BS EN 1434-1:2007

Heat meters —

Part 1: General requirements

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ICS 17.200.10

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British Standards

National foreword

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Foreword

This document (EN 1434-1:2007) has been prepared by Technical Committee CEN/TC 176 “Heat meters”, the secretariat of which is held by DS.

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of an identical text or by endorsement, at the latest by August 2007, and conflicting national standards shall be withdrawn at the latest by August 2007.

This document supersedes EN 1434-1:1997.

The other parts are:

Part 2 - Constructional requirements

Part 3 - Data exchange and interfaces

Part 4 - Pattern approval tests

Part 5 - Initial verification tests

Part 6 - Installation, commissioning, operational monitoring and maintenance

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1 Scope

This European Standard specifies the general requirements and applies to heat meters, that is to instruments intended for measuring the heat 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.

2 Normative references

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

EN 60751, *Industrial platinum resistance thermometer sensors (IEC 60751:1983 + A1:1986)*

EN 61010-1, *Safety requirements for electrical equipment for measurement, control and laboratory use — Part 1: General requirements (IEC 61010-1:2001)*

3 Types of instrument

3.1 General

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

3.2 Complete instrument

A heat meter, which does not have separable sub-assemblies as defined in 3.5.

3.3 Combined instrument

A heat meter, which has separable sub-assemblies as defined in 3.5.

3.4 Hybrid instrument (often called a "compact" instrument)

A heat meter, which for the purpose of pattern approval and verification can be treated as a combined instrument as defined in 3.3. However, after verification, its sub-assemblies shall be treated as inseparable.

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

3.5.1 General

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

3.5.2 Flow sensor

A sub-assembly through which the heat-conveying liquid flows, at either the flow or return 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.

3.5.3 Temperature sensor pair

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

3.5.4 Calculator

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

3.6 Equipment under test (EUT)

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

4 Terms, definitions and symbols

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

4.1
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

4.2
fast response meter
meter suitable for heat exchanging circuits with rapid dynamic variations in the exchanged heat

4.3
rated voltage U_n
voltage of the external power supply required to operate the heat meter, conventionally the voltage of the AC mains supply

4.4
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

4.5
reference conditions
set of specified values of influence factors, fixed to ensure valid inter-comparison of results of measurements

4.6
influence quantity
quantity, which is not the subject of the measurement, but which influences the value of the measurand or the indication of the measuring instrument

4.7
influence factors
influence quantity having a value within the rated operating conditions

4.8
disturbance
influence quantity having a value outside the rated operating conditions

4.9
types of error

4.9.1
error (of indication)
indication of the measuring instrument minus the conventional true value of the measurand

4.9.2
intrinsic error
error of a measuring instrument determined under reference conditions

4.9.3
initial intrinsic error
error of a measuring instrument as determined once prior to performance tests and durability tests

4.9.4
durability error
difference between the intrinsic error after a period of use and the initial intrinsic error

4.9.5
maximum permissible error; MPE
extreme values of the error (positive or negative) permitted

4.10
types of fault

4.10.1
fault
difference between the error of indication and the intrinsic error of the instrument

4.10.2
transitory fault
momentary variations in the indication, which cannot be interpreted, memorized or transmitted as measurements

4.10.3
significant fault
fault greater than the absolute value of the MPE and not being a transitory fault

NOTE If the MPE is ± 2 % then the significant fault is a fault larger than 2 %.

4.11
reference values of the measurand; RVM
specified value of the flow-rate, the return temperature and the temperature difference, fixed to ensure valid intercomparison of the results of measurements

4.12
conventional true value
value of a quantity, which for the purpose of this European Standard is considered as the true value

NOTE 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.

