DANAK
PROD Reg. No. 7026

FORCE Certification

EU-Type Examination Certificate

Measuring Instrument Directive

Certificate number: DK-0200-MI004-031

Issued by FORCE Certification A/S, Denmark
EU-notified body number 0200

In accordance with The Danish Safety Technology Authority's statutory order no. 544 of May 28, 2018 which implements the Directive 2014/32/EU of the European Parliament and Council of February 26, 2014 on measuring instruments (MID).

Issued to: **Kamstrup A/S**
Industrivej 28, Stilling
DK-8660 Skanderborg

Type of instrument:	Heat Meter, complete meter
Type designation:	MULTICAL® 302 (type 302-T/C)
Valid until:	30-10-2023
Number of pages:	18, including appendix
Date of issue:	06-06-2019
Version No.:	15 This new version of DK-0200-MI004-031 is issued due to changes to the meter. All previous certificates are withdrawn.

Approved by

Michael Møller Nielsen
Certification Manager

Processed by

Lars Poder
Examiner

FORCE Certification references:
TASK no.: 119-28182.01 and ID no.: 0200-MID-06684

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DK-0200-MI004-031

Appendix to

EU-Type Examination Certificate
Measuring Instrument Directive

Number: DK-0200-MI004-031
Issued by FORCE Certification A/S, Denmark
EU-notified body number 0200

Version	Issue date	Changes
DK-0200-MI004-031	30-10-2013	Original certificate
DK-0200-MI004-031 rev 1	19-12-2013	New software version, new IP class, new pressure loss value
DK-0200-MI004-031 rev 2	14-01-2014	New software version
DK-0200-MI004-031 rev 3	15-05-2014	New software version
DK-0200-MI004-031 rev 4	07-07-2014	New hardware variant, new software revision, sealing changed
DK-0200-MI004-031 rev 5	24-09-2014	New software version, new M-Bus variant, new temperature sensor variant
DK-0200-MI004-031 rev 5.1	02-10-2014	Replacement certificate issued due to an error in the revision history in version 5
DK-0200-MI004-031 rev 6	26-05-2015	Material modification of measuring tubes, new measuring tube added
DK-0200-MI004-031 rev 7	26-02-2016	New meter type with θ_{hc} change-over function added
DK-0200-MI004-031 ver 8	19-05-2016	Language neutral type labels added, previous versions of this certificate withdrawn
DK-0200-MI004-031 ver 9	10-08-2017	Two new photos of alternative sealing methods added, minor editorial changes
DK-0200-MI004-031 ver 10	15-12-2017	Type test reference to EN 1434:2015, alternative test temperature for flow sensor, informative Annex added, minor editorial changes
DK-0200-MI004-031 ver 11	15-03-2018	New software version, non-condensing changed to condensing
DK-0200-MI004-031 ver 12	06-08-2018	New meter type 302-C added
DK-0200-MI004-031 ver 13	26-10-2018	New software version, added support for "RF On" and "RF Stop"
DK-0200-MI004-031 ver 14	26-11-2018	Replacement certificate issued due to an error in the DANAK logo on page 8 – 18 in version 13
DK-0200-MI004-031 ver 15	06-06-2019	New sealing example added, drawing in security measures updated

Applied standards and documents:
EN 1434:2015

The instruments/measuring systems shall correspond with the following specifications:

Type designation:
MULTICAL® 302 (type 302-T/C)

Description:
The meter consists of a calculator and a flow sensor, which make out a heat meter together with a Pt500 type approved temperature sensor pair. The electrical connection between the calculator and the flow sensor is a 120 cm long cable, and the units cannot be disassembled. The calculator unit has a display indicating registered thermal energy, and additionally via a push button, other values can be shown.

The calculator includes either wired or wireless M-Bus communication, or no communication. The volume measurement is made by means of bi-directional ultrasonic technique according to the transit time method. Through two ultrasonic transducers sound signals are sent both with and against the flow direction. The flow sensor consists of a meter body made of brass, in which the ultrasonic heads are placed. Above the meter body a two-parted plastic cabinet forms the calculator. The calculator cabinet has a rail for mounting of the calculator on the wall or on the meter body.

Technical documentation:
Reference no.:

- 119-28182.01
- 118-24299.03
- 118-24299.02
- 118-24299.01
- 117-31509.02
- 117-31509.01
- 114-33017.04.08.03
- 114-33017.04.08.02
- 114-33017.04.08.01
- 114-21535.0004.0021
- 114-21535.0004.0016
- 114-21535.0004.0015
- 114-21535.0004.0011
- 113-21029.0004.0010
- 113-21029.0004.0009

