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Heat meters - Part 5: Initial verification tests

Wärmezähler - Teil 5: Ersteichung

Compteurs d'énergie thermique - Partie 5: Essais de vérification initiaux

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Heat meters - Part 5: Initial verification tests

Compteurs d'énergie thermique - Partie 5: Essais de vérification initiaux

Wärmezähler - Teil 5: Ersteichung

This European Standard was approved by CEN on 7 January 2007.

CEN members are bound to comply with the CEN/CENELEC Internal Regulations which stipulate the conditions for giving this European Standard the status of a national standard without any alteration. Up-to-date lists and bibliographical references concerning such national standards may be obtained on application to the CEN Management Centre or to any CEN member.

This European Standard exists in three official versions (English, French, German). A version in any other language made by translation under the responsibility of a CEN member into its own language and notified to the CEN Management Centre has the same status as the official versions.

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Foreword

This document (EN 1434-5:2007) 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of an identical text or by endorsement, at the latest by August 2007, and conflicting national standards shall be withdrawn at the latest by August 2007.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 1434-5:1997.

The other parts are:

Part 1 - General requirements

Part 2 - Constructional requirements

Part 3 - Data exchange and interfaces

Part 4 - Pattern approval tests

Part 6 - Installation, commissioning, operational monitoring and maintenance

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, Cyprus, Czech Republic, Denmark, Estonia, Finland, France, Germany, Greece, Hungary, Iceland, Ireland, Italy, Latvia, Lithuania, Luxembourg, Malta, Netherlands, Norway, Poland, Portugal, Romania, Slovakia, Slovenia, Spain, Sweden, Switzerland and United Kingdom.

1 Scope

This European Standard specifies initial verification tests 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 1434-1:2007, *Heat meters — Part 1: General requirements*

EN 60751:1995, *Industrial platinum resistance thermometer sensors (IEC 60751:1983 + A1:1986)*

3 General

Initial verification of a measuring instrument is a series of tests and visual examinations carried out to determine whether an instrument manufactured to replicate a given pattern conforms to that pattern and to regulations, and that its metrological characteristics lie within the limits of the maximum permissible errors. If the instrument passes all tests and examinations, it is given legal character by its acceptance as evidenced by stamping and/or issuance of a certificate of verification.

The provisions of this standard also apply to the re-verification of heat meters.

The instrument shall be tested under rated operating conditions at the extremes and midpoints of its ranges.

Initial verification is divided into metrological, technical and administrative phases.

In tests of a heat meter as a combined instrument, the flow sensor, the temperature sensors and the calculator shall each be tested separately.

Unless otherwise stated in the certificate of pattern approval, the verification shall be carried out in accordance with this standard.

NOTE Modern heat meters are mainly equipped with CMOS microprocessors with a very low power consumption, allowing battery operation. Testing and adjusting of this type of meter needs a completely different approach. Until now, almost every meter type needed its own test equipment to handle the manufacturer's specific requirements. This is a very complicated and expensive way for users of several types of meters and for initial verification institutes. The more different types of heat meters a user has installed, the more testing equipment he may need. An economical testing of several meters should be possible and an easy adaptation to the existing test bench is of great interest.

Since this problem came up, experts have been researching an acceptable solution to it. Details of one example of an acceptable solution are given in "Normierter Wärmezähler Adapter" (Standardised heat meter adapter) Version 1.5 of September 2000, AGFW Merkblatt 6, Band 2, Frankfurt, Germany.

4 Uncertainty of test equipment

Standards, instruments and methods used in verification shall suit the purpose, be traceable to more precise standards and be part of a reliable calibration programme.

The uncertainties associated with these standards, methods and measuring instruments shall always be known. They shall either:

a) not exceed 1/5 of the MPE (maximum permissible error) of the EUT (equipment under test),

or, if exceeding 1/5,

b) be subtracted from the MPE of the EUT to obtain a new MPE.

It is recommended that option a) is used.

5 Tests to be carried out

5.1 General

If the error determined lies outside the MPE, the test shall be repeated twice. The test is then declared satisfactory if both

- the arithmetic mean of the result of the three tests

and

- at least two of the test results are within or at the MPE.

5.2 Flow sensors

The verification of the flow sensor shall be carried out within each of the following flow-rate ranges at a liquid temperature of (50 ± 5) ºC for heating applications and (15 ± 5) ºC for cooling applications

a) $q_i \leq q \leq 1{,}1\ q_i$

b) $0{,}1\ q_p \leq q \leq 0{,}11\ q_p$

c) $0{,}9\ q_p \leq q \leq 1{,}0\ q_p$

If the pattern approval certificate so provides, the verification may be carried out with cold water in accordance with the procedures laid down in the certificate.

