EMATEM - Summer School 2023

Seeon 20.09.2023 – 21.09.2023

Aktuelle Probleme der Wärmemengen- und Durchflussmesstechnik

Recent problems in measurements of thermal energy and flow

Overview about activities in standardization
at **CEN TC - revision of EN 1434**
by ongoing workitems

Dr.-Ing. Jürgen Rose

DIN NHRS Head SpA NA 041-03-05 AA
CEN TC 176 Convenor WG 2 - EN 1434
DAkkS Reviewer
EMATEM e.V.

EMATEM

Contexts

- Normen- und Richtlinienentwicklungen CEN TC 176 - EN 1434 zur Verminderung von Handelsbarrieren

  Developments in standardization at CEN TC 176 to avoidance trade barriers, ongoing by EN 1434

- Motivation EMATEM – TOPICS EMATEM Sommerschulen

  Motivation for projects, topics on EMATEM Summer Schools

- Normative Messgenauigkeitsbestimmung und Messbeständigkeiten im gesetzlichen Messwesen

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

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

EMATEM

European Metrology Association for Thermal Energy Measurement EMATEM e. V.

19. Internationale EMATEM-Sommerschule
19th International EMATEM-Summer School

Mittwoch 20. September 2023 / Wednesday 20 September 2023

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

ab/from 08:45	Registrierung/ Registration	G. Eichhorn
09:00 – 09:15	Eröffnung, Begrüßung (durch den Vorstand) *Welcome / Opening (by the management board)*	J. Rose, J. Wien, H. Spoor
09:15 – 10:00	Gesetzliches Messwesen, Entwicklungen Technischer Richtlinien und PTB-Anforderungen *Legal metrology, developments of technical guidelines and PTB requirements*	S. Baack PTB
	Workitems zur Entwicklung der EN 1434 *Work items for the development of EN 1434*	J. Rose, CEN TC 176 WG2
10:00 – 10:30	Konformitätsbewertungen für thermische Energiemessgeräte in Kanada *Thermal Energy Type Approval in Canada*	P. LeBlanc, Measurement Canada
10:30 – 11:00	*Kaffeepause / coffee break*	
11:00 – 11:30	Gesetz zum Neustart der Digitalisierung der Energiewende (GNDEW) - Submetering über ein Smart Meter Gateway im Fokus *Act to restart the digitalization of the energy transition (GNDEW) - focus on submetering via a smart meter gateway*	I. Stracke, Qundis GmbH
11:30 - 12:00	Duldung Bestandstauchhülsen in Deutschland / Umsetzung in Praxis für symmetrischen und asymmetrischen Einbau *Toleration of the field situation with existing pockets in Germany / Implementation in practice for symmetric al and asymmetric al installation*	D. Bott, Jumo GmbH
12:00 – 12:30	Feldsituation des Austausches kurzer Tauchhülsen / Relation von Einheiten Heizkostenverteiler zu Einheiten von Wärme in kWh und einige Ursachen *Situation of changing of short pockets in the field / relation between units of heatcost allocaters to energy units in kWh and some reasons for the relations*	J. Wien, Minol GmbH *)
12:30 – 13:30	*Mittagessen / lunch*	

*) weiterer Vortrag
F.Adunka: Jahresmessfehler bei Verwendung von Wärmezählern in Wohngebäuden
Behavior of annual measurement error with use of heat meters in residential buildings

13:30 – 14:00	Lifetime Testing für Lebensdauern oberhalb von 10 Jahren *Lifetime testing for lifetimes above 10 years*	P. Holoch, Belimo Automation AG
14:00 – 14:30	Lebensdaueruntersuchungen oberhalb von 10 Jahren *Lifetime tests above 10 years*	H. Spoor, Sontex S.A.
14:30 – 15:00	Modell zur Alterung von Temperaturfühlern unter zyklischer Temperaturbelastung für Aussagen zur Durability oberhalb von 10 Jahren *Model for the aging of temperature sensors under cyclic temperature loads for statements on durability above 10 years*	I. Jursic Jumo GmbH
15:00 – 15:30	*Kaffeepause / coffee break*	
15:30 – 16:00	Experimentelle und numerische Evaluierung der Fast-Response-Testmethode *Experimental and numerical evaluation of fast response test method*	L. Lanza, Hemina SPA
16:00 – 16:30	Auswirkung von Abtastintervallen auf die Messrichtigkeit von elektronischen Hauswasserzählern unter realen Verbrauchsbedingungen *Effect of sampling intervals on the measurement accuracy of electronic domestic water meters under real consumption conditions*	A. Borchling, PTB
16:30 – 17:00	Techem Verbrauchskennwerte-Studie 2022 - Erkenntnisse und Schlussfolgerungen *Techem Consumption Parameters Study 2022 - Insights and Conclusions*	A. Kähler, Techem GmbH **)
17:30 – 19:00	*Führung durch die Haustechnik* *Guided tour of the building technology* kurze Führung durch die Kirche mit einer anschließenden musikalischen Darbietung *hort guided tour of the church followed by a musical performance*	
19:30 – 22:00	*Abendprogramm / Evening program*	

**) abgesagt

Donnerstag 21. September 2023 / Thursday 21 September 2023

Messverfahren, Messtechnik, Praxisberichte
Measurement method, Measurement technology, Field reports

