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Vgradnja merilnikov toplote - Smernice za izbiro, vgradnjo in delovanje merilnikov toplote

Installation of thermal energy meters - Guidelines for the selection, installation and operation of thermal energy meters

Installation von thermischen Energiemessgeräten - Richtlinien für Auswahl, Installation und Betrieb von thermischen Energiemessgeräten

Compteur d’énergie thermique installation - Lignes directrices pour la sélection, l’installation et le fonctionnement des compteurs d’énergie thermique

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Installation of thermal energy meters - Guidelines for the selection, installation and operation of thermal energy meters

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This draft Technical Report is submitted to CEN members for Vote. It has been drawn up by the Technical Committee CEN/TC 176.

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EUROPEAN COMMITTEE FOR STANDARDIZATION
COMITÉ EUROPÉEN DE NORMALISATION
EUROPÄISCHES KOMITEE FÜR NORMUNG

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European foreword

This document (FprCEN/TR 13582:2020) has been prepared by Technical Committee CEN/TC 176 "Thermal energy meters", the secretariat of which is held by SIS.

This document is currently submitted to the Vote on TR.

Introduction

Metering devices for thermal energy (heat and cooling meters) are only working correctly and consistently if the system design considers the minimum and maximum ratings for temperature, temperature difference and flow rate according to the approved ranges. The metering device should be selected for the approved legal range and the application area. The thermal energy meter should be installed according to the valid requirements. During commissioning the thermal energy meter is checked for both correct installation and full functionality and afterwards sealed against unauthorized opening.

According to the European harmonized standard EN 1434-6 a commissioning is obligatory to ensure that the metering device accurately measures the planned or predicted consumption.

Installing the metering devices or their sub-assemblies incorrectly (e.g. an incorrect combination of temperature sensors with non-approved pockets) does not guarantee the measuring accuracy. Hence, the measurement deviations may exceed the permissible error limits. National calibration laws state that the metering point operator should ensure that the metering device is set up, connected, handled and maintained correctly to guarantee the measuring accuracy. Incorrect measurements result in bills that cannot be used in business transactions.

The metering point operator is in district heating networks responsible for a proper installation and commissioning of the metering devices. The metering point operator can also delegate this task to a service company. The building owner or the building owner's representative (e.g. a metering service company) is in sub metering applications responsible for a proper installation and commissioning of the metering devices.

The EN 1434 standards provide technical principles and practical advice in selecting, installing and commissioning of thermal energy meters. However, because a standard cannot cover all areas completely, this report shall assist users of thermal energy meters.

1 Scope

The EN 1434 standards provide technical principles and practical advice in selecting, installing and commissioning of thermal energy meters. However, because a standard cannot cover all areas completely, this document assists users of thermal energy meters.

2 Normative references

The following documents are referred to in the text in such a way that some or all of their content constitutes requirements 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.

prEN 1434-1:2020, *Thermal energy meters - Part 1: General requirements*

EN 1434-2, *Thermal energy meters - Part 2: Constructional requirements*

3 Terms and definitions

For the purposes of this document, the terms and definitions given in prEN 1434-1 and the following apply.

ISO and IEC maintain terminological databases for use in standardization at the following addresses:

- IEC Electropedia: available at http://www.electropedia.org/
- ISO Online browsing platform: available at https://www.iso.org/obp

3.1
DH (network)
district heating system, DC: district cooling system

3.2
meter: thermal energy meter
heat meter or cooling meter

3.3
water
domestic water

3.4
hot water
domestic hot water

3.5
fluid additive
fluid used to supplement a shortage of the heat transfer medium due to leaks

3.6
fluid
heat transfer medium in a DH/DC system

3.7
MID
Measurement Instrument Directive 2014/32/EU

4 Selecting a metering device for thermal energy

4.1 General

A thermal energy meter consists of the following three parts: a flow sensor, a temperature sensor pair and a calculator (see Figure 1).

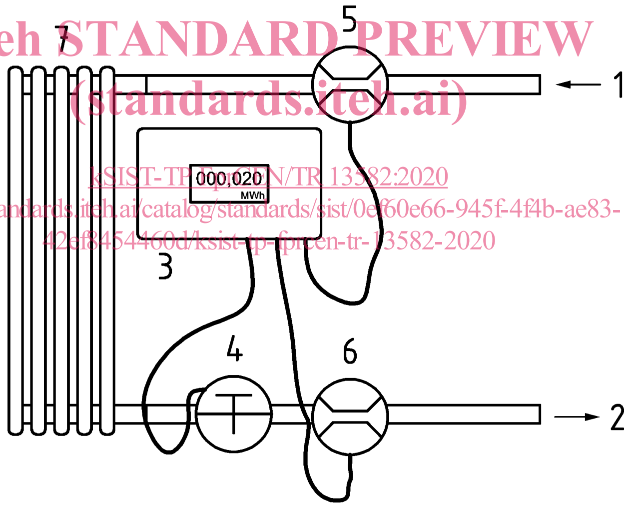
These sub-assemblies can be defined as complete instruments, combined instruments or hybrid instruments (see prEN 1434-1).

