

## Information on the activities of the Central Office of Measures (GUM) in the field of CCM

### Main works and activities related to the area of CCM activities

The activities of GUM in the field of mass and related quantities (CCM) were carried out in accordance with the organizational structure of GUM approved in January 2020, where after the organizational change, the then L7 Mass Laboratory consisted of the Mass Laboratory, the Strength and Hardness Laboratory and the Pressure Laboratory and the Physicochemical Laboratory and Laboratory of Thermodynamics were located in the Laboratory of Chemistry L3. Since January 2022, the activities of CCM have been carried out at the Department of Mechanics and Acoustics (mass, force, torque, pressure), the Department of Time and Length (hardness, gravimetry) and the Department of Physical and Environmental Chemistry (density).

GUM continues to cooperate with external economic, expert and research communities in order to strengthen cooperation with science and industry, integrate and improve activities in Polish metrology and economy. It is implemented through the participation of GUM employees in the projects of the "Polish Metrology" program and individual contacts.

The year 2020, due to the pandemic situation, was very difficult for many tasks, the deadline for implementation had to be changed or limited. The experiences of 2020 will allow for more efficient operation in the pandemic situation that persists in 2021.

#### Mass

The main activities concerned the launch of a new automatic vacuum comparator AVK-1000 dedicated to the 1 kg national standard No. 51. In 2022 and 2023, research work was carried out on comparison in air, vacuum and noble gas atmosphere - these activities precede the launch of the procedure of transferring the kg unit to the new 1 kg calibration no. 51.

The second activity is the continuation of work related to the draft of the legal act and the calibration manual and testing of automatic devices for weighing road vehicles in motion and measuring axle load. Further assumptions for the construction of a laboratory in this regard were developed and a facility was selected to prepare a special laboratory with a properly prepared right-of-way. Two projects from the implementation doctorate program were also launched.

#### Force and Torque

In the area of force and moment of force, the activities focused on the area of routine tasks that meet the needs of the Polish economy and participation in work on EMPIR projects:

19ENG05 NanoWires, starting 01/09/2020

19ENG08 WindEFCY, starting 01/09/2020

18SIB08 ComTraForce, starting 01/09/2019

Two projects from the implementation doctorate program were also launched. Tasks resulting from the launch of new measurement stations in the GUM Laboratory Campus in Kielce are being carried out.

## Pressure

In the area of pressure, the activities focused on the area of routine tasks that meet the needs of the Polish economy. Tasks resulting from the launch of new measurement stations in the GUM Laboratory Campus in Kielce are being carried out. Three projects from the implementation doctorate program were launched - including two in relation to new measuring stations in the field of dynamic pressure.

## Density

Since 2021, there have been changes in the structure of GUM – in 2022 the Chemistry Laboratory, producing the most of CRMs, was transferred into the Department of Physical Chemistry and Environment, which consists of 5 laboratories: Temperature, Humidity, Gas Analysis, Electrochemical and Inorganic Analysis, Physicochemical Standards. In the Physicochemical Standards Laboratory we have density, viscosity, refractometry, polarimetry, breath analyzers, surface tension and static volume.

### Main research and development activities

In the Physicochemical Standards Laboratory we continue such activities as modernization and automation of installations, improving measurement methods and data acquisition programs prepared in the LabVIEW graphical environment, in the fields of :

- density: hydrostatic weighing of solids and liquids (long term strategy resulting from the participation in the EMPIR rhoLiq project), calibration of measuring instruments (density meters, oscillating-type density meters, hydrometers, pycnometers etc), production and calibration of CRMs,
- viscosity: master capillary viscometers in the wide range of viscosity and temperature, automatic viscometers, calibration of measuring instruments (viscometers: glass, automatic, Hoppler, rotational and flow cups), production and calibration of CRMs,
- static volume: gravimetric methods, calibration of piston and glass instruments in the range of (1 ÷ 10000) ml
- breath analysis: new generations of wet and dry gaseous ethanol standards for calibration of breath analyzers (long term strategy resulting from the participation in the EMPIR AlcoRef project), calibration of measuring instruments by means of wet and dry gaseous standards, production and calibration of CRMs,
- refractometry: testing and implementation of the goniometric method for measuring the refractive index of liquids, calibration of measuring instruments, production and calibration of CRMs,
- polarimetry: calibration of measuring instruments, production and calibration of CRMs.

The Laboratory has purchased and implemented new equipment: DMA 5001 density meter, automatic viscometer SVM 3001, automatic viscometer CAV 4.2, Pipette Calibration Balance XPE26PC, MKT 50 thermometers, facilities for washing and drying of capillary viscometers, spectral lamp Na/10, PT-401 thermometer.

Additionally in the field of viscosity: preparations for a new lab in the Campus Kielce, with a new installation for non-Newtonian liquids (modern rotational viscometer).

