

MASS LABORATORY

Main works and activities related to the area of CCM activities

Until December 2018, the activities of Mass Laboratory were carried out according to the organizational structure of GUM implemented in January 2017, which included: Standards and Weights Section, Force and Hardness Section, Physical Chemistry Section (density, viscosity, surface tension, static volume), Thermodynamics Section (Pressure, Breath Analyzers) and the Certification Team.

From 1 January 2020, following an organizational change, Mass Laboratory comprises: Mass Section, Force and Hardness Section and Pressure Section. The tasks of the Physical Chemistry Section and the Thermodynamics Section have been transferred to the Chemistry Laboratory, and the Certification Team to the Certification Department.

GUM continues its dialogue with external economic, expert, scientific and research circles, within the framework of Teams established to tighten cooperation with science and industry, integration and improvement of activities in Polish metrology and economy.

The year 2020 due to the pandemic situation was very difficult for many tasks and it was necessary to change the date of implementation or reduce it. The experience of 2020 will allow for more efficient action in the continuing pandemic situation in 2021.

Mass

The main activities concerned the commissioning of the new automatic modular-vacuum comparator AVK-1000 dedicated to the national standard 1 kg No. 51. In the years 2020 and 2021 research works were and are carried out on comparisons in air, vacuum and noble gas atmospheres - these activities precede the start of the procedure of transferring the kg unit after the new calibration of 1 kg No. 51.

The second activity is the continuation of work related to the draft instruction on calibration of automatic instruments for weighing road vehicles in motion and measuring axle loads. New assumptions were developed for the construction of a laboratory in this area and a site was selected for the preparation of a special road lane.

Force and Hardness

In the area of force and hardness the activity focused on the area of routine tasks satisfying the needs of the Polish economy and participation in the work on EMPIR projects:

19ENG05 NanoWires, start 01.09.2020.

19ENG08 WindEFCY, start 01.09.2020

18SIB08 ComTraForce, start 01.09.2019.

Pressure

In the pressure area, activity focused on the area of routine tasks meeting the needs of the Polish economy and participation in the EMPIR 16RPT03 inTense project, which was completed in 2020. The report EURAMET.M.P-S16 Bilateral comparison in high gauge pressure 250 MPa (draft beta), CMI-GUM was also completed,

Participation in relevant comparisons

In the last period, the most important activity was the comparison (calibration) of the national measurement standard of mass unit 1 kg No. 51 with the prototype 1 kg (IPK) after determining

its new value. The comparisons took place in 2020, the value of the standard was confirmed in the BIPM calibration certificate of 1 February 2021.

Comparisons in the field of hardness: CMI - GUM, 2019: Vickers (HV0.1, HV0.3, HV0.5, HV1, HV5, HV10) bilateral comparisons; restart of Rockwell HRC hardness bilateral comparisons with INRiM in 2020.

List of relevant publications:

Fidelus J. D., Wiśniewski W., Pierwszy Polski modułowy/próżniowy komparator masy wspomagający przenoszenie i utrzymanie narodowego wzorca odniesienia masy 1 kg. Pomiary w nauce i technice. Studia i Monografie, Politechnika Opolska 2019,

Szumiata T., Dobieszewski M., Hantz A., Wiśniewski W., Szutkowski J., Podgórní A., Analiza strategiczna polskiego projektu wagi Kibble'a. Metrologia i Probiernictwo nr 1(22)/2019,

Wiśniewski W., Wasilewska J., Kania-Markocka A., Łazowski K., Osińska-Kaczmarek A., Cybul K., Taras J., Strzałka P., Piętaszewska M., Przewodnik po dziedzinie Masa i wielkości pochodne, GUM 2019,

Szumiata T., Hantz A., Wiśniewski W., Szutkowski J., Podgórní A., Lewandowski W., Solecki M., Żukowska A., Janeczko M., Redefinition of the kilogram in Poland -The proper choice of Kibble balance project. Materiały Konferencyjne Quantum and Precision Metrology, Kraków 2019,

Fidelus J. D., Cybul K., Study on short-term creep effect and hysteresis for the HBM Z4A force transducer under compressive and tensile forces, ACTA IMEKO, vol. 9, no. 5, pp. 137-142, 2020,