4.13
meter model
different sizes of heat meters or sub-assemblies having a family similarity in the principles of operation, construction and materials

4.14
electronic device
device employing electronic elements and performing a specific function

4.15
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

4.16
qualifying immersion depth of a temperature sensor
immersion depth over which the sensor is considered stable enough for the purpose of this European Standard

4.17
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

4.18
meters other than for heating

4.18.1
cooling meter
heat meter designed for cooling applications at low temperatures, normally covering the temperature range 2 ºC to 30 ºC and $\Delta\Theta$ up to 20 K

4.18.1
meters for heating and cooling
instrument measuring heating and cooling energy in two separate registers

4.19
flow direction
is described by the terms flow and return. Flow meaning the forward direction to the system and return meaning output from the system. (Flow/return means high/low temperature for a heat meter but low/high temperature for a cooling meter)

4.20
electrical pulse
electrical signal (voltage, current or resistance), that departs from an initial level for a limited duration of time and ultimately returns to the original level

4.21
pulse output and input device
two types of pulse devices are defined and specified:

a) the pulse output device;

b) the pulse input device.

Both devices are functional parts of flow sensor, calculator or auxiliary devices such as remote displays or input devices of control systems

4.22
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 (< 200 h in the total life time of the unit) without a significant fault after the exposure to this maximum admissible temperature

4.23
Long life flow sensor
flow sensor designed to have a longer lifetime that a normal flow sensor, which typically lasts for 5 years

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.

5.2 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 flow and return 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.

5.3 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 (< 1h / 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 Maximum admissible working pressure; PS

The maximum positive internal pressure that the heat meter can withstand permanently at the upper limit of the temperature range, expressed in bar.

5.6 Nominal pressure; PN

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.

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 supplier 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, except where the heat meter includes a flow controller or also acts as a pressure reducing device.

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 supplier, no registration is allowed.

NOTE 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 shall not result in a positive 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 so 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. The supplier 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.

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 1/3^rd 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.

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 of the heat-conveying liquid, pressure shall be regarded as a parameter.

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 supplier to be either 1, 2, 3, 5 or 10 K. The preferred lower limit is 3 K for heating applications.

NOTE 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 flow and return through a heat exchanger is integrated with respect to time. The equation for its operation is as follows:

$$Q = \int_{t_0}^{t_1} q_m \, \Delta h \, dt$$

where

Q is the quantity of heat given up or absorbed;

q_m is the mass flow-rate of the energy-conveying liquid passing through the heat meter;

Δh is the difference between the specific enthalpies of the energy-conveying liquid at the flow and return temperatures of the heat-exchange circuit;

t is the time.

If the instrument determines mass by volumetric means, its equation becomes:

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

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 flow and return 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 Equation (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 supplier 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 in the book "Handbuch der Wärmeverbrauchungsmessung", Dr. F. Adunka, 3. Auflage 1999, Vulkan-Verlag, Essen; ISBN 3-8027-2373-2.

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:

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

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

$E_c = \pm (0{,}5 + \Delta\Theta_{min}/\ \Delta\Theta)$

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

9.2.2.2 Temperature sensor pair

$E_t = \pm (0{,}5 + 3\ \Delta\Theta_{min}/\ \Delta\Theta)$

where the error, E_t, 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.

9.2.2.3 Flow sensor

Class 1: $E_f = \pm (1 + 0{,}01\ q_p/q)$, but not more than ± 3,5 %.

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.

9.3 Application of maximum permissible errors

9.3.1 A supplier of a combination of subassemblies or of a complete instrument, consisting of legally inseparable subassemblies shall declare how the metrological behavior 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 3.5, 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.