Technical data

Instrument type according to	: EN 1434:2015				
Instrument types	: Complete instrument or				
	: Hybrid instrument (A heat meter, which for the purpose of pattern approval and verification can be treated as a combined instrument. However, after verification, its sub-assemblies shall be treated as inseparable)				
Sub-assembly for the Hybrid instrument	: Calculator, flow sensor and temperature sensor pair : Flow sensor with optional built-in temperature sensor				
Energy indication	: GJ, kWh or MWh (Wh in calibration mode)				
Temperature range	: θ_{min} - θ_{max} : 2°C...150°C (or narrower range)				
Temperature diff. range	: $\Delta\Theta_{min}$ - $\Delta\Theta_{max}$: 3K...130K (or narrower range)				
Temperature sensors	: 2 paired Pt 500 sensors used as direct short (DS) sensors or installed in pockets type 6557302 Max. 1.5 m unshielded 2-wire cable				
Flow sensor, nominal sizes	: From q_p 0.6 m³/h, q_p 1.5 m³/h and q_p 2.5 m³/h				
Flow sensor, position	: Inlet or outlet pipe (programmable via push button)				
Flow meter cable (shielded)	: 1.2 m				
Temperature of medium, flow sensor	: θ_q 2°C...130°C (or narrower range), type 302-T θ_q 2°C...50°C (or narrower range), type 302-C				
Pressure stages	: PN16 and PN25				
Nominal volume flow rate	: q_p [m³/h]		0.6	1.5	2.5
Pressure loss, max. @ q_p	: Δp [bar]		0.02	0.09	0.09
Dynamic range, q_p 0.6 /1.5 /2.5 m³/h	: q_i:q_p	1:100			
	q_s:q_p	2:1			
Dynamic range, q_p 1.5 /2.5 m³/h	: q_i:q_p	1:250			
	q_s:q_p	2:1			
Accuracy class	: 2 and 3				
Environment class	: E1, M1 and M2				
Climatic class	: 5...55°C, Condensing, closed location				
Durability specification	: 10 years				
Protection class	: Flow sensor IP 68 : Calculator IP 65				
Power supply	: 3.65 VDC, 1x A-cell Lithium battery or 3.65 VDC, 2x A-cell Lithium battery				

Software identification

The software versions are related to the product type number. The product type number is written on the front of the meter.

Software versions for the following product type number ranges (where "x" means all combinations):

- 302-x-**00**-x-xx-xx-x-xx
- 302-x-**20**-x-xx-xx-x-xx
- 302-x-**21**-x-xx-xx-x-xx
- 302-x-**30**-x-xx-xx-x-xx

Version no.	Checksum for metrological part of the software
xxxx0301 / C1	57344
xxxx0302 / C2	21441
xxxx0401 / D1	5888
xxxx0501 / E1	22365
xxxx0601 / F1	31835
xxxx0701 / G1	5622
xxxx0801 / H1	23184
xxxx1001 / J1	48876

(xxxx is the meter type)

The SW version is shown under Index 2-11-08 in the display (See "TECH loop" in the Technical Description for MULTICAL® 302)

Software versions for the following product type number ranges (where "x" means all combinations):

- 302-x-**58**-x-xx-xx-x-xx

Version no.	Checksum for metrological part of the software
xxxx0301 / C1	32717
xxxx0401 / D1	44950

(xxxx is the meter type)

The SW version is shown under Index 2-11-08 in the display (See "TECH loop" in the Technical Description for MULTICAL® 302)

Type number combination

Type MULTICAL® 302			□	□□	□	□□	□□	□	□□
Sensor connection									
Pt500 Heat/Cooling meter			T						
Pt500 Heat/Cooling meter			C						
Communication									
No communication				00					
M-Bus (delivered with 1.5 m premounted cable)				20					
M-Bus (delivered with 2.0 m premounted cable)				21					
Wireless M-Bus, 868 MHz (configurable mode C1 or T1)				30					
Radio TC, 868 MHz				58					
Battery supply									
6 years battery life, Normal Response meter					1				
12 years battery life, Normal Response meter					2				
6 years battery life, Fast Response meter					3				
Temperature sensors									
Pt500, ø 5.2 mm temperature sensors with 1.5 m cable						Q9			
Pt500, ø 5.2 mm temperature sensors with 1.5 m cable and brass unions						QF			
Flow part q_p [m³/h]	Connection	Length [mm]							
0.6	G¾B (R½) DN 15	110					1Y		
1.5	G¾B (R½) DN 15	110					4Y		
1.5	G1B (R¾) DN 20	130					7Y		
2.5	G1B (R¾) DN 20	130					AY		
Meter type									
Heat meter	MID Module B+D	θ_{hc} = OFF						2	
Heat meter with cooling register	MID Module B+D	θ_{hc} = OFF						3	
Heat meter with cooling register	MID Module B+D	θ_{hc} = ON						6	
Country code									
Country code (language on label etc.)									XX

Y: Used e.g. dynamic range and accessories

Verification

Errors:	Maximum permissible errors according to Directive 2014/32/EU of the European Parliament and Council of February 26, 2014 on measuring instruments (MID), Annex VI
Procedure:	Test points and verification requirements according to EN 1434-5:2015
	Complete instrument according to: [3.] (6.7)
	Hybrid instrument according to: [7.1] (6.2), [7.2] (6.3), [7.3] (6.4), (6.5)
	[MID 2014/32/EU, Annex VI] (EN 1434-5:2015)

Test points

	Inlet	Outlet		Inlet	Outlet
	a) 44.3°C	41°C	or	a) 43°C	40°C
	b) 80°C	65°C		b) 50°C	40°C
	c) 147°C	20°C		c) 130°C	40°C

	Inlet	Outlet		Inlet	Outlet
or	a) 53°C	50°C	or	a) 43°C	40°C
	b) 70°C	50°C		b) 110°C	40°C
	c) 130°C	20°C		c) 130°C	40°C

During verification of the flow sensor a water temperature of 20 ± 5 °C can be used.