Fidelus J. D., Kozuchowski M., GUM's Rockwell hardness standard machines after modernization, ACTA IMEKO, vol. 9, no. 5, pp. 240-246, 2020,

Fidelus J. D., Udział Głównego Urzędu Miar w europejskim projekcie badawczym EMPIR w dziedzinie siły (Participation of the Central Office of Measures in the European industrial project EMPIR in the field of force), Metrologia i Probiernictwo – Biuletyn Głównego Urzędu Miar, 1 (24) / 2020,

Fidelus J. D., Cybul K., Realizacja projektu EMPIR JRC 18SIB08 „Comprehensive traceability for force metrology services” w Głównym Urzędzie Miar, rozdział w monografii naukowej Politechniki Śląskiej, MKM 2020 r.

Fidelus J. D., Gotszalk T., Europejski projekt metrologiczny NanoWires wspierający rozwój nanotechnologii dla przemysłu energii odnawialnej, Metrologia i Probiernictwo – Biuletyn Głównego Urzędu Miar, 2 (25) / 2020,

Hantz A., Analiza świadectw wzorcowania na przykładzie wagi i wzorca masy. Jakie korzyści i jakie zagrożenia dla laboratorium niesie za sobą zachowanie lub brak spójności pomiarowej w odniesieniu do wymagań normy PN-EN ISO/IEC 17025:2018-02?” Biuletyn informacyjny POLLAB BI 1/58/2020 Elementy doskonalenia pracy laboratoriów, Warszawa 2020,

Wasilewska J., Chmielarek M., Skupiński W., Rh/TiO₂-SiO₂ system in photolytic water splitting, Springer, February 2021.

CHEMISTRY LABORATORY

Summary of GUM activities related to CCM, covering the period since the 17th CCM

Since 2019, there have been some changes in the structure of the Laboratories - most of CRM producers are gathered in the Chemistry Laboratory.

In the Physicochemical Standards Section of the Chemistry Laboratory there are now density, viscosity, refractometry, polarimetry, breath analyzers, surface tension and static volume.

Main research and development activities

In all the activities poor progress has been observed, due to pandemic situation and necessity to cope with current work with limited staff (partial lock-down), but nevertheless we continue:

- modernization and automation of the hydrostatic weighing installations for liquids (activities resulting from the participation in EMPIR project), solids and hydrometer calibration; continuation of automation and data acquisition programs prepared in the LabVIEW graphical environment,
- calibration of the new set of glass capillary Ubbelohde viscometers against master viscometers in the wide range of viscosity and temperature; elaboration of methods for calibration of different types of rotational viscometers and flow cups; improvement of the use of the Stabinger viscometer; implementation of automation and data acquisition programs prepared in the LabVIEW graphical environment,
- modernization of the static volume measurement stands and improvement of methods to calibrate piston pipettes in the range of (1 ÷ 10000) ml, burettes, dispensers etc.- acquisition of a new microbalance, new data acquisition programs prepared in the LabVIEW graphical environment,
- activities resulting from the participation in EMPIR project, focused on new generations of standards for calibration of breath analyzers, modernization and automation of the reference stands for breath analyzers calibration by means of wet and dry gaseous standards.
- modernization and automation of the installation for refractive index measurements.

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

Participation in relevant comparisons:

- CCM.V-K3 Viscosity measurements of standard liquids
- CCM.V-K4 Viscosity measurements of standard liquids
- 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 2017, Spring 2018, Spring 2019
- COOMET.PR-S2 Supplementary Comparison Angle of rotation of plane of polarization (COOMET project 438/RU/08).

List of relevant publications:

Janko P., Kordulasiński R., Wasilewska J., Lenard E., Calibration of the breath analyzers using in situ produced wet gas standards, *Metrologia i Probiernictwo – Biuletyn Głównego Urzędu Miar* (nr 2/2018),

Furtado A., Pereira J., Schiebl M., Mares G., Popa G., Bartos P., Bebic J., Lenard E., Alic A., Alisic S., Neuvonen P., Wolf H., Sariyerli G., Bescupschii A. and Laky B., Establishing traceability for liquid density measurements in Europe: 17RPT02-rhoLiq a new EMPIR joint research project, *Journal of Physics: Conf. Series* 1065 (2018) 082013,

Furtado A., Pereira J., Quendera R., et al. (2020). First density comparison on viscoelastic samples by oscillation-type densimetry. *ACTA IMEKO*,9(5), 79-84.http://dx.doi.org/10.21014/acta_imeko.v9i5.943,

