

CENTRAL OFFICE OF MEASURES



Four-year strategic action plan of the Central Office of Measures 2018-2021

2017

CENTRAL OFFICE OF MEASURES

Elektoralna 2

Warsaw

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Photo no. 1 Cover photo: probe head of a coordinate measuring machine.

DEAR READERS,

Ever since the Central Office of Measures was formed back in 1919, we have been striving towards maintaining measurement capabilities necessary to ensure the sustainable growth of the economy as well as an appropriate quality of life in Poland. For the above reason, we have also continued the development of new measurement standards which allow us to ensure a greater measurement precision and accuracy. Our contemplated actions include the implementation of the following projects: the modernisation of the atomic time and frequency standard by expanding the measurement standard system by cesium fountain and hydrogen maser as well as the modernisation of the mass standard resulting from the redefinition of the kilogramme (from material to quantum).

The dynamic changes taking place in the modern world pose great challenges for the Polish economy, with precise measurements forming a crucial aspect thereof. The laboratories of the Central Office of Measures serve to support economic growth, ensuring the presence of appropriate measurement tools and methods applied, among others, in laboratory diagnostics as well as in product quality control at all manufacturing stages and during their use.

In the course of its efforts aimed at establishing an environment conducive towards the growth of entrepreneurship and an efficient use of national measurement capabilities, in 2016 the Central Office of Measures (GUM) created a new platform for cooperation with industry and science. A number of Consultative Metrological Teams were formed, consisting of representatives of the business, the expert community as well as the science and research community. The task of these Teams is to identify the needs of the industry within the scope of measurement technologies and supporting it in solving metrological problems as well as proposing appropriate regulatory changes, as reflected in the recently enacted amendment to the Act on measures. This amendment provided strategic planning instruments, established the Metrology Council and changed the structure of regional measurement administration. In addition, the GUM will also form Technical Committees for the individual areas of metrology. These Committees will consist of the best Polish and, should the need arise, international specialists. Their task will be to provide substantive support to individual laboratories of the GUM.

The current results of the operation of Consultative Teams were duly taken into account in the course of determination of the strategic priorities for the activities of the Central Office of Measures. Cooperation within the framework of Consultative Teams will continue. The activities of the Teams are intended to ensure that the work of the GUM remains oriented on the actual needs of the economy.

The changes currently being implemented are intended to transform the GUM into a state-of-the-art, innovative institution tasked with ensuring the appropriate resources and conditions serving the needs of modern metrology. This task will be achieved through the establishment of a research and measurement laboratory campus.

The present document reflects our view on the development of metrology and will ensure the attainment of the objectives to be completed by 2021. I hope that the plan will also serve as the basis for further discussions between the partners operating in the area of metrology and that all comments and observations shall be helpful in formulating subsequent requirements in the field of new measurement capabilities and directions for the development of metrology.

Włodzimierz Lewandowski PhD Eng.
President of the Central Office of Measures

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INTRODUCTION

Metrology – the science of standards and measurements – remains an important first-choice tool in the course of scientific research, development of advanced technologies and innovation in the field of prototype technical solutions. It remains essential whenever accurate measurement forms the basis of innovation. During the last decade, the development of metrology focused on the application of quantum phenomena to the definitions of measurement units, which had a significant impact on progress in other areas of both science and technology.

Metrology provides significant support to the process of development new and improved products as well as technologically advanced industrial processes by establishing precise measurement standards along with state-of-the-art, mathematical measurement result analysis methods. The existence of appropriate measurement tools and methods plays a key role both in the field of laboratory diagnostics and in the course of product quality control and testing at all stages of the manufacturing process and in the course of use thereof. This is especially true now that the global economy is undergoing dynamic changes, faced with both the rising consumer requirements as to the quality of products and services and the continuing degradation of the environment. The Polish metrology is facing various challenges in the field of comprehensive support of the Polish economy by ensuring the presence of appropriate measurement capabilities along with the necessary technical infrastructure.

Within the next few years, metrology will continue to play a vital role for both socio-economic change and scientific advancement. These changes will bring about further challenges associated with the need to ensure:

- the intensive growth in the field of scientific research and development of new inventions,
- the rise of an energy-efficient economy based on innovative entrepreneurship,
- the increase in the quality of life and safety of individual citizens.

Only a state-of-the-art national system of measures, adjusted to the needs of the economy, will be able to satisfy the requirements arising due to the changes referred to above. The leading role in such a system belongs to the domestic metrological institution – the Central Office of Measures (GUM). For the above reason, it remains crucial to ensure the transformation of the GUM into a technology development centre, modelled after the best domestic metrological institutions currently in existence in other countries, thus ensuring the active support of the competitive and innovative economy.

The plan for the changes and expansion of the activities of the GUM remains consistent with the assumptions of the “Responsible Development Strategy” (RDS) for 2017.

In the light of the RDS, the quality of the functioning and usefulness of the GUM for Polish citizens needs to be enhanced, which also entails an increased role of the GUM in various economic processes. Another important issue is increasing GUM’s involvement in the international arena.

By making a contribution to technological development, metrology remains the driving force behind the growth of all sectors of the modern economy.

Faces the challenges of a dynamically changing world, ensuring precise and accurate measurement.

The changes affecting the role and operations of the GUM will involve new initiatives pertaining to the active participation in various research consortia formed together with the Polish industry and science sector as well as participation in European research programmes in the field of metrology. The aforementioned activities will also include the establishment of a state-of-the-art, specialised metrology campus equipped with technologically advanced measurement infrastructure, as well as the development of technical competences of our well-qualified metrological personnel. An important factor conducive towards economic growth shall also be knowledge transfer implemented by the GUM at various levels, with the knowledge in question being derived, among others, from the resolution adopted by the General Conference on Weights and Measures (CGPM) as well as from the works of consultative committees of the International Committee for Weights and Measures (CIPM) and the technical committees of the European Association of National Metrology Institutes (EURAMET) concerning the development directions for modern metrology; in addition, the GUM will also strive towards the transfer of associated know-how to a broader audience.

In order to ensure the ongoing dialogue with external business, expert and R&D groups, Consultative Metrological Teams were appointed in 2016, with the issues covered by the Teams in question being technology and industrial processes, energy, infrastructure and special applications, healthcare, environment and climate change as well as market regulation. Teams dedicated to the area of assay were also appointed. The primary tasks of the Teams include the identification and analysis of the needs of the Polish state and national economy in matters of measurement and market regulation. In addition, Technical Committees designed to support the development of various areas of measurement, consisting of eminent experts, shall also be appointed.

The efficient implementation of the aforementioned changes at the GUM shall be made in accordance with the Four-Year Strategic Action Plan, implemented pursuant to the amended Act on measures (2017 amendment). The plan in question takes into account the recommendations and conclusions of the Supreme Audit Office (NIK), formulated in the course of audit no. KGP.410.009.01.2016, P/16/020 and pertaining to strategic management. Due to the fact that, in their follow-up statement, the Supreme Audit Office made a negative assessment of the implementation of the strategy by the Central Office of Measures between 2010 and 2015, these recommendations had a significant impact on the designation of the primary objectives included in the present document.

1. CURRENT SITUATION AND DEVELOPMENT PROSPECTS – A DIAGNOSIS

The NATIONAL SYSTEM OF MEASURES is a structure comprising various institutions and laboratories taking care of both measurement standards and technical equipment necessary to conduct tests, measurements and calibration. The System also supports the development of technologically advanced measurement methods. The System protects the interests of the state and its citizens and reinforces the confidence of users towards innovative products and processes. A modern system of measures remains the cornerstone for the development of new technologies and guarantees their implementation within the economy.

A National Measurement Institute (NMI) remains at the core of any domestic system of measures. This crucial role has been defined in various documents issued by international

metrological organisations, e.g. EURAMET Guide

1 EURAMET and the Operation of NMIs (2015), OIML D1 Considerations for a Law on Metrology.

The domestic system of measures in Poland consists of the following entities:

- The National Measurement Institute (NMI) – the Central Office of Measures;
- Designated Institutes (DI) – The POLATOM National Centre for Nuclear Research – Isotope Centre (NCBJ, OR POLATOM) as well as the Institute for Low Temperatures and Structural Research of the Polish Academy of Sciences (INTiBS);
- Regional Offices of Measures (OUMs);
- Research and calibration laboratories;
- Military metrology;
- Manufacturers of measurement equipment and devices;
- Users of measurement devices.

The activities of the system are also supported by the Polish Committee for Standardisation (PKN) and the Polish Centre for Accreditation.

The objectives and tasks laid down in the strategic plan are intended to prepare the Polish system of measures for the challenges which the modern national economy is meeting today.

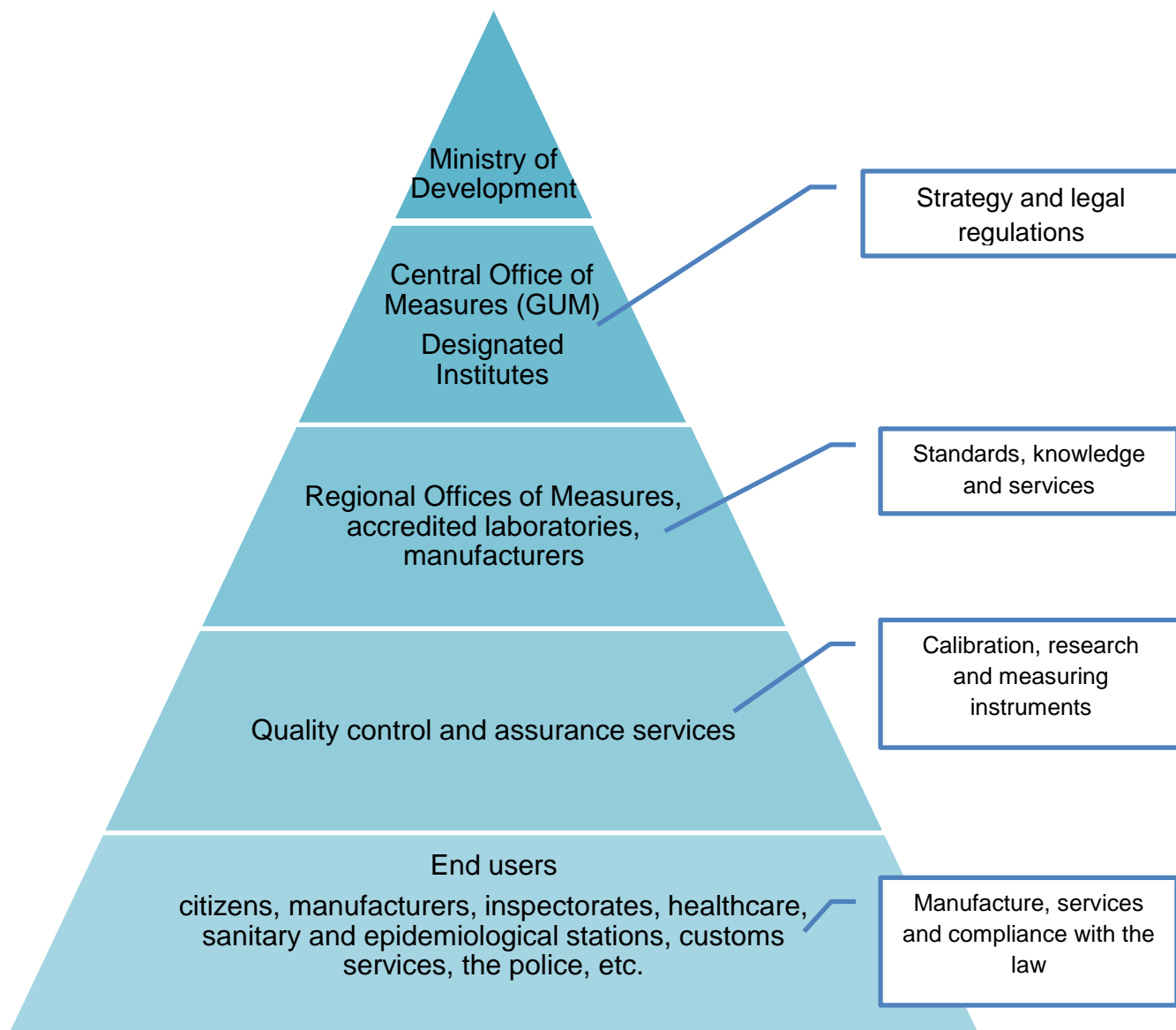


Fig. 1. The Polish system of measures

The CENTRAL OFFICE OF MEASURES (GUM) was established under the provision of the “Decree on Measures”, signed by the Chief of State Józef Piłsudski on November 8, 1919. Zdzisław Rauszer became the first director of the Office. At the time of signature of the Metric Convention by the Republic of Poland in 1925, the Central Office of Measures was incorporated into the structure of the national system of measures and has remained Poland’s national metrological institution ever since.

After World War II, the Office went through a number of organisational changes and mostly engaged in activities in the field of quality and normalisation. In 1966, pursuant to the Act on measures and measurement instruments, the GUM was transformed into the Central Office of Quality and Measures. In 1972, the Act on the establishment of the Polish Committee for Standardisation and Measures entered into force, followed a few years later by the 1979 by the Act on the establishment of the Polish Committee for Standardisation, Measures and Quality. Following the above organisational changes, in 1994 the Office returned to its original name, with the status of the Office now being governed by the Act on the establishment of the Central Office of Measures, enacted on April 3, 1993. At that time, the scope of research activities were reduced to a bare minimum and only included the development and modernisation of measurement standards.

However, the 1990s formula devised for the Central Office of Measures is no longer meet the challenges faced by the modern economy. In all developed states as well as most developing states, a designated organisational entity exists which is tasked with the maintenance and management of the national system of measures. The entities in question may differ in terms of size, scope of activities, legal status and degree of independence from other public institutions; however, due to the common area in which they operate, they are collectively referred to as National Metrology Institutes (NMIs). Contemporary domestic metrology institutions focus their efforts on the broadly understood support of the national economy. The largest among these institutions maintain the position of global leaders in the field of innovation and technological progress.

The Central Office of Measures remains an NMI in the formal sense, as a depositary of the national measurement standards; however, it does not perform the function of the centre for the development of state-of-the-art technologies, unlike its foreign counterparts. This is due to the prevailing institutional limitations as well as to the nature of the GUM, which remains a typical government administration authority in terms of both its structure, legal form and the tasks performed.

The members of both the industry and the research community have frequently noted that this system remains ill-adjusted to the challenges of the modern world. The implementation of actions indented to eliminate negative phenomena and bring about the institutional reform of the Polish metrology was recommended by the deputies of the joint parliamentary committees of the 6th term of the Polish Sejm (lower house of parliament) in Recommendation No. 10/4 of the Committee for Education, Science and Youth as well as Committee for the Economy for the Prime Minister, concerning the institutional reform of the Polish metrology, as well as by the deputies of the joint parliamentary committees of the 7th term of the Polish Sejm in Recommendation No. 11/13 of the Committee for Education, Science and Youth as well as Committee for the Economy for the Prime Minister, concerning the reform of the Polish metrology, adopted during a joint session held on March 4, 2015.

In 2009, the Ministry of the Economy approached Terry J. Quinn PhD, one of the most eminent experts in the field of metrology, director of the International Bureau of Measures in Sevres near Paris in the years 1988-2003, about preparing an expert opinion concerning the institutional aspects of the development of metrology in the Republic of Poland, including the current structure and role of the Central Office of Measures.

The findings contained in his report concerning the status of the Polish metrology system indicate that:

- 1) The GUM barely satisfies the minimum requirements with respect to ensuring traceability to national measurement standards through the performance of calibration services;
- 2) without scientific research, even the current capabilities of the GUM are becoming obsolete, remaining below the standards applied by the comparable NMIs in Europe and will no longer be capable of satisfying the future needs of the Polish industry;
- 3) The GUM is by no means able to satisfy the overall scope of tasks typically performed by an NMI, especially given the needs of a large country such as the Republic of Poland.

It has been stressed that the current priority, focusing on ordinary calibration activities, remains completely inconsistent with the priorities of other NMIs in major European countries, which place an emphasis on high-level calibration, scientific research and technology transfer to the industry.

The current activities of the GUM include:

1. formulation, maintenance and development of measurement standards at the highest level of accuracy, linked to the international system of measures;
2. performance of research and development works in the field of standards and measurement techniques, aimed at generating innovative technological solutions;
3. manufacture and certification of reference materials,
4. performance of precise calibrations of measuring instruments;
5. organisation and performance of domestic inter-laboratory comparisons,
6. performance of activities in the field of compliance assessment;
7. performance of the tasks of the state in the field of regulation and the supervision of measuring instruments applied in the fields of healthcare, environmental protection, public order and security as well as consumer rights protection;
8. actions intended to ensure the existence of links between the domestic and the international measurement systems;
9. limited participation in the transfer of measurement technologies to the industry.

In order to improve the current situation, a structural reform was implemented at the Central Office of Measures. As a result, using the structure of Technical Committees of the EURAMET and of the Consultative Committees of the International Committee for Weights and Measures (CIPM) as a starting point, the GUM established laboratories tasked with the identification of all the relevant issues and challenges in specific areas, both domestically and internationally. At the present stage, the GUM has a total of ten laboratories which operate in the following areas:

- acoustics and vibrations,
- time and frequency,
- chemistry,
- length,
- electricity and magnetism,
- photometry and radiometry,
- mass and related quantities,
- ionising radiation,
- flows,
- thermometry,
- as well as two laboratories tasked with the analysis of taximeters and tachographs, cash registers and measuring instrument software.

The laboratories specialising in individual areas of metrology are tasked with the safekeeping and maintenance of the various measurement standards of top metrological quality. The traceability of these standard with the global measurement system is maintained through calibration or international comparisons organised by the International Bureau of Weights and Measures (BIPM), the EURAMET or other regional metrology organisations. These comparisons are intended to determine the degree of equivalence of the Polish standards with the corresponding international standards as well as to confirm the technical competences of individual laboratories. The above activities remain significant constituent parts of the process of international review and recognition of the services performed by the Central Office of Measures, resulting in the entry of the top-ranking measurement capabilities (the so-called CMC – Calibration and Measurement Capability) into the Key Comparison Data Base (KCDB) maintained by the BIPM.

The experiences of the leading NMIs indicate that the high quality of work associated with the

development and maintenance of measurement standards naturally generates technological progress and contributes towards the development of innovative solutions.

The GUM measurement standards as well as activities intended to foster development in the individual areas of metrology are specified in greater detail in appendix no. 5.

However, the overall level of activity of the Central Office of Measures remains underwhelming. The Office does not do enough to support manufacturers, in spite of the fact that accurate measurement remains crucial to entities of this kind, both at the design and manufacturing stage and at the quality control stage. Insofar as regulatory activities are concerned, the list of measuring instruments subject to the obligatory assessment of compliance with technical requirements prior to their placing on the market as well as during their service life is still insufficient in its scope. Control and supervisory activities do not provide a sufficient degree of protection for the interest of the state as well as of its citizens insofar as the application of measuring instruments is concerned. This is confirmed by numerous suggestions made by the various groups involved in the operations of the Consultative Teams.

The establishment of Technical Committees (TCs) will be one of the essential steps towards enhancement of the effectiveness of the Central Office of Measures. The TCs shall consist of eminent domestic and international experts representing various areas of metrology which remain relevant insofar as the scientific and research activities of the GUM are concerned. The primary task of the members of the TCs shall be the provision of advice and opinions as well as the assessment of the activities of laboratories, participation in the preparation of development plans for individual areas of metrology, the analysis of the technical competences of staff as well as of the condition of their equipment and the preparation of reports on the actions performed and the provision of recommendations to the President of the Central Office of Measures aimed at ensuring the development and increasing the efficiency of activities of individual laboratories.

The existing technical infrastructure, scientific staff and scope of activities of the aforementioned laboratories are insufficient, since they are unable to satisfy the needs of the economy, the scientific community and society as such. In addition, the problems resulting from insufficient scope of regulations pertaining to technical issues – including, in particular, the supervision of control and measurement instruments – make it impossible for numerous state-of-the-art technical solutions necessary from the standpoint of developmental processes to be implemented.



REGIONAL UNITS

The measurement and assay administration units currently operating all across the country continue to perform important tasks for domestic stakeholders. Measurement administration units are responsible for issuing placing on the market and operational authorisations for measuring instruments as well as for the supervision thereof throughout the entire duration of their service life. Assay administration remains responsible for the performance of tasks within the scope of alloys or products hallmarking.

Due to the aggressive deregulation efforts performed, in particular, after the year 2000, the measurement administration was largely forced to refocus on commercial services (calibration, certification, evaluation). Despite the deregulation scheme, the measurement

administration remains a self-financing structure to a substantial degree (with about 50% of all funds being obtained in this manner); the amount of revenue generated by the measurement administration may have been much greater if the appropriate conditions existed. Most of all it touches the restoration of mandatory metrological control in some areas, and to update metrology activities fees, that since 2004 were valorised only by 10 %, that causes its level is far from the real cost of its conduction.

REGIONAL OFFICES OF MEASURES

The regional measurement administration consists of nine Regional Offices of Measures as well as of a number of branch offices; the scope of tasks performed by these entities includes the following:

- legal metrological control;
- control of entities authorised to engage in the verification of measuring instruments as well as of entrepreneurs which hold certificates allowing them to perform business activities in the field of installation or repair of traffic measurement instruments used in road transport (tachographs) as well as in the field of verification of compliance of such devices;
- control of the packaging of products and the filling of measuring bottles in the course of manufacturing process;
- performance of calibration services, conducting expert evaluation of measuring instruments, supervision of entities maintaining digital tachograph installation, repair and testing workshops as well as exercising market surveillance.

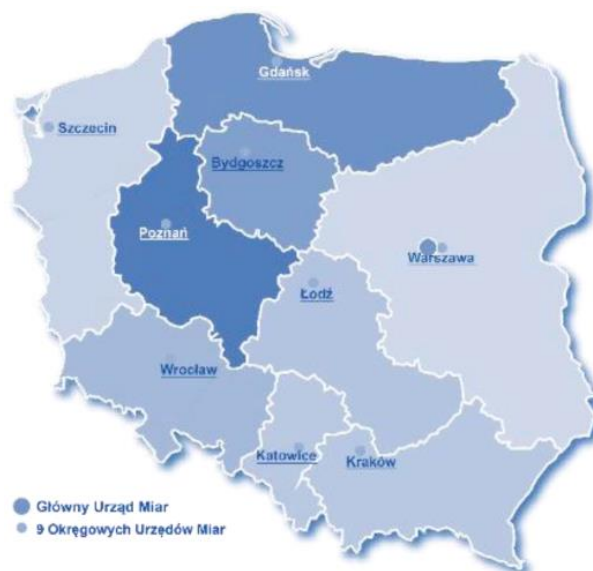


Fig. 2. Administrative division of Regional Offices of Measures (OUMs) in Poland (where: Główny Urząd Miar - Central Office of Measures; 9 Okręgowych Urzędów Miar - 9 Regional Offices of Measures)

In order to support both manufacturers and end users, OUMs perform calibrations and prepare expert reports. However, the overall policy of measurement administration in this particular area needs to be changed. Plans have now been drawn up for the development of a consistent policy of calibration and testing for the entire measurement administration. In order to ensure a more efficient use of the existing potential – including budget funds – specialisations will be introduced in some areas of activity. These activities should also include actions pertaining to the assessment of compliance of those measuring instruments to which the MID and NAWI directives apply, within the framework of selected modules.

As a result of various changes implemented over the period of many years, the organisational structure of individual offices tends to differ substantially. This makes it impossible to ensure effective and efficient management of regional units; for that reason, changes need to be

introduced which enhance the way in which regional measurement administration operates.

The current structure of the measurement administration does not fully meet the needs of the economy. For the above reason, it is necessary to reorganise the Regional Offices and to adjust the scope of their activities to the needs of the local stakeholders, resulting in a well-organised network of specialised regional units capable of handling new, complex tasks.



REGIONAL ASSAY OFFICES

The assay administration consists of two regional assay offices along with their respective branch offices. The entities in question perform the following tasks:

1. Testing and marking products made of precious metals as well as containing such metals,
2. Supervision of the application of the provisions of the Assay Law,
3. Maintenance of the register of marks used by private entities.



The obligatory assay system currently in place in Poland provides that any entity which engages in the placing on the market of products made of precious metals shall be subject to certain statutory obligations pertaining to the use of hallmarks on such products.

Fig. 3. Administrative division of Regional Assay Offices (OUPs) in Poland (where: Główny Urząd Miar - Central Office of Measures; 2 Okręgowe Urzędy Probiercze - 2 Regional Assay Offices)

For the first time in the history of the Polish assay administration, a special discussion platform for all stakeholders – the Consultative Assay Team – has been formed. The initial discussions conducted so far indicated that there is a need for the activities of the assay offices to be expanded into new areas in the future. At the present stage, the works have not progressed beyond the initial phase. In the future, when the relevant tasks are designated in a more precise manner, the activities encompassed by the strategy will become expanded.

Even today, the requirements of the market with respect to jewellery trade, the constantly developing technologies for the manufacture of precious metal alloys as well as new techniques for the production of items of this kind have resulted in the need for constant improvement in the field of both analytical methods and product marking. The need for the implementation and improvement of non-destructive testing methods and expansion of the scale of laser product marking also keeps increasing.



LOCATION

The headquarters of the Central Office of Measures (GUM) is located inside a historical building at 2 Elektoralna street in Warsaw, originally designed in the Classicist style by Antonio Corazzi and Jan Jakub Gay and subsequently extended during the period between 1825 and 1928. Following its destruction during the Warsaw Uprising, the edifice was reconstructed after World War II came to an end.

During the 19th and the 20th century, the building performed a variety of functions. From January 29, 1828, it served as the headquarters of the Bank of Poland; following its liquidation, the edifice became the property of the Russian Exchange Office (from January 1, 1886 onwards). From 1917 onwards, the building remained under the administration of the Ministry of Industry and Trade, while in 1922 it officially became the headquarters of the Central Office of Measures – a function which it performs to this day.

The current location of the Central Office of Measures, however – in the city centre, close to numerous undesirable sources of interference such as metro and tram lines as well as heavy traffic – means that the building no longer satisfies the requirements applicable to a laboratory environment where national measurement standards are maintained and where precise measurement operations and high-level research activities are performed.

The fact that the current headquarters of the GUM remains incompatible with the tasks which it is intended to perform (such as taking measurements of the highest accuracy) has already been stressed by Terry Quinn PhD, the former director of the BIPM, in the document known as “Report and recommendations on the institutional aspects of the development of metrology in Poland”, released in 2009. The inadequacy of the current location stems mostly from the adverse influence of its surroundings on the measurement results and on the estimated uncertainty values. Sources of electromagnetic radiation as well as ground vibrations which typically occur in city centres remain the primary environmental causes of additional measurement errors.

Following an in-depth analysis which takes into account the assessment made by T. Quinn (Recommendation no. 8 of the aforementioned 2008 Report), it has been decided that the GUM campus will need to move to a new location. The recommended location would lie outside the city centre and would be selected in accordance with the needs of the NMI in a manner which ensures convenient access for both domestic and international stakeholders.



The buildings of the regional measurement and assay offices were likewise found to be inadequate, both in terms of architecture and location. The obsolete, ageing buildings used by both OUMs and OUPs continue to require frequent repair or refurbishment works. Similarly, laboratory premises are also in a dire need of refurbishment or adaptation works, with some of the works requiring a complete replacement of technical resources.

The infrastructure of regional offices also needs to be improved. The many years of neglect in this regard have resulted in a situation where the needs for a new modernisation programme becomes ever more pressing. This will necessarily require an increase in investment and renovation expenditure.

INTERNATIONAL COOPERATION

The participation of the GUM in the global system of measures requires a programme of broadly understood international cooperation encompassing various kinds of activities.

The necessity of such cooperation stems from the following factors:

- the need to create links between the domestic system of measures and the global system as well as to satisfy the preconditions for these links to be recognised by other countries in all aspects thereof,
- the need to ensure the uniformity of legal regulations, thereby creating the possibility for the results of metrological operations carried out by the competent bodies in Poland to be recognised within the regulatory environment of the European Union,
- the need to harmonise metrological requirements from an international perspective.

The Central Office of Measures formally represents Poland in the course of operations of both leading and working bodies set up under the provisions of the Metre Convention. The representatives of the GUM participate in the works of the General Measurement Conference, the International Bureau of Weights and Measures (BIPM), the Consultative Committees of the International Committee for Weights and Measures (CIPM) as well as one of the Joint Committees of the BIPM. There are plans for the role played by the representatives of the GUM in individual committees to be expanded.

The GUM remains the member of the EURAMET, a European regional organisation formed by the cooperating national and designated metrological institutions. The EURAMET performs activities in the field of theoretical fundamentals of metrology, various issues related to measurement standards, traceability as well as measurement techniques. GUM's membership of this organisation must now be intensified.

Of particular importance is the CIPM MRA agreement on mutual recognition of measurement standards as well as of research and calibration results published by the NMI. The provisions of this agreement are being implemented within the framework of the EURAMET.

The GUM participates in the European scientific cooperation scheme in the field of metrology, including, in particular, in the programmes co-funded by the European Commission (the EMRP and EMPIR programmes). There are plans for increasing the scope of GUM's participation in future projects.

Insofar as cooperation in the field of legal metrology is concerned, GUM's membership of the OIML and WELMEC remain of utmost importance. Representatives of the GUM participate in the works of OIML Technical Committees as well as of WELMEC Working Groups.

As a notified body, the GUM also takes part in all operations of the NoBoMet platform, formed by various entities designated by the appropriate domestic authorities to implement tasks in the field of compliance assessment.

Insofar as cooperation in the area of assay is concerned, the cooperation of assay authorities takes part within the framework of three international institutions:

- The Standing Committee of the Convention on the Control and Marking of Articles of

Precious Metals, which Poland acceded to four years ago (the Convention itself has been ratified by the President of the Republic of Poland on July 19, 2005),

- The International Association of Assay Offices (IAAO, formerly known as the Association of European Assay Offices), of which the Polish assay offices have been members since 1994,
- The GV4 – the Visegrád Group, which has been a forum for cooperation between Poland, Hungary, Czech and Slovakia from 1993.



The challenges which the Polish economy faces today, including the need to ensure that the Polish industry becomes more competitive, require the GUM to step up its efforts in the international arena in order to ensure that the greatest possible advantage is taken of the international achievements in the field of metrology as well as that the knowledge inherent in these achievements is transferred to the interested sections of the Polish business.

DOMESTIC COOPERATION

The domestic cooperation of institutions engaged in activities related to metrology is necessary to ensure the proper functioning of the economy. However, this cooperation has been substantially reduced in scope in recent years. This situation must be changed by ensuring that a greater amount of activities are performed in this area.

In the future, the essence of domestic cooperation shall be various R&D projects based on knowledge and technology transfer, implemented in cooperation with educational institutions, scientific institutes, military metrology institutes as well as commercial entities, all acting for the benefit of the national economy.

Domestic cooperation in the field of metrology needs to be reinforced in order to ensure that advantage is taken of the synergies between all entities which perform tasks that benefit the economy.

The cooperation with the Polish Centre for Accreditation (PCA) will also be intensified in matters of support for the accreditation system; likewise, the GUM will also cooperate more closely with the Polish Committee for Standardisation (PKN) by taking part in various standardisation schemes.

Before 2016, there was no cooperation between business entities existed despite its importance which stems from the fact that such cooperation defines the directions for the development of measurement technologies, which in turn enhances the competitiveness of the economy. In order to make up for the many years of neglect, Consultative Metrological Teams were established.

Given the role of metrology, accreditation and standardisation for the development of new technologies and overall progress – including, in particular, in the field of industry – the cooperation in these areas definitely needs to be intensified.



COOPERATION WITH THE INDUSTRY

It needs to be emphasized that cooperation with the industry entails synergistic effects in the form of technological enhancements stemming from the greater precision of measurements taken at each stage of the manufacturing process, which in turn has a positive impact on the quality and competitiveness thereof.

The efforts being taken to increase the innovativeness of the Polish economy and to foster the growth thereof as well as the need to ensure a more greater balance in the international trade in goods and services have all made it necessary to adjust the overall level of domestic metrology in order to meet new challenges as well as to adopt the common, global standardisation models.

Fostering growth in many areas of science and technology requires cooperation in matters of development of universal measurement standards and methods. This cooperation is being coordinated by international metrological organisations focusing on mutual relations in the field of application of accepted rules.

The competitiveness of technical solutions devised in Poland and the Polish technological expertise in general will only be possible if we choose to apply the same solutions as those used in developed countries. Polish companies frequently continue to face barriers in the form of certifications or requirements imposed on similar entities on the markets they are intending to expand into. The role of the Central Office of Measures is to support the efforts intended to allow them to overcome these barriers as well as to provide the Polish industry with information concerning state-of-the-art technologies and measurement methods which would make it easier for businesses to operate – both domestically and on the international market.

The level of material culture in industry is determined by the forms of metrological supervision exercised by the state and its various designated bodies.

The Central Office of Measures is acting to promote the development of domestic industry in many areas of cooperation, including in the technological dimension. Development processes in which contemporary businesses are involved – automation, robotisation or miniaturisation – need to be underpinned by technologically advanced measurement standards, traceable to the International System of Units (SI). The task of the GUM is to ensure the availability of such standards as well as various services provided for the benefit of the economy, such as:

- dissemination of the measurement units through the calibration process and expert studies,
- manufacturing of high quality certified reference materials,
- carrying out interlaboratory comparisons,
- performing activities within the framework of the conformity assessment system,
- conducting software and metrological data research in cash registers and measuring instruments,
- conducting training programmes pertaining to modern technological solutions in the field of metrology, new measurement techniques or the determination of measurement uncertainty,
- providing technical consultation in the field of metrology,
- providing technologically advanced measurement standards,
- ensuring compliance with documentation quality requirements,
- performing control activities within the framework of supervision duties as well as taking decisive legal steps whenever any irregularities are found.

Ensuring that the activities of the Central Office of Measures remained oriented on the needs of all sectors of the national economy has made it necessary to embark upon effective dialogue with various external groups and entities – businesses, experts and R&D institutions. In order to achieve this goal, Consultative Metrological Teams (KZM) and Consultative Assay Teams (KZdsP) were appointed back in 2016.

The scope of issues to be addressed by these Consultation Teams was designated taking into account the substantial role played by accurate and precise measurements in such sectors of the economy as industry, the energy sector, infrastructure, healthcare, the environment or the market. Consultative Teams have been formally established in the field of healthcare, energy, technologies and industrial processes, infrastructure and special applications, environment and climate change, market regulation as well as assay. The 8 teams formed so far consist of 40 Working Groups focusing on various aspects of the aforementioned areas as well as 53 Task Forces formed in order to ensure the implementation of specific projects.

The activities of the Consultative Metrological Teams have already resulted in various proposals for research and development projects being advanced despite the fact that the Teams have only been active for barely a year. The proposals in question included initiatives of key importance for the national economy, related to the development of new measuring instruments, manufacture of new certified reference materials, development of new measurement methods or preparing the tenets for new legal regulations which require various preparatory research and testing activities to be carried out.

More than 70 common research themes have been identified in the course of the work performed by the Consultative Teams, including healthcare, the environment, technologies, energy, infrastructure and assay. More than 600 individuals representing about 200 domestic economic operators have been involved in the works referred to above. Access to the system is generally available to all Polish economic operators through the publication of appropriate information on the website of the Central Office of Measures. The implementation of joint research projects allows these entities to gain access to unique metrological knowledge and GUM's measurement stands. The proposed projects included those to be implemented within the framework of research consortia covered by the grants provided by the National Centre for Research and Development. The remaining projects shall be carried out by the Central Office of Measures on the basis of commercial orders.

Number of entities participating in the works of the CMTs

Area	Number of entities	Area	Number of entities
Industry	74	Public administration	21
Science	35	Measurement administration	14
Infrastructure	24	Healthcare	1
Energy	22	Environment	1
Military	2	Police	1
Measurement laboratories	7	Space	1
Geodesy	2	Other	31

Number of representatives of the industry involved in the works of the CMTs

CMT for:	Sector of the economy	Number
Market Regulation	industry	52
Technology and Industrial Processes	industry	14
Environment and Climate Change	industry	8
The Energy Sector	industry	8
Infrastructure and Special Applications	industry	7
Healthcare	industry	3
Assay	industry	7

Number of research and development areas being developed by the CMTs

Name	Number of areas (themes)
CMT for Environment and Climate Change	20
CMT for Market Regulation	15
CMT for Infrastructure and Special Applications	15
CMT for the Energy Sector	10
CMT for Technology and Industrial Processes	9
CMT for Assay	4
CMT for Healthcare	1

Due to its interdisciplinary nature, the efforts of the GUM are intended to support all sectors of the economy by facilitating access to a system of measures unified at the global level, while the works on new measurement systems and schemes remain conducive to both the development of new technologies and the gradual increase of competitiveness of our economy. All the efforts referred to above also remain consistent with all current National Smart Specialisations.

The participation of the GUM in the implementation of research and development projects within the framework of CMTs

Name of activity	Number
Provision of sources of traceability	56
Performance of measurements	29
Preparation of tenets for legal regulations	25
Knowledge transfer	24
Development of measurement methods	22
Other	22
Development of standards	7

Development of measuring instruments	4
Participation in development (or individual development) of designs	3
Provision/preparation of new reference materials	3
Participation in the development of technologically advanced solutions	1

The activities of the GUM shall concentrate on the establishment of conditions for the development and implementation of innovative solutions in the industry. These actions shall also support economic growth and the wider application of new, breakthrough products and technologies.

There are also plans for the systematic modernisation of customer service systems through the application of a new, electronic communication platform.

COOPERATION WITH SCIENCE AND RESEARCH INSTITUTIONS

The many years of cooperation with domestic science and research centres, intended to promote an increase in innovativeness, number of new inventions and scope of educational activities in the field of metrology has always been an important part of the development strategy of the Central Office of Measures. To a considerable extent, the aim of this strategy is to ensure the implementation of joint research projects in the field of development of new measurement methods, construction of prototype measuring instruments, dissemination of metrological knowledge on estimating measurement uncertainties as well as development of sources of traceability (measurement unit standards). All of the joint efforts made so far were intended to improve the quality of measurements performed domestically as well as ensure a greater knowledge transfer to the national economy.

Cooperation with the scientific community in the field of joint research and publications remains an important factor for the development of the Central Office of Measures. In many cases, employees of the GUM actively initiate joint projects by participating in scientific and technical conferences; the cooperation platform offered by the Consultative Metrological Teams (CMTs) is also frequently used for this purpose. Many such initiatives have resulted in the conclusion of formal agreements.

Under the framework contracts under which this form of cooperation takes place, the GUM provides access to technical infrastructure (measuring instruments and stands), facilitates student internships and participation in scientific seminars as well as provides the necessary knowledge in the field of metrology. The partner under such agreement – the science and research institution – provides substantive support and enables the employees of the Office to engage in research and measurement within the framework of PhD dissertations or habilitation theses as well as facilitates participation in postgraduate study programmes pertaining to the areas of knowledge linked to the work performed. The fact that cooperation is placed on a formal footing allows both of the partnering institutions to support one another by participating in a mutual transfer of knowledge and thereby acting for the benefit of the economy as a whole.

The cooperation between the Central Office of Measures and science and research institutions may have a significant impact on the opportunities for graduates on the labour market. Students/graduates of educational institutions focusing on technology may take advantage of the GUM laboratories, manned with well-qualified staff – a perfect environment

to develop their skills in the field of metrology. Furthermore, their participation in internships and work placements allows them to gain new knowledge and practical experience in matters of measurements performed at the level of the domestic NMI.

Today, the Central Office of Measures is implementing 20 framework contracts or agreements. The scope of substantive cooperation includes the following areas:

- maintenance of atomic time and frequency standards as well as atomic time scales, time servers controlled by signals from atomic clocks, determination of the International Atomic Time (TAI) and Coordinated Universal Time (UTC), determination and calculation of the Polish atomic time scale – TA(PL) in cooperation with the Centre for Space Studies of the Astrogeodynamic Observatory in Borowiec near Poznań (with respect to the GPS CV remote time-scale comparison);
- performing time and frequency measurements as well as electrical metrology; In cooperation with the Department of Electrical Engineering, Information Technologies and Telecommunication, the GUM implemented two research projects in the field of time and frequency measurements and electrical metrology: “The integrated system for the monitoring and control of measurement systems for the national time and frequency standard” as well as “The measurement system for the calibration of reference resistors with low resistance values within the scope of acoustic frequencies”;
- educational programmes conducted by the employees of the GUM for students of the Chemistry Department of the University of Warsaw;
- implementation of a joint project with the AGH University of Science and Technology in Cracow – conducting an analysis of the possibility for establishment and implementation of an automatic road vehicle weighing system (HS-WIM) to ensure its practical application and the presence of appropriate legal regulations;
- conducting research in the field of long-term stability of stabilised metrological lasers (in cooperation with the Electronics and Telecommunications Department of the Poznań University of Technology);
- conducting electrical measurements (high resistance measurements) in cooperation with the Electrical Engineering Department of the Wrocław University of Technology (project name: “Transfer of resistance unit from the QHR primary standard to high-resistance standards based on Hamon transfer technique”);
- implementation of the JRP ENV07 METEOMET project within the framework of the EMRP programme as well as performance of measurements pertaining to comparisons involving the national standards with respect to the definition points for Hg and H₂O (in cooperation with the Institute for Low Temperatures and Structural Research);
- implementation of nanometric measurements of microgeometric surface standards with inequality level below 1 µm with respect to 2D and 3D parameters (in two and three dimensions) – project implemented in cooperation with the Koszalin University of Technology;
- performance of nanometric measurements of microgeometric surface standards with inequality level below 1 µm with respect to 2D and 3D parameters (in two and three dimensions) – project implemented in cooperation with the Koszalin University of Technology;

- performance of high-precision measurements of electrical and magnetic values (inductance measurements, electrical capacity measurements, AC/DC measurements, voltage and alternating current thermal transducers) – project implemented in cooperation with the Institute of Metrology, Electronics and Automatics in Gliwice, Department of Electrical Engineering of the Silesian University of Technology;
- cooperation with the Institute of Geodesy and Cartography within the scope of gravitational standards and measurements;
- performance of environmental measurements, including, in particular, those pertaining to the use of microphones for noise measurement within the scope of frequency between 10 kHz and 40 kHz – project implemented in cooperation with the Central Institute for Labour Protection (CIOP) in Warsaw;
- implementation of the EMRP – ENV07 METEOMET research project in cooperation with the Institute of Meteorology and Water Management – State Research Institute.

PERSONNEL

The experienced and competent personnel forms a strategic asset of the organisation. An integrated, involved and well-motivated team of employees is the fundamental prerequisite to the achievement of the designated objectives and the constant improvement of the institution as a whole.

The current personnel structure at the Central Office of Measures and its regional offices, however, remains inadequate when viewed in the light of the contemplated tasks, both in terms of staff number and competences. Working at research laboratories requires a high level of qualifications and experience, which should be passed on to future generations. Due to the difficulties involved in the acquisition of new personnel, however, many laboratories are now facing the issue of maintaining continuity of staff competences. This situation is the result of the many years of inadequate HR policies, which have failed to ensure the appropriate salary level that would reflect the high level of qualifications required. The Central Office of Measures currently faces the challenge of overhauling its Staff Policy in a manner which would ensure new opportunities in terms of professional development as well as greater involvement of the existing staff in the operations being carried out.

PERSONNEL OF THE CENTRAL OFFICE OF MEASURES

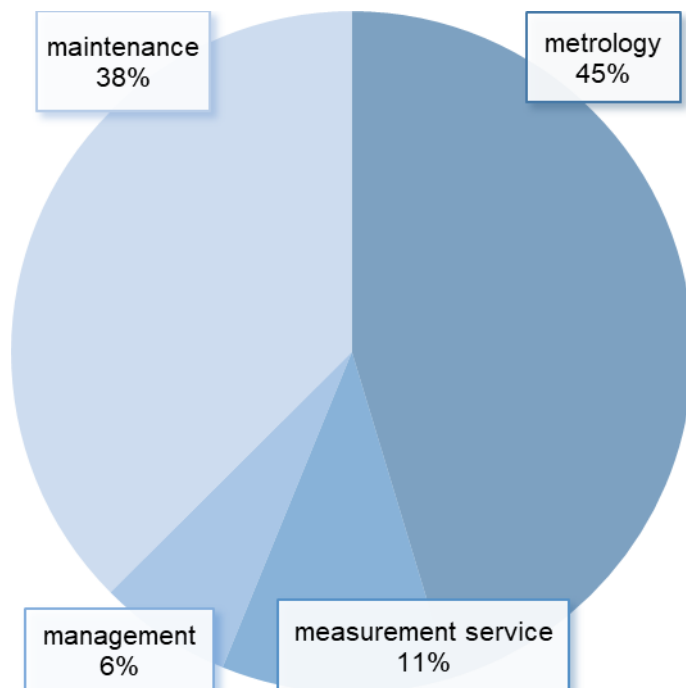


Fig. 4. GUM employment structure as at December 31, 2016

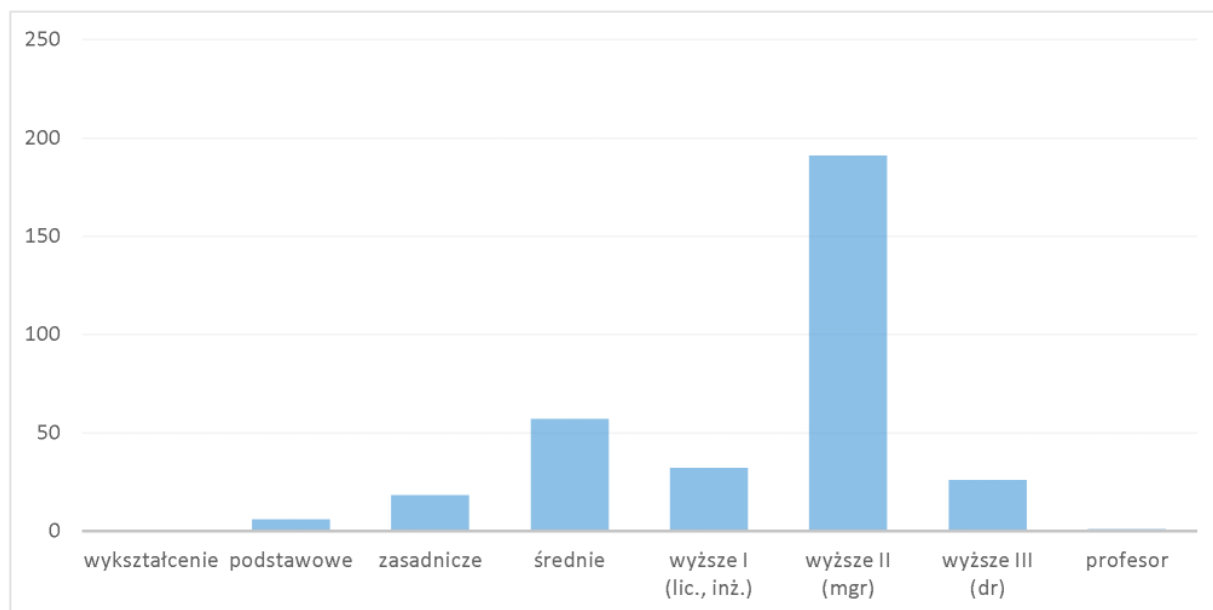


Fig. 5. GUM employee educational qualifications structure as at December 31, 2016 (where: wykształcenie podstawowe - primary education; zasadnicze - vocational; średnie - secondary; wyższe I (lic., inż.) - higher (level I – BA/Eng); wyższe II (mgr) - higher (level II – MA); wyższe III (dr) - higher (level III – PhD); Profesor – Professor)

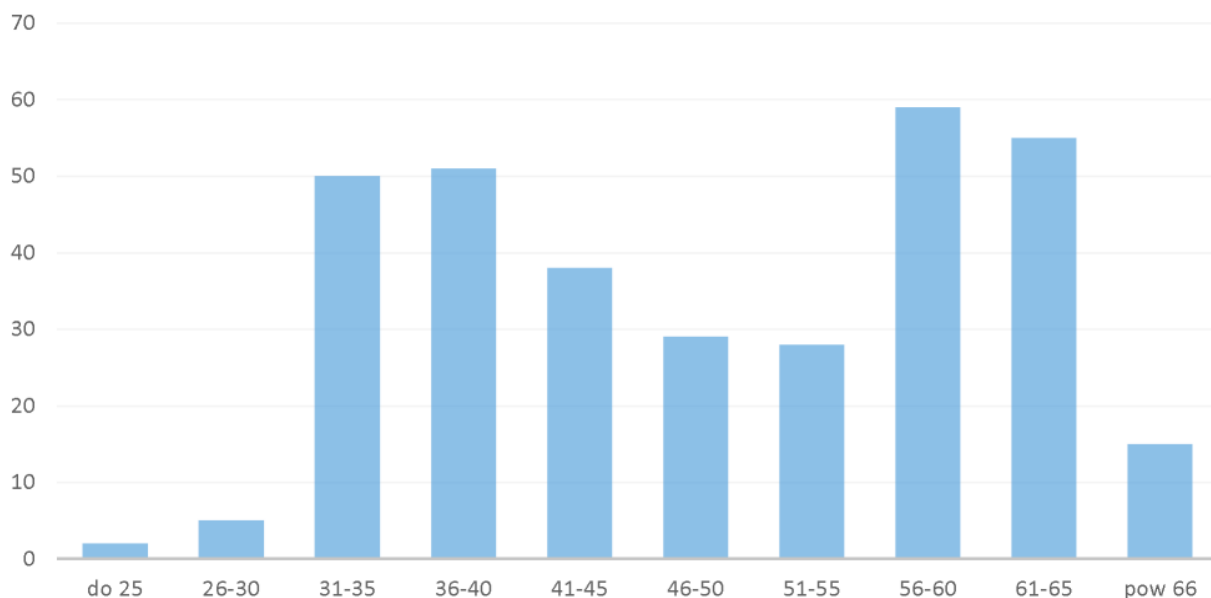


Fig. 6. GUM employee age structure as at December 31, 2016 (where: do 25 - up to 25 y.o.; pow 66 - above 66 y.o.)

In order to ensure the continuing implementation of the objectives of the Central Office of Measures, the current employment structure is expected to be overhauled, resulting in the part of the team responsible for metrology being reinforced both in terms of competences and overall staff numbers. The process of building up a highly qualified team requires a well-prepared and successively implemented personnel management plan, beginning with the recruitment process and bolstered by attractive models of skill acquisition.



The process of change has already begun. A personnel restructuring scheme has been implemented at the GUM, resulting in a reduction of maintenance personnel and corresponding increase of the number of staff dealing with metrological issues.

There are also plans for a comprehensive employment structure analysis with respect to regional offices, followed by a precise determination of staffing needs and opportunities in terms of employee reassignment in order to ensure a more efficient performance of the designated tasks.

PERSONNEL OF THE REGIONAL OFFICES OF MEASURES (OUMs)

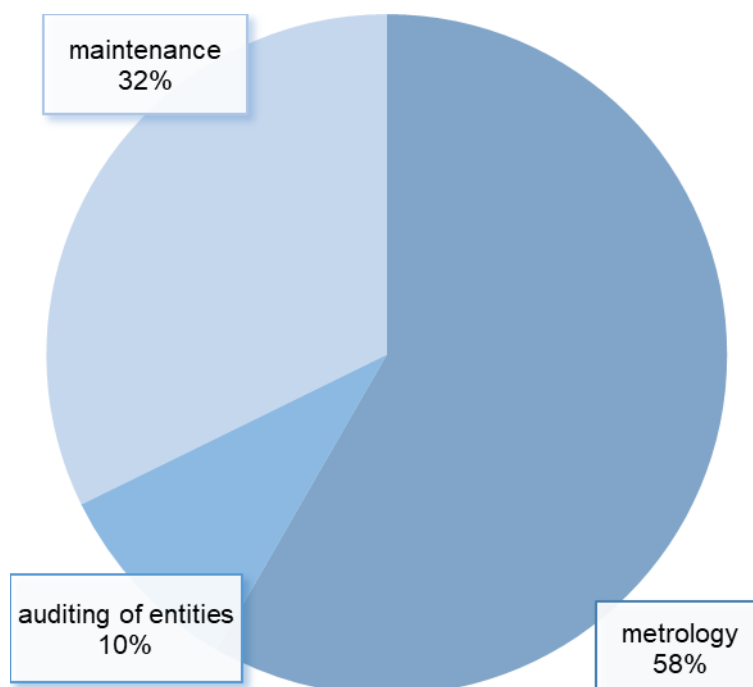


Fig. 7. OUM employment structure as at December 31, 2016

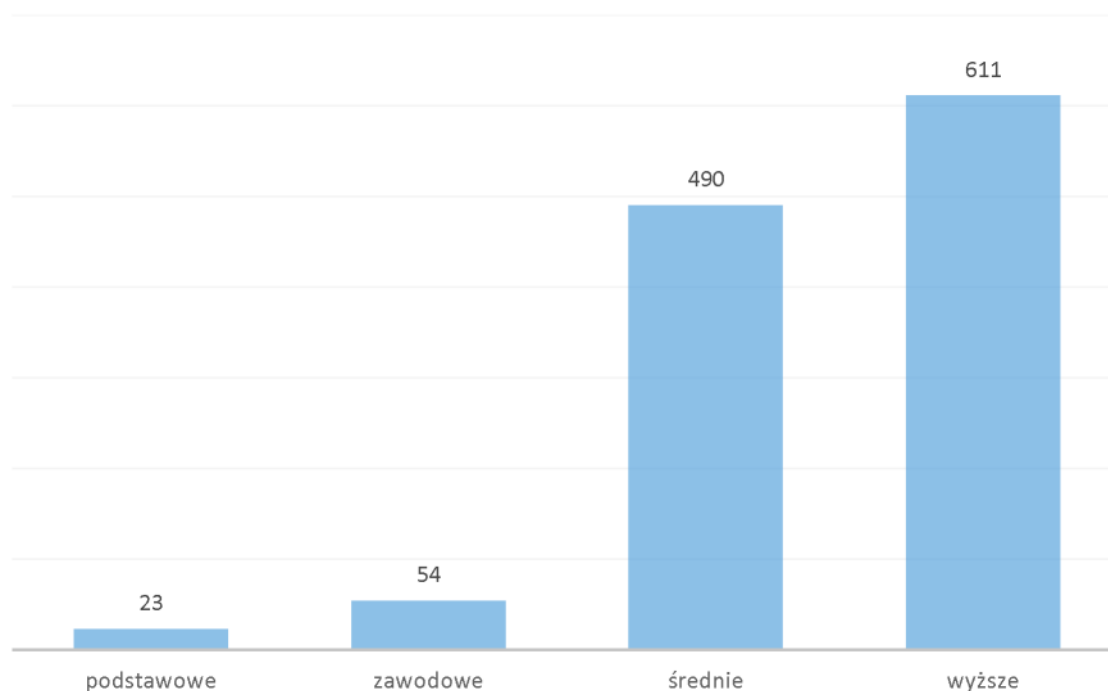


Fig. 8. Structure of educational qualifications of OUM employees as at December 31, 2016 (where: podstawowe - primary; zawodowe - vocational; średnie - secondary; wyższe – higher)

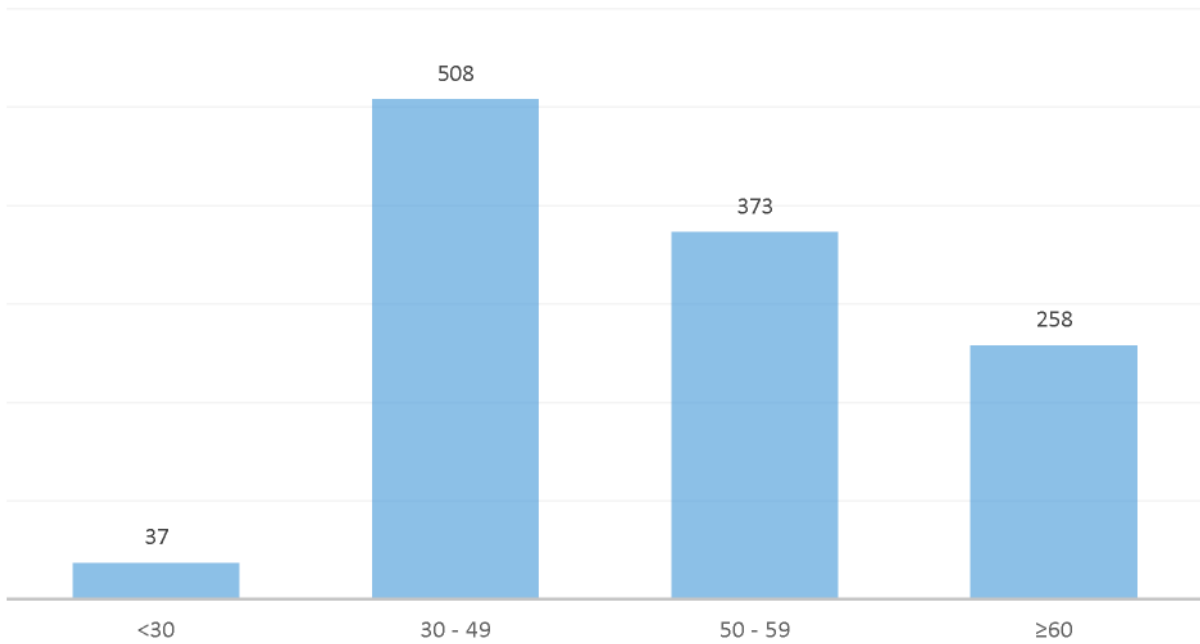


Fig. 9. OUM employee age structure as at December 31, 2016

PERSONNEL OF THE REGIONAL ASSAY OFFICES (OUPs)

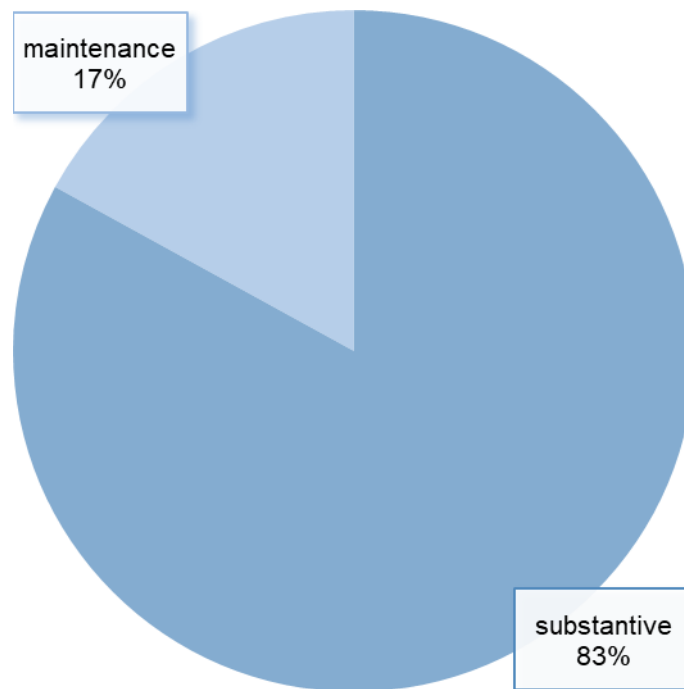


Fig. 10. OUP employment structure as at December 31, 2016

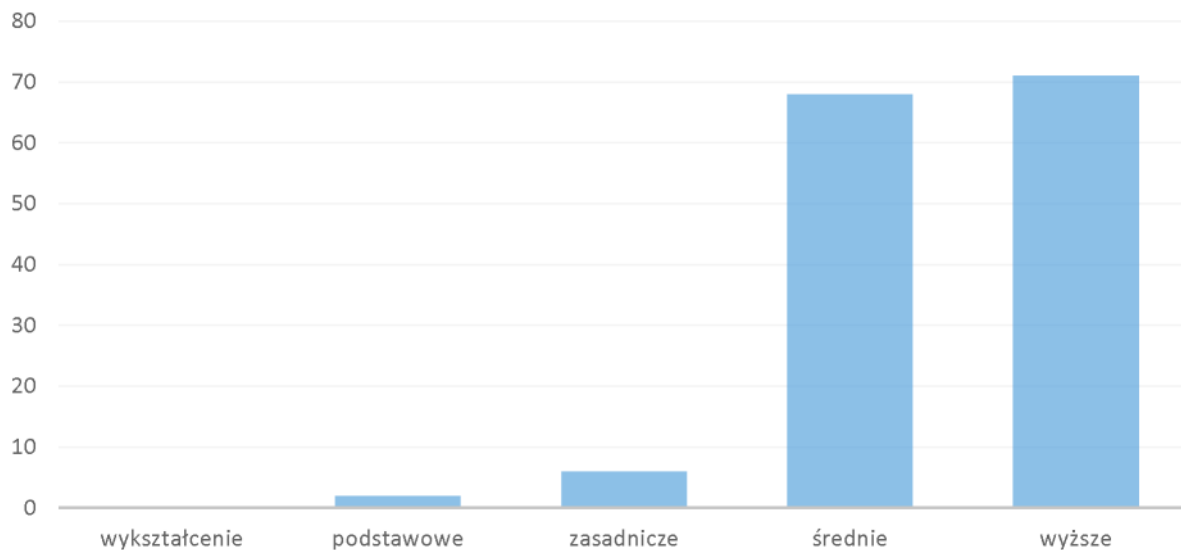


Fig. 11. Structure of educational qualifications of OUM employees as at December 31, 2016 (where: podstawowe - primary; zasadnicze - vocational; średnie - secondary; wyższe – higher)

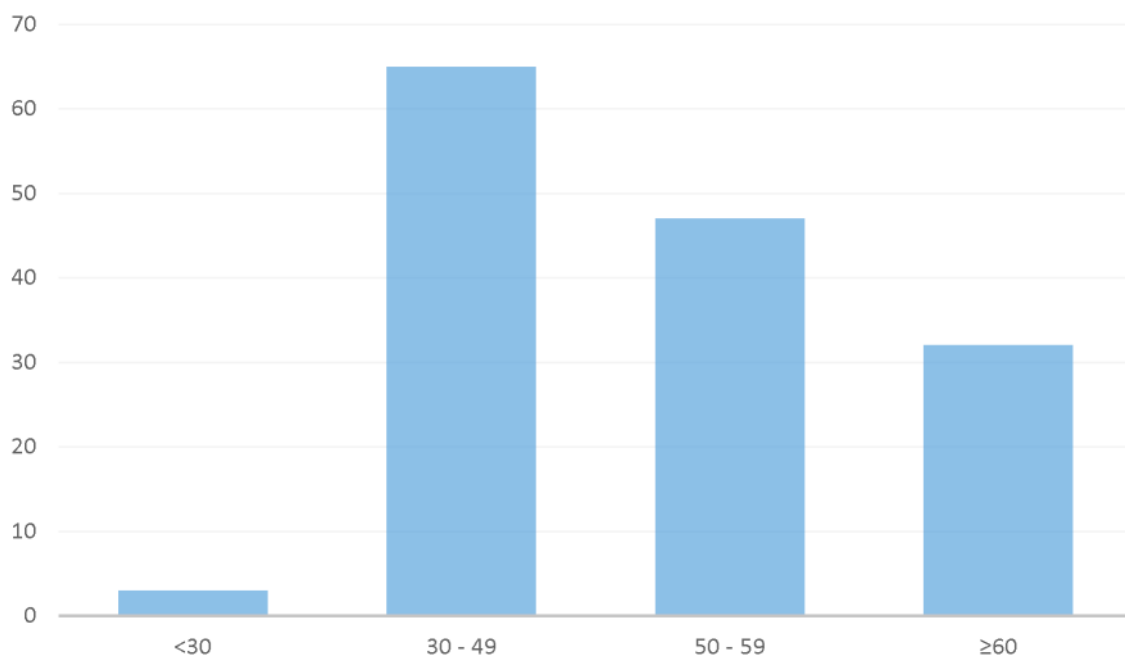


Fig. 12. OUP employee age structure as at December 31, 2016

FINANCE – BUDGET STRUCTURE

Much like other national metrological institutions, the Central Office of Measures performs its activities mostly on the basis of public funds allocated under part 64 of the state budget.

The implementation of ongoing tasks as well as development objectives and activities contained in the Strategic Plan for the GUM, the measurement administration and the assay administration for years 2018–2021 shall mostly be based on budget funds.

The existing budget, however, was mostly passive in nature and was not development-

oriented. Most of the allocated funds were intended to cover employee salaries; since the GUM remains an institution whose basic activities are carried out in a laboratory environment, this necessarily had to impede the technological development thereof. This state of affairs must not be allowed to persist. It is now a foregone conclusion that the development budget needs to provide for a greater amount of funds for the development of metrological infrastructure and various activities focusing on different areas of measurement.

The percentage allocation of the GUM expenditure for years 2015 and 2016 shows clearly that the funds allocated for laboratory infrastructure (ensuring the continuing operation and development of various areas of measurement) were 4 % and 7 % of the entire budget respectively. The salary costs and related costs account for approximately 70 % of all expenses. The remaining part of the budget, referred to as “maintenance”, are the costs of auxiliary activities associated with the exploitation of infrastructure, supporting international cooperation etc.

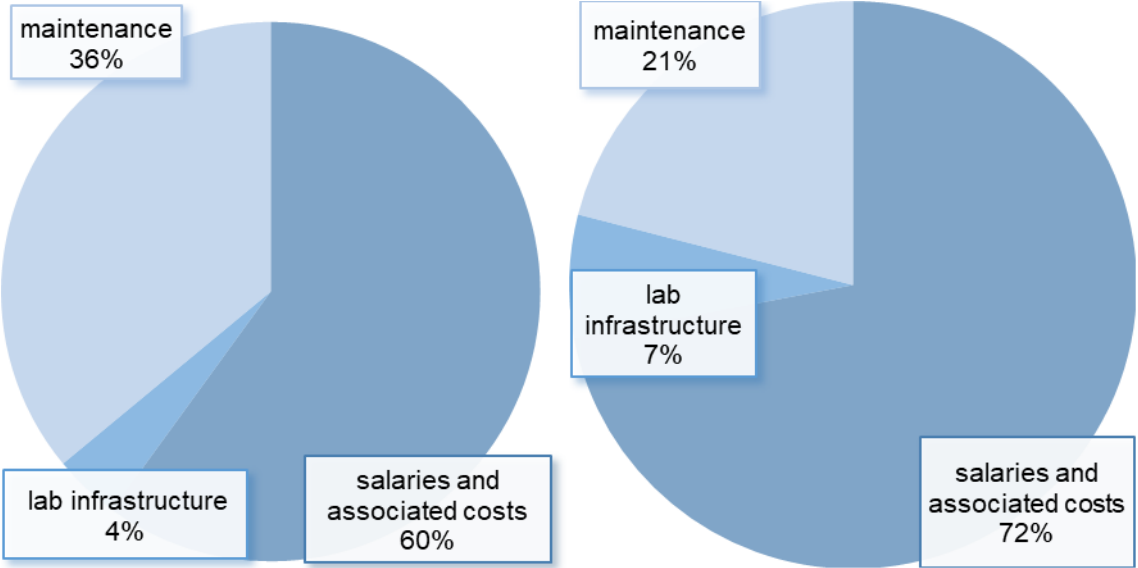


Fig. 13. Expenditure structure according to the GUM expenditure plan for 2015 (A) and 2016 (B)

Insofar as the maintenance and development of the laboratory infrastructure at the Regional Offices of Measures (OUMs) looks even less promising. The current structure of expenditures demonstrates that in 2015 and 2016, only 0.2 % and 1 % of the budget respectively was allocated for those activities at some of the OUMs.

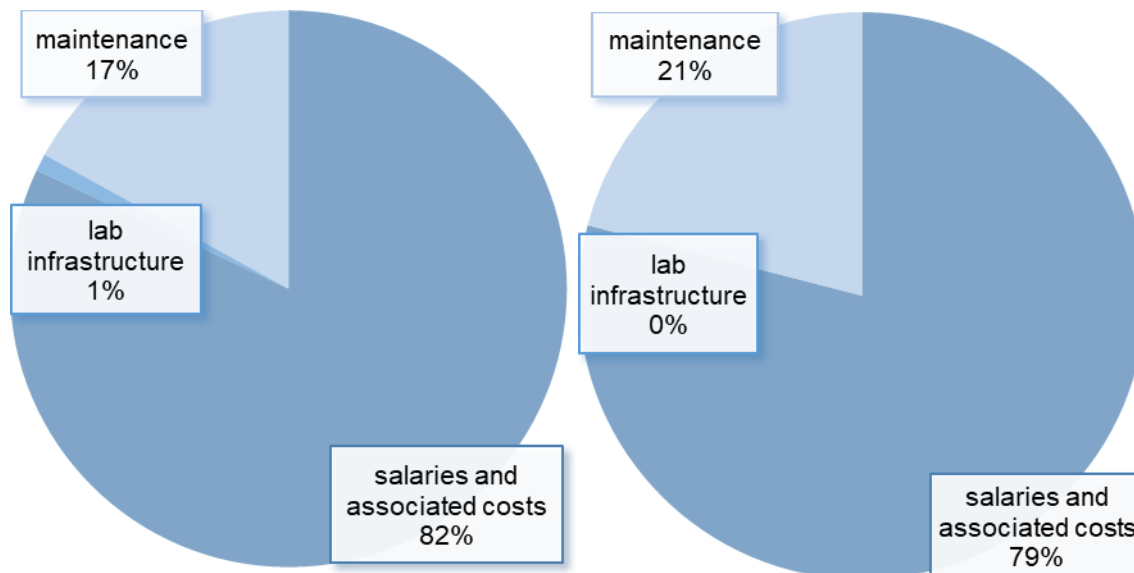


Fig. 14. Expenditure structure according to the OUM expenditure plan for 2015 (A) and 2016 (B)

As for the Regional Assay Offices, the analysis of expenditure shows that 2 % and 3 % of the entire budget was allocated to laboratory infrastructure in 2015 and 2016 respectively at some of the OUPs. The funds allocated to investment tasks remain insufficient; this aspect of the activity of the OUPs requires radical change.

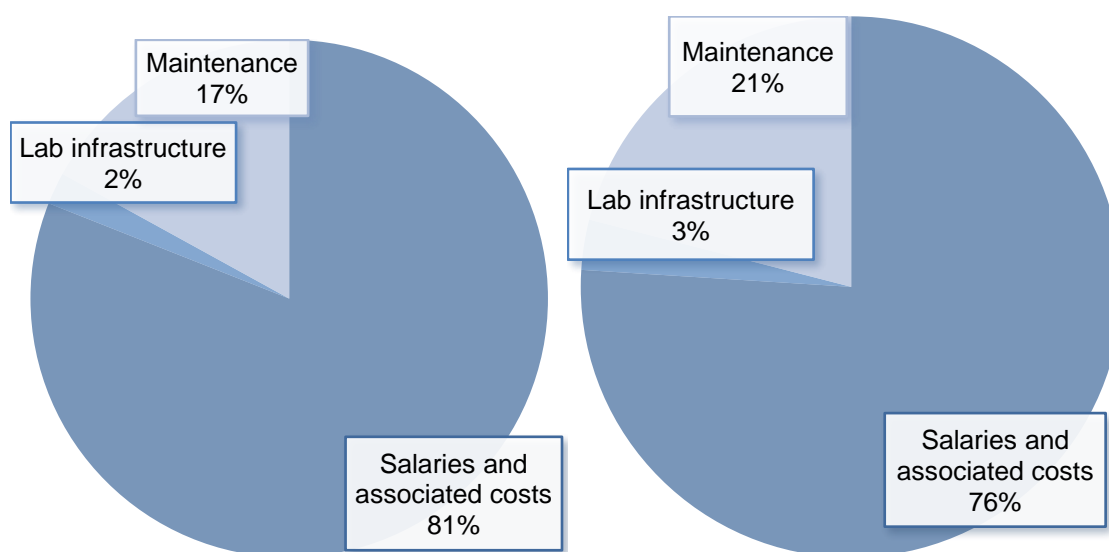


Fig. 15. Expenditure structure according to the OUP expenditure plan for 2015 (A) and 2016 (B)

The allocated budget funds are far below the expected level. For the above reason, the Central Office of Measures has already taken certain steps towards the procurement of non-budgetary funds, including from the EU structural funds. There are also plans for a successive increase of the scope of research and development activities based on the funds provided under various European research programmes. such as the EMPIR programme.

Part 64 of the state budget (Central Office of Measures) for 2017 provides for a total of 45 416 000 PLN; the budget has been prepared and subsequently modified in accordance with the conclusions of the analysis performed. The assessment of the current state of affairs demonstrated that in order for the Central Office of Measures to expand the scope of its activities and ensure the efficient implementation of its tasks so that the GUM may continue

making its contribution towards a competitive and innovative economy, the amount of the allocated funds must be increased.

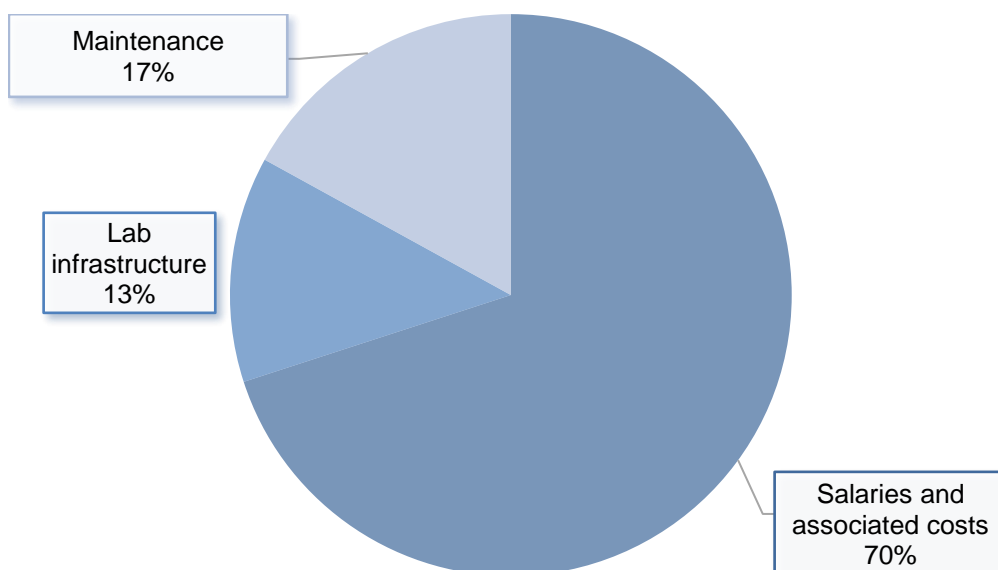


Fig. 16. Expenditure structure according to the GUM expenditure plan for 2017

The financial condition of the District Offices of Measures and District Assay Offices has improved slightly in 2017; however, changes still need to be made in order to ensure that the existing laboratories continue to expand their capabilities, including technical infrastructure. Only 3 % of the OUM budget and 5 % of the OUP budget is allocated to the operation and development of technical competences of laboratories (modernisation or establishment of measurement stands, development and enhancement of measurement methods and techniques). Salaries and associated costs continue to account for the vast majority of the funds allocated to the OUMs and OUPs, much like in the case of the Central Office of Measures.

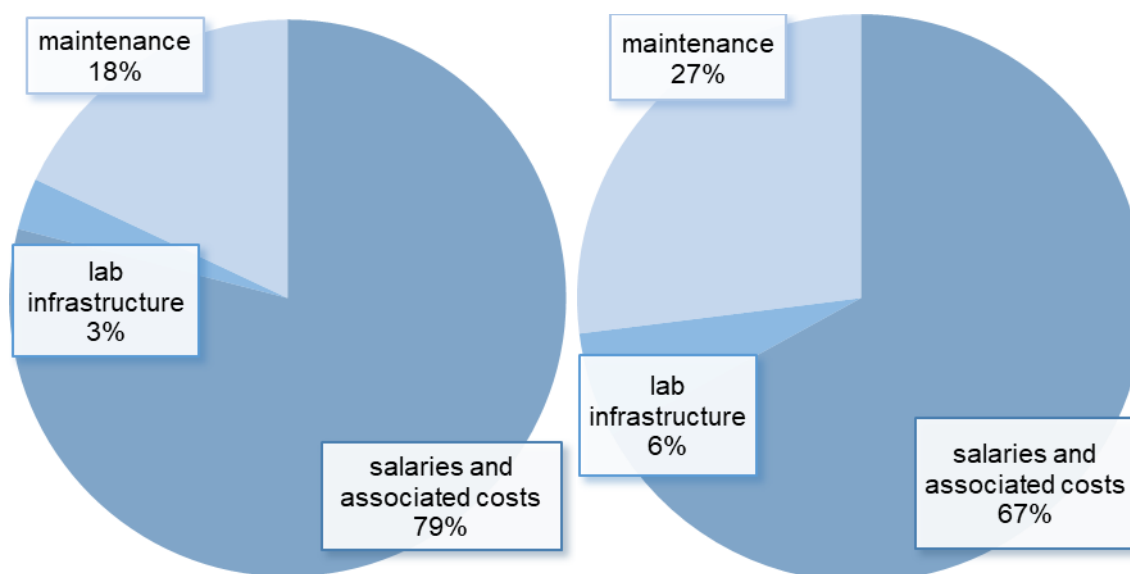


Fig. 17. Expenditure structure according to the OUM (A) and OUP (B) expenditure plan for 2017

The current strategy assumes that, due to the specialised activities performed both by the

GUM and the regional administration (based mostly on tasks performed in a laboratory environment), the optimum budget would provide for approximately 20 % of all funds to be allocated to the development of technical capabilities; a further 20 % would be allocated to ongoing maintenance, with salary costs accounting for the rest of the allocated funds.

The implementation of strategic tasks will require the level of financial expenditure to be increased. In this connection, the GUM is making efforts towards the procurement of additional budget funds as well as new sources of financing.



CONCLUSION FROM THE ANALYSIS

The analysis performed allowed an assessment to be made with respect to the condition of resources and level of activity of the GUM in areas of key importance to the functioning of a modern NMI, actively supporting sustainable economic growth and the development of state-of-the-art technologies and innovativeness of the Polish industry. These areas are as follows:

- location
- structure
- personnel
- measurement infrastructure
- domestic and international cooperation
- financing
- implementation of tasks

It has been determined that the solutions currently applied in Poland are not up to the standards expected of a contemporary NMI. The most important state body operating in the field of metrology – the Central Office of Measures – remains an NMI only in the formal sense, as a depository of the national measurement standards; however, it does not perform the function of the centre for the development of state-of-the-art technologies, unlike its foreign counterparts. This is due to the prevailing institutional limitations as well as to the nature of the GUM, which remains a typical government institution in terms of both its structure, legal form and the tasks performed. The disadvantages presented by the Polish system include the inadequacy of the institutional structure from the standpoint of the needs of both the market and the scientific community – the absence of an NMI that would be able to support the competitive economy through both research and technology transfer – as well as insufficient level of external supervision (including expert supervision) over the functioning of the existing institution, insufficient number of employees possessing the adequate academic degrees and the negligible cooperation between the measurement administration and the scientific community and state-of-the-art industry. Furthermore, the continuing lack of investment in measurement infrastructure at the laboratories maintained by the GUM in various areas of metrology, the inadequate location of the existing facilities as well as insufficient qualifications of the current staff, who also lack the necessary motivation due to lack of prospects and low prestige of the institution which they serve, will likewise have a detrimental impact on the development of the GUM and will prevent it from evolving into an institution which could serve as one of the pillars of the national economy. Innovative solutions in the field of metrology require that all the necessary resources are maintained at the requisite level.

The unfavourable image of the measurement administration resulting from its ineffective communication with the outside world as well as insufficient adjustment of service quality and

scope to the increasing needs of entrepreneurs decreases the overall prestige of the Central Office of Measures as a potential partner in the process of economic growth.

The continuing stagnancy as well as low output in terms of R&D projects or other initiatives, however, cannot always be blamed upon the Central Office of Measures as an organisation. Due to the presence of legal regulations in both domestic and EC law under which the GUM is not classified as a research unit, the Office is unable to partner in any kind of consortia with economic operators in order to implement projects within the OP Smart Growth scheme, coordinated domestically by the National Centre for Research and Development.

Nevertheless, the GUM, aware of its usefulness for both the Polish state and its citizens, continues to perform activities aimed at further development regardless of the unfavourable regulatory environment, placing emphasis on expanded cooperation with various economic operators.

Ultimately, what the GUM needs is a profound institutional and legal reform which would allow the GUM to be transformed into what we may tentatively refer to as the State Centre for Technologies and Standards – an entity with a different legal status which would be able to take advantage of improved conditions insofar as implementation of tasks related to research and development operations as well as broadly understood technology transfer to the industry are concerned. The arguments for the change in legal status of the Polish national metrological institution include, first and foremost, the fact that the formula of a public administration body remains ill-suited to the performance of the basic tasks expected of an NMI, which should be implemented in close cooperation and partnership with both businesses and scientific institutions. Neither this type of relations nor the tasks referred to above are fully compatible with the deeply ingrained nature of a public administration body. This nature remains the product of the forms of activity of such a body (which include mostly administrative decisions, as defined under the provisions of legal regulations on administrative proceedings), its constitutional standing (lack of legal personality, separate property, capacity to appear as a party in judicial proceedings or separate identity in the course of legal transactions), its staff policy (based on the regulations pertaining to the civil service) or, last but not least, the methods of financing of its operations (absence of financial autonomy, extremely limited capacity to obtain external financing such as European funds). For the above reason, it is necessary to establish an entity which, on the one hand, shall retain the status of a public body implementing government tasks and strategy and acting in the public interest (as opposed to being profit-oriented); on the other hand, however, the reformed organisation should no longer be constrained by the limits inherent in its status of a public administration body.

Based on the conclusions contained in the analysis performed, the primary development directions have been designated, allowing the vision for the organisation's future to be formulated. The areas in which specific actions need to be taken have been identified as: Standards, Technologies, Measurement Service. In addition, the primary objectives for the Four-Year Strategic Plan have likewise been specified (to be completed within the 2018-2021 timeframe).

In formulating the primary objectives and tasks, the responsible team took into account the directions for the development of the national economy as well as the trends in the development of international metrology.

DIRECTIONS FOR ECONOMIC GROWTH

The dynamic growth of the national economy, based on research, knowledge, state-of-the-art technologies, new manufacturing methods for highly specialised products and the application of advanced communication techniques poses new challenges for the science and practice of metrology.

In tackling these challenges, the GUM will focus on solving measurement problems and knowledge and technology transfer associated, among others, with the needs for attaining a higher innovation level and building a sustainable, energy-efficient economy.

Selected directions for the development of the economy to be supported by the Central Office of Measures have been listed below.

Innovations and R&D

- smart factories;
- research for innovation and development.

Sustainable, energy-efficient economy

- monitoring the environment and climate change;
- energy security.

High quality of life and safety of citizens

- healthcare;
- green economy.

SMART FACTORIES

The intelligent factories of the future will be based on self-optimising, automated systems, directly involved in the management of the manufacturing processes. These systems will also perform an assessment of the current condition of available resources and manufacturing needs, minimising both energy consumption and environmental impact.

They will make it possible to merge enterprises or processes implemented at different manufacturing facilities to form smart networks.

The efficient functioning of the system will be ensured through precise and accurate measurements, performed at the level of all constituent parts thereof.

RESEARCH FOR INNOVATION AND DEVELOPMENT

Metrology plays a pivotal role in research and development works. Accurate and precise measurements have contributed to many great scientific discoveries of the past, such as the invention of the efficient blue electroluminescent diode, the development of the method for the measurement of quantum system parameters or the discovery of the quantum Hall effect.

Metrology continues to support technological and technical progress through the development of measurement capabilities and methods for the validation of results, which are the essential prerequisites at the stage of design and modelling as well as in smart satellite monitoring and navigation systems such as the European *Copernicus* and *Galileo* programmes.

MONITORING OF CLIMATE CHANGE AND THE ENVIRONMENT

The efficient management of environmental resources and responding to climate change are fundamental prerequisites for the growth of both society and the economy. The degradation of the environment caused, *inter alia*, by urbanisation, greenhouse gas emission, intensive exploitation of natural resources as well as contamination of water and soil requires constant monitoring and applying appropriate remedies where necessary. The effective monitoring – including registration, research and analysis of climate and environmental parameters – is based on accurate, stable and precise measurements performed over time. Dedicated Earth monitoring programmes (such as the Copernicus programme implemented by the European Commission) are constantly being developed.

ENERGY SECURITY

High energy consumption, inadequate level of development of power and fuel generation and transmission infrastructure, dependency on external suppliers as well as various obligations in the field of environmental and climate protection have made it necessary to ensure that Poland's energy system becomes rationalised. This drive towards rationalisation has found expression in the state energy policy which takes the concept of sustainable development into account. Its primary objectives are as follows:

- ensuring the availability of power generation capacity which caters for the existing energy needs, taking into account the transmission capabilities of the system as well as the necessary reserves,
- reduction in harmful solid and gaseous substance emissions,
- increasing energy efficiency and quality of electricity supply

By ensuring reliable, precise measurements in the power generation, storage and transmission systems, the GUM makes a significant contribution towards the process of ensuring the energy security of the entire country.

HEALTHCARE

Demographic changes, developments in the field of medicine as well as the increased knowledge and awareness among patients are all the driving factors behind the development of the healthcare system. These issues remain the subject of interest of various scientific disciplines, including metrology. The development of new technological solutions which are being applied in personalised medical diagnostics as well as the use of such methods in practice and the implementation of innovative solutions in the field of medications and new treatment methods open up the opportunities for creating a technologically advanced metrological infrastructure capable of ensuring traceability in these areas.

GREEN ECONOMY

The civilisational development and a number of related factors, such as the rising consumption, climate change and environmental degradation as well as the rising population have made it necessary to ensure the appropriate management of the available resources and infrastructure. This would allow for the relations between economic growth and the protection of the environment (both natural and man-made) to be shaped in a rational manner, while at the same time preserving an appropriate quality of life. The sustainable development of the economy will be effectively supported by metrological infrastructure.

The maintenance of various means of transport and the related infrastructure (road, rail and

inland navigation networks, Motorways of the Sea, seaports and inland ports, airports and other interconnections between modal networks) at an appropriate level requires an increasing amount of expenditure to be made. The current global trends focus on resource-efficient transportation which is both environmentally friendly, rapid and increasingly more affordable. The application of state-of-the-art transportation technologies will allow the designated objectives to be achieved.

2. FIELDS OF ACTIVITY: STANDARDS, TECHNOLOGIES AND THE MEASUREMENT SERVICE

Within the framework of the main areas of activity, the primary objectives and actions have been determined which remain consistent with the Responsible Development Strategy and which shall be conducive to the development of various sectors of the economy, including:

- the manufacture of means of transport (e.g. e-buses, railway vehicles, special vessels);
- electronics (e.g. smart energy meters);
- specialist telecommunications and IT technologies (e.g. fintech, automated systems for machinery and buildings, cyber-security, computer games, bio-IT);
- aviation and space systems (e.g. drones, satellite components);
- manufacture of medicines, medical devices and state-of-the-art medical services (e.g. e-medicine, medical devices, therapies, biosimilar medications);
- extraction systems (e.g. smart mining), water and food quality testing systems;
- military systems.

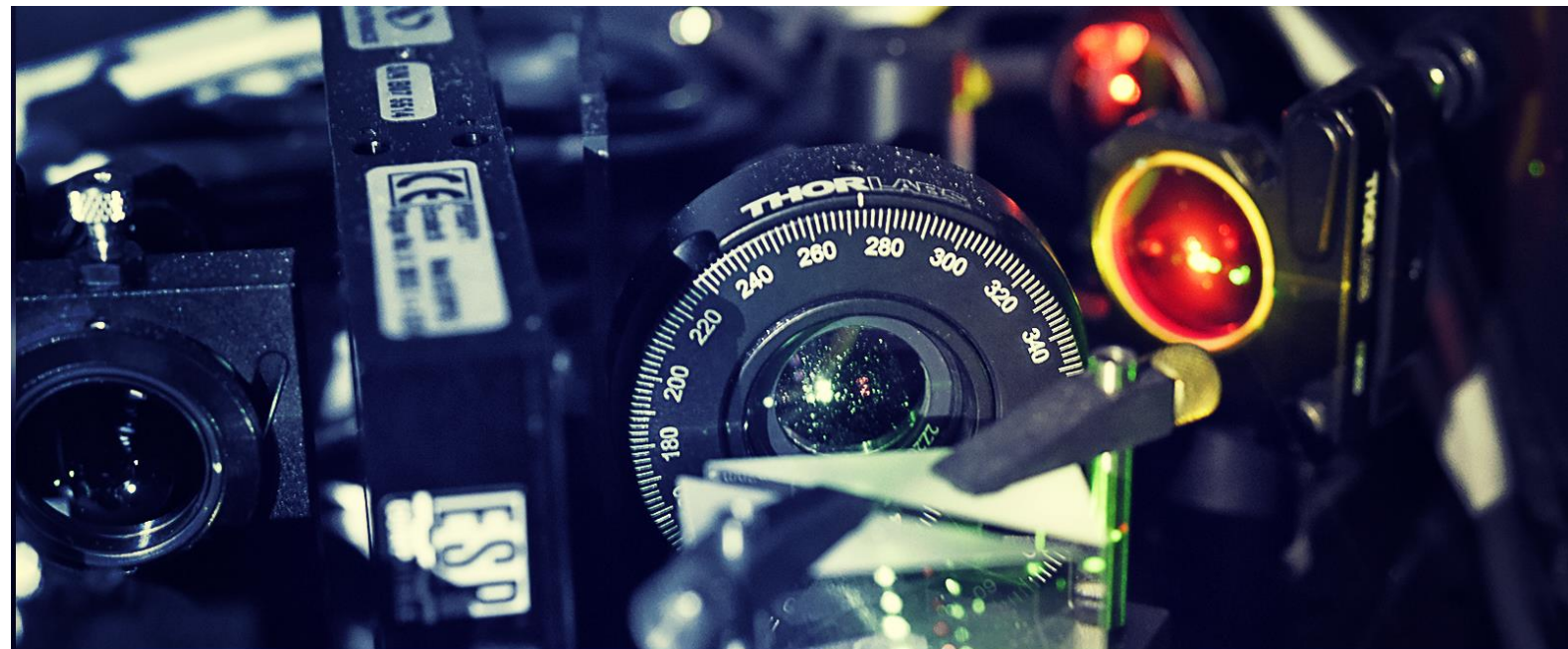


Photo no. 3 National length standard – optical frequency synthesiser



STANDARDS

Ensuring technologically advanced measurement standards traceable to the International System of Units (SI) constitutes one of the most important tasks of the Central Office of Measures. The inclusion of quantum phenomena in the definitions of measurement units will make a significant impact on progress in many fields of both technology and science, initiating the development of new and improved products and advanced industrial technologies.

The adoption by Poland of the resolution of the General Conference on Weights and Measures pertaining to the implementation of the Quantum SI scheme, whereby base unit definitions would be based on physical constants (e.g. h , N_A , e etc.) will make it possible, *inter alia*, to achieve the following objectives:

- Establishment of a technologically advanced national metrological infrastructure.
- Ensuring technical solutions corresponding to international measurement standards.
- Manufacture of high quality certified reference materials in new areas of application.
- Supporting research and technologies which take advantage of precise and accurate measurements.

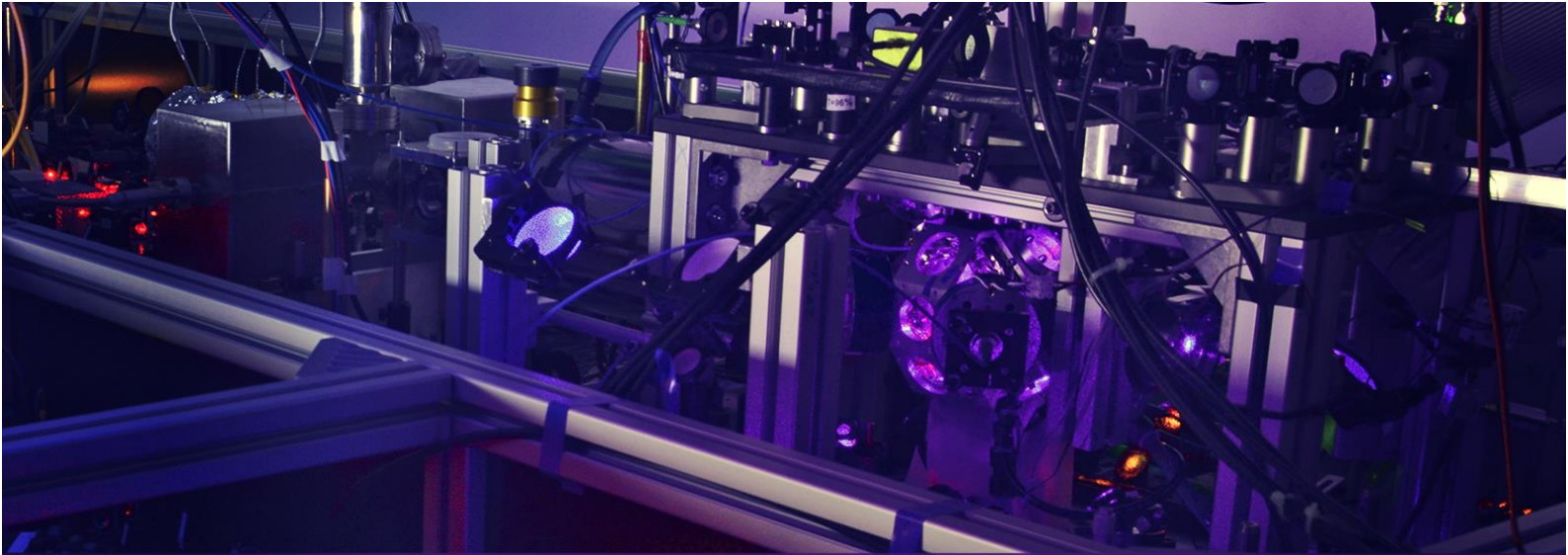
OBJECTIVES

1. Technologically advanced measurement standards which ensure the efficient functioning of the Polish economy and which satisfy the needs of society as well as ensure an appropriate quality of life.
2. Respectable status in international organisations.

SI MEASUREMENT STANDARDS AT THE GUM

MEASUREMENT UNIT	QUANTITY	MEASUREMENT STANDARD	
		2017	2021
METRE	LENGTH	Iodine-stabilised helium–neon laser and optical frequency synthesiser. Realisation of the laser radiation wave length values: $(532 \div 1064)$ nm, corresponding to the standard frequencies within the $(281 \div 563)$ THz range. Relative expanded uncertainty: $1 \cdot 10^{-11}$	Enhancement of measurement capabilities through the development of a measurement system based on an optical frequency synthesiser, used for long-distance measurement and air refractive index.
KILOGRAMME	MASS	Kilogramme prototype no. 51 in the form of a platinum-iridium cylinder with a mass of $1 \text{ kg} + 227 \cdot 10^{-9} \text{ kg}$ (1990). Combined standard uncertainty: $2,3 \cdot 10^{-9} \text{ kg}$.	Construction of an automated vacuum mass comparator with external adjustment, ensuring mass traceability.
SECOND	TIME AND FREQUENCY	A set of atomic time and frequency standards along with the associated systems for internal and external comparisons. Input signals: 1 Hz – Rectangular pulses with duration of 20 μs , 100 kHz, 1 MHz, 5 MHz, 10 MHz – sinusoid signals. Relative standard uncertainty for realisation of time and frequency units not exceeding $1,7 \cdot 10^{-14}$ for averaging time of 5 days	Addition of active hydrogen maser with resonant cavity autotuning as well as primary frequency standard (cesium fountain) into the national measurement standard system will significantly improve the level of standard uncertainty for the realisation of time and frequency units, making it possible to attain the value of approximately $0,5 \cdot 10^{-14}$ for averaging time of 5 days. The UTC(PL) time scale stability will improve significantly, making it possible to maintain the scale at the level of ± 10 ns towards the UTC time scale.
AMPERE	ELECTRICITY	Resistance: Measurement system based on the quantum Hall effect Nominal resistance value: 12 906.4035 Ω and 6453.20175 Ω Relative expanded uncertainty for measurement unit realisation: $\geq 6,8 \times 10^{-10}$ Direct current: Measurement system consisting of a primary standard based on the Josephson effect, equipped with connector with a rated voltage of 10 V. Relative expanded uncertainty for measurement unit realisation: $5 \cdot 10^{-9}$.	Continuation of works related to the new definition of electric current unit – installation of a new measurement stand.

MEASUREMENT UNIT	QUANTITY	MEASUREMENT STANDARD	
		2017	2021
KELVIN	THERMODYNAMIC TEMPERATURE	Temperature standard with range between $-189.3442\text{ }^{\circ}\text{C}$ and $961.78\text{ }^{\circ}\text{C}$. The standard consists of a set of temperature fixed point cells ensuring a specific state of thermodynamic balance as well as platinum resistance sensors used as interpolation instruments. Expanded uncertainty for the determination of temperature depending on the fixed point substance is between $0.00011\text{ }^{\circ}\text{C}$ and $0.0046\text{ }^{\circ}\text{C}$.	Extension of the measurement scope of the standard through the addition of the current reference standard, allowing the national standard to encompass values between $-189.3442\text{ }^{\circ}\text{C}$ and $1084.62\text{ }^{\circ}\text{C}$.
MOLE	AMOUNT OF SUBSTANCE	The standard is intended for the realisation of values within the following scope: from 0.001 mol to 0.01 mol (solid substances), between 0.0001 mol to 0.01 mol (liquid substances). Expanded uncertainty between 0.01% and 0.05% .	Development of procedures for the manufacture and calibration of primary reference materials forming a realisation of the measurement unit for amount of substance (acidimetric, oxidimetric, reductometric and complexometric standards).
CANDELA	LUMINOUS INTENSITY	Group of five photometric incandescent lamps with 100 V nominal voltage and 200 W power Expanded relative uncertainty: 0.011 .	Modernisation of the measurement standard stand through the enhancement of the setting precision for standard and measurement head lamps and ensuring precise readouts on photometric bench with the length of 4 m and uncertainty not exceeding 1 mm .



TECHNOLOGIES

Photo no. 4 Optical clock

Using its technically advanced metrological infrastructure, the Central Office of Measures will actively support the development of new technologies, based on accurate and precise measurements. By cooperating with domestic economic operators as well as with science and research institutions, inter alia within the framework of Consultative Metrological Teams (CMTs), the GUM will participate in problem solving efforts in the field of metrology, both at the design and manufacturing stage and at the finished product stage, including its parametrisation. These activities, designed to satisfy the needs of partners in the industrial sector, will be performed through knowledge transfer (including know-how in the field of metrology) from the GUM and higher educational institutions into the economy.

By modernising the existing measurement stands and developing new ones, the Central Office of Measures will also be able to expand the scope of its offer. Furthermore, the application of IT tools in the customer service process will increase the efficiency of order realization.

Technical and technological progress presents unlimited opportunities for new applications of measurements; for this reason, the GUM will continue developing new, innovative solutions, including in the following areas:

- design and manufacture of nanomaterials,
- application of smart calibration methods for integrated network components,
- design of machinery and devices with embedded measurement functions.

OBJECTIVES

3. In-depth cooperation as well as knowledge and technology transfer arising from the increasing needs of the Polish industry and society.
4. Extensive offer and high service quality
5. A competent, growth-oriented and well-motivated personnel, prepared for the implementation of tasks for the benefit of an innovative, competitive economy.



MEASUREMENT SERVICE

A business-friendly regulatory environment within the scope of measures and assay will have a significant impact on the competitiveness of the Polish industry, the economic and technical security of the state as well as the protection of the interest of its citizens. This objective will be achieved through the implementation of the following measures:

- Introduction of simpler legal regulations.
- Application of an effective control system with respect to measuring instruments and packaged goods.
- Implementation of an effective system for the testing of software and metrological data in cash registers and measuring instruments.
- Reform of the measurement administration structure.

OBJECTIVES

6. A well-organised network of specialised branch offices, equipped with the technical facilities and personnel capable of meeting their designated objectives.
7. Consistent market regulations conducive towards the development of domestic industry and business
8. An efficient system for the protection of economic and technical security of the state as well as the interests of citizens

3. VISION, MISSION AND MAIN OBJECTIVES

The vision was formulated by the GUM management and employees. In the course of formulating the vision for the organisation, the suggestions, conclusions and opinions of the

representatives of the industry and the science community developed in the course of the activities of the Consultative Metrological Teams and Consultative Assay Teams were all taken into account. Global trends in the development of metrology included in the strategic documents prepared by global metrological organisations were also taken under considerations; the documents in question included those released by the EURAMET (Strategy 2020, Strategic Research Agenda for metrology in Europe (2016)) as well as the documents developed by selected national metrological institutions (NMIs) such as the NPL, NSAI, PTB and NIST.

When formulating the vision of the GUM, the following factors were taken into account:

- the assessment of the condition of technical infrastructure in the individual fields of metrology as well as the possibilities for the further development thereof;
- the so-called road maps, developed within the framework of the activities of the Technical Committees of the EURAMET, indicating the directions for the development of European metrology;
- the assessment of the needs and expectations of the GUM stakeholders with regard to the opportunities for the inception and development of new measurement capabilities.

A number of factors having an impact on the development of metrology were also taken into account, including:

- the implementation of the definitions for the basic measurement units of the International System of Units (SI) based on quantum effects;
- the development of state-of-the-art computation and simulation techniques as well as methodologies for the analysis of large quantities of variables and different datasets (the so-called big data).
- technological progress;
- the increasing needs and expectations of stakeholders with respect to the implementation of new services, including services available on-line.

VISION		
<p>The Central Office of Measures will become a public institution characterised by exemplary organisational structure, highly valued and appreciated by Polish citizens, while at the same time attaining the status of a reliable and credible partner for both businesses and other public institutions.</p> <p>The GUM will take on the role of a national leader of technological progress and innovation in the field of metrology, dynamically striving towards the achievement of the status of one of the leading NMIs both in Europe and worldwide.</p>		
MISSION		
<p>The mission of the GUM in its capacity of the national metrological institution, combining many years of experience and a high level of competences with a modern approach to the science of measurement, is to ensure the requisite measurement capacities which meet the needs of the economic and technical security of the state while at the same time remaining conducive towards the protection of the environment, health and quality of life of Polish citizens.</p>		
STANDARDS	TECHNOLOGIES	MEASUREMENT

		SERVICE
<p>OBJECTIVE 1</p> <p>Technologically advanced measurement standards ensuring the efficient functioning of the Polish economy, satisfying the needs of society and ensuring an appropriate quality of life.</p>	<p>OBJECTIVE 3</p> <p>In-depth cooperation as well as knowledge and technology transfer arising from the increasing needs of the Polish industry and society.</p>	<p>OBJECTIVE 6</p> <p>A well-organised network of specialised branch offices, equipped with the technical facilities and personnel capable of meeting their designated objectives.</p>
<p>OBJECTIVE 2</p> <p>Respectable status in international organisations.</p>	<p>OBJECTIVE 4</p> <p>Extensive offer and high service quality.</p>	<p>OBJECTIVE 7</p> <p>Consistent market regulations conducive towards the development of domestic industry and business</p>
	<p>OBJECTIVE 5</p> <p>A competent, growth-oriented and well-motivated personnel, prepared for the implementation of tasks for the benefit of an innovative, competitive economy.</p>	<p>OBJECTIVE 8</p> <p>An efficient system for the protection of economic and technical security of the state as well as the interests of citizens.</p>
<p>100 YEARS OF EXPERIENCE AND HIGH LEVEL OF COMPETENCE IN THE FIELD OF MEASUREMENTS</p>		

4. Main OBJECTIVES – MEASURES



OBJECTIVE 1

Technologically advanced measurement standards ensuring the efficient functioning of the Polish economy, satisfying the needs of society and ensuring an appropriate quality of life.

Expected effect upon reaching objective:

Acting on the basis of state-of-the-art technologies, the Central Office of Measures will enhance the metrological characteristics of its current measurement standards and develop new standards in response to the needs of the industry. It will also take actions associated with the construction of a state-of-the-art specialist campus, and technologically advanced research and measurement laboratories.

Indicators	Measurement unit	Baseline value	Target value for 2021	Central Office of Measures (GUM)	OUM/OUP
1. Measurement standards with the highest metrological parameters in the country	Number	56 (2017)	no less than 64	√	–
2. New and modernised measurement stands developed according to existing needs	Percentage	30 (2016)	no less than 60	√	–
3. State of financial involvement in the construction of the technologically advanced laboratory campus	Percentage	0 (2016)	50	√	–

OBJECTIVE 2

Respectable status in international organisations.

Expected effect upon reaching objective:

Increased prestige of the GUM in the international arena. Increased influence on international policies in the field of metrology and access to unique knowledge base.

Indicators	Measurement unit	Baseline value	Target value for 2021	Central Office of Measures (GUM)	OUM/OUP
1. GUM representatives in the CIPM Consultative Committees	Number	4 (2016)	no less than 6	√	–
2. Posts held in working bodies of metrological organisations	Number	3 (2016)	no less than 6	√	–
3. International research projects implemented with the GUM's participation	Number	7 (2014-2016)	no less than 13	√	–



TECHNOLOGIES

OBJECTIVE 3

In-depth cooperation as well as knowledge and technology transfer arising from the increasing needs of the Polish industry and society.

Expected effect upon reaching objective:

Intensification of the research and development activities as well as initiation of projects aimed at developing new inventions in order to meet the needs of the national economy. Increasing the level of knowledge dissemination.

Indicators	Measurement unit	Baseline value	Target value for 2021	Central Office of Measures (GUM)	OUM/OUP
1. R&D works	Number	157 (2010-2015)	no less than 245	√	–
2. Publications	Number	8 (2005-2017)	no less than 18	√	–
3. Offer in the field of training and other forms of knowledge dissemination	Number	261 (2014-2016)	no less than 348	√	√
4. Publications written by GUM employees	Number	10 (2016)	no less than 30, including no less than 4 indexed publications	√	–

OBJECTIVE 4

Extensive offer and high metrological service quality.

Expected effect upon reaching objective:

Extended scope of metrological services in response to customer needs. Optimisation of the service process, enhancing customer communication.

Indicators	Measurement unit	Baseline value	Target value for 2021	Central Office of Measures	OUM/OUP
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				ures (GUM)	
1. Introduction of new metrological services in response to customer needs (CMTs)	Percentage	0* (2016)	no less than 70	√	√
2. Share of top marks in customer experience surveys	Percentage	70 (2016)	no less than 80	√	√

* base value of 0% due to the commencement of operations by CMTs in 2016

OBJECTIVE 5

A competent, growth-oriented and well-motivated personnel, prepared for the implementation of tasks for the benefit of an innovative, competitive economy.

Expected effect upon reaching objective:

Ensuring the presence of highly qualified staff tasked with the performance of R&D works (number of personnel according to existing needs) GUM to become an employee-friendly company.

Indicators	Unit	Baseline value	Target value for 2021	Central Office of Measures (GUM)	OUM/OUP
1 Share of holders of scientific degrees in total number of personnel	Percentage	8 (2016)	no less than 12	√	–
2 Internships for GUM employees in international institutions	Number	0 (2016)	no less than 4	√	–
3 Share of persons engaging in continuing education in relation to the total number of employees	Percentage	0.9 (2016)	no less than 5	√	√



MEASUREMENT SERVICE

OBJECTIVE 6

A well-organised network of specialised branch offices, equipped with the technical facilities and personnel capable of meeting their designated objectives.

Expected effect upon reaching objective:

Increase in the availability of services and expansion of the scope of services offered.
Increasing the efficiency of operations of regional administration units.

Indicators	Unit	Baseline value	Target value for 2021	Central Office of Measures (GUM)	OUM/OUP
1. Modernised measurement stands for research and calibration, as dictated by existing needs	Percentage	50 (2016)	no less than 70		√
2. Unification of the procedure for metrological activities	Percentage	0 (2016)	no less than 90	√	√

OBJECTIVE 7

Consistent market regulations conducive towards the development of domestic industry and business

Expected effect upon reaching objective:

A business-friendly regulatory environment in the field of measures and assay

Indicators	Measurement unit	Baseline value	Target value for 2021	Central Office of Measures (GUM)	OUM/OUP
1 Effective notification of streamlined legal regulations in the field of measures and assay (enacted amendments to existing legal regulations)	Number	10 (2014-2016)	no less than 22	√	
2 Average time of processing of applications for type approval, compliance assessment with respect to measuring instruments.	Days	103 (2014-2016)	shorter by at least 30%	√	√
3 Average time of processing of applications for cash register assessment.	Days	239 (2014-2016)	shorter by at least 30%	√	

OBJECTIVE 8

An efficient system for the protection of economic and technical security of the state as well as the interests of citizens.

Expected effect upon reaching objective:

An effective and efficient measurement administration, supported by state-of-the-art IT tools.
An effective nationwide system for control and supervision, implemented on the basis of a documented risk assessment.

Indicators	Unit	Baseline value	Target value for 2021	Central Office of Measures (GUM)	OUM/OUNP
1. Effective implementation of follow-up recommendations.	Percentage	0 (2016)	no less than 95%		√
2. Audits in areas characterised by elevated risk	Percentage	0 (2016)	no less than 90%		√
3. Implementation of IT systems supporting the process of compliance assessment and regulatory metrological control of measuring instruments	Yes/No	No (2016)	Yes	√	√

* base value of 0% due to the fact that this type of data was not being collected in previous years.

5.IDENTIFIED RISK FACTORS

Item no.	Name of objective	Name of risk factor	Risk factors	Mitigation actions
1.	OBJECTIVE 1 Technologically advanced measurement standards ensuring the efficient functioning of the Polish economy, satisfying the needs of society and ensuring an appropriate quality of life.	Failure to satisfy the needs of the industry in the field of new or improved measurement standards	<ol style="list-style-type: none"> 1. Insufficient funding 2. Ineffective communication with stakeholders 	<ol style="list-style-type: none"> 1. Lobbying for project implementation 2. Taking effective advantage of the cooperation within the framework of Consultative Metrological Teams 3. Procurement of non-budget financing
2.		Lack of qualified, competent personnel	<ol style="list-style-type: none"> 1. Inexperienced personnel (departure of experienced, qualified employees from the institution) 2. Unattractive employment prospects (workplace, remuneration, non-wage aspects of work performed) 	Ensuring attractive work conditions, developing a system for knowledge transfer to new employees.
3.		Inexpedient expenditure of funds allocated for the construction and commissioning of the science campus	<ol style="list-style-type: none"> 1. Insufficient funding 2. Underestimated project budget 3. Technical errors in the project documentation 4. Actions of groups inimical to the concept of the Central Office of Measures as a state-of-the-art institution tasked with the performance of research in the field of metrology 5. Government policies 	<ol style="list-style-type: none"> 1. Lobbying for the allocation of additional funding 2. Having the budget verified by an independent auditing firm 3. Technical assessment of the project documentation to be confirmed prior to the commencement of the construction process; monitoring of project implementation

Item no.	Name of objective	Name of risk factor	Risk factors	Mitigation actions
			6. Non-availability of competent personnel on the local labour market	<p>process</p> <p>4. Lobbying for the project in government circles and in the scientific community</p> <p>5. Enhancing the positive image of the Central Office of Measures</p> <p>6. Effective cooperation with the academic community in the field of scientific research, development of measurement infrastructure as well as professional development of the scientific personnel of the GUM</p> <p>7. Liaising with the international scientific community through participation in conferences and releasing publications in JCR periodicals</p>
4.	OBJECTIVE 2 Respectable status in international organisations	The GUM will not be capable of attaining the desired elevated status in the international arena	<p>1. Incompetent and scientifically inadequate metrological staff</p> <p>2. Insufficient funding</p> <p>3. Conflict of interest in international organisations</p>	<p>1. Staff enrolment policy conducive towards the professional development of meteorological staff</p> <p>2. Ensuring the availability of the necessary funding</p> <p>3. Intensification of activity in international organisations</p>
5.	OBJECTIVE 3	Operating profile of	1. Incompetent staff	1. Staff enrolment

Item no.	Name of objective	Name of risk factor	Risk factors	Mitigation actions
	In-depth cooperation as well as knowledge and technology transfer arising from the increasing needs of the Polish industry and society.	the GUM inconsistent with adopted development strategy	<ol style="list-style-type: none"> 2. Insufficient funding for research 3. Ineffective international cooperation 4. Inadequate knowledge of the needs of stakeholders 	<p>policy conducive towards the professional development of meteorological staff</p> <ol style="list-style-type: none"> 2. Lobbying for additional funding 3. Expanding the scope of activities of the GUM in international projects/initiatives (e.g. bilateral initiatives at laboratory level) 4. Effective communication, e.g. within the framework of market testing or the activities of Consultative Metrological Teams.
6.	OBJECTIVE 4 Extensive offer and high service quality	Inflexible offer incapable of satisfying the needs of stakeholders	<ol style="list-style-type: none"> 1. Competitive offer of foreign NMIs 2. Lack of interest in new services on the market; unfavourable location of laboratory facilities 3. Bottlenecks in customer communication 4. Inadequate legal regulations/lack of secondary legislation for the purposes of performance of activities/services in the field of metrology 	<ol style="list-style-type: none"> 1. Market research (appropriate survey) 2. Effective promotion of services offered by the GUM, competitive offer (price, time of implementation) 3. Specialist operations of regional measurement administration to be moved to new locations 4. Implementation of an electronic customer communication platform ("e-administration"). 5. Lobbying for the introduction of the appropriate legal

Item no.	Name of objective	Name of risk factor	Risk factors	Mitigation actions
				regulations.
7.	<p>OBJECTIVE 5 A competent, growth-oriented and well-motivated personnel, prepared for the implementation of tasks for the benefit of an innovative, competitive economy.</p>	The GUM will not be able to perform tasks for the benefit of the economy at the expected level without a competent metrological staff.	<ol style="list-style-type: none"> 1. Lack of appropriate competences 2. Unattractive employment prospects 3. Low unemployment level, regional policies of the government 	<ol style="list-style-type: none"> 1. Staff enrolment policy conducive towards the professional development of meteorological staff, internships at foreign NMI and other organisations 2. Ensuring that the Office is perceived as a prestigious institution
8.	<p>OBJECTIVE 6 A well-organised network of specialised branch offices, equipped with the technical facilities and personnel capable of meeting their designated objectives.</p>	Inadequacy of the service offer vis-à-vis the needs of the regions in which individual branch offices operate.	<ol style="list-style-type: none"> 1. Absence of specialist personnel on the local labour market 2. Technical infrastructure failing to meet stakeholder needs 3. Inefficacy of expenditure in relation to the results obtained in the course of implementation of new services 4. Insufficient funding 	<ol style="list-style-type: none"> 1. Regional educational policy for the purposes of metrology 2. Specialist operations of regional measurement administration units 3. Profit and loss account supported by in-depth analysis 4. Lobbying for additional funding for the development of regional measurement and assay administration 5. Promotional efforts aimed at increasing regional awareness of the services rendered.
9.	<p>OBJECTIVE 7 Consistent market regulations conducive towards the development of domestic industry and business</p>	Stakeholders no longer taking advantage of services rendered by the GUM.	<ol style="list-style-type: none"> 1. Protracted legislative process 2. Absence of secondary legislation 3. Government policy in the field of regulations 	<ol style="list-style-type: none"> 1. Lobbying to expedite the legislative process.

Item no.	Name of objective	Name of risk factor	Risk factors	Mitigation actions
			<p>pertaining to measures and assay</p> <p>4. Absence of the decision of the competent minister, resulting in the non-availability of sufficient funding for the establishment of technical facilities making it possible to ensure compliance with the current legal regulations.</p>	
10.	<p>OBJECTIVE 8 An efficient system for the protection of economic and technical security of the state as well as the interests of citizens</p>	<p>Measuring instruments, packaged goods and services currently on the market are not compliant with the technical requirements imposed under the provisions of the Law on Measures and other applicable laