



Central  
Office  
of Measures

EN



ACTIVITY OF CENTRAL OFFICE OF MEASURES  
AND REGIONAL UNITS  
ANNUAL REPORT 2019

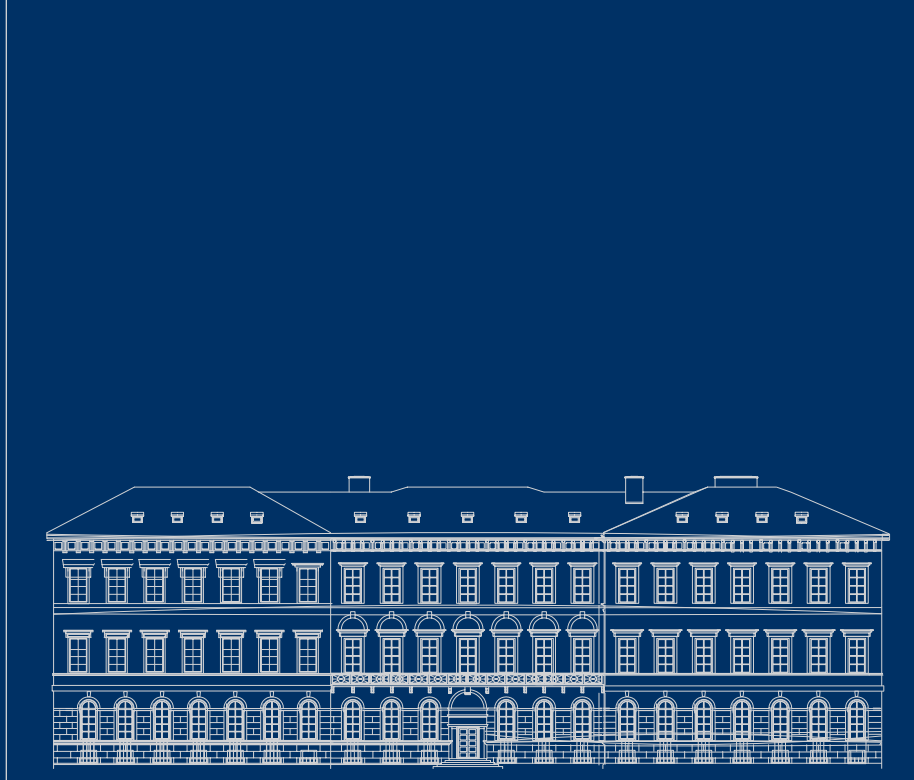




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*The Central Office of Measures (GUM) is a national metrology institute that deals with theoretical and practical issues connected with measurements, among others: with the definitions of measurement units, technologically advanced measurement standards, measuring systems and methods, as well as with legal issues.*

*The GUM activities within the above-mentioned scope focus on:*

- assurance of measurement capabilities necessary for the sustainable development of the economy,*
- assurance of an appropriate level of quality of life of society and the protection of the interest of its citizens,*
- protection of state economic and technical security.*



**Central  
Office  
of Measures**



This is the annual report of the Central Office of Measures, an institution which celebrated the 100th anniversary of its activity last year.

On 1 April 1919, under the Decree on measurements, signed by the Head of State, Józef Piłsudski, the Central Office of Measures (GUM) was founded. The decree was one of the earliest legal acts in the reborn Republic of Poland, whereas the Office was among the first state administration institutions in independent Poland. Since its inception, GUM cares for economic interests of the state and the citizens, as well as addresses the needs of scientific communities and helps develop modern metrology.

On 20 May 2019, the anniversary of the World Metrology Day, a redefinition of the International System of Units (SI) entered into force, which was adopted during the session of the 26th General Conference on Weights and Measures (CGPM) in Versailles. It was established to ensure the cohesion and integrity of units of measurement on the basis of universal and consistent basic constants, and adapt them to the needs of modern global civilisation. Please visit the homepage of the Central Office of Measures: #SI redefinition.

In 2019, efforts in order to determine specialisation in regional administration of measures were continued, resulting in establishment of competence centres at Regional Offices of Measures. We are proud to have established a new Regional Office of Measures in Białystok on 1 January 2019 whose head office – thanks to our efforts – is located at the first Metrologist street in Poland. We have also introduced organisational changes at the GUM which involve the development of new statute and regulations of the GUM, appropriate for the importance of this renowned metrological institution.

Also considerably involving was the activity related to the implementation of long-term interdisciplinary projects: “Construction of the Świętokrzyskie Laboratory Campus of the Central Office of Measures”, “IT Support System for Services of the Regional Administration of Measures – ŚWITEŻ” and “e-MiM – Vehicle Mass and Size Measurement System”. A particularly important characteristic of our activity is cooperation of GUM with national partners representing industry and science, as well as foreign metrological institutes.

In 2019, efforts for the purpose of obtaining EU subsidisation for two prestigious projects were started, namely: “IT system for implementation of public services and tasks of the Central Office of Measures regarding tachographs – TRANS-TACHO” and “e-CzasPL – system for reliable and credible distribution of official time within the Republic of Poland”.

The comprehensive efforts of our institution presented above are to help reinforce and develop GUM as the National Metrology Institute (NMI), responding the needs of the changing world. Details of our national and international activity are contained in 2019 Report.



dr hab. inż. Radostaw Wiśniewski  
President of the Central Office of Measures

## ORGANISATION OF THE CELEBRATIONS OF THE 100TH ANNIVERSARY OF THE CENTRAL OFFICE OF MEASURES

The year 2019 was notable for the celebration of the 100th anniversary of the establishment of the Central Office of Measures. On 8 February 1919, the "Decree on measures", one of the first legal acts in the re-established Republic of Poland, was signed by Józef Piłsudski, the Head of the State. Under the decree, the Central Office of Measures, an institution responsible for measurement units in Poland, was founded. The anniversary received National Patronage of the President of Poland for the Centenary of Regaining Independence. Furthermore, the Central Office of Measures joined the "Niepodległa (Independent)" campaign of the Ministry of Culture and National Heritage, therefore the GUM's 100th anniversary celebrations became a part of national observances of the 100th anniversary of Polish independence.

A number of events commemorating the establishment of the GUM were organised as part of the celebrations, which presented its 100-year history and the new challenges ahead.



dr h. c. inż. Zdzisław Erazm Rauszer

## GUM - 2019 IN A NUTSHELL

*Official observances of the anniversary began with a ceremony organised on 18 May 2018 at the GUM head office during which a bust of dr h. c. inż. Zdzisław Erazm Rauszer, the first Director of the Office (1919-1949) and creator of the structures of administration of measures in reborn Poland, was unveiled.*

*niepodległa*

POLSKA  
STULE



The anniversary also included the unveiling of a plaque at the GUM commemorating the employees of the Polish administration of measures, who were killed by Nazi and Soviet invaders during the World War II. Most of the deaths occurred in the line of duty. The first event of 2019 anniversary was a ceremony organised in cooperation with the Regional Office of Measures in Kraków held on 8 February at Wieliczka Salt Mine. That was exactly 100 years from the day the Decree on measures was signed. During the ceremony, distinguished employees were decorated with the Honoris Gratia awards.

The main celebrations of the 100th anniversary were held on 1 April 2019 in Sala pod Kopułą at the Ministry of Entrepreneurship and Technology on the anniversary of appointment of Zdzisław Rauszer as the director of the Central Office of Measures.

The ceremony was attended by great guests from Poland and abroad – i.a. scientists specialising in physics and chemistry, including Nobel Prize winner, professor Klaus von Klitzing, representatives of national and international metrological organisations, representatives of the NMI and special guests.

On the anniversary year, particular celebrations were devoted to the World Metrology Day. On 20 May 2019, during the ceremony at the Belvedere, Residence of the President of the Republic of Poland, 33 employees of Polish administration of measures were decorated with Gold, Silver and Bronze Crosses of Merit – for achievements in efforts for development and promotion of modern metrology, as well as with 57 Medals for Long Service. On the same day a Metrological Picnic was organised for the employees of the Polish administration of measures.

To celebrate the centenary, additional 9 regional events were held by regional offices of measures during which decorations and commemorative distinctions were awarded to long-term employees. The conclusion of the anniversary was organised at Białystok University of Technology on 14 June 2019, during which Pro Masovia, the most important of Masovia decorations, have been awarded.

GUM anniversary was enriched by a collection of commemorative publications – a special historical booklet and a new edition of a biographical dictionary of the GUM employees and a monograph dedicated to the history of administration of measures by PhD Andrzej Barański, and a postcard with a printed postage stamp, issue: 100 years of the Central Office of Measures has been put into circulation on 1 April 2019.

All GUM events have been marked by signs of: National Patronage of the President of Poland, Ministry of Culture and National Heritage – NIEPODLEGŁA and the sign of DOKŁADNIE 100 LAT 1919-2019 celebrations.



Commemorative medal made on the basis of the concept Rosław Szaybo



Rosław Szaybo (Fot. Czesław Czaplinski/FOTONOVA)

### Rosław Szaybo

(born August 13, 1933 in Poznań, d. May 21, 2019 in Warsaw)

Polish poster artist, photographer and book cover designer, winner of numerous awards and juror of Polish competitions and foreign, representative the so-called Polish school of poster

(Wikipedia)

## REDEFINITION OF BASE UNITS OF THE INTERNATIONAL SYSTEM OF UNITS (SI)

On 20 May 2019, the day of the World Metrology Day, SI redefinition entered into force, adopted during the 26th General Conference on Weights and Measures (CGPM) on 13-16 October 2018 in Versailles.

That was the most crucial step for metrology based on fundamental constants and physical phenomena, metrology referring to fundamental laws describing the universe – theory of relativity and quantum mechanics, metrology constituting a bridge of sorts between the laws of nature and development of civilisation.

Due to the above, in 2019 a number of adaptation projects have been conducted at the GUM, including the modernisation of existing standards and measuring stands, as well as construction of new ones. Efforts involving, among others, the construction of a modular measuring stand for the national measurement standard of unit of mass, metrological infrastructure providing measurement traceability to unit of mass after the redefinition of the kilogram, were continued.