09:00 - 09:30	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
09:30 – 10:00	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
10:00 – 10:30	Entwicklung geeigneter Prüfstände zum messtechnischen Nachweis normativer Vorgaben für Temperaturfühler *Development of suitable test rigs for the metrological verification of normative specifications for temperature sensors*	P. Hermann, Testo Sensor
10:30 – 11:00	*Kaffeepause / coffee break*	
11:00 – 11:30	Neuer PTB-Prüfstand schnellansprechender Wärmezähler, Stand Projekt Metrologie schnellansprechender Messgeräte thermischer Energie *New PTB test rig for fast-response heat meters, status of Project Metrology for Fast-Response Thermal Energy Meters*	M. Kühn, PTB
11:30 – 12:00	Status Q-Sweep EMATEM Projekt *Status Q-Sweep EMATEM Project*	H. Spoor, Sontex S.A. (A. Rombach)
12:00 – 12:30	Statisch thermische Messabweichungen von Industriethermometern *Static thermal measurement deviations of industrial thermometers*	P. Pasemann, (Endress + Hauser Deutschland)
12:30 – 12:45	Zusammenfassung / Ausblick *Summary / Outlook*	
12:45 – 13:45	*Mittagessen / lunch*	
	Abreise / Departure	

Es werden wieder Simultanübersetzungen englisch / deutsch und deutsch / englisch angeboten.

Simultaneous translations will be offered in English / German and German / English.

Harmonized Standards and Normative Documents

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

April 2022

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

Items of recent version EN 1434:2022

1. Complete clauses 12.4 "Maintenance instructions" and 12.5 "Hints for disposal instructions" of EN 1434-1 by instructions on how to separate different parts of meters before disposal
2. Clarify specifications for "Fast response meters", Annex C of 1434-1 "Define time based and volume based measurement principles.", for EN 1434-4 - description of test procedures (EN 1434-5 - nothing has to be done)
3. Test possibilities for testing complete meters in field: Clause 7a of EN 1434-2 (after the list) - add a requirement to make it possible to dismantle temperature sensors for testing the sensors itself in field, for EN 1434-4 and EN 1434-5 - test methods for complete meters without using of bathes
4. Clause 7.8.2.4 of EN 1434-4: A more than 10 year durability test - check if additional tests are necessary
5. Standardized user interactions and display indications (symbols) including error messages for commissioning of heat and cooling meters as informative annex
6. Clarification of state of the art in measuring energy using liquids other than water (e.g. water/glycol solutions)
7. Clarify if it's possible to make realistic recommendations for conditioning the test water for durability tests, source paper CEN/TC 176/WG 2 N 183
8. New clock wise swirl disturbance body instead of part 4, cl.7.22 - prevent instabilities of disturbance generation
9. Cellular phone disturbances in close proximity to the meter
10. Influences on performances coming by pumps, steps in tubes and conical valves
11. Revision of the CEN report "Installation of heat meters"

https://ematem.org/wp-content/uploads/2022/11/01_Rose_gesetzliches_MW.pdf

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EN 1434:2022

CEN/TC 176 "Thermal energy meters"
Secretariat: **SIS**
Secretary: **Beqiri Bledar Mr**

Result of voting

(National Members having abstained are not counted in this vote.)

Approved by National Members

National Members approving: 13
National Members disapproving: 0
Number of Members approving: 100.000 % (requirement >= 55 %)
Weighted percentage of Population approving: 100.000 % (requirement >= 65 %)

Steps:
finished final template-sessions by HAS-consultants, 13.09.2022 document no. CEN/TC 176 N 614 -> out for translation into German and French
(done in July 2022)

https://www.din.de/de/meta/suche/62730!search?query=DIN+EN+1434&submit-btn=Submit

-> **Publication in 'The Official Journal'** *to let free as harmonized standard according to MID !*

Meeting CEN TC 176 WG 2 on 18.04.2023 document no. N 924, TOP 4

Mr. **Beqiri** informed the meeting that in February the old version of EN 1434-series was withdrawn from the list of harmonized standards in the Official Journal of the European Commission (OJEC) and that the new version was not introduced yet.
The desk officer in the European Commission responsible for the new listing was constantly requested by CMC to fulfil his task up to now without success.

The meeting agreed that new standards should be followed despite the fact they were not listed in the OJEC yet.

https://single-market-economy.ec.europa.eu/system/files/2021-10/2014_32_EU%20Measuring%20Instruments_Summary%20list%20of%20harmonised%20standards_Generated%20on%2031.08.2021.pdf

Legislation reference (A)	ESO (B)	Reference number of the standard (C)	Title of the standard (D)	Date of start of presumption of conformity (1)	OJ reference for publication in OJ (2)	Restriction (3)	Date of start of presumption of conformity with restriction (4)	OJ reference for publication of a restriction in OJ (5)	Date of withdrawal from OJ (end of presumption of conformity) (6)	OJ reference for withdrawal from OJ (7)
						apply: (i) EN ISO 4892-3:2016; (ii) ISO 7724-3:1984				
2014/32/EU	CEN	EN 1434-1:2007	Heat meters - Part 1: General requirements	20/04/2016	OJ C 218 - 24/07/2012	-		-	26/02/2023	OJ L 302 - 26/08/2021
2014/32/EU	CEN	EN 1434-2:2007, EN 1434-2:2007/AC:2007	Heat meters - Part 2: Constructional requirements	20/04/2016	OJ C 218 - 24/07/2012	-		-	26/02/2023	OJ L 302 - 26/08/2021
2014/32/EU	CEN	EN 1434-4:2007, EN 1434-4:2007/AC:2007	Heat meters - Part 4: Pattern approval tests	20/04/2016	OJ C 218 - 24/07/2012	-		-	26/02/2023	OJ L 302 - 26/08/2021
2014/32/EU	CEN	EN 1434-5:2007	Heat meters - Part 5: Initial verification tests	20/04/2016	OJ C 218 - 24/07/2012	-		-	26/02/2023	OJ L 302 - 26/08/2021
2014/32/EU	CEN	EN 12261:2002, EN 12261:2002/AC:2003, EN 12261:2002/A1:2006	Gas meters - Turbine gas meters	20/04/2016	OJ C 218 - 24/07/2012	-		-	26/02/2023	OJ L 302 - 26/08/2021
						Restrictions: for the purposes of				

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

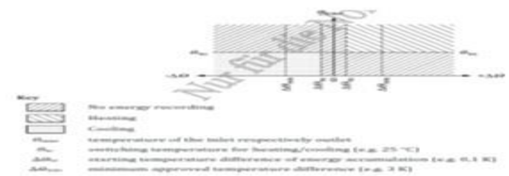
Additional work items for the Working Group 2 in 2023

- New version of CEN/TR 13582 “Installation of thermal energy meters - Guidelines for the selection, installation and operation of thermal energy meters”

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

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 $\theta_{inlet} < \theta_{hc}$.

Additional work items for the Working Group 2 in 2023

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

Part 1, chapter 6.6

The wording reflects only to '*liquids <u>other</u> than water'* and has to be enlarged to all heat conveying liquids including the water medium. New wording has to be harmonized in sense of part 6, chapter 4.1.1.

In part 1, chapter 6.6, the sentence "The difference in measuring result with and without specified pockets shall be within ½ of the MPE" shall be switched to the beginning of this chapter.

6.6 Effect on temperature sensor pairs by mounting in pockets **Part 1**

Pockets in circuits with heat-conveying liquid other than water may be used starting from meter size q_p 6 m³/h. For smaller meters, the temperature sensors shall be installed directly immersed. The difference in measuring result with and without specified pockets shall be within 1/2 of the MPE.

4.1 Design requirements **Part 6**

4.1.1 When designing the heating and cooling system, the thermal energy meter's manufacturer specification and installation instructions shall be followed. The design shall make monitoring and maintenance possible. An example is given in Annex B.

For q_p 6 m³/h and less, it is recommended to use direct short sensors. To achieve good temperature sensitivity, direct sensors should be installed without temperature pockets. Temperature pockets should only be used when required for safety reasons.

These installation points shall be insulated in accordance with the applicable legal regulations or other technical measures shall be taken to reduce dissipation errors.

Additional work items for the Working Group 2 in 2023

- 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 °).

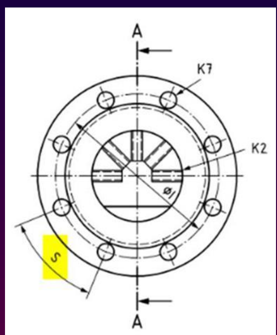


Table D.2 — Dimensions for the wafer type asymmetric swirl generator (see Figure D.2) with general tolerance class m according to ISO 2768

DN	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	R	S
50	—	104	50	28	25	16,9	25,5	4	125	1,5	7	41,75	165	1,57 1,52	18	—	45°
65	—	124	65	36	33	21,9	33,4	4	145	1,5	7	54,28	185	1,57 1,52	18	—	45°
80	—	139	80	43	40	26,9	40,6	8	160	1,5	7	66,80	200	1,57 1,52	18	—	22 1/2°
100	—	159	100	53	50	33,6	50,8	8	180	1,5	7	83,50	220	1,57 1,52	18	—	22 1/2°

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).

Work Item to further revisions of EN 1434

- 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

Thermal energy meters — Part 1: General requirements

Thermische Energiemessgeräte — Teil 1: Allgemeine Anforderungen

Compteurs d'énergie thermique — Partie 1: Prescriptions générales

3.9
types of errors

3.9.1
error of indication
indication of the measuring instrument minus the conventional true value of the measurand

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

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

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

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

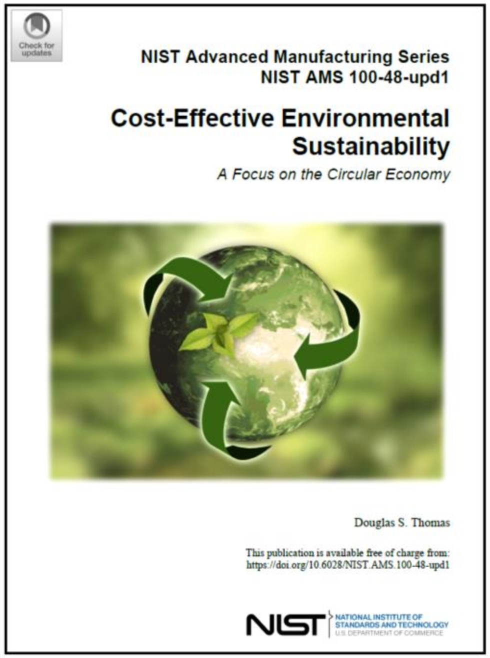
Attention !

