BS EN 1434-1:2015

BSI Standards Publication

Heat meters

Part 1: General requirements

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National foreword

This British Standard is the UK implementation of EN 1434-1:2015. It supersedes BS EN 1434-1:2007 which is withdrawn.

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European foreword

This document (EN 1434-1:2015) has been prepared by Technical Committee CEN/TC 176 “Heat meters”, the secretariat of which is held by SIS.

This European Standard shall be given the status of a national standard, either by publication of an identical text or by endorsement, at the latest by May 2016, and conflicting national standards shall be withdrawn at the latest by May 2016.

Attention is drawn to the possibility that some of the elements of this document may be the subject of patent rights. CEN [and/or CENELEC] shall not be held responsible for identifying any or all such patent rights.

This document supersedes EN 1434-1:2007.

This document has been prepared under a mandate given to CEN by the European Commission and the European Free Trade Association, and supports essential requirements of EU Directive.

For relationship with EU Directive, see informative Annex ZA, which is an integral part of this document.

EN 1434, *Heat meters* consists of the following parts:

— *Part 1: General requirements*

— *Part 2: Constructional requirements*

— *Part 3: Data exchange and interfaces*[1)]

— *Part 4: Pattern approval tests*

— *Part 5: Initial verification tests*

— *Part 6: Installation, commissioning, operational monitoring and maintenance*

In comparison to EN 1434-1:2007, the following changes have been made:

— special cases for combined cooling and heating meters are added;

— additional functionality for smart metering applications are added;

— metrological requirements for smart metering applications are added;

— definitions and requirements for the cooling meter are added;

— tariff meters are added;

— terms and definitions, requirements for registration devices and cooling meters are added;

— requirements for fast response meters are added (informative Annex C).

[1)] EN 1434-3 is maintained by CEN/TC 294.

According to the CEN/CENELEC Internal Regulations, the national standards organizations of the following countries are bound to implement this European Standard: Austria, Belgium, Bulgaria, Croatia, Cyprus, Czech Republic, Denmark, Estonia, Finland, Former Yugoslav Republic of Macedonia, France, Germany, Greece, Hungary, Iceland, Ireland, Italy, Latvia, Lithuania, Luxembourg, Malta, Netherlands, Norway, Poland, Portugal, Romania, Slovakia, Slovenia, Spain, Sweden, Switzerland, Turkey and the United Kingdom.

1 Scope

This European Standard specifies the general requirements for heat meters. Heat meters are instruments intended for measuring the energy which in a heat-exchange circuit is absorbed (cooling) or given up (heating) by a liquid called the heat-conveying liquid. The heat meter indicates the quantity of heat in legal units.

Electrical safety requirements are not covered by this European Standard.

Pressure safety requirements are not covered by this European Standard.

Surface mounted temperature sensors are not covered by this European Standard.

This standard covers meters for closed systems only, where the differential pressure over the thermal load is limited.

2 Normative references

The following documents, in whole or in part, are normatively referenced in this document and are indispensable for its application. For dated references, only the edition cited applies. For undated references, the latest edition of the referenced document (including any amendments) applies.

EN 1434-2:2015, *Heat meters — Part 2: Constructional requirements*

EN 1434-4:2015, *Heat meters — Part 4: Pattern approval test*

EN 60751, *Industrial platinum resistance thermometers and platinum temperature sensors (IEC 60751)*

EN 61010-1, *Safety requirements for electrical equipment for measurement, control and laboratory use — Part 1: General requirements (IEC 61010-1)*

3 Terms and definitions

For the purposes of this document, the following terms and definitions apply.

3.1
response time
$\tau_{0,5}$
time interval between the instant when flow or temperature difference is subjected to a specified abrupt change and the instant when the response reaches 50 % of the step value

3.2
fast response meter
meter suitable for heat exchanging circuits with rapid dynamic variations in the exchanged heat

Note 1 to entry: See also Annex C.

3.3
rated voltage
U_n
voltage of the external power supply required to operate the heat meter, conventionally the voltage of the AC mains supply

3.4
rated operating conditions
conditions of use, giving the range of values of influence quantities, for which the metrological characteristics of the instrument are within the specified maximum permissible errors

3.5
reference conditions
set of specified values of influence factors, fixed to ensure valid inter-comparison of results of measurements

3.6
influence quantity
quantity, which is not the subject of the measurement, but which influences the value of the measurement and or the indication of the measuring instrument

3.7
influence factors
influence quantity having a value within the rated operating conditions

3.8
disturbance
influence quantity having a value outside the rated operating conditions

3.9
Types of errors
3.9.1
error (of indication)
indication of the measuring instrument minus the conventional true value of the measurand

3.9.2
intrinsic error
error of a measuring instrument determined under reference conditions

3.9.3
initial intrinsic error
error of a measuring instrument as determined once prior to performance tests and durability tests

3.9.4
durability error
difference between the intrinsic error after a period of use and the initial intrinsic error

3.9.5
maximum permissible error
MPE
highest values of the error (positive or negative) permitted

3.10
Types of faults
3.10.1
fault
difference between the error of indication and the intrinsic error of the instrument

3.10.2
transitory fault
momentary variations in the indication, which cannot be interpreted, memorized or transmitted as measurements

3.10.3
significant fault
fault greater than the absolute value of the MPE and not being a transitory fault

Note 1 to entry: If the MPE is ± 2 % then the significant fault is a fault larger than ± 2 %.

3.11
reference values of the measurand
RVM
specified value of the flow rate, the outlet temperature and the temperature difference, fixed to ensure valid intercomparison of the results of measurements

3.12
conventional true value
quantity value attributed by agreement to a quantity for a given purpose

Note 1 to entry: A conventional true value is, in general, regarded as sufficiently close to the true value for the difference to be insignificant for the given purpose.

EXAMPLE A true value is the heat coefficient according to Annex A.

3.13
meter model
different sizes of heat meters or sub-assemblies having a family similarity in the principles of operation, construction and materials

3.14
electronic device
device employing electronic elements and performing a specific function

3.15
electronic element
smallest physical entity in an electronic device which uses electron hole conduction in semi-conductors, or electron conduction in gases or in a vacuum

3.16
qualifying immersion depth of a temperature sensor
immersion depth over which the sensor measures with an accurate temperature value

Note 1 to entry: The conditions to define the qualified immersion depth are written in EN 1434-4:2015, 7.4.4.1.

3.17
self-heating effect
increase in temperature signal that is obtained by subjecting each temperature sensor of a pair to a continuous power dissipation of 5 mW when immersed to the qualifying immersion depth in a water bath, having a mean water velocity of 0,1 m/s

3.18
heat meter
instrument intended for measuring the energy which in a heat-exchange circuit is absorbed (cooling) or given up (heating) by a liquid called the heat-conveying liquid

3.19
meters other than for heating
3.19.1
cooling meter
heat meter designed for cooling applications at low temperatures, normally covering the temperature range 2 °C to 30 °C and $\Delta\Theta$ up to 20 K

3.19.2
bifunctional meters for change-over systems between heating and cooling
instrument measuring heating and cooling energy in two separate registers

Note 1 to entry: In other directives and requirements, bifunctional meters are called combined meters.

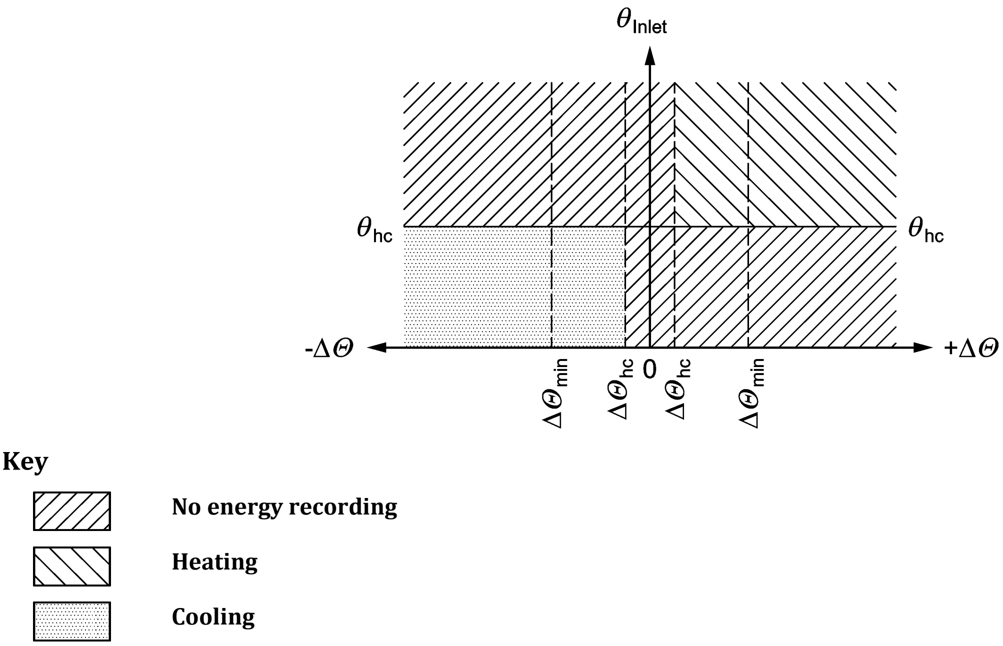


Figure 1 — Example for function of heating and cooling register

3.20
flow direction
direction of the liquid going through the system from inlet to outlet

Note 1 to entry: The inlet is for the heating case the hot side and for the cooling case the cold side.

Note 2 to entry: In the literature the word “flow” is also being used for “inlet”, and the word “return” is also being used for “outlet”.

Note 3 to entry: Different temperature values for θ_{hc} for heating and cooling applications may also occur.

3.21
electrical pulse
electrical signal (voltage, current or change in resistance), that departs from an initial level for a limited duration of time and ultimately returns to the original level

3.22
pulse output and input devices

3.22.1
pulse output device
functional part of flow sensor, calculator or auxiliary devices

EXAMPLE Remote displays or input devices of control systems.

3.22.2
pulse input device
functional part of flow sensor, calculator or auxiliary devices

EXAMPLE Remote displays or input devices of control systems.

3.23
maximum admissible temperature
maximum temperature of the heat conveying liquid the meter can withstand in combination with the maximum admissible working pressure and the permanent flow rate for short periods of time (< 1 h / day; < 200 h / year) without a significant fault after the exposure to this maximum admissible temperature

3.24
durability
characteristic of a measuring instrument to keep the metrological characteristics over time (e.g. to fulfil the double of MPE), provided that it is properly installed, maintained and used within the permissible environmental conditions

3.25
long life flow sensor
flow sensor designed to have a longer lifetime than a normal flow sensor, which typically has a durability of 5 years under the specified operating conditions

3.26
user interface
interface forming part of the instrument that enables information to be passed between a human user and the measuring instrument or its components (e.g. display)

3.27
communication interface
electronic, optical, radio or other technical interface that enables information via correct transceiving of at least thermal energy to be passed between measuring instruments, sub-assemblies or external devices

3.28
meter for smart metering
heat meter or cooling meter with the capability of data communication and support of smart metering functionalities

Note 1 to entry: Data could be transmitted via user interface and/ or communication interface in fixed time intervals and/or on request.

Note 2 to entry: For more information on smart meters, see standard series EN 13757 and CEN/CLC/ETSI/TR 50572.

3.29
registration device
an optional additional device fitted to the meter as an integral part or separate device, in order to register the amount of thermal energy accumulated in additional registers during periods, depending on conditions, e. g. flow rate, inlet or outlet temperatures, temperature differences or time points

3.30
register
component of a registration device which contains accumulated or actual values e. g. thermal energy, volume, maximum flow rate, power or temperature

3.31
interval register
register which contains frequently accumulated or copied values used for registration of billing purposes and/ or for controlling processes

Note 1 to entry: During consecutive time intervals values could be achieved by copying from an accumulating main register which contains actual values of e.g. thermal energy or volume.

Note 2 to entry: During consecutive time intervals the measured process values of flow rate and/or temperature could be additionally stored.

3.32
maximum flow
highest rate of flow which is expected at operating conditions

Note 1 to entry: For the limits of flow rates, see 5.3.

4 Types of instruments

4.1 General

For the purposes of this European Standard, heat meters are defined either as complete instruments or as combined instruments.

4.2 Complete instrument

A heat meter, which does not have separable sub-assemblies as defined in 4.5.

4.3 Combined instrument

A heat meter, which has separable sub-assemblies as defined in 4.5.

4.4 Hybrid instrument

A heat meter, which for the purpose of pattern approval and verification can be treated as a combined instrument as defined in 4.3 or combinations between sub-assemblies. However, after verification, its sub-assemblies shall be treated as inseparable.

NOTE Hybrid instruments are often called “compact instruments”.

4.5 Sub-assemblies of a heat meter, which is a combined instrument

4.5.1 General

The flow sensor, the temperature sensor pair and the calculator or a combination of these.

4.5.2 Flow sensor

A sub-assembly through which the heat-conveying liquid flows, at either the inlet or outlet of a heat-exchange circuit, and which emits a signal, which is a function of the volume or the mass or the volumetric or mass flow rate.

4.5.3 Temperature sensor pair

A sub-assembly (for mounting with or without pockets), which senses the temperatures of the heat-conveying liquid at the inlet and outlet of a heat-exchange circuit.

4.5.4 Calculator

A sub-assembly, which receives signals from the flow sensor, and the temperature sensors and calculates and indicates the quantity of heat exchanged.

4.6 Equipment under test (EUT)

A sub-assembly, a combined sub-assembly or a complete meter subject to a test.

5 Rated operating conditions

5.1 Limits of temperature range

5.1.1 The upper limit of the temperature range, θ_{max}, is the highest temperature of the heat conveying liquid, at which the heat meter shall function without the maximum permissible errors being exceeded.

5.1.2 The lower limit of the temperature range, θ_{min}, is the lowest temperature of the heat-conveying liquid, at which the heat meter shall function without the maximum permissible errors being exceeded.

5.1.3 The optional switching over temperature, θ_{hc}, is for switching over between heating and cooling in bifunctional meters.

