 07:44:09	Exit from "SETUP" mode
2	29/06/2010 07:43:45	End of reset
3	29/06/2010 07:43:45	Data clearing …
4	29/06/2010 07:42:20	3.2.Archive _Volume_
5	29/06/2010 07:42:02	"SETUP" mode enter

Annex F

Circuits of device cable

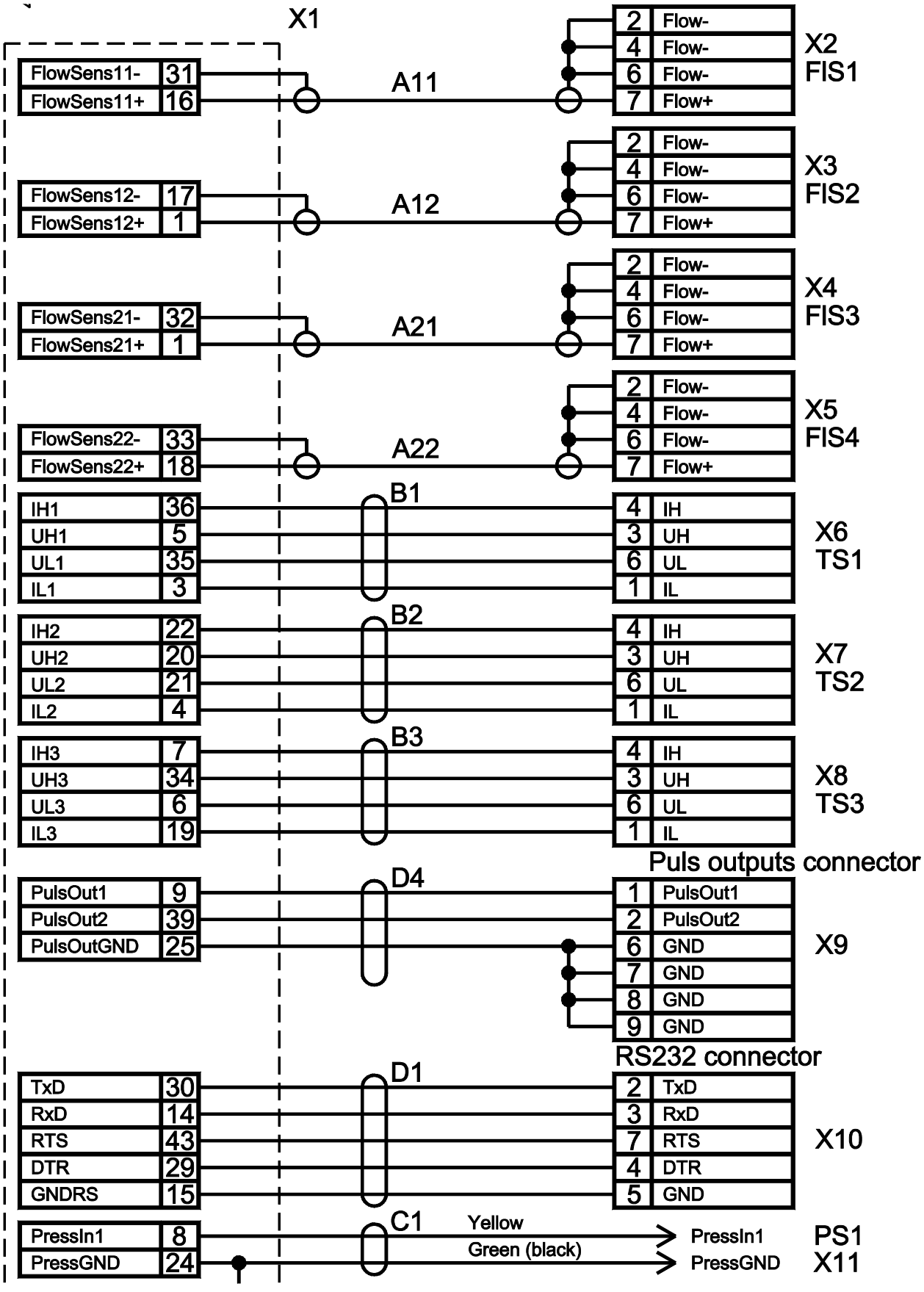


The notice. Enumeration of connection lines according to tables 9.3 and 9.4.