Also initiated were activities adjusting legal acts associated with measurement units to the changes introduced in the SI as well as popularising knowledge on this topic.

Condensed information on the “new SI” have been prepared in form of tables, along with non-SI units accepted for use with the SI. Tables have been placed on the GUM website for printing. They constitute an aid just as helpful in primary schools as in universities.

## RATIONALISATION OF THE FUNCTIONING OF REGIONAL OFFICES OF MEASURES

In 2019, works on determining the specialisation of the Regional Administration of Measures were continued, which was the first step towards the establishment of competence centres at Regional Offices of Measures (the OUMs) – for measurements of various types of measuring instruments, entire measurement areas, metrological activities and specific metrological phenomena.

A map of metrological specialisations was developed which includes market demand for specific types of measurements within the operation area of a given OUM, as well as its technical and staff capabilities. The effect of these activities was the removal of administrative barriers in form of areas of operation of OUM local branches which limited the clients to a specific “assigned” unit. The client can currently select the most convenient local branch in order to save time and money.

As the result of conducting initial analyses, it was established that the most adequate technical and staff potential from each region to a given area is contained within laboratories of the following regional units:

SPECIALISATION AREAS	REGIONAL UNIT
Acoustics and Vibrations	OUM in Łódź, OUM in Gdańsk, OUM in Białystok
Chemistry	OUM in Łódź
Electricity and Magnetism	OUM in Kraków, OUM in Poznań
Mass	Local Branch in Siedlce and Local Branch in Piła (standards of large mass), OUM in Katowice
Ionising Radiation	OUM in Warszawa (testing of aerosol)
Flow and Volume	OUM in Łódź, Local Branch in Leszno Local Branch in Jasło (capacity serving measures)
Pressure	OUM in Szczecin

## IT SUPPORT SYSTEM FOR SERVICES OF THE REGIONAL ADMINISTRATION OF MEASURES “ŚWITEŻ”

Providing an effective national economic and technical security protection system through the increase in the availability and quality of services provided by the measurement authority was one of the challenges faced by the administration of measures in 2019.

Therefore, the implementation of “ŚWITEŻ” projects was so important, which will result in introduction and launching of a modern platform of electronic public services available to clients.

In 2019, as part of the project activities, tender procedures were completed and agreements were signed with companies: COMARCH Polska S.A. (for development of IT system software, infrastructure hosting, personnel training) and ThinkIT Consulting Sp. z o.o. (for advisory services and technical support). At the same work was conducted on process description, form templates, and example reports within the extent of designed services and, as complementary activities, work on determining the specialisation in regional administration of measures was continued.

## LAUNCH OF “e-MiM” – A SYSTEM OF MASS AND DIMENSION MEASUREMENT OF VEHICLES IN POLAND

Increasing the safety of road users and preventing degradation of roads due to overloaded vehicle traffic is an important task for every country. GUM supports activities in that area, i.a. through participation in “e-MiM” project (electronic Measurement in Motion).

In 2019, further works involving the construction of a reference measuring stand for determining the reference mass value in the process of dynamic weighing of vehicles on the basis of reference weighbridge mass, as well as the development of metrological methodology of the system for mass and dimension measuring of vehicles.

A series of meetings with representatives of the General Directorate for National Roads and Motorways (GDDKiA), General Inspectorate of Road Transport (GITD) and Mazowieckie Voivodeship Road Authority (MZDW) on development of methodology, as well as preparation and implementation of national legislation. During the working meeting of GDDKiA and GITD with producers of dynamic mass measurement systems, design characteristics for the discussed systems were explored. An important issue during the implementation of the project was “Construction of a measuring stand for certification of measurement systems for non-standard vehicle parameters”, including the objectives for construction and determining the location of a roadway where research for approval of systems of dynamic mass measurement will be conducted. Furthermore, preparations of appropriate legislation associated with establishing legal metrological supervision over those systems.

## CHANGES AT THE GUM

In 2019 there was a change in the position of the President of the GUM. On 2 August 2019, dr hab. inż. Radosław Wiśniewski was appointed for that position by Jadwiga Emilewicz, Minister of Entrepreneurship and Technology. GUM President graduated from the Faculty of Geodesy and Land Management of the University of Warmia and Mazury in Olsztyn. In years 2005-2012 he was a Deputy Dean of the Faculty of Geodesy and Land Management of the University of Warmia and Mazury in Olsztyn, and between 2012 and 2017 he was a Dean of the Faculty of Geodesy, Spatial Engineering and Construction at that university. During years 2017-2018 he occupied the position of the Director of the Department of Geoinformation Policy in the Ministry of Digital Affairs. In 2017, he became a member of WG6 Working Group for Spatial, Geodetic, Geophysical and Satellite Techniques Applications, operating within the framework of the Consultative Metrology Team for infrastructure and special applications by the GUM President.

In order to increase the effectiveness of the GUM, taking into account the experiences from previous years, the organisational structure of the GUM was changed by granting the institution a new statute. The changes involved, among others, the establishment of a new Industry Support Laboratory, whose tasks involved the intensification of cooperation with various economic entities and division of offices in a way which clearly and conclusively describes the goals and responsibilities regarding certification, supervision, control and finances.



## TRANS-TACHO AND e-CzasPL PROJECTS

In 2019 efforts on obtaining EU subsidisation for two projects had been started:

1. “IT system for implementation of public services and tasks of the Central Office of Measures regarding tachographs –TRANS-TACHO”

E-services will be created within the framework of TRANS-TACHO which will facilitate:

- conducting tachograph workshops,
- training tachograph workshop technicians regarding installation, assessment, review and repair of tachographs,
- working as a tachograph workshop technician,
- introduction of tachographs on the EU market.

Launching of the TRANS-TACHO IT system will allow remote customer service regarding tachographs, which will result in lower running costs and save time necessary to obtain permits and certificates, as well as increase effectiveness of the measurement authority and decrease administrative costs on part of the clients.

2. “e-CzasPL – a system for reliable and credible distribution of official time within the Republic of Poland”.

The objective of the project is delivering reliable and flawless official time signal distribution within the territory of the Republic of Poland and signals of Polish implementation of the international Coordinated Universal Time UTC(PL) and synchronising monitoring service in accordance with the needs of the economy and the society.

The result of implementation of the e-CzasPL project will be:

- increased availability to reliable, flawless, high quality legal time linked to the UTC, which will improve the reliability of user synchronisation systems and directly lead to the improvement of the quality of services relying on reliable time sources,
- simplified process of obtaining information about legal time and synchronisation with that time for citizens and entrepreneurs on individual devices and in specialised IT systems such as systems used in banking and finances, power engineering or telecommunication.
- establishment of the capabilities to obtain information about the current state or become familiar with summary statistics from any reporting period on qualitative characteristics of synchronisation with the official time (time monitoring-authentication system).

## CZAS GUM – NEW MOBILE APPLICATION

The “Czas GUM” application was developed and made available as part of the process of popularising knowledge about legal time.

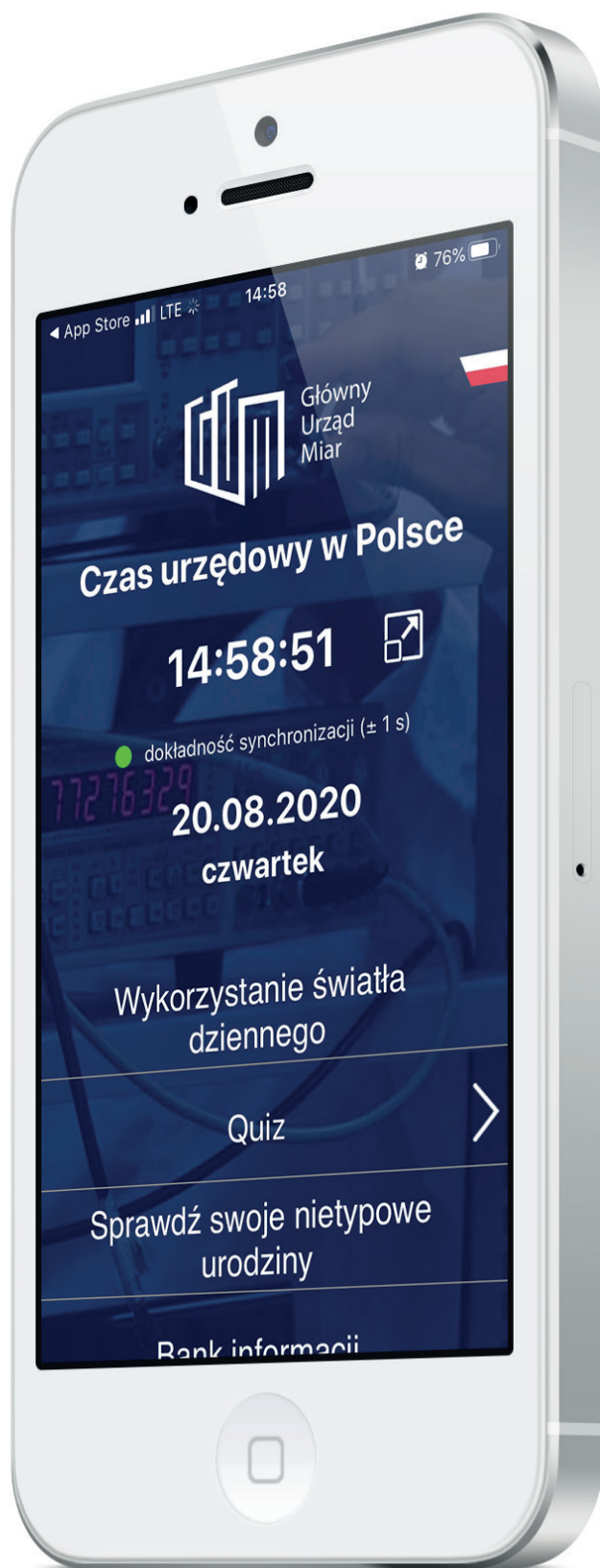
The application displays current official time within the area of the Republic of Poland, with error no greater than 1 s, retrieved from legal time servers located at the GUM. Legal time servers are controlled via signals from the national time and frequency unit standard, whereas the implemented communication protocols NTP and SNTP (Network Time Protocol, Simplified Network Time Protocol) allow synchronisation of the clock within the application with the legal time via the internet.

