Standards and documents applied:
EN 1434-1:2015+A1:2018;
EN 1434-2:2015+A1:2018;
EN 1434-4:2015+A1:2018;
EN 1434-5:2015+A1:2019;
WELMEC 7.2:2015.

The measuring instrument must correspond to following specifications:

1 Design of the instrument

1.1 Construction

Complete thermal energy meter consists of a flow sensor and calculator with inseparably connected temperature sensor Pt 500 pair.
Flow sensor consists of brass body with built-in ultrasound transducers. The flow sensor inseparably connected with the calculator via 1,2 m length cable (2,5 m and 5 m – optional). The flow sensors q_p = (0,6 – 6,0) m³/h has intended place for temperature probe installation. The calculator can be mounted directly on the flow sensor housing or separately on the wall or on a standard DIN rail.
The meter can be powered by:

- 3,6 V DC lithium battery;
- remote 12 V to 42 V DC or 12 V to 36 V AC power source;
- 230 V AC mains.

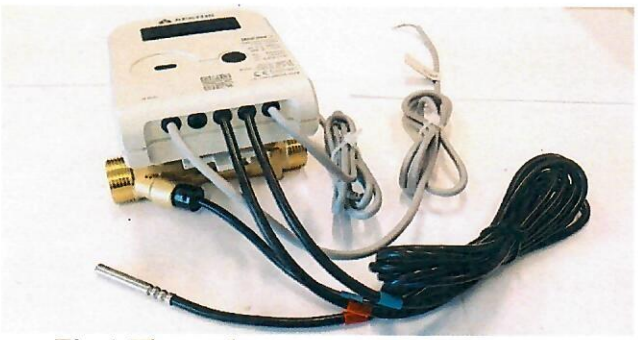

Fig.1.Thermal energy meter INVONIC 2

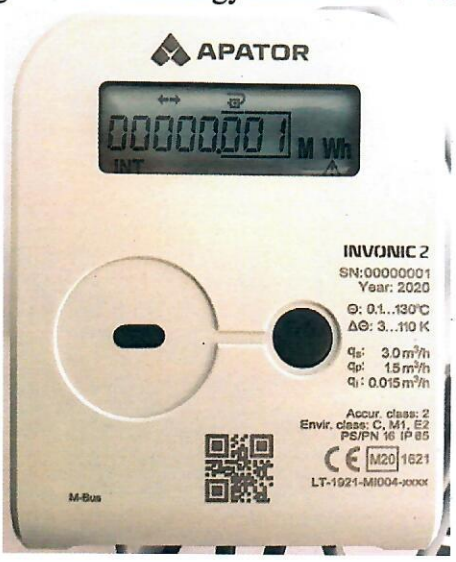

Fig.2. Calculator of the thermal energy meter INVONIC 2

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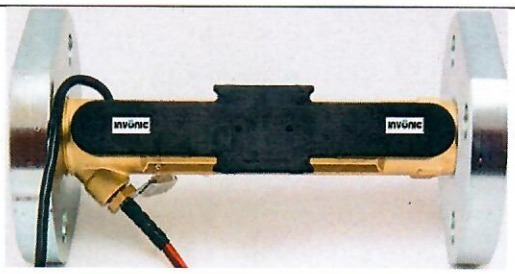
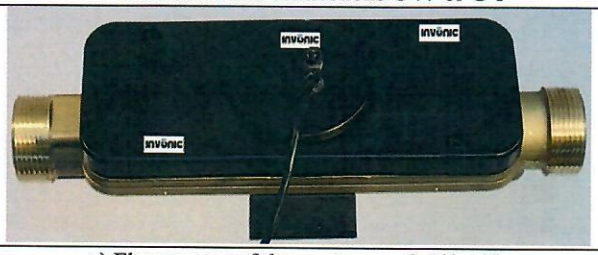
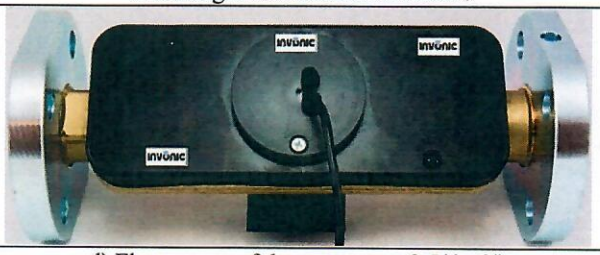
