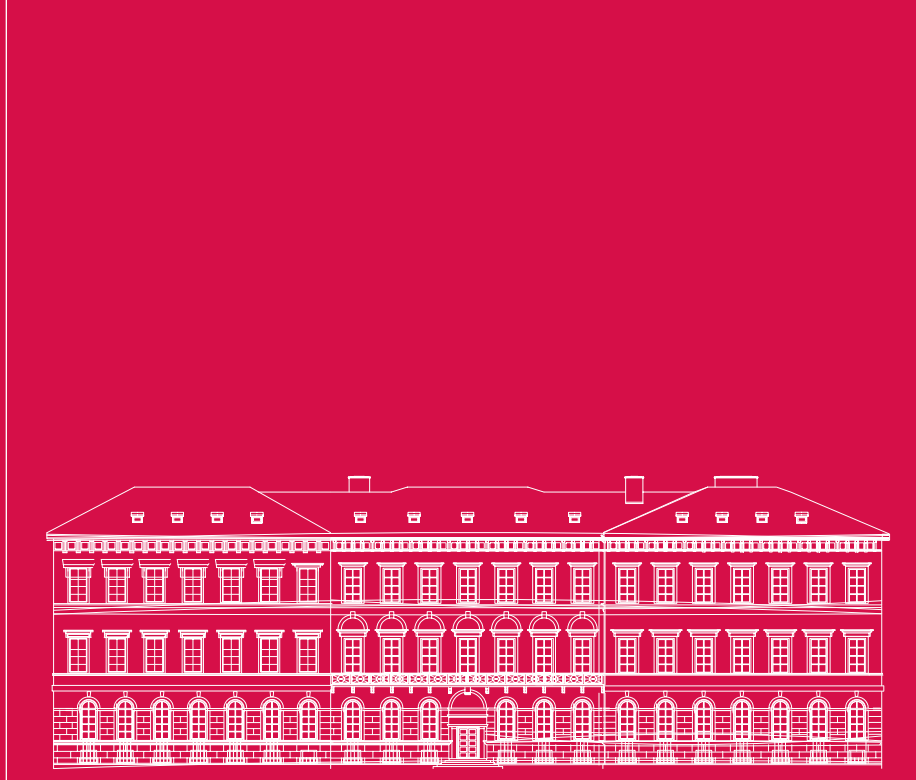




Central
Office
of Measures



ACTIVITY OF THE CENTRAL OFFICE OF MEASURES
AND REGIONAL OFFICES
THE 2021 ANNUAL REPORT



The Central Office of Measures (GUM) is a national metrology institute (NMI) dealing with theoretical and practical matters involving measures such as: measurement units, technologically advanced measurement standards, measuring systems and methods, as well as transfer of metrological knowledge and legal aspects in the field of metrology.

The GUM is a primary element of the national measurement system in Poland.

The GUM's activities focus on:

- ensuring the measurement capabilities necessary for the sustainable development of the economy,*
- providing the society with appropriate standards of living and protecting the interests of the citizens,*
- protecting economic and technical security of the state.*



**Central
Office
of Measures**



President
Central Office of Measures

prof. JACEK SEMANIAK

Ladies and Gentlemen,

I am presenting you the Annual Report of the Central Office of Measures (GUM) for 2021 which describes the completed tasks, achievements and initiatives in the key areas of GUM's activities.

2021 was a year of significant involvement in the implementation of domestic, long-term, interdisciplinary projects, such as for instance:

- „Świętokrzyski Laboratory Campus of the Central Office of Measures – Phase 1”,
- „IT Support System for Services of the Regional Administration of Measures – ŚWITEŻ”,
- „IT system for implementation of public services and tasks of the Central Office of Measures regarding tachographs – TRANS-TACHO”,
- „e-CzasPL – system for reliable and credible distribution of official time within the Republic of Poland”,

as well as in the implementation of international projects carried out under the „European Metrology Programme for Innovation and Research”(EMPIR). Furthermore, GUM joined a new programme, i.e. „European Partnership on Metrology” which is institutionalised partnership of the Horizon Europe framework programme.

Efforts were also made to strengthen the position of GUM as coordinator of research and development in the field of metrology by boosting research and development which support science and high-tech industry and by forging partnership with the scientific, business and social communities.

Activities in this area were fostered by the establishment of the Polish Metrological Union and the launching of a dedicated programme called „Polish Metrology” by the Minister of Education and Science.

Furthermore, measurement standards database were maintained and extended while the international standing of GUM was strengthened. This was supported by very good results in international key comparisons and excellent representation of calibration and measurement capabilities entries in the KCDB database of the International Bureau of Weights and Measures.

Last year also saw structural changes involving the organisation of the entire GUM, and above all, the way it operates. The process was programmed so that potential of the metrological infrastructure in GUM and its regional administration would develop faster to provide dynamic and effective support for the Polish economy in all its aspects.

2021 was the last year of the implementation of the first “Four-Year Strategic Action Plan of the Central Office of Measures for 2018-2021”. Analysis and recapitulation of its implementation and the need to strengthen GUM's scientific position and boost the quality of its operation were the basis for drafting a strategic plan for 2022-2025 in a new formula.

Despite another year of the COVID-19 pandemic and the ensuing restrictions, GUM provided services for clients with integrity and timeliness.

Details of GUM's domestic and international activities in 2021 may be found in this report.

2021 IN A NUTSHELL

FLAGSHIP GUM PROJECTS

IT Support System for Services of the Regional Administration of Measures – ŚWITEŻ

The aim of the project is to enhance the processes related to the provided services, increasing the availability and quality of e-services and launching high-quality electronic services by various institutions of the measures administration for their clients.

The following steps were taken as part of the project:

- the following tests were carried out and accepted: automatic, acceptance, efficiency, load, migration, quality, security and WCAG;
- the as-built documentation and the final report were accepted;
- the method of conducting training for internal users and administrators was agreed with the Contractor;
- an order was placed for the delivery of computers for the regional measures administration.

e-CzasPL – system for reliable and credible distribution of official time within the Republic of Poland

The aim of the project is to provide the service of reliable and credible distribution of official time signals in the territory of the Republic of Poland and signals of the Polish realisation of Coordinated Universal Time UTC(PL), generated according to the national standard for units of time and frequency.

As part of the project:

- the technical dialogue on design, execution, configuration and verification of the key elements of the encoded digital distribution system was finalised for long wave time signals using the 225 kHz carrier wave;
- notice of public procurement for the provision of dedicated equipment for the above-mentioned system (time signal modulator) was announced;
- purchases were made for key elements of laboratory infrastructure – in particular, an active hydrogen maser, two cesium clocks, atomic clock combiner;
- the inclusion of the provided standards and other hardware in the system of the national standard of units of time and frequency began – the devices will be part of the official time generation, maintenance and distribution system in the territory of Poland;
- tenders were announced for the development of dedicated software and dedicated equipment and the development of a highly stable source of 225 kHz radio frequency began.



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The KAMPUS project includes the construction, in cooperation with the Kielce University of Technology, of a laboratory research and implementation base, which will allow for effective and professional research and development aimed at strengthening cooperation between research and science on the one hand and business on the other.

As part of the project:

- construction works started in January, and by the end of the year, 7 out of 8 buildings reached the building shell stage;
- contracts were signed for regular and backup power grid connections and connection to the municipal heating grid;
- the catalogue of research services in the business and non-business sectors was updated;
- a plan for onboarding metrologists at the KAMPUS was developed;
- the stage of recruiting metrological staff began – the first 4 metrologists were hired, trained and onboarded at the KAMPUS;
- tendering procedures for some metrological equipment were prepared.

ŚWIĘTOKRZYSKI LABORATORY CAMPUS OF THE CENTRAL OFFICE OF MEASURES

– PHASE 1 (KAMPUS)



TRANS-TACHO

IT system for implementation
of public services and tasks of the
Central Office of Measures regarding
tachographs – TRANSTACHO

The aim of the TRANS-TACHO project is to facilitate doing business and exercising the regulated profession in the field of tachographs by introducing four electronic public services A2B and A2C and strengthening the supervision system for the tachograph system through the implementation of suitable IT solutions. As a result, formalities on the stakeholders' side will be reduced while transport safety will be boosted.

As part of the project:

- a tender procedure was conducted to hire a Technical Advisor with whom an agreement was signed for the preparation of documentation necessary for planning the system and tender documentation to hire a system Contractor;
- the process of hiring a system Contractor was prepared and launched;
- a concept for promoting the project was developed;
- measures related to the compilation of the specification of requirements for the system were taken by conducting numerous internal and external consultations, the requirements were defined and the implemented processes and services were designed for the future system.