The application also allows the user to:

learn the pros and cons of regular time changes (daylight saving time) versus keeping the same time throughout the year,

- gain knowledge such as the operation of atomic clocks and the notion of time transfer, as well as find information regarding metrology and the Central Office of Measures,
- find out when you would celebrate your birthday if you lived, e.g., on Mars,
- see the largest knowledge base about time.

“Czas GUM” is a multiplatform application – it can be opened via any desktop browser by going to [www.czas.gum.gov.pl](http://www.czas.gum.gov.pl). The users of Android and iOS systems will find dedicated applications which they can download for free from dedicated stores.





2019 was a time of intensified activities involving the implementation of a project called "Świętokrzyski Laboratory Campus of Central Office of Measures – development of a concept of functioning and opening of the campus". The goal of the project is to increase the market presence of R&D activity regarding metrology and therefore to improve competitiveness of Polish companies on the European and international markets, as well as the establishment of a Polish metrology centre in Kielce, a place where science, research and other directly or indirectly economy-related circles could meet.

The project is being implemented within the framework of the Regional Operational Programme of Świętokrzyskie Voivodeship (RPOWŚ), and its time frame encompasses years 2019-2023. In November, a consortium comprising: State Treasury (Central Office of Measures) and Kielce University of Technology have received confirmation of a construction project and a construction permit for a Świętokrzyski Laboratory Campus of Central Office of Measures (ŚKLGUM) in Kielce.

As a result of the conducted and concluded contest for development of an architectural concept of the ŚKLGUM, an agreement was signed with the winner of the contest BDM Architekci company. Technical dialogue with potential contractors for the investment was being conducted in parallel with the design work. On the basis of collected information, tender documentation was prepared which allows the tender procedure to be announced in order to choose the main contractor of ŚKLGUM construction works.

A binding construction permit was obtained in the 4th quarter of 2019.



Rzeczpospolita  
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WOJEWÓDZTWO  
ŚWIĘTOKRZYSKIE

U I Europejska  
Europejski Fundusz  
Rozwoju Regionalnego





# CAMPUS

technologically advanced  
research and measurement  
laboratories



Świętokrzyski  
Kampus  
Laboratoryjny | Głównego  
Urzędu  
Miar

# KIELCE





## METROLOGY COUNCIL

In 2019, on 15 March and 13 November, chaired under prof. Ewa Bulska, two meetings of the Metrology Council – an advisory and opinion forming authority operating by the GUM president – were held.

During the spring meeting, the Metrology Council issued a positive opinion on both the “Report on the activity of the Central Office of Measures in 2019” and “Annual action plan of the Central Office of Measures for 2020”, documents which were being consulted with Members of the Metrology Council.

During the autumn meeting, the Metrology Council adopted a resolution issuing a positive opinion on the “Annex to the Four-year strategic operation plan of the Central Office of Measures 2018-2021”.

Final versions of the above mentioned documents, positively approved by the Metrology Council, were submitted to the minister appropriate for economic affairs.

During the autumn meeting, the President of Central Office of Measures discussed the GUM tasks and directions of developments regarding standards, technology and measurement services, and presented the plans of structural and organizational changes in Polish administration of measures. He also presented projects implemented at the GUM, as well as strategic and operational pillars in perspective 2020+.

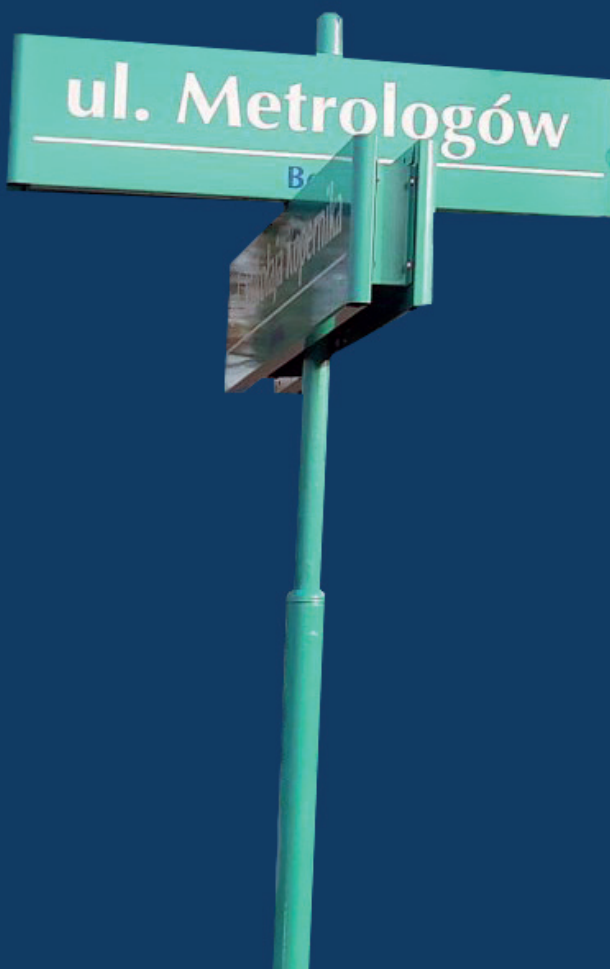
## AWARDS AND DISTINCTIONS

- Grand Prix award of EuroLab Fair 2019 was given for long-standing cooperation.
- The prestigious Złoty Oktan award was given by the Polish Chamber of Liquid Fuel for continuing the 100-year tradition of reliable measurements, professionalism, modern approach to metrology and cooperation with the petroleum industry.
- Second degree Złoty Herold award given by the Programme Council of the ICT Forum for active and effective support of the Forum’s message: “Building of a modern state based on universal use of IT should not be an antagonistic goal for anyone!”
- Symbolic commemoration of the 100th anniversary of the GUM by the Polish Post – 1 April 2019 in form of a postcard with a printed postage stamp was entered into circulation, issue: 100 years of the Central Office of Measures.



# The first Metrologist street in Poland

*Through a resolution of the City of Białystok, of 23 September 2019, a street located by the Regional Office of Measures in Białystok was named “Metrologist street”. The motion for assigning the name came from the employees of OUM Białystok in relation to the 100th anniversary of establishing the Central Office of Measures. Changing the name of the street is a form of honouring the commitment of the employees of the administration of measures.*



Białystok

# GUM FOR THE ECONOMY AND SOCIETY

New trends in economy, technology, environment and health described, among others, through evolution and development in areas such as artificial intelligence, machine learning, robotics, nanotechnology, 3D print technology, genetics and biotechnology, provide metrology with new challenges. Metrology, as an important element of functioning in a modern society and processes occurring in the economy, has to become a source of modern methods and measurement standards which can support activities in the mentioned areas, as well as inspire their growth.

In order to respond to the above mentioned challenges, GUM modernizes measurement stands and increases the number of technologically advanced measurement standards.

## MEASURING STANDARDS AND STANDS

### **Construction of a the primary measurement standard of absorbed dose in water in X-radiation fields (from average photon energy of 50 keV) and gamma fields (Co-60 cobalt) – calorimetric standard**

The main result of the construction of the stand is increasing the safety of the personnel and patients treated with radiotherapy thanks to providing a more accurate determination of ionising radiation dose used in treatment of cancers via external sources. At the current stage a prototype of graphite calorimeter was build and elements for four a suitable calorimeters were completed. Electronic systems (Wheatstone bridges, reference voltage) were also made along with and software for controlling the calorimeter and data acquisition. The first calorimeter was assembled with designation of mechanical and electrical parameters. Mass of the core, thickness of each element and distances between them were measured, and calibration of the bridge and thermistors was conducted.

### **Upgrading and modernisation of metrological infrastructure providing measurement traceability in acoustics in relation to infrasound frequencies**

Ensuring reliable and flawless measurements of infrasound originating from the natural environment or resulting from human activity is the main goal of these activities. This effects will benefit Polish producers of acoustic equipment, as well as research and scientific institutions conducting research on infrasound noise, both at workplaces and in the natural environment.

Within the framework of conducted activities, methodology of LS2 class microphone calibration with the use of reciprocal method was implemented within frequency range from 2 Hz at the national measurement standard of acoustic pressure. Repeatability of measurements was examined, alongside other factors affecting the measurement uncertainty of the national measurement standard within the range between 2 and 20 Hz and class LS2 microphone calibration uncertainty budget in that range was established.

### **Modernisation of measuring stand for calibration of row I Rockwell hardness standards in scale ranges A, B, C, D, E, F, G, H, as well as N and T**

The extent of cooperation of GUM with MERICORE led to the development of automatisatation and modernisation of a measuring stand used for calibration of row I Rockwell hardness standards within scale ranges A, B, C, D, E, F, G, H, K and a GUM reference measurement standard for Rockwell hardness measurement for scales N and T, in accordance with the PN-EN ISO 6508-3. A new system for controlling the station, hydraulic pump, room measuring system was made alongside an application allowing the operator to control the measurement station. A convenient programme (written in LabVIEW) allows quick processing of measurement data and generation of report and calibration certificates. Automatized reference Rockwell hardness standards are prepared for network use in accordance with the Industry 4.0 idea.

### **Modernisation of the power and energy standard of alternating current – extension of the range to 200 A.**

A precise three-phase power and energy calibrator was implemented into the alternating current power and energy measurement standard together with amplifiers extending current ranges up to 200 A and software for harmonisation of the approach to AC power measurements within the framework of European NMIs. Thanks to these operations, the accuracy of power and energy measurements within large current ranges will increase, which will lead to lower volume losses of generated electric energy, as well as provide measurement traceability of measurements made by science, research and industrial laboratories.



### Construction of a mobile relative humidity generator

Mobile humidity generator (MGW) shall ensure adjustment of relative humidity within the range from several percent to 98 %. MGW will be used as a travelling standard both for current checks and for calibrating instruments measuring relative humidity without the possibility for transporting to a calibration laboratory.