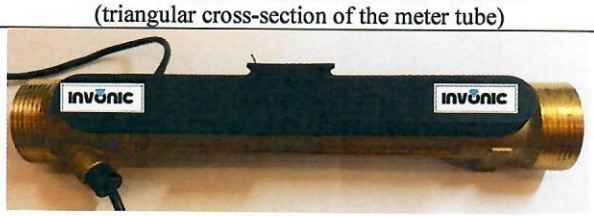
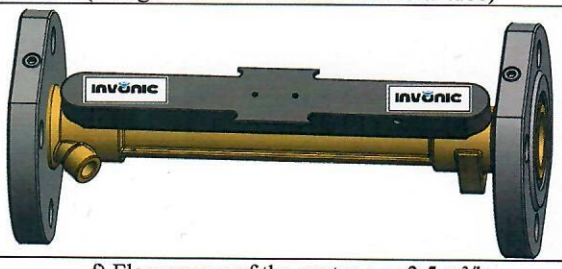
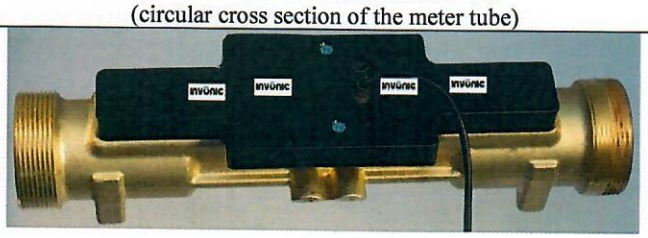
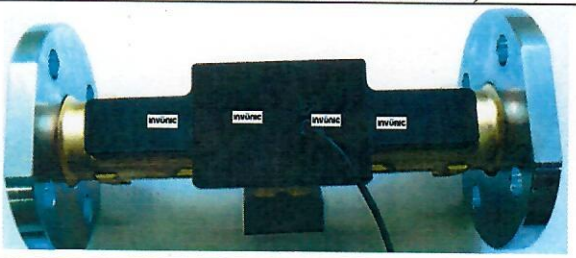
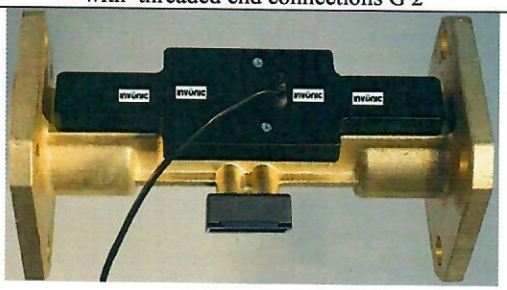
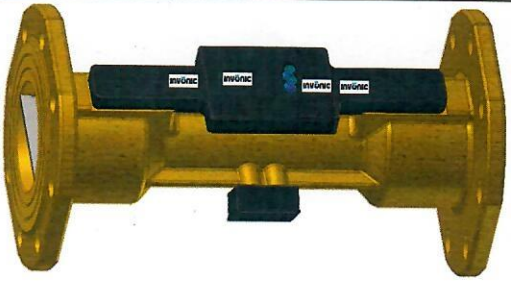
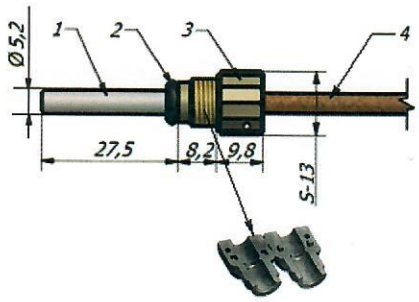
	
a) Flow sensor of the meter q_p = 0,6/1,0/1,5/2,5 m³/h with threaded end connections G ¾ or G 1	b) Flow sensor of the meter q_p = 0,6/1,0/1,5/2,5 m³/h with flanged end connections DN20
	
c) Flow sensor of the meter q_p = 3,5/6 m³/h with threaded end connections G 1¼ or G 1½ (triangular cross-section of the meter tube)	d) Flow sensor of the meter q_p = 3,5/6 m³/h with flanged end connections DN25 or DN32 (triangular cross-section of the meter tube)
	
e) Flow sensor of the meter q_p = 3,5/ m³/h with threaded end connections G 1¼ (circular cross section of the meter tube)	f) Flow sensor of the meter q_p = 3,5 m³/h with flanged end connections DN25 or DN32 (circular cross section of the meter tube)
	
g) Flow sensor of the meter q_p = 10 m³/h with threaded end connections G 2	h) Flow sensor of the meter q_p = 10 m³/h with flanged end connections DN40
	
i) Flow sensor of the meter q_p = 15 m³/h with flanged end connections DN50	j) Flow sensor of the meter q_p = 25/40/60 m³/h with flanged end connections (DN65/DN80/DN100)

