EMATEM 20th International Summer School

Seeon 18.09.2024 – 19.09.2024

Aktuelle Probleme der Wärmemengen- und Durchflussmesstechnik

Recent problems in measurements of thermal energy and flow

Overview and concept about activities in standardization at CEN TC - revisions of EN 1434 by ongoing work items

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EMATEM

Contexts

- Normen- und Richtlinienentwicklungen CEN TC 176 WG 2 - EN 1434 zur Verminderung von Handelsbarrieren, Organisation

  Developments in standardization at CEN TC 176 WG 2 for avoidance of trade barriers, EN 1434 developments, internal structure

- EMATEM e.V. - Projektanstöße, Sommerschulen und Seminare

  Motivations on projects, topics on EMATEM Summer Schools, Seminars

- Normative Messgenauigkeitsbestimmung und Messbeständigkeiten im gesetzlichen Messwesen

  Standardized uncertainty of performance in measurements and durabilities in legal metrology processes

EMATEM

EUROPEAN STANDARD
NORME EUROPÉENNE
EUROPÄISCHE NORM

EN 1434:2022
Thermal energy meters

ICS 17.200.10

English Version

Thermal energy meters - Part 1: General requirements

Compteurs d'énergie thermique - Partie 1: Prescriptions générales

Wärmezähler - Teil 1: Allgemeine Anforderungen

EUROPEAN STANDARD
NORME EUROPÉENNE
EUROPÄISCHE NORM

ICS 17.200.20

Will supersede EN 1434-1:2015+A1:2018

English Version

Thermal energy meters - Part 1: General requirements

Compteurs d'énergie thermique - Partie 1 : Prescriptions générales

Thermische Energiemessgeräte - Teil 1: Allgemeine Anforderungen

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

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

CEN-CENELEC Management Centre: Rue de la Science 23, B-1040 Brussels

Ref. No. EN 1434-1:2015+A1:2018 E

INTERNATIONAL RECOMMENDATION

OIML R 75-1

Edition 2002 (E)

Heat meters

Part 1: General requirements

Compteurs d'énergie thermique
Partie 1: Exigences générales

ORGANISATION INTERNATIONALE DE MÉTROLOGIE LÉGALE

INTERNATIONAL ORGANIZATION OF LEGAL METROLOGY

INTERNATIONAL RECOMMENDATION

OIML R 75-2

Edition 2002 (E)

Heat meters

Part 2: Type approval tests and initial verification tests

Compteurs d'énergie thermique
Partie 2: Essais d'approbation de type et essais de vérification primitive

ORGANISATION INTERNATIONALE DE MÉTROLOGIE LÉGALE

INTERNATIONAL ORGANIZATION OF LEGAL METROLOGY

INTERNATIONAL RECOMMENDATION

OIML R 75-3

Edition 2006 (E)

Heat meters

Part 3: Test Report Format

Compteurs d'énergie thermique

Partie 3: Format du rapport d'essai

ORGANISATION INTERNATIONALE DE MÉTROLOGIE LÉGALE

INTERNATIONAL ORGANIZATION OF LEGAL METROLOGY

Harmonized Standards and Normative Documents to the Directive 2014/32/EU of the EUROPEAN PARLIAMENT and the COUNCIL

Work Items of WG 2 to further revisions of EN 1434 (2026 subsequent)

- Durability tests for flow sensors with more than 10 years for water and heat conveying liquids other than water, to predict durabilities of electric and electronic components of energy meters, medium temperatures for more than 90 °C - covered by product life extension and environmental design, life-time testings

- Fast response measuring, to define energy tests for combined meters and calculators, adaptive modes

- Sensitive measuring of the inconstant heat-coefficients in field, behaviour of water glycol solutions

- Flow profiles in water and water glycol solution networks, e.g. 90 ° bend and double bend out of plane, influences on accuracy caused by disturbed profiles, field situations, CFD simulations and measurements

- Usage of conductive pastes in pockets, stability of thermal contacts between temperature sensors and pockets, handling

Member's area at CEN/TC 176/WG 2

The several subgroups, to find compromises on further test descriptions in part 4 and 5 of standard