Activities involving the construction of the first prototype of relative humidity generator have been conducted in 2019. Analyses of existing solutions were conducted as well as metrological tests of relative humidity generation systems. A prototype of a cassette for relative humidity generator has been developed and initial measurements of the cassette have been done for measurements below 0 °C.

**Construction of metrological infrastructure for underwater acoustics** – Establishment of Underwater Acoustics Section at the GUM Laboratory of Acoustics and Vibrations in Gdynia-Witomino.

Initial concept of the metrological system for underwater acoustics was developed in Poland. An application was prepared for conducting research within the framework of the national project, financed from the budget of the Ministry of National Defence (MON) "Metrological system providing measurement cohesion for underwater acoustics for the purposes of passive defence of a ship and underwater reconnaissance". The projects envision close cooperation between the Central Office of Measures, Polish Naval Academy and other research institutions, including the MON and the Polish Navy.

Graphite calorimeter (primary standard of absorbed dose to water). Dr Adrian Knyziak Head of Ionizing Radiation Laboratory.



## NEW MEASUREMENT METHODS AND SERVICES

GUM, through increasingly advanced metrological infrastructure, actively supports the development of new technologies based on accurate and precise measurements. Development of new measurement methods and introduction of new metrological services constitute activities done for the purpose of adjusting the GUM offer of services to the needs of the economy.

### **Designation of light refraction coefficient values of liquid refractometric standards with the use of the goniometric method**

The method was modified by implementing new software for collecting data from goniometer-spectrophotometer and for calculation of the angles and light refraction coefficient values. Measurements were conducted as well as goniometer errors and coefficient values of light refraction in 5 glass prisms were determined.

### **Calibration method measuring stands with control drum containers with the use of Venturi nozzles of critical flow**

The method allows calibration of small measurement doses for use in measuring gas flows at low pressure.

### **Calibration method for ear simulators and acoustic couplers used in audiometry, including the method of determining the acoustic impedance of the ear simulator**

The method complies with the method presented in PN-EN 60318-1. Calibration of ear simulators encompasses determining the sensitivity of the ear simulator system with the microphone and pre-amplifier as well as acoustic impedance of the ear simulator in frequency function. Calibration of mechanical couplers involves determining the effectiveness level at constant value of dynamic force and mechanical impedance level and impedance phase angle.

### **Laser rangefinder calibration method**

An optoelectronic system was designed in order to cause a delay in the measuring system and elements for construction of the system were bought. Internal signals of selected rangefinders available on the market were initially studied. Further approach to the problem of calibrating laser rangefinders in laboratory rooms of limited space – if successful – will allow this measuring service to be conducted in a larger number of laboratories.

### **Measuring methods of the highest accuracy in thermometry**

In 2019, GUM in cooperation with the Institute of Low Temperatures and Structure Research (INTiBS), conducted research on resistance bridges and compared its metrological parameters. Current results were presented at “Symposium on Temperature and Thermal Measurements in Industry and Science – TEMPMEKO” international conference and the national Metrology Congress. The topic is meant to be continued in order to further refine RBC measuring (Resistance Bridge Calibrator).

### **Measuring method and measurement stand for non-invasive measuring of harmonic distortions in high voltage power networks**

A concept of a research-measurement stand has been developed, which makes use of the phenomenon of magnetostriction for non-invasive measuring of harmonic distortions in high voltage power networks. On the basis of the developed measurement system and initial measurements made, a report on the execution of work was prepared, which contained theoretical assumptions, description of the developed method, progress of research and conclusions. The report pointed out the difficulty in practical implementation of the system in actual conditions existing within the region for conducting diagnostic research of energy networks due to the existence of undesirable background noise such as the sound of street or industrial traffic, nature sounds etc. which disrupted the recording of analysed sounds generated by the energy network.

**A method of calibrating clocks with use of high-speed camera** – decreased measurement uncertainty and increased the resolution of legal time displaying and developed of calibration method regarding X-radiation time meters.

### **Calibration of climate chambers**

In order to satisfy the needs of calibrating, research and industrial labs, a new climate chamber calibration service was developed and implemented in 2019. Calibration of climate chambers is conducted at a measuring stand which contains air temperature reference standards, dew point temperature and relative humidity along with climate chambers. The range of conducted calibration spans from  $-70\text{ }^{\circ}\text{C}$  to  $95\text{ }^{\circ}\text{C}$  for air temperature and for relative humidity from 10% to 90% for temperatures from  $-40\text{ }^{\circ}\text{C}$  to  $95\text{ }^{\circ}\text{C}$ . GUM's calibration will be used to implement interlaboratory comparisons for the purpose of confirming the competences of the personnel and validity of results in, i.a., the process of external laboratory accreditation.

*2019 was also a time for launching new services in measurement administration and unification of procedures in assay administration.*



### Harmonisation of assay procedures

Within the framework of convergence in assay activity procedures, miniaturised hallmarks used for marking jewellery products via laser were developed at the Regional Assay Office in Kraków. The process of assay property miniaturisation for all silver and gold hallmarks and "MET" markings used for laser marking of jewellery products resulted from the need of ensuring the quality of markings on products of small mass and complicated shape. At the same time hallmark miniaturisation was introduced at the Regional Assay Office in Warszawa, which – similarly as in all areas of activity of both offices – allows them to ensure uniform procedures of both clients and maintaining identical standards.





## EXTENSION OF THE ACCREDITATION AT REGIONAL OFFICES OF MEASURES

**In 2019, at OUM in Poznań** the range of provided services was extended by development and introduction of calibration methods for photometric calibrators. On 20 November 2019, the Laboratory of Electricity and Photometry received a passing score on PCA assessment regarding the calibration method of photometric calibrators.

**At OUM in Gdańsk** the range of accreditation was extended with calibration of: measuring plates, electric/builder's spirit level, kilovoltmeter. Also extended was the range of calibration in non-automatic electronic scales from 6 Mg to 120 Mg.

**At OUM in Bydgoszcz** the range of possessed PCA accreditation was extended with calibration of: thermo-hygrometer, torque wrenches, pyrometers (larger measuring range) and pH meters with the use of certified reference materials.

## DIALOGUE WITH INDUSTRY AND SCIENCE

Cooperation between industry, science and metrology constitutes a basis of economic development of every country. Realising the importance of such cooperation, GUM initiated a series of activities improving its effectiveness.

The proposed offer of the GUM for science included:

1. joint research and development works,
2. organisation of metrological events,
3. implementation of engineer, BA, MA and PhD theses,
4. presentation of joint research results in scientific publications and during conferences,
5. exchange of experiences at scientific and industrial metrology level.

On 11 January 2019, a meeting of representatives of the GUM and UW took place in the Biological and Chemical Research Centre of the University of Warsaw, the goal of which was initiation of cooperation within the scope of joint activities in areas of: physics, chemistry, mathematics, IT and mechanics.

Within the framework of joint metrological event organisation GUM was a co-organiser of a unique conference on national and European scale showcasing the role and significance of reference materials in the process of establishing measurement traceability and during monitoring of important results of research and calibrations. The conference was organised by: The Central Office of Measures, University of Warsaw Biological and Chemical Research Centre, Polish Centre for Accreditation and Polish Committee for Standardisation. The conference took place at the University of Warsaw Biological and Chemical Research Centre. The main theme of the conference had a particularly important influence on the development of technology in industries dealing with food production, environment, workplace safety and many others. During the conference the representatives of GUM and OUM in Łódź presented the results of the works and progress in reference material production.

For over 20 years the Regional Assay Office in Kraków has cooperated with the Faculty of Non-Ferrous Metals of the AGH University of Science and Technology (WMN AGH). Visits of students at the Office allowed them to discover the specifics of working at each position and seen the specialised equipment used for examining precious metal alloys. Students specialising in precious metals in industry and jewellery also took part in the Seminar on Assay law. Furthermore, a student of WMN AGH was serving her practical training at the Faculty of Technology, which was concluded with an initiative to write engineering thesis named "Optimisation of the possibilities of using X-radiation fluorescence method in examining precious metal alloys during deciding on the hallmark". The entirety of the research part of the above mentioned thesis was being done at OUP in Kraków.

## AGREEMENTS AND ARRANGEMENTS

An expression of closer cooperation of the GUM with various economic entities was the signing of seven agreements in 2019, including one with a foreign institution.

The main terms of the agreement signed by the GUM with the National Institute of Telecommunications involve cooperation regarding research, standards, interlaboratory comparisons and development of other areas of metrology and standard application. The common goal is the use of research potential of both parties and achieving unique results in these areas.

Within the framework of the agreement on scientific and research cooperation signed by the Regional Office of Measures in Gdańsk and Gdańsk University of Technology joint organisation of popular science and scientific-technological events, open lectures, training, internships and student practice programmes.

Under the agreement between the GUM and Polskie Radio, Polskie Radio will distribute a coded legal time signal on long waves. That way entities requiring accurate time will be provided with freely available signal for time synchronisation.

The intention of the agreement signed between the Polish Committee for Standardisation, Polish Centre for Accreditation and Central Office of Measurements is the introduction of ISO/IEC Guide 98 Uncertainty of Measurement guidebooks



in Polish into the collection of Polish standardisation documents. Guidebooks are an important source of knowledge on general rules of assessment and expression of uncertainties in measurements which is employed in many areas on various levels of accuracy – from production halls to basic testing.

Agreement between the Regional Office of Measures and the University of Technology and Life Sciences in Bydgoszcz confirmed the joint activities of both institutions in relation to promotion of metrology both among the academic community and the region's society. It encompasses, among others, joint organisation of scientific meetings, seminars, conferences, courses and specialised training, as well as carrying out joint projects regarding research, analysis, innovation and implementation works.

The Central Office of Measures, seeking improved cooperation with Ukrainian institutions which are concerned with metrology, signed an agreement on cooperation with the National Centre for Research, Production, Standardisation, Metrology, Certification and Consumer Rights Protection (UKRCSM) in Kiev. The agreement will allow practical, mutually beneficial cooperation with UKRCSM, encompassing, i.a., employee exchange, calibration, measuring instrument testing and sharing information on legal acts related to metrology. The agreement constitutes a real expression of improving cooperation of the GUM with metrological institutions of other countries, especially within our geographical region.

