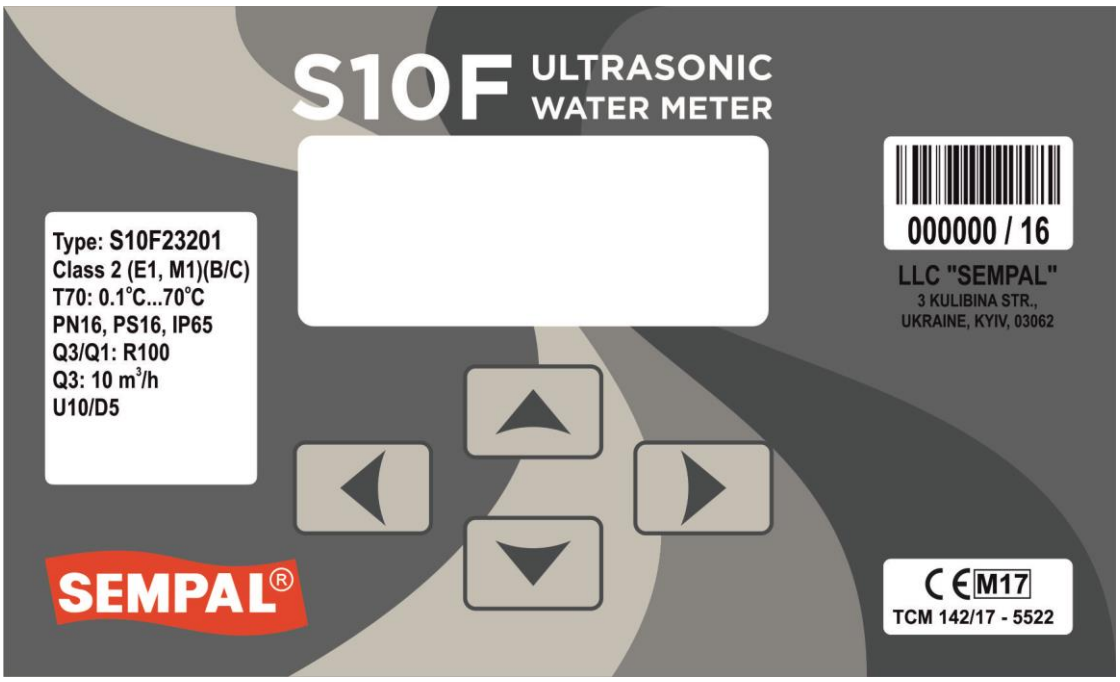



# SEMPAL S10F
# Ultrasonic Water Meter
# Battery powered

## Operating Instructions
## Part 1

Contents

## 1 General description

S10F water meters (hereinafter, meters) are applied for fiscal metering, control of supply and consumption of cold and hot water by industrial facilities and municipal services.
S10F meters are complex measuring devices, for which all starting-up and adjustment procedures should be accomplished by qualified personnel.

While meters are in operation, it is necessary to strictly comply with the requirements of these Operating Instructions.

The Manufacturer's guarantee is 48 months from the date of shipment for meters which were put into operation by specialized enterprises authorized by the company-manufacturer.
Recalibration interval is up to 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 regarding procurement, maintenance, operation and servicing of meters, contact us or our authorized regional representatives.

**"SEMPAL Co LTD" contact details:**
info@sempal.com
Phone/fax: (+38044) 239-2197, (+38044) 239-2198.
www.sempal.com

## 2 Mechanical construction and completeness

Meters consist of the following **functional units**:

- Measurement transducer - flow metering section (FS) with ultrasonic flow sensors (FlS). They may be represented by 1-path or 2-path configurations on demand;
- Resistive temperature detectors (RTD) or temperature sensors on demand;
- Pressure sensors on demand;
- S10F electronic unit (calculator).

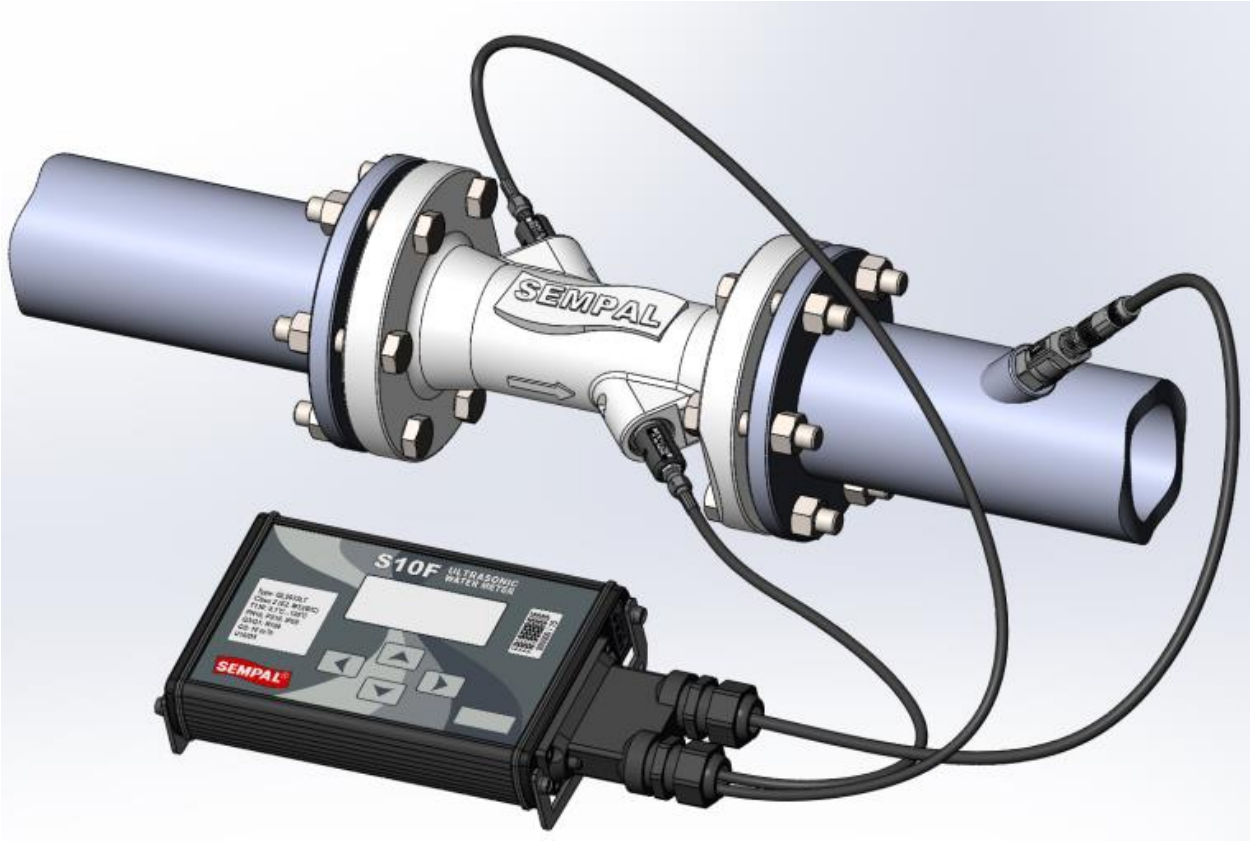
The basic complete set includes the following :

| № | Name | Quantity, pcs | Picture |
|---|---|---|---|
| 1 | S10F Water Meter | 1 |  |
| 2 | Flow sensor | 2 |  |
| 3 | Flow metering section | 1 |  |
| 4 | Flange | 2 |  |
| 5 | Connection cable | 1 |  |
| 6 | Battery | 1 |  |

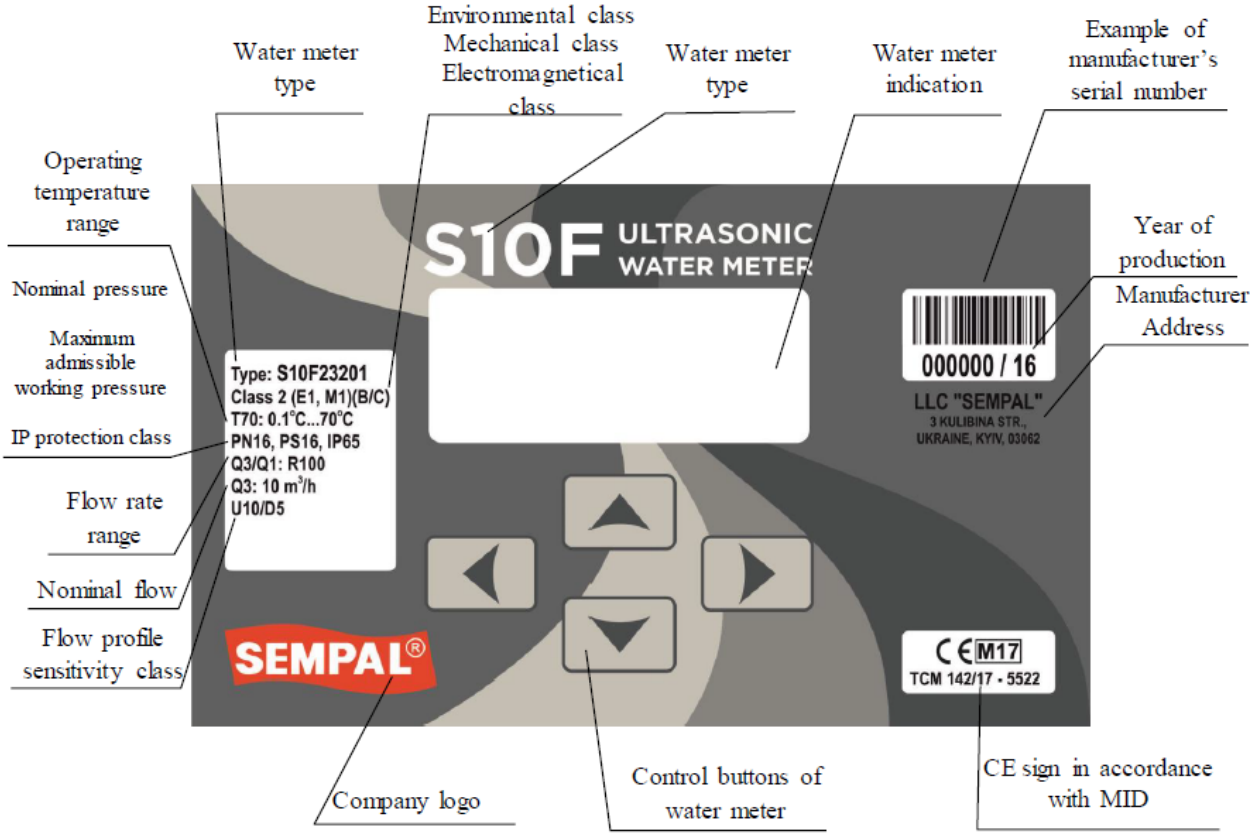
| № | Name | Quantity, pcs | Picture |
|---|---|---|---|
| 7 | Fasteners | 16 |  |
| 8 | Mounting elements for Calculator | 1 |  |
| 9 | Rubberized fabric gasket | 2 |  |
| 10 | Operating instruction (OI) | 1 | |

**Accessories:**

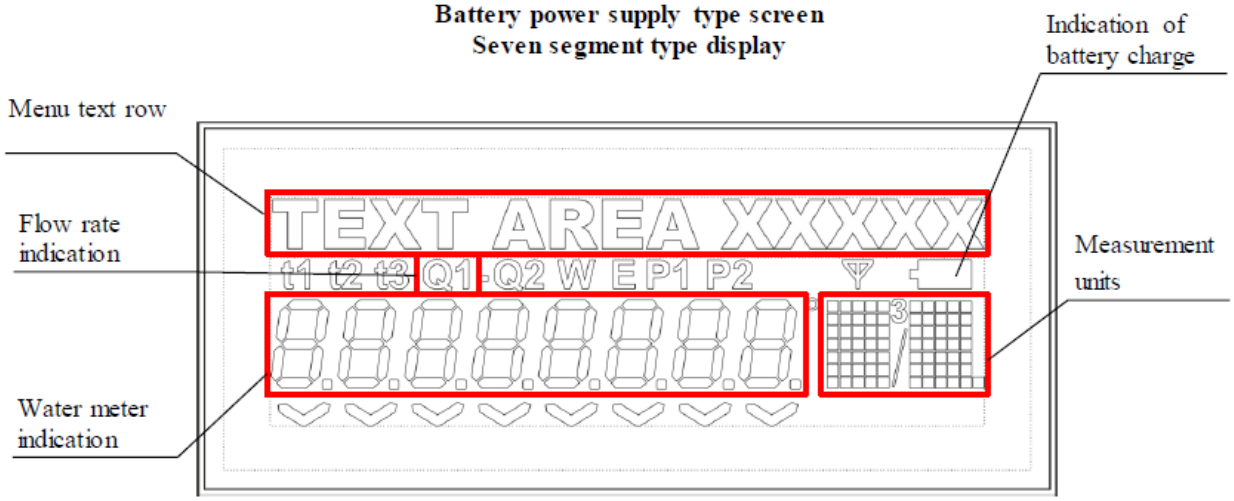
- On customer's demand meters may incorporate one or two pressure transducers converting overpressure to proportional current signal from 4 to 20 mA.
- Meter has 2 open drain pulse outputs with maximal voltage of 10 V and maximal frequency 100 Hz.



**Calculator**




**Battery power supply type screen**
**Seven segment type display**




Other segments are not in use.

## 3 Technical specification

### 3.1 General information

S10F Water Meters are intended for measurement of cold and hot water volume and mass. Meters also measure the temperature and overpressure of the 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 water).

| | |
|---|---|
| Climatic Environment class | B and C |
| Calculator enclosure protection class | IP 65 |
| Flow sensors protection class | IP68 |
| Meters may be operated under the following conditions:<br><br>Atmospheric pressure<br>Ambient temperature<br><br>Relative humidity not exceeding | <br><br><br>from 84.0 to 106.7 kPa<br>from +0.1 to +55 $^0$C (for calculator);<br>from +0.1 to +70 $^0$C (for flow meter body)<br>95 % |
| Meters' power supply | built-in lithium battery of 3.65 VDC, 1D cell lithium.<br>Battery lifecycle is up to 10 years. Battery replacement can be done directly on-site without meter shutdown. Time for meter commissioning after battery installation is no more than 10 minutes |
| Pressure stage | PN 16 |
| Accuracy class | 1 and 2 |
| Limits of permissible absolute error of temperature measurements | ±0.2 $^0$C |
| Limits of absolute error of time measurement | ± 1 sec in 24 h |
| MTBF of<br>- meters is not less than<br>- calculators is not less than | <br><br>50 000 h<br>100 000 h |
| Lifespan of meters is not less than | 12 years |

### 3.2 Calculator functions

The calculator displays and transmits the following physical quantities:

- Volume (mass) of the water, $m^3$ (ton);
- Volumetric flow rate of the water, $m^3$/h (ton/h);
- Temperature of the water, $^0$C;
- Overpressure of the water MPa (kgf/$cm^2$);
- Work time and non-work time, h;
- Current time (hour, minute, second) and date.