- *SG 1 Durability of flow sensors for more than 10 years, failure mechanism (head Mrs. Wagner)*
- *SG 2 Sensitive measuring for the constants of heat coefficients for mediums other than water (head Mr. Holoch)*
- *SG 3 Influence of flow profiles on performance of flow sensors in water and water glycol circuits (head Mr. Straka)*
- *SG 4 Conductive pastes for temperature sensor's pockets (head Mr. Holmsten)*
- *SG 5 Fast response metering test rig for thermal energy meters and subassemblies (head Mr. Baack)*
- *SG 6 Durability of electronic compounds, product life extension with environmental aspects, failure mechanism (head Mr. Bonde)*
- *SG 7 Revision of CEN/TR 13582 Installation of thermal energy meters - Guidelines for the selection, installation and operation of thermal energy meters (head Mr. Holoch, out for final handling via WG2, secretary DIN and CEN/TC 176 for publishing in 2024)*
- *SG 8 Error-listing of EN 1434:2022-edition with observation of associated reference standards (cecretary Mr. Schmidt DIN)*

Arbeitsabläufe in Arbeitsgruppen und Forschungsvorhaben

Work processes in subgroups and research assignments

- Erhebung und Bewertung von Einflüssen auf Messgenauigkeit und Beständigkeit in Anwendungsfeldern thermischer Energiemessgeräte

  Inquiry and assessment of influences on performance and durability in user fields of thermal energy instruments

- Prüfung auf Konformität zu den grundlegenden und spezifischen MID-Anforderungen bzgl. Umgebungs- und mechanischer Klassen

  Conformity checks onto essential and specific requirements according to MID with its environmental and mechanical classes (application classes A, B, C respectively M1 - M3)

- detaillierte Erhebung thermodynamischer und Umgebungsbedingungen der Sensorik von Durchflusssensoren und Temperaturfühlern im Kontakt zu Wasser und anderen Wärmeträgerflüssigkeiten

  Detailed inquiry on thermodynamics and environmental conditions onto flow and temperature sensors with touch to water and other heat conveying liquids

- Erhebung mechanischer, thermischer und EMV-Einflüsse auf elektrische Kontaktierung und Elektronikkomponenten der Rechenwerke und Schnittstellen
  Inquiry on influences by mechanic, thermic and EMC burdens onto electric contact pads and electronic components of calculators and interfaces

- Bewertung praxisbewährter Testverfahren industriellen Umfelds
  Assessment of referred test technologies in industrial sphere

- Definitionen, Begrifflichkeiten und Konstruktion für Normteile 1 und 2
  Definitions, clarification and design to parts 1 and 2 of standard

- Organisation von Ringvergleichen zu Messunsicherheiten der Notified Bodies, Konformitätsbewertungsstellen und Labore
  Organization of ring comparisons to state of measuring's uncertainties

- Entwicklung wirtschaftlicher, beschleunigter und skalierbarer Tests zur Abschätzung der Messbeständigkeit für Normteil 4
  Derivation of economic accelerated durability tests to part 4

- Ableitung von Vorgaben zur Installation und Instandhaltung für Normteil 6
  Derivation of requirements for installation and maintenance to part 6

Example to work of SG 1 and SG 6

3.9
types of errors

Thermal energy meters — Part 1: General requirements

Thermische Energiemessgeräte — Teil 1: Allgemeine Anforderungen

Compteurs d'énergie thermique — Partie 1: Prescriptions générales

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

Requirements on durability under scope of legal metrology have to be distinguished as they are much severer as a 'life-time extension'

First - an accepted definition of 'life-time' has to be created

Water Liquid composition

Stress parameter	Wear out mechanism	Effect	Overstress
low pH value	Corrosion in the system	Dissolution of materials, Particles in the system → leading to depositions and turbidity Change of roughness of wall surface → changing of the flow profile	Damage of components of the flow chamber
High pH value		Cu: Dissolution of materials Particles in the system → leading to depositions and turbidity Change of roughness of wall surface → changing of the flow profile	Damage of components of the flow chamber
High El. Conductivity	Corrosion in the system	Hugh amount of ions in the medium→ leading to depositions → changed signal amplitude Change of roughness of wall surface → change in flow profile	
Hardness	Coating deposits on transducers and reflectors of the flow chamber	changed signal amplitude; change flow profil in cause of the particles	Mismeasurement
Dissolved oxygen, nitrogen in concentration	Corrosion in the system; Abrashion through mini-gas bubbles	Dissolution of Fe-components in the system → leading to Ironoxid depositions Change of roughness of wall surface → change in flow profile	Mismeasurement Damage of components of the flow chamber
Sulfite (sodium sulfite) And other oxygen scavengers	Corrosion in the system Coating deposits on transducers or reflectors (e.g. Cu or Fe Sulfid)	Dissolution of Fe or Cu-materials, building of FeS or CuS particals, changed signal amplitude	Over dosing of the conditioning reagents leads to damage of Cu-Components

Examples of different water chemistry compositions for durability tests of flow sensors

The following parameters are selected on basis of the main materials of heat meters that are in contact with the heat transfer medium: steel, brass and plastics.
Plastic parts will not be attacked by magnetite, but it is deposited if the material becomes brittle and then may alter the measurement.