10.2 Environmental class A (Domestic use, indoor installations)

- Ambient temperature +5 ºC to +55 ºC
- 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 ºC to +55 ºC
- Normal level humidity conditions
- Normal electrical and electromagnetic conditions
- Low level mechanical conditions

10.4 Environmental class C (Industrial installations)

- Ambient temperature +5 ºC to +55 ºC
- Normal level humidity conditions
- High electrical and electromagnetic conditions
- Low level mechanical conditions

11 Heat meter specification

11.1 General

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

11.2 Flow sensor

- Supplier
- 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 admissible working pressure (PS in bar)
- 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 7.1.3 of EN 1434-2:2007)
- 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

- Supplier
- 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

11.4 Calculator

- Supplier
- 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
- The conditions for switching between heating and cooling metering if applicable
- Display unit options (MJ, kWh)
- Dynamic behaviour (see 5.4 of EN 1434-2:2007)
- 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 7.1.5 of EN 1434-2:2007)
- 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 7.1.3 of EN 1434-2:2007)
- 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

11.5 Complete meters

- Supplier
- 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
- 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 7.1.3 of EN 1434-2:2007)
- Output display/signal for testing (type/levels)
- Performance at flow-rates greater than q_s
- Liquid if other than water
- Dynamic behaviour (see 5.4 of EN 1434-2:2007)
- 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 delivered with the meter or sub-assemblies

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

a) Flow sensor:

- Flushing the system before installation

- Install in flow or return as stated on calculator
- Minimum installation pipe length upstream and downstream
- Orientation limitations
- Need for flow straightener
- Requirement for protection from risk of damage by shock and vibration
- Requirement to avoid installation stresses from pipes and fittings

b) Temperature sensor pair

- Possible need for symmetrical installation in the same pipe size
- Use of pockets or fittings for temperature sensor
- Use of thermal insulation for pipe and sensor heads

c) Calculator (and flow meter electronics)

- Free distance around the meter
- Distance between meter and other equipment
- Need for adaptor plate to fit standardized holes

d) Wiring

- Need for earth connection
- Maximum cable lengths
- Required separation between signal and power cables
- Requirements for mechanical support
- Requirements for electrical screening

e) Other

- Initial function check and operating instructions
- Installation security sealing

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 $k(p, \Theta_f, \Theta_r)$. The heat coefficient is a function of the measurable physical quantities pressure p, flow temperature Θ_f and return temperature Θ_r, and satisfies Equation (A.1).

heat coefficient for water $$k(p, \Theta_f, \Theta_r) = \frac{1}{v} \frac{h_f - h_r}{\Theta_f - \Theta_r} \qquad \text{(A.1)}$$

where v is the specific volume, h_f, h_r are the specific enthalpies (f-flow; r-return). The quantities v, h_f and h_r 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).

specific volume $$v = (\partial g / \partial p)_T \qquad v(\pi, \tau) \frac{p}{RT} = \pi \gamma_\pi \qquad \text{(A.2)}$$

where g is the specific Gibbs free energy and

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

$$\gamma_\pi = \sum_{i=1}^{34} - n_i I_i (7{,}1 - \pi)^{I_i - 1} (\tau - 1{,}222)^{J_i} \qquad \text{(A.3)}$$

For the figures of n_i, I_i and J_i see Table A.1.

specific enthalpy $$h = g - T(\partial g / \partial T)_p ; \qquad \frac{h(\pi, \tau)}{RT} = \tau \gamma_\tau \qquad \text{(A.4)}$$

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

$$\gamma_\tau = \sum_{i=1}^{34} n_i (7{,}1 - \pi)^{I_i} J_i (\tau - 1{,}222)^{J_i - 1} \qquad \text{(A.5)}$$

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}

with $p_s(T)$: saturation pressure.

For the figures of n_i, I_i and J_i see Table TA.1.