### 3.2.1 Data logger

The Calculator stores information of the measured values of flow rate and volume (or mass) of the water, work time and non-work time, as well as measured temperature average values:

| Data logging interval | Data logging depth |
|---|---|
| Hourly logger | 70 days |
| Daily logger | 1 year |

The entire stored information and measured parameters may be transmitted via communication interfaces RS232 (built in), RS485, MBus (external modules).
Measurement information about volume of the water, as well as work time and non-work time is stored in the meter nonvolatile memory for not less than 12 years after meter power supply cut.

### 3.2.2 Display

Number of digits displayed by the calculator:

| Parameter | Number of digits |
|---|---|
| Volume (mass) of the water | 8 |
| Volumetric flow rate of the water | 5 |
| Temperature of the water | 5 |
| Overpressure of the water | 3 |
| Work time or non-work time, current time | 7 |
| Date | 8 |

Display resolution:

| Parameter | Resolution |
|---|---|
| Volume (mass) of the water | from $10^{-7}$ to 1 $m^3$ (from $10^{-7}$ to 1 ton) |
| Volumetric (mass) flow rate of the water | from 0.001 to 0.1 $m^3$/h (from 0.001 to 0.1 ton/h) |
| Temperature of the water | 0.01 $^0$C |
| Overpressure of the water | 0.1 kgf/$cm^2$ (0.01 MPa or 10.0 bar) |
| Operation time or out-of-service time | from $10^{-5}$ to 1 h |
| Current time | 1 sec |

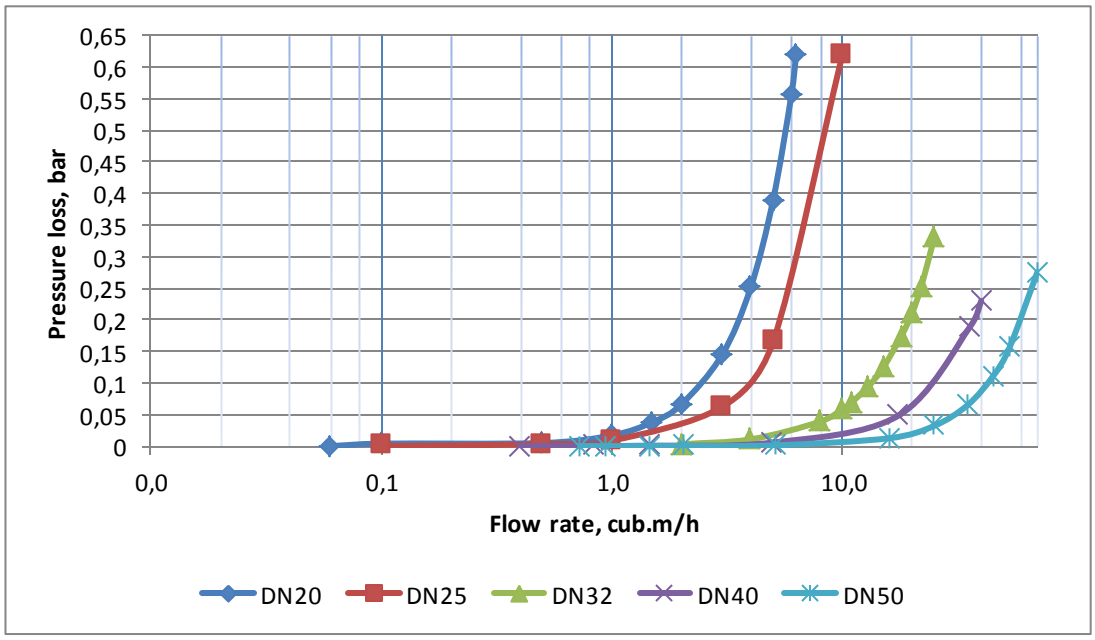
### 3.2.3 Tariffs

The consumer may set the day/night tariff mode. If done so, the time for beginning of the night tariff and the time for beginning of the day tariff can be set. When the tariff mode is on, all stored parameters, such as volume, mass are stored and archived in separate meters for day and night tariff.

### 3.3 Approved meter data

| DN mm | Min. flow Q1 m3/h | Transition flow Q2 m3/h | Nom. flow Q3 m3/h | Max. flow Q4 m3/h | Dynamic range Q3/ Q1 | Pressure loss Δp at Q3 bar | Overall length mm | Connection on meter |
|---|---|---|---|---|---|---|---|---|
| 20 | 0,06 | 0,1 | 6,3 | 7,9 | 100 | 0,62 | 160 | G1B |
| | | | | | | | 200 | DN20 |
| 25 | 0,10 | 0,16 | 10 | 12,5 | 100 | 0,62 | 160 | G1 |
| | | | | | | | 200 | DN25 |
| 32 | 0,25 | 0,4 | 25 | 31,3 | 100 | 0,33 | 180 | M48×2 |
| | | | | | | | 200 | DN32 |
| 40 | 0,40 | 0,64 | 40 | 50,0 | 100 | 0,23 | 200 | G2 |
| | | | | | | | 220 | DN40 |
| 50 | 0,63 | 1,008 | 63 | 78,8 | 100 | 0,22 | 180 | DN50 |
| 65 | 1,00 | 1,60 | 100 | 125,0 | 100 | 0,22 | 200 | DN65 |
| 80 | 1,60 | 2,56 | 160 | 200,0 | 100 | 0,22 | 210 | DN80 |
| 100 | 2,50 | 4 | 250 | 312,5 | 100 | 0,22 | 230 | DN100 |
| 125 | 4,00 | 6,4 | 400 | 500,0 | 100 | - | 265 | DN125 |
| 150 | 6,30 | 10,08 | 630 | 787,5 | 100 | - | 315 | DN150 |
| 200 | 10,00 | 16 | 1000 | 1250 | 100 | - | 540 | DN200 |
| 250 | 20 | 32 | 2000 | 2500 | 100 | - | 620 | DN250 |
| 300 | 25 | 40 | 2500 | 3125 | 100 | - | 680 | DN300 |
| 400 | 40 | 64 | 4000 | 5000 | 100 | - | 820 | DN400 |

### 3.4 Pressure loss



## 4 Data communication

The meter has following data communication channels:

| Communication channel | Completeness | Description |
|---|---|---|
| RS232C | Basic | Connection to computer, modem |
| USB Host | External module | Storage of logged information on USB Flash |
| RS485 | External module | Modbus protocol support |
| M-Bus | External module | |

**Information interfaces**

The meter has interface RS232 for data reading.
RS232 is delivered in basic variant and enables meter connection to a computer, modem (wire modem, GSM/GPRS modem). The same interface provides data transfer from the meter to a computer.

USB Host (external module) is used for connection of USB Flash (no limitations for USB storage capacity) with FAT or FAT32 initialization. Data storage on the Flash in «Check» mode is accomplished via connection of the USB Flash to the relevant USB port. In this case all data collected by the meter are recorded.

To speed up the process of recording, the device records only information that has been stored from the time of the last recording on current flash.

RS485 (external module) supports Modbus RTU data communications protocol.
Modbus protocol enables the meter connection to the Modbus network. Current status and data loggers are accessed. The interface rate is adjusted by the customer.

USB Host, RS485, and M-Bus interfaces are delivered on demand as external modules.

## 5 Meter outputs

The calculator has two drain pulse outputs. Pulse outputs meet to class OD.
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/m3), mass (pulse/ton).

## 6 Measuring principle and functioning

The transit time principle is based on time difference measurements. When the ultrasonic signal is transmitted toward the upstream side against the flow direction, more propagation time is required (T1). On the other hand, when it is transmitted toward the downstream side with the flow direction, the propagation time is less (T2). That is, the signal is delayed or speeded up by the moving fluid. The difference in time between "T1" and "T2" is proportional to the flow velocity, and the flow volume can be calculated by multiplying it by the cross-sectional area. Temperature of the liquid (water) is measured by platinum resistive temperature detectors.
The meter can have one or two channels depending on customer's request. Each channel may serve one circuit of water consumption system. So, the meter can perform metering in two circuits at the same time (depending on the required configuration).

The flow rate measuring process is continuous. It is conducted four times per second and the obtained data are collected. Once a second, flow data are read and volume is calculated.
Measurement cycle for temperature and pressure is one time in 10 sec.

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

Calculation and storage of average temperature values the meter carries out as arithmetic mean for set period of time (hour or day).

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 date/time (taking into account daylight saving).

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 flow meter indicator in a mode «Indication of additional parameters».

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.

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

Meters have a few separate modules which connected between themselves. They are calculator, temperature sensors, flow measurement section with ultrasonic flow sensors.

The calculator housing has four control buttons, the digital display, and slot for connecting cable.

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

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 30 m (max 50 m) for RS-232 interface.

**7 Preparation for operation**

**Checking the completeness and performance of device**

Before unpacking:

Keep indoors for 2 hours at ambient temperature from 10 to 30 $^{0}$C and relative humidity of no more than 80 %.

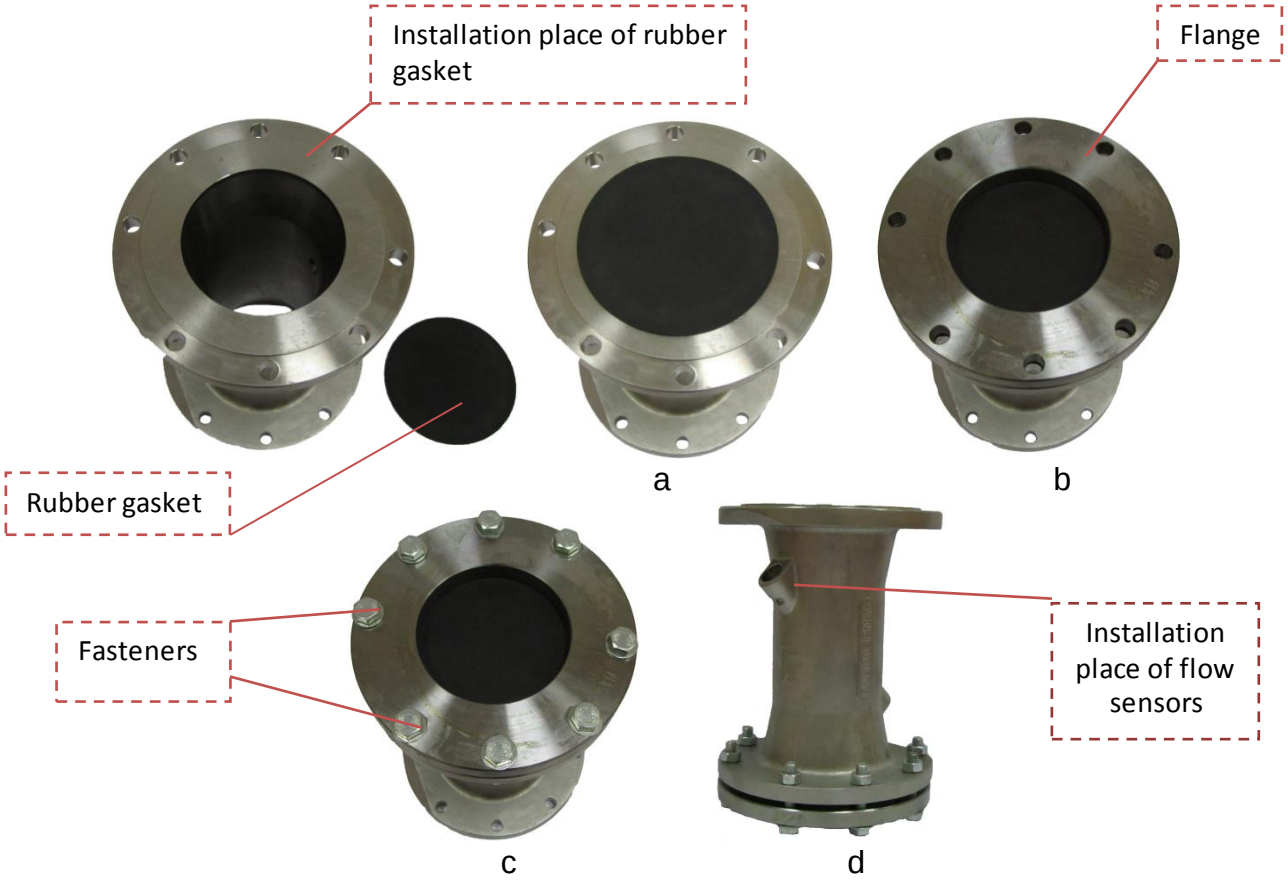
To unpack, please follow the guidance:

- open the packing boxes;
- take out the package with the calculator and operational documentation;
- check order completeness;
- take meter components out of the packing boxes, visually inspect and make sure that there are no mechanical damages, coating is well and isolation faults in connecting cables are absent.

Test assembly kit:

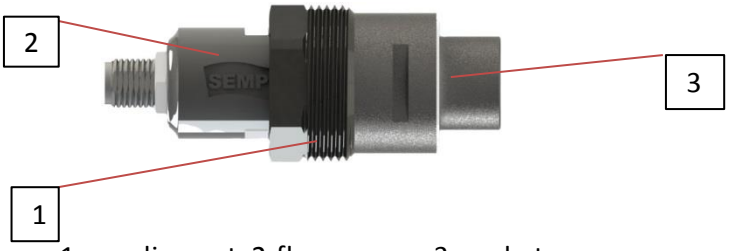
Before installing the flow meter at the facility it is necessary to make the test of assembly kit. For this:

1. Assembly the flow metering section with process plug at the end




a – install the rubber gasket, b – set the rubber gasket above the flange, c – fix the flange by sundries, d – put flow metering section (FS) into the vertical position

2. Install the flow sensors in FS and fix their coupling nuts




1-coupling nut, 2-flow sensor, 3- gasket

3. Fill the measurement transducer with water

4. Remove air bubbles
5. Connect to the appropriate cables of flow sensors.

| Cable application (connected unit) | Marking on the cable | Marking on cable lugs of flow meters main (standby) and their arrangement with regard to the flow | | | |
|---|---|---|---|---|---|
| | | For modification of Accuracy class 1 | | For modification of Accuracy class 2 | |
| | | Marking | Arrangement | Marking | Arrangement |
| FlS1 of channel 1 | A11 | 11 (11p) | first downstream | 11 (11p) | without any reference to the flow |
| FlS2 of channel 1 | A12 | 12 (12p) | second down stream | 11 (11p) | |


6. Connect the cable to the calculator.


While sensors are properly connected there are no error messages on Calculator's screen. At that «no rSt» message periodically appears - it indicates, that the meter does not set into accounting process. The flow meter should show zero water flow. For this **set the hydraulic zero** in the **'Setup'** Menu mode is foreseen. After this it is necessary to set meter into accounting by using menu "Setup".

**Warning!**
Hydraulic zero setting must be done for flow meters of DN20 - DN400 mm.
Follow '**Instructions on hydraulic zero setting'** using Meter control menu.

### 7.1 Meter control menu

**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)

«Channel 3» / "Channel 3" → See continuation on the next page with corresponding title

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

**Indication of menu item**

| |
|---|
| t3<br>123.56 °C |

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

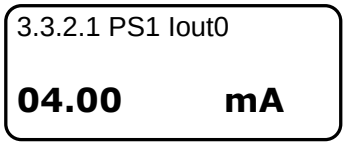
| |
|---|
| 1.3. Mass channel 1<br>12345678 t |

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.