Fig.3. Flow sensor of the thermal energy meter INVONIC 2

1.2 Sensor

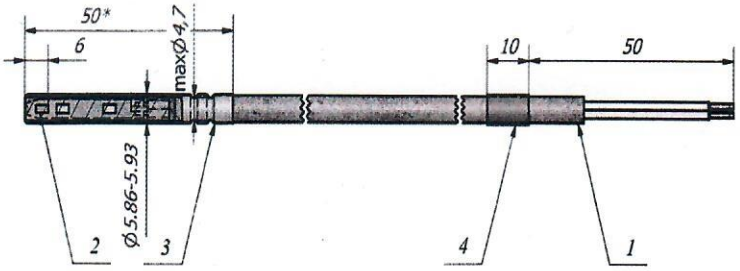
Thermal energy meter hardware consist of an ultrasonic flow sensor and calculator with inseparably connected resistance temperature sensors Pt 500. For meters q_p = (0,6 – 6,0), direct mounted DS design type temperature probes are used according to EN 1434-2. In case of large size meters, pocket mounted PL design type temperature probes are used according to EN 1434-2. The pockets are available in 85; 120 or 210 mm.

Design and main dimensions of the temperature probes are described in Fig. 4.



1- protective sheat
2- Sealing ring
3- nut
4- connected cable

a) temperature probe type DS



1 - connected cable
2 – temperature sensing element
3 – protective sheat
4 – thermo tube

b) temperature probe type PL

Fig.4. Design and main dimensions of the temperature probes

1.3 Measurement value processing

The energy, consumed for heating, is calculated by integrating the temperature difference and the volume of the heat-conveying liquid over time. The temperature difference is calculated from the resistance of the temperature sensors pair connected to the calculator and converts it to temperature according to formulas of EN 60751.

1.4 Indication of the measurement results

The accumulated quantity of thermal energy is presented on the LCD display in the MWh. Other units (Gcal, GJ) can be chosen too as an option.

1.5 Optional equipment and functions subject to MID requirements

None.

1.6 Technical documentation

Ultrasonic heating and cooling energy meter INVONIC 2. Technical description and operational guide, 30-03-2022.
Test instruction of the thermal energy meter INVONIC 2, 02-2020.

Other reference documents on which basis this certificate is issued, are stored in a file Nr. LEI-12-MP-126.22.

1.7 Integrated equipment and functions not subject to MID

Optical interface according to the requirements of EN 62056-21, integrated in the meter, is intended for data reading, meter parameters setting and optical pulse output in test mode.

Two pulse outputs for energy and volume pulses (optional). Class of pulse output device according to EN 1434-2: OB in operating mode, OD in test mode.
Two programmable pulse inputs for volume pulses (optional). Class of pulse input device – IB according to EN 1434-2.
When the meter has a pulse input/otput function, it is supplied with inseparably connected 1,5 m input/output cable.
The meter can be without a communication interface or equipped with one or both of the following communication interfaces:

- M-Bus;
- 868 MHz RF.

The meter can be equipped with one of the following additional communication interfaces:

- M-Bus;
- CL (current loop);
- MODBUS RS485;
- BACNET RS485;
- MiniBus.

The meter can be used also for cooling energy measurement under rated operating conditions, listed in section 2.1.

2 Technical data

2.1 Rated operating conditions

2.1.1 Measurand

Heating energy, calculated from the measured volume of water and the measured difference of water temperature in flow and return pipes.

2.1.2 Measurement range

Limits of the temperature Θ : 0,1 °C to 90 °C or
0,1 °C to 130 °C (optional).

Limits of temperature differences $\Delta\Theta$: 2K* to 70 K, or 3 K to 70 K;

2 K* to 110 K or 3 K to 110 K (optional).

Note: * - for meters with the lower limit of the temperature difference 2 K, the requirements of the Directive 2014/32/EU are not applied.