(samples of values for Θ_f = 70 ºC and Θ_r = 30 ºC at 16 bar:)

Table A.1 — Base values

	Flow measured at high temperature pipe	**Flow measured at low temperature pipe**
specific volume in (m^3/kg)	0,102 204 $\times 10^{-2}$	0,100 370 $\times 10^{-2}$
specific enthalpy$_{\mathbf{flow}}$ in (kJ/kg)	0,294 301$\times 10^{3}$	0,294 301$\times 10^{3}$
specific enthalpy$_{\mathbf{return}}$ in (kJ/kg)	0,127 200 $\times 10^{3}$	0,127 200 $\times 10^{3}$
heat coefficient in (MJ/(m^3 K))	4,087 442	4,162 135

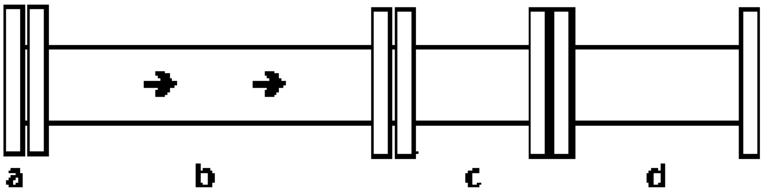
Table A.2 — Coefficients and exponents of Equations (A.3) and (A.5)

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

Annex B
(normative)

Flow conditioner package

If needed according to 6.22 of EN 1434-4:2007 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 $5 \times D$ upstream the meter

c meter

d straight pipe section of $3 \times D$

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 0,10D on a pitch circle diameter of 0,18D;

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

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

The perforated plate thickness shall be 0,12D.

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

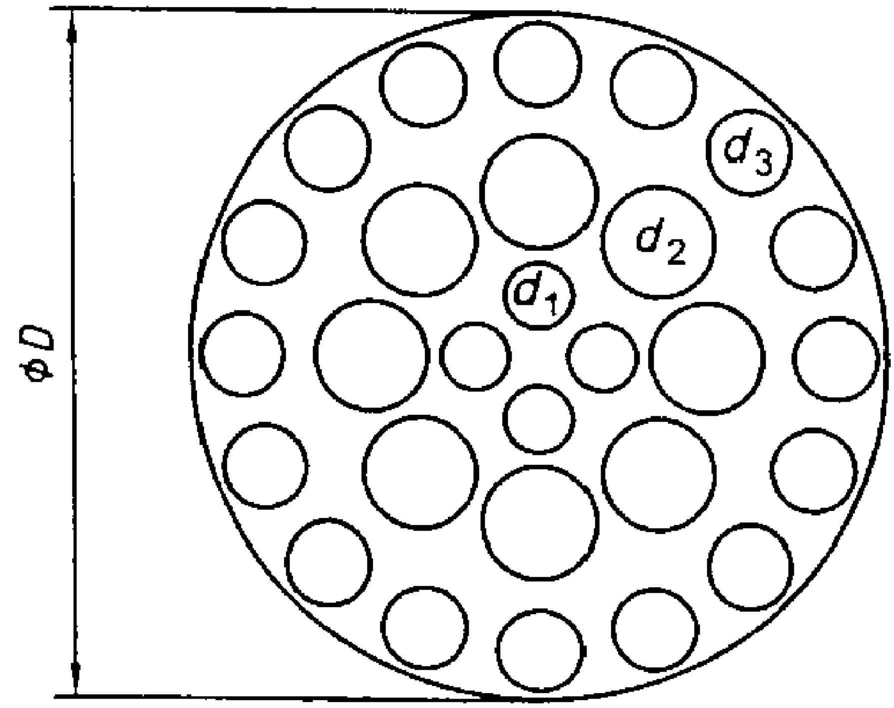


Figure B.2 — Flow straightener

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 to provide a means of conforming to Essential Requirements of the New Approach Directive 2004/22/EC on measuring instruments.

Once this standard is cited in the Official Journal of the European Communities under that Directive and has been implemented as a national standard in at least one Member State, compliance with all the normative clauses in Parts 1, 2, 4 and 5 of this standard confers, within the limits of the scope of this standard, a presumption of conformity with the relevant Essential Requirements of that Directive and associated EFTA regulations.

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

NOTE A corresponding annex is included in EN 1434-2, EN 1434-4 and EN 1434-5.

Bibliography

[1] EN 1434-2:2007, *Heat meters — Part 2: Constructional requirements*

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

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