Basic circuit for device cable

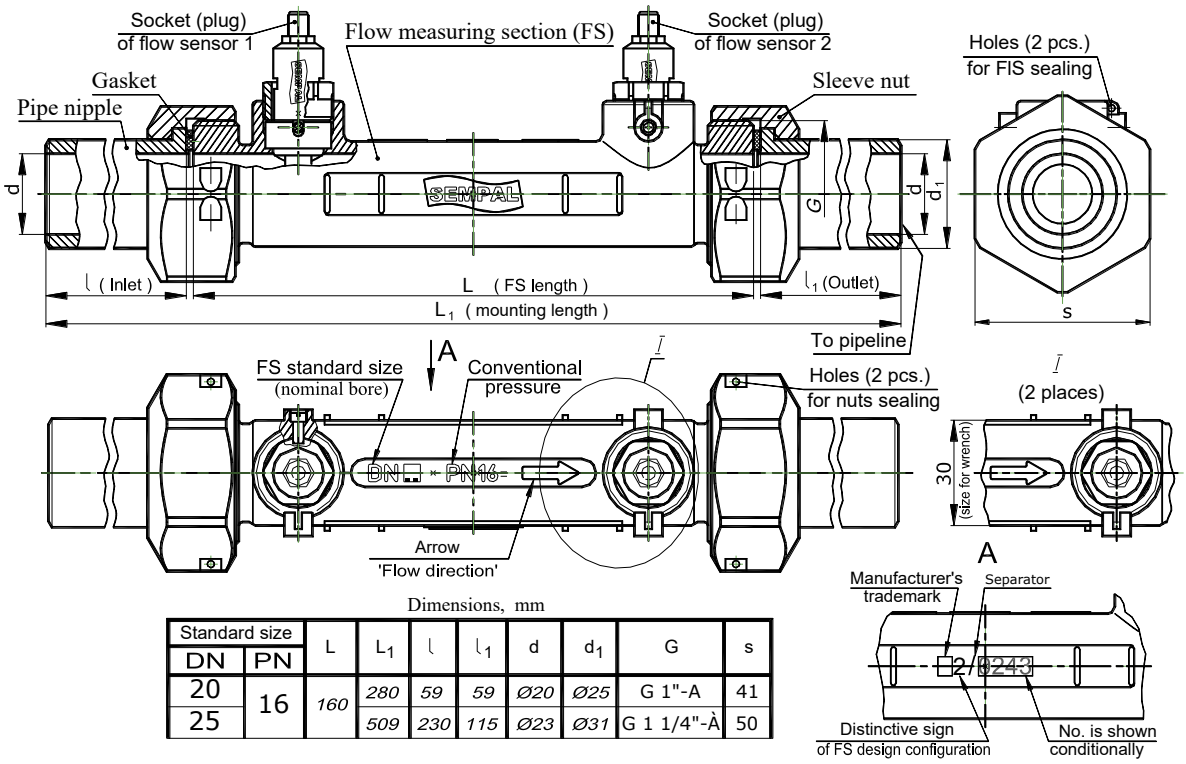
⟸ To connector X1 of S10H calculator

To sensors and peripheral devices ⟹



Annex L
Overall and connecting dimensions for flow sensor units (FS)

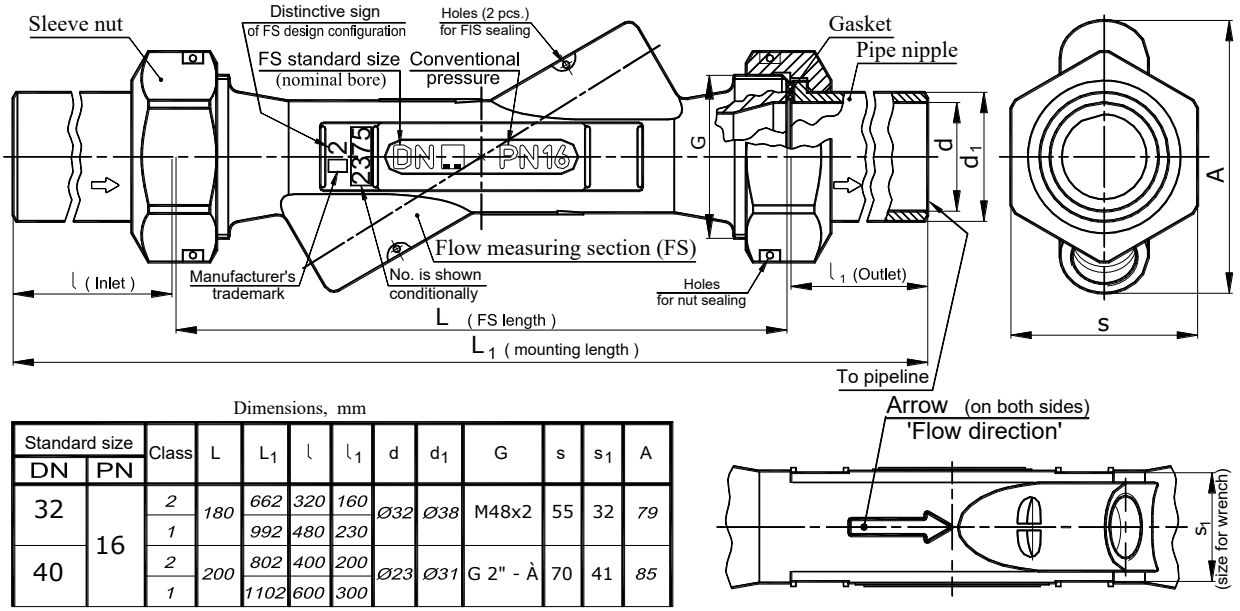
Overall and connecting dimensions of DN 20 & DN 25 set embodiments