Technical data of thermal energy meter flow sensor are presented in Table 1:

Table 1

End connections	Flow-rate, m³/h			Pressure loss at q_p, kPa	Overall length, mm
	Permanent q_p	Maximum q_s	Minimum q_i		
G ¾	0,6	1,2	0,006	7	110
G 1 or DN20	0,6	1,2	0,006	0,9	190
G ¾	1,0	2,0	0,010	11,3	110

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End connections	Flow-rate, m³/h			Pressure loss at q_p, kPa	Overall length, mm
	Permanent q_p	Maximum q_s	Minimum q_i		
G 1 or DN20	1,0	2,0	0,010	2,5	190
G ¾	1,5	3,0	0,006	17,1	110
G ¾	1,5	3,0	0,006	17,1	165
G 1 or DN20	1,5	3,0	0,006	5,8	190
G ¾	1,5	3,0	0,015	17,1	110
G ¾	1,5	3,0	0,015	17,1	165
G 1 or DN20	1,5	3,0	0,015	5,8	190
G 1	1,5	3,0	0,015	7,2	130
G 1	2,5	5,0	0,010	19,8	130
G 1 or DN20	2,5	5,0	0,010	9,4	190
G1	2,5	5,0	0,025	19,8	130
G 1 or DN20	2,5	5,0	0,025	9,4	190
G 1¼, or G 1½, or DN25, or DN32	3,5	7,0	0,035	4*	260
G 1¼, or DN25, or DN32	3,5	7,0	0,014	9**	260
G 1 ¼, or DN25, or DN32	3,5	7,0	0,035	9**	260
G 1¼, or G 1½, or DN25, or DN32	6,0	12,0	0,024	10	260
G 1¼, or G 1½, or DN25, or DN32	6,0	12,0	0,060	10	260
G 2 or DN40	10,0	20,0	0,040	18	300
G 2 a or DN40	10,0	20,0	0,100	18	300
DN50	15,0	30,0	0,060	12	270
DN50	15,0	30,0	0,150	12	270
DN65	25,0	50,0	0,100	20	300
DN65	25,0	50,0	0,250	20	300
DN80	40,0	80,0	0,160	18	300
DN80	40,0	80,0	0,400	18	300
DN100	60,0	120,0	0,240	18	360
DN100	60,0	120,0	0,600	18	360

Notes:
1. * - flow sensor with triangular cross-section of the meter tube.
2. ** - flow sensor with circular cross section of the meter tube.

Temperature limits of heat-conveying liquid Θ_q:
- when the calculator is mounted on the flow sensor : 0,1 °C to 90 °C;
- when the calculator is mounted separately, and specially ordered : 0,1 °C to 130 °C.

2.1.3 Accuracy class

Accuracy class : 2 according to EN 1434-1.

2.1.4 Environmental conditions / Influence quantities

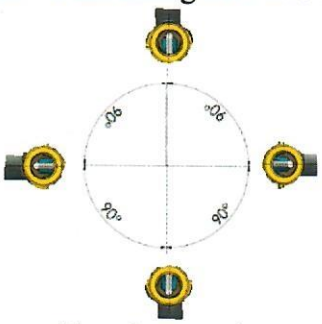
Ambient temperature	:	5 °C to 55 °C;
Humidity level	:	condensing;
Installations	:	indoor;
Mechanical environment	:	class M1;
Electromagnetic environment	:	class E2.

2.1.5 Maximum admissible working pressure

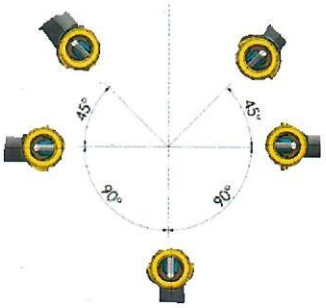
The maximum admissible working pressure/nominal pressure (PS/PN) of meter is 16 bar or 25 bar.

2.1.6 Mounting position of the flow sensor

Flow sensor of the meter can be mounted either horizontally, vertically or inclined.
In case of installation horizontally or inclined, flow sensors with end connections G ¾, G 1 or DN20 can be rotated about the mounting axis at any angle (Fig. 5a)). Larger size flow sensors must by rotated about the mounting axis as shown in Fig. 5 b).



a) for flow sensors with end connections G ¾, G 1 or DN20



b) for flow sensors other sizes

Fig.5. Mounting positions of the flow sensor to the longitudinal axis

3 Interfaces and compatibility conditions

Communication interfaces of the meter are presented in section 1.7 of this appendix.

4 Requirements on production, putting into use and utilization

4.1 Requirements on production

At the end of the manufacturing and adjustment process the thermal energy meters shall be tested according to the requirements of the EN 1434-5. Errors of heat meters shall not exceed the maximum permissible errors, described in Annex VI (MI-004) of Directive 2014/32/EU.
The flow sensors can be tested with cold water (25 ± 5) °C.