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Rozwoju Regionalnego





Piotr Ziółkowski

CHANGES AT GUM

MANAGEMENT

On **1 February 2021**, the President of GUM, prof. Jacek Semaniak, appointed Mr. Piotr Ziółkowski to the position of GUM's general director.

Mr. Piotr Ziółkowski is a graduate of the Faculty of Economics and International Relations of the University of Crakow University of Economics and the Faculty of Theology of the Pontifical University of John Paul II in Krakow.

He also completed doctoral studies at the Faculty of Political Science at the Pedagogical University of Krakow and is preparing to defend a doctoral dissertation in politics and administration.

From 2015 to 2020 he worked at the Ministry of Science and Higher Education. He was, amongst others, director of the Ministerial Programme and Project Office and deputy director general.

From the start, he was involved in work on the reform of science and higher education and in its implementation, consulting the proposed changes with the academic community.

At the Ministry of Education and Science, he was director of the Office of the General Director and a proxy for Minister of Education and Science for the merger of the Ministry of National Education with the Ministry of Science and Higher Education.

On **16 June 2021**, Deputy Prime Minister, Minister of Development, Labour and Technology, Mr. Jarosław Gowin entrusted Mr. Andrzej Kurkiewicz with the duties of the Vice President of GUM.

Mr. Andrzej Kurkiewicz has PhD of humanities in the discipline of management sciences.

He is an academic teacher at the Faculty of Management and Social Communication of the Institute of Public Affairs of the Jagiellonian University.

In 2006 and 2007 he taught a series of courses at INHolland University in Rotterdam as a CAF Expert in the field of education.

From 2008 to 2021 he worked at the Ministry of Science and Higher Education (renamed as Ministry of Education and Science). At that time, he worked, amongst others, in the Minister of Science and Higher Education's team for the preparation of the reform of higher education and science and was the Chairman of the Advisory Team of the Minister of Education and Science to evaluate applications and reports under the "Industrial PhD" programme.

He is a member of the Team of Experts for Vocational Education and Training (VET) at the Education System Development Foundation.

He was the vice president responsible for supervising GUM laboratories until the end of 2021.



ORGANISATION STRUCTURE

Taking into account the experience of previous years, as well as the challenges that GUM faces today, the organisation structure of GUM was changed and the institution received a new statute.

The changes were introduced in two stages.

The first stage included changes to the entities supporting the activities of metrological units, including reorganisation of tasks in the administrative section. In place of five bureaus, four departments were set up:

- Certification Department;
- Innovation and Development Department;
- Supervision and Inspection Department;
- International Cooperation and Analyses Department

as well as Director General's Bureau as service unit.

The second stage affected the laboratory structure. Independent GUM Laboratories were merged into five departments:

- Certification Tests Metrology Department;
- Physical Chemistry and Environment Metrology Department;
- Time and Length Metrology Department;
- Electricity and Radiation Metrology Department;
- Mechanics and Acoustics Metrology Department.

The Digital Technology Metrology Department was also set up.

The main aim of the introduced changes was to increase the efficiency of GUM operation, both in the implementation of the statutory competences of the President of GUM, as well as in the area of scientific work.

An interdisciplinary approach to the tasks carried out by the departments, in particular research and development projects, will allow better use of the existing human resources and research equipment.

The establishment of the Digital Technology Metrology Department was a response to the challenges faced by metrology with new technologies, cybersecurity, artificial intelligence, as well as the trend of miniaturisation of products in areas such as computer science, robotics and automation.

THE FOUR-YEAR STRATEGIC ACTION PLAN OF THE CENTRAL OFFICE OF MEASURES

2021 was the last year of the implementation of the first "Four-Year Strategic Action Plan of the Central Office of Measures for 2018-2021". Therefore, the concept of the plan for 2022-2025 was developed. A draft plan was made focusing on a modern approach to measurements, reliable and up-to-date metrological infrastructure and on measures boosting the economic and technical security of the state, high quality of life for the citizens and economic development. It is also aimed at strengthening the scientific position of GUM and raising the operating standard and usefulness of the administration of measures.

There are plans to increase the participation of GUM in national and European research programmes and develop metrological infrastructure to answer the emerging needs of the economy.

THE METROLOGY COUNCIL

On 19 March and 26 November, the annual meetings of the Metrology Council, a consultative and advisory body to the President of GUM, were held under the chairmanship of Professor Ewa Bulska. Due to the COVID-19 pandemic the meetings were held in a hybrid mode.

During the first meeting, the Metrology Council accepted both "Report on the implementation of the annual action plan of the Central Office of Measures in 2020" and "The Annual action plan of the Central Office of Measures for 2021". Organisational changes which had taken place at GUM after the granting of a new GUM statute were also discussed during the meeting.

In the course of the second meeting, the Metrology Council adopted a resolution approving "The Four-Year Strategic Action Plan of the Central Office of Measures for 2022-2025". The members of the Council were also informed on the progress in the implementation of the KAMPUS project and on the establishment by the Minister of Education and Science of the "Polish Metrology" programme.

INVENTIONS

In 2021, a patent application for an invention called "System and method for arbitrary simulating instrument transformers errors during calibration the bridges for calibration instrument transformers" was submitted to the Patent Office of the Republic of Poland through a law firm. This is a solution for the power industry. The application is currently being reviewed for novelty.

INVESTMENTS

Additional funds amounting to PLN 3 554 thousand from a special reserve of PLN 12 000 thousand were obtained for investments following an amendment to the budget act.

As a result, the original budget for property expenditures, including investment expenditures and expenditures on investment purchases in the entire administration of measures increased from PLN 8 346 thousand to PLN 24 044 thousand (excluding expenditures on co-financing of projects implemented with the participation of the European Union funds). As part of the amount, GUM received PLN 14 380 thousand, while the Regional Offices (JT) got PLN 9 664 thousand.

Additional funding allowed, amongst others, to acquire new metrological infrastructure and develop the existing, modernise GUM and Regional Offices and support the process of their computerisation and digitisation. It enhanced the properties of metrological measuring stands which allowed to extend the service offer.

Some of completed investments include: virtualisation software, elements of metrological infrastructure in the field of ultrasound in medical applications, an environmental gas analyser, an inductively coupled plasma optical emission spectrometer (ICP-OES), an HDR irradiator with two sources of gamma radiation (Co-60 and Ir-192), a measuring probe head for a force gauge calibration stand, a multifunctional calibrator of electrical quantities, an oscillatory densimeter, a mass comparator (max \geq 1 kg, d = 0.1 mg), a mobile stand for checking preselection weighing instruments etc.

DOMESTIC COOPERATION

Cooperation with business and scientific entities allows for the implementation of tasks related to various areas of social and business sectors where reliable measurements play a crucial role.

It enables effective metrological support for new and developing fields and the implementation of new measurement methods and technology transfer.

THE POLISH METROLOGICAL UNION (PUM)

At the Centre for Innovation and Advanced Technologies of Lublin University of Technology on 30 August 2021 Minister of Education and Science, Przemysław Czarnek, signed a commission for Lublin University of Technology to carry out a task entitled "Establishment and coordination of the activities of the Polish Metrological Union (PUM)".

The aim of PUM is to network and position actions in the field of polish metrology, to set new trends in research and development, to implement joint research projects, to consolidate the potential of research equipment, to form joint research teams, to promote innovation, to support human resources development and to organise forums, conferences and congresses.

The establishment of the PUM is an example of good understanding how science develops, with emphasis on joint action rather than competition.

GUM is an important part of PUM through its metrological staff as well as laboratories located in Warsaw and in the currently constructed Świętokrzyski Laboratory Campus of GUM.

The main tasks of PUM include:

- integration of communities involved in metrology (networking of interinstitutional cooperation);
- measures aimed at obtaining domestic and international grants;
- promotion of the latest solutions and innovations in the field of metrology;
- organisation of seminars, symposiums, conferences and congresses;
- setting new trends for the development of metrology;
- cooperation with the industry in the field of metrology;
- support and promotion of industrial PhD programmes;
- measures aimed at the development of metrology staff.

PUM was launched on 18 October 2021 during the National Integration Forum of Polish Metrology. It was attended by representatives of the scientific community from all over Poland, who on behalf of the institutions which they represented signed a declaration of will to cooperate for the benefit of metrology.

THE "POLISH METROLOGY" PROGRAMME

By an announcement of the Minister of Education and Science of 2 November 2021, a programme called "Polish Metrology" was launched.