The calculator unit calculates the energy consumption using the signals from the temperature sensor pair and the flow sensor.

The minimum temperature difference of the calculator shall not fall below the smallest permissible value (according to MID the minimum temperature difference is 3 K).

The temperature sensors are usually platinum resistance thermometers of type Pt 100, Pt 500 or Pt 1000. The sensor pair determines the temperature difference between the inlet (flow) and outlet (return) of the thermal conveying medium.

The flow sensor is granted an error limit of 2 % to 5 %. Due to faulty design, incorrect installation or wear the wider error limits of this part/sub-assembly of a meter is exceeded occasionally. This case can be avoided by selecting the correct flow sensor. An overview of the different types of flow sensors is given in 8.3.7.



Key

1 inlet
2 outlet
3 calculator
4 flow sensor
5 inlet temperature sensor
6 outlet temperature sensor
7 thermal load

Figure 1 — Thermal energy meter

When operating the heat exchanger circuit system, one may discover that the chosen thermal energy meter design is not applicable due to the actual requirements.

Flow sensors that are designed for higher flow rates may not have the required accuracy at low flow rates. If the actual flow rate is below the minimum permissible flow rate, measurements may be skipped until the measurement fails completely.

Fast changes in energy consumption that place high demands on the dynamics of the meter may cause significant deviations in the measurement accuracy of the accumulated energy. Fast-response meters provide measurement characteristics that reduce this deviation (see 8.5.4)

The effects of dirt deposits and flow disturbances over the entire service life of the flow sensors shall be considered when selecting a meter.

4.2 Metrological characteristics

The accuracy classes and the maximum permissible relative errors of thermal energy meters are described in prEN 1434-1. Be aware that some national regulations do not allow the use of class 3 meters at all and that other national regulations do not allow the use of class 3 meters for e.g. for q_p 6 m³/h and higher.

Class 2 accuracy is the most frequently used accuracy class for flow sensors.

Due to the very high requirements on both flow sensors and test equipment, the availability of class 1 flow sensors is very limited.

4.3 Environmental classifications

The environmental classes are described in prEN 1434-1. Thermal energy meters have an environmental classification A, B and C regarding Domestic/Industrial EMC requirements and Indoor/Outdoor ambient conditions.

Table 1 — Relationship between prEN 1434-1 and MID re. EMC levels

	prEN 1434-1	MID (2014/32/EU)
Domestic EMC level	Class A and B	E1
Industrial EMC level	Class C	E2

Meters with Class C (E2) marking can be used also in domestic installations, but meters with Class A and B (E1) shall not be used in industrial installations (see Table 1).

Classes A and C are defined for indoor installations with +5 °C to 55 °C ambient temperature.

Class B is defined for outdoor installation. Since the availability of thermal energy meters for outdoor installation is limited, special care shall be taken to select a suitable meter or to select a suitable protective cabinet.

Most thermal energy meters are installed in locations without any vibration. For such installations, meters with the mechanical class M1 are suitable. In case some vibrations may occur at the installation site a meter with class M2 shall be selected. In case of more intense vibrations a meter with class M3 shall be selected (see Table 6 for more details).

5 Dimensioning

5.1 General

When selecting a thermal energy meter, it is important to determine the upper and lower flow limits for the flow sensor as required by the operating conditions. Based on the range for nominal flow q_p and minimum flow q_i one needs to select a suitable flow sensor from the various devices offered by different manufacturers. This selection results in the nominal diameter of the measuring line where the flow sensor shall be installed.

Simply selecting a flow sensor according to the nominal diameter of an existing pipe is not necessarily correct. Otherwise the coverage of the lower flow range may be insufficient.

It is often good practice that flow sensor sizes of one nominal diameter smaller than the pipe are chosen when the expected average flow rates are low.

The thermal energy output commissioned with the customer and the maximum inlet and outlet temperature for the planned application build the base for calculating the thermal energy supply.