Dimensions, mm

Standard size		L	L_1	l	l_1	d	d_1	G	s
DN	PN								
20	16	160	280	59	59	Ø20	Ø25	G 1"-A	41
25			509	230	115	Ø23	Ø31	G 1 1/4"-À	50

Overall and connecting dimensions of DN 32 & DN 40 set embodiments

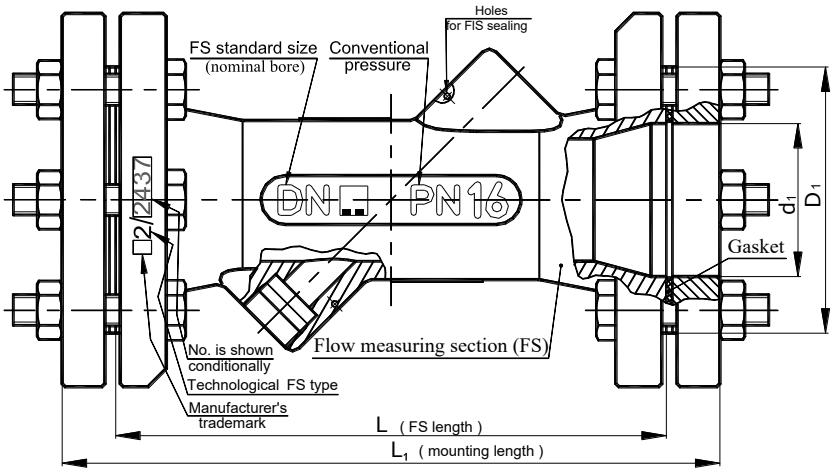


Dimensions, mm

Standard size		Class	L	L_1	l	l_1	d	d_1	G	s	s_1	A
DN	PN											
32	16	2	180	662	320	160	Ø32	Ø38	M48x2	55	32	79
		1		992	480	230						
40		2	200	802	400	200	Ø23	Ø31	G 2" - À	70	41	85
		1		1102	600	300						

Overall and connecting dimensions of DN 50 ... DN 100 set embodiments

Fig. 1.



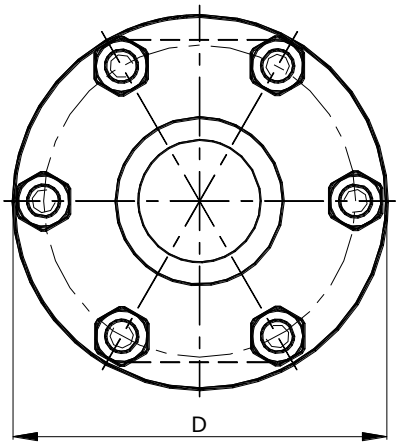
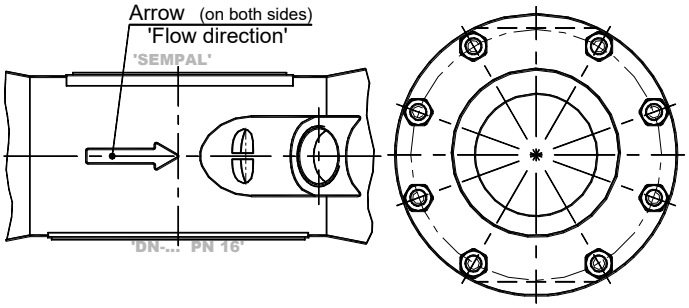