Note: the energy measuring error determination test shall be carried out when the flow sensor is installed in inlet and when the flow sensor is installed in outlet (in both cases).

4.2 Requirements on putting into use

The thermal energy meter must be installed in accordance with the requirements of technical description listed in section 1.6.
Before the putting into use, the meter is supplied in transport mode (this is indicated by the „<->“ symbol on LCD display). In this mode, the configuring of the meter parameters (referred to the technical description, section 5.2.1) by means of a button or via the optical interface using the HEAT3-SERVICE software is possible without prejudice the break-out protective restraints (see section 6.1.1 of this appendix).

Transport mode switches off itself after 0,001 m³ of water volume passed through the meter, or it can be switched of by means via the optical interface using the HEAT3-SERVICE software.

For flow sensors with nominal diameter DN65 to DN100 necessary straight pipelines lengths are: upstream $\geq 5 \times$ DN, downstream $\geq 3 \times$ DN. For flow sensors of other sizes the straight pipelines installation in upstream and downstream the sensor are not necessary.

4.3 Requirements for consistent utilization

No special requirements identified.

5 Control of the measuring process after tasks of the instrument in use

5.1 Documentation of the procedure

Test instruction of the thermal energy meter INVONIC 2, 02-2020.

5.2 Special equipment or software

- optical reading head according to standard EN 62056-21;
- service software **HEAT3-SERVICE**.

5.3 Identification of hardware and software

Identification of hardware:

- see Fig. 1, Fig. 2 and Fig. 3 of this appendix.

Identification of software: version number of the software is **0.01**. This number can be displayed on the device's display according to the request.

5.4 Calibration-adjustment procedure

The tests are carried out according to the test instruction of the thermal energy meter INVONIC 2 given on pages 11 to 13 of this appendix in accordance with the requirements of the EN 1434-5.

6 Security measures

6.1 Sealing

6.1.1 Sealing of the meter calculator

For the calculator of the newly produced meter additional sealing does not apply. Access to the calculator cover release latch (Fig. 6, pos. 1), the parameter change and test mode activation contacts (Fig. 6, pos. 2) and adjustment data activation contacts (Fig. 6, pos. 3) is protected by easy break-out screens.

