MINUTES

of the 16th meeting of the COOMET Technical Committee TC 1.10 "Thermometry and Thermophysics"

All-Russian Scientific Research Institute for Physical-Engineering and Radiotechnical Metrology

VNIIFTRI East-Siberian Branch

27-29 August 2019, Irkutsk, the Russian Federation

1. Opening of the session. Greetings. Presentation of the participants of the meeting. Approving of the agenda.

VNIIFTRI East Siberian branch Deputy Director S. Morozov opened the meeting. Deputy Director addressed the participants of the meeting, delivered a welcome speech and wished all successful work.

The floor was then turned over to Chairperson of the COOMET Technical Committee TC 1.10 "Thermometry and Thermophysics" A. Pokhodun.

A. Pokhodun welcomed the TC Members, who were present at the meeting. The meeting was attended by the representatives of 10 COOMET Member Countries: Spain, Germany, Belarus, Kazakhstan, Moldova, the Russian Federation, Slovakia, Uzbekistan, Kyrgyzstan and Ukraine.

SPAIN
Mª Dolores del Campo Maldonado, Centro Espanol de Metrologia

GERMANY
Mr. Yu. Mikhaylov, Michell Instruments GmbH
Mrs. M. Beiso, Michell Instruments GmbH

BELARUS
Mrs. T. Dikun, BelGIM
Mr V. Givojno, Ltd. "POINT"

KAZAKHSTAN
Ms. K. Duysebaeva, KazInMetr, Almaty branch
Mr. N. Kadirov, KazinMetr, Almaty branch

MOLDOVA
Mr. K. Bordianu, NIM

RUSSIAN FEDERATION
Mr. A. Pokhodun, VNIIM
Mr. S. Morozov VNIIFTRI
Mr. Ya. Razhba, VNIIFTRI
Mr. S. Osadchiy, VNIIFTRI
Mr. Yu. Barbar, TKA Scientific Imstruments
Mr. A. Dikevich, Ltd. "Microfor"

Mr. A. Dikevich, Ltd. “Microfor”
Mr. A. Anashko, VNIIFTRI
Mr. A. Vinge, VNIIFTRI
Mr. M. Vinge, VNIIFTRI

SLOVAKIA
Mr. S. Djuris, Slovak Institute of Metrology
Mrs. S. Dyurisova, Slovak Institute of Metrology

UZBEKISTAN
Mr. D. Zakhirov, UzNIM

KYRGYZSTAN
Mrs. M. Denisova, NISM

UKRAINE
Mrs. S. Fil, NSC “Institute of Metrology”

The following agenda was approved:

1. Report on the activities of the COOMET Technical Committee TC 1.10 in 2018.

2. Report on the activities of the EURAMET Technical Committee TC-T.

3. On the implementation of the new definition of kelvin in practice. Discussion on the implementation of the new definition of kelvin in practice in COOMET Member States.

4. On the improvement of the structure and expansion of the activities of the COOMET Technical Committee TC 1.10. On the strategy development.

5. Discussion of the progress of work on COOMET projects in the field of “Thermometry and Thermophysics”. The course of work on the topics:

1) Project 704 / RU / 16 “Regional key comparisons of national temperature unit measurement standards at the triple point of mercury”.

2) Project 544 / RU-a / 11 “Regional comparisons of gas humidity measurement standards. Temperature of dew/frost point is from minus 50 °C to 20 °C”.

3) Project COOMET 768 / GE / 18 “Comparisons of the measurements of relative humidity instruments in the range of relative humidity (30-90)% at 23 °C.

4) Project 744 / RU / 18 “Comparisons in range of measurements of energy of combustion of coals with different concentrations of sulfur”.

5) Project 780 / RU / 19 “Comparisons of national standard gas calorimeters on gas mixture samples”.

6) Project COOMET 787 / UZ / 19 “Pilot comparisons of measurements in the field of calibration of platinum thermometers”.

6. About new devices of ensuring the uniformity of temperature measurements and other thermophysical quantities produced by enterprises of COOMET Member Countries.
7. The workshop on humidity.
8. About the place and time of the next meeting of the COOMET Technical Committee TC 1.10.
9. Closing of the session.

1. Report on the activities of the COOMET Technical Committee TC 1.10 in 2018.

Speaker: A. Pokhodun (VNIIM)

Chairperson of TC 1.10 A. Pokhodun identified the countries, national institutes of which actively participated in TC 1.10 projects: The Russian Federation, Germany, Slovakia, Cuba, Bosnia and Herzegovina, Uzbekistan, Georgia, Azerbaijan, Kyrgyzstan, Turkey, Kazakhstan, Moldova, Belarus and Ukraine.