On 30 January 2019, Central Office of Measures signed the Simple Language Declaration. A total of 35 signatories of the agreement wish to simplify communication, promoting simple official language. The primary goal of the initiative is simplifying communication directed to clients. The declaration is also an attempt to make the staff more receptive to the needs of others, regardless of age, level of disability or education.

## METROLOGICAL CONSULTING TEAMS

As an important partner in industry-science-administration relationship, GUM conducted in 2019 dialogue with external economic, scientific and research, and expert circles by carrying out activities at Metrological Consulting Teams (KZMs) and Metrological Consulting Team for Assaying (KZP). By cooperating with national economic entities as well as scientific and research entities, GUM took part in solving measurement issues.

In 2019, cooperation with economic entities was continued within the framework of KZMs. 7 working meetings organised by GUM employees were held with representatives of government and administrative institutions, scientific institutes, universities, trade associations, state-owned and private companies, manufacturers.

The result of the maintained cooperation was:

- initiation of gathering equipment for the construction of an ultraprecise exhaust analyser,
- development of a report on establishing metrological supervision over geodetic devices and measurement systems,
- conducting analysis of projects of the new act on tachographs and its executive acts,
- conducting operations for the implementation of online cash registers in Poland and development of testing instructions of these cash registers at the GUM.





GUM FOR THE SAFETY  
OF THE STATE  
AND THE CITIZENS

*locations conducting processing,  
manufacturing, repair and sales  
of precious metal products*



## SUPERVISORY ACTIVITIES

Market surveillance is not only an important element of ensuring fair competition on the market but most importantly a question of securing consumer rights. By establishing the directions of supervisory activities, reinforced by appropriate guidelines of the President, emphasis is put on the identification of causes and mechanisms leading to deficiencies by analysing certain issues and the probability of such deficiencies to appear.

To ensure secure economic circulation and consumer rights, supervisory activities involving obeying the law regarding acts on "Law on measures", "Hallmarking law", and on packaged products and tachograph system together with executive acts of these acts were continued.

The following items were inspected:

- measuring equipment subject to legal metrological supervision,
- entities and entrepreneurs granted approvals for conducting specified activities by the GUM President,
- packaging entities,
- locations conducting processing, manufacturing, repair and sales of precious metal products.

In 2019, 16 369 inspections were conducted in various areas, 9 286 of which involved increased risk areas.

Furthermore, as part of the improvement of supervision methods of online precious metal product trading based on experiences of other countries, activities associated with supervision of online precious metal product trading were being conducted. In 2019, the character of supervision was preventive and informational. The activities conducted by the supervisory department in that regard involved informing the entrepreneurs (producers and entities introducing precious metal products into market), who submitted applications for entry of a hallmark into the registry, about the rules of conducting e-trade.

At the same time, legislative work on changing the "Hallmarking law" act, by introducing, i.a., provisions regarding introduction of a regulation which allows inspecting entrepreneurs conducting online trading.

## REGULATORY ACTIONS

In 2019, the following legal regulations were introduced:

- 1 January: provisions of act of 5 July 2018 on tachographs concerning permissions and workshop technicians,
- 1 May: Act of 15 March 2019 amending the act on goods and services tax and the "Law on measures" act,
- 26 April: Regulation of the Minister of Entrepreneurship and Technology of 12 April 2019 on the level of charges for the activities of measurement administration authorities concerning tachographs,
- 27 April: Regulation of the Minister of Entrepreneurship and Technology of 22 March 2019 on legal metrological supervision over measurement equipment.

A series of activities were conducted in 2019 towards simplification of law regulations and adjusting them to the needs of economic entities.

Preparing law regulations regarding the development of a draft act on the change of the "Hallmarking law" act with drafts of executive acts resulting from the extent of changes contained in the draft act.

Also prepared were drafts of:

1. Amendment of the regulation on legal measurement units.
2. Regulation issued on the basis of Article 9a of the act "Law on measures" concerning sound level meters.
3. Regulations concerning legal metrological supervision and use of HS-WIM systems.
4. Regulations concerning legal metrological supervision over analysers of alcohol concentration in exhaled air.
5. Regulation amending the regulation concerning necessary requirements of measuring containers and detailed extent of testing and examination conducted during legal metrological control of that measuring instruments.



# GUM EUROPE WORLD

*International cooperation in the field of metrology is dictated by important economic, social and scientific aspects. The cooperation led to development of the economy and makes economic cooperation more effective and less costly.*

*Membership in international metrological organizations brings many benefits. It allows to participate in international comparisons and calibrations. It allows to take a part in research projects and access to the knowledge in the field of calibrations and measurement methods.*

*It gives Poland the opportunity to participate in the global development trend and a real impact on solutions adopted in the field of metrology.*

## SCOPE OF METROLOGY

In 2019, GUM continued cooperation with international organisations: International Bureau of Weights and Measures (BIPM), International Organization of Legal Metrology (OIML) and regional units: European Association of National Metrology Institutes (EURAMET), European Cooperation in Legal Metrology WELMEC as well as foreign metrological institutions on the basis of bilateral agreements.

It took part in activities involving reorganisation of the BIPM, filing membership to the newly established group for institutional reform of the BIPM.

GUM conducted research and development, calibration and comparison within the framework of EURAMET. Furthermore, it organised workshops within the framework of EMPIR international programme, as well as took part in the activities of European Metrology Networks (ESM) by signing a document for accession to 5 of the existing networks and to the future Food Safety project.

GUM was one of the founders of WELMEC e.V., an organisation established on WELMEC's foundation which, in contrast to the predecessor, has a status of an association, according to German law. WELMEC e.V. brings most European countries together. GUM provided a significant contribution into the preparation of statute for the new organisation.

In 2019, the activity within the OIML organisation focused mostly on participation in activities concerning amendment of OIML technical directives, promotion of metrology (Poland was invited to help with preparation of substantial documents regarding broadly understood promotion) and exhaust analysers.

Appreciation of the Polish efforts in the field of legal metrology was awarding of the most prestigious OIML medal for outstanding achievements to GUM employee, PhD Engineer Jerzy Borzymiński.

## EMPIR RESEARCH PROJECTS

As part of international cooperation, GUM participated in 16 research projects in cooperation with international partners, within the framework of the European Metrology Programme for Innovation and Research (EMPIR), while 5 new projects from call 2019 were accepted for realisation in 2020.

The project was completed in 2019 – 15RPT01 RFMicrowave “Development of RF and microwave metrology capability”.

The general goal of the project planned for years 2016-2019 was the improvement of European measurement infrastructure for measurements of high frequency electrical quantities and calibration of equipment for electromagnetic compatibility research. This was achieved through participation in workshops and training, involvement in interlaboratory comparisons, co-authorship of publications, execution of tasks involving modification of existing measuring services and introduction of new ones. GUM participation in the project led to the following results:

- automatization of the measuring method for dispersal parameters,
- more insightful analysis of measurement uncertainties, associated with taking into consideration the real parameters of standards and measurement stands,
- raising competences of employees at the Microwaves, Electromagnetic Field and Electromagnetic Compatibility Section in relation to the measurements of dispersal parameters,
- acquisition of knowledge necessary for conducting calibration of high frequency low power sensors,
- implementation of the measuring method and develop a detailed uncertainty budget for calibration of power sensors with the use of standardised suppressors,
- publication of the “good metrological practice” guide containing an operational instruction for measuring low power sensor calibration and rules of building an uncertainty budget.
- acquisition of knowledge necessary for construction of measurement stand and conducting measuring of effective high frequency signal generator reflection coefficient,
- development of a detailed uncertainty budget for calibration of high frequency power sources within the range of reflection coefficient and possibility of verification of the budget with the use of Monte-Carlo method.

Research projects in progress:

- 16RPT02 ALCOREF “Certified forensic alcohol reference materials”,
- 16RPT03 inTENSE “Developing research capabilities for traceable intraocular pressure measurements”,
- 17IND03 LaVA “Large Volume Metrology Applications”,
- 17NRM03 EUCom “Standards for the evaluation of the uncertainty of coordinate measurements industry”,
- 17RPT01 DOSEtrace “Research capabilities for radiation protection dosimeters”,
- 17RPT02 rhoLiq “Establishing traceability for liquid density measurements”,
- 17RPT03 DIG-AC “A digital traceability chain for AC voltage and current”,
- 17RPT04 VerslCaL “A versatile electrical impedance calibration laboratory based on digital impedance Bridges”,
- 18SIB01 GeoMetre “Large-scale dimensional measurements for geodesy”,
- 18RPT01 ProbeTrace “Traceability for contact probe and stylus instrument measurements”,
- 18HLT04 UHDpulse “Metrology for advanced radiotherapy using particle beams with ultra-high pulse dose rates”,
- 18RPT02 adOSSIG “Developing an infrastructure for improved and harmonised metrological checks of blood-pressure measurements in Europe”,
- 18SIB08 ComTraForce “Comprehensive traceability for force metrology services”,
- 18SIB05 ROCIT “Robust Optical Clocks for International Timescales”,
- 18SIB09 TEMMT “Traceability for electrical measurements at millimetre-wave and terahertz frequencies for communications and electronics technologies”.

Research projects from EMPIR call 2019 which were accepted for realisation and in which the GUM will participate.

ENERGY:

- JRP-g13 Nanowires “High throughput metrology for nanowire energy harvesting devices”,
- JRP-g04 WindEFCY “Traceable mechanical and electrical power measurements for efficiency determination of wind turbines”.

## EUROPEAN METROLOGY NETWORKS (EMNs)

European Metrology Networks are a program implemented under EURAMET, approved during the 12th EURAMET General Assembly in May 2018. The goal of metrology networks is to coordinate European metrology by analyzing global and European metrology needs, coordinating European strategies for metrology research, infrastructure, knowledge and services.

Currently, there are 6 metrology networks: Mathematics and Statistics, Laboratory Medicine, Quantum Technologies, Smart Electricity Grids, Energy Gases and Climate and Ocean Observation. There are plans to establish a number of other networks, in the field of e.g. food safety, optical fibers, the so-called smart factory etc.