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

At first an accepted term (definition) of 'life-time' has to be created.

Durability acc.to MID under scope of legal metrology meeting the MPE and 'Product Life Expectancy with Repairability' under aspect of subsequent verifications

-> Examples to state-of-the-art of durability of electronics in calculators, see recent AGFW - studies
(in lesson of S.Baack)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https://www.nist.gov/el/applied-economics-office/manufacturing/circular-economy/product-longevity

NIST AMS 100-48-upd1
May 2023

Executive Summary

This report focuses on understanding the processes, forces, and decision making that result in an unsustainable economy. It further seeks to identify cost effective solutions to alter these decisions. The unsustainable economy (i.e., an economy that expends limited effort to preserve resources) is, typically, a result of decisions made by individuals and firms from their stakeholder perspective. It develops primarily as a result of a misalignment of incentives where those that bear the costs of increased sustainability do not receive commensurate benefits. Successful solutions to this problem will tend to alter the economy so that the logical and rational outcome for the individual or business matches that of society. Alternatively, successful solutions might mitigate negative outcomes. This report focuses on standards and technologies as a solution to facilitating a more sustainable economy. Four means of achieving sustainability are identified: increasing product longevity, reusing/repairing products, reducing material and energy use, and recycling.

Product Life Expectancy and Repairability: Extending the useful life of products is an effective means for reducing environmental impact for durable goods (e.g., automobiles, machinery, computers, and appliances). Three means for extending the use of a product is to design the product to last longer, reusing a product, and repairing a product rather than discarding it. A 50 % increase in life expectancy of a product decreases the needed replacements by up to approximately 33 %, which can equate to a 33 % reduction in environmental impact to produce that type of good and a potential savings of up to $316.6 billion in U.S. consumer savings. A 100 % increase in life expectancy reduces needed replacements by up to 50 %, which can equate to up to a 50 % reduction in environmental and up to $474.9 billion in savings. Note that these are upper bound estimates. Producers have limited means for signaling their product has a longer life expectancy, likely resulting in decreased sales of long-life expectancy products. The following needs were identified:

- Ability to differentiate product brands and models by life-expectancy
- Ability to differentiate product brands and models by repairability

Work Item to further revisions of EN 1434

- 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

5.1 Durability tests for flow sensors with more than 10 years for water and for heat conveying liquids other than water

Motivation based on EN 1434-4, cl. 7.8.1 **CEN TC 176 WG 2**

7.8 Durability test

7.8.1 General

In order to determine the durability of the thermal energy meter, sub-assemblies of the thermal energy meters shall be subject to accelerated wear tests as far as such tests are reasonable for the pattern.

- *For flow sensor's hydraulic in contact with heat conveying liquids, there are some suggestions of WG 2, see stand in document N 892*
- Companions' analyses for entire flow sensors show that predictions of *the durability shall be enlarged for their* ***electronic components, electric connectors and p-c boards***

Work Item to further revisions of EN 1434

- 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

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

CEN TC 176 WG 2

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)

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.

Work Item to further revisions of EN 1434

- 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

CEN/TC 176/WG 2 **N 892**

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

Durability of flow sensors

Document type	Related content	Document date	Expected action
Project / Other	Meeting: VIRTUAL 23 Mar 2022	2022-04-05	INFO

Table Y — Accelerated test procedures

Estimated durability period	Mechanical flow sensors	Static flow sensors
5 years	4000 flow rate load changes	4000 temperature load changes
10 years	8000 flow rate load changes	8000 temperature load changes
15 years	16000 flow rate load changes	16000 temperature load changes
20 years	24000 flow rate load changes	24000 temperature load changes

After the test the error of indication shall be determined at the flow rates stated in 7.4.2 at (50 ± 5) °C for heating applications or (15 ± 5) °C for cooling applications.

No significant error shall occur.

Work Item to further revisions of EN 1434

- 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

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***

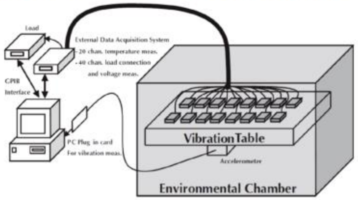
Highly Accelerated Life Test strategies for safeguarding durability with its tool Highly Accelerated Stress Screening

e.g.

*) **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

Work Item to further revisions of EN 1434

- 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

Lifetime Testing für Lebensdauern oberhalb von 10 Jahren *Lifetime testing for lifetimes above 10 years*	P. Holoch, Belimo Automation AG
Lebensdaueruntersuchungen oberhalb von 10 Jahren *Lifetime tests above 10 years*	H. Spoor, Sontex S.A.
Modell zur Alterung von Temperaturfühlern unter zyklischer Temperaturbelastung für Aussagen zur Durability oberhalb von 10 Jahren *Model for the aging of temperature sensors under cyclic temperature loads for statements on durability above 10 years*	I. Jursic Jumo GmbH
Entwicklung geeigneter Prüfstände zum messtechnischen Nachweis normativer Vorgaben für Temperaturfühler *Development of suitable test rigs for the metrological verification of normative specifications for temperature sensors*	P. Hermann, Testo Sensor
Statisch thermische Messabweichungen von Industriethermometern *Static thermal measurement deviations of industrial thermometers*	P. Pasemann, (Endress + Hauser Deutschland)