After verification, but before commissioning, the meter can be reprogrammed with a view to:

Placing of flow sensor in inlet pipe or outlet pipe, measuring unit of energy indication (kWh, MWh or GJ)* and decimal point in energy* and volume* indication*

Mounting the flow sensor in Inlet or in Outlet:

If the meter is set to be an inlet meter, the "Inlet arrow" is displayed.

If the meter is set to be an outlet meter, the "Outlet arrow" is displayed.

*) Register resolution requirements according to EN 1434-1:2015, point 6.3.7 must be observed.

Test description

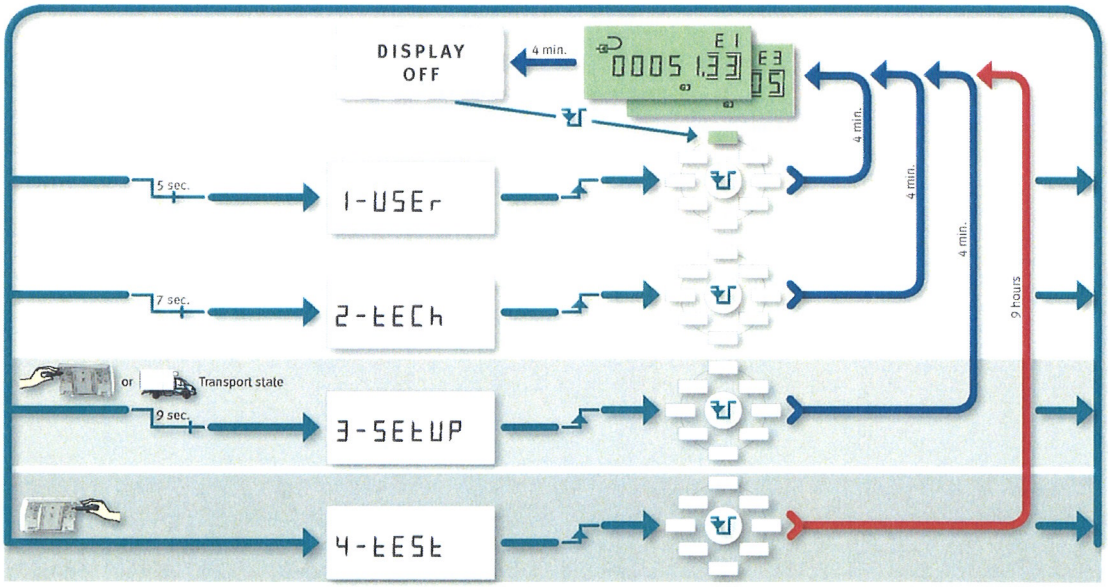
MULTICAL® 302 can be tested as a complete meter or as a hybrid meter determined by the available equipment.

The test as a complete meter can be carried out without disassembling the meter, except from the fact that the "TEST" seal must be broken (see "Test mode"). The high-resolution test registers can be read from the display, via serial data reading, or via high-resolution pulses.

Before test as a hybrid meter MULTICAL® 302 must be disassembled and the sensor pair must be soldered off. Subsequently, the calculator is tested separately by means of precision resistors and the meter's built-in "Auto-integration". Flow sensor and temperature sensors are tested separately too. During test of the flow sensor it is important that the temperature sensor, to be mounted in the flow sensor, is installed.

If "energy verification" with separate temperature baths is used, it is important that the medium in the flow sensor and the temperature bath, in which the temperature sensor mounted in the flow sensor is placed, have the same temperature.

By means of the push-button on the front of the meter you can choose between four display loops. No matter which display you have selected you can change to User-loop by pressing the push-button for 5 sec. until "1-User" is displayed and then releasing the button. If the button is pressed for 7 sec. instead, "2-Tech" is displayed, and if you release the push-button now, you have access to Tech loop.



Front key:

9 sec. = Press and hold the specified number of seconds

= Activated on release

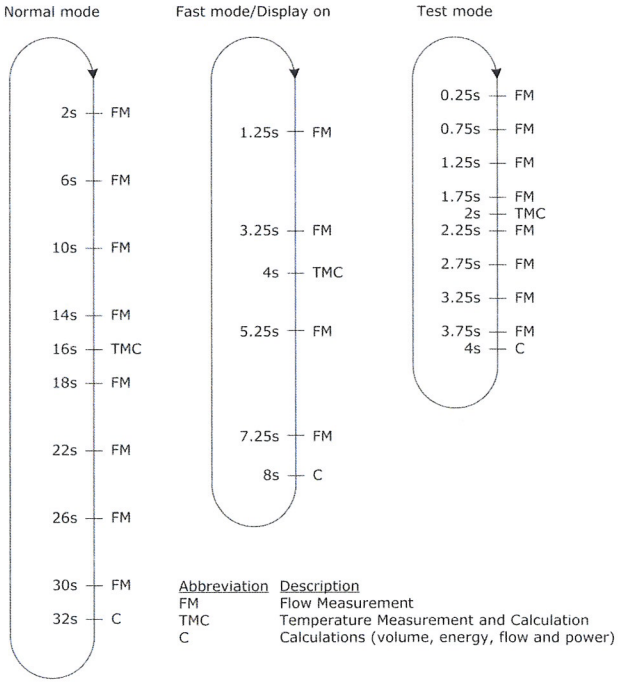
= Activated on click

In order to obtain quick test/verification of MULTICAL® 302, the meter has a test mode which repeats the measuring sequence every four seconds, i.e. eight times faster than in normal mode or twice as fast as in fast mode. In test mode heat energy, cooling energy and volume are displayed with a resolution which is higher than normal in order to enable a shorter test duration.

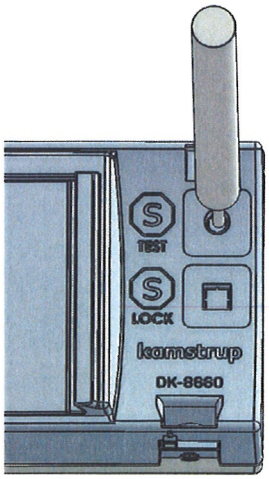
MULTICAL® 302 uses more current in test mode, but under normal circumstances where the meter is in test mode a few times during its lifetime, this is without importance for the meter's battery lifetime.

Meter modes

The meter can operate in three different modes: "Normal", "Fast" and "Test" mode, as shown to the right . The choice between normal and fast mode must be made when ordering the meter and this choice cannot be changed subsequently. No matter whether the meter is supplied with normal mode or fast mode, test mode (see "Test mode") can be selected.

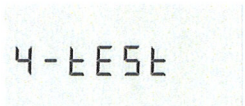


Test mode



In order to access test mode the "TEST" seal Ⓢ on the back of the meter must be carefully broken with a screwdriver and the contact points behind the seal short-circuited with a short-circuit pen or a screwdriver.

Subsequently, test is displayed.



The meter remains in test mode until the front button is activated for 5 sec. However, a time-out secures that the meter returns from test mode to normal mode after 9 hours.
When tests are finished the seal must be re-established using a void label size 15 x 15 mm. The seal is important with a view to the meter's approval and to maintain its protection class.

Test loop

Test loop includes six different main readings and three different sub-readings:

Test loop (Loop_4) Main		Test loop (Loop_4) Sub			Index number in display
1.0	High-resolution heat energy *)				4-01
		1.1	Heat energy (E1)		4-01-01
2.0	High-resolution cooling energy *)				4-02
		2.1	Cooling energy (E3)		4-02-01
3.0	High-resolution volume *)				4-03
		3.1	Volume		4-03-01
4.0	T1 (Inlet)				4-04
5.0	T2 (Outlet)				4-05
6.0	Flow				4-06

After 9 hours the meter reverts to energy reading in "User loop".

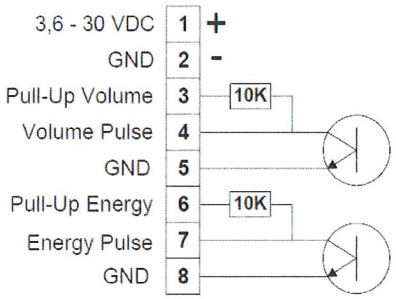
*) Register/resolution of the high-resolution registers are as follows: "0000001 Wh" and "00000.01 l"

Test-loop can only be displayed if the verification seal is broken and the switch activated. The high-resolution registers can only be reset in connection with a total reset.

Test connection

During test either optical reading head with USB plug (66-99-099) for serial reading of high-resolution energy and volume registers, or Pulse Interface (66-99-143) with optical reading head and connection unit for high-resolution pulse outputs is used. Do not forget that the meter must be in Test mode.

Verification pulses



When Pulse Interface type 66-99-143 is connected to power supply or battery, the unit is placed on the meter, and the meter is in test mode, the following pulses are transmitted:

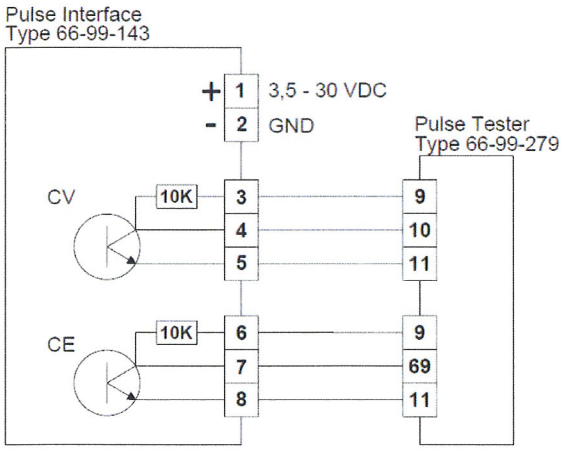
- High-resolution energy pulses (1 Wh/pulse) on terminals 7 and 8
- High-resolution volume pulses (10 ml/pulse) on terminals 4 and 5

Pulse Interface 66-99-143, technical data

Supply voltage	3.6 – 30 VDC
Current consumption	< 15 mA
Pulse outputs	< 30 VDC < 15 mA
Pulse duration	3.9 ms.
Energy pulse	1 Wh/pulse (1000 pulses/kWh)
Volume pulse	10 ml/pulse (100 pulses/litre)

Use of high-resolution pulses

High-resolution energy and volume pulses can be connected to the test stand used for calibration of the meter, or to Kamstrup's Pulse Tester, type 66-99-279, as shown in the drawing below.