Poland (GUM and the Designated Institution - Institute of Low Temperature and Structural Research) is a member of 6 networks (except the Laboratory Medicine Network).

In the frame of EMPIR programme there are realized projects which are support for existing and future networks. From 2020 (call 2019) GUM will be one of the partners in following projects:

- JNP-w04 AdvManuNet “Support for a European Metrology Network on advanced manufacturing”,
- JNP-w01 EMN-Quantum “Support for a European Metrology Network on quantum technologies”,
- JNP-w08 supportBSS “Support for a European Metrology Network on reliable radiation protection regulations”.

## AREA OF ASSAYING

In 2019, Regional Assay Offices (OUP) continued international cooperation conducted within the framework of the Standing Committee of the Vienna Convention, Technical Working Group of that Convention, International Association of Assay Offices (IAAO), Visegrad Group (GV4). Representatives of OUPs in Warszawa and Kraków took part in GV4 meeting during which issues associated with functioning of assay offices in states of the group were discussed. A common position regarding the topic of the planned structural reform within international ASSAY organisations, which involved introduction of the International Association of Assay Offices (IAAO) into the structures of the Vienna Convention was established.



Just as every year, OUP took part in international proficiency research within the framework of programmes: Round Robin, organised by the Standing Committee of the Vienna Convention, Labtest programme – organised by Assay Office in Prague and in proficiency testing organised by the Institute of Metrology in Bosnia and Institute of Metrology in Slovenia. The results were positive for all programmes.

A three-day internship was organised for an Assay Office worker from Sri Lanka in the OUP in Warszawa. The internship involve a technical part, legal part and practical participation in assay examination. The intern also visited the OUP in Kraków and Local Branch in Białystok.

To acknowledge the commitment in international activity within the framework of assaying, a representative of OUP in Warszawa – Magdalena Ulaczyk, was entrusted with the function of the 1st deputy chairman of the Standing Committee of the Vienna Convention on supervision and marking of precious metal products.

## VISITS

On 8 March 2019, a visit from NMIs representatives, specialists in the field of mass from India, China, Belarus, Macedonia and Bangladesh, took place in the Central Office of Measures.

On 13 June 2019, the Central Office of Measures hosted representatives of Physikalisch Technische Bundesanstalt – PTB. The meeting was dedicated to the discussion of a possible future cooperation of the GUM with PTB in implementation of support projects for Ukraine and the possibility and expectations involving the commitment of our institutions of programmes such as Twinning.

On 16 December 2019, a delegation of the National Market Regulation Agency, National Metrology Institution and Chinese metrological association was hosted in the Central Office of Measures. The visit was a tangible example of intensifying mutual relationships with leading metrological institutions of the world.

On 12 July 2019, a meeting with representatives of Moldovan Office for Consumer Protection and Market Supervision took place in the GUM. Issues involving supervision were discussed. The Moldovan office, as opposed to its Polish equivalent (UOKIK) has competence to supervise the market regarding the compliance with regulations on measuring equipment. Representatives of the Moldovan office were also interested in questions involving the broadly understood market supervision over the utilisation of measuring equipment used in trade – fuel dispensers, scales, etc. The meeting was concluded by mutual expression of interest in further cooperation and signing a cooperation agreement.

In 2019, a working visit of a Ukrainian UKRMETRTST- STANDARD designated institute delegation took place at the Acoustics and Vibrations Laboratory. The goal of the visit was to establish cooperation, become familiar with the activity of the Acoustics and Vibrations Laboratory, conduct bilateral comparisons of vibration transducers with the use of primary method. Furthermore, discussions regarding metrological supervision of equipment for measuring road traffic vehicle speed were conducted with specialists at the Length Laboratory.





# KNOWLEDGE TRANSFER

## TRAINING EVENTS AND OTHER OCCURRENCES

As part of knowledge transfer conducted at the GUM and JT, 124 training events regarding calibration methods and measuring equipment tests, rules of conduct during legal metrological inspection and conformity assessment, as well as general metrology aspects.

GUM organised practice and internship for students of the Warsaw University of Technology. Furthermore, lectures and exercises for students of the Postgraduate Studies of the University of Warsaw – Metrology in Chemistry took place in GUM laboratories.

A doctoral candidate was undergoing internship at the Photometry and Radiometry Laboratory. A doctoral candidate in Kharkiv familiarised herself with measurements in all 3 studios of the Photometry and Radiometry Laboratory and shared her valuable experiences in the field of spectrophotometry gained while working at the Institute of Metrology. The internship is also the first step on the road to joint cooperation of GUM with NIM in Kharkiv. Two one-week-long training events (lectures and exercises) have been conducted within the framework of Capacity Building EURAMET programme at the Acoustics and Vibrations Laboratory:

- the participants of EURAMET Training Course on Acoustics Measurements were representatives of Estonia, Greece, Macedonia and Spain,
- the participants of EURAMET Training Course on Vibration Measurements were representatives of Bulgaria, Greece, Slovenia and Spain.

GUM organised two-day workshops associated with the implementation of EMPIR project named “Development of research capabilities concerning eye pressure measuring while maintaining traceability (16RPT03 inTENSE). The workshops were attended by about a dozen representatives of national metrological institutions and representatives of the Central Office of Measures, Office for Registration of Medicinal Products, Medical Devices and Biocidal Products and Polish Centre for Testing and Certification. A possibility of introducing inspections of tonometers in use in Poland was discussed during the workshops. Also presented were Czech and German models of tonometer inspection and experiences with legalisation of contactless tonometers. ČMI representatives demonstrated calibration of a contactless tonometer.

Furthermore, a series of events popularising knowledge on metrology were organised in 2019.

Just like every year, the GUM took part in International Trade Fair of Analytics and Measurement Technology (EUROLAB), where the visitors interested in aspects of measuring and metrology could receive information at GUM booths. GUM experts shared knowledge on the latest measuring methods and reference materials used in laboratories.

GUM was the host of the collective body of the Commission for Metrology of the POLLAB Polish Testing Laboratories Club. Participants of the meeting listened to lectures on the most interesting





metrological topics from the viewpoint of cooperation and research laboratory development. The “Law on measures” act alongside executive acts from the perspective of laboratory practice was presented.

GUM was a host of the 36th Meetings of an Interlaboratory Group for Comparisons of National Atomic Standards of Time and Frequency. The meeting gathered a total of over 50 representatives of national laboratories, universities, institutions and companies associated with maintaining atomic time and frequency standards, construction and development of optical standards of frequency, development of technologies and advancement of precise techniques of time and frequency transfer.

The main topic of the 2019 edition of the Science Picnic was the slogan: WE AND MACHINES. Representatives of the GUM, in cooperation with technological partners proposed several main topics to the visitors which encompassed modern measuring technologies, so called reverse engineering, precise thermographic measuring and mass measuring.

## GUM – SECRETS OF THE WORLD OF METROLOGY

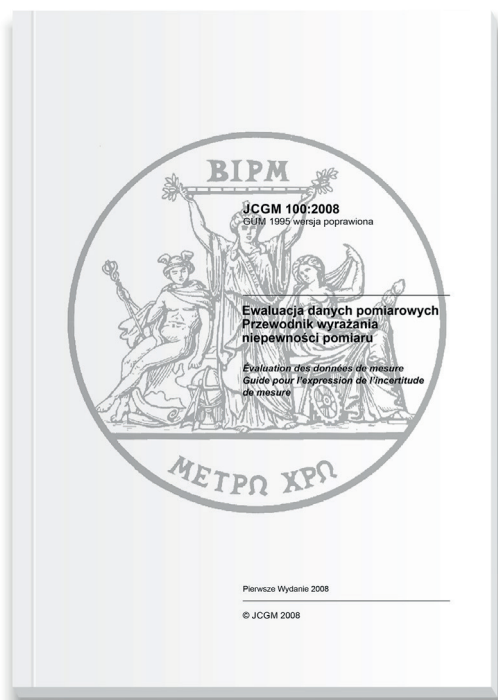
“W miarę, fajna impreza metrologiczna” – nearly 300 future metrologists visited Browar B Culture Centre in Wrocław “w miarę, a great metrology event”. The event associated with the Collection of Scales and Measures in Wrocław was meant to popularise the topic of SI unit redefinition, commemoration of the 100th anniversary of establishing the Central Office of Measures and introduction of a uniform metric system of measurements in Poland. During the event the visitors saw a collection of scales, measured the accuracy of their watches with the use of chronocomparator, checked the reaction time with the use of an instrument for time measuring, saw a sound wave and even generated one in Chladni figure generator, tried their luck in logic puzzles with the use of knowledge of scales. The co-organiser of the event was the Regional Office of Measures in Bydgoszcz – Local Branch in Wrocław.

“How they measured in the past” – exhibition at the Arts Factory in Tczew. The Exhibition which could have been viewed in the Arts Factory at ul. Podmurna 15 in Tczew had an educational-informational profile. It showcased almost 90 exhibits, most of which were measuring instruments. On the day of the internissage, a multimedia lecture of a GUM employee took place named “SI redefinition. Basic constant play the leading role”. The presentation was intended to familiarise Tczew high school students with the topic of new definitions of measuring units.

A meeting of GUM representatives with teachers and students of Radom Schools took place in the 6th High School in Radom as part of a seminar dedicated to “Changes of definitions of SI base units”. Redefinition of the SI system, in particular involving changes of measurement units after 20 May 2019, were the main topic of the meeting. The seminar was attended by 140 students and 40 teachers.



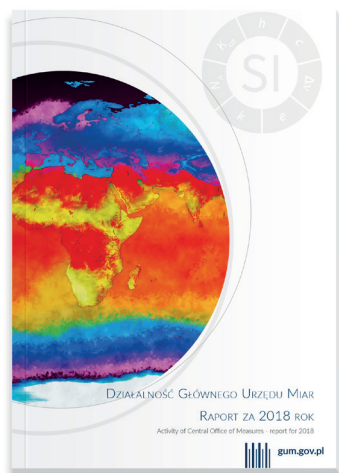
# PUBLICATIONS



## GUM PUBLICATIONS

2019 was abundant in paper and electronic publications. All were prepared in accordance with guidelines of the current brand book. 15 publications were made and published, 2 of this are guides in fields: **Photometry and Radiometry**, as well as **Mass and Related Quantities**.