In transfer stations for district heating and cooling, the fluid flow rate shall be limited to the commissioned value by using a flow rate limiter and/or a differential pressure controller. The controller protects the consumer circuit and the flow sensor from overloading. Arrange the controller in series after the flow sensor in the outlet to avoid additional disturbances in the flow profile before the flow sensor.

The expected yearly average flow rate, when known, should preferably be around 2/3 of the nominal flow q_p of the flow sensor. As for each flow sensor size the nominal flow q_p corresponds with about 2 m/s average flow velocity. This is the basis for the relationship between DN and q_p, and it minimizes the risk of cavitation as well as loss of accuracy due to wrong meter size.

5.2 Determining the thermal energy power

The metering point operator should perform calculations to determine the thermal energy power only as a check. Contracted values shall be specified by the customer exclusively.

5.3 Thermal energy load

5.3.1 Standard thermal energy load in new builds

The standard heat load in new buildings and major redevelopments should be determined by a qualified project engineer, e.g. according to EN 12831-1:2017, Clause 6.

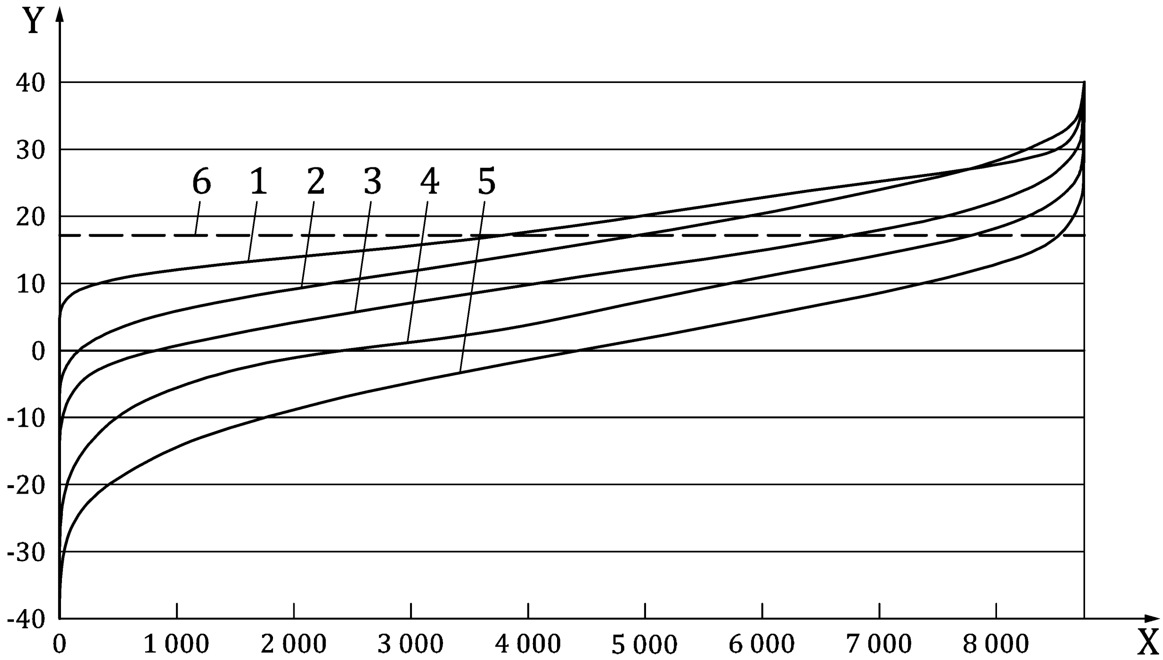
5.3.2 Thermal energy load of buildings with no standard load calculation

If existing buildings are being connected to a thermal energy supply with no standard load calculation, one could use an approximation or estimation method to determine the thermal energy load for dimensioning the flow sensor.

If a building connected to a district heating or cooling supply already contains a central heating system, an approximate thermal energy load can be calculated from an average of the last three years' annual consumption, an outside-temperature (see Figure 2) and the expected full usage hours.

Maximum values stored in the thermal energy meter can also be used to determine the output.