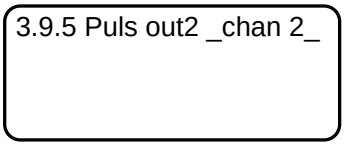
After pressing the button "Right" edited symbol begins to blink.

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.

### 7.2 Menu modes

All measured values, parameters of the meter and the meter control commands are described in several sections – meter control **modes**.

Separate service modes («Setup», "Verification") require a password to access.

The meter modes are given in Annexes 2-7.

**'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 accounting modes:

'Not in account' – this is initial mode. In this mode it is possible setup some parameters in 'Setup' menu. This mode indicated by periodically display 'no rSt' text ;

'In account' mode. This is main mode for accounting. There is no additional indication for this mode.

'Stop' mode. This mode can be activated, when no water in pipe for long period, etc. In this mode no data are placed in archive and no errors indicated.

**While working in 'Indication of main parameters' mode errors code of the failure is displayed. Error codes are shown as follows:**

- for 4 seconds error code is shown;
- for 4 seconds measured data are shown.

**'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.

**'Indication of additional parameters' Mode**

This mode is intended for displaying of minor (rarely viewed) measuring parameters.

**'Check' Mode**

'Check' Mode is intended for display of parameters to be controlled. 'Check' Mode does not interrupt measuring process and may be used both by representatives of supervising agencies and by the customer. In particular, this mode depicts meters that are being in 'Setup' and 'Verification' modes.

This mode is used for reviewing the meter data history and the event's log.

**'Setup' Mode**

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

It should be considered that in account modes 'In account' and 'Stopped' entrance to 'Verification' mode is blocked. In addition, those items of 'Setup' mode which should be unchangeable during process of measurement are also blocked.

**'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 flow meter performance verification in case of regular verification. Verification is conducted only by authorized personnel.

**'Limit prolongation' Mode**

This mode is available if 'time limit' mode is enabled at shipment. 'Limit' mode allow to block indication (and information reading by any interface) of meter after end of limit time.

It is intended for password entering if time limit prolongation is needed. In this menu, a password is requested to prolong the limits for operation or for disabling this mode. Passwords are issued for a certain date and are valid for 24 hours.

**'Password entering' Mode**

Access to service modes **'Setup' and 'Verification'** is provided only after **the relevant passwords are entered to avoid unauthorized access to** parameters stored in the calculator. The consumer has to enter a password after a relevant mode has been chosen in the menu.

The manufacturer has set the following **standard passwords for service modes**:

| MODE | STANDARD PASSWORD |
|---|---|
| **«Setup»** | 25205757 |
| **"Verification"** | 31415926 |

At customer's request the manufacturer may set INDIVIDUAL PASSWORDS for service modes, which is equivalent to the additional ELECTRONIC SEALING of the calculator and guarantees protection of collected information from unauthorized persons.

The password is represented by 8 digits and must be entered to get access to one of the service modes.

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

Non-masked (open) value of input digit is displayed only at the digit place, in which entering of the password digits is required (editing).

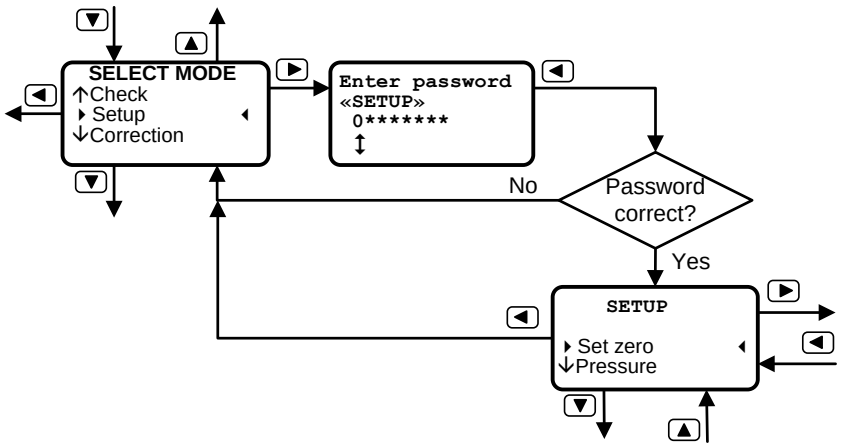
While entering a password, press the button ▶ to move the cursor one digit placed to the right to change certain places of the password.

Pressing buttons ▲ and ▼ changes the value of the edited digit.

Pressing button ◀ – terminates entering the password.

If in 10 min no button was pressed, the meter switches to 'Indication of main parameters' mode.

Figure gives an example of password entering to get access to the 'Setup' mode.



### 7.3 How to start metering process

**Instructions on hydraulic zero setting**

Setting of hydraulic zero is necessary for exception of a systematic measurement error. It's possible occurrence 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.

This action allows eliminating of a systematic measurement error from measuring results.

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 during routine maintenance;
- after changing of order of cable connections to flow metering section;
- at inspection of flow measurement channel functionality.

Zero setting in each flow metering channel is desirable to conduct at first out of pipe (on 'tapped' flow metering section) 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 flow sensors, which has been used during zero setting in laboratory conditions. Thus FS should not be dismantled from 'tapped' FS.

1 Inspection of correctness for zero setting on 'tapped' flow metering section:

1.1 Assemble a flow measurement section with technological tap at the end face, locate it vertically, fix flow sensors and completely fill flow metering section 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 flow metering section.

1.2 Connect flow sensors 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 flow sensor types these numbers of measurement cycles usually coincide. For different flow sensor 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 positively, 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 interferences created by surrounding equipment, should not exceed a permissible level for the meter.

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

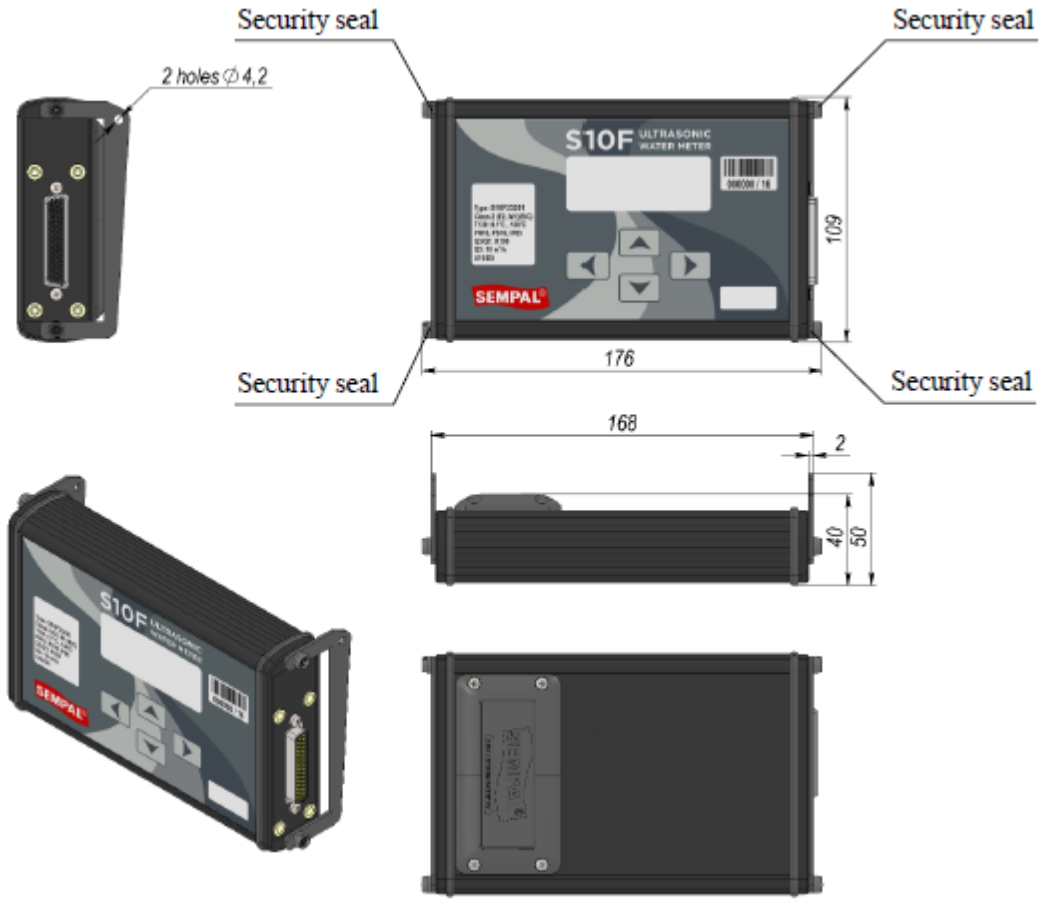
If value of the first group of digits, displayed on the meter indicator and registered by the meter as water zero velocity noticeably exceeds 500 or number of measurement cycles, then some obstacles are possible on tapped flow metering section:

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

## 8 Marking and sealing

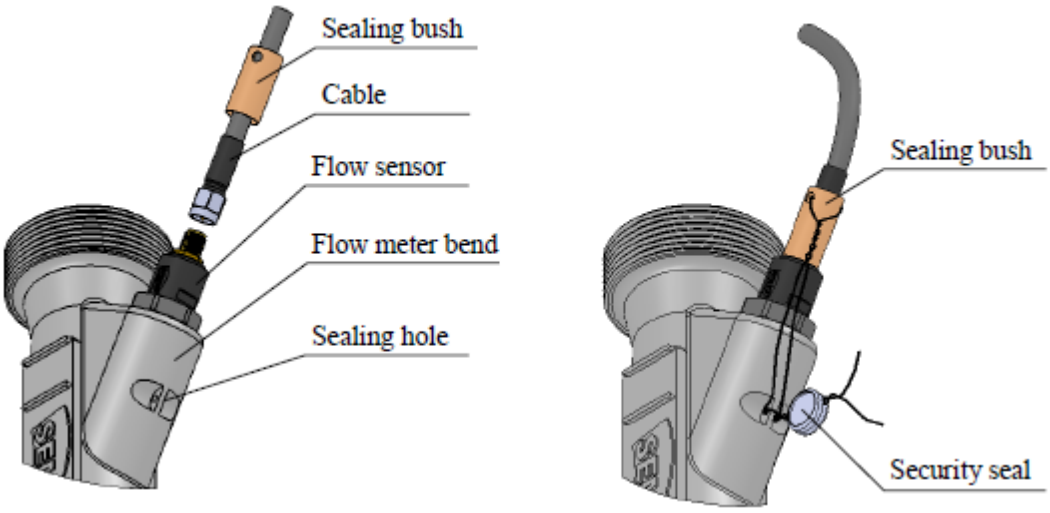
The meter components are sealed to prevent unauthorized access to adjustment. The calculator is sealed by applying two ink seals with symbols “CEM” on front side and special hidden manufacturer symbol on back side. Seals are placed on Calculator’s side panel fixing screws and on flow sensors.

**Sealing of calculator**




These seals may only be broken by authorized laboratories in case of test and reverification of the meter. The sealing must be provided by an authorized laboratory using the sealing stamp and the security mark

**Sealing of flow sensors**




## 9 Procedure for installation and mounting

### 9.1 General requirements to the place of Meter's installation

While choosing the place for Meter installation, please pay attention to the nearby radio and television stations (radiofrequency interferences), subways (pulse interferences and "noise" in power supply lines), close location to high-voltage overhead transmission lines (electromagnetic interference), powerful electric motors (supply line surges), equipment operating with large transformers (magnetism), and close vicinity of electric welding equipment (all types of interferences). If such interferences are available, length of communication lines between flow meters and the calculator must be minimal and their length should be determined by the level of interferences at the particular facility.

To reduce the level of interferences from the overhead power transmission lines, it is recommended to install RF filters. The level of electronic interferences can be reduced by applying additional estimated screening devices around the meter and the source of interferences. The effect of interferences can be significantly reduced by using the shortest possible connecting lines.

Places of flow meter and temperature sensor installation must be protected from direct contact with water, dirt, oil and aggressive fluids.

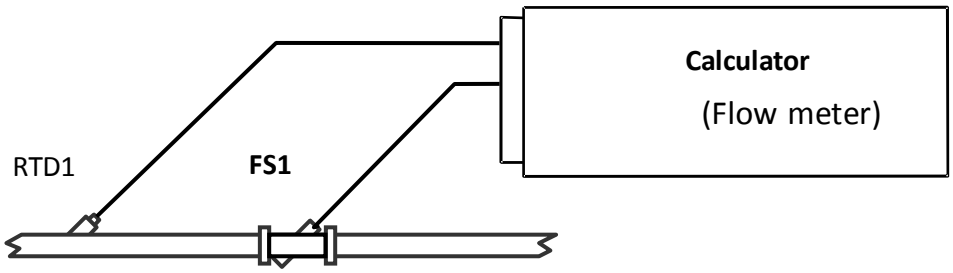
The content of acid and alkali vapors in the area of premises where meters are installed must be within the sanitary norms and rules.

While mounting the flow meter on the open air, it is recommended to provide protection from direct contact of ultrasonic flow sensors with precipitations.

Installation of standard flow meters with possible short time flooding is permissible when places for ultrasonic flow sensors or temperature sensors connection must be protected from contact with water by applying ceiling couplings, profiled sealing components or other means recommended by the manufacturers.

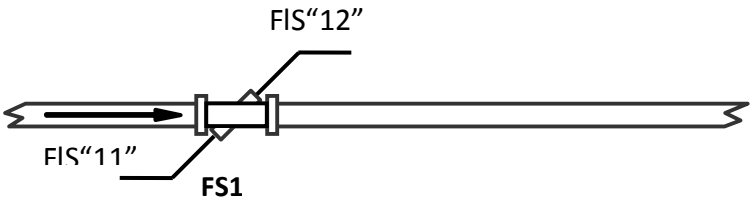
**9.2 Configurations**

**Configuration 1**



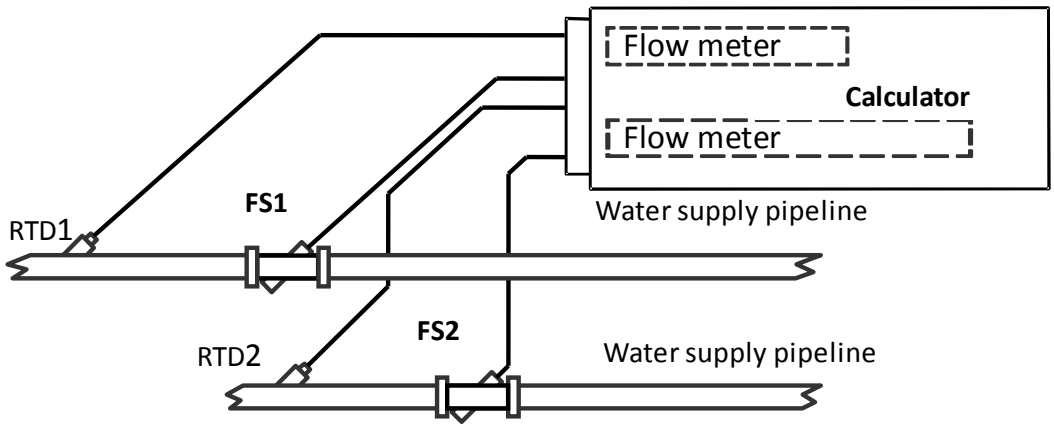

One water meter
Main function is measurement of the water volume (mass) or flow rate

**Configuration 1/1**




One water meter
Main function is measurement of the water volume or flow rate

**Configurations 3**




Two independent flow meters

### 9.3 Requirements to the place of flow meter installation and arrangement

**Installation requirements**

Installation of meter components is carried out in accordance with chosen configuration, necessity of application of the additional equipment, and also parameters of water consumption object.

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

1) In a place for flow metering section and RTD installation:

- ambient temperature can vary from -40 $^0$C up to +70 $^0$C;
- ambient humidity is up to 95 %, while temperature is 35 $^0$C;

2) In a place for calculator installation:

- ambient temperature can vary from 5 $^0$C up to 55 $^0$C;
- ambient humidity is up to 93 % while temperature is 25 $^0$C.

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

Protection of places for flow metering section and RTD 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 flow metering section installation it is recommended to provide protection (canopy) against direct ingress of atmospheric precipitates on ultrasonic flow sensors.

Flow metering section installation in places with possible short-term water flooding is allowed while observing following protection measures for flow sensors and entrance cables:

- 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.

**Requirements to flow metering section installation and arrangement**

Flow metering section should be installed into a pipeline.

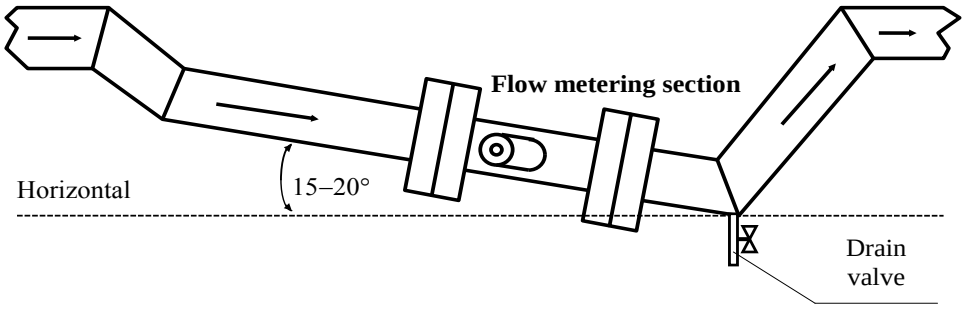
Flow metering section installation place should be as much as possible moved away from sources of vibrations, jolting, electromagnetic interferences (electromotors, pumps, compressors, etc.). No electric voltage relative to a protective contour of grounding in the place, where flow metering section should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

The distance between flow metering section and an installation place for the calculator should be minimal and not exceed 10 m. It is possible to increase the distance up to 30 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 would be diagnosed.

Flow metering sections can be installed in vertical position; however submission of the water thus should be carried out in a direction bottom-top for providing flow metering section with water filling.

Flow meter operation in special conditions (incomplete filling of flow metering section with the water or polluted water) determines its location as resulted in figure below. In this case complete water filling of flow metering section is guaranteed. The most polluted pipeline section appears in a place below flow metering section.



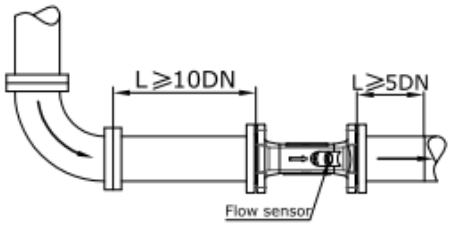
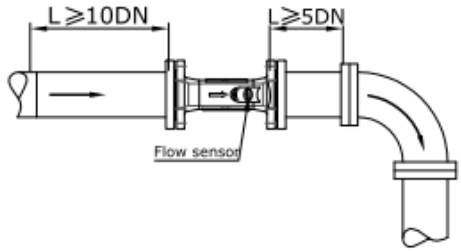
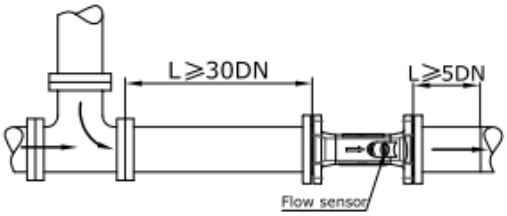
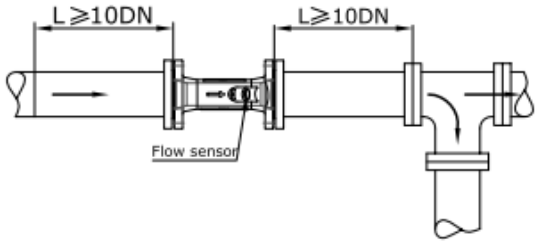
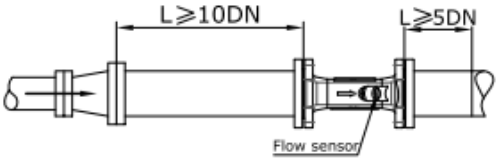
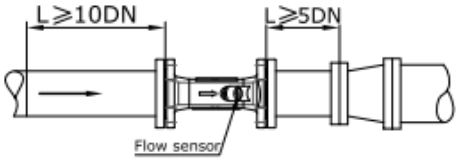
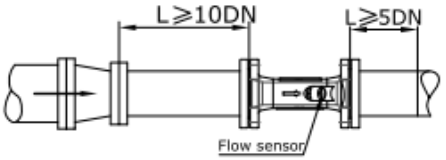
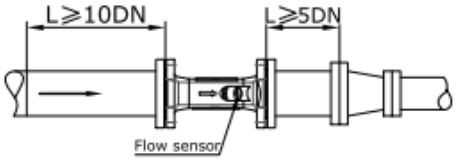
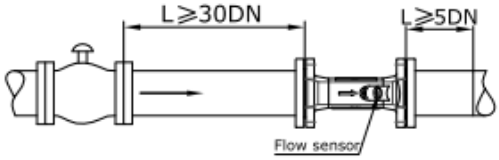
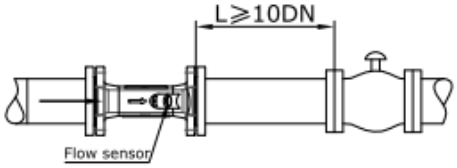
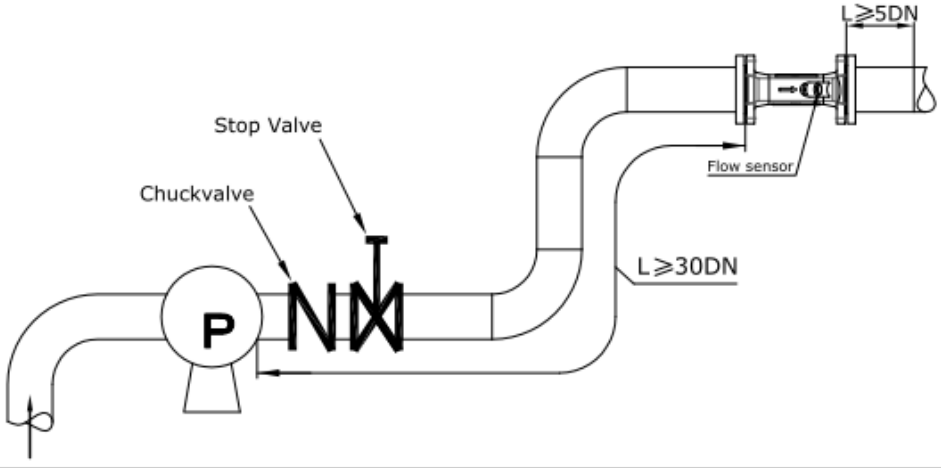

To remove the liquid from the lower section of the pipeline, the drain valve is foreseen.

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

– the pipeline section chosen for flow meter installation, should be located in horizontal plane (a deviation from a horizontal within the limits of $\pm 20°$).

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

Minimal straight pipe distances downstream of flow disturbances in accordance with specified meter accuracy should be as follows

| Structural condition | Upstream straight pipe length | Downream straight pipe length |
|---|---|---|
| 90° bend |  |  |
| T shape joint |  |  |
| Increasing Diameter |  |  |
| Reducing Diameter |  |  |
| Control valves |  Flow control at upper side |  Flow control at lower side |
| Pump |  | |

**Installation of meter componentry**

**Flow Metering Section installation**

Flow metering section is insertion type of a flow meter.

Delivery sets with flow metering sections of DN32 and DN20 include special pipe branches (nipples), which are welded to straight sections of the pipe during installation.

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

Pipe branch with sleeve nut, which is included in delivery sets for flow metering sections of DN20 and DN32, 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 0.5 mm (± 2.5%) for flow metering section of DN20 and 0.8 mm (± 2.5%) for flow metering section of DN32.

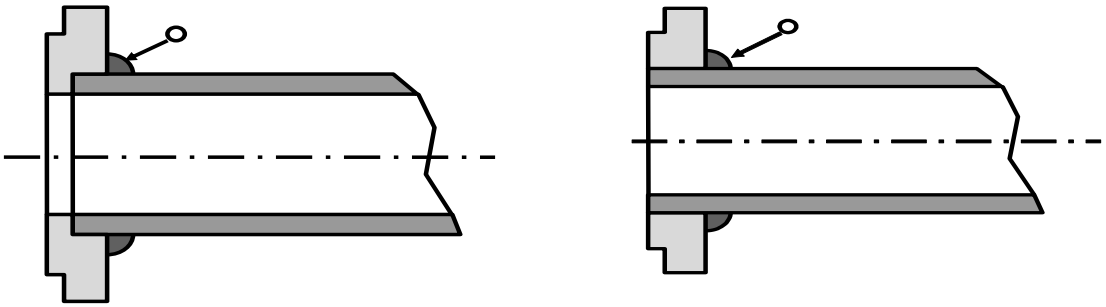
While installing flow metering section of DN20 (flow metering section connection to welded pipe branches with sleeve nut) its position should be fixed (to prevent a revolution) by a screw driver S = 30 mm, which is based on special faces of flow metering section (see figure in Annex 9).

**It is strongly prohibited** to apply another place of flow metering section to prevent flow metering section revolution (PS connectors, flow metering section body, faces with marking).

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

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 below.

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.



**WARNING!**

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

**Installation of flow sensors**

The order for installation of flow sensors listed below is applied for flow metering sections of DN 32... DN 150.

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

After installation of flow metering section 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 diffusion of flow sensor materials with material of flow metering section it is necessary to grease a bush thread and a lateral cylindrical surface of ultrasonic flow sensors with graphite greasing;
- flow sensor effective area (edge) should be cleaned from greasing;
- insert ultrasonic flow sensors in bushes (pipe-bends) of flow measurement section. Marking is put on sensor cable outputs. So flow sensors with marks "11" (or "21" for the second flow measurement channel) should be inserted in first (according to flow direction) bush, flow sensors with marks "12" (or "22" for the second flow measurement channel) should be inserted in second (according to flow direction) bush of flow metering section;
- 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 flow metering section surface and flow sensor ring surface outside of its sealing gasket. For flow sensor installed in flow metering section 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 install flow sensors with marks "11" ("21"), intended for installation in the first flow meter bush (according to flow direction), into the second bush and sensors with marks "12" ("22") to install into the first bush;
- to drop ultrasonic flow sensors or to knock on them at transportation and installation;
- to carry out mounting and dismantling of flow metering section with installed ultrasonic flow sensors;
- to accomplish metalwork or welding works on the pipeline closely to flow metering section with the installed ultrasonic flow sensors;
- to exceed the mentioned above force for tightening of flow sensor;
- to dismount stuck to flow sensors, while turning them in bushes during regular service.

For the removal of the flow sensor its design provides special elements. The manufacturer has developed and can propose special removers or complete set of design documentation for their manufacturing.

**Installation of temperature sensors**

Temperature sensors (manufactured by SEMPAL Co.) RTD-T 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 RTD with the water;
- by screw-driving in thermal pockets, which, in turn, are screwed in bushes (lugs) of the second type. The last ones are welded into the pipeline for contact with the water via a protective thermal pocket.

Choosing a way of 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.

**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. 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).

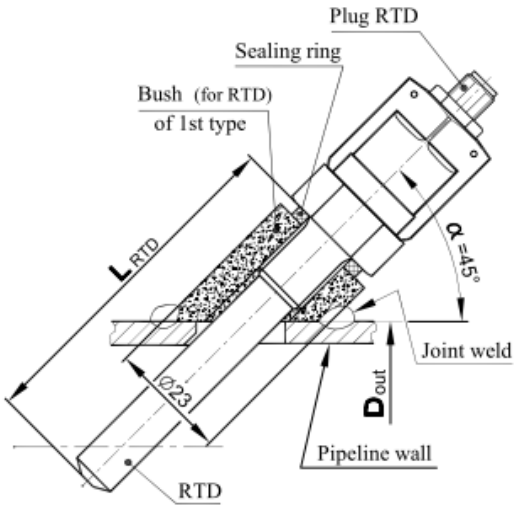
While installing the RTD with inclination 45° or 60°, it is necessary to drill 10 mm hole (16 mm for a thermal pocket) and to saw it up to a necessary oval depending on thickness of a pipe wall (see figure ).

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

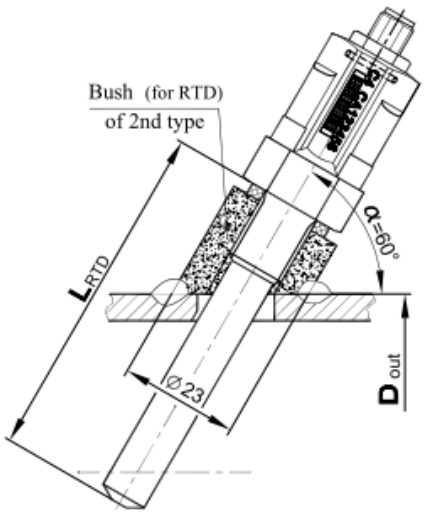
Before application of sealing gasket (fluoroplastic ring) a sealing surface of the bush should be greased.

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.