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

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

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

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

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

— temperature sampling time/ temperature sampling time interval:

≤ 4 Seconds (non-residential buildings, e.g. medical practice);

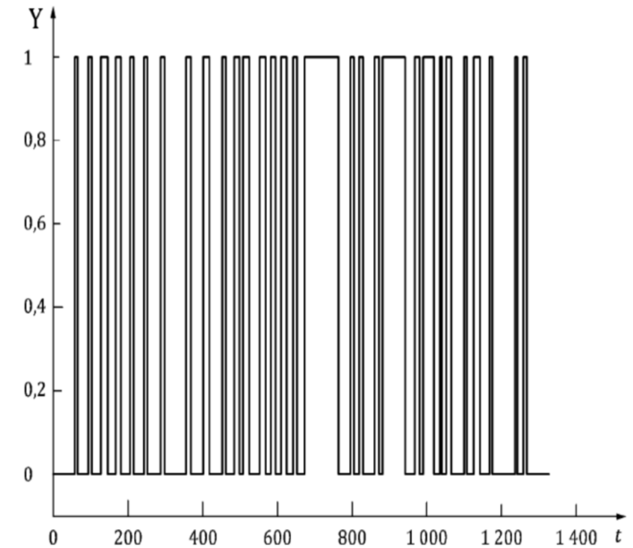
≤ 8 Seconds (family houses, multi apartment / residential buildings);

— volume sampling time / volume sampling time interval:

≤ 2 Seconds (non-residential buildings and family houses);

— integration time shall not be longer than the maximum of the sampling time for volume or temperature.

Volumetric testregime acc. to EN 1434-4:2022



Key

t	time [s]
Y	q_p

Figure 1 — Tapping profile for fast response flow sensor/meter test. The flow is switching between 0 x q_p and 1 x q_p. Flow and Pause times are varying according to Table 5

https://ematem.org/wp-content/uploads/2022/11/01_Rose_gesetzliches_MW.pdf

Work Item to further revisions of EN 1434

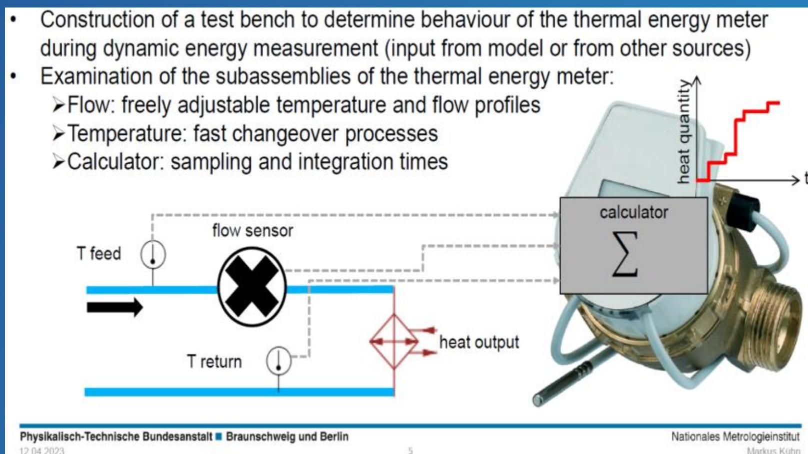
- Fast response measuring, to define energy tests for combined meters and calculators, adaptive modes

Experimentelle und numerische Evaluierung der Fast-Response-Testmethode *Experimental and numerical evaluation of fast response test method*	L. Lanza, Hemina SPA
Auswirkung von Abtastintervallen auf die Messrichtigkeit von elektronischen Hauswasserzählern unter realen Verbrauchsbedingungen *Effect of sampling intervals on the measurement accuracy of electronic domestic water meters under real consumption conditions*	A. Borchling, PTB

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

Work Item to further revisions of EN 1434

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



Neuer PTB-Prüfstand schnellansprechender Wärmezähler, Stand Projekt Metrologie schnellansprechender Messgeräte thermischer Energie *New PTB test rig for fast-response heat meters, status of Project Metrology for Fast-Response Thermal Energy Meters*	M. Kühn, PTB

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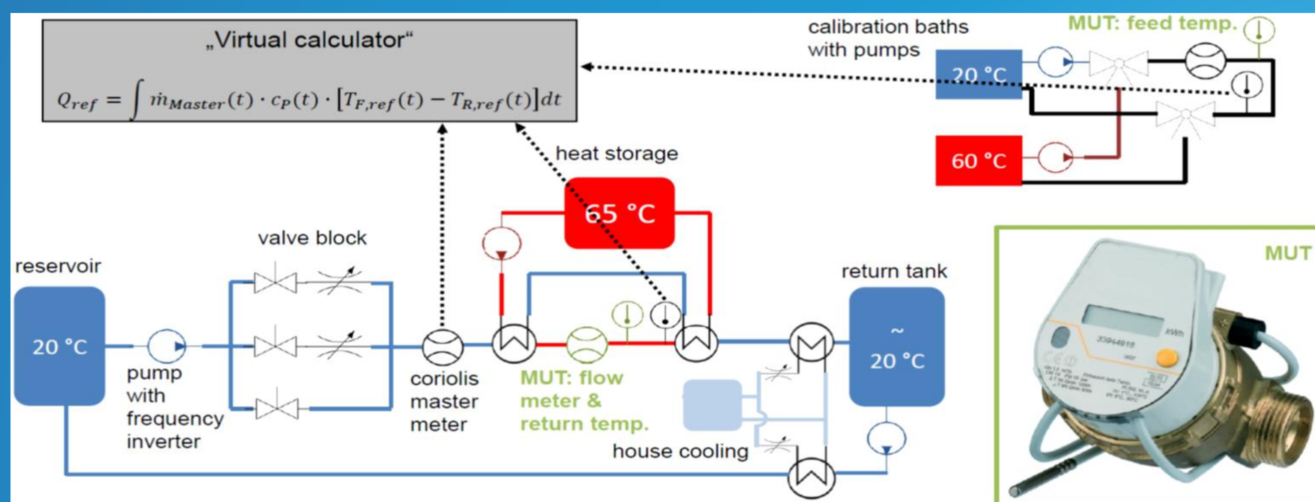