5.2 Limits of temperature differences

5.2.1 The temperature difference, $\Delta\Theta$, is the absolute value of the difference between the temperatures of the heat-conveying liquid at the inlet and outlet of the heat-exchange circuit.

5.2.2 The upper limit of the temperature difference, $\Delta\Theta_{max}$, is the highest temperature difference, at which the heat meter shall function within the upper limit of thermal power, without the maximum permissible errors being exceeded.

5.2.3 The lower limit of the temperature difference, $\Delta\Theta_{min}$, is the lowest temperature difference, above which the heat meter shall function, without the maximum permissible errors being exceeded.

5.2.4 The value $\Delta\Theta_{hc}$ for switching over between heating and cooling energy and reversed is the threshold in bifunctional meters for change-over systems between heating and cooling.

5.3 Limits of flow rate

5.3.1 The upper limit of the flow rate, q_s, is the highest flow rate, at which the heat meter shall function for short periods (<1 h / day; < 200 h / year), without the maximum permissible errors being exceeded.

5.3.2 The permanent flow rate, q_p, is the highest flow rate, at which the heat meter shall function continuously without the maximum permissible errors being exceeded.

5.3.3 The lower limit of the flow rate, q_i, is the lowest flow rate, above which the heat meter shall function without the maximum permissible errors being exceeded.

5.4 Limit of thermal power

The upper limit of the thermal power is the highest power at which the heat meter shall function without the maximum permissible errors being exceeded.

5.5 Limits of working pressure (PS and P_{min})

PS is the maximum positive internal pressure that the heat meter can withstand permanently at the upper limit of the temperature range, expressed in bar. P_{min} is the lowest pressure permitted in order to avoid deterioration of its metrological performance, e.g. cavitation.

NOTE P_{min} is depending on flow rate and temperature.

5.6 Nominal pressure (PN)

A numerical designation, which is a convenient rounded number for reference purposes.

All equipment of the same nominal size (DN) designated by the same PN number shall have compatible mating dimensions.

5.7 Limits in ambient temperature

The ambient temperature range in which the heat meter shall function without the maximum permissible errors being exceeded.

5.8 Limits in deviations in supply voltage

The supply voltage range in which the heat meter shall function without the maximum permissible errors being exceeded.

5.9 Maximum pressure loss

The loss of pressure in the heat conveying liquid passing through the flow sensor, when the flow sensor is operating at the permanent flow rate q_p.

5.10 Specific requirements on registration devices

5.10.1 General

A registration device is an additional functionality of smart meters outside of the requirements of the MID. For a registration device, the essential requirements for meters shall apply, if applicable. In addition, the requirements 5.10.2 to 5.10.5 shall apply.

5.10.2 Suitability

a) The registration device shall register energy in different registers activated by:

   1) signals of an internal time switch;

   2) signals of an internal quantity dependent threshold indication;

   3) remote control signals at peripheral interface terminals; and/or

   4) signal of an result or measurement or an internal register.

b) A registration device shall be designed to provide:

1) one or several non-resettable registers counting, e.g. the thermal energy and volume after activation, starting with the value registered at the last deactivation; and/or

2) a set of interval registers for controlling processes.

c) A registration device shall be able to provide the time and date at which an interval value and/ or the related error status have been registered.

d) The number of interval registers shall be sufficient to cover sufficient time intervals. If a new interval value is memorized, the oldest value shall be deleted.

e) Thermal power shall be determined on basis of discrete interval values. Peak values shall be determined for separate periods, e.g. as a day, or a week, or a month or a year and stored in particular registers.

f) In addition to the interval values, a registration device can determine and register average values of quantities, if measured by the meter.

5.10.3 Rated operated conditions

Taking into account the internal resolution of the thermal energy meter and the properties of the used interface, the manufacturer shall specify the rated operating conditions, in particular the minimum length of measuring intervals, in order to avoid inadmissible errors for the intended measurement task.

5.10.4 Indication

The registration device shall provide on a legally controlled display

— the information which register(s) is (are) currently activated;

— the information which register(s) is (are) intended for billing purposes;

— values of registers and / or interval registers;

— the unit of values, which are assigned to the displayed values;

and, if applicable

— information identifying the direction of thermal energy flow belonging to the values for delivered and absorbed energy;

— date and time;

— lifetime of internal battery supply;

— list of registers and their definitions;

— the threshold values used for activating registers; and

— parameters and information important for the correct working of the registration device and the inability of changing legally parameters in use.

The description of the main identifiers shall be on the nameplate or in the documentation accompanying the instrument.

The registration device itself or an appropriate associated software for use by the consumer shall allow to verify the correct assignment of single interval values or sums of interval values to rates (like the maximum consumption or the sum of consumption during daily periods), if such processed values serve as basis for the price to pay.

And if applicable other registers can also be displayed.

5.10.5 MPE

5.10.5.1 Clock

If applicable for the instrument:

For frequent time based tariff switches between registers (e.g. for day and night tariff) within a billing period, the deviation from legal time shall be one of the following three options.

Option 1: deviation less than 1 h/year

Option 2: deviation less than 6 min from legal time

Option 3: deviation less than 7 s from legal time

NOTE The above chosen maximum time deviations are derived from the physical inertia (thermal capacity to be heated or cooled) of the heat conveying liquid, within the heat and cooling circuits.

For periodic interval registers for a billing period (e.g. hourly, daily, weekly or monthly registers), the time deviation shall not be more than 1 % of the length of this period. In this case the deviation of the internal clock from legal time is the accumulated deviation of all measurement periods.

5.10.5.2 MPE of tolerance quantities used for threshold activation of additional energy accumulations

1,0 K	for temperature measurement in case of a complete meter (calculator with single temperature sensor); up to 100 °C
0,7 K	for temperature measurement in case of a combined meter (single temperature sensor); up to 100 °C

NOTE In applications of smart metering, one or both single sensors of the pair are used as additional single sensor. In case of Platinum (Pt) sensors, according to EN 60751, at least class B with 4 wire connections is recommended.

6 Technical characteristics

6.1 Materials and construction

6.1.1 All the constituent elements of heat meters shall be solidly constructed of materials having appropriate qualities to resist the various forms of corrosion and wear which occur under rated operating conditions, especially those due to impurities in the heat conveying liquid. Correctly installed meters shall also be able to withstand normal external influences. Meters shall, in all circumstances, withstand the maximum admissible pressure and the temperatures for which they are designed, without malfunction.

6.1.2 The manufacturer of the heat meter shall declare any limitations with regard to installation of the heat meter and its orientation, with respect to the vertical.

6.1.3 The casing of a heat meter shall protect the interior parts against water and dust ingress. The minimum forms of enclosure protection shall be IP54 for heating applications and IP65 for cooling applications for equipment that is to be installed into pipe work and IP52 for other enclosures, all in accordance with EN 61010-1.

6.1.4 Heat meters may be fitted with interfaces allowing the connection of supplementary devices. Such connections shall not modify the metrological qualities of the heat meter.

6.1.5 The maximum pressure loss at q_p shall not exceed 0,25 bar.

6.2 Requirements outside the limiting values of the flow rate

When the true value of the flow rate is less than a threshold value declared by the manufacturer, no registration is allowed.