The aim of the programme is to support research or development in areas related to metrology, conducted by entities of the higher education and science system in cooperation with the President of GUM. The programme provides for the implementation of projects aimed at boosting research capabilities of metrology institutes, strengthening intellectual capital, increasing the competitiveness of the Polish economy in areas strategic for the country, developing state-of-the-art technologies, stimulating the development of metrology, in particular in the fields of health, the environment, energy and advanced measurement techniques, as well as developing digital technologies.

The budget of the programme amounts to PLN 20 million and the maximum funding for a single project may not exceed PLN 1 million.

The first call for applications formally lasted from 2 November to 23 December, however the decision of the President of GUM was announced on 17 December. A total of 98 applications from 37 Polish universities and other scientific institutions were submitted at GUM.

Ultimately, 83 applications were submitted at the Ministry of Education and Science and were accepted by the President of GUM.

AGREEMENTS

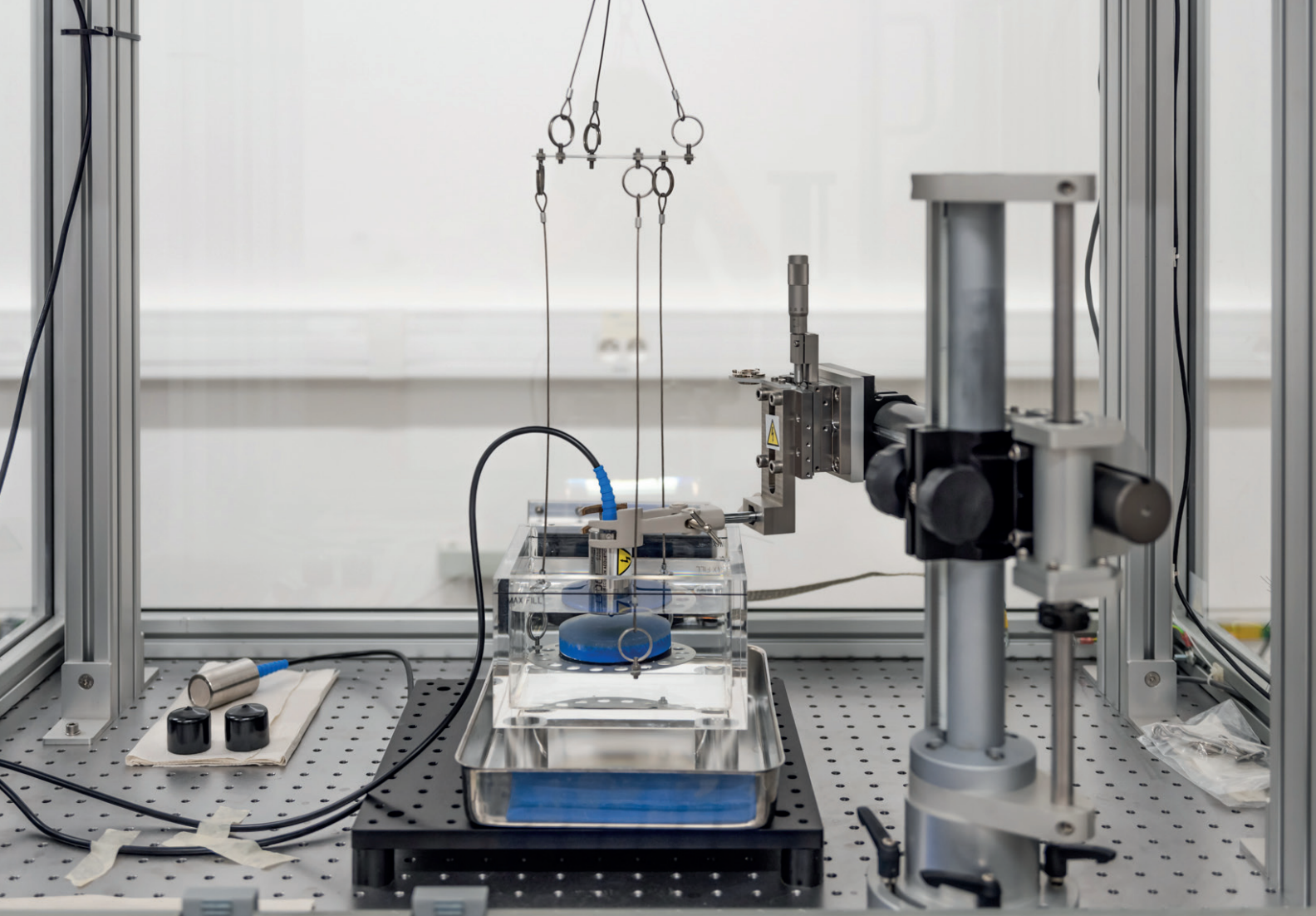
Tightening cooperation and closer partnerships between the administration of measures and the scientific, business and social communities was expressed by the signing in 2021 of over a dozen cooperation agreements with institutions such as:

- Gdynia Maritime University;
- University of Gdańsk;
- Lublin University of Technology;
- Białystok University of Technology;
- Institute of Physics of the Polish Academy of Sciences;
- Kielce University of Technology and Jan Kochanowski University in Kielce;
- Faculty of Geodesy and Cartography, Warsaw University of Technology;
- State Higher Vocational School in Racibórz;
- National Information Processing Institute – National Research Institute;
- Świętokrzyskie Cancer Centre;
- Chief Inspector of Road Transport;
- Targi Kielce;
- Polish Power Transmission and Distribution Association.

The signed agreements enable close cooperation aimed at initiating and conducting joint research and development, application of metrology know-how and technologies and knowledge transfer by co-organising trainings, courses, scientific conferences, organising internships and apprenticeships.

Agreements with universities also provide for mutual assistance in work on diploma, doctoral and habilitation theses by students, doctoral students and employees of universities and GUM. This cooperation should ultimately translate into the economic and social development of Poland.

On 14 October 2021, the President of GUM, prof. Jacek Semaniak signed the "Sectoral Agreement for the Development of Hydrogen Economy in Poland". The agreement initiated by the Minister of Climate and Environment was signed by 138 entities in total – representatives of government administration, local government and the research and development community, industry organisations and businesses. This is the first initiative of this type following the announcement by the European Commission of the "A hydrogen strategy for climate-neutral Europe". It is assumed that university curricula will be updated in order to provide education for specialised staff, while cost-effective models of production will be developed, low-emission renewable hydrogen will be stored and supplied, cooperation for the representation of Polish interests on an international scale will be strengthened as part of the agreements.



GUM FOR THE ECONOMY AND SOCIETY

Research and development constitutes a significant part of the activity of developed national metrology institutes, which is why GUM, as the Polish NMI, treats it as crucial. Actions aimed at the development of new measurement methods or of prototypes of measuring devices have an impact not only on the infrastructure of GUM itself, but mainly on the quality of measurements performed in the country and the transfer of knowledge to the economy.

In 2021, documentation was compiled and the process of recognition of three GUM measurement standards as national standards was completed. The status of a national measurement standard was acquired by the kinematic viscosity measurement standard and the alternating current power measurement standard, and the national measurement standard of density was extended by an additional element – a sphere-shaped silicon monocystal called SILO2.

MEASUREMENT STANDARDS AND STANDS

The national kinematic viscosity measurement standard

This national standard is a measuring system consisting of a set (59 pieces) of standard glass capillary viscometers of the Ubbelohde type, a set of instruments for precise temperature measurement, a viscometric bath and a primary standard – twice distilled water with assigned tabular kinematic and dynamic viscosity values. The stand measures the flow time of constant volumes of viscometric standards by capillaries of standard viscometers in the kinematic viscosity range: from $1 \times 10^{-7} \text{ m}^2 \text{ s}^{-1}$ to $1.5 \times 10^{-1} \text{ m}^2 \text{ s}^{-1}$. To produce viscometric liquid standards, mineral oils and polybutenes which display the properties of Newtonian fluids are used.

Poland is one of 11 countries around the world (Germany, USA, France, Japan, Italy, China, Russia, Netherlands, Slovakia, Turkey) with own independent scale of viscosity of water (ISO/TR 3666: 1998 (E)).