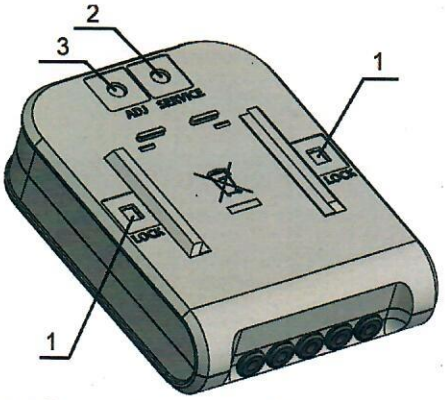


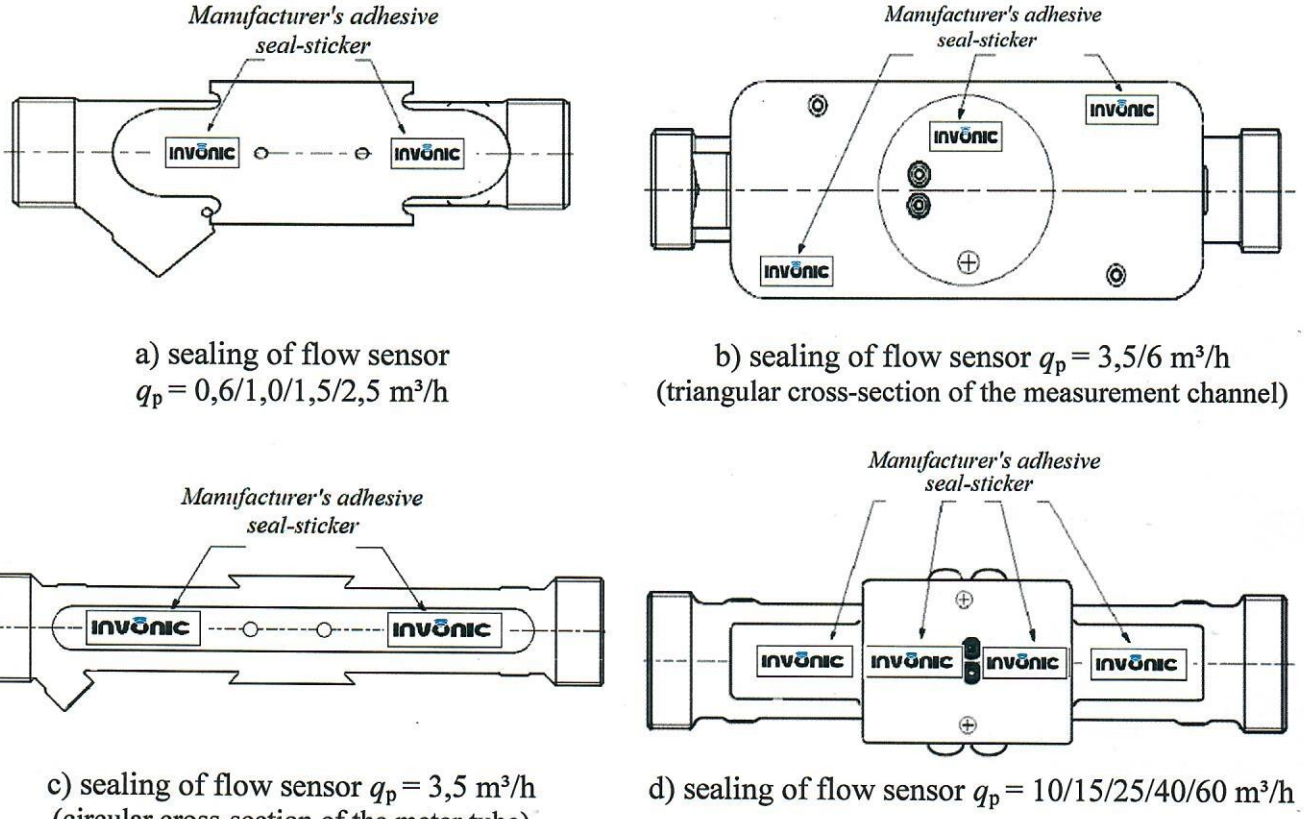
Fig.6. Sealing of the calculator of the thermal energy meter

When the abovementioned casing screans are break-out (after opening the calculator casing, changing the meter parameters, adjusting the meter or activation the test mode), open slots are sealed with metrological seal-stickers (pos. 1 and pos. 3) and with the protective seal-sticker of heat supplier (pos. 2).

6.1.2 Sealing of the flow sensor

The following flow sensor sealing is provided:

- the manufacturer's adhesive warranty seal - sticker on the bolts of the cover (Fig.7).



a) sealing of flow sensor q_p = 0,6/1,0/1,5/2,5 m³/h

b) sealing of flow sensor q_p = 3,5/6 m³/h (triangular cross-section of the measurement channel)

c) sealing of flow sensor q_p = 3,5 m³/h (circular cross-section of the meter tube)

d) sealing of flow sensor q_p = 10/15/25/40/60 m³/h

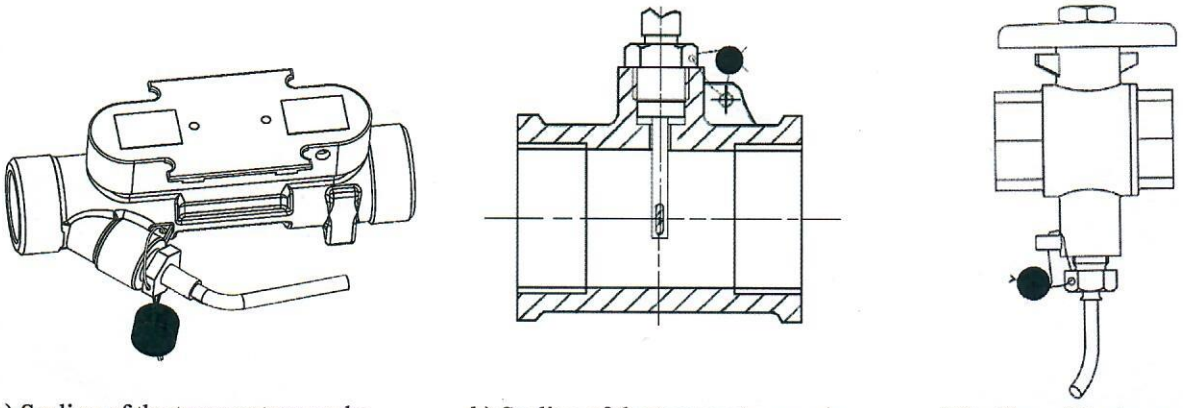
Fig.7. Sealing of the flow sensor

Fig. 8. Manufacturer's adhesive seal-sticker

6.1.3 Sealing of the temperature sensor pair

The temperature sensors must be sealed with hanged seal of heat supplier to ensure that after the temperature sensors have been installed, it is not possibility of dismantle, remove or altering the sensors without evident damage on the sensors or the seal (Fig. 9 and Fig. 10).