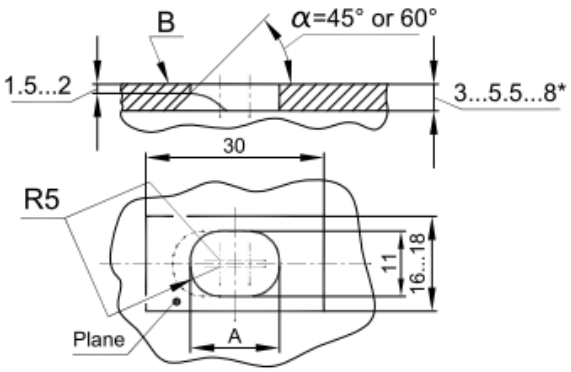



DN 32; DN 40; DN 150



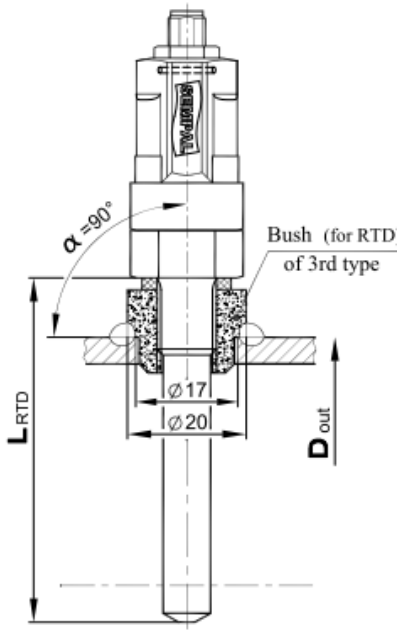

DN 50; DN 200

Scribing and hole dimensions
for mounting of RTD with angle 45° or 60°




| Angle α | A, mm |
|---|---|
| 45° | 15 |
| 60° | 13 |

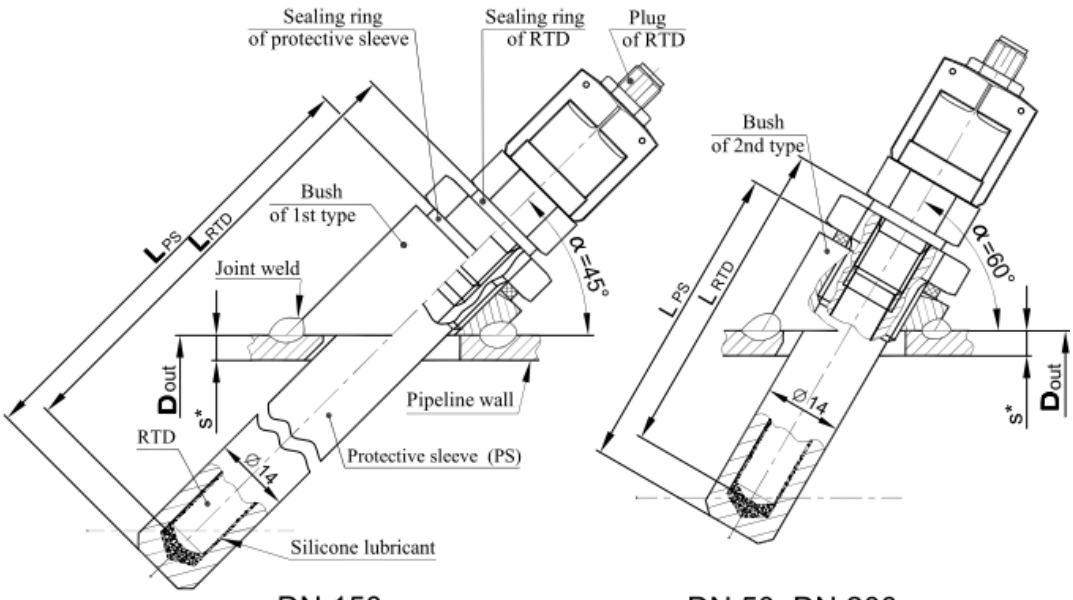
It is recommended to notch the plane
for bush of RTD for all variants
of installation on the sufrace B



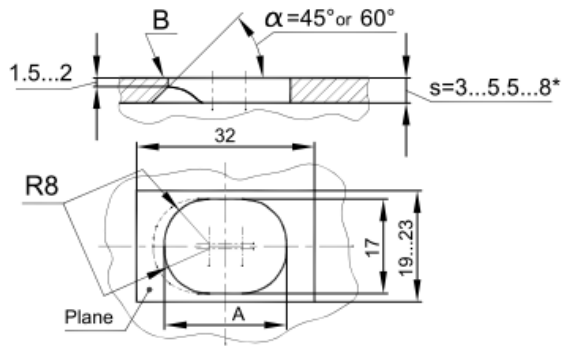

DN 65...125; DN 250...

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.

**Installation of RTD of type 2, 3 and 4 without protective sleeve**

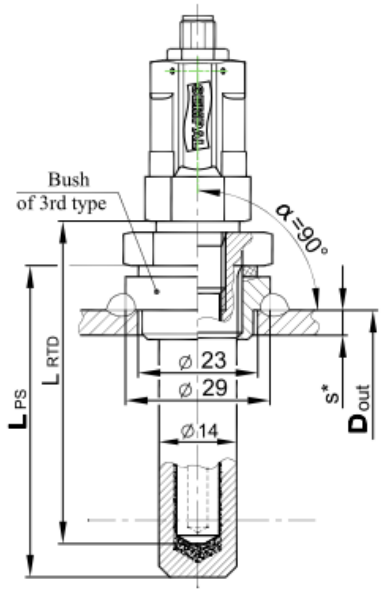



**Scribing and hole dimensions for mounting of protective sleeve for RTD with angle 45° or 60°**




| Angle α | A, mm |
|---|---|
| 45° | 25 |
| 60° | 22 |

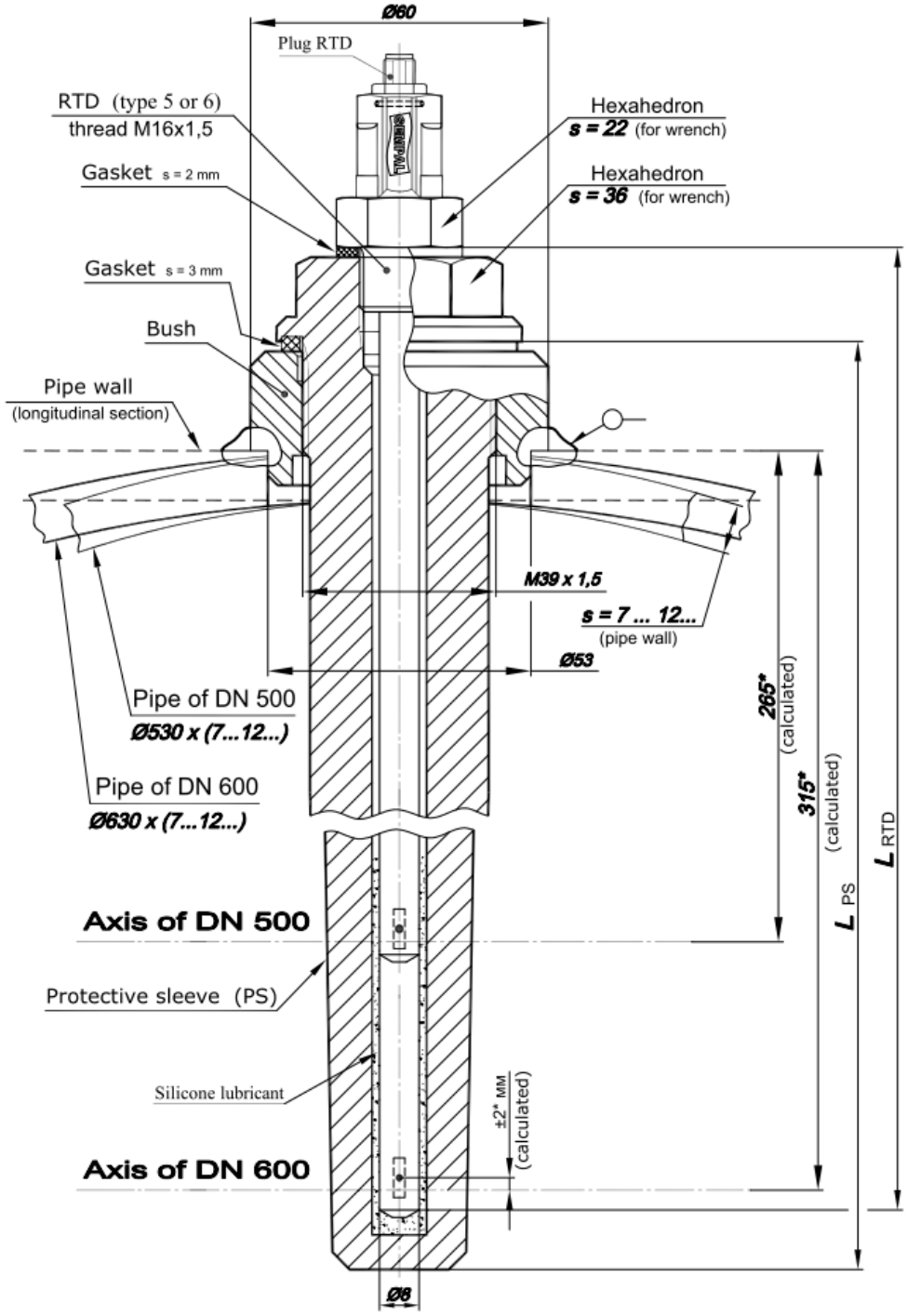
It is recommended to notch the plane for bush of protective sleeve for all variants of installation on the sufrace B




DN 65...125; DN 250...

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

**Installation of RTD of type 2, 3 and 4 with protective sleeve**




**Installation of RTD of type 5 and 6 with protective sleeve**

**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 appendix Chapter 8. Marking and sealing.

**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, RTD 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.

Marking on communications channels has been adjusted with marking on flow sensor cable outputs (for 1-path flow meters):

| Cable function (connected unit) | Marking on device cable | Marking on flow sensor cable outlets | |
|---|---|---|---|
| | | Marking | Arrangement |
| FS1 of channel 1 | A11 | 11 | First downstream |
| FS2 of channel 1 | A12 | 12 | Second downstream |
| FS1 of channel 2 (FS3) | A21 | 21 | First downstream |
| FlS2 of channel 2 (FlS4) | A22 | 22 | Second downstream |

Marking on communications channels of device cable is given to connect temperature sensors, pressure transducers and peripheral devices:

| Cable function (connected unit) | Marking on device cable | Cable function (connected unit) | Marking on device cable |
|---|---|---|---|
| TS1 | B1 | PT1 | C1 |
| TS2 | B2 | PT2 | C2 |
| TS3 | B3 | RS232 | D1 |
| | | Pulse outputs | D4 |

**CAUTION! IT IS FORBIDDEN:**

1 To break the procedure of cable connection according to marking in mentioned above tables.
2 To swap RTD of temperature sensors TS1, TS2, TS3 and pressure sensors PT1 and PT2.
3 To increase or shorten the length of cables of ultrasonic flow sensors FS.
4 To apply FS, RTD, ultrasonic flow sensors FS and calculators from different delivery sets.
5 Cable twisting, kinking and sharp bends is not permitted while connecting to FS.

**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.**

**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 FS, TS, PT 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 flow 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 measuring section.

– 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.

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

**10 Servicing**

The S10F water meter is protected from consumer intervention as well as intervention of water supply organization. Any changes of a water 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 temperature sensors 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.

It is necessary to consider, that flow meter commissioning begins with reset (zeroing) of its integrated indications (accumulated measuring data) on setting account mode to 'In account'. Reset of indications also should be carried out after meter repair or verification.

Difference between power on time and time of correct work means that a flow 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 FS and connector housings is stipulated.

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.

Maintenance service is carried out by the representative of service organization. There are two types of maintenance for meters: #1 and #2.

**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.

It is recommended to clean flow sensor surfaces using washing-up liquids, weak solutions of alkalis or acids (without mechanical cleaning). If flow 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.

**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;
- dismantling and cleaning of FS and dismantling and cleaning of RTD if severe precipitation has been detected.

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

## 11 Data reading

### Data reading from the display

The main menu of the meter includes the following:

- Display of parameters used by each calculation channel: flow rates, temperature and pressure, as well as calculation channel results – current and integral parameters.
- Display of all measured initial parameters – all flow rates, temperature and pressure – current and integral parameters.
- Display of current errors (if errors are not available, the menu item is not highlighted)
- Access to service menu.

After energizing, the meter is in the mode displaying all measured parameters.

In «Check» mode, the user may review the data logger (hourly and daily) and the logbook of events.

### Reading via RS232

In its basic configuration, the meter has RS232 interface, which enables connection of the computer, data reader or modem.

In connecting to the computer or data reader, the procedure is described in the operating instructions for the Data Reader or data reader software. No additional operations with the meter require.

To work with modems, the meter must be configured. To do so, in menu «Block MDM», select the required type of modem. Modem drives can be downloaded by applying special software. If necessary, the consumer can add new or modified modem drives.

After connecting the modem, two variants of the communication channel control.

- wire modem or GSM modem in CSD mode of data transfer (hereinafter, CSD mode)
- GSM modem in GPRS mode of data transfer (hereinafter, GPRS mode).

In CSD mode, the meter waits for the incoming call. After that, the meter picks up the receiver and establishes the communication channel. After that, it waits incoming commands to transmit data.

In this mode, it is possible to set the time interval, during which the meter will pick up the receiver, as well as the number of ringing signals to respond. This procedure is used with wire modems connected in parallel to ordinary phone sets.

In GPRS mode, the meter communication with the server via Internet. To do so, network access parameters must be determined. Settings of GPRS (entered by applying a special software only - available free of charge on the company's site):

- Access point name GPRS – provided by the mobile network operator;
- User's name – provided by the mobile network operator;
- Password – provided by the mobile network operator;
- IP address of the server – real IP address of the computer to contact. This address is provided by the Internet provider;
- IP port of the server. This parameter depends on the server settings.

The device may communicate to provide information on the following events:

- At the request. In the event of the incoming call, the device immediately disables and initiates GPRS Channel
- By task scheduler. Periodicity of meter communications. The following time intervals are possible – once a month, once a week, once a day, or with preset interval in hours (for example, every 3 hours).

## 12 Error codes

Diagnostic errors are subdivided into groups depending on their priority. The smaller the number or the group the more important error is. Apart from that, error code includes its number and the number of the measuring channel where error has been occurred.

Let's examine the error example:

**Error 1.3.1**
**Short-circuit in TS1**

Here, 1.3.1 is an error code that denotes the group (first digit), error number (second digit) and the number of the measuring channel (third digit). In this case, the number of the measuring channel is the number of the temperature sensor. Only one error may be displayed on the indicator. *Code of the above error will be represented in the printout as «***1_3_1»***.* To see all errors use the 'Errors' mode.

**System errors**

As mentioned above, the lower the number of the error, the higher its priority. System errors have no priorities. System errors are errors of internal meter's hardware, which generally close out operation of the meter. In case of such errors parameters are not measured. System errors are displayed on the indicator as follows (example):

**«SYSErr02»**

The number means the error type. If possible, the system errors are registered in the logbook of events with comments.

**In case of a system error, the meter should be returned to the manufacturer for repair.**

**Group «0» errors**

This group «0» includes the following errors:

- «**0_1_0**» - Error of flow rate measuring unit. Flow rate measurement in both channels is impossible.
- «**0_2_0**» - Error of ADC. Temperature measurement in all channels is impossible.
- «**0_3_0**» - Error of calibration for temperature sensor.
- «**0_4_0**» - Error of calibration for pressure sensor.

**Group «1» errors**

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

- «**1_1_x**» - break of temperature sensor x.
- «**1_2_x**» - shorting (short-circuit) of temperature sensor x.
- «**1_3_x**» - temperature sensor x is failed. Resistance of mentioned temperature sensor is out of specified limits.
- «**1_4_x**» - faulty temperature sensor x. Resistance of specified sensor goes beyond permissible limits.
- «**1_5_x**» - error in coefficients for temperature sensor x. Wrong coefficients have been entered for the specified temperature sensor. This error may occur after sensor calibration or while manual entering new values during verification.