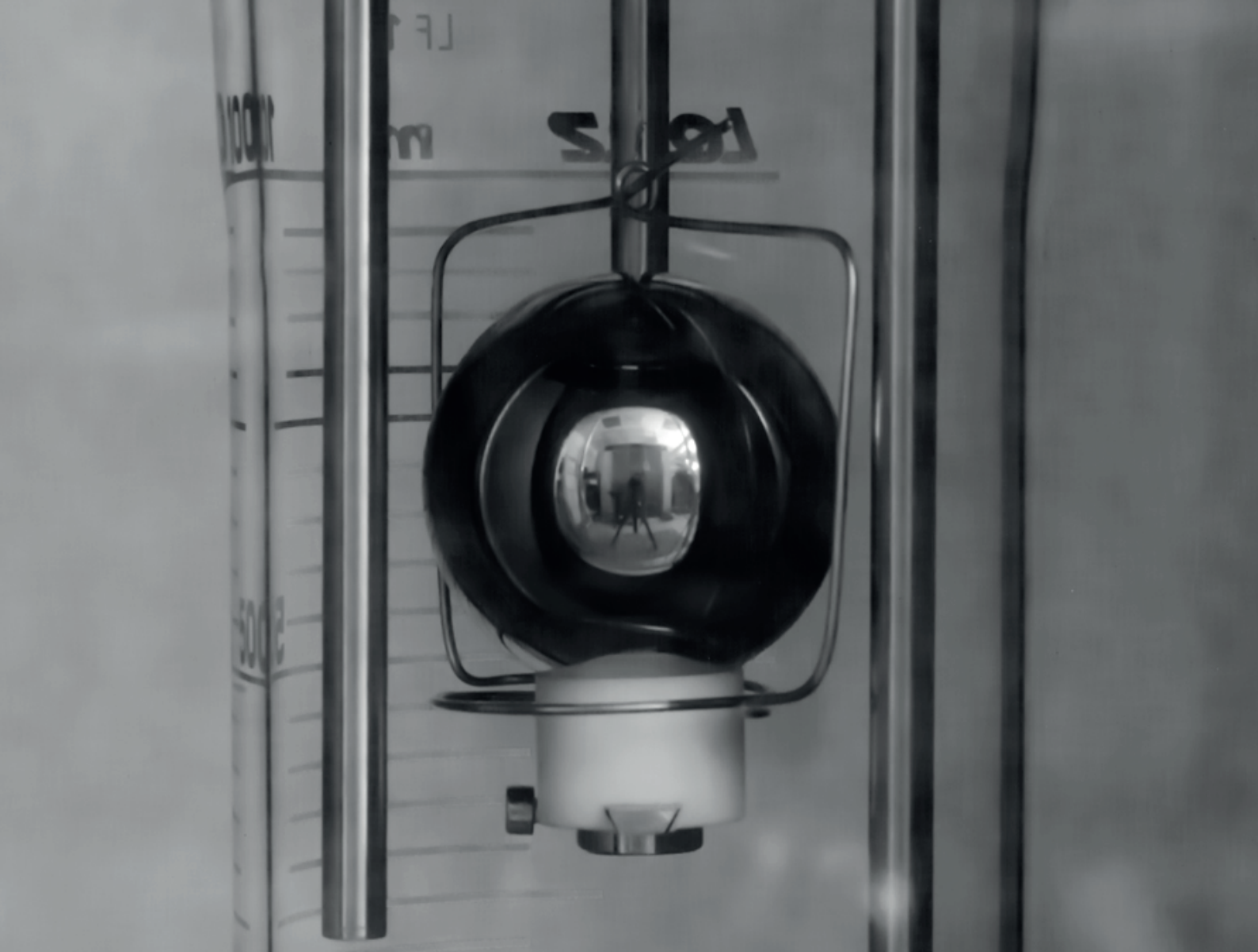
The national AC power measurement standard

This national standard is a measuring system consisting of: high-class multimeters operating in the mode of voltage sampling, set of current shunts, sources of current and voltage and standard energy meters.

It is used to reproduction the measurement unit of:

- AC active power in the range from 0.03 W to 360 000 W with uncertainty from $67 \mu\text{W}/\text{VA}$ to $140 \mu\text{W}/\text{VA}$,
- AC reactive power in the range from 0.03 var to 360 000 var with uncertainty from $67 \mu\text{var}/\text{VA}$ to $140 \mu\text{var}/\text{VA}$,
- AC non-active power in the range from 0.03 VA to 360 000 VA with an uncertainty from $67 \mu\text{VA}/\text{VA}$ to $140 \mu\text{VA}/\text{VA}$.





The national density measurement standard

This national standard consists of two standards made of silicon monocrystals:

- The WASO 9.2 cuboid measuring 28 mm × 39 mm × 60 mm and mass 153 g, with density of 2.329 0889 g/cm³ at a temperature of 20 °C and a pressure of 10⁵ Pa. The expanded uncertainty for determining the density is 0.000 0020 g/cm³ at an coverage probability of about 95 % and an coverage factor of $k = 2$.
- The SILO2 sphere with a diameter of 94 mm and a mass of 997.3 g, with density of 2.329 114 63 g/cm³ at a temperature 20 °C, at a pressure of 101 325 Pa. The expanded uncertainty for determining the density is 0.000 001 10 g/cm³ with coverage probability of approx. 95 % and coverage factor $k = 2$.

Both standards are secondary standards with values of density determined based on Primary Standards of Physikalisch-Technische Bundesanstalt (PTB), Germany. They are intended to realization and dissemination of the unit of density of liquids and solids on a hydrostatic weighing stand.

Primary ionometric standard of the absorbed dose to water for high-energy x-rays used in radiotherapy

The development of the ionometric standard of the original absorbed dose to water for high-energy x-rays used in radiotherapy is the first in the research and development schemes carried out under an agreement between GUM and the Świętokrzyskie Cancer Centre.

This is the first solution of this type in the world. There are currently three such standards for absorbed dose to water, including one at GUM, but only for gamma radiation of the Co-60 nuclide.

As part of the research, a mobile standard was developed and tested using the Świętokrzyskie Cancer Centre accelerator beams. The obtained results are so promising that they were presented in 2022 at the World Congress of Medical Physics and Biomedical Engineering (IUPESM WC2022) in Singapore. Due to high quality of the standard, comparisons with other leading metrological centres are planned in the near future and ultimately the establishment of a primary and national standard.

Thanks to cooperation with GUM, centres such as the Oncology Centre acquire opportunities for calibration of dosimetric devices directly in therapeutic beams, without any recalculations and intermediate standards, which will reduce uncertainty while increasing the accuracy of the application of ionizing radiation doses in patients.

Portable time and frequency standard for interlaboratory comparisons based on a rubidium generator

The development of the standard was completed, it included the development of generation output signal systems and control system, development of the electronic system, verification of correct operation, optimisation of operating parameters and installation of the device and its final characterisation. Measurement noise not exceeding the typical stability of the reference signal from the rubidium generator was obtained. The facility is ready for interlaboratory comparisons.

INTERNATIONAL COMPARISONS

GUM measurement standards are comparable with the world-wide measurement system through calibrations in other NMIs or international comparisons organised by the International Bureau of Weights and Measures (BIPM), Consultative Committees (CCs) of the International Committee of Weights and Measures (CIPM), The European Association of National Metrology Institutes (EURAMET) or by other regional metrology organisations. These comparisons are used to determine the degree the equivalence of standards with international standards and the confirmation of technical competences of laboratories. They are an essential element in the international process of review and recognition of services provided by GUM, the effect of which is listing of the best calibration and measurement capabilities, called CMCs (Calibration and Measurement Capabilities), in the KCDB (Key Comparison Database) of BIPM.

In 2021, GUM took part in 14 international comparisons, including:

- 6 organised by EURAMET;
- 4 organised by BIPM;
- 3 organised by CCs;
- 1 organised by ASTM (American Society for Testing and Materials)

and in continuous comparison for developing TAI and UTC international atomic time scales.

EXTENSION OF THE SCOPE OF ACCREDITATION IN REGIONAL OFFICES OF MEASURES (OUM)

At the Regional Office of Measures in Gdańsk, the scope of accreditation was extended to include calibration of: mass standards of F1 accuracy class from 1 g to 10 kg, mass standards of F2 and M1 accuracy class from 1 mg to 5 mg and 25 kg standards outside the seat of the office, electric thermometers (including electronic ones) up to 500 °C, pressure gauges (relative pressure – vacuum and overpressure (gas)) up to 1 MPa, pressure gauges (relative pressure – overpressure (oil)) up to 260 MPa, as well as spring and electronic pressure gauges from 0.1 accuracy class.

At the Regional Office of Measures in Kraków, the scope of accreditation was updated regarding force and AC and DC currents with clamp meters and regarding chemical quantities.

At the Regional Office of Measures in Bydgoszcz, the scope of accreditation was extended to include calibration at the office of glass and electric thermometers at very low temperatures, i.e. up to –80 °C, which made it possible to increase the offer of services in the field of thermometry.

NEW METHODS AND MEASUREMENT SERVICES

Strengthening cooperation with various businesses, learning about their needs and expectations in the field of solving metrological problems yielded results in the form of developing new measurement methods and introducing new metrological services.