When testing the flow sensors, the guidelines in the pattern approval certificate shall be followed (e.g. requirements for water conductivity, water temperature, straight inlet/outlet tubes).

To enable rapid testing of the flow sensor, it is customary to bypass the output signal used by the calculator. However, for at least one test, this signal shall be included.

5.3 Temperature sensor pair

5.3.1 Error in temperature difference

The individual temperature sensors of the temperature sensor pair shall be tested, without their pockets, in the same temperature bath at temperatures within each of the three temperature ranges in Table 1.

Table 1 — Test temperature ranges

No.	For Θ_{min}	Test temperature range	
		Heating	Cooling
1	< 20 °C	Θ_{min} to Θ_{min} + 10 K	0 °C to 10 °C
	≥ 20 °C	35 °C to 45 °C	
2	All Θ_{min}	75 °C to 85 °C	35 °C to 45 °C
3	All Θ_{min}	Θ_{max} - 30 K to Θ_{max}	75 °C to 85 °C
NOTE If specified in the pattern approval certificate, variations in the temperature ranges and the number of temperatures are permissible.			

The immersion depth of the sensor under test shall be at least 90 % of the total length.

The determined resistance values shall be used in a system of three equations to calculate the three constants of the temperature/resistance equation of EN 60751 and a curve shall be drawn through the three test points. Thereby the characteristic curve for the temperature sensor is known.

The "ideal" curve using the standard constants of EN 60751 shall be generated. To give the error at any temperature, the "ideal" curve shall be subtracted from the characteristic curve for each temperature sensor.

As a further step, the worst case error of the temperature sensor pair shall be determined over the temperature range and over the temperature difference range specified for the sensors.

For return temperatures above 80 °C, only temperature differences over 10 K shall be taken into account.

The error determined as described above shall be within the limits stated in 9.2.2.2 of EN 1434-1:2007.

When measuring resistance, the current shall be such, that the power dissipation does not exceed 0,2 mW RMS.

5.3.2 Insulation resistance

The resistance between each terminal and the sheath shall be measured with a test DC-voltage between 10 V and 100 V and under ambient conditions between 15 ºC and 35 ºC and at a relative humidity not exceeding 80 %. The polarity of the test current shall be reversed. In all cases the resistance shall not be less than 100 MΩ.

5.4 Calculator

The calculator shall be tested, at least within each of the following temperature difference ranges:

For heating applications:

a)	$\Delta\Theta_{min}$	≤	$\Delta\Theta$ ≤	1,2 $\Delta\Theta_{min}$
b)	10 K	≤	$\Delta\Theta$ ≤	20 K
c)	$\Delta\Theta_{max}$ - 5 K	≤	$\Delta\Theta$ ≤	$\Delta\Theta_{max}$

For cooling applications:

a)	$\Delta\Theta_{min}$	≤	$\Delta\Theta$ ≤	1,2 $\Delta\Theta_{min}$
b)	0,8 $\Delta\Theta_{max}$	≤	$\Delta\Theta$ ≤	≤ $\Delta\Theta_{max}$ but < 15 K

The simulated flow rate signal shall not exceed the maximum acceptable by the calculator.

The return temperature shall be in the temperature range between 40 °C and 70 °C for heating applications and (20 ± 5) °C for cooling applications, if not otherwise stated in the pattern approval certificate.

To enable rapid testing of the calculator, it is customary to by-pass the indicating device of the heat meter. However, for at least one test, the meter's indicating device shall be included.

5.5 Calculator and temperature sensor pair.

The sub-assembly of calculator and temperature sensor pair shall be tested using temperature ranges of 5.3 and the temperature difference ranges of 5.4.

Additionally, a final test of the sub-assembly is necessary, with the temperature sensor pair immersed in two temperature regulated baths. The temperature difference of the baths shall be between 3 K and 4 K. The simulated flow-rate shall not create a signal exceeding the maximum signal acceptable by the calculator.

If the calculator and temperature sensor pair are tested as an inseparable sub-assembly, it shall be tested in accordance with 5.4.

5.6 Combined heat meter

The flow sensor, the temperature sensor pair and the calculator shall be each tested separately, in accordance with 5.2 to 5.4.