XX.1 Stressing parameters for low-salt mode of operation for district heating systems

For low-salt mode of operation, the test medium should not be buffer-capable and should be aggressive when external water (such as drinking water) enters the circuit water.

Basic Water is demineralized water (deionized water).

Stressing ingredients and dosage:

3) conductivity of approx. 4 µS/cm
4) pH-value of 8.2, adjusted it with ammonia. The pH value must be checked and (if necessary) adjusted on a daily basis.

XX.2 Stressing parameters for salty operation of a district heating systems

Basic water is drinking water softened down to 0.2 mmol/l, but not less than that value. In order to promote the self-alkalization of the water, the content of hydrogen carbonate ions must not be completely removed.

Stressing ingredients and dosage:

5) Conductivity 1500 µS/cm, set with Na_2SO_4. (The conductivity resulting from softened drinking water will be around 800 µS/cm. Add non-critical substances such as Na_2SO_4 to obtain a conductivity of 1500 µS/cm. A variance from 1200 to 1500 µS/cm is possible without corrosive effects on the test)
6) Add 2 mg/l sulphide, for example 4.8 mg/l sodium sulphide (Na_2S). It must be checked each day.
7) Add 1 mg/l ammonium but only as ammonium sulphate to get no amount of the pH-Value, that means 1 mg/l Ammonium = 2.5 mg/l Ammonium sulphate ($(NH_4)_2SO_4$).
8) Adjust the pH value to 8.2 with sodium bisulphite.

XX.3 General requirements for XX.1 and XX.2

3) The system must be gas-open to allow for continuous input of oxygen and nitrogen. Oxygen access to the system must be ensured to accelerate corrosion reactions and must be ensured in the best possible way

Development of combined Flow - Heat Load Change Tests with <u>adapted</u> mediums acc.to realistic field situations, derived from 'AGFW FW 510' (district water chemistry) and 'VDI 2035' (domestic water chemistry)

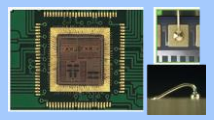
CEN/TC176/WG2 document no. N 892

4) The testing fluid must be treated with magnetite-containing filtered remainders from a district heating network, so that a daily average magnetite concentration of approx. 400 µg/l to 500 µg/l is achieved.

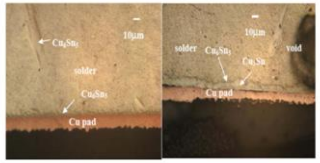
Since magnetite does not dissolve in water, the instantaneously value of the magnetite concentration fluctuates and is a function of the flow rate. To prevent the magnetite from settling on the bottom of the storage tank, a circulation pump must be installed feeding the test water into the bottom of the storage tank.

NOTE The error of indication shall be determined 48h after completion of the last load cycle, so that a deposit of magnetite on the flow sensor can be simulated. During the test, due to high fluctuations in flow rate, no deposition of magnetite is possible, furthermore the simulation of erosion due to particle flow may take place.