The flow rate through a "nominally" closed valve or the movement of liquid in the pipe behind a closed valve caused by thermal expansion and contraction should not be recorded.

For flow rates greater than q_s, the behaviour of the meter, e.g. by producing spurious or zero signals shall be declared by the manufacturer. Flow rates greater than q_s until declared maximum flow shall not result in an error greater than 10 % of the actual flow rate.

6.3 Display

6.3.1 The quantity of heat shall be indicated in Joules, Watt-hours or in decimal multiples of those units. The name or symbol of the unit, in which the quantity of heat is given, shall be indicated adjacent to the figures of the display.

6.3.2 Heat meters shall be designed that in the event of a failure or interruption of the external power supply (mains or external DC) the meter indication of energy remains accessible for a minimum of one year (totally). The manufacturer shall specify how the indication of energy is handled in case of a failure or interruption in the external power supply (mains or external DC).

NOTE The energy indication can either be stored in a permanent way (memory) at certain intervals, or it can be stored through a controlled shut-down process (powered from an internal source).

6.3.3 The reading of the indication shall be sure, easy and unambiguous.

6.3.4 The real or apparent height of the figures on the display for energy shall not be less than 4 mm.

6.3.5 The figures indicating decimal fractions of a unit shall be separated from the others, either by a comma or by a point. In addition, the figures indicating decimal fractions of energy shall be clearly distinguishable from the others.

6.3.6 Where the display is of the roller-type, the advance of a figure of a particular significance shall be completed during the time, when the figure of next lower significance changes from 9 to 0. The roller carrying the figures of lowest significance may have a continuous movement, of which the visible displacement shall then be from bottom to top.

6.3.7 The display indicating the quantity of heat shall be able to register, without overflow, a quantity of heat at least equal to the transfer of energy, which corresponds to a continuous operation for 3 000 h at the upper limit of the thermal power of the heat meter.

The quantity of heat, measured by a heat meter, operating at the upper limit of the thermal power for 1 h shall correspond to at least one digit of lowest significance of the display.

6.4 Protection against fraud

Heat meters shall have protective devices which can be sealed in such a way, that after sealing, both before and after the heat meter has been correctly installed, there is no possibility of dismantling, removing, or altering the heat meter or its adjustment devices without evident damage to the device(s) or seal(s).

Means shall also be provided for meters with external power supply, either to give protection against the meter being disconnected from the power supply, or to make it evident, that this has taken place. This requirement does not apply to meters with external power supply with automatic switchover to internal battery supply.

NOTE Embodiment of an hour's run counter in the meter casing will make it evident if the power supply has been disconnected.

6.5 Supply voltage

6.5.1 AC mains operated heat meters or subassemblies shall have a rated voltage, 196 V < U_n < 253 V.

6.5.2 Remote DC or AC operated heat meters or subassemblies shall have a rated voltage U_n of 24 V. The tolerance for DC shall be 12 V to 42 V and for AC 12 V to 36 V.

If the remote supply lines are also used for data transmission (e.g. M-bus, see EN 1434-3) these values shall be maintained during any data transmission.

6.5.3 Local external DC operated meters or subassemblies shall preferably have a rated voltage U_n of 6 V, 3,6 V or 3 V, in accordance with Table 1.

Table 1 — Standardized levels for external powering

Nominal voltage	6 V	3,6 V	3 V
Max. average current	100 mA	10/20/50/100/200 µA	10/20/50/100/200 µA
Tolerance at average current	5,4 V to 6,6 V	3,4 V to 3,8 V	2,8 V to 3,3 V
Peak current	100 mA	10 mA	5 mA
Min. voltage at peak current	5,4 V	3,2 V	2,7 V

6.6 Qualifying immersion depth of a temperature sensor

By immersion beyond the qualifying immersion depth the resistance shall not change by more than what correspond to 0,1 K.

6.7 The influence on a temperature sensor pair caused by mounting in pockets

The difference in measuring result with and without specified pockets shall be within 1/2 of the MPE.

6.8 Reproducibility

The application of the same meter (or sub-assembly) in a different location or by a different user, all other conditions being the same, shall result in the close agreement of successive measurements. The difference between the measurement results shall be small when compared with the maximum permissible error.

6.9 Repeatability

The application of the same meter (or sub-assembly) under the same conditions of measurement shall result in the close agreement of successive measurements. The difference between the measurement results shall be small when compared with the maximum permissible error.

6.10 Software

Software that is critical for metrological characteristics shall be identified as such and shall be secured.

Its identification shall be easily provided by the meter (or sub-assembly).

Evidence of an intervention shall be available for a reasonable period of time.

When a meter (or sub-assembly) has associated software which provides other functions besides the measuring function, the software that is critical for the metrological characteristics shall be identifiable and shall not be inadmissibly influenced by the associated software.

Reference to guideline "WELMEC Software Guide 7-2"

NOTE In WELMEC Software Guide 7–2 (recent 5th issue: March 2012) heat meters belong to P-meters with risk class C.

7 Specified working range

7.1 General

The working parameters of the heat meter are bounded by the limiting values of the temperature range, the temperature difference, the thermal power and the flow rates (q_s and q_i).

If the measurement of heat is affected by the pressure and/or the differential pressure between inlet and outlet of the heat-conveying liquid, pressure and differential pressure shall be regarded as parameters.

7.2 Temperature difference

The ratio of the upper and lower limits of the temperature difference shall not be less than 10, with the exception of heat meters intended for cooling circuits. The lower limit shall be stated by the manufacturer to be either 1, 2, 3, 5 or 10 K. The preferred lower limit is 3 K.

For temperature difference values below 3 K the temperature test equipment should be of the highest precision.

7.3 Flow rate

The ratio of the permanent flow rate to the lower limit of the flow rate (q_p/q_i) shall be 10, 25, 50, 100 or 250.

8 Heat transmission formula

Heat transmitted to or from a body can be determined from a knowledge of its mass, specific heat capacity and change of temperature.

In a heat meter the rate of change of enthalpy between the inlet and outlet through a heat exchanger is integrated with respect to time. The equation for its operation is as follows:

$$Q = \int_{V_0}^{V_1} k \Delta\Theta dV \tag{1}$$

where

Q is the quantity of heat given up or absorbed;

V is the volume of liquid passed;

k called the heat coefficient, is a function of the properties of the energy-conveying liquid at the relevant temperatures and pressure;

$\Delta\Theta$ is the temperature difference between the inlet and outlet of the heat exchange circuit.

The conventional true value of the heat coefficient *k*, for water, if it is used as the system heat conveying liquid, shall be obtained from Formula (A.1) in Annex A - where the pressure shall be set to 16 bar.

For meters intended for use with heat-conveying liquids other than water the manufacturer shall declare the heat coefficient used as a function of temperature and pressure.

NOTE Tables with values for the heat coefficient for liquids other than water can be found, e.g. in the book "Handbuch der Wärmeverbrauchsmessung", Dr. F. Adunka.

9 Metrological characteristics (Maximum Permissible Error, MPE)

9.1 General

9.1.1 Flow sensors of heat meters and complete heat meters belong to one of the following three accuracy classes:

Class 1, Class 2 and Class 3.

