

VNIIM report to CCM 2022

Mass and Related Quantities

State Primary Measurement Standard of Unit of Mass – Kilogram (GET 3)

On December 08, 2022, the 26th Online Meeting of COOMET TC 1.6 “Mass and Related Quantities” was conducted. More than 40 representatives from the following 11 COOMET Member Countries participated in the meeting: Azerbaijan, Armenia, Belarus, Bosnia and Herzegovina, Georgia, Kazakhstan, Kyrgyzstan, Cuba, Russia, Tajikistan, and Uzbekistan.

State Primary Measurement Standard of Unit of Density (GET 18)

In 2022, research was continued on methods and means of converting a density unit into standard density measures from secondary standards of regional centers in order to find ways to reduce uncertainty when converting a density unit. The following works were carried out:

1. Development of recommendations establishing requirements for the technical characteristics of standard density indicators.
2. Investigation of thermal expansion coefficients of standard density measures.
3. Comparative analysis of the results of the study of standard density indicators from different manufacturers. Investigation of the contribution of the uncertainty of thermal expansion coefficient of standard density indicators to the total standard error of measuring the density of comparator liquid according to secondary standards.

In 2022, upgrading of GET 18 was initiated, aimed at expanding functionality of the standard in the field of reproduction and transmission of a density unit in the range of gas densities from 0.1 to 400 kg/m³ under pressure up to 30 MPa.

In 2023, upgrading of GET 18 will be continued.

State Primary Measurement Standard of Unit of Dynamic and Kinematic Viscosity (GET 17)

In 2022, the following studies were continued:

1. Research of metrological characteristics of the standard setups EK GET 17/1-KVI and EK GET 17/2-KVN.
2. Research of metrological characteristics of the reference setup GET 17/3-DVP.
3. Research of metrological characteristics of the reference setup GET 17/4-DVD.

In 2022, CCM.V-K4 Comparison Report, draft version A-3, was approved. Pilot laboratory: CENAM, 12 participants.

In 2023, stability studies of GET 17 metrological characteristics will be continued.

State Primary Measurement Standard of Unit of Fluid Flow

GET 63-2019 includes 3 reference units of water flow:

1. EU-1 reproduction and transmission of a water flow unit in the range from 2,5 m³/h to 500 m³/h with an expanded uncertainty of less than 0,033 % (P = 0,95).
2. EU-2 reproduction and transmission of a water flow unit in the range from 0,01 m³/h to 500 m³/h with an expanded uncertainty of less than 0,030 % (P = 0,95).
3. EU-3 reproduction and transmission of a water flow unit in the range from 2,5 m³/h to 500 m³/h with an expanded uncertainty of less than 0,036 % (P = 0,95).

GET 118-2017 includes 5 reference units of air flow at atmospheric pressure in the range from 0,0003 m³/h to 16 000 m³/h (from 0,00036 kg/h to 19200 kg/h) with expanded uncertainty in the range from 0,06 % to 0,19 %, and at overpressure up to 1,0 MPa – from 10 m³/h to 2300 m³/h (from 12 kg/h to 2700 kg/h) with expanded uncertainty less than 0,11 %.

Since 2021, VNIIM has been developing the state primary standard of natural gas in the range from no more than 5 m³/h to no less than 400 m³/h with an expanded uncertainty of less than 0,08%, at a pressure in the range from 0,1MPa to 10 MPa. This work will be completed in 2024.

State Primary Measurement Standard of Unit of Pressure and Vacuum

VNIIM Pressure Laboratory is participating in the international comparison of pressure standards in the range from 0,3 mPa to 0,9 Pa – COOMET.M.P-K15 (COOMET 711/TR/16). Participants: UME (Turkey) – pilot, VNIIM (Russia). At present, the final report is being approved. Completion has been postponed to 2023.