Failure mechanisms in TE meters - Electronics

Stress parameter	Wear out failure mechanisms (acc. models apply) 	Effect (Wear out failures)	Overstress failure mechanisms (acc. models do not apply) (use outside of specified operation conditions)
Temperature	Diffusion, Evaporation, Thermal ageing (polymers), Relaxation	Bad contacts (+sticking reed contacts), component drift, Kirkendall voiding (bond lifting), dry out of electrolytic capacitors, “weak” displays (bad segments), “gate sinking” and “ohmic contact degradation”, Piezo ceramics (transducer), cable degradation/brittle (e.g. PVC, Silicone etc.), thermal contact paste degrades	Melting, Freezing, Boiling, Explosion, T_g transition (of polymers)
Humidity	Sorption (Adsorption/Absorption), Corrosion, Hydrolysis),	PCB tracks corrode, breaking vias, bad contact, component short circuit, plastic soaking with humidity and expanding, thermal contact paste degrades, cable degradation/brittle (e.g. PVC, Silicone etc.),	Condensation
Vibration	High Cycle Fatigue (HCF)	Broken vias, broken solder joints, broken components (e.g. capacitors),	M1, M2 and M3, “overstress” or specs.?
Thermal cycling	Low Cycle Fatigue (LCF)	Broken vias, broken solder joints, broken components, delamination withing transducer, bad contacts,	xxxx
Voltage	TDDB (Time Dependent Dielectrical Breakdown)	Relevant?	EOS (Electrical Overstress), Electrostatic discharge
Current	Electromigration	Relevant?	EOS (Electrical Overstress),
Others	Creep, Wear, Ultra Low Cycle Fatigue, Rats, Water (flooding)	Buttons wear, bearing of mech. meter (covered in other group), self-cutting screws in housing (design related),	Impact,
Combined	Fretting corrosion, Migration, Corrosion, TDDB, Electromigration	Relevant?	
UV light	Photo chemical degradation,	Degradation of housing/cables, ONLY RELEVANT FOR OUTDOOR USE!	

SAC solder joint, before and after 1000 h of thermal ageing



Which are next steps for WG 2, to handle with Thermal Energy Meters for "Durability with more than 10 years" ?

1. *Derivation of specific failure rates of electronic components, electric connectors and p-c boards*
2. *Comparison with International Standards and Recommendations *)*
3. *Define specific HALT/HASS tests with test chambers into EN 1434-4, cl. 7.8.1*

e.g. ***Highly Accelerated Life Test strategies for safeguarding durability with its tool Highly Accelerated Stress Screening***

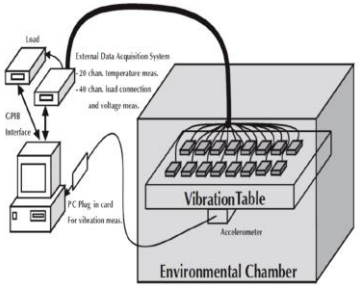
*) **IEC 61709 Electric components - Reliability - Reference conditions for failure rates and stress models for conversion**

SN 29500 MTBF calculation (Siemens standard)

IEC 61649 Weibull analysis

IEC 62506 METHODS FOR PRODUCT ACCELERATED TESTING

IPC 9592 Requirements for Power Conversion Devices for the Computer and Telecommunications Industries



Example to work of SG 2

- Sensitive measuring of the inconstant heat-coefficients in field, behaviour of water glycol solutions

Wärmeträgerfluide: Stand der Technik sowie interne und externe Einflussfaktoren auf die thermophysikalischen Eigenschaften *Heat transfer fluids: state of the art as well as internal and external factors influencing thermophysical properties*	H. Kemlein-Schiller, Aqua Concept GmbH
Clariant Wärmeträgerflüssigkeiten – Eine Übersicht über den Herstellprozess, Spezifikationen und Messmethoden *Clariant Heat Transfer Fluids - An overview of the manufacturing process, specifications and measurement methods.*	Ch. Mahler Clariant Produkte (Deutschland) GmbH

https://ematem.org/wp-content/uploads/2023/05/Programm.pdf

EMATEM

Ringvergleich - Messgenauigkeit kalorimetrischer Größen

Ring comparison on calorimetric figures, measuring uncertainty

Ringvergleich zur spezifischen Wärmekapazität von Wärmeträgerflüssigkeiten

Zeitraum: 2024

Anmeldeschluss: 05.04.2024

Pilotlabor: Center for Applied Energy Research e.V.

Koordinator und Ansprechpartner:

Probenherkunft:

- Wasser (Lieferant: aqua concept GmbH)
- Ethanol-Wasser Gemisch (Lieferant: aqua concept GmbH)
- Monoethylenglykol-Wasser Gemisch (Lieferant: Clariant International Ltd)

Gemessene Eigenschaft: spezifische Wärmekapazität

Messprogramm:
Temperaturen: 5 °C bis 95 °C

Zu liefernde Daten:
Werte der spezifische Wärmekapazität in 5 K Schritten (5 °C, 10 °C, …, 95 °C)

Unsicherheitsangabe ist zwingend, Unsicherheitsbudget ist Voraussetzung für Beitrag zum Referenzwert. Messwerte beinhalten zwingend die Angabe einer Messunsicherheit. Ergebnisse, für die keine Messunsicherheit angegeben wird, werden nicht berücksichtigt.