– «**1_6_x**» - temperature sensor x is below the permissible level. Temperature measured by specified sensor is below the permissible level (below -50 ºC).

– «**1_7_x**» - temperature sensor x exceeds the permissible level. Temperature measured by specified sensor exceeds the maximum permissible level (above +150 ºC).

If TS with an error is involved into flow rate measurement process, then all measurements in the proper flow measurement channel would be canceled.

**Group «2» Errors**

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 path «x». This error can be caused by following reasons:
– failure of flow sensors;
– failure of flow sensors' cable – breakdown or fault;
– no water in flow meter.

**Group «3» Errors**

This group includes errors referring to flow rate measurement. If multi-path flow meter is applied the error in measurement along one of sound paths not necessary leads to flow measurement error of flow meter. (sign «x» indicates the channel number):

– «**3_1_x**» - flow measurement by flow meter x is impossible. This error may be caused by the following:
– Faulty flow meters;
– Faulty cable of flow meters –break or short-circuit;
– No water in the flow meter.
– «**3_2_x**» - temperature of flow meter x. As far as temperature sensor is faulty it is impossible to measure flow. This error indicates the error of temperature sensor measurement.
– «**3_3_x**» - velocity in flow meter x is too high. Volumetric flow rate in flow meter x exceeds the maximum permissible for this type by more than 2 times.
– «**3_4_x**» - flow rate in flow meter x is within the range of [0.5·Qmin, Qmin].
– «**3_5_x**» -flow rate in flow meter x exceeds Qmax.

**Group «6» errors**

This group includes pressure measuring errors (sign «x» indicates the channel number):

– «**6_1_x**» - Pressure sensor x is below the tolerance. Measured pressure is below zero. It can be caused by object conditions (underpressure), or with breakage of certain sensor.
– «**6_2_x**» - Pressure sensor x 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 pressure sensor.
– «**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);

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 history 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 history) 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.

The list of certain faultiness and methods of their elimination are resulted in table

| 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.

**13 Manufacturer's warranty**

The manufacturer warrants compliance of the produced Water meters with all technical requirements for 48 months from the date of shipment.

Installation and startup operations of the Meter should be carried out by authorized company performing such installation procedures.

The warranty covers defects of the meter components that are part of the delivery set and were closed by a workmanship defect, defects in the material and completing items.

The warranty provides for the replacement of defective parts and check of their serviceability by the manufacturer.

The faulty device should be delivered to the manufacturer for testing and repair.

The warranty is not provided as compensation for dismantling, transportation and reinstallation costs, as well as any other fault related expenses.

Faults revealed within the warranty period should be noted and submitted to the authorized representative of Manufacturer.

**Annex 1**

**Battery replacement**

**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

Battery resource is indicated in 'Check' menu and also included in current status report. Battery replacement (lithium battery, voltage 3.6 V) should be done at least once every 6 years. Replacement can also 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;

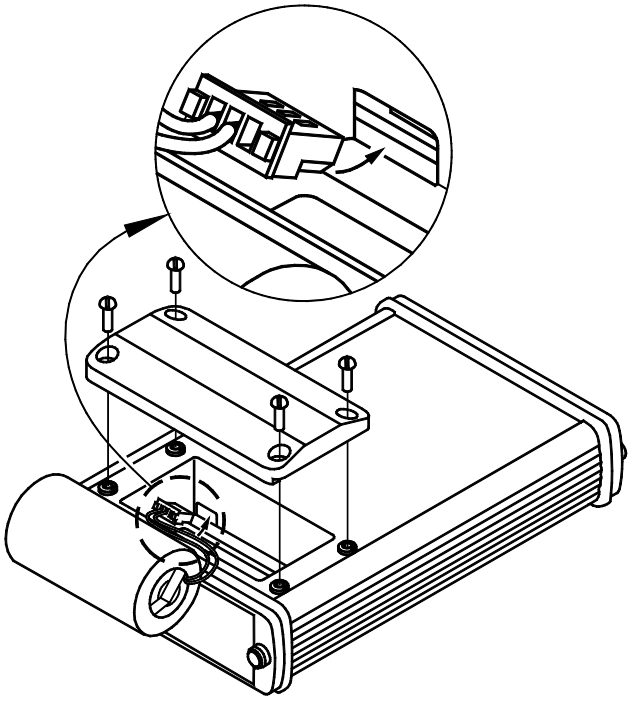
– install the new battery, put it in the slot so, that the wire should not be bent by slot cover;

– 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.

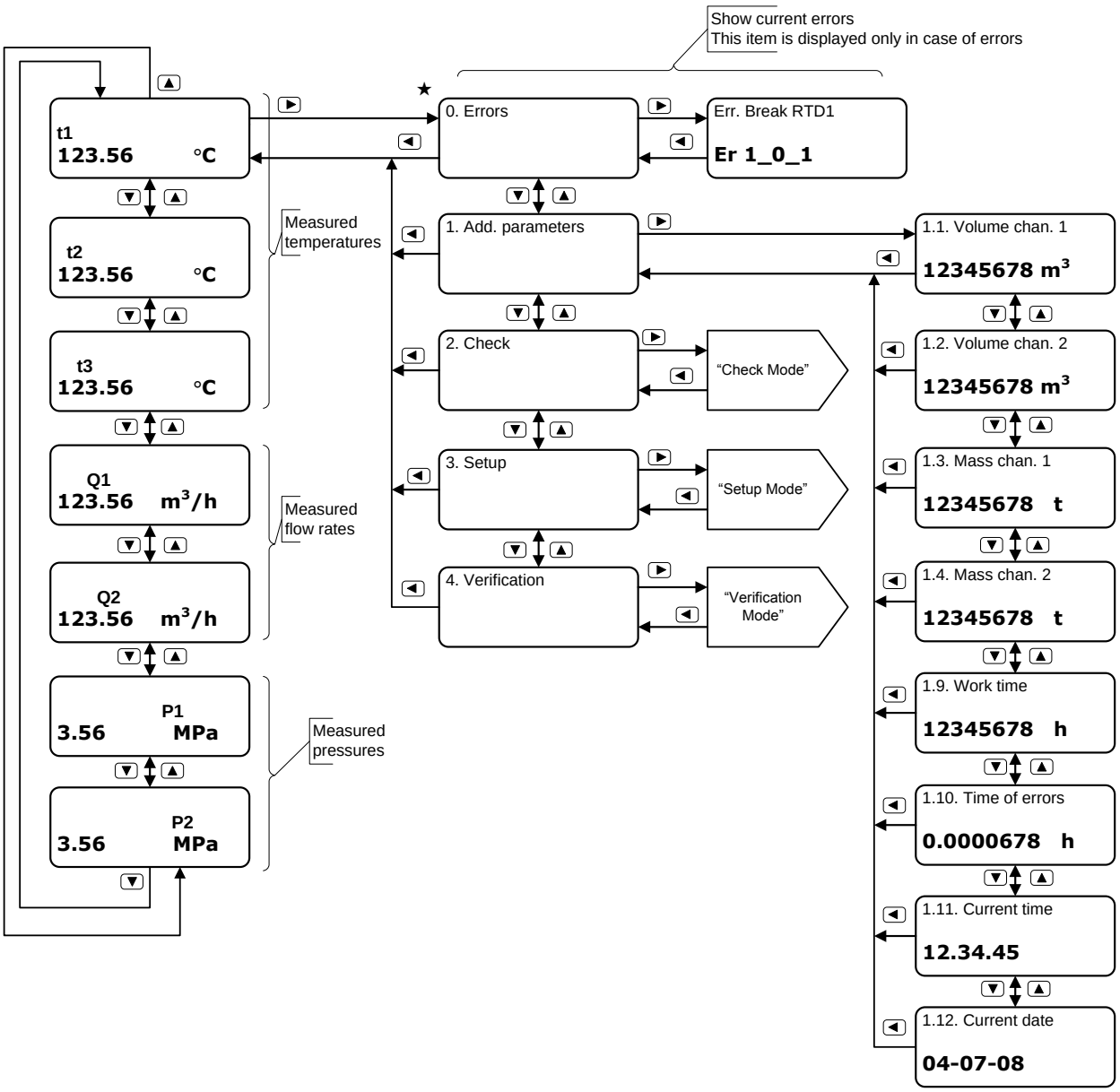
Time of starting and ending of battery replacement is recorded in the event journal and time period of replacement is identified as meter non-work time.

**WARNING!** Meter is delivered with switched off battery. While delivering by air transport the battery should be switched off and removed from the meter.