### Participation in EMPIR projects:

- EMPIR project 16RPT02 ALCOREF Certified forensic alcohol reference materials
- EMPIR project 17RPT02 rhoLiq Establishing traceability for liquid density measurements

### Participation in EURAMET Projects 1109 and 1303 Peer reviews of QMSs:

- 2012 – peer review in the field of viscosity in GUM/Poland

- 2013 – peer review in the field of density, viscosity in SMU/Slovakia
- 2014 – peer review in the field of density, static volume in GUM/Poland
- 2016 – peer review in the field of refractometry in GUM/Poland
- 2017 – peer review in the field of breath analyzers, in GUM/Poland
- 2017 – peer review in the field of viscosity in GUM/Poland
- 2019 – peer review in the field of density, static volume in GUM/Poland
- 2021 – peer review in the field of density, viscosity in SMU/Slovakia

#### **Participation in relevant comparisons:**

- CCM.V-K3 Viscosity measurements of standard liquids
- CCM.V-K4 Viscosity measurements of standard liquids
- CCM.D-K5 Comparison on density determination of liquid samples using oscillation-type density meters
- CCM.D-K6 Refractive index of liquids (planned)
- EURAMET Project 1240 Comparison of density determinations of liquid samples by density meters
- EURAMET Project 1297 Comparison of a 50 ml pycnometer and a 500 ml flask
- Annual ASTM D02.07 Cooperative Kinematic Viscosity Program, Spring 2020, Spring 2021, Spring 2022
- COOMET.PR-S2 Supplementary Comparison Angle of rotation of plane of polarization (COOMET project 438/RU/08)
- EURAMET Project 1522 Key comparison on density determination of liquids by hydrostatic weighing
- EURAMET Project 1523 Key comparison on density determination of liquids using oscillation type density meters
- EURAMET Project 1533 Comparison of piston-operated volumetric instruments

#### **Publications**

- Fidelus J., Puchalski J., Trych-Wildner A., Weidinger P., “The creep behaviour of a 2 kN·m torque transducer tested at GUM and PTB”, an article sent for Measurement 2023 - 14th International Conference on Measurement 29 – 31, May 2023 – Smolenice, Slovakia
- Pruchnik B., Fidelus J., Gacka E., Piasecki T., Gotszalk T. „Atomic force microscopy in single-specimen measurements of nanowires”, SPM workshop 2023, s. 26, 20-21 April 2023, Lednice, Czech Republic
- Knott A., Sander J., Kumme R., Tegtmeier F., Hiti M., Vavrecka L., Fidelus J., Prato A., Germak A., Dizdar H., Aydemir B., Korhonen J., Oliveira R.S. „Calibration procedure for testing machines to extend the traceability chain from static to continuous forces which can be used for forces in the range of 1 N to 1 MN”, February 2023
- Hantz A. „Weryfikacja spełnienia wyspecyfikowanych wymagań wyposażenia pomiarowego przed jego włączeniem do użytkowania w odniesieniu do wymagań normy PN-EN ISO/IEC 17025:2018-02, Symposium of the POLLAB Club, Ustka, Poland, 2023
- Janko P., Malejczyk E., Nawotka M. “Development of certified reference materials of ethanol in aqueous solution resulting from the participation of GUM in EMPIR 16RPT02 ALCOREF project, Accreditation and Quality Assurance”, 28(1), 2023-02
- Fidelus J., Bejma D., Prato A., Germak A., „Alignment tilt and force transducer creep effects on hardness in conventional hardness tests”, Proceedings of IMEKO 24th Conference on the Measurement of Force, Mass and Torque (together with the 14th TC5 Conference on the

Measurement of Hardness, the 6th TC16 Conference on Pressure and Vacuum Measurement, and the 5th TC22 Conference on Vibration Measurement), 11 – 13 October 2022, Cavtat-Dubrovnik, Croatia, DOI.: 10.21014/tc5-2022.104

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- Pekka Neuvonnen T., Furtado A., Moura S., Laky B., Malejczyk E., Lenard E. “Good practice guide for the measurement of the density of liquids in industry”, [www.rholiq.org](http://www.rholiq.org), May 18, 2022
- Janko P., Wasilewska J., Lenard E. „Analizatory wydechu. Przewodnik Analizatory wydechu”, GUM, 2022
- Philipp R. et al., Janko P., “Supplementary comparison study - measurement capabilities for the quantification of ethanol in water”, Metrologia 59, Jan 2022
- Janko P., “Revision of International Organization of Legal Metrology Recommendation OIML R 126:2021 Evidential Breath Analyzers”, Metrologia i Probiernictwo – Bulletin of the Central Office of Measures in Poland – vol. 28, nr 1/2022
- Janko P., „Cykl porównań międzylaboratoryjnych w dziedzinie wzorcowania analizatorów wydechu organizowanych przez GUM w 2021 roku Metrologia i Probiernictwo” – Bulletin of the Central Office of Measures in Poland, vol. 27, nr 2/2021
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- Malejczyk E., “Homogeneity and stability assessment of certified reference materials on the example of the liquid density standard”, Metrologia i Probiernictwo – Bulletin of the Central Office of Measures in Poland– vol. 27, nr 2/2021
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