The Polish version of the **Guide to expressing measurement uncertainty** is worth noting, being particularly useful in everyday operation of calibration and testing laboratories. The guide is one of the most important documents on measurement data analysis published so far. It constitutes a basis for expressing measurement uncertainty in all measurement laboratories worldwide. It standardises the method of providing measurement values, which makes it possible to ensure measurement traceability. The guidelines presented in it concerning the conduct while carrying out measurement data analysis are universal and timeless.





Especially interesting are publications dedicated to the 100-year-old activity of the GUM and people who constitute Polish achievements in metrology of the time:

**100 years of the Central Office of Measures** – a monograph depicting the history of the GUM and Polish measurement administration since the oldest times to present time, with a special emphasis on the interwar period and the time of occupation. The study combines characteristics of a historic publication and literary essay with fictional plots.

**Biographic dictionary of Employees of the Central Office of Measures** – the corrected and supplemented second edition of the Dictionary contains the bios included in the first edition, as well as the new bios of people who passed away in the last decade.



The purpose of these publications was to commemorate the distinguished employees of Central Office of Measures who, thanks to their work, commitment, achievements and responsibility for different fields of metrology, earned a special place in the history of the Office.

**Historical booklet** – a collection of articles making references to the past of the Polish measurement administration and presenting the profiles of people who represent it. The most important events in the history of metrology and Polish measurement administration have been described in an original and engaging manner. The publication is a guide of sorts for younger readers to the history and the present state of the Central Office of Measures.



## GUM EMPLOYEE PUBLICATIONS

The legacy of GUM employees is represented in numerous articles and reports published in international and national publications. Numerous conference materials in form of papers and posters comprise a large part of it. The output is supplemented by articles published in the bulletin of the GUM.

Presented below is a summary of the publishing/scientific output of GUM employees in 2019.

1. P. Balling, Z. Ramotowski, R. Szumski, A. Lassila, P. Křen, P.I. Mašika: Linking the optical and the mechanical measurements of dimension by a Newton's rings method. *Metrologia* 56(2019). IF 3,447.
2. M. Szymko, L. Michalik, A. Knyziak, A. Wójtowicz: Development and characterization of air kerma cavity standard. *Measurment* nr 136 (2019). IF 2,791.
3. Z. L. Warsza, J. Puchalski: Udoskonalona metoda wyznaczania niepewności w pomiarach wieloparametrowych. Część 1. Podstawy teoretyczne dla skorelowanych wielkości mierzonych. *Pomiary, Automatyka, Robotyka* nr 1/2019. pkt. 20.
4. Z. L. Warsza, J. Puchalski: Udoskonalona metoda wyznaczania niepewności w pomiarach wieloparametrowych. Część 2. Przykłady pomiarów wielkości skorelowanych. *Pomiary, Automatyka, Robotyka* nr 2/2019. pkt. 20.
5. Z. L. Warsza, J. Puchalski: Rozszerzona metoda oceny niepewności pośrednich pomiarów wieloformatowych i układów do tych pomiarów Część 1. Wpływ korelacji i niepewności funkcji przetwarzania zależności podstawowe. *Pomiary, Automatyka, Robotyka* nr 3/2019. pkt. 20.
6. Z. L. Warsza, J. Puchalski: Rozszerzona metoda oceny niepewności pośrednich pomiarów wieloparametrowych i układów do tych pomiarów Część 2. Zastosowanie na przykładzie układu do pośrednich pomiarów dwuparametrowych. *Pomiary, Automatyka, Robotyka* nr 4/2019. pkt. 20.
7. D. Czułek: Projekty strategiczne Samodzielnego Laboratorium Długości Głównego Urzędu Miar. *Metrologia i Probiernictwo* nr 1(22)/2019.
8. J. D. Fidelus, W. Wiśniewski: 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.
9. P. Fotowicz: Od metra dawnego do współczesnego. *Metrologia i Probiernictwo* nr 1(22)/2019.
10. P. Fotowicz: Światło w służbie jednostek miar. *Metrologia i Probiernictwo* nr 2(23)/2019.
11. A. Gadomska: Redefinicja SI. *Laboratoria Aparatura Badania* nr 2/2019.
12. J. Gębicka, S. Górnik, Ł. Litwiniuk, G. Szajna, A. Zydorowicz: Fotometria i Radiometria Przewodnik po dziedzinie. *GUM* 2019.
13. W. Gosk: Weryfikacja wpływu wyników porównań prowadzonych w warunkach zrównoważonego eksperymentu wewnątrzlaboratoryjnego na CMC laboratorium wzorcującego. *Metrologia i Probiernictwo* nr 1(22)/2019.
14. M. Gruszczynski, A. Czubla, M. Szolucha: Konsekwencje wydarzenia „GPS week number rollover” w synchronizacji czasu na potrzeby gospodarki i społeczeństwa oraz w metrologii czasu i częstotliwości. *Metrologia i Probiernictwo* nr 2(23)/2019.
15. P. Janko: Budowa układu konfekcjonowania certyfikowanych materiałów odniesienia w postaci wodnych roztworów etanolu do opakowań jednostkowych. *Metrologia i Probiernictwo* nr 2(23)/2019.
16. M. Kolczyński: Projekt „ŚWITEŻ” – wdrożenie platformy elektronicznych usług publicznych w administracji miar. *Metrologia i Probiernictwo* nr 2(23)/2019.
17. M. Kusyk: Konsultacyjny Zespół Metrologiczny ds. regulacji rynku. *Metrologia i Probiernictwo* nr 1(22)/2019.
18. A. Lewicka, J. Brennejzen, A. Lewicki: Znaczenie i zasady certyfikacji w obszarze przyrządów pomiarowych. *Metrologia i Probiernictwo* nr 2(23)/2019.
19. A. Łukaszewska: Konsultacyjne Zespoły Metrologiczne – krótkie podsumowanie działalności. *Metrologia i Probiernictwo* nr 1(22)/2019.
20. D. Matkowska, J. Gębicka, Ł. Litwiniuk: Wstępne badania w celu opracowania nowej metody wzorcowania czytników mikro płytek w GUM – analiza porównawcza wyników. *Metrologia i Probiernictwo* nr 2(23)/2019.
21. A. Młyńska, D. Dobrowolska: Badania stanu symulatorów ucha używanych w Polsce wpływu ich parametrów akustycznych na wyniki badań słuchu. *Bezpieczeństwo Pracy. Nauka i Praktyka* nr 5(572)/2019.
22. Z. L. Warsza, J. Puchalski: Ocena niepewności charakterystyki z pomiarów z dwu pomiarów kontrolnych. *Przemysł Chemiczny* nr 98/6(2019).
23. Z. L. Warsza, J. Puchalski: Wyznaczanie niepewności w pomiarach wieloparametrowych wielkości o skorelowanych składowych typu A oraz B. *Przemysł Chemiczny* nr 98/7(2019).

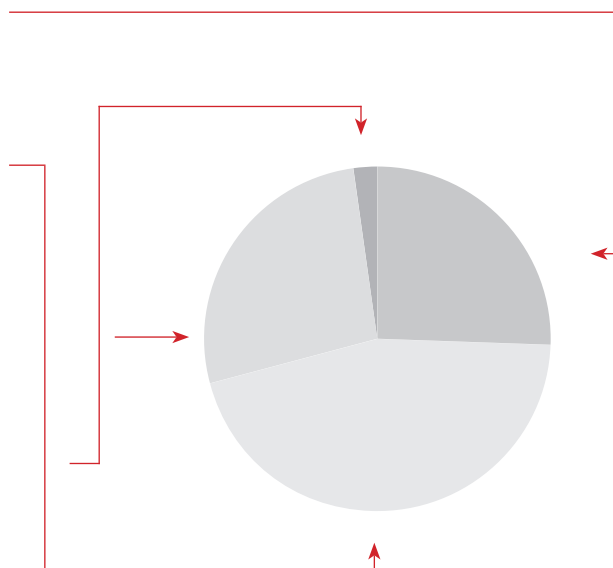
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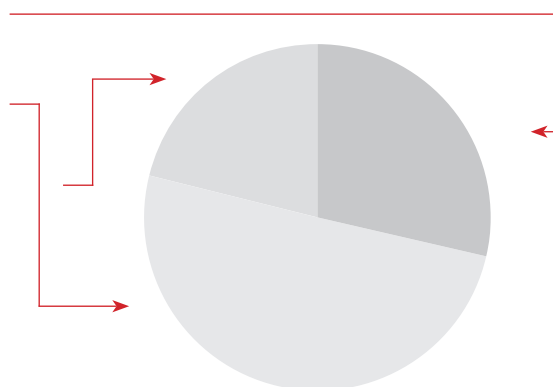
# GUM IN NUMBERS

## GUM BUDGET IN 2019

revenues	in thousands of PLN	%
Performing official activities	2 207	26,4
Performing activities under civil law contracts	3 917	46,8
Performing activities related to digital tachographs	2 071	24,7
Other revenues	176	2,1
<b>Total revenues</b>	<b>8371</b>	<b>100</b>

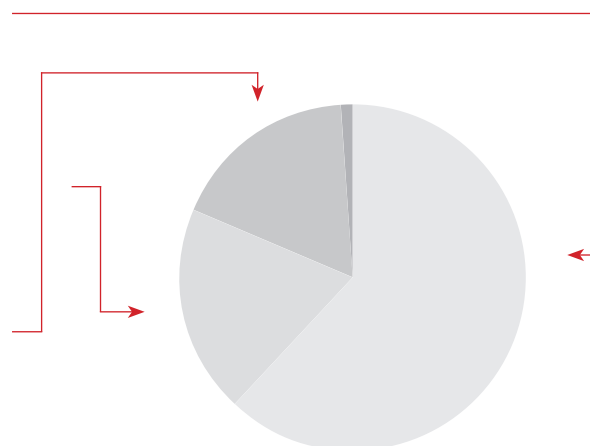


expenditures	in thousands of PLN	%
Ongoing expenditure	14 479	28,7
Salaries	25 418	50,3
Property-related expenditure	10 599	21,0
<b>Total expenditure</b>	<b>50 496</b>	<b>100</b>