Fig. 9. Sealing of the PL type temperature probes



a) Sealing of the temperature probe, mounted in the flow sensor body

b) Sealing of the temperature probe, mounted in the three-way fitting

c) Sealing of the temperature probe, mounted in the ball valve

Fig. 10. Sealing of the DS type temperature probes

7 Marking and inscriptions

7.1 Information to be borne by and to accompany the measuring instrument

At least the following information shall appear on the thermal energy meter calculator label:

- EU-type examination certificate number (LT-1621-MI004-042);
- manufacturer's mark or name;
- type designation;
- year of manufacture and serial number;
- limits of the temperature;
- limits of temperature differences;
- limits of flow-rate: maximum q_s, permanent q_p and minimum q_i;
- the maximum admissible working pressure/nominal pressure (PS/PN);
- accuracy class;
- climatic class;
- electromagnetic class;
- mechanical class.

Information about the location of the meter's flow sensor is shown on the device's LCD indicator: when the flow sensor is installed in inlet – the sign, when the flow sensor is installed in outlet – the sign.

Arrow to indicate the direction of the flow shall appear on flow sensor body.

The inlet temperature sensor cable must be marked with a red color plastic tube.
The outlet temperature sensor cable must be marked with a blue color plastic tube.

Pockets, in which the PL tip temperature probes are fitted, must be marked with the mark "EN1434".

7.2 Conformity marking

In addition, the meter calculator label should contain the following marking:

- „CE" marking;
- metrology marking, consisting of the capital letter „M" and the last two digits of the year of its affixing, surrounded by a rectangle;
- identification number of the notified body, which carried out the conformity assessment.

8 List of the drawings attached to the certificate.

Drawings are not added.

9 Certificate history

Issue	Date and reference №	Description
LT-1621-MI004-042	20-02-2020, No. LEI-12-MP-100.20	Type examination certificate first issued
LT-1621-MI004-042 Revision 1	29-04-2022, Nr. LEI-12-MP-126.21	1. The manufacturer's address has changed: Apator Powogaz S.A. Jaryszki 1c, 62-023 Żerniki, Poland 2. The technical description issued on 03-02-2020 has been replaced by the technical description issued on 30-03-2022.

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Test instruction of the thermal energy meter INVONIC 2

1. Activation of the test mode

The test mode can be activated in one of the following ways:

1.1. Activation of the test mode with the button

The test mode is activated by the meter's control button according to the following procedure:

- long press the button, on the meter's LCD select page „**INF**";
- short press the button, select „**tEST on Wh**" (when it is necessary to activate the energy pulse output via the optical inreface) or „**tEST On m³**" (when it is necessary to activate the volume pulse output via the optical interface);
- long press the button, open the 4- digits security password input window:

- short press the button, select digit in the first position, after that long press the button and go to the next position;
- after selecting the digit in the fourth position, long press the button, the massage „**PASS**" appears briefly (when the password entered correctly) and the meter switches to test mode – the sign „**TEST**" appears;
- if the password was entered incorrectly, the message „**FAIL**" appears briefly and the meter returns to the operating mode, and the procedure for turning on the test mode must be repeated initially;
- the password value is fixed: **0001**.

REMARK: when the test mode is activated by the button, the volume and energy accumulated in the test mode are added to the meter's energy and volume readings in operating mode (after turning off the test mode).

1.2. Activation of the test mode with the jumper

Remove the screen „SERVICE" on the back of the calculator or, if the screen has already broken down, a protective seal-sticker is removed (Fig. 6, pos. 2 of this appendix). Circuit the „SERVICE" contacts for short time. The SERVICE mode is activated, symbol „<->" and sign „**TEST**" are displayed on the LCD.
In this mode:

- volume pulses are generated via the optical interface of the meter. Energy pulse output can be switched on optionally, when menu item „**tEST on Wh**" is selected with the button;
- the energy pulses are generated in the 1st pulse output and the volume pulses in the 2st pulse output (when the meter is supplied with a connected pulse input/output cable);
- it is possible to simulate volume pulses for determination the energy measurement errors;
- it is possible to change the parameters of the meter configuration.