Auto-integration

The purpose of auto-integration is to test the calculator's accuracy. During auto-integration the water flow through the meter must be cut off to make it possible to read the volume and energy counted during auto-integration without the meter continuing normal counting in the registers afterwards.

At the beginning of an auto-integration the meter receives a serial data command with test volume and number of integrations over which the meter is to distribute the volume.

In MULTICAL® 302 the high-resolution test registers cannot be separately reset, so the test must be based on the increase in the high-resolution registers during test.
After auto-integration all volume and energy registers – incl. the high-resolution test registers – have been enumerated by the given volume and the calculated energies. Furthermore, the average of the temperatures measured during auto-integration has been saved in two registers, "T1 average inlet temperature" and "T2 average outlet temperature".

For calculation of accuracy the below-mentioned registers can be read after auto-integration:

Verification registers		RID
Heat energy	E1HighRes	266
Cooling energy	E3HighRes	267
Volume	V1HighRes	239
T1 average inlet temperature	T1average_AutoInt	229
T2 average outlet temperature	T2average_AutoInt	230

Handling different test methods

Standing start/stop
Standing start/stop is a method used for testing the flow sensor's accuracy. During the test the meter must be mounted in a flow test stand. The flow through the sensor is cut off. Subsequently, water flow is added for a certain period, during which the water passing through the sensor is collected. Having switched off the flow the volume of the collected water is compared to the volume counted by the meter. In general, standing start/stop requires bigger test volume than flying start/stop.

Standing start/stop via display reading
Condition: MULTICAL® 302 must be in test mode (see "Test mode").
The high-resolution display readings are updated at 4-second intervals.

Standing start/stop using pulse outputs
Condition: MULTICAL® 302 must be in test mode (see "Test mode").
Verification pulses are connected as described in "Verification pulses" above.

Flying start/stop
Condition: MULTICAL® 302 must be in test mode (see "Test mode").
Verification pulses are connected as described in "Verification pulses" above.

"Flying start/stop" is the most frequently used method for testing the accuracy of flow sensors. During the test the meter must be mounted in a flow test stand and there is constant water flow through the sensor.

Verification pulses, as described in "Verification pulses", can be directly used for the test stand if it is designed to control the start/stop synchronization. Alternatively, Pulse Tester, type 66-99-279, can be used as external start/stop pulse counter.

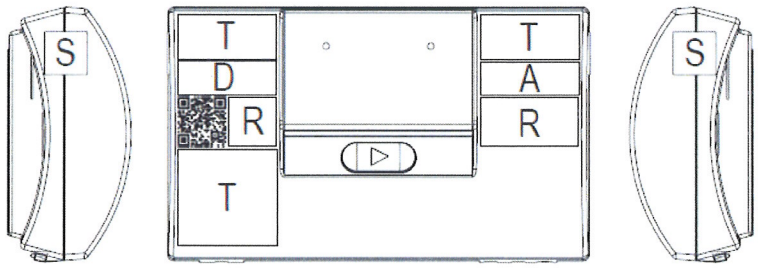
As the meter calculates volume and energy every four seconds in test mode (see "Test mode"), the verification pulses will also be updated every four seconds as described in "Verification pulses".

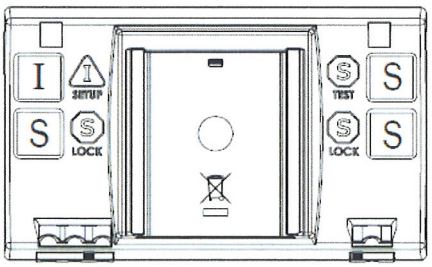
It is important to allow for this time interval, which means that the test duration from start to stop must be so long that the update time does not influence the measuring uncertainty to any very considerable extent.

Security measures

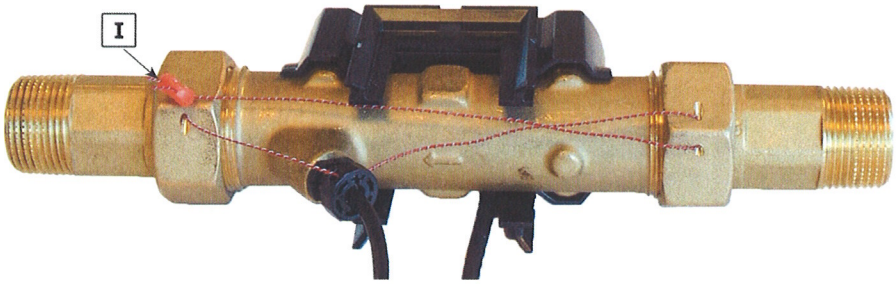
Sealing

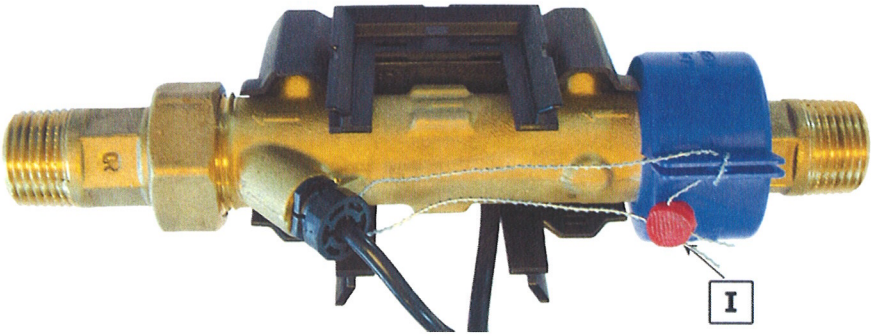
S	Security seals. "LOCK" = Covering release for PCB box (Label or integrated part of PCB box)
D	Module D marking (Part of type label/engraving or separate label)
T	Type label
I	Installation seals (Seal, Label or integrated part of PCB box)
R	Re-verification marking

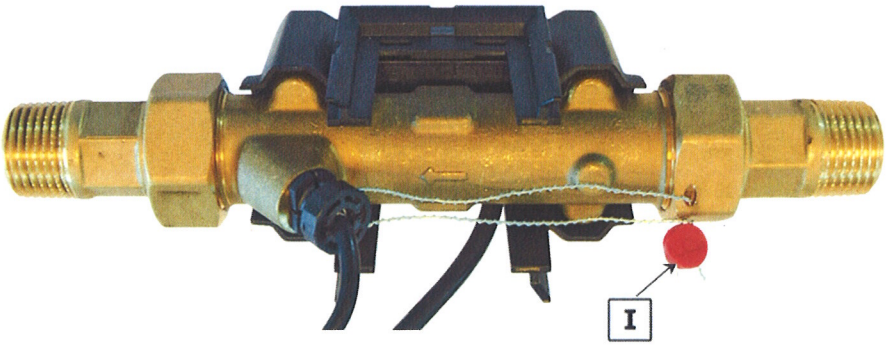


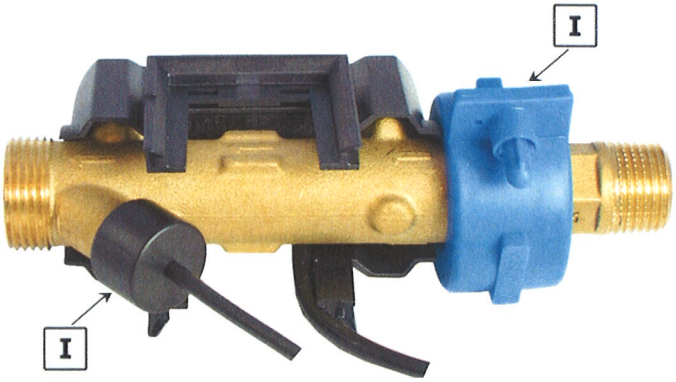


Sealing examples









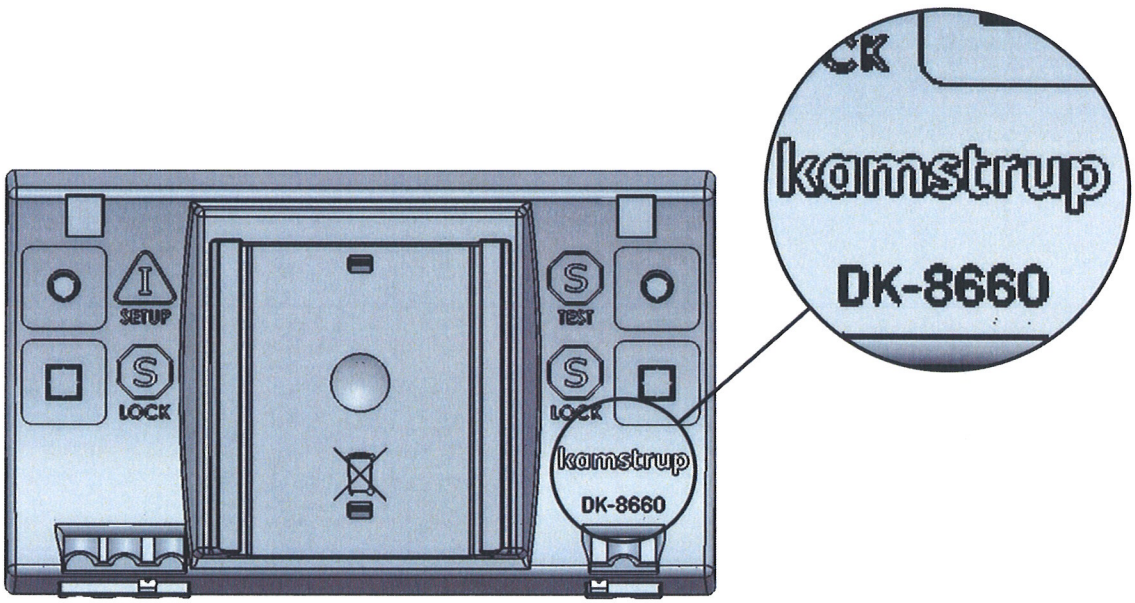
Inscriptions

Front cover for MULTICAL® 302

System designation
Type, production year and serial number
Mechanical and electromagnetic environment classes
Temperature limits (θ_{min} - θ_{max})
Differential temperature limits ($\Delta\Theta_{min}$ - $\Delta\Theta_{max}$)
Temperature sensor type (Pt500)

Rear cover for MULTICAL® 302

Manufacturer postal address

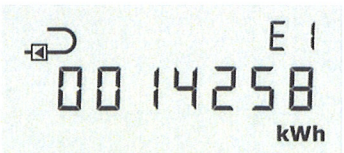


Additional info in the display

Unit of measurement
Software version

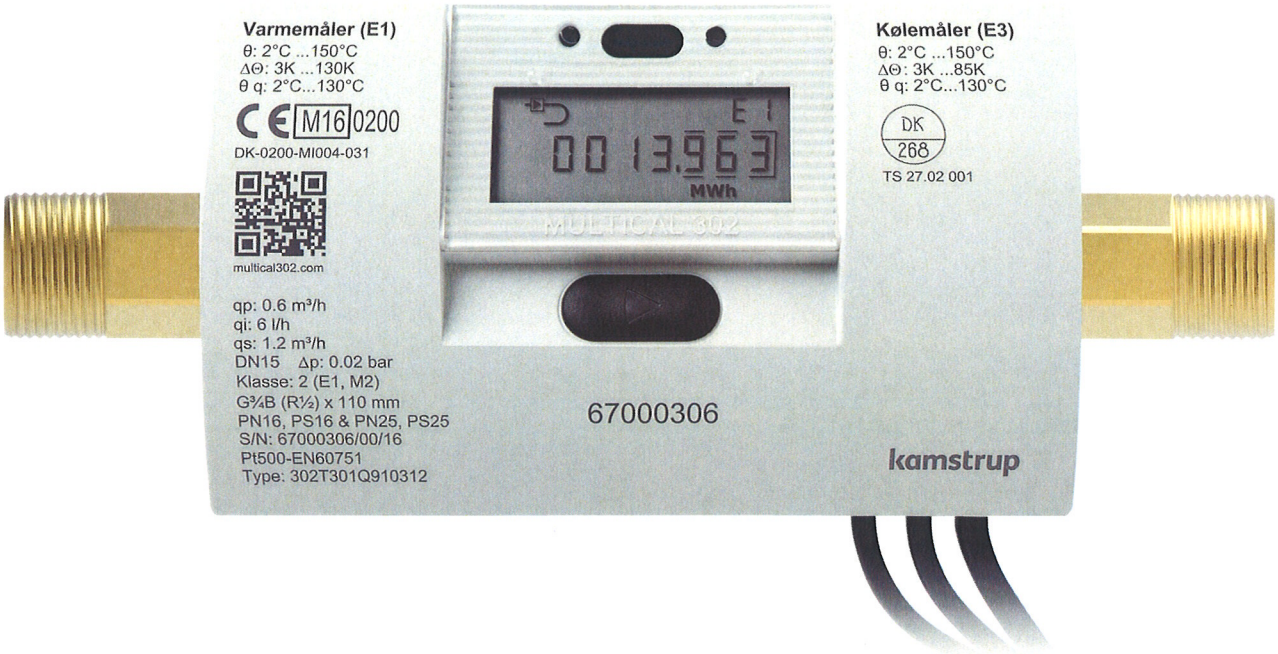
Mounting the flow sensor in Inlet or in Outlet:

If the meter is set to be an inlet meter, the "Inlet arrow" is displayed.

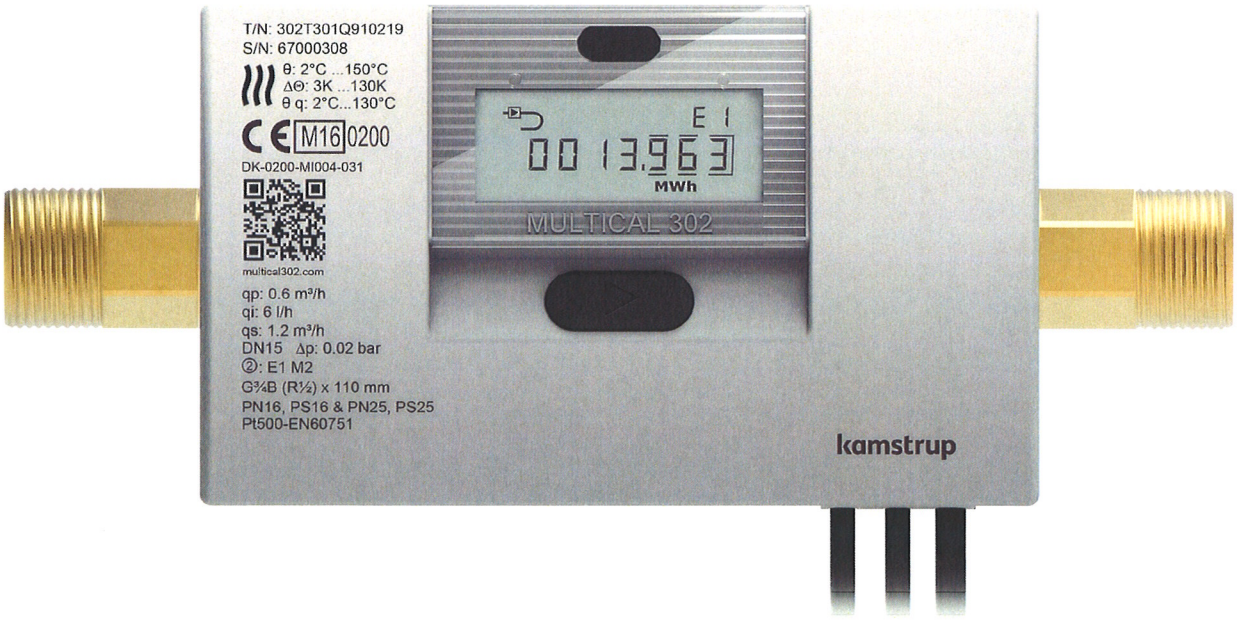


If the meter is set to be an outlet meter, the "Outlet arrow" is displayed.

Example of inscriptions for MULTICAL® 302



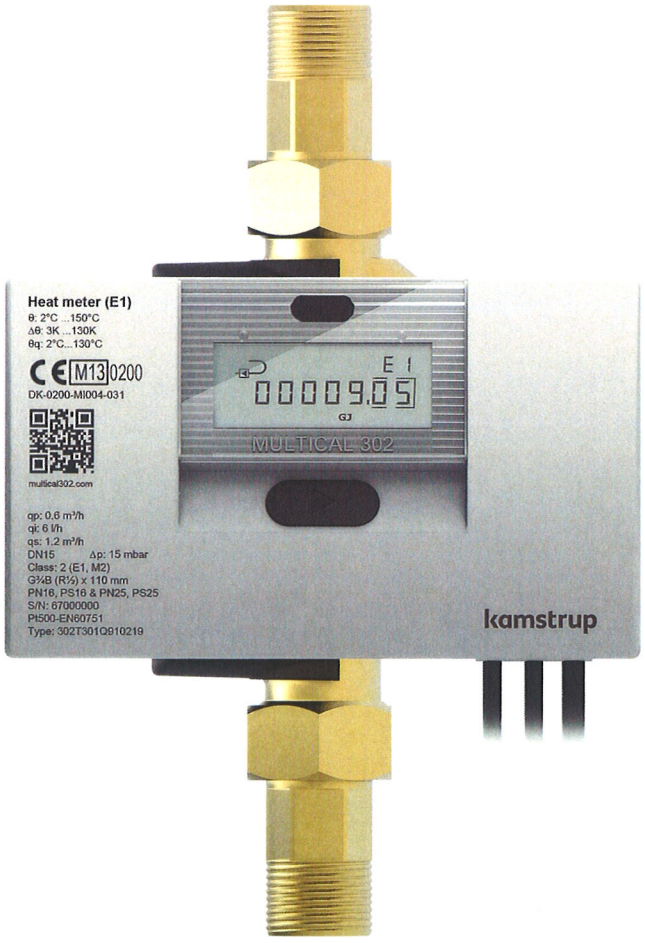
Heat meter, Inlet or Outlet (Traditional text, individual for each country)



Heat meter, Inlet or Outlet (Language neutral version)

Symbols, as an alternative to textual inscriptions, are acceptable if explained in the manual that accompanies the instrument.

Photos of MULTICAL® 302



Informative Annex

Integrated functions not subject to the Measuring Instruments Directive:

Integrated bi-functional Heat/Cooling function

The MULTICAL® 302 is type tested as Heating, Cooling and as bi-functional Heating/Cooling energy meters according to EN 1434-4:2015.

On this basis the energy meter is national type approved for Cooling according to the Danish law[1], System designation TS 27.02 001.

The integrated bi-functional Heating/Cooling function can therefore be utilized under the operating conditions as described in this certificate.

The meter is type tested in the temperature differential range $\Delta\Theta_{min}$ - $\Delta\Theta_{max}$: 2 K...130 K and can be used as so.

Re-verification

Re-verification of the calculator as a heat meter or as a cooling meter is allowed, due to the extended type test.

During re-verification of the flow sensor a water temperature of 20 ± 5 °C can be used.

[1] BEK No. 1178 of 06/11/2014, Ordinance on metrological control of meters used for measuring consumption of cooling energy in district cooling systems and central cooling systems as amended by BEK. No. 549 of 01/06/2016.