9.1.2 The maximum permissible errors of heat meters, positive or negative, in relation to the conventional true value of the heat, are represented as relative errors, varying as a function of the temperature difference and flow rate.

9.1.3 The maximum permissible error of sub-assemblies, positive or negative, are calculated from the temperature difference in the case of the calculator and the temperature sensor pair, and from the flow rate in the case of the flow sensor.

9.1.4 The relative error, E, is expressed as:

$$E = \frac{V_d - V_c}{V_c} 100\% \tag{2}$$

where

V_d is the indicated value;

V_c is the conventional true value.

9.2 Values of maximum permissible errors

9.2.1 Maximum permissible relative errors of complete heat meters

The MPE of a complete heat meter is the arithmetic sum of the MPE's of the subassemblies as defined in 9.2.2.

9.2.2 Maximum permissible relative error of sub-assemblies

9.2.2.1 Calculator

$$E_c = \pm\left(0,5 + \frac{\Delta\Theta_{min}}{\Delta\Theta}\right) \tag{3}$$

where

E_c is the error, which relates the value of the heat indicated to the conventional true value of the heat.

9.2.2.2 Temperature sensor pair

$$E_t = \pm\left(0,5 + 3\frac{\Delta\Theta_{min}}{\Delta\Theta}\right) \quad (4)$$

where

E_t is the error, which relates the indicated value to the conventional true value of the relationship between temperature sensor pair output and temperature difference.

The relationship between temperature and resistance of each single sensor of a pair shall not differ from the values of the equation given in EN 60751 (using the standard values of the constants A, B and C) by more than an amount equivalent to 2 K.

For heat meters and cooling meters with tariff depending on absolute temperature the tolerance of each single sensor should fulfil class B of EN 60751.

9.2.2.3 Flow sensor

Class 1: $E_f = \pm (1 + 0{,}01\ q_p/q)$, but not more than ± 5 %.

Class 2: $E_f = \pm (2 + 0{,}02\ q_p/q)$, but not more than ± 5 %.

Class 3: $E_f = \pm (3 + 0{,}05\ q_p/q)$, but not more than ± 5 %.

where the error, E_f, relates the indicated value to the conventional true value of the relationship between flow sensor output signal and mass or volume.

For heat meters and cooling meters with tariff depending on absolute volume the tolerance should at least belong to class 2.

9.3 Application of maximum permissible errors

9.3.1 A manufacturer of a combination of subassemblies or of a complete instrument, consisting of legally inseparable subassemblies shall declare how the metrological behaviour of each subassembly guarantees the MPE of the combination respectively of the complete instrument.

9.3.2 For a combination of sub-assemblies as defined in 4.5, the maximum permissible error for the combination is the arithmetic sum of the maximum permissible errors of each sub-assembly.

9.3.3 The errors of combined instruments shall not exceed the arithmetic sum of the maximum permissible errors of the sub-assemblies indicated in 9.2.2.1 to 9.2.2.3.

10 Environmental classification

10.1 General

Heat meters shall conform to one or more of the following environmental classifications according to the application.

NOTE For correspondence between MID classifications and the environmental classes defined in this document, see OIML D11:2013.

10.2 Environmental class A (Domestic use, indoor installations)

— Ambient temperature +5 °C to +55 °C

— Low level humidity conditions

— Normal electrical and electromagnetic conditions

— Low level mechanical conditions

10.3 Environmental class B (Domestic use, outdoor installations)

— Ambient temperature −25 °C to +55 °C

— Normal level humidity conditions

— Normal electrical and electromagnetic conditions

— Low level mechanical conditions

10.4 Environmental class C (Industrial installations)

— Ambient temperature +5 °C to +55 °C

— Normal level humidity conditions

— High electrical and electromagnetic conditions

— Low level mechanical conditions

10.5 Mechanical classes M1 to M3

Mechanical classes M1 to M3 as described in the MID

According to the MID mechanical environments are classified into classes M1 to M3 as described below.

M1 This class applies to instruments used in locations with vibration and shocks of low significance, e.g. for instruments fastened to light supporting structures subject to negligible vibrations and shocks transmitted from local blasting or pile-driving activities, slamming doors, etc.

M2 This class applies to instruments used in locations with significant or high levels of vibration and shock, e.g. transmitted from machines and passing vehicles in the vicinity or adjacent to heavy machines, conveyor belts, etc.

M3 This class applies to instruments used in locations where the level of vibration and shock is high and very high, e.g. for instruments mounted directly on machines, conveyor belts, etc.

11 Heat meter specification

11.1 General

The manufacturer shall make available data sheets containing at least the following information:

11.2 Flow sensor

— Manufacturer;

- Type identification;
- Accuracy class; may differ depending on mounting orientation and on type of liquid;
- Limits of flow rate (q_i, q_p and q_s). Different sets of q_i and q_s may be given depending on mounting orientation and type of liquid;
- Maximum flow rate;
- Maximum admissible working pressure (PS in bar);
- Minimum pressure P_{min} to avoid cavitation;
- Nominal pressure (PN);
- Maximum pressure loss (pressure loss at q_p);
- Maximum admissible temperature;
- Limits of temperature (θ_{min} and θ_{max}).

An additional set of limits for the cooling range may be specified for heating/cooling meters:

- Nominal meter factor (litres/pulse or corresponding factor for normal and test output);
- Installation requirements including installation pipe lengths, etc.;
- Basic mounting orientation and other specified orientations;
- Physical dimensions (length, height, width, weight, thread/flange specification);
- Pulse output device class (see EN 1434-2:2015, 7.1.3);
- Output signal for testing (type/levels);
- Performance at flow rates greater than q_s;
- Low flow threshold value;
- Liquid if other than water;
- Response time - for fast response meters;
- Mains power supply requirements - voltage, frequency;
- Battery power supply requirements - battery voltage, type, life-time;
- Nominal voltage level for external power supply;
- Current used (average and peak) at external power supply;
- Energy used per year at external power supply;
- Cabling requirement at external power supply (max. cable length and possible requirement for shielded or twisted cable);

— Voltage limit at which the meter switches automatically from external power supply to internal battery;

— Time limit at which the meter switches automatically from external power supply to internal battery;

— Environmental classification.

11.3 Temperature sensor pair

— Manufacturer;

— Type identification;

— Limits of temperature (θ_{min} and θ_{max}). An additional set of limits for the cooling range may be specified for heating/cooling meters;

— Limits of temperature difference ($\Delta\Theta_{min}$ and $\Delta\Theta_{max}$). An additional set of limits for the cooling range may be specified for heating/cooling meters;

— Maximum admissible working pressure for direct mounted sensors (PS in bar);

— Maximum admissible temperature;

— Wiring of sensors (e.g. four or two wire);

— Principle of operation;

— Maximum RMS value of sensor current;

— Physical dimensions;

— Installation requirements (e.g. for pocket mounting);

— Maximum liquid velocity for sensor over 200 mm length;

— Total resistance of a 2-wire cable;

— Output signal for rated operation (type/levels);

— Response time;

— Physical dimensions (including cable diameter if applicable).