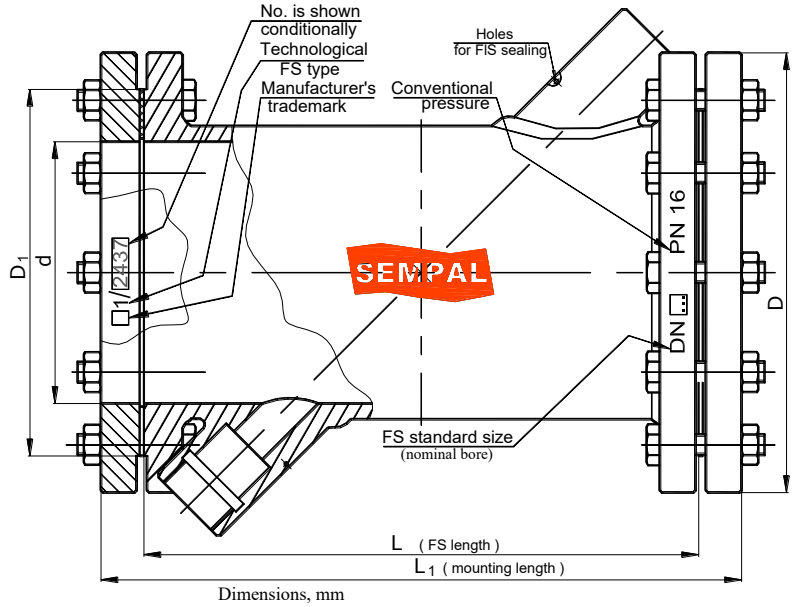
Fig. 2. FS-100 flange view

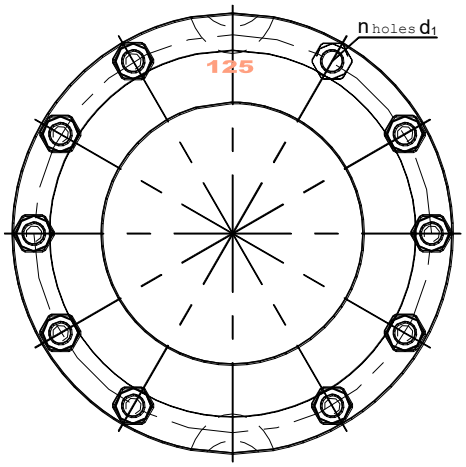
Dimensions, mm

Standard size		d	D	D_1	L	L_1	n (quantity)	Bolts (items per flange)	Note
DN	PN								
50	16	Ø50	Ø122	Ø87	180	230	6	M10x50	
65		Ø65	Ø144	Ø109	200	250			
80		Ø80	Ø155	Ø120	210	260			
100		Ø100	Ø184	Ø149	230	280	8		see fig.2



Overall and connecting dimensions of DN 125 & DN 150 set embodiments





Dimensions, mm

Standard size		d	d_1	D	D_1	L	L_1	n (quantity)	Bolts, size (items per flange)	Note
DN	PN									
125	16	Ø119...131	Ø11	Ø210	Ø175	265	309	10	M10x50	
150		Ø143...156	Ø13	Ø236	Ø195	315	359		M12x50	

1 - path flow measuring sections (FS)