Furtado A., Pereira J., Schiebl M., Mares G., Popa G., Bartos P., Bebic J., Lenard E., Alic A., Alisic S., Neuvonen P., Wolf H., Sariyerli G., Bescupschii A. and Laky B., Establishing traceability for liquid density measurements in Europe: 17RPT02-rhoLiq a new EMPIR joint research project, XXII IMEKO World Congress, Belfast, UK, 3-5 September 2018. (poster / by IPQ),

Lenard, E., Malejczyk, E., Reference Materials – production and application in laboratories. RM' 2019, coorganized by the Polish Committee for Standardization, the Polish Centre for Accreditation, the Central Office of Measures and The University of Warsaw Biological and Chemical Research Centre (CNBCh UW), June 27, 2019, Warsaw, Poland (poster/ by GUM),

Janko P., Certification of novel reference materials – ethanol aqueous solutions for breath analyzers testing and calibration (EMPIR 16RPT02 ALCOREF project). RM' 2019, coorganized by the Polish Committee for Standardization, the Polish Centre for Accreditation, the Central Office of Measures and The University of Warsaw Biological and Chemical Research Centre (CNBCh UW), June 27, 2019, Warsaw, Poland,

Janko P., Certified reference materials of ethanol in water. planned extension of GUM's offer (participation in EMPIR 16RPT02 ALCOREF project. RM' 2019, coorganized by the Polish Committee for Standardization, the Polish Centre for Accreditation, the Central Office of Measures and The University of Warsaw Biological and Chemical Research Centre (CNBCh UW), June 27, 2019, Warsaw, Poland (poster/ by GUM),

Janko P., Malejczyk, E., Nawotka, M., Development of new certified reference materials - aqueous ethanol standard solutions. Results of GUM participation in EMPIR 16RPT02 ALCOREF project. 9th Conference "Quality in analytical chemistry", 20-22.11.2019, Mory, Poland,

Malejczyk E., Janko P., Karasiński J., Torres J., Homogeneity and stability assessment of certified reference materials – aqueous ethanol standards. 9th Conference "Quality in analytical chemistry", 20-22.11.2019, Mory, Poland,

Janko P., Construction of a packaging system for dispensing of certified reference materials of ethanol in aqueous solution into individual units, Metrologia i Probiernictwo – Biuletyn Głównego Urzędu Miar (nr 2/2019),

Janko P., Malejczyk E., Nawotka M., Results of GUM participation in EMPIR 16RPT02 ALCOREF project: GUM offer extended by new certified reference materials – ethanol aqueous solutions, Metrologia i Probiernictwo – Biuletyn Głównego Urzędu Miar (nr 2/2020),

Sokołowska B., Wojciechowska N., Modernization of measuring stand for polarimetric standards calibration, Metrologia i Probiernictwo – Biuletyn Głównego Urzędu Miar (1/2020),

Malejczyk E., Hyk W., Certification of reference materials on the example of the selected liquid density standard. Part 1. Homogeneity assessment, Analityka 4/2019,

Malejczyk E., Hyk W., Certification of reference materials on the example of the selected liquid density standard. Part 2. Stability assessment, Analityka 1/2020,

Malejczyk E., Hyk W., Certification of reference materials on the example of the selected liquid density standard. Part 3. Metrological characterization, Analityka 2/2020,

Malejczyk E., Reference Materials – production and application in laboratories. RM' 2019, coorganized by the Polish Committee for Standardization, the Polish Centre for Accreditation, the Central Office of Measures and The University of Warsaw Biological and Chemical Research Centre (CNBCh UW), June 27, 2019, Warsaw, Poland (presentation/ by GUM),

Malejczyk E., Certification of reference materials according to ISO Guide 35, illustrated by an example of aqueous ethanol standards, PTiZE Seminar, January 27th 2020, University of Warsaw,

Malejczyk E., Certification of reference materials illustrated with density of selected liquid standard, PTiZE Seminar, March 30th 2021, University of Warsaw.

FLOW LABORATORY

Participation in EURAMET Project No. 1518

Intercomparison of gas provers in the gas flow range 0,25m³/h to 25 m³/h

Participants: METAS, BEV, GUM, INRIM