Distribution of outdoor temperatures for five European locations, 1881–2000. An indoor temperature has been added as example



Key

X hours per year

Y temperature, °C

1 Palermo, Italy

2 Florence, Italy

3 Strasbourg, France

4 Helsinki, Finland

5 Kiruna, Sweden

6 effective indoor temperature 17 °C

Figure 2 — Outdoor temperature duration in Europe [1)]

5.4 Thermal energy power for water heating

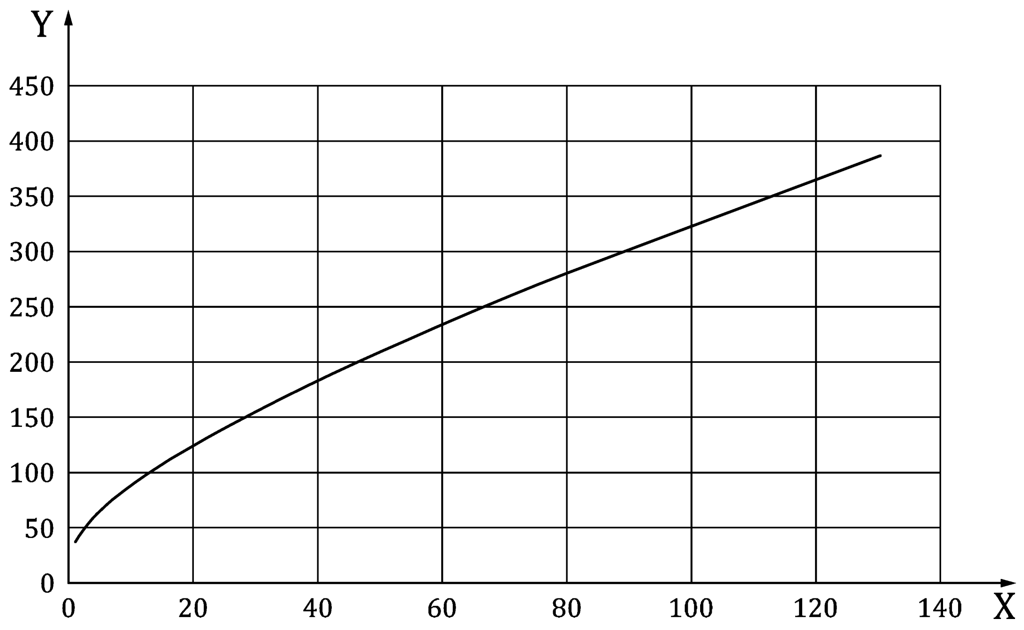
The thermal energy power for water heating usually needs to be determined by a qualified project engineer according to accepted engineering standards (e.g. EN 12831).

Using a priority control for the water heating and taking advantage of the building's heat storage capacity it may be possible to provide the required thermal energy output for short-term peaks of water heating without having a significant drop in room temperature.

If a priority control is used the qualified project engineer can select the higher value of the required thermal energy power between the thermal energy output for central heating or cooling and the thermal energy power for water heating. The higher value is the deciding factor in the selection of the flow sensor.

Parallel operations shall be considered separately.

1) Source reference: Svend Frederiksen, Svend Werner. 2013. District Heating and Cooling. Studenterlitteratur AB, Lund. Source reference: Figure 4.2 from "District Heating and Cooling" Svend Frederiksen, Svend Werner ISBN 978-91-44-08530-2



Key

X number of normal apartments

Y required power (kW)

Figure 3 — Outdoor temperature duration in Europe[2)]

5.5 Thermal energy power for ventilation and air conditioning systems

The thermal energy power required for ventilation and air conditioning systems should be calculated by a qualified project engineer.

Depending on climatic requirements, the flow sensor may encounter flow rate peaks during the low load season if there are ambient inlet temperatures in the district thermal energy network. These peaks shall be investigated and considered for dimensioning the flow sensor.

5.6 Thermal energy power for cooling systems

In bifunctional systems the flow sensor shall be selected by the maximum flow required for either heat or cooling. The power should be calculated by a qualified project engineer.

5.7 Thermal energy power for engineering purposes

When supplying heating or cooling for industrial and commercial engineering, it is recommended that the requirements of the customer and the customer's qualified project engineer regarding the flow sensor design are checked. A modulating operating curve in the district thermal energy network can cause increased flow rate values, especially when there are power peaks in the low load season. This shall be considered when dimensioning the flow sensor.

2) Source reference: Svend Frederiksen, Svend Werner. 2013. District Heating and Cooling. Studenterlitteratur AB, Lund. Source reference: Figure 4.2 from "District Heating and Cooling" Svend Frederiksen, Svend Werner ISBN 978-91-44-08530-2

6 Determining the flow rate

6.1 Principles of thermodynamics

6.1.1 General

The nominal heat or cooling load specifies the thermal energy power required at the measuring point in the (projected) application.