The following were developed and implemented:

- a two-touch method for calibrating gauge blocks with nominal dimensions up to 500 mm (the Regional Office of Measures in Poznań);
- a method of calibrating of material measures of length up to 5 m (the Regional Office of Measures in Poznań);
- checks up of taximeters following conformity assessment in two new locations, i.e. at Local Branches in Piła and Konin;
- secundometers calibration service (the Regional Office of Measures in Wrocław).

Moreover, in view of an amendment of two technical regulations containing technical requirements for online cash register devices and ones with electronic copies of printouts, the methodology of research in the field of test procedures for cash register devices of the above-mentioned types was improved.



GUM FOR THE SECURITY
OF THE STATE
AND THE CITIZENS



CONTROL ACTIVITIES

Effective market surveillance and enforcement of legal regulations for business are a mandatory condition for smooth operation of an open economy; they also ensure the security of citizens. Market surveillance is not only an important element which guarantees fair competition; it serves above all to secure the rights of consumers.

Out of concern for the protection of the security of business transactions and consumer rights, monitoring of compliance with the law was continued by GUM and Regional Offices according to the Law of Measures, Hallmarking Law, Act on Prepackaged Goods, Act on Tachographs and the Act on Conformity Assessment Systems and Market Surveillance together with their executive acts.

6 741 inspections were carried out in various areas, of which 4 257 were inspections in areas of increased risk, which accounts for 63.2 % of the total number of inspections. 78 % of post-inspection recommendations were effectively introduced.

REGULATORY ACTIONS

Works related to updating the applicable legal regulations were carried out and included the drafting of an act amending the Hallmarking Law and the act Law on Measures, along with draft executive acts. The draft law is aimed, in particular, at conducting research activities in the field of precious metals and their alloys and methods of hallmarking products made of such alloys; to boost the effectiveness and efficiency of hallmarking inspections; to improve procedures related to the performance of hallmarking operations and collecting fees for these operations; to update lists of operations that are subject to hallmark fees; to determine the amount of maximum fees for hallmarking and metrology operations as well

as to enable the payment of fees and remuneration in cashless form.

In addition, regulations of the minister of economy were drafted:

- on the requirements to be met by sound level meters and a detailed scope of tests performed during legal metrological control of such measuring instruments;
- amending the regulation on the equipment necessary for the installation, testing, checks-up and repair of analogue or digital tachographs;
- amending the regulation on the requirements to be met by measurement tanks and a detailed scope of tests and checks-up performed during legal metrological control of such measuring instruments;
- amending the regulation on legal metrological control of measuring instruments.

GUM – EUROPE – WORLD

International cooperation in the field of metrology is dictated by important economic, social and scientific considerations. It unquestionably provides a major contribution to the development of the economy by making it more efficient and, above all, less costly.

International cooperation in GUM is conducted mainly through participation in the work of international organisations and institutions and implementation of provisions of international agreements. It focuses on metrology and hallmarking. Matters related to hallmarking are dealt with by assay offices.



METROLOGY

GUM representatives continued their work in Consultative Committees (CCs) of the International Committee for Weights and Measures (CIPM), in the working bodies of the International Organization of Legal Metrology (OIML), the European Association of National Metrology Institutes (EURAMET) and the European Cooperation in Legal Metrology (WELMEC).

The outcomes of cooperation with EURAMET included acceptance of this organisation's new strategy focusing on the most current issues in the field of metrology related to social development – green governance, digitisation, healthcare and sustainable development.

In order to increase the involvement and use of GUM's potential in the work of individual international organisations, numerous activities were undertaken, including in particular:

- joining the newly set-up project group OIML-CD/SC7/p6 "New Document: Guide for the application of ISO/IEC 17020 to the assessment of OIML Issuing Authorities under the OIML-CS", dealing with issues related to the OIML Certificate System;
- intensifying work within BIPM through active participation in the BIPM management group;
- contributing to the new WELMEC strategy;
- signing bilateral agreements on cooperation with Centro Español de Metrología (CEM), the Spanish NMI; the agreement was concluded for a period of 5 years with the possibility of extension. It focuses on cooperation in the field of scientific, applied and legal metrology – in particular on the exchange of information, publications, experience in the field of metrology infrastructure and management, mutual working visits and trainings, joint participation in the works of CIPM-MRA, in research and development, in comparisons, conferences, seminars, as well as in cooperation in other areas of crucial importance for GUM and CEM;
- attending a meeting in the Physikalisch-Technische Bundesanstalt (PTB), the German NMI; during the meeting, apart from a presentation of both institutions and a visit to the headquarters of PTB, the possibility of further cooperation was discussed concerning, amongst others, internships, staff exchanges and joint projects as well as cooperation between GUM and EURAMET whose secretariat is located at PTB in Braunschweig.



EMPIR RESEARCH PROJECTS

GUM staff participated in 24 projects implemented under the European Metrology Programme for Innovation and Research (EMPIR), of which 5 projects were started, and 4 projects were completed in 2021.

COMPLETED PROJECTS

16RPT02 ALCOREF “Certified forensic alcohol reference materials”

The overall aim of the project was to enable National Metrology Institutes (NMIs) or Designated Institutes (DIs) to acquire and confirm competency in the production of new certified reference materials (CRMs) – aqueous ethanol solutions for use in exhalation simulators to calibrate exhalation analysers with wet ethanol gas standards and ultimately add them to their service offer. GUM aims concerning its participation in the 16RPT02 ALCOREF project were reached. A CRMs production methodology was developed and it included the determination of ethanol purity based on density measurement. The suitability of this method was confirmed in an interlaboratory comparison organised for project participants. Homogeneity and material stability tests were carried out as part of the certification campaign. The values of the uncertainty components of the assigned heterogeneity and instability were determined and budgeted for certified value uncertainties. The uncertainty value meets the criteria set for target uncertainty. Competence in producing and assigning CRMs property values was confirmed by the results obtained in a EURAMET QM-S13 comparison while the competence to determine ethanol in aqueous solutions with the results from an EURAMET QM-S14 comparison. They constitute the basis for applying for CMCs entries in KCDB BIPM.

Reference materials were developed to meet the assumed criteria and they are suitable for their intended use. The prepared documentation for the production of CRMs in accordance with ISO 17034 was incorporated into the GUM management system. As an outcome of GUM's participation in the project, the offer of metrological services was extended by new certified reference materials, aqueous ethanol standard solutions.

17NRM03 EUCoM “Standards for the evaluation of the uncertainty of coordinate measurements in industry”

The aim of the project was to develop and verify two methods of uncertainty assessment in coordinate measurements:

- A posteriori (Method A): estimating the uncertainty with experimental data from repetition of measurements in four different orientations.
- A priori (Method B): estimating the uncertainty using expert knowledge and characteristics of previous experience with the used coordinate measuring machine.

Two measurement campaigns were carried out at GUM as part of the verification of the above-mentioned methods:

Two measurement campaigns were carried out at GUM as part of the verification of the above-mentioned methods:

- for prismatic geometries – as part of this task, the Multi-Feature Check standard was measured;
- for free geometries – as part of this task, the Hyperbolic Paraboloid standard was measured.



Online seminars were conducted – (one in Polish) to promote the recommendations developed by the EUCoM project.

One of the developed B methods was found ready for use in the standardisation works. It is the subject of works of ISO/TC 213.

The possible inclusion of the method in the ISO 15530 standard may formalise its use for typical industrial applications. Correct uncertainty assessment at inspections is necessary to avoid wrong decisions such as accepting non-conforming elements. Coordinate measurements are the most popular dimension control technique in industry, therefore recognised and practical uncertainty evaluation methods will improve quality and have a positive impact on the Polish and European manufacturing sector.

17RPT01 DOSEtrace "Research capabilities for radiation protection dosimeters"

The aim of the project was to improve measurement traceability of the operating quantities used in radiological protection of the participating NMIs and DIs. EURAMET.RI (I) -S18 Calibration Coefficients for Ambient Dose Equivalent – $H^*(10)$ for Photon Radiation complementary comparisons were performed under the project. As a result, a code of conduct was drafted for the measurement and reconstruction of operating quantities along with short- and long- term strategies for radiation protection.

Three prototypes of Hp (0.07) secondary standards were designed, developed and tested.

In case of 2 standards (GUM and SCK CEN – Belgian Nuclear Research Centre), tests were carried out in hospital conditions, the third of the developed prototypes (USC – Universidad de Santiago de Compostela) could not be investigated in hospital conditions due to metrological parameters.