11.4 Calculator

— Manufacturer;

— Type identification;

— Environmental classification;

— Maximum value of thermal power;

— Limits of temperature (θ_{min} and θ_{max}). An additional set of limits for the cooling range may be specified for heating/cooling meters;

— Limits of temperature difference ($\Delta\Theta_{min}$ and $\Delta\Theta_{max}$). An additional set of limits for the cooling range may be specified for heating/cooling meters;

— User information, where to find the threshold value $\Delta\Theta_{hc}$ [in the range of ± (0 to 0,5) K] for switching over between heating and cooling energy and reversed in bifunctional meters for change-over systems between heating and cooling. Optional switching over temperature θ_{hc} for switching over between heating and cooling energy and reversed in bifunctional meters for change-over systems between heating and cooling;

— The conditions for switching between heating and cooling metering if applicable;

— Display unit options (MJ, kWh);

— Dynamic behaviour (see EN 1434-2:2015, 5.4);

— Other functions in addition to heat indication;

— Installation requirements including wiring of temperature sensors, indicating if screened cables are necessary or not;

— Physical dimensions;

— Mains power supply requirements - voltage, frequency;

— Battery power supply requirements - battery voltage, type, lifetime;

— Nominal voltage level for external power supply;

— Current used (average and peak) at external power supply;

— Energy used per year at external power supply;

— Cabling requirement at external power supply (max. cable length and possible requirement for shielded or twisted cable);

— Voltage limit at which the meter switches automatically from external power supply to internal battery;

— Time limit at which the meter switches automatically from external power supply to internal battery;

— Handling of energy indication by external power failure (see 6.3.2);

— Pulse input device class (see EN 1434-2:2015, 7.1.5);

— Required input signal from temperature sensors;

— RMS value of temperature sensor current;

— Maximum permissible flow sensor signal (pulse rate);

— Output signal for normal operation (type/levels);

— Pulse output device class (see EN 1434-2:2015, 7.1.3);

— Output signal for testing (type/levels);

— Liquid if other than water;

— If the flow sensor shall be operated at the high or low temperature level;

— Installation requirements including wiring of temperature sensors, indicating if screened cable is necessary or not, minimum and maximum diameter of cables to ensure the protection class according to 6.1.3.

11.5 Complete meters

— Manufacturer;

— Type identification;

— Accuracy class ; may differ depending on mounting orientation and on type of liquid;

— Environmental classification;

— Display unit options (MJ, kWh);

— Other functions in addition to heat indication;

— Maximum value of thermal power;

— Limits of flow rate (q_i, q_p and q_s). Different sets of q_i and q_s may be given depending on mounting orientation and type of liquid;

— Low flow threshold value;

— Maximum admissible working pressure for flow sensor (PS in bar);

— Nominal pressure (PN);

— Maximum pressure loss of flow sensor (pressure loss at q_p);

— Maximum admissible temperature;

— Limits of temperature (θ_{min} and θ_{max}) of the flow sensor / temperature sensor pair. An additional set of limits for the cooling range may be specified for heating/cooling meters;

— Limits of temperature difference ($\Delta\Theta_{min}$ and $\Delta\Theta_{max}$). An additional set of limits for the cooling range may be specified for heating/cooling meters;

— User information, where to find the threshold value $\Delta\Theta_{hc}$ [in the range of ± (0 to 0,5) K] for switching over between heating and cooling energy and reversed in bifunctional meters for change-over systems between heating and cooling. Optional switching over temperature θ_{hc} for switching over between heating and cooling energy and reversed in bifunctional meters for change-over systems between heating and cooling;

- The conditions for switching between heating and cooling metering if applicable;
- Installation requirements, including installation pipe lengths, etc.;
- Basic mounting orientation and other specified orientations;
- Physical dimensions (length, height, width, weight, thread/flange specification);
- Mains power supply requirements - voltage, frequency;
- Battery power supply requirements - battery voltage, type, lifetime;
- Handling of energy indication by external power failure (see 6.3.2);
- Output signal for normal operation (type/levels);
- Pulse output device class (see EN 1434-2:2015, 7.1.3);
- Output display/signal for testing (type/levels);
- Performance at flow rates greater than q_s;
- Liquid if other than water;
- Dynamic behaviour (see EN 1434-2:2015, 5.4);
- Response time for the temperature sensor pair;
- If the meter shall be installed at the high or low temperature level;
- Response time - for fast response meters;
- Nominal voltage level for external power supply;
- Current used (average and peak) at external power supply;
- Energy used per year at external power supply;
- Cabling requirement at external power supply (max. cable length and possible requirement for shielded or twisted cable);
- Voltage limit at which the meter switches automatically from external power supply to internal battery;
- Time limit at which the meter switches automatically from external power supply to internal battery.

12 Information to be made available by the manufacturer or supplier

12.1 Installation instructions

Installation instructions under the following headings shall include at least the following information:

a) Flow sensor

1) Flushing the system before installation;
2) Install in inlet or outlet as stated on calculator;
3) Minimum installation pipe length upstream and downstream;
4) Orientation limitations;
5) Need for flow straightener;
6) Requirement for protection from risk of damage by shock and vibration;
7) Requirement to avoid installation stresses from pipes and fittings.

b) Temperature sensor pair

1) Possible need for symmetrical installation in the same pipe size;
2) Use of pockets or fittings for temperature sensor;
3) Use of thermal insulation for pipe and sensor heads.

c) Calculator (and flow meter electronics)

1) Free distance around the meter;
2) Distance between meter and other equipment;
3) Need for adaptor plate to fit standardized holes.

d) Wiring

1) Need for earth connection;
2) Maximum cable lengths;
3) Required separation between signal and power cables;
4) Requirements for mechanical support;
5) Requirements for electrical screening;

e) Other

1) Initial function check and operating instructions;
2) Installation security sealing.

12.2 Parameter setting instructions

Parameter setting instructions under the following headings shall, when applicable, include at least the following information for both the setting procedure and a verification check of the result.

a) Flow sensor

1) Nominal meter factor (litres/pulse or corresponding factor) for normal and test output;
2) Pulse shape, duty cycle (bursts) and amplitude;
3) Sampling frequency;
4) Security sealing procedures, electronic and/or mechanical.

b) Calculator

1) Nominal meter factor for flow input signal;
2) Pulse shape, duty cycle (bursts) and amplitude;
3) Flow sensor in inlet or outlet pipe;
4) Type of temperature sensor (e.g. Pt 100 or Pt 500);
5) Nominal value of possible output signal;
6) Display resolution and settings;
7) Sampling frequency;
8) Operation, service or test mode;
9) Security sealing procedures, electronic and/or mechanical.

12.3 Adjustment instructions

Adjustment instructions under the following headings shall, when applicable, include at least the following information:

a) Flow sensor

1) Adjustment procedure;
2) Security sealing procedures, electronic and/or mechanical.

b) Calculator

1) Adjustment procedure;
2) Security sealing procedures, electronic and/or mechanical.