Zeitplan:
Nach Bekunden der Teilnahme erhalten die Teilnehmer und die Proben und weitere Hinweise zur Durchführung des Ringvergleichs zugesandt. Die Durchführung erfolgt nach dem Leitfaden zur Planung und Durchführung von Ringvergleichen des Arbeitskreises-Thermophysik in der GEFTA (https://ak-thermophysik.de/download/ringvergleiche/leitfaden_rv.pdf).

- April: Probenpräparation und Versand
- April - Juni: Probenvermessung
- Juli: Auswertung der Ergebnisse
- August: Rückmeldung an die Teilnehmer
- September: Abschluss des Ringvergleichs und Bericht an die Teilnehmer
- Anschließend Peer-reviewed Veröffentlichung

- Belimo Automation AG
- Deutsche Zentrum für Luft- und Raumfahrt e.V. (DLR), Institut für Systemleichtbau
- AIT Austrian Institute of Technology GmbH
- PTB Physikalisch-Technische Bundesanstalt, Arbeitsgruppe 1.44
- aqua-concept Ges. für Wasserbehandlung mbH
- Institut für Luft- und Kältetechnik gemeinnützige Gesellschaft mbH (ILK Dresden)
- Clariant Produkte GmbH
- Center for Applied Energy Research e.V.
- Netzsch-Gerätebau GmbH

Example for work of SG 4

- Usage of conductive pastes in pockets, stability of thermal contacts between temperature sensors and pockets, handling

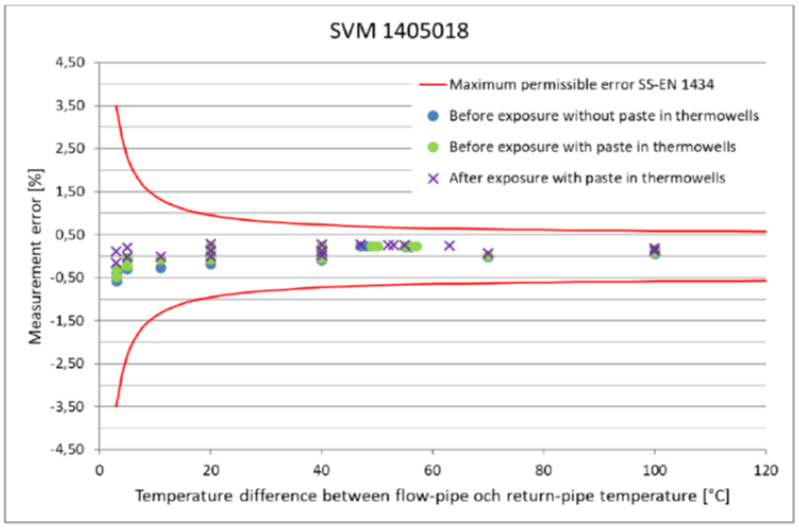
CEN/TC 176/WG 2 **N 926**

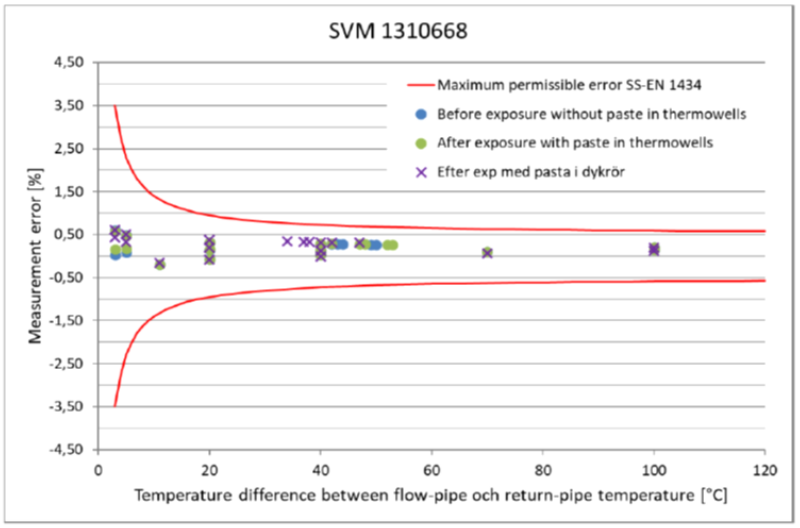
CEN/TC 176/WG 2 "Thermal energy meters - Requirements, test methods and technical editing"
WG Secretariat: **DIN**
Convenor: **Rose Jürgen Mr Dr.**

Presentation - Pockets Pastes WG2 2022-03-23 (Holmsten, Sweden)