17RPT04 VersICaL "A versatile electrical impedance calibration laboratory based on digital impedance bridges"

The aim of GUM's participation in the VersICaL project was to reduce the gap in technological advancement in the field of impedance between others European NMIs.

Under the VersICaL project, GUM designed and developed a digital impedance bridge modelled on the bridge owned by Trescal. The need to develop the bridge resulted from the necessity to improve the existing ones and get new CMC listings in the KCDB database and thus perform more accurate calibration and testing services for clients.

During the project, GUM staff attended trainings in three institutions which had developed digital impedance bridges under the AIM QuTe project – in Trescal, CMI and INRIM (the Czech and Italian NMIs, respectively). Cooperation with the University of Technology Silesia was crucial here. The software that controls the entire measurement process and a database of new impedance standards to verify the parameters of the new bridge were developed in collaboration with that university.

The digital impedance comparator allows to compare different types of impedance, which in turn allows to obtain the unit of resistance (AC) from the quantum Hall effect, the unit of electric capacitance from resistance (AC) and the inductance unit from electric capacitance.

The project was successfully completed – its initial assumptions were implemented – the new impedance bridge operates in the medium impedance range (100 Ω – 10 k Ω) for acoustic frequencies.



PROJECTS IN PROGRESS

- 17IND03 LaVA “Large Volume Metrology Applications”
- 17RPT02 rhoLiq “Establishing traceability for liquid density measurements”
- 17RPT03 DIG-AC “A digital traceability chain for AC voltage and current”
- 18RPT01 ProbeTrace “Traceability for contact probe and stylus instrument measurements”
- 18RPT02 adOSSIG “Developing an infrastructure for improved and harmonised metrological checks of blood-pressure measurements in Europe”
- 18SIB01 GeoMetre “Large-scale dimensional measurements for geodesy”
- 18SIB05 ROCIT “Robust Optical Clocks for International Timescales”
- 18SIB08 ComTraForce “Comprehensive traceability for force metrology services”
- 18SIB09 TEMMT “Traceability for electrical measurements at millimetre-wave and terahertz frequencies for communications and electronics technologies”
- 18HLT04 UHDpulse “Metrology for advanced radiotherapy using particle beams with ultra-high pulse dose rates”
- 19ENG05 NanoWires “High throughput metrology for nanowire energy harvesting devices”
- 19ENG08 WindEFCY “Traceable mechanical and electrical power measurement for efficiency determination of wind turbines”
- 19NET01 AdvManuNet “Support for a European Metrology Network on advanced manufacturing”
- 19NET02 EMN-Quantum “Support for a European Metrology Network on quantum technologies”
- 19NET03 supportBSS “Support for a European Metrology Network on reliable radiation protection regulation”
- 20FUN03 COMET “Two-dimensional lattices of covalent- and metal-organic frameworks for the Quantum Hall resistance standard”
- 20IND02 DynaMITE “Dynamic applications of large volume metrology in industry of tomorrow environments”
- 20IND07 TracOptic “Traceable industrial 3D roughness and dimensional measurement using optical 3D microscopy and optical distance sensors”
- 20IND08 MetExSPM “Traceability of localised functional properties of nanostructures with high speed scanning probe microscopy”
- 20SCP01 Smart PhoRa “Smart specialisation and stakeholder linkage in Photometry and Radiometry”

In addition, GUM staff were involved in the work related to the first call under the new programme – European Partnership in Metrology – including, amongst others, arrangements with potential co-authors of the proposed projects for implementation.

EUROPEAN METROLOGY NETWORKS (EMNs)

The EMN programme was approved at the 12th EURAMET General Assembly in May 2018 in Bucharest and its aim is to coordinate European metrology through analysis of global and European needs in this area, as well as to unify European strategies on research, infrastructure, knowledge and metrology services. The networks represent an association of NMIs and DIs from various EURAMET member countries who jointly implement relevant projects.

GUM continued its work in the following networks:

- Energy Gases;
- Climate and Ocean Observation;
- Mathematics and Statistics;
- Quantum Technologies;
- Smart Electricity Grids

and was involved in the works of two new networks set up in 2021:

- Advanced Manufacturing;
- Radiation Protection.

These networks will focus on measures that go beyond the capabilities of a single national metrology institute and strive for cooperation with European stakeholders in the field of radiation protection and advanced industry.

HALLMARKING

Regional Assay Offices (OUP) in Warsaw and Krakow continued their participation in international research programmes verifying the measurement trueness of the results obtained in laboratories (Round Robin, LABTEST). Laboratories of Regional Assay Office in Warsaw also participated in programmes organised by: Institute of Metrology of Bosnia and Herzegovina in Sarajevo, Metrology Institute of the Republic of Slovenia in Celje and Assay Office in Prague. The research results in all the programmes were found to be correct.

Cooperation was continued within the framework of international assay organisations:

- The Convention on the Control and Marking of Articles of Precious Metals – the 87th and 88th meetings of the Convention were held in form of teleconferences. The following topics were discussed: the Round Robin programme, delegation of research mandates within one country and abroad and product cases of atypical design and the possibility of marking them with CCM. The impact of Brexit on the trade in precious metal products in the EU was also discussed. Moreover, two meetings of the Technical Working Group were held in the form of a teleconference and attended by a Regional Assay Office in Warsaw staff member acting as deputy chairman of this group;
- Visegrad Group of Assay Offices (GV4) – on 12-15 October 2021 a GV4 meeting was held in Egerszalok, Hungary. The following subjects were discussed during the meeting: the activity of offices during the pandemic, including impact on the quantity of products reported in 2020 and in early 2021, the staffing and financial status of offices and international cooperation in the field of hallmarking supervision.



KNOWLEDGE TRANSFER

GUM staff participated, mainly online, in many events disseminating information about metrology and its role in the contemporary world, about the redefinition of base units of SI and new measurement standards and methods.

Information on the latest trends in domestic and international metrology were provided in 38 publications (including 17 publications in the journals with IF) by GUM staff and in 5 publications by Regional Units staff.

Despite the restrictions connected with the state of the pandemic, 42 training courses were conducted at GUM and Regional Offices as part of knowledge transfer.



EVENTS

Seminars on prepackaged goods

More than 700 participants, including representatives of businesses and staff from state institutions operating in the area of prepackaged goods, participated in four rounds of online seminars organised by GUM between 20-28 April 2021. The topics of the seminars covered the most important issues related to the Act on Prepackaged Goods, especially regarding markings on prepackaged goods and metrology of prepackaged goods.

During the seminars, information was also provided on how to properly apply and enforce the provisions of the Law on Measures in the scope of units of measurement and measuring instruments.

Industrial Measuring Technology Fair. A panel discussion entitled "GUM for modern economy. An offer for businesses."

During the meeting, entrepreneurs had the opportunity to discuss the challenges of contemporary metrology, the necessity of conducting and implementing joint research and development projects, with particular emphasis on the needs of small and medium-sized enterprises.

An important point of the panel discussion was the presentation of the offer of GUM's Świętokrzyski Laboratory Campus currently being constructed in Kielce.

The 53th Inter-University Metrology Conference at the Central Office of Measures

The Inter-University Metrology Conference (MKM) is organised by the scientific community of Polish universities and has long-standing tradition. In 2021, due to the epidemiological situation, it was held in hybrid mode. GUM was one of the co-organisers of the of the conference and hosted the participants and speakers of the MKM.

During the conference sessions, GUM staff presented the following topics:

- Research on innovative nanomaterials in the European project 19ENG05 NanoWires in the field of renewable energy;
- Assessment of the accuracy of measurements in the linear regression method, taking into account the principles of the Guide to the Expression of Uncertainty in Measurement;
- Implementation of the European project 19ENG08 WindEFCY in the area of wind energy at the Central Office of Measures.

PUBLICATIONS

The achievements of the staff are reflected in articles and reports published in international journals and domestic publishing houses.