Fig. 1. Embodiments (1 & 2) FS-200...1000 with standby flow sensors FIS

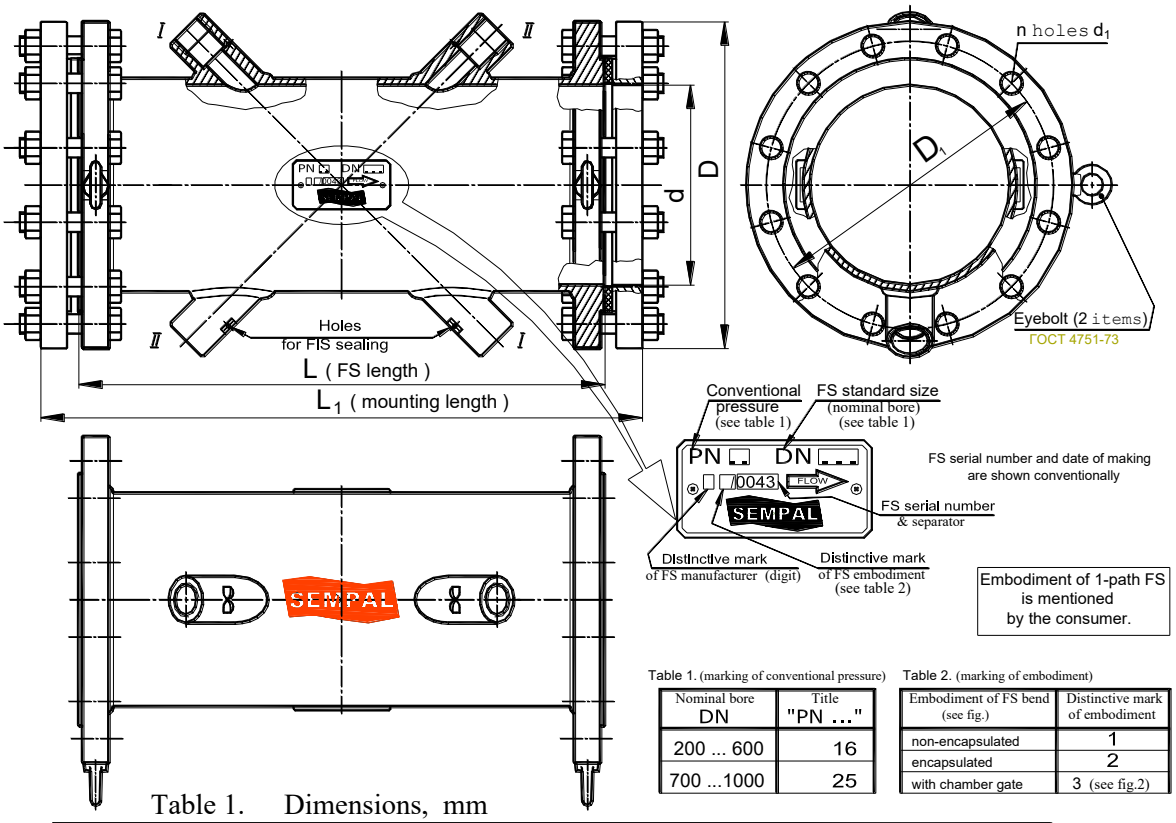


Table 1. (marking of conventional pressure)

Nominal bore DN	Title "PN ..."
200 ... 600	16
700 ...1000	25

Table 2. (marking of embodiment)

Embodiment of FS bend (see fig.)	Distinctive mark of embodiment
non-encapsulated	1
encapsulated	2
with chamber gate	3 (see fig.2)

Table 1. Dimensions, mm

Standard size DN	Standard size PN	d	D	D_1	L	L_1	d_1	n (quantity)	Bolts (items per flange)	Eyebolt (2 items)	Note
200	16	Ø190 Ø205	Ø335	Ø295	540	598	Ø22	12	M20x90	M12-7H	Complementary flanges are delivered in a set (not shown on the Fig.)
250		Ø235 Ø255	Ø405	Ø355	620	680	Ø26		M24x100		
300		Ø285 Ø310	Ø460	Ø410	680	740					
350		Ø335 Ø360	Ø520	Ø470	740	804		16			
400		Ø385 Ø410	Ø580	Ø525	820	892	Ø30		M27x110		
500		Ø480 Ø510	Ø710	Ø650	970	1062	Ø33	20	M30x140	M20-7H	
600		Ø585 Ø610	Ø840	Ø840	1110	1206	Ø36		M36x150		
700		Ø690	Ø910	Ø910	1240	1340	Ø39	24	M36x150		
800		Ø795	Ø1020	Ø1020	1360	1464			M36x160		
900		Ø900	Ø1120	Ø1120	1500	1614		28	M36x170	M24-7H	
1000		Ø1000	Ø1255	Ø1255	1550	1672	Ø45		M42x180		
700	25	Ø690	Ø960	Ø960	1240	1356	Ø45	24	M42x170	M30-7H	
800		Ø795	Ø1075	Ø1075	1360	1492			M42x190		
900		Ø900	Ø1185	Ø1185	1500	1648	Ø53	28	M48x220		
1000		Ø1000	Ø1315	Ø1315	1550	1720	Ø56		M52x250		

1 - path flow measuring sections (FS)

Fig. 2. Embodiment (3) FS-200...1000 with flow sensors lock chamber (FIS)