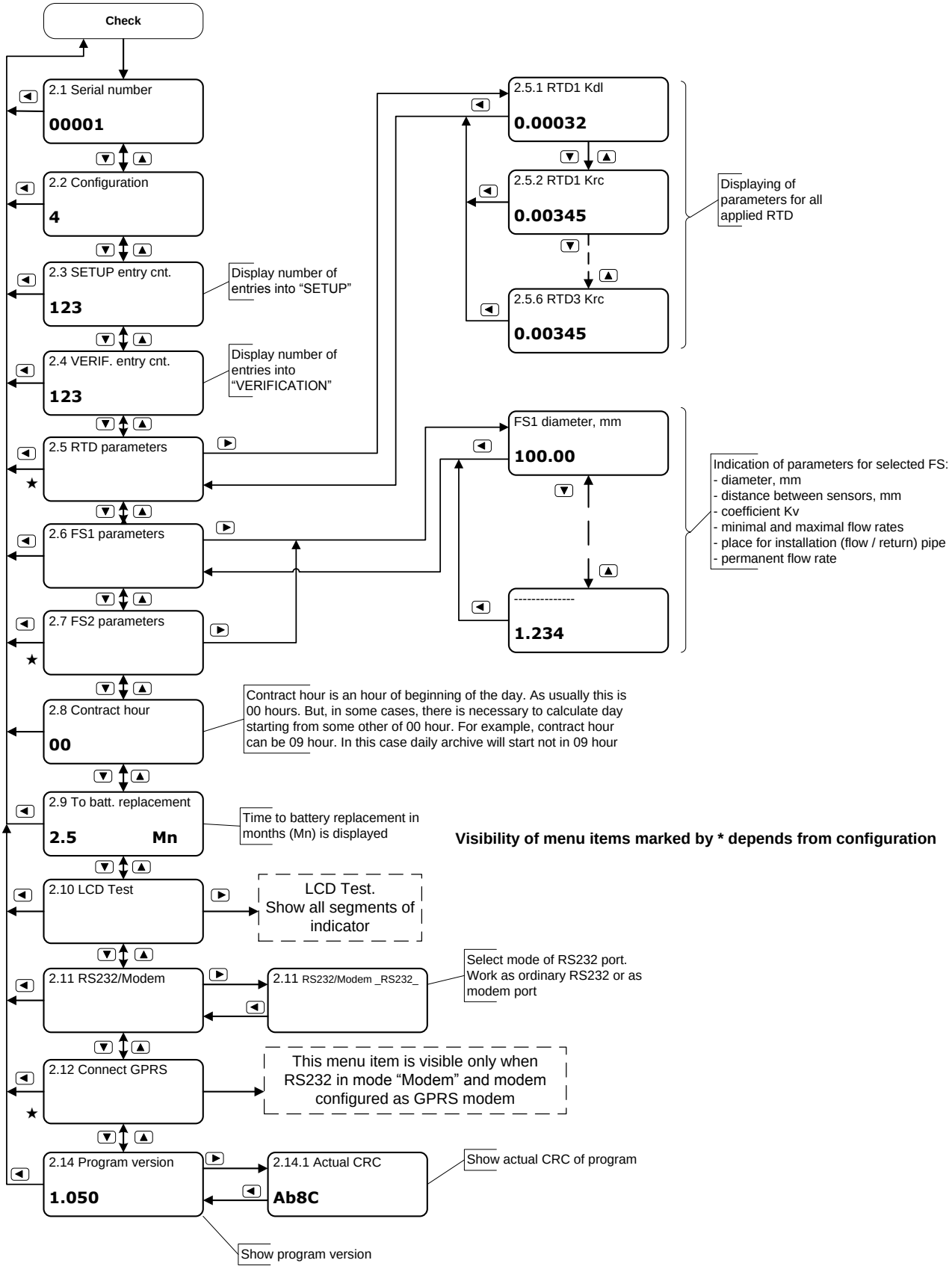
**Annex 2**

**'Indication of main parameters' mode**

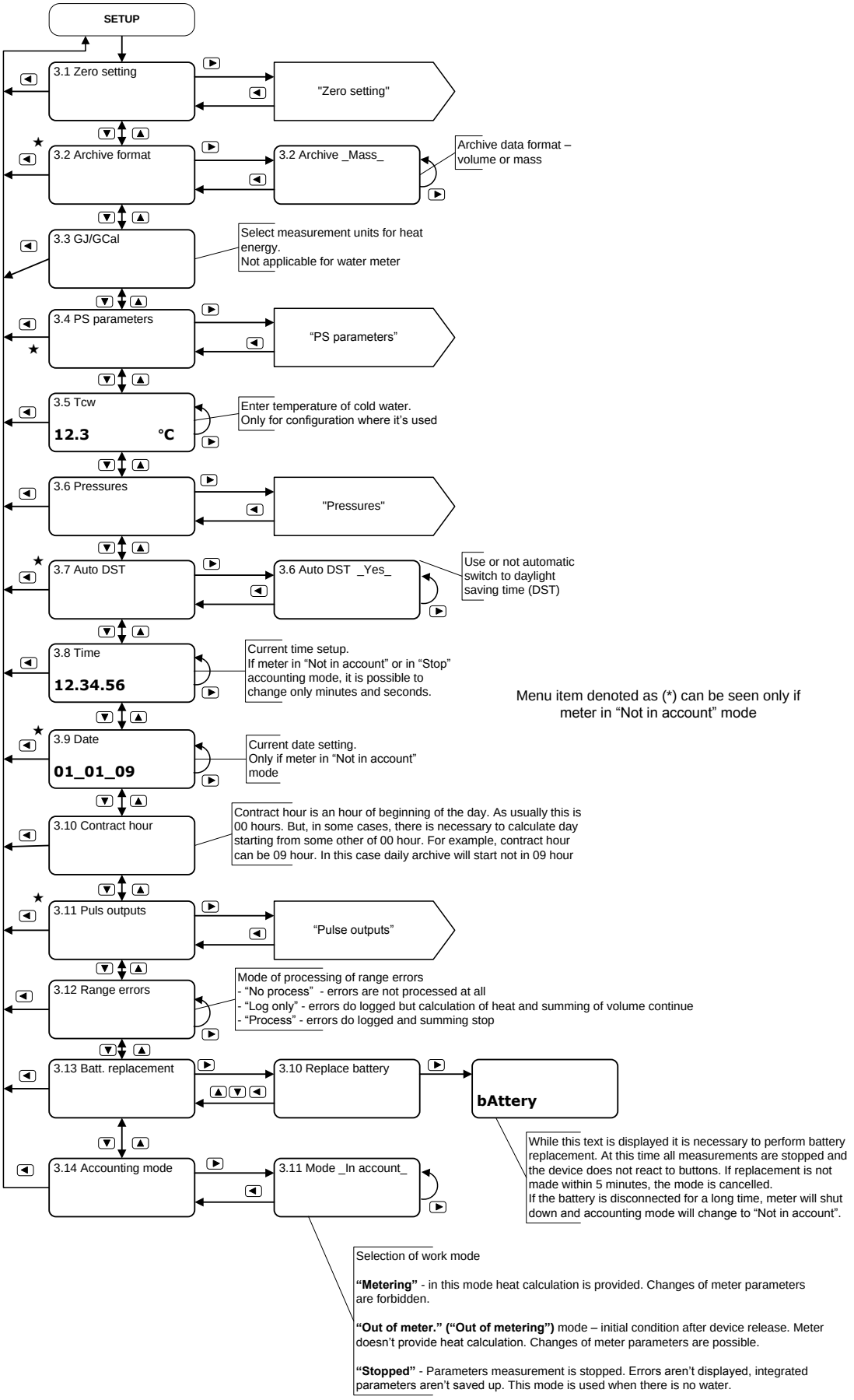


## Annex 3

## ’Check’ mode



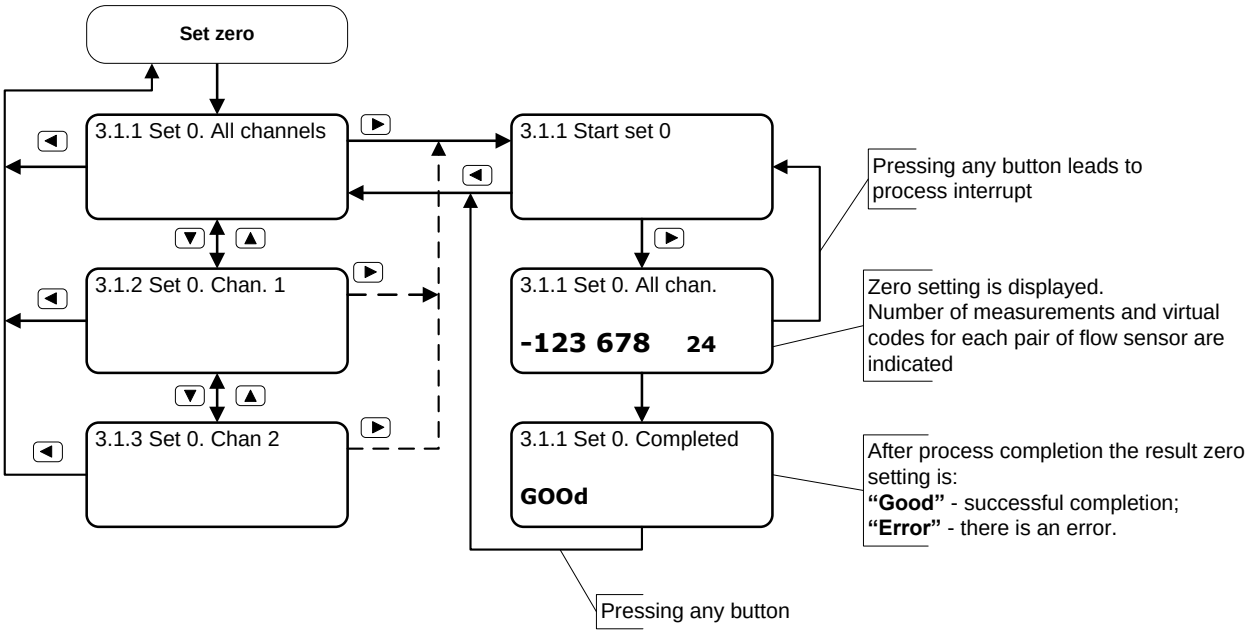
## Annex 4
## 'Setup' mode



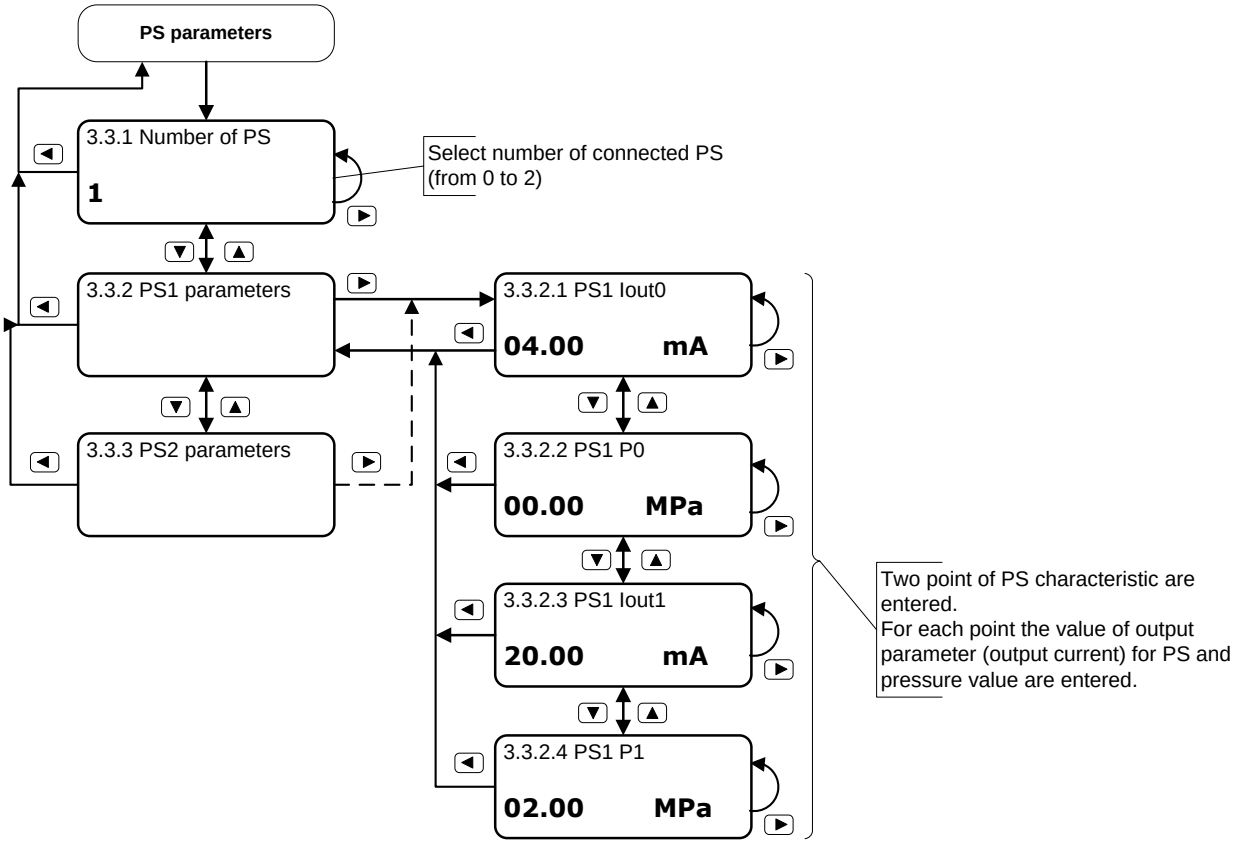

Menu item denoted as (*) can be seen only if meter in "Not in account" mode

## Annex 5

### ‘Setup / Set zero’ mode

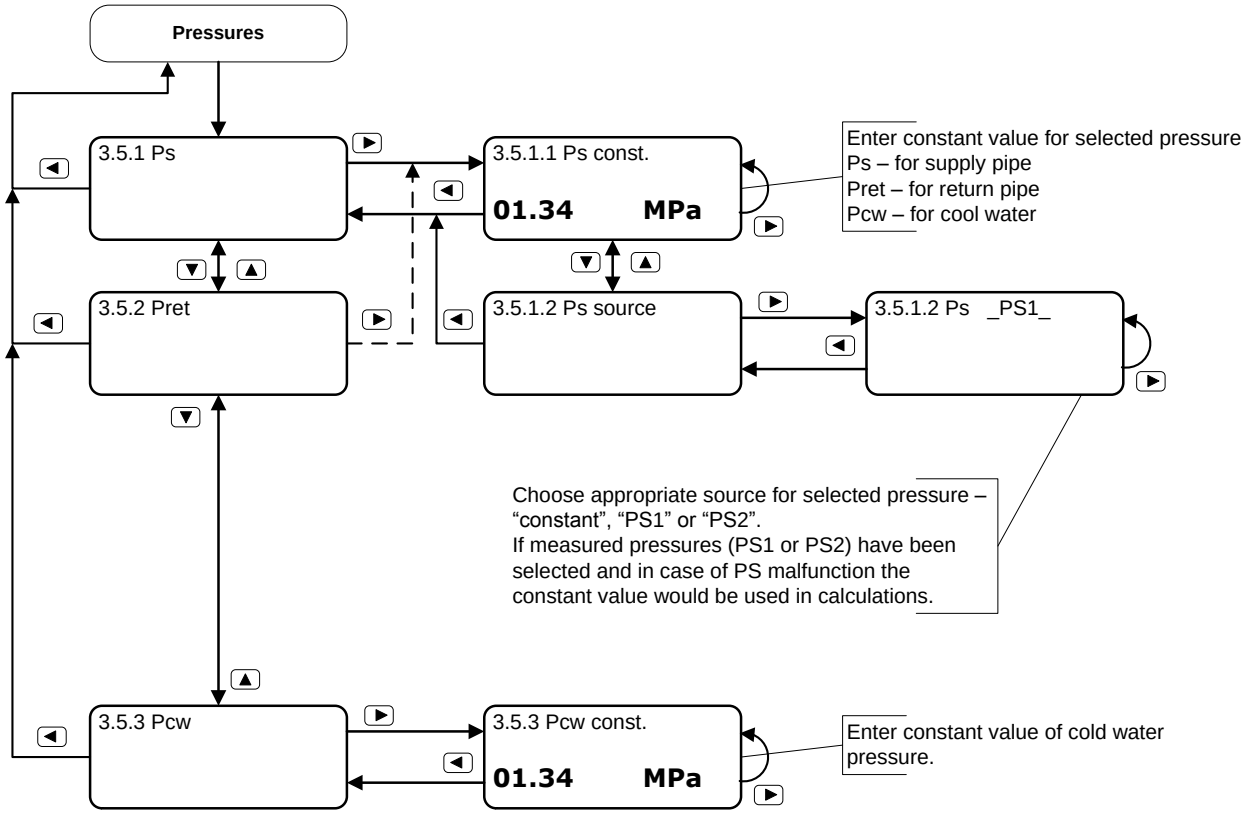



### ‘Setup / PS parameters’ mode



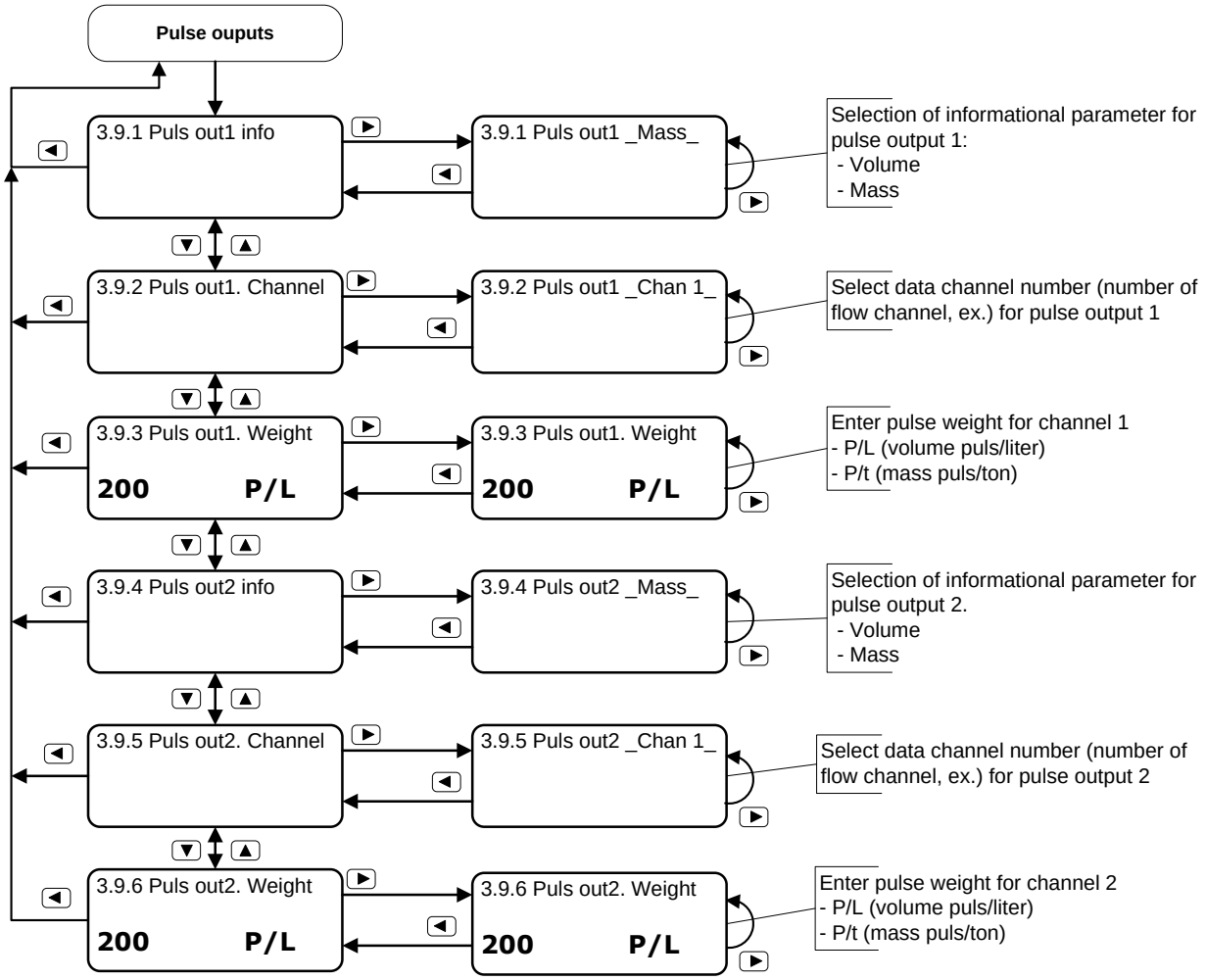
**Annex 6**

**'Setup/Pressures' mode**



**Annex 7**

**'Setup / Pulse outputs' mode**



**Annex 8**

## Examples of reports, creating by "Sempal Device Manager" software

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

| 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 |

Errors report example

Journal 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 |

**Event journal for meter S/N 00050**

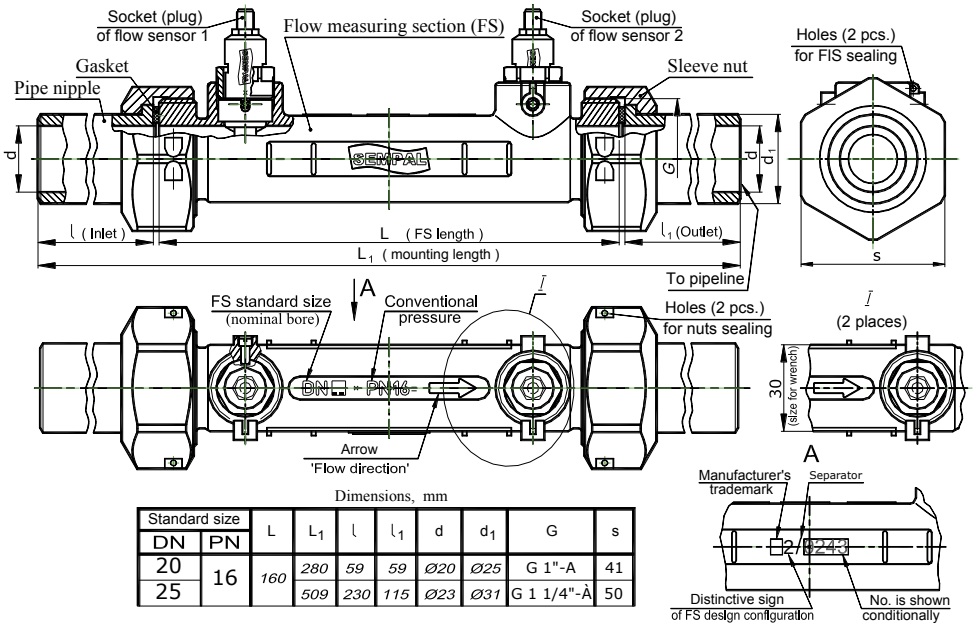
from 29/06/2014 to 29/06/2014

14/09/2014 13:41:03; page 1 of 1

| os. | Date | Journal record |
|---|---|---|
| | 29/06/2014 07:44:09 | Exit from "SETUP" mode |
| | 29/06/2014 07:43:45 | End of reset |
| | 29/06/2014 07:43:45 | Data clearing … |
| | 29/06/2014 07:42:20 | 3.2.Archive _Volume_ |
| | 29/06/2014 07:42:02 | "SETUP" mode enter |