REMARK: when the test mode is activated by shortening the "SERVICE" contacts, the volume and energy accumulated in the test mode are not added to the meter's energy and volume readings in operating mode (after turning off the test mode).

1.3. Activation of the test mode with the HEAT3-SERVICE software

The test mode can be activated via the optical interface, using the software HEAT3-SERVICE and optical head in accordance with LST EN 62056-21 standard. In this case, optionally volume or energy pulses are generated via the optical interface of the meter.

2. Determination of measurement errors of the meter

2.1. Volume measuring errors determination test

The volume measuring errors should be evaluated using hydrodynamic test bench, in the following order:

1) The test mode is activated in accordance with section 1.1, 1.2, or 1.3 of this instruction;

Breslaujos str. 3. LT-44403 Kaunas, tel.: +370 (37) 401 863, e-mail: testlab@lei.lt, https://www.lei.lt

2) The volume measuring errors should be evaluated at control flow rates specified in LST EN1434-5. The volume of water, passing through the meter can be read directly from the indicating device (with resolution 1 ml), via meter optical output, using the optical reading head according to LST EN 62056-21 or trough wired volume pulse 2nd output (when the meter is supplied with a connected pulse input/output cable and the test mode is activated in accordance with section 1.2 of this instruction);
3) Volume pulse values in test mode are presented in table 1p:

Table 1p

Permanent flow-rate q_p of the meter, m³/h	Volume pulse value in test mode, litre/pulse.
0,6 and 1,0	0,002
1,5	0,004
2,5	0,005
3,5 and 6	0,02
10; 15 and 25	0,05
40 and 60	0,2

2.2. Energy measuring errors determination test

For calculator with temperature sensor pair the energy measuring errors determination is carried out immersing the temperature sensors in a temperature regulated baths, in the following test order:

1) The test mode is activated in accordance with section 1.2 of this instruction;
2) The temperature sensors of the meter are immersed in a temperature regulated baths in which are generated temperature and temperature difference ranges according to LST EN 1434-5;
3) Long press the button (longer than 5 seconds), starts the simulation of the meter volume pulses (on the meter LCD the sign „**SF**“ and the permanent flow rate in m³/h periodically are displayed):

4) After 2,5 minutes the volume pulse simulation has finished, the sign „**SF**“ switches off. The values of the simulated volume and energy read directly from the meter indicating device to calculate the energy measurement error;
5) The amount of volume and/or energy can be read via wired pulse output (if it available in the meter);
6) The amount of volume or energy can be read via meter optical output, using the optical reading head according to LST EN 62056-21;
7) Energy pulse values in test mode are presented in table 2p:

Table 2p

Permanent flow-rate q_p of the meter, m³/h	Energy pulse value based on displayed energy units:		
	„kWh“, „MWh“	„GJ“	„Gcal“
0,6 and 1,0	0,1 Wh/pulse	0,5 kJ/ pulse	0,1 kcal/ pulse
1,5	0,2 Wh/ pulse	1 kJ/ pulse	0,2 kcal/ pulse
2,5	0,5 Wh/ pulse	2 kJ/ pulse	0,5 kcal/ pulse
3,5 and 6	1 Wh/ pulse	5 kJ/ pulse	1 kcal/ pulse
10; 15 and 25	2 Wh/ pulse	10 kJ/ pulse	2 kcal/ pulse
40 and 60	5 Wh/ pulse	20 kJ/ pulse	5 kcal/ pulse
0,6 and 1,0	10 Wh/ pulse	50 kJ/ pulse	10 kcal/ pulse

REMARK: the energy measuring error determination test shall be carried out when the flow sensor is installed in inlet and when the flow sensor is installed in outlet (in both cases).

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3. Turn off the test mode

The test mode can be turned off in one of the following ways:

- long press the button, on the meter's LCD select page „**INF**", short press the button, select „**tEST off**" on the LCD, long press the button and the test mode is turn off, there is no sign „**TEST**" on the screen (when the test mode is activated in accordance with section 1.1 of this instruction);
- by circuit the „SERVICE" contacts for short time (when the test mode is activated in accordance with section 1.2 of this instruction);
- via the optical interface, using the software HEAT3-SERVICE and optical head in accordance with LST EN 62056-21 standard (when the test mode is activated in accordance with section 1.1 or 1.3 of this instruction);
- the meter switches to the operating mode by itself 12 hours after activation the test mode.

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