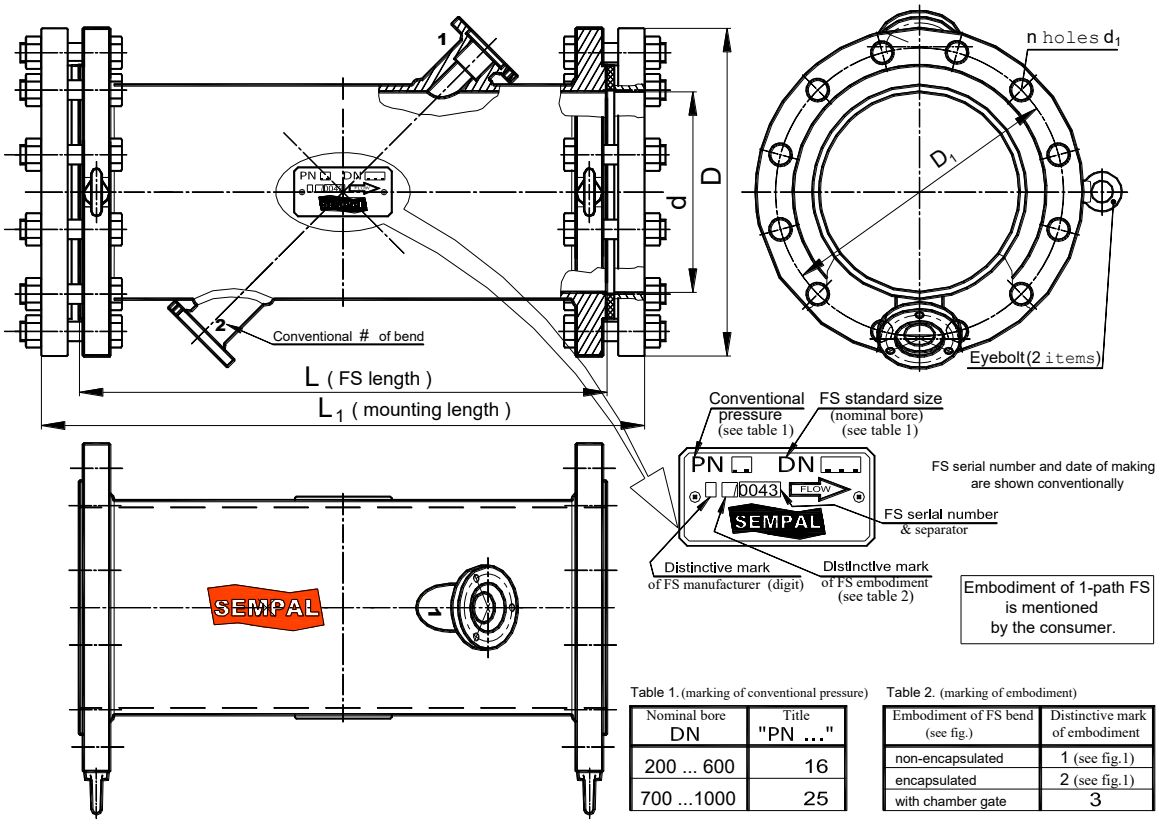


Table 1. (marking of conventional pressure)

Nominal bore DN	Title "PN ..."
200 ... 600	16
700 ...1000	25

Table 2. (marking of embodiment)

Embodiment of FS bend (see fig.)	Distinctive mark of embodiment
non-encapsulated	1 (see fig.1)
encapsulated	2 (see fig.1)
with chamber gate	3

Dimensions - see Table 1, Fig. 1

2 - path flow measuring sections (FS)

Fig. 1. Embodiments (4 & 5) FS-200...1200 with standby flow sensors (FIS)

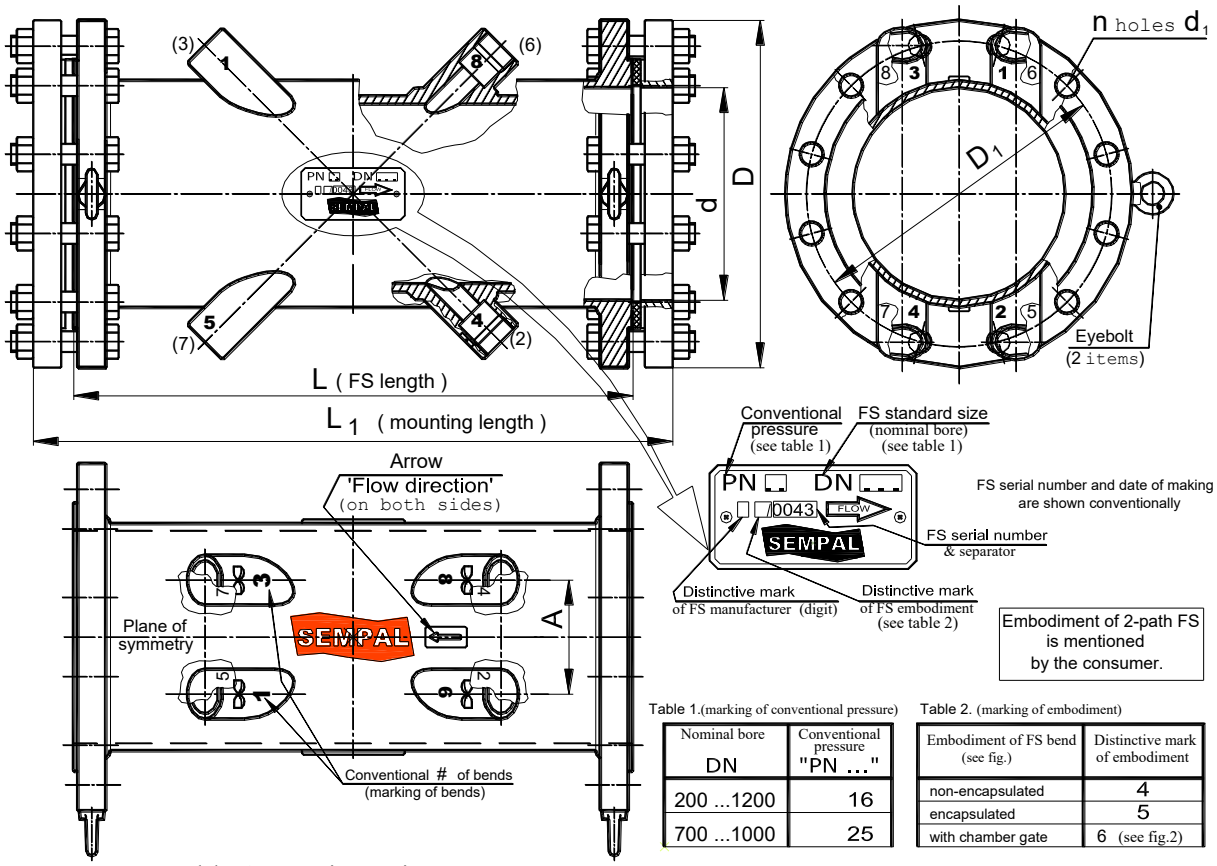


Table 1.(marking of conventional pressure)