The implementation of the mutual recognition agreement on calibration certificates for measurements of national measurement standards is one of the main activities of TC 1.10. To realize mutual trust, firstly, comparisons of national measurement standards are needed, and COOMET comparisons must be associated with comparisons of a consultative committee so that to determine the equivalence of national measurement standards in a common database.

The development of COOMET recommendations related to calibration of measuring instruments is another activity of TC 1.10 as well as informing the NMIs of COOMET about the activities of CCT and involving these institutes in CCT projects.

Chairperson of TC 1.10 noted that the Russian Federation is the only country, institutes of which are represented in the technical committee. Thus, it is only the Russian Federation that enables the other TC 1.10 Members to establish the equivalence of their national measurement standards, which is the main challenge today. Chairperson of TC 1.10 A. Pokhodun reminded that VNIIM carries out an expert examination of CMC entries from year to year. In this regard, the emphasis was placed on the need for active participation of other COOMET NMIs in performing the expert examination of CMC entries in the field of thermometry, thermophysics and humidity.

It was noted that a lot of NMIs are located far away from the pilot laboratory, for example, Cuba, which makes their participation in comparisons challenging.

Decisions

- *To take note of the information on the challenges faced by COOMET Technical Committee TC 1.10.*

- *The representative of NIM (Moldova) K. Bordianu proposed his initiative concerning the work with CMC entries.*

2. Report on the activities of the EURAMET Technical Committee TC-T.

The representative of EURAMET TC-T M[a] Dolores del Campo Maldonado presented a report on the structure, role of TC-T organization and projects, which EURAMET is involved in. TC-T is a forum for scientific and technical cooperation in the field of thermometry and related quantities. TC-T promotes the development and realization of research programs in metrology.

The structure of TC-T was presented, which consists of five groups: Working Group on Knowledge Transfer, Working Group on Humidity, Working Group on Thermophysical Quantities, Working Group on CMC entries, Working Group on Strategy.

The role of the TC-T Working Group on Strategy is to form all necessary structures for cooperation and research in order to ensure EURAMET TC-T permanent and timely fulfilment of tasks. The main tasks of this Working Group are: discussion and preparation of decisions, identification and recommendations of possible development and research priorities, encouragement of joint projects, liaison strengthening with stakeholders.

Several current comparisons at the regional level were summarized.

M[a] Dolores del Campo Maldonado specifically noted that the *InK2* project had been completed. As a result of this project it was possible to reduce the uncertainty in calculating the difference between T and T_{90}.

M[a] Dolores del Campo Maldonado announced the start of the *RealK* project in 2019. A common goal is to redefine the kelvin and realize it by:

- using the most well-tested realization methods for primary thermometry described in *MeP-K-19* and developing these methods for realization and dissemination for thermodynamic temperature with the same uncertainty or better than certain scales can offer;
- conducting studies on life extension for the current scale (ITS-90) in order to give other primary thermometry methods time to mature.

Chairperson of EURAMET TC-T also provided information on the *INCIPIT* project, which began in July 2019. This project has two goals: to develop calibration methods for instruments to measure liquid atmospheric precipitation and to evaluate the contribution of uncertainty components for these instruments.

TC-T publications were announced, which are under preparation: Guidelines on Surface Temperature Calibrators, Guidelines on Calibration of Radiation Thermometers, Guidelines on Calibration of Dew Point, Guidelines on Calibration of Thermal Diffusivity.

Decision

- *To take note of the information on the activities of EURAMET TC-T.*

3. On the implementation of the new definition of kelvin in practice. Discussion on the implementation of the new definition of kelvin in practice in COOMET Member States.

The representative of VNIIFTRI S. Osadchiy presented a presentation on the practical implementation of the new definition of kelvin in the range from 5 K to 273.16 K. The measurement results of two thermometers (platinum and acoustic) near the triple point of water were provided. The difference between the thermometers was 0.2 mK. Such studies will contribute greatly to laying the foundations of temperature dissemination in accordance with the new definition of kelvin. The problem with such measurements is that the realization of a measurement takes several months, so today the main task, which needs to be worked on, is to reduce this period of measurements, thereby reducing their cost.

S. Osadchiy provided information about the installation for relative acoustic gas thermometry by VNIIFTRI, which is located in the Institute.

The installation operates in the range from 4 K to 216 K. It is based on a cavity with a radius of 50 mm. The weight of the cavity is 10 kg. The main problem is high cost of cooling process. To cool the installation to 4 K, more than 100 litres of liquid helium are needed. In view of the above, VNIIFTRI is creating a new installation, which operates in the range from 4 K to 80 K on the basis of a cavity with a radius of 30 mm. The cavity weighs less, so cooling process costs less, respectively. In the near future, the installation will undergo various types of research.

The representative of VNIIIFTRI also informed that the development of equipment for realization of cryogenic fixed points in the range from 24 K to 273 K (the triple point of oxygen, neon, argon and mercury) is another important activity of the Institute. Experimental data on the realization of the triple point of oxygen were presented. As a result of three realizations of oxygen melting points, a good reproducibility is observed. The difference in the liquidus point is about 50 μK.

The triple point of water is fundamental in ITS-90, and the uncertainty of temperature reproducibility at the TPW is very important for practical thermometry. As a result of lengthy work the relative uncertainty of temperature reproducibility at the TPW is minimized and limited by the requirements for water composition. Thus, the combined standard uncertainty of temperature reproducibility at the TPW, as soon as the new definition of kelvin comes into force, will increase by the measurement uncertainty of the TPW thermodynamic temperature.

Chairperson of TC 1.10 A. Pokhodun presented a report on the practical realization of the new definition of kelvin in the field of high temperatures at VNIIM. The use of high-temperature fixed points based on phase changes of metal-carbon eutectics is proposed. The values of thermodynamic temperature as well as the uncertainty, which is obtained when realizing indirect methods, should already be assigned to the fixed points, which are used to realize this method. It is expected that these methods will provide the uncertainty, which is similar (or slightly higher) than primary radiometry offers. However, these methods will be much easier to realize.

The representative of NSC "Institute of Metrology" S. Fil identified the main advantages of relative primary methods:

- relatively low cost of equipment in comparison with absolute primary radiometric methods;
- a possibility of expanding the range to 3300 K with a fairly low uncertainty;
- reduced requirements for the value of relative spectral response function of a standard pyrometer;
- minimized uncertainty effects, which is associated with non-linearity of the characteristics of a standard pyrometer;
- a possibility of multi-point interpolation at n>3 using the least square adjustment method;
- a large number of fixed points, which provides additional reliability when realizing the scale.

NSC "Institute of Metrology" is currently working to improve its national measurement standard by creating a set of equipment to build a thermodynamic temperature scale based on high-temperature metal-carbon fixed points.

The representatives of the NMI from Belarus, Moldova, Uzbekistan and Kazakhstan reported a lack of demand and funding to establish measurement standards for the realization of the new definition of kelvin.

Decisions

- *To take note of the information on the practical realization of the new definition of kelvin in the field of low and high temperatures.*
- *To hold a workshop on the practical realization of the new definition of kelvin in COOMET.*

4. On the improvement of the structure and expansion of the activities of the COOMET Technical Committee TC 1.10. On the strategy development.

There was a discussion on possible activities of the COOMET Technical Committee TC 1.10. The participants of the meeting worked out a joint decision to create a Working Group on Strategy within COOMET TC 1.10.

It is assumed that this Working Group on Strategy will carry out research, identification and recommendations regarding possible development priorities of TC 1.10. This Working Group on Strategy will be also responsible for liaison strengthening with stakeholders.

Chairperson of TC 1.10 proposed to prepare a draft strategy document on the development of TC 1.10 for the next meeting of the technical committee.

Decision

- *To prepare a draft strategy document on the development of TC 1.10 for the next meeting of the technical committee.*

5. Discussion of the progress of work on COOMET projects in the field of "Thermometry and Thermophysics". The course of work on the topics:

1) Project 704 / RU / 16 "Regional key comparisons of national temperature unit measurement standards at the triple point of mercury".

Speaker: S. Osadchiy (VNIIIFTRI)

The coordinator of the Project is VNIIFTRI, the Russian Federation. The participants of the comparisons are: Belarus, Moldova, Kazakhstan, Georgia, Germany (PTB), Bosnia and Herzegovina, Georgia and VNIIFTRI. Bosnia and Herzegovina refused the comparisons. The comparisons involve transportation of standard stick platinum resistance thermometers belonging to a particular participant and to the coordinator. The comparison scheme provides for consistent graduation of the thermometers at the triple point of mercury of a participant, at the triple point of mercury of the coordinator's laboratory and re-graduation of the other participants' thermometers.

The comparison protocol is agreed. The first measurement stage is completed. The re-graduation of the NMI thermometers is in progress.

2) Project 544 / RU-a / 11 "Regional comparisons of gas humidity measurement standards. Temperature of dew/frost point is from minus 50 °C to 20 °C".

Speaker: A. Pokhodun (VNIIM)

The purpose of the comparisons is to determine the equivalence degree between the participating national metrological institutes when realizing local scales of dew/frost point temperature in the range from minus 50 °C to 20 °C. The comparison process was suspended indefinitely.