Work Item to further revisions of EN 1434

- 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

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Work Item to further revisions of EN 1434

- 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 *for water*

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

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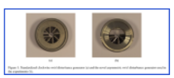


Abstract

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.

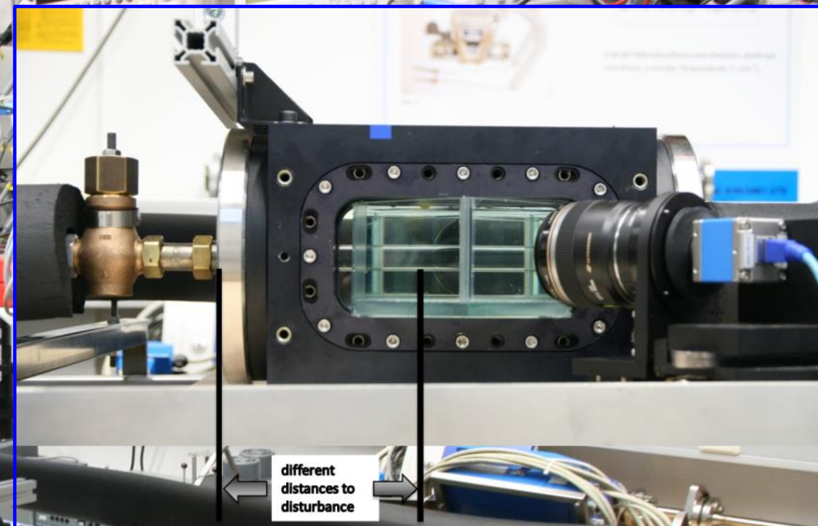
https://ematem.org/wp-content/uploads/2020/02/12-Straka_-Segmental-orifice-plates-and-their-practical-relevance-on-flow-meter-test-rigs.pdf

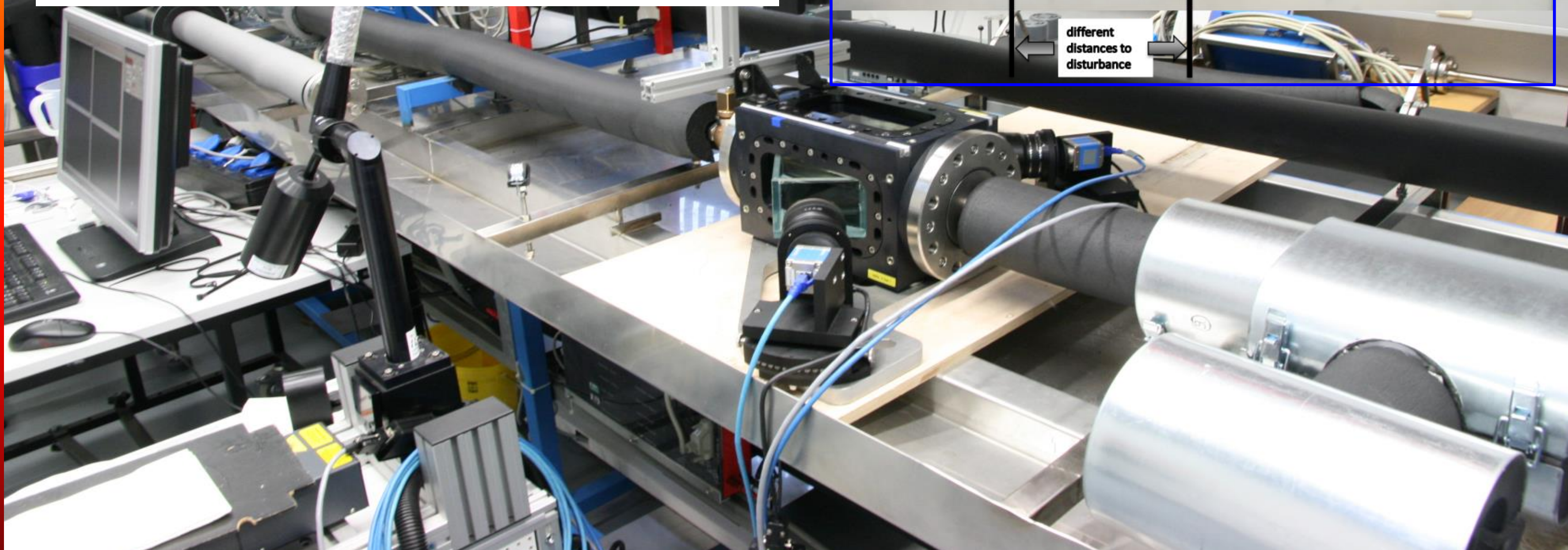
Laser Profile measurements with LDV, PIV