## Annex 9
## Dimensioned sketches

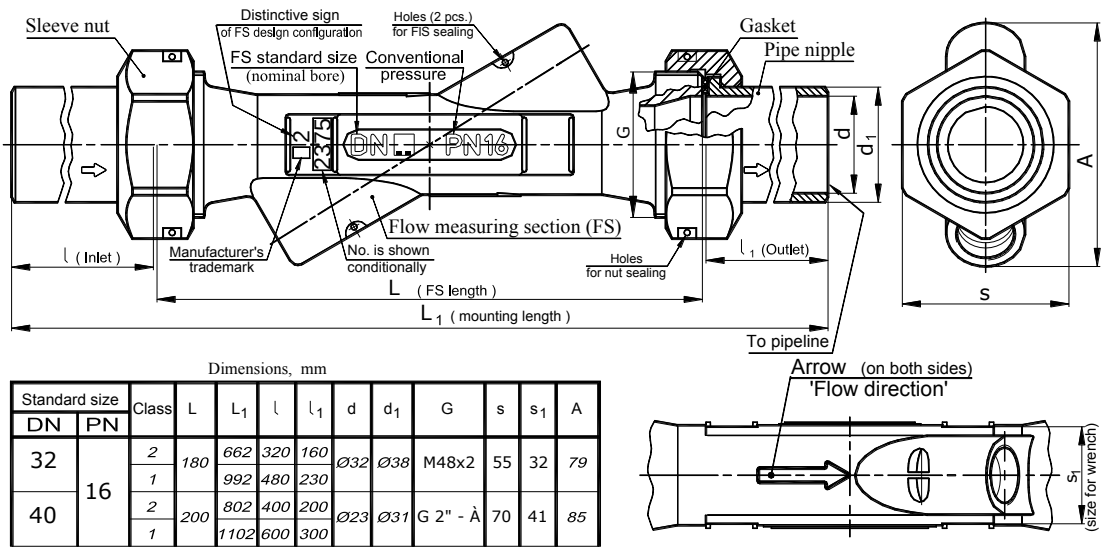
Overall and connecting dimensions of DN 20 & DN 25 set embodiments




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

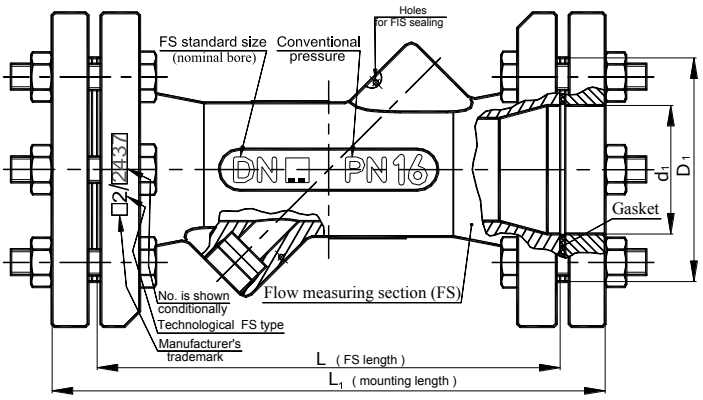



Dimensions, mm

| 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.



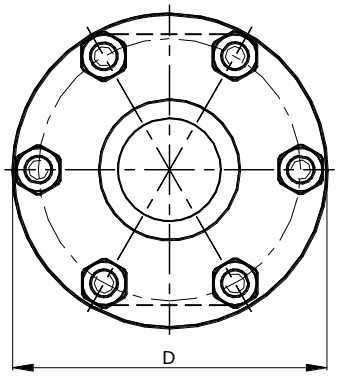
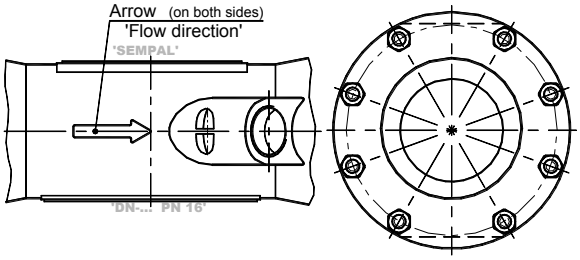



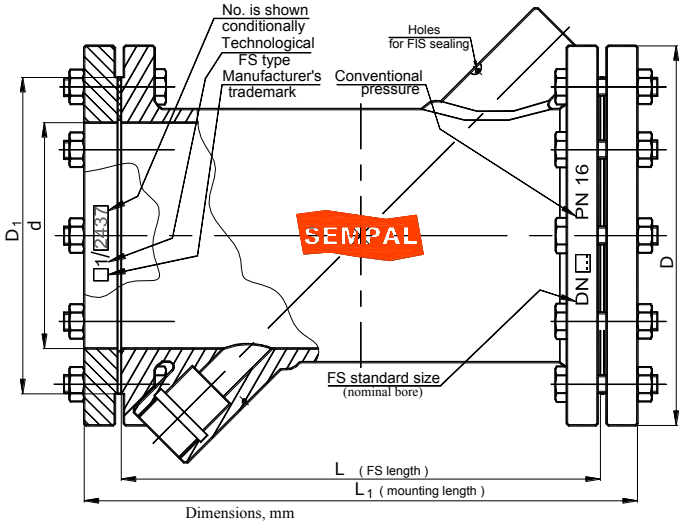

Fig. 2. FS-100 flange view

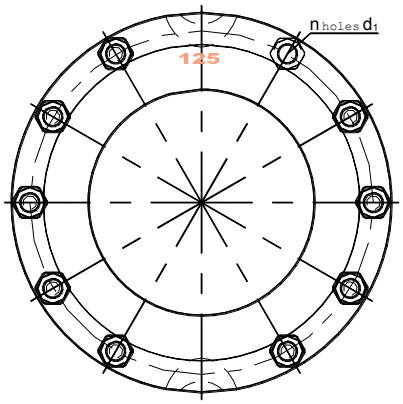
Dimensions, mm

| Standard size DN | PN | d | D | $D_1$ | L | $L_1$ | n (quantity) | Bolts (items per flange) | Note |
|---|---|---|---|---|---|---|---|---|---|
| 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 DN | PN | d | $d_1$ | D | $D_1$ | L | $L_1$ | n (quantity) | Bolts, size (items per flange) | Note |
|---|---|---|---|---|---|---|---|---|---|---|
| 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

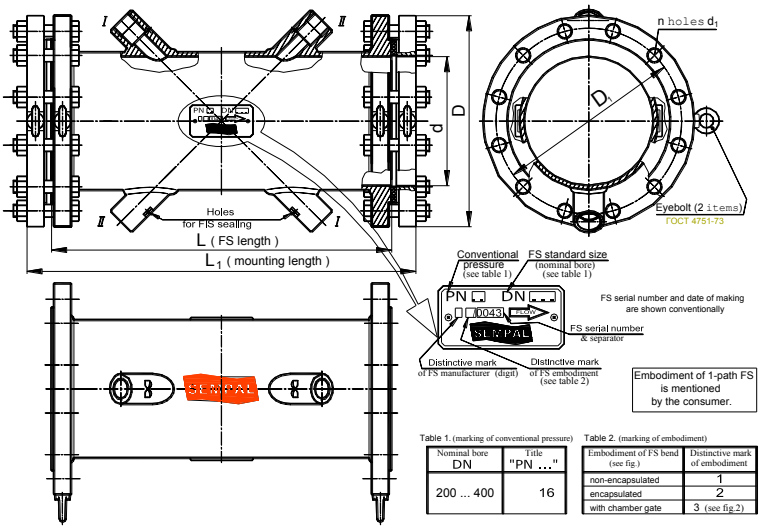



Table 1. (marking of conventional pressure)

| Nominal bore DN | Title "PN ..." |
|---|---|
| 200 ... 400 | 16 |

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 | PN | d | D | $D_1$ | L | $L_1$ | $d_1$ | n (quantity) | Bolts (items per flange) | Eyebolt (2 items) FS flange | Eyebolt (2 items) conjugate flange | 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 | | | |

## 1 - path flow measuring sections (FS)

Fig. 2. Embodiment (3) FS-200...400 with flow sensors lock chamber (FIS)

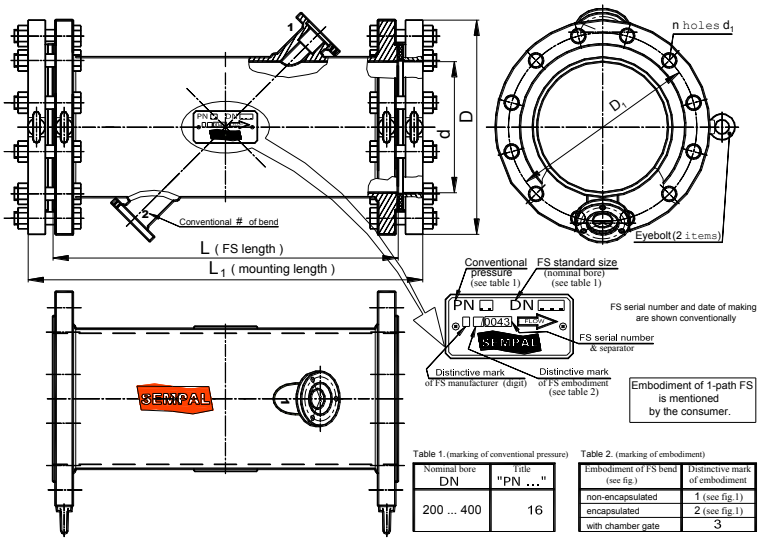



Table 1. (marking of conventional pressure)

| Nominal bore DN | Title "PN ..." |
|---|---|
| 200 ... 400 | 16 |

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)

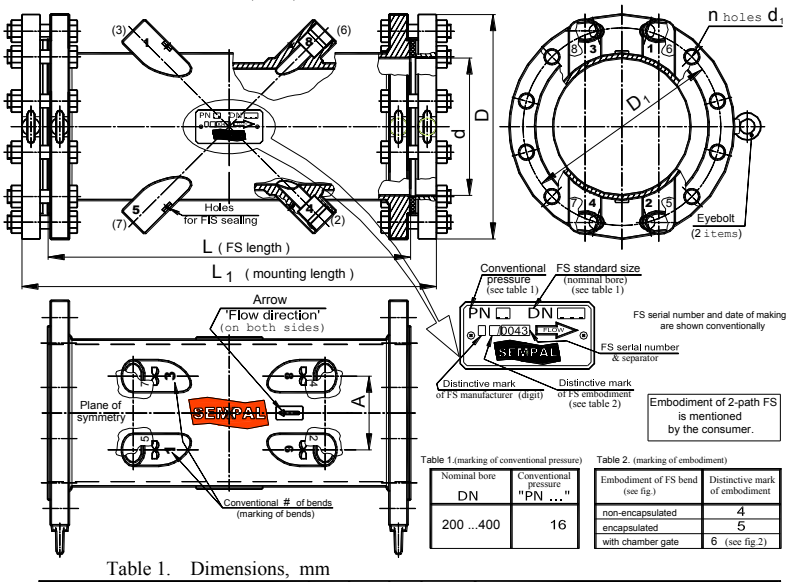



Table 1.(marking of conventional pressure)

| Nominal bore DN | Conventional pressure "PN ... " |
|---|---|
| 200 ...400 | 16 |

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 | PN | d | D | $D_1$ | L | $L_1$ | A | $d_1$ | n (quantity) | Bolts, size (items per flange) | Eyebolt (2 items) FS flange | Eyebolt (2 items) conjugate flange | 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 | | | M24x100 | | | |
| 300 | | 310 | 460 | 410 | 680 | 740 | 168 | 26 | | | | | |
| 350 | | 360 | 520 | 470 | 740 | 804 | 195 | | 16 | | | | |
| 400 | | 410 | 580 | 525 | 820 | 892 | 220 | 30 | | M27x110 | | | |

## 2 - path flow measuring sections (FS)

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

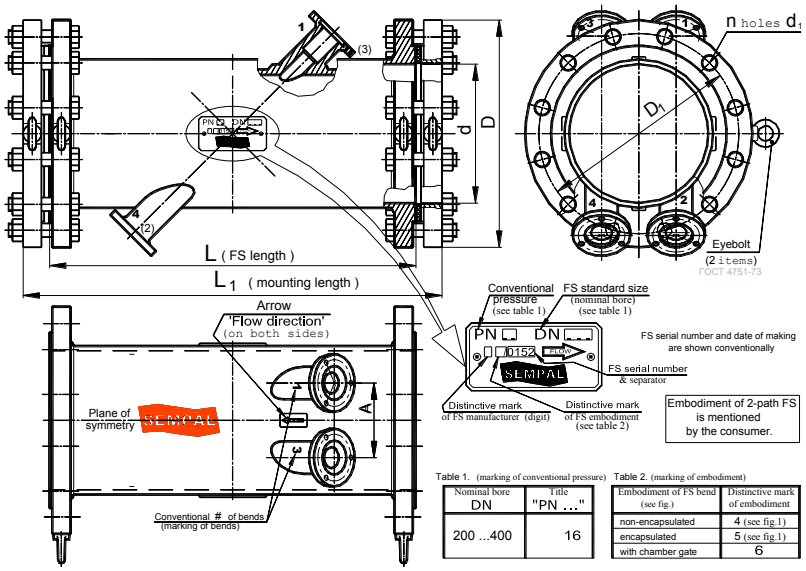



Table 1. (marking of conventional pressure)

| Nominal bore DN | Title "PN ..." |
|---|---|
| 200 ...400 | 16 |

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