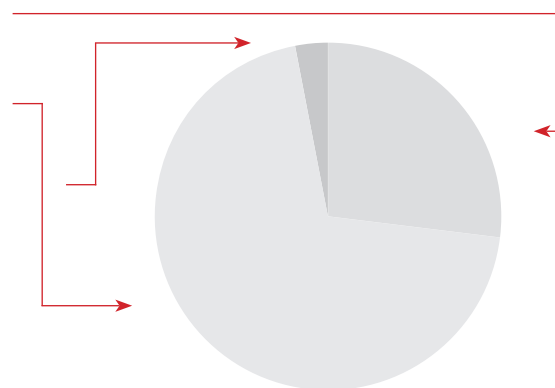


## REGIONAL UNITS BUDGET IN 2019

revenues	in thousands of PLN	%
Performing official activities	39 914	62,1
Performing activities under civil law contracts	12 451	19,4
Performing assay activities	11 238	17,5
Other revenues	641	1
<b>Total revenues</b>	<b>64 244</b>	<b>100</b>



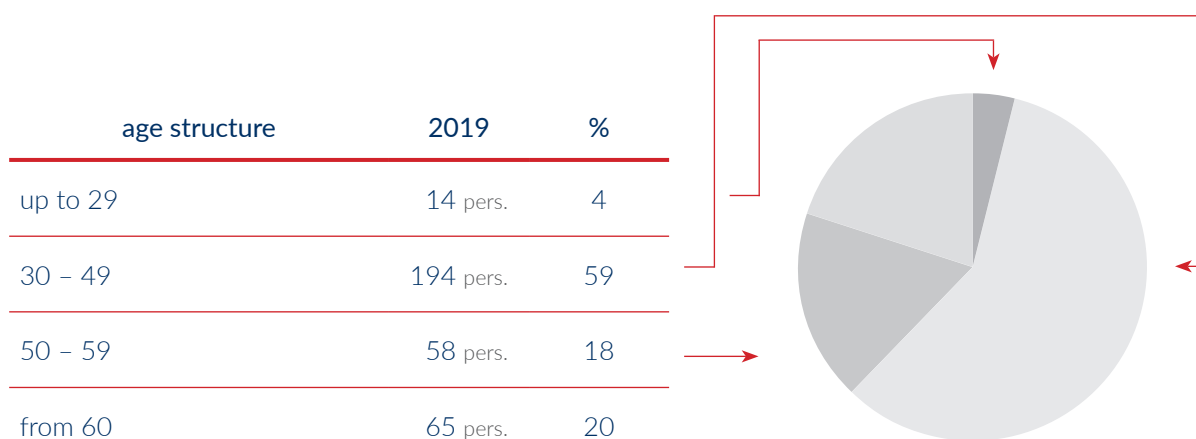
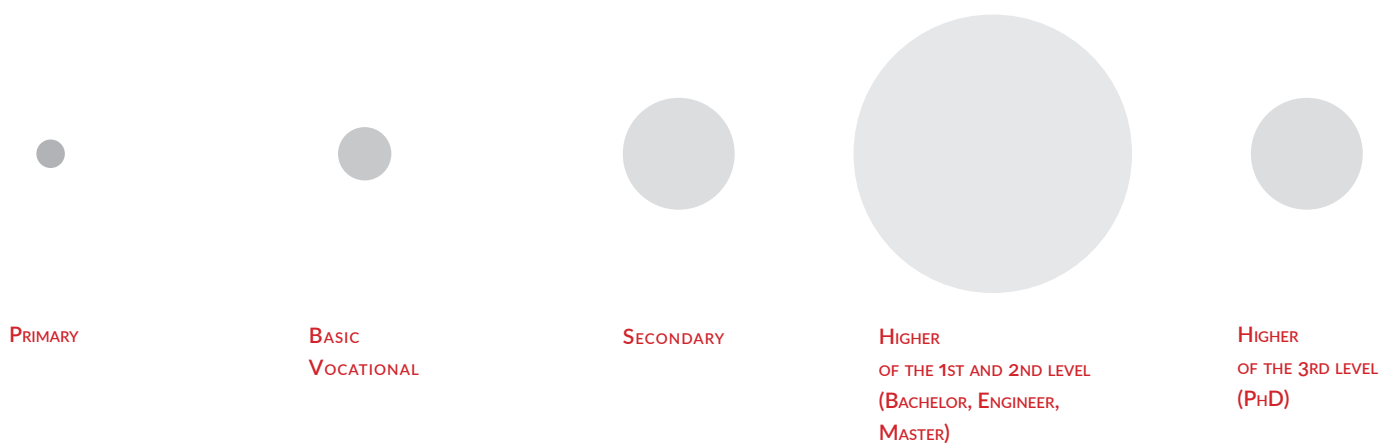
expenditures	in thousands of PLN	%
Ongoing expenditure	28 266	27
Salaries	73 263	70
Property-related expenditure	3 141	3
<b>Total expenditure</b>	<b>104 670</b>	<b>100</b>





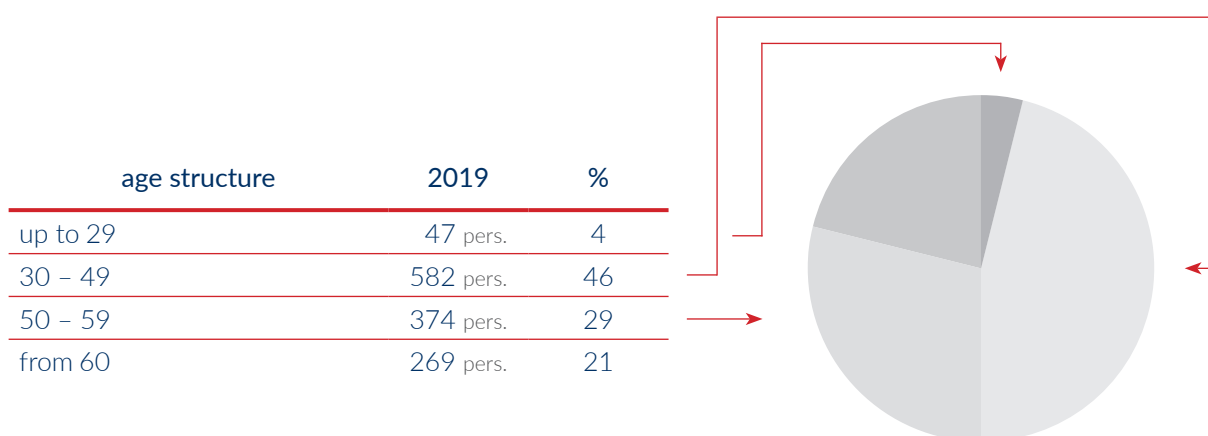
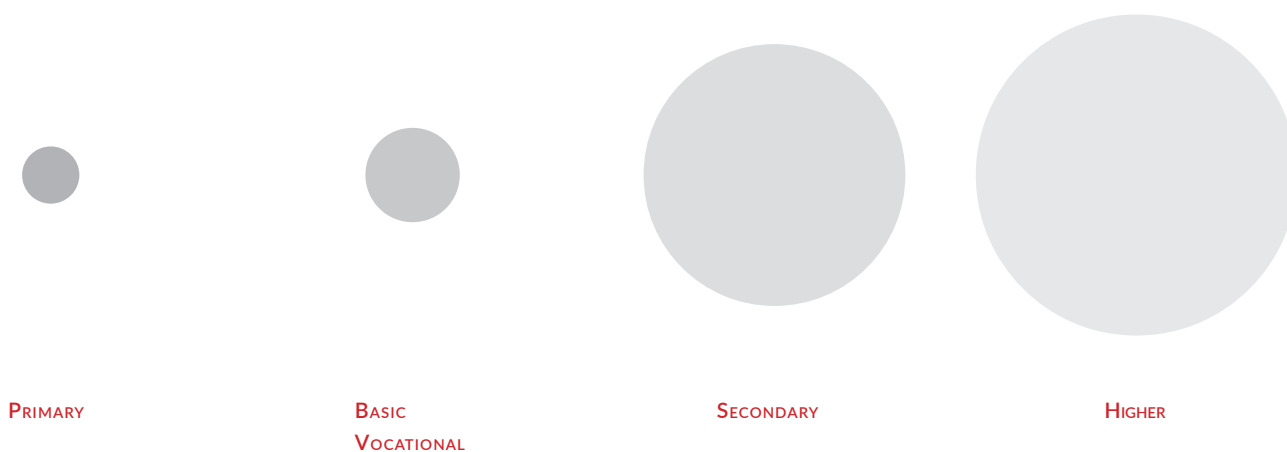
## GUM'S PERSONNEL

education	women
Primary	2
Basic Vocational	8
Secondary	38
Higher of the 1st and 2nd level (Bachelor, Engineer, Master)	245
Higher of the 3rd level (PhD)	38



PERSONNEL – REGIONAL UNITS

education	pers.
Primary	20
Basic Vocational	58
Secondary	475
Higher	719



## SERVICES

service	number		
	GUM	OUM*	OUP**
Calibrations	13 264	160 637	-
Expertise cases	133	5 596	-
Tests	9	3 023	5 572 543
Production and certification of reference materials	1 882	7 986	-
Type approvals (testing)	98	74	-
Type approvals (decisions)	92	-	-
Verifications	-	1 040 612	-
Conformity assessment (testing)	6	10 610	-
Conformity assessment (certificates)	5	4 878	-
Certification of cash registers	43	-	-
Organization of exams	43	-	-
Authorizations for verification	3	-	-
Creation of verification units	78	35	-
Issuing of permits – digital tachographs	214	2	-
Organization of domestic comparisons	49	-	-
Subcontractors evaluation (suppliers of large standards)	60	-	-
<b>TOTAL</b>	<b>15 979</b>	<b>1 233 453</b>	<b>5 572 543</b>

\*) Regional Offices of Measures

\*\*\*) Regional Assay Offices









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