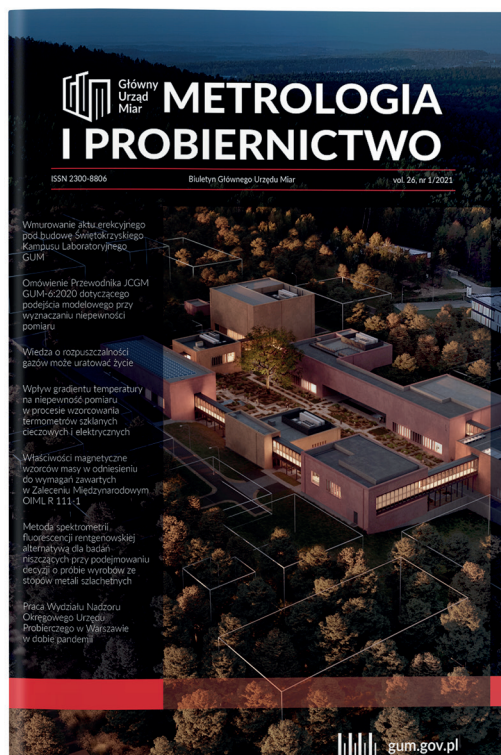
GUM publications

Another issue of the Bulletin of Central Office of Measures "Metrology and Hallmarking" was published on the GUM website (vol. 26, No. 1/2021) in a new, more attractive layout, containing the following articles:

1. **P. Fotowicz**, GUM: Description of the JCGM GUM-6: 2020 Guide concerning the use of the measurement models in evaluation of measurement uncertainty.
2. **I. Misztal**, OUM Katowice: Knowledge of gas solubility can save lives.
3. **H. Bodzek**, OUM Bydgoszcz: Impact of temperature gradient on measurement uncertainty in the calibration process of liquid glass and electric thermometers.
4. **H. Michalska, K. Kapela**, OUM Bydgoszcz: Magnetic properties of mass standards in relation to the requirements of the International Recommendation OIML R 111-1.
5. **A. Górkiwicz-Malina, P. Kowalówka**, OUP Kraków: The method of X-ray fluorescence spectrometry as an alternative to destructive testing when making a decision on the standards of articles of precious metal alloys.
6. **J. Motyka**, OUP Warszawa: How the Supervision Division of Regional Assay Office in Warsaw works during global pandemic time.

In addition, the following were prepared and posted on the GUM website:

- Report on users of e-CzasPL services (developed under the project "e-CzasPL - reliable and credible system and dissemination of official time in the territory of the Republic of Poland");
- Activities of the Central Office of Measures and Regional Units. 2020 Annual Report – in Polish and English;
- The International System of Units (SI) - a supplemented version of the Polish edition of the BIPM brochure;
- Report on the implementation of the annual action plan of the Central Office of Measures in 2020;
- Annual action plan of the Central Office of Measures for 2021;
- Four-Year Strategic Action Plan of the Central Office of Measures for 2022 – 2025.



Publications of GUM staff

The staff's publications appeared, amongst others, in journals, monographs, conference materials and were posted on websites.

1. Ł. Sobolewski, W. Miczulski, A. Czubla: Experimental Verification of the Neural Network Predicting Procedure. Sobolewski, W. Miczulski, **A. Czubla**: Experimental Verification of the Neural Network Predicting Procedure Applied for UTC(PL). IEEE Transactions on Instrumentation and Measurement. Volume 70, 2021.
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3. A. Przyklenk, A. Balsamo, D. O'Connor, A. Evans, T. Yandayan, S. Asli Akgöz, O. Flys, D. Phillips, V. Zeleny, **D. Czulek**, F. Meli, C. S. Ragusa, H. Bosse: New European Metrology Network for advanced manufacturing. Measurement Science and Technology, Volume 32, Number 13, 2021.
4. A. Röttger, A. Veres, V. Sochor, M. Pinto, **M. Derlacinski**, M.-R. Ioan, A. Sabeta, R. Bernat, C. Adam-Guillermin, J. H. Gracia Alves, D. Glavič-Cindro, S. Bell, B. Wens, L. Persson, M. Živanović, R. Nylund: Metrology for radiation protection: a new European network in the foundation phase, Advances in Geoscience, Volume 57, 1-7, <https://doi.org/10.5194/adgeo-57-1-2021>, 2021.
5. **J. Puchalski**: A New Algorithm for Generalization of Least Square Method for Straight Line Regression in Cartesian System for Fully Correlated Both Coordinates. International Journal Automation, Artificial Intelligence, Machine Learning, Volume 2, Issue 2, 2021.
6. **J. D. Fidelus**, A. Germak, C. Origlia: Bilateral comparison in Rockwell C hardness scale between INRiM and GUM. Measurement: Sensors 18 (2021).
7. M. Zweiffel, J. M. Q. Crespo, L. Vavrečka, M. A. Sáenz-Nuño, J. Maldonado, N. Eich, H. Zhang, **J. D. Fidelus**, R. S. Oliveira, Ch. Mester, Ch. Lehrmann, Z. Song, N. Yogal, J. Teigelkötter, E. Bernabeu, T. Kananen, P. Weidinger: Deliverable D1 within 19ENG08- Summary report describing current state-of-the-art. developments on efficiency determination methods for wind turbines and nacelles in the field and on test benches respectively, their traceability, and general methods for direct and indirect efficiency determination.
8. Z. Song, P. Weidinger, L. Vavrečka, M. Heller, **J. D. Fidelus**, R. S. Oliveira, M. Zweiffel, T. Kananen: Deliverable D2 within 19ENG08- Report describing the requirements of tachometers such as the evaluation of existing tachometer measuring principles and their capabilities, and the procedure developed to calibrate tachometers with an uncertainty of 0.01 %.

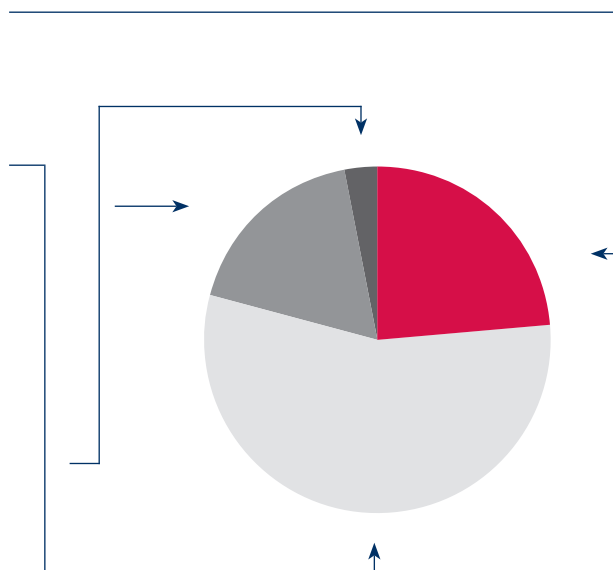
9. C. Kessler, D. Burns, **A. Knyziak, M. Szymko, M. Derlaciński**: Key comparison BIPM.RI(I)-K1 of the air-kerma standards of the GUM Poland and the BIPM in Co-60 gamma radiation. *Metrologia*, Volume 58, Number 1A, 2021.
10. D. T. Burns, C. Kessler, **Ł. Michalik**: Key comparison BIPM.RI(I)-K3 of the air-kerma standards of the GUM Poland and the BIPM in medium-energy x-rays. *Metrologia*, Volume 58, Number 1A, 2021.
11. C. Kessler, D. Burns, **A. Knyziak, M. Szymko, M. Derlaciński**: Key comparison BIPM.RI(I)-K4 of the absorbed dose to water standards of the GUM Poland and the BIPM in Co-60 gamma radiation. *Metrologia*, Volume 58, Number 1A, 2021.
12. **A. Trych-Wildner**, K. Wildner: Characterisation and effective monitoring of 4D printed structures through microgeometry analysis. *Measurement Science and Technology*, Volume 32, Number 8, 2021.
13. G. B. Picotto, M. Aksulu, F. Alqahtani, N. Alqahtani, A. Arce, M. Äremann, M. Astrua, G. Bajić, C. Bandis, G. Baršić, D. Bellelli, R. Bellotti, T. Bozovic, D. de Borst, V. Duchoň, B. Gastaldi, R. Hanrahan, O. Jusko, M. Karanfilovic, M. Katić, R. Koops, G. Kotte, A. Lassila, M. Matus, F. Meli, I. Meral, R. Milne, R. Muñoz, M. Pometto, E. Prieto, J. Salgado, V. Šimunović, J. Spiller, G. Szikszai, **R. Szumski**, A. Stelmaszczuk, D. Teodorescu, R. Thalmann, J.B. Toftegaard, M. Trösch: Calibration of diameter standards (EURAMET.L-K4.2015). *Metrologia*, Volume 58, Number 1A, 2021.
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15. E. Flores, J. Viallon, F. Idrees, P. Moussay, R. Wielgosz, U. Shinji, **D. Cieciora**, F. Rolle, M. Sega, O. Sang-Hyub: International comparison CCQM-K74.2018: Nitrogen dioxide, 10 μmol mol⁻¹. *Metrologia*, Volume 58, Number 1A, 2021.
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18. **M. Gruszczyński, A. Czubla, Ł. Czerski**: Generowanie i dystrybucja czasu urzędowego w Polsce. IT w Administracji, kwiecień 2021.
19. **A. Czubla, M. Gruszczyński**: Jak porównanie atomowego wzorca czasu w Polsce współgra z satelitami? <https://space24.pl>, 2021
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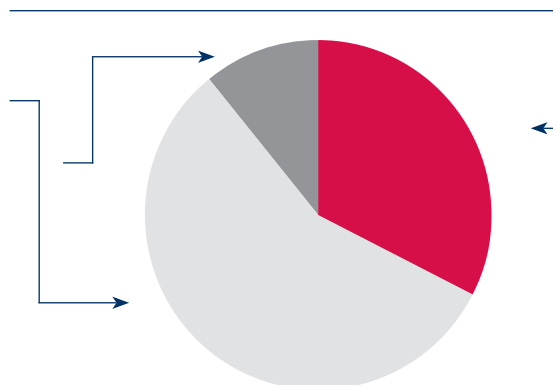
GUM IN FIGURES