Nominal bore DN	Conventional pressure "PN ..."
200 ...1200	16
700 ...1000	25

Table 2. (marking of embodiment)

Embodiment of FS bend (see fig.)	Distinctive mark of embodiment
non-encapsulated	4
encapsulated	5
with chamber gate	6 (see fig.2)

Table 1. Dimensions, mm

Standard size DN	Standard size PN	d	D	D_1	L	L_1	A	d_1	n (quantity)	Bolts, size (items per flange)	Eyebolt (2 items)	Note
200	16	205	335	295	540	598	111	22	12	M20x90	M12-7H	Complementary flanges are delivered in a set (not shown on the Fig.)
250		255	405	355	620	680	140	26		M24x100		
300		310	460	410	680	740	168		16			
350		360	520	470	740	804	195					
400		410	580	525	820	892	220	30		M27x110		
500		510	710	650	970	1062	278	33	20	M30x140	M20-7H	
600		610	840	840	1110	1206	330	39		M36x150		
700		690	910	910	1240	1340	372		24			
800		795	1020	1020	1360	1464	430			M36x160		
900		900	1120	1120	1500	1614	486		28	M36x170	M24-7H	
1000		1000	1255	1255	1550	1672	540	45		M42x180		
1200		1200	1485	1390	2000	2148	648	52	32	M48x220	M30-7H	
700	25	690	960	960	1240	1356	372	45	24	M42x170		
800		795	1075	1075	1360	1492	430			M42x190		
900		900	1185	1185	1500	1648	486	53	28	M48x220		
1000		1000	1315	1315	1550	1720	540	56		M52x250		

2 - path flow measuring sections (FS)