12.4 Maintenance instructions

Maintenance instructions under the following headings shall, when applicable, include at least the following information:

a) Flow sensor

1) Cleaning procedure;
2) Battery replacement procedure;

3) Parts that are recommended to be especially checked or replaced at revision;

4) Any needed special tools or equipment;

5) Security sealing procedures, electronic and/or mechanical;

6) Visual and acoustic inspection.

b) Temperature sensors

1) Visual inspection.

c) Calculator

1) Visual inspection;

2) Battery replacement procedure;

3) Security sealing procedures, electronic and/or mechanical.

12.5 Hints for disposal instructions

When a heat meter is taken out of service for recycling and/or disposal, it shall be taken into account that there are acting European directives and local regulations, e.g. the European Directives 2006/66/EC (batteries directive) and 2012/19/EU (WEEE directive).

Annex A
(normative)

Heat coefficient equations

For the determination of heat exchanged in an exchange circuit, heat meters shall take the type of heat-conveying liquid (generally water) into account by means of the heat coefficient $k(p, \theta_i, \theta_o)$. The heat coefficient is a function of the measurable physical quantities pressure p, inlet temperature θ_i and outlet temperature θ_o, and satisfies Formula (A.1).

Heat coefficient for water

$$k\left(p,\theta_i,\theta_o\right)=\frac{1}{v}\frac{h_i-h_o}{\theta_i-\theta_o} \quad \text{(A.1)}$$

where

v is the specific volume;

h_i is the specific enthalpies (inlet);

h_o is the specific enthalpies (outlet).

The quantities v, h_i and h_o can be calculated according to the Industrial Standard for the Thermodynamic Properties of Water and Steam (IAPWS-IF 97) using the International Temperature Scale of 1990 (ITS-90). Base values are given in Table A.1.

Specific volume

$$\upsilon=(\partial g/\partial p)_T \quad \text{(A.2)}$$

$$\upsilon(\pi,\tau)\frac{p}{RT}=\pi\gamma_\pi \quad \text{(A.3)}$$

where

g is the specific Gibbs free energy, and

$\pi = p/p^*$ with p^* = 16,53 MPa

$$\gamma_\pi=\sum_{i=1}^{34}-n_i I_i(7,1-\pi)^{I_i-1}(\tau-1,222)^{J_i} \quad \text{(A.4)}$$

For the figures of n_i, I_i and J_i see Table A.2.

Specific enthalpy

$$h=g-T(\partial g/\partial T)_p \quad \text{(A.5)}$$

$$\frac{h(\pi,\tau)}{RT}=\tau\gamma_\tau \quad \text{(A.6)}$$

where

$\tau = T^*/T$ and T^* = 1 386 K

$$\gamma_\tau = \sum_{i=1}^{34} n_i (7{,}1 - \pi)^{I_i} \; J_i (\tau - 1{,}222)^{J_i - 1} \qquad \text{(A.7)}$$

with 273,15 K ≤ T ≤ 623,15 K; $p_s(T) \le p \le$ 100 MPa and R = 461,526 J~kg^{-1}~K^{-1}

where

$p_s(T)$ is the saturation pressure.

For the figures of n_i, I_i and J_i, see Table A.2.

(samples of values for θ_i = 70 °C and θ_o = 30 °C at 16 bar)

Table A.1 — Base values

	Flow measured at high temperature pipe	Flow measured at low temperature pipe
specific volume in (m³/kg)	0,102 204 × 10^{-2}	0,100 370 × 10^{-2}
specific enthalpyinlet in (kJ/kg)	0,294 301 × 10^{3}	0,294 301 × 10^{3}
specific enthalpyoutlet in (kJ/kg)	0,127 200 × 10^{3}	0,127 200 × 10^{3}
heat coefficient in (MJ/(m³ K))	4,087 442	4,162 135

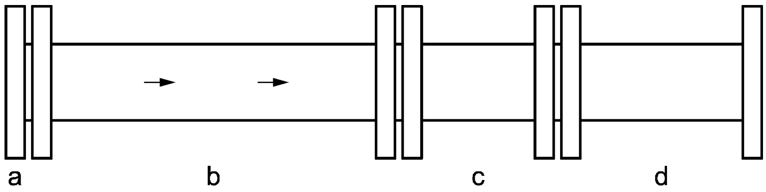
Table A.2 — Coefficients and exponents of Formulae (A.4) and (A.7)

i	I_i	J_i	n_i	i	I_i	J_i	n_i
1	0	−2	0,146 329 712 131 67	18	2	3	−0,441 418 453 308 46 × 10^{-5}
2	0	−1	−0,845 481 871 691 14	19	2	17	−0,726 949 962 975 94 × 10^{-15}
3	0	0	−0,375 636 036 720 40 × 10^{1}	20	3	−4	−0,316 796 448 450 54 × 10^{-4}
4	0	1	0,338 551 691 683 85 × 10^{1}	21	3	0	−0,282 707 979 853 12 × 10^{-5}
5	0	2	−0,957 919 633 878 72	22	3	6	−0,852 051 281 201 03 × 10^{-9}
6	0	3	0,157 720 385 132 28	23	4	−5	−0,224 252 819 080 00 × 10^{-5}
7	0	4	−0,166 164 171 995 01 × 10^{-1}	24	4	−2	−0,651 712 228 956 01 × 10^{-6}
8	0	5	0,812 146 299 835 68 × 10^{-3}	25	4	10	−0,143 417 299 379 24 × 10^{-12}
9	1	−9	0,283 190 801 238 04 × 10^{-3}	26	5	−8	−0,405 169 968 601 17 × 10^{-6}
10	1	−7	−0,607 063 015 658 74 × 10^{-3}	27	8	−11	−0,127 343 017 416 41 × 10^{-8}
11	1	−1	−0,189 900 682 184 19 × 10^{-1}	28	8	−6	−0,174 248 712 306 34 × 10^{-9}
12	1	0	−0,325 297 487 705 05 × 10^{-1}	29	21	−29	−0,687 621 312 955 31 × 10^{-18}
13	1	1	−0,218 417 171 754 14 × 10^{-1}	30	23	−31	0,144 783 078 285 21 × 10^{-19}
14	1	3	−0,528 383 579 699 30 × 10^{-4}	31	29	−38	0,263 357 816 627 95 × 10^{-22}
15	2	−3	−0,471 843 210 732 67 × 10^{-3}	32	30	−39	−0,119 476 226 400 71 × 10^{-22}
16	2	0	−0,300 017 807 930 26 × 10^{-3}	33	31	−40	0,182 280 945 814 04 × 10^{-23}
17	2	1	0,476 613 939 069 87 × l0^{-4}	34	32	−41	−0,935 370 872 924 58 × 10^{-25}

Annex B
(normative)

Flow conditioner package

If needed according to EN 1434-4:2015, 6.22 to get the specified flow range and accuracy class, a flow conditioning package as Figure B.1 shall be specified as part of the installation:



Key

a flow straightener as the specification below

b straight pipe section of 5 × D upstream the meter

c meter

d straight pipe section of 3 × D

Figure B.1 — Flow conditioner package

The flow straightener shall be as shown in Figure B.2. The dimensions of the holes are a function of the pipe inside diameter, *D*. There are:

— a ring of 4 holes (d_1) of diameter 0,10*D* on a pitch circle diameter of 0,18*D;*

— a ring of 8 holes (d_2) of diameter 0,16*D* on a pitch circle diameter of 0,48*D;*

— a ring of 16 holes (d_3) of diameter 0,12*D* on a pitch circle diameter of 0,86*D.*

The perforated plate thickness shall be 0,12*D*.