- **September 2023: ongoing due to recent funding by the German furtherance project for technology, science, patents and standardization**

  Richtlinie zur Förderung des Technologie- und Wissenstransfers durch Patente, Normung und Standardisierung zur wirtschaftlichen Verwertung innovativer Ideen von Hochschulen und Unternehmen "WIPANO - Wissens- und Technologietransfer durch Patente und Normen"

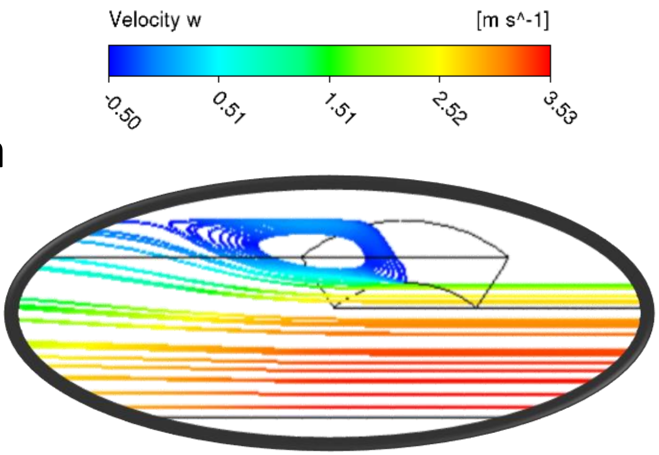
Bundesministerium für Wirtschaft und Klimaschutz





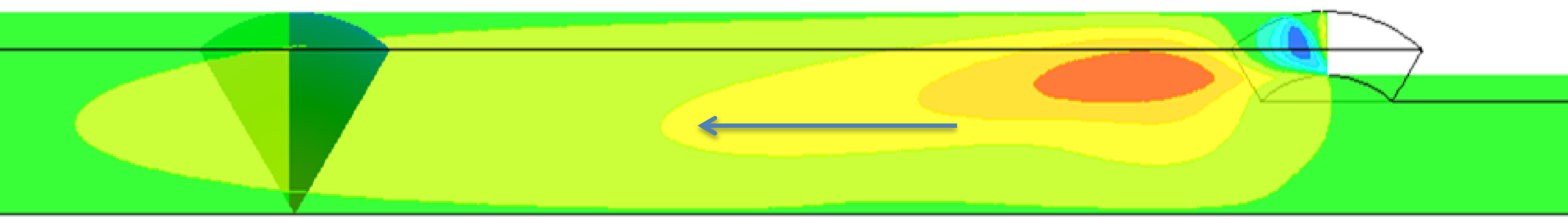
Ø - step of 12 mm onto 17.5 mm (Diffusor)

- flow has lost behind the step
- dead water area with swirl up to z/d = 1 ... 2
  with cut off profile area
- flow sensors are located outside of the lost area
- upstairs to the flow -> charper profiles
- disturbance are equalized only at:
  - 20 diameters in laminar case
  - 40 diameters in turbulent case