Fig. 2. Embodiment (6) FS-200...1000 with FIS with chamber gate

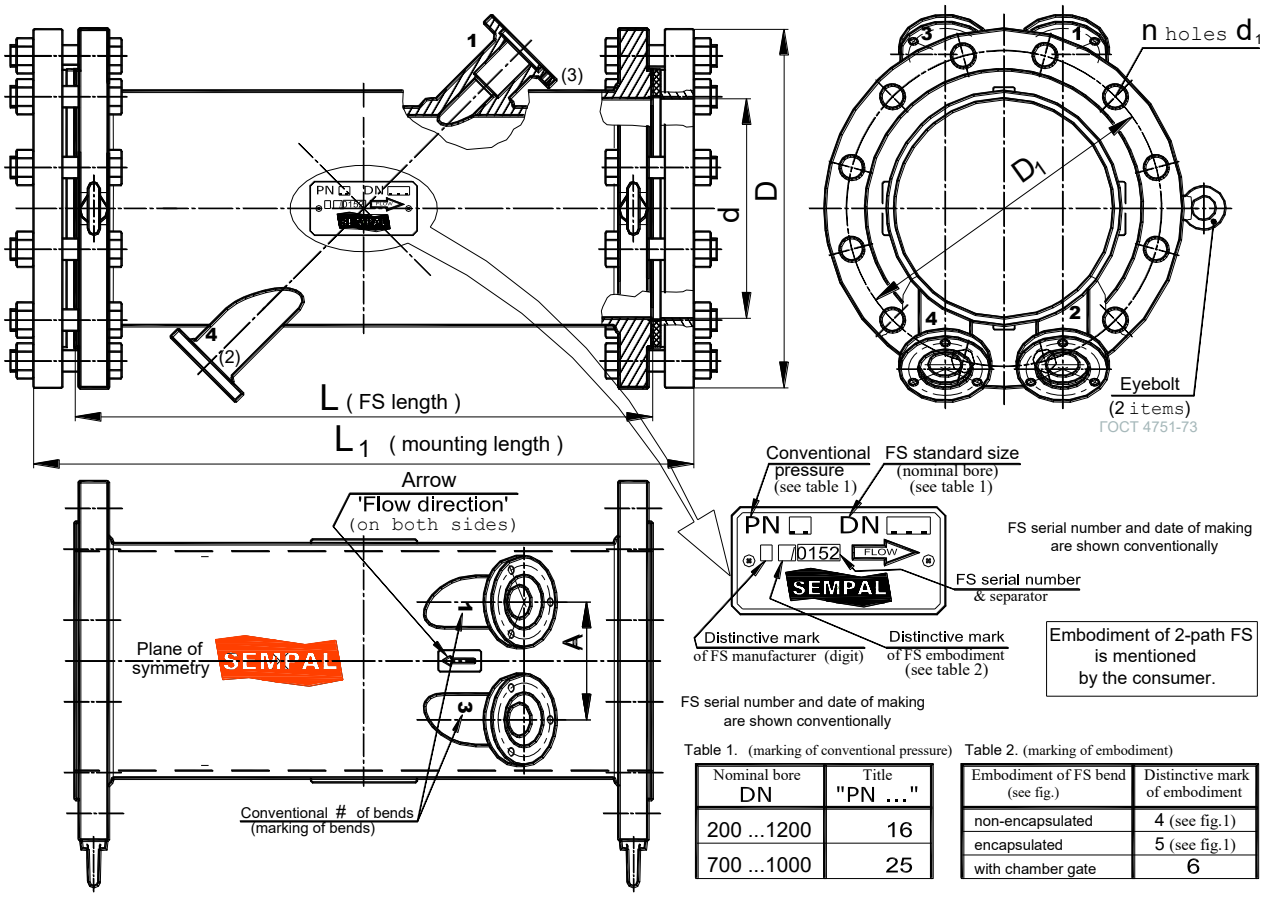


Table 1. (marking of conventional pressure)

Nominal bore DN	Title "PN ..."
200 ...1200	16
700 ...1000	25

Table 2. (marking of embodiment)

Embodiment of FS bend (see fig.)	Distinctive mark of embodiment
non-encapsulated	4 (see fig.1)
encapsulated	5 (see fig.1)
with chamber gate	6

Dimensions - see Table 1, Fig. 1

Annex M

How to set hydraulic zero

Setting of hydraulic zero should be completed to exclude systematic error of measurement. Its occurrence possibly can be caused by difference in manufacturing and real conditions of setting zero.

This phenomenon appears as non-zero meter indications when the real flow velocity is equal to zero.

Device maintenance without zero setting or with incorrect zero setting can lead to significant flow measurement errors, especially in a range of low flow rates.

Zero setting should be carried out:

– at device commissioning;
– after mounting (dismantling) of flow sensors (FlS) during routine maintenance;
– after changing of order of cable connections to flow sensor unit (FS);
– at inspection of flow measurement channel functionality.

Zero setting in each water meter channel is desirable to conduct at first out of pipe (on 'tapped' FS) and then (it is obligatory) on the object. If there is no possibility to cut off a water, zero setting out of pipe is a unique way for correct device commissioning. Thus it is necessary to provide repeated connection of flow measurement channels cables and FlS, which has been used during zero setting in laboratory conditions. Thus FlS should not be dismantled from 'tapped' FS.

1 Inspection of correctness for zero setting on 'tapped' FS:

1.1 Assemble a flow measurement section with technological tap at the end face, locate it vertically, fix flow sensors and completely fill FS with preliminary boiled or settled water. Clean end faces of flow sensors from remained air bubbles manually (by a finger or a brush) if they were appeared during filling of FS.

1.2 Connect flow sensors (FlS) and resistive temperature detectors (RTD) to corresponding cables.

1.3 No error messages concerning flow rate and temperature measurements.

1.4 Enter the mode 'Zero setting' and make setting on both channels simultaneously or separately. While setting, two groups of digits are displayed on the screen. The first one represents the hardware information about zero water velocity. This group is stored before following resetting. The second group shows number of zero velocity measurement cycles. For identical FS types these numbers of measurement cycles usually coincide. For different FS types they can be different, within the limits of 96 cycles, but do not exceed 120.

1.5 If zero setting has not been completed successfully, it is necessary to check up serviceability of cables, quality of connections in sockets and then repeat the previous item.

2 For successful zero setting on an object it is necessary to provide**:**

– reliable water cutting off from both sides of flow measurement section by means of valves;

– qualitative installation and serviceability of flow sensors, temperature sensors and also device entrance cables;

– the level of electromagnetic interference created by surrounding equipment, should not exceed a permissible level for the meter.

Before hydraulic zero setting it is necessary to run the heat meter in waterworks on the maximal water flow rate for half an hour. Then to cut off a valve after flow sensor unit, and after that to cut off a valve before flow sensor unit. Hydraulic zero setting can be conducted in a few minutes after water fluctuations in the tapped section will stop.

If value of the first group of digits, displayed on the meter indicator and registered by the meter as water zero velocity noticeably exceeds 500 or number of measurement cycles, then some obstacles are possible on tapped FS:

- air bubbles in FS;
- water leak through valves;
- significant level of external electromagnetic noise.