The maximum thermal energy released or absorbed by a thermal conveying medium in a heating or cooling circuit is calculated as follows:

$$\overset{\circ}{Q} = k \cdot \overset{\circ}{V} \cdot \left(\theta_{\mathrm{i}} - \theta_{\mathrm{o}}\right) \tag{1}$$

where

$\overset{\circ}{Q}$ is the thermal energy power, e.g. kW;

$\overset{\circ}{V}$ is the flow rate of the thermal conveying medium, in m³/h;

k is the thermal coefficient, in kWh/m³K;

θ_{i} is the design temperature in inlet, in °C;

θ_{o} is the design temperature in outlet, in °C.

Convert the formula to calculate the flow rate for the design case.

$$\overset{\circ}{V} = \frac{\overset{\circ}{Q}}{k \cdot \left(\theta_{\mathrm{i}} - \theta_{\mathrm{o}}\right)} \tag{2}$$

6.1.2 Total maximum power for heating or cooling

Add the outputs specified in Clause 5 to calculate the total thermal energy power.

$$\overset{\circ}{Q}_{\mathrm{tot}} = \sum_{\mathrm{i}=1}^{n} \overset{\circ}{Q}_{\mathrm{i}} \tag{3}$$

where

$\overset{\circ}{Q}_{\mathrm{tot}}$ is the total thermal energy power, in kW;

$\overset{\circ}{Q}_1$ is the standard thermal load, in kW;

$\overset{\circ}{Q}_2$ is the thermal power for hot water heating, in kW;

NOTE If using priority control, use only the larger value, either $\overset{\circ}{Q}_1$ or $\overset{\circ}{Q}_2$.

$\overset{\circ}{Q}_3$ is the thermal energy power for ventilation and air conditioning systems, in kW;

$\overset{\circ}{Q}_4$ is the thermal energy power for engineering purposes, in kW.

For cooling systems, the thermal load has to be added the same way (identical).

6.1.3 Inlet and outlet temperature

The difference between inlet and outlet temperatures is the temperature difference.

$$\Delta\Theta = \theta_{\text{inlet}} - \theta_{\text{outlet}} \left[K\right] \quad (4)$$

In general, the inlet temperature of the heating or cooling medium is regulated by the outside temperature and the outlet temperature is based on the design and operating mode of the heating system.

6.1.4 Thermal coefficient

The thermal coefficient k shall be determined according to prEN 1434-1:2020. For example, with θ_{inlet} = 100 °C, θ_{outlet} = 50 °C the approximate value of 1,15 [kWh/(m^{3}K)] can be expected for outlet meters and 1,12 [kWh/(m^{3}K)] for inlet meters.

7 Selecting a flow sensor for a thermal energy meter

Because the design case described above occurs only for a few days of the year, a flow sensor shall be selected so that it ensures that the smallest possible deviation occurs over the whole range of the year.

The range of the most frequent flow values (main operation range) at the measuring point is the deciding factor for selecting the flow sensor.

The operating range of the flow sensor shall be within the approved range which is spread between the smallest flow q_i and the nominal flow q_p.

A flow sensor shall be selected to fulfil all the following criteria:

— the nominal flow q_p of the flow sensor is as close as possible to the calculated flow rate;

— the minimum flow q_i of the flow sensor is smaller than/equal to the minimum flow of the thermal energy circuit;

— the maximum flow q_s of the flow sensor is reserved for short term overload (1 hour per day; 200 hours per year) in the thermal energy circuit.

If the minimum flow rate of the thermal energy circuit is not covered by the minimum flow q_i of the flow sensor, it shall be checked whether a smaller flow sensor will cover the design case better.

To achieve the minimum flow rate of the thermal energy circuit, a flow sensor with a higher dynamic range, q_p/q_i, shall be selected.

The nominal flow q_p shall not be exceeded when selecting the flow sensor.

Selecting a flow sensor may be easier if technical measures are taken to reduce the fluctuation range of the flow.

When selecting a flow sensor statutory regulations and standards, such as EN 1434, the operating conditions, the manufacturer's installation instructions and nationally applicable requirements shall all be considered.

The nominal pressure level (PN/PS) of the flow sensor shall correspond to the pressure class at the measuring point. In praxis the average pressure should be well below PN.

The permissible temperature range of the flow sensor shall comply with the temperature range of the thermal conveying medium as well as the ambient temperature at the measuring point. Because of temperature stress, the flow sensor should generally be installed in the outlet. This is the cooler pipe for flow sensors in heat meters and this is the warmer pipe for cooling meters.

In combination with low temperature heating installations flow sensors are also installed in the inlet pipe which is done to avoid measurement drop outs due to water loss in the installation.