Document type	Related content	Document date	Expected action
Project / Other	Meeting: Berlin (Germany) 18 Apr 2023	2023-05-10	INFO

Measurement error (Performance test)





Disassembly - results

- Sensors of brass and mounted with thermal paste no. 1 were stucked in the thermowell
- The thermal paste no.2 was hard
- The 2 sensors mounted with thermal paste no.2 were very hard to remove
  (the other sensors of the same type mounted with thermal paste no. 1 were easy to remove)

Conclusions

- The improvements in terms of response time due to the usage of thermal paste mostly persists over time even if the consistency of the paste changes.
- There is a large difference in the consistency for the two different pastes in the project. This is not possible to judge from the specification.
- The same paste reacts differently depending on the sensor type.
- Some combinations of materials in the thermowell / sensor and paste is not suitable.

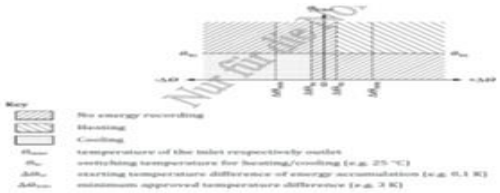
More knowledge about thermal paste is needed in order to ensure that temperature sensors can be disassembled after a longer exposure

Examples for work of SG 8

- Error - listing, to clarify EN 1434:2022 as amendment (quotation)

EN 1434-5:2022 (sign error in print version)

With respect to figure 1 in part 1 cl. 3.19.2
to be overworked



Input regarding to part 5 **cl. 6.7 energy-testing**
Complete meter **-> should be changed** (equal to cl. 6.4)

An example for the switching over from heating to cooling register and reversed is given in FprEN 1434-1:2022, Figure 1. It shall be tested that:

— heating energy shall only be recorded at $\Delta\theta > \Delta\theta_{hc}$ and at $\theta_{inlet} > \theta_{hc}$;

— cooling energy shall only be recorded at $\Delta\theta > \Delta\theta_{hc}$ and at $\theta_{inlet} < -\theta_{hc}$.

in cl. 6.7 to be changed as

Additional test for bifunctional meters for change-over systems between heating and cooling:

An example for the switching over from heating to cooling register and reversed is given in FprEN 1434-1:2022, Figure 1.

It shall be tested that:

— heating energy shall only be recorded at $\Delta\theta > \Delta\theta_{hc}$ and at $\theta_{inlet} > \theta_{hc}$.

— cooling energy shall only be recorded at $\Delta\theta < -\Delta\theta_{hc}$ and at $\theta_{inlet} < \theta_{hc}$.

- Error - listing, to clarify EN 1434:2022 as amendment (quotation of examples):

Part 4, Annex D Asymmetric swirl generator

Table D.2 with its columns H and S show wrong numbers of boreholes with their angles.
E.g. for DN 80, the calculation of (H) 8 boreholes times (S) 22 ½ ° is only a half circle (180 °).

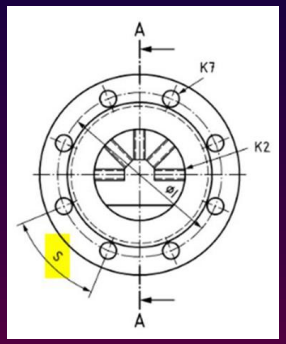


Table D.2 — Dimensions for the wafer type asymmetric swirl generator (see Figure D.2) with general tolerance class m according to ISO 2768

DN	A	B	C	D	E	G	H	I	J	K	L	N	O	R	S
50	—	104	50					125				1,57 1,52	18	—	45°
65	—	124	65	36	33	21					54,28	185	1,57 1,52	1	
80	—	139	80					160					1,57 1,52	18	—	22 1/2°
100	—	159	100	53		33,6	50,8	8	180	1,5	7	83,50	1,57 1,52	18	—	22 1/2°

to be changed by CEN/TC176/WG2 document no. N 948

In the test description in chapter 7.22 Flow disturbances are prescribed rotations around axis in steps of each 45 ° resulting in four uniformly distributed testing positions:

> Firstly, the ASG shall be orientated with the segmental orifice plate directed upwards (top orientation). Afterwards, the ASG shall be rotated around the pipe axis for three times in the clockwise direction (looking upstream) in steps of each 45° (±5°), resulting in four uniformly distributed testing positions.

➔ With this, in table D.2 the numbers of flanges (H) have to be doubled and the angles (S) have to be halved with respect to the top orientation for the first borehole of the orifice plate.