VNIIM Pressure Laboratory is participating in the international comparison of pressure standards in the range from 1 MPa to 10 MPa – COOMET.M.P-S1 (COOMET 711/TR/16). Participants: NSC “IM” (Ukraine) – pilot, VNIIM (Russia), BelGIM (Belarus), KazStandart (Kazakhstan), INIMET (Cuba), VMT/VMC (Lithuania), INM-MD (Moldova). At present, Final draft (Draft B) is approved. At present, the project is under review by CCM experts.

State Primary Measurement Standard of Unit of Torque

In 2022, VNIIM – Affiliated Branch of VNIIM completed upgrading GET 149, which began back in 2019. As a result, a new, fourth setting was introduced into the standard setup with a lower limit of unit reproduction equal to 0.1 Nm.

Design of the new setting differs from the other three since it uses air bearing to support the arm of the new device. The improved standard will reproduce the unit of torque in the range from 0.1 N·m to 20.0 kN·m.

Upgrading of the primary standard expands its calibration and measurement capabilities (CMCs), as well as the prospects for its participation in comparisons.

State Primary Measurement Standard of Hardness

In 2022, National Primary Measurement Standard of Vickers hardness scales GET 31-2010 was upgraded in order to add the Knoop hardness scale to the metrological capabilities of the standard and expand the reproduction range of Vickers hardness numbers to 5000 HV.

Moreover, VNIIFTRI maintains and applies National Primary Measurement Standards of Brinell scale, Rockwell and Superficial Rockwell scale, Martens scale and indentation scale, Leeb scale and Shore D scale for metals.

VNIIFTRI participates as pilot laboratory in supplementary regional comparisons in the field of

nanoidentation (COOMET.M.H-S2). At present, Draft A report is in progress.

Publications:

1. E. Aslanyan, E. G. Aslanyan, S. M. Gavrilkin, A. S. Doynikov, A. A. Petukhov, P. V. Sorokina, A. N. Shchipunov, and L. V. Yurov «GET 33-2020 State primary Brinell hardness standard», *Measurement Techniques*, 2022, Vol. 65, No. 5, pp. 315-320, DOI 10.1007/s11018-022-02091-8.
2. E. Aslanyan «Regional comparisons of National primary standards of hardness according to the Vickers and Brinell scales», *Measurement Techniques*, 2021, Vol. 64, No. 8, pp. 628-632, DOI 10.1007/s11018-021-01982-6.
3. E. Aslanyan, E. G. Aslanyan, S. M. Gavrilkin, A. S. Doynikov, A. N. Shchipunov «GET 161–2019: State primary standard of the hardness of metals based on the Shore D scale and the Leeb scales», *Measurement Techniques*, 2020, Vol. 63, No. 2, pp. 81-86, DOI 10.1007/s11018-020-01754-8.
4. Aslanyan, E. Aslanyan, E. Oboznyi, E. Galat, Y. Dovzhenko, M. Zhamanbalin «RMO Brinell supplementary comparison COOMET M.H.-S4», *Metrologia*, 2020, Vol. 57, No. 1A, p. 07003, DOI 10.1088/0026-1394/57/1A/07003.
5. E. G. Aslanyan, A. E. Aslanyan, S. M. Gavrilkin, A. S. Doynikov, P. V. Sorokina, A. N. Shchipunov «GET 30-2018, State primary standard of hardness according to the Rockwell and Super Rockwell scales», *Measurement Techniques*, 2018, Vol. 61, No. 8, pp. 745-750, DOI 10.1007/s11018-018-1495-1.

State Primary Measurement Standard of Gravimetry (GET 190)

In 2022, the State Primary Standard of Acceleration Unit for Gravimetry GET 190-2019 was upgraded. Its main goal was to include equipment developed carrying out research & Development works commissioned by the Russian industry.

The standard includes the absolute ballistic gravimeter “ABG-GROT-1” as a travelling measurement standard (with the combined uncertainty of 4 μ Gal), as well as a new gravimetric site “Lomonosov-2”, and measuring instruments for measuring parameters of seismic environments and gravitational field structure at gravimetric sites.

A long-term program of studies of gravimetric sites and equipment included in the standard is being carried out.