3) Project COOMET 768 / GE / 18 "Comparisons of the measurements of relative humidity instruments in the range of relative humidity (30-90)% at 23 °C.

Speaker: A. Pokhodun (VNIIM)

The results and protocol were sent for comments to the reviewer. The comments were received. The process of compliance with comments is in progress.

4) Project 744 / RU / 18 "Comparisons in range of measurements of energy of combustion of coals with different concentrations of sulfur".

Speaker: A. Pokhodun (VNIIM)

A new technical protocol was prepared. The results of inter-laboratory comparative tests were processed and the average value of the mass fraction of total sulfur in the selected coal samples was obtained. The initial mass of each coal sample was ground and pulverized. The packing of the samples to the participants (three for each) and preparation for transportation is in progress.

5) Project 780 / RU / 19 "Comparisons of national standard gas calorimeters on gas mixture samples".

Speaker: A. Pokhodun (VNIIM)

The comparisons are proposed to be carried out using samples of pure gases and gas mixtures in cylinders. The registration of this Project was conducted in COOMET. The responses to the questionnaire, which had been sent to the potential participants, were received. The participants of the comparisons are: PTB (Germany), Tubitak UME (Turkey) and VNIIM (The Russian Federation). A new version of the technical protocol has been prepared.

6) Project COOMET 787 / UZ / 19 "Pilot comparisons of measurements in the field of calibration of platinum thermometers".

Speaker: K. Bordianu (Moldova)

To confirm the equivalence of national measurement standards of Uzbekistan, the Project on pilot comparisons of measurements in the field of calibration of platinum thermometers is in progress. The participants are: NIM (Moldova) and UzNIM (Uzbekistan).

Decisions:

- *To take note of the information about the work on COOMET projects.*

- *The participants of the Project COOMET 544 / RU-a / 11 to respond appropriately to eliminate difficulties when performing the comparisons.*

6. About new devices of ensuring the uniformity of temperature measurements and other thermophysical quantities produced by enterprises of COOMET Member Countries.

Speakers: V. Givojno (Point), S. Osadchiy (VNIIFTRI).

The representative of POINT LLC (Belarus) reported on a new established humid air generator (HAG-001), which operates in the range of (2-98) % with instability of 0.2 % and accuracy of ± 1 %. He also informed that POINT LLC produces precision humidity meters; platinum thermometers of the 1 rank with an uncertainty of ± 0.01 °C.

The representative of VNIIFTRI (The Russian Federation) informed that VNIIFTRI produces both thermostats for low-temperature reference points and ampoules of reference points, as well as thermometers.

7. The workshop on humidity

A workshop on humidity was held. During this workshop the issues of metrological support for measurements of relative humidity in the serial production of thermohygrometers were considered.

The representative of the NMI of Slovakia S. Dyurisova presented a report on the humidity measurement standard and the main challenges in the unit transfer.

The representative of Michell Instruments GmbH Yu. Mikhaylov presented a list of standard equipment for reproducibility and measurement of gas humidity.

The representative of VNIIFTRI M. Vinge presented a presentation on the topic: "Improving the measurement standard of dew point and hydrocarbon condensation temperature". Gas quality is one of the most important indicators. Therefore, it is important to take into account gas humidity, including consideration at what pressure this humidity is measured. In view of

the above, the improved measurement standard will make it possible to take into account all gas parameters.

The reports by the representatives of VNIIFTRI S. Morozov and A. Anashko were listened to, who presented a humid gas generator MSVD-1 and a standard humid gas generator *SARMA*. Both generators have stable high reproducibility. S. Morozov noted that *SARMA* has a low error, which is ± 0.25 % at relative humidity and 0.2 °C at the dew point.

The representative of VNIIFTRI A. Vinge reported on the need for amendments to the State verification scheme for gas humidity measuring instruments.

Decisions

- *To take note of the information presented at the workshop on humidity.*
- *To hold annually a workshop on humidity as a part of the TC 1.10 meeting.*
- *To publish the heard reports in the editions "Pribor" or "Izmeritel`naya Tekhnika".*

8. About the place and time of the next meeting of the COOMET Technical Committee TC 1.10.

The representative of VNIIFTRI S. Osadchiy proposed to hold the next session in September 2019 in the city of Moscow (The Russian Federation) based on VNIIFTRI.

Decision

- *To decide to hold the next meeting of the COOMET Technical Committee TC 1.10 in Moscow till the end of 2019.*

9. Closing of the session.

Chairperson of the COOMET Technical Committee TC 1.10 "Thermometry and Thermophysics" prof. A Pokhodun thanked the participants of the meeting for their active work and the organizers for the high level of preparation and holding of the meeting.

Chairperson of TC 1.10 A. Pokhodun

Secretary of TC 1.10 S. Fil