➔ Additional to this, the elaboration under K 6 ‘maschine housing 3.2 µm all over’ surface is not exact explained for all sections of the swirl generator, so detailed elaborations are necessary (e.g. for the fans).

Mittwoch 18. September 2024 / Wednesday 18 September 2024

Messwesen, Normung, Prüfprogramme, Konformitätsuntersuchungen
Legal Metrology, standardization, test programs, conformity assessments

ab/from 08:45	Registrierung/ Registration	G. Eichhorn
09:00 – 09:10	Eröffnung, Begrüßung (durch den Vorstand) *Welcome / Opening (by the management board)*	J. Rose, J. Wien, H. Spoor
09:10 – 09:40 09:40 – 09.55	Gesetzliches Messwesen, Entwicklungen Technischer Richtlinien und PTB-Anforderungen *Legal metrology, developments of technical guidelines and PTB requirements* Diskussion / *Discussion*	S. Baack PTB
09:55 – 10:10 10.10 – 10:20	Workitems zur Entwicklung der EN 1434 *Work items for the development of EN 1434* Diskussion / *Discussion*	J. Rose, PTB
10:20 – 10:50	*Kaffeepause / coffee break*	
10:50 – 11:00 11:00 – 11:10	Die Revision der OIML R 75 *The Revision of OIML R 75* Diskussion / *Discussion*	K. Jousten, PTB
11:10 – 11:25 11:25 – 11:40	Metrologie schnellansprechender Wärmezähler - Aktueller Status von Projekt & Prüfstand Metrology of fast-responding thermal energy meters - current state of the project and the testing facility Diskussion / *Discussion*	M. Kühn, PTB
11:40 – 12:00 12:00 – 12:15	WÄRMEENERGIEZÄHLER Schnelles Prüfverfahren für den kompletten Zähler und die Teilgeräte *THERMAL ENERGY METER* *Fast response test method for complete meter and subassembly* Diskussion / *Discussion*	Luisfilippo Lanza Hemina S.p.A.

12:15 – 13:00	*Mittagessen / lunch*	
13:00 – 13:20 13:20 – 13:35	Messung der Ansprechzeit im Kontext der Zulassung und der Qualitätssicherung für die Fertigung von TEM-Temperaturfühler *Measurement of the response time in the context of approval and quality assurance for the production of TEM-temperature probes* Diskussion / *Discussion*	P. Hermann, Testo Sensor GmbH
13:35 – 13:55 13:55 – 14:10	Qualifizierende Eintauchtiefe von ø 5,2 mm Temperaturfühlern – Experimentelle Bestimmung in verschiedenen Aufbauten sowie eine kritische Diskussion über Einflussgrößen und der Testbeschreibung in EN 1434 und EN IEC 60751 *Qualifying immersion depth of ø 5.2 mm temperature probes – Experimental determination in different set-ups and a critical discussion about influence quantities and the test description in EN 1434 and EN IEC 60751* Diskussion / *Discussion*	Ivan Jursic Jumo
14:10 – 14:30	*Kaffeepause / coffee break*	
14:30 – 14:50 14:50 – 15:05	Thermische Ansprechzeit von kurzen direkten Temperaturfühlern – Experimentelle Bestimmung in verschiedenen Aufbauten und Konsequenzen in einer realen Installation *Thermal response time of short direct sensors – Experimental determination in different set-ups and consequences in a real installation* Diskussion / *Discussion*	C. Bombis, Kamstrup
15:15 – 22:00	*Ausflug Chiemsee + gemeinsames Abendessen / Trip to Chiemsee + dinner*	

EMATEM

Donnerstag 19. September 2024 / Thursday 19 September 2024

Messverfahren, Messtechnik, Praxisberichte *Measurement method, Measurement technology, Field reports*		
09:00 - 09:20	„AGFW- Ringversuch Durchflusssensoren 2023 in staatlich anerkannten Prüfstellen für Wärme“ Methodik, Auswertungsansätze, Ergebnisse, Erkenntnisse für zukünftige Ringversuche *“AGFW - intercomparison of flow in State-approved testing facilities for thermal energy 2023”* *Methodologies, evaluation, results, findings for future intercomparisons*	N. Mathies, Krohne Messtechnik
09:20 – 09:35	Diskussion / *Discussion*	
09:35 – 09:55	Überprüfung des EN 1434 Strömungsstörungstests und dessen Weiterentwicklung *Review of the EN 1434 flow disturbance test and its ongoing development*	K. Hertha-Dunkel, St. Rademacher PTB/WSG
09:55 – 10:10	Diskussion / *Discussion*	
10:10 – 10:40	*Kaffeepause / coffee break*	
10:40 – 11:20	FEM-Simulation zur Konzeptionierung eines schnellansprechenden Temperaturfühlers/ *FEM-modeling for concept design of fast-responding temperature probes*	T. Lapp, JUMO
	Vorstellung zum Forschungsprojekt: Innovative Ansätze zur Verbesserung der Genauigkeit thermischer Energiemessung durch Simulation und Analyse der Einbaustellen *Introduction to the research project: Innovative approaches to improving the accuracy of thermal energy measurement by simulating and analysing the installation points*	D.Bott, JUMO
11:20 – 11:35	Diskussion / *Discussion*	
11:35 – 11:55	Projekt MoniGeoFluid – Flüssigkeits-Monitoring in kalten Nahwärmenetzen Systembeschreibung, Labor- und Felduntersuchungen mit verschiedenen Flüssigkeiten, Energiemessung, Anforderungen aus Anwendersicht *Project MoniGeoFluid – Fluid monitoring in low temperature district heating/cooling networks* *System description, lab and field investigations with various liquids, energy metering, application requirements*	M. Lugmair, P. Holoch, FH Salzburg / Belimo
11:55 – 12:10	Diskussion / *Discussion*	
12:10 – 13:00	*Mittagessen / lunch*	
13:00 – 13:20	Erkenntnisse und Ableitungen für die Wohnungswirtschaft aus der Techem-Verbrauchskennwertestudie 2022 / 2023 *Findings and conclusions for the German housing industry from the Techem consumption data study 2022/2023*	A. Kähler, Techem/TRIOS
13:20 – 13:35	Diskussion / *Discussion*	
13:35 – 13:55	Verbrauchserfassung von mit Gebläse unterstützten Heizkörpern mit elektronischen Heizkostenverteilern *Determination of the consumption of radiators supported with ventilators with electronic heat cost allocators*	J. Wien, MINOL
13.55 – 14:10	Diskussion / *Discussion*	
14:10 – 14:30	Status Q-Sweep EMATEM Projekt *Status Q-Sweep EMATEM Project*	H. Spoor, Sontex S.A. (A. Rombach)
14:30 – 14:45	Diskussion / *Discussion*	
14.45 – 15:00	Zusammenfassung / Ausblick *Summary / Outlook*	J. Rose, J. Wien, H. Spoor
	Abreise / Departure	

EMATEM

Example for work of SG 3

- Flow profiles in water and water glycol solution networks, e.g. 90 ° bend and double bend out of plane, influences on accuracy caused by disturbed profiles, field situations, CFD simulations and measurements
  -> established steps in EN 1434-4:2022 only *for water*

The asymmetric swirl disturbance generator: Towards a realistic and reproducible standard

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Abstract

Flow meters are exposed to very disparate and usually adverse flow conditions produced by the pipe configuration at the installation location. These so-called installation effects may affect the accuracy of the flow measurement. Within performance tests of water, heat, and cooling meters at flow laboratories, a selection of such installation effects are emulated by standardized disturbance generators. In particular, the standardized swirl disturbance generator is designed to reproduce the flow conditions downstream from a double-bend out of plane, a common installation in realistic pipe networks. However, recent studies suggest that tests with standardized swirl disturbance generators might not be sufficiently reproducible due to instabilities generating random flow patterns downstream. Here, we analyze the flow profile generated by a novel asymmetric swirl disturbance generator using laser-Doppler velocimetry. Our results suggest that the asymmetric swirl disturbance generator produces flow disturbances with similar features as those downstream from a double-bend out of plane. In consequence, the asymmetric flow disturbance generator is a good candidate for more reproducible and realistic tests of installation effects at flow laboratories and shall replace the actual swirl generator in the standards.

https://ematem.org/wp-content/uploads/2020/02/12-Straka_-Segmental-orifice-plates-and-their-practical-relevance-on-flow-meter-test-rigs.pdf

EMATEM 20th International Summer School

Seeon 18.09.2024 – 19.09.2024

Aktuelle Probleme der Wärmemengen- und Durchflussmesstechnik

Recent problems in measurements of thermal energy and flow

Overview and concept about activities in standardization at CEN TC - revisions of EN 1434 by ongoing work items

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Thanks to all lecturers and activists !

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