NOTE This straightener is normally known as the NEL (Spearman) type.

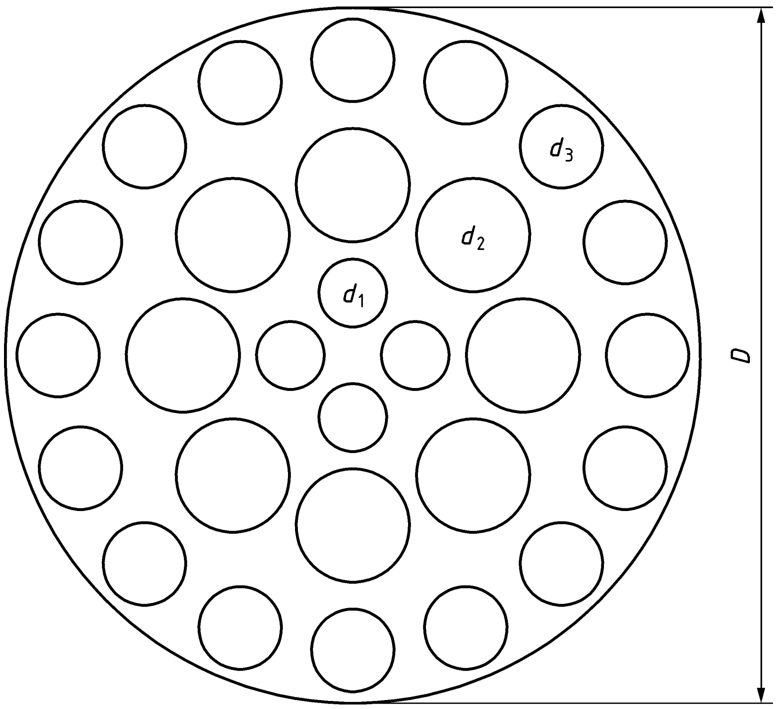


Figure B.2 — Flow straightener

Annex C
(normative)

Fast response meters

A meter or sub-assembly defined as “Fast response meter” shall have at least the following additional specifications:

— Response time ($\tau_{0,5}$): max. 6 s for long temperature sensors; max. 2,5 s for short temperature sensors.

— For battery driven meters the time between measuring samples (flow and temperature) and as well as incremental energy calculations: for time interval based measurement 8 s are recommended. For volume quantum based measurement 8 s * q_p/q or by equivalent volume fraction are recommended.

— For meters driven by mains the time between measuring samples (flow and temperature) and as well as incremental energy calculations: for time interval based measurement 4 s are recommended. For volume quantum based measurement 4 s * q_p/q or by equivalent volume fraction are recommended.

Annex ZA
(informative)

Relationship between this European Standard and the Essential Requirements of EU Directive 2004/22/EC, MID

This European Standard has been prepared under a mandate given to CEN by the European Commission and the European Free Trade Association to provide a means of conforming to Essential Requirements of the New Approach Directive 2004/22/EC, MID.

Once this standard is cited in the Official Journal of the European Union under that Directive and has been implemented as a national standard in at least one Member State, compliance with the clauses of this standard given in Table ZA.1 confers, within the limits of the scope of this standard, a presumption of conformity with the corresponding Essential Requirements of that Directive and associated EFTA regulations.

Table ZA.1 — Correspondence between this European Standard and Directive 2004/22/EC, MID

Clause(s)/sub-clause(s) of this EN	**Essential Requirements (ERs) of Directive 2004/22/EC, MID**	**Qualifying remarks/Notes**
	Annex I, Essential Requirements, Definitions:	
Scope	Measurand	In scope of standard defined.
3.4	Rated operating conditions	In standard, specific quantities of values of influences are declared.
3.6	Influence quanitity	Formulation in standard is covered by MID
3.8	Disturbance	Formulation in standard is covered by MID.
3.8	Critical change value, Material Measure, Direct sales	Requirements coming from MID.
Clause 10 Environmental classification	Climatic environment	Formulation in standard is covered by MID.
Clause 10 Environmental classification Clause 12 Information to be made available by the manufacturer or supplier	Utility	In standard is information about the obligations of the supplier.
	Annex I, Essential Requirements:	
3.9 Types of errors	1. Allowable Errors	Formulation in standard is covered by MID, types of errors are specified.
3.24 Durability	5. Durability, 6. Reliability	
Clause 5 Rated operating conditions	4. Discrimination and Sensitivity	

5.10.2 Suitability	7. Suitability	
4.6 Equipment under test Clause 11 Heat meter specification	12. Conformity evaluation	
5.10.4 Indication 6.3 Display 6.10 Software	10 Indication of result 11. Further processing of data to include the trading transaction	
6.4 Protection against fraud	8. Protection against corruption	
6.8 Reproducibility	2. Reproducibility	
6.9 Repeatability	3. Repeatability	
Clause 10 Environmental classification	1.3.1 Climatic environments 1.3.2 Mechanical environments 1.3.3 Electromagnetic environments 1.3.4 Other influences	Formulation in standard is covered by MID. For correspondence between MID classifications and environmental classes in standard, the OIML Recommendation D 11 is referenced.
Clause 11 Heat meter specification Clause 12 Information to be made available by the manufacturer or supplier	9 Information to be borne by and to accompany the instrument	
	Annex (MI-004), Specific Requirements:	
3.4 Rated operating conditions	1. Rated operation conditions	
3.24 Durability	5. Durability	
Clause 9 Metrological characteristics	2. Accuracy classes 3. MPEs applicable	
9.1.1 Accuracy classes	2. Accuracy classes 3. MPEs applicable	
Clause 10 Environmental classification	4. Permissible influences of electromagnetic disturbances	
Clause 11 Heat meter specification	6. Inscriptions on a thermal meter	
Clause 12 Information to be made available by the manufacturer or supplier	7. Sub-assemblies	

WARNING — Other requirements and other EU Directives may be applicable to the product(s) falling within the scope of this standard.

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[2] EN 13757-2, *Communication systems for meters and remote reading of meters — Part 2: Physical and link layer*

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[4] EN 13757-4, *Communication systems for meters and remote reading of meters — Part 4: Wireless meter readout (Radio meter reading for operation in SRD bands)*

[5] EN 13757-5, *Communication systems for meters and remote reading of meters — Part 5: Wireless relaying*

[6] CEN/CLC/ETSI/TR 50572, *Functional reference architecture for communications in smart metering systems*

[7] ISO 7268, *Pipe components — Definition of nominal pressure*

[8] 2006/66/EC - Directive 2006/66/EC of the European Parliament and of the Council of 6 September 2006 on batteries and accumulators and waste batteries and accumulators and repealing Directive 91/157/EEC

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[10] Measuring Instruments Directive (MID) 2004/22/EC

[11] OIML D11:2013 General requirements for measuring instruments — Environmental conditions

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