THE 2021 GUM BUDGET

income	in PLN	%
Statutory operations	1 626 720.46	23.8
Activities connected with civil-law contracts	3 788 248.89	55.5
Activities connected with digital tachographs	1 216 907.92	17.8
Other income	195 807.76	2.9
Total income	6 827 685.03	100

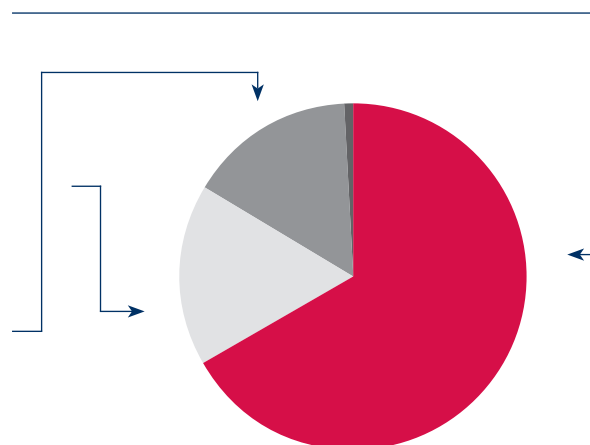


expenses	in PLN	%
Current expenses	17 411 696.33	32.6
Salaries	30 309 954.48	56.7
Property expenses (excluding non-expiring expenses)	5 713 821.66	10.7
Total expenses	53 435 472.47	100

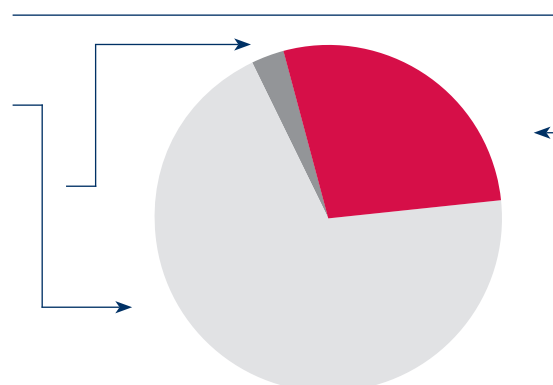


THE 2021 REGIONAL UNITS BUDGET.

income	in PLN	%
Statutory operations	47 641 250.00	66.8
Activities connected with civil-law contracts	12 035 053.14	16.9
Activities connected with hallmarking	11 042 109.47	15.5
Other income	605 799.67	0.8
Total income	71 324 212.28	100

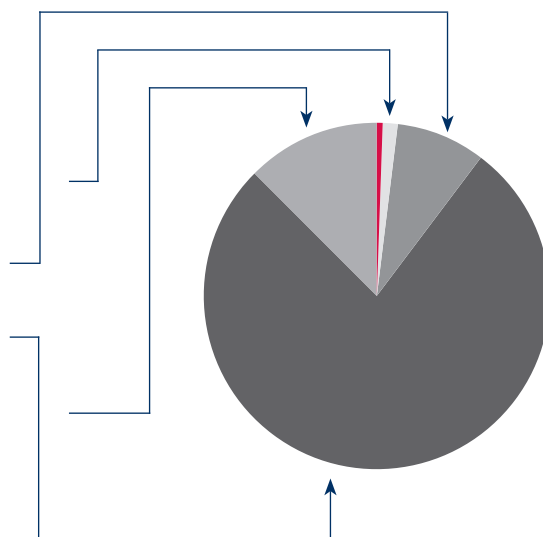


expenses	in PLN	%
Current expenses	32 622 363.40	27.5
Salaries	82 727 783.78	69.7
Property expenses (excluding non-expiring expenses)	3 329 692.04	2.8
Total expenses	118 679 839.22	100

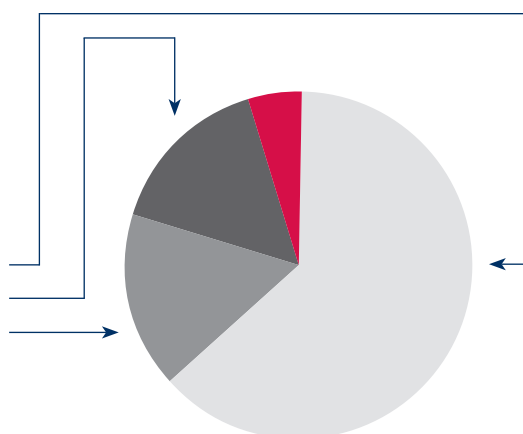


GUM STAFF

education	No. of staff	%
primary	2	0.56
vocational	5	1.39
secondary	30	8.36
higher <small>(1st and 2nd cycles - Bachelor, Engineer, Master)</small>	278	77.44
higher <small>(3rd cycle - PhD)</small>	44	12.25
Total staff	359	100

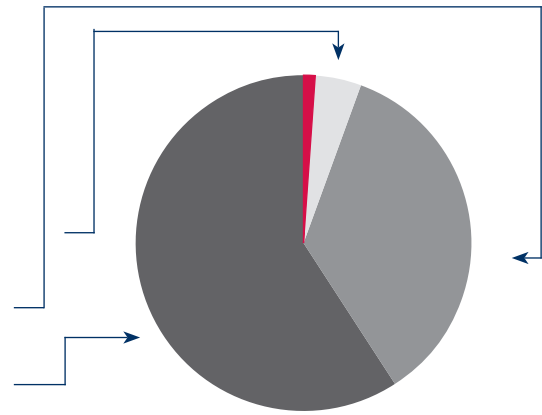


age structure	No. of staff	%
<30	18	5.01
30 - 49	227	63.23
50 - 59	55	15.32
≥ 60	59	16.44
Total staff	359	100

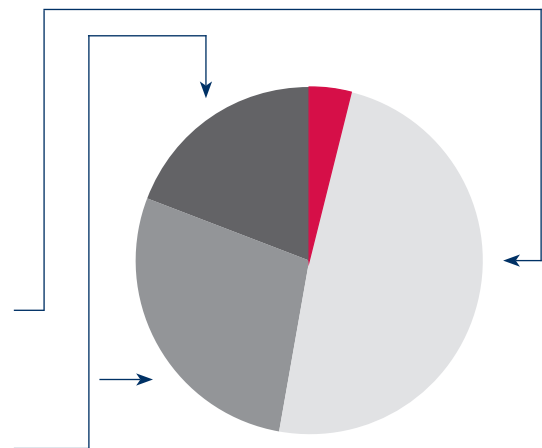


REGIONAL UNITS STAFF

education	No. of staff	%
primary	15	1.19
vocational	58	4.60
secondary	445	35.26
higher	744	58.95
Total staff	1 262	100



age structure	No. of staff	%
<30	53	4.20
30 - 49	615	48.73
50 - 59	349	27.66
≥ 60	245	19.41
Total staff	1 262	100



SERVICES

service	figures		
	Central Office of Measures	Regional Offices of Measures	Regional Assay Offices
Calibrations	11 803	141 770	-
Expertise	88	3 423	-
Tests	3	2 826	-
Production and certification of reference materials	2 562	7 865	-
Type approval (tests and decisions)	105	86	-
Verification	-	1 480 643	-
Assaying and hallmarking of precious metal products	-	-	4 189 661
Conformity assessment	10	15 180	-
Certification of cash register devices	19	-	-
Organisation of exams	54	-	-
Authorizations for verification	4	-	-
Setting up verification units	70	35	-
Issuing of permits – digital tachographs	188	8	-
Organisation of domestic comparisons	18	2	-
Subcontractors evaluation (suppliers of large standards)	15	-	-
TOTAL	14 939	1 651 838	4 189 661



**Central
Office
of Measures**

Central Office of Measures

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