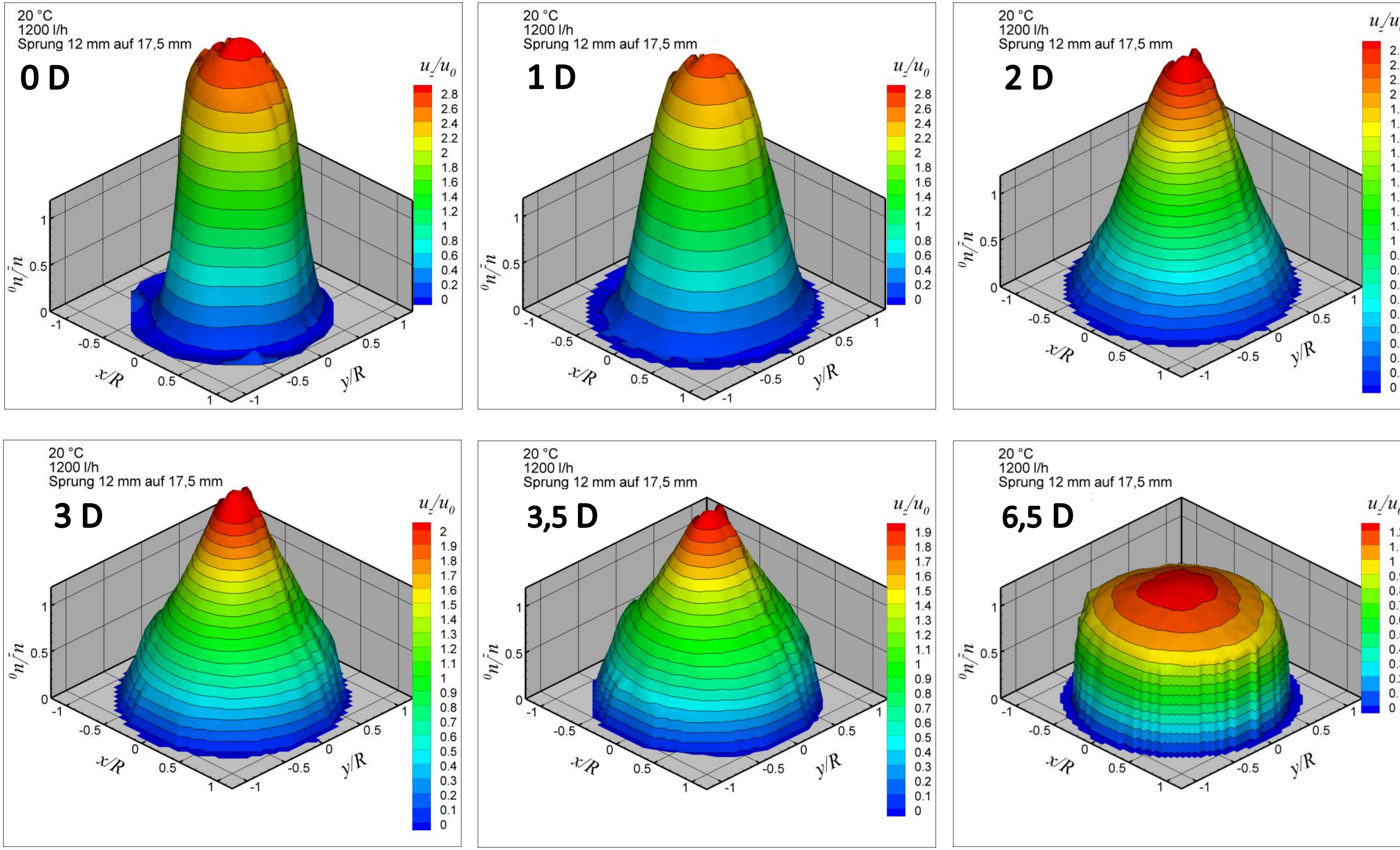


SPIV measuring area

Step 12 mm -> 17.5 mm



SPIV profiles at 1200 l/h with different distances behind the step



Work Item to further revisions of EN 1434

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

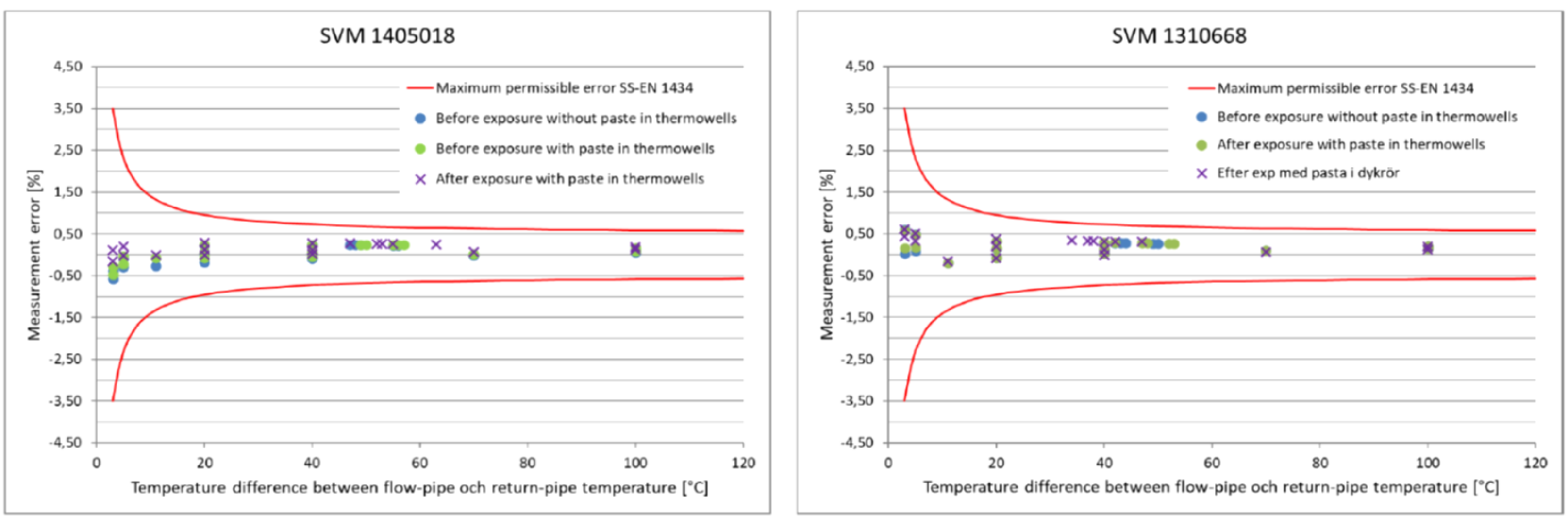
CEN/TC 176/WG 2 **N 926**

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)



Work Item to further revisions of EN 1434

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

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)

RISE – Research Institutes of Sweden

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

EMATEM - Summer School 2023
Seeon 20.09.2023 – 21.09.2023

Aktuelle Probleme der Wärmemengen- und Durchflussmesstechnik

Recent problems in measurements of thermal energy and flow

Overview about activities on standardization at **CEN TC - revision of EN 1434** by ongoing workitems

Thanks to all lecturers and activists !

Dr.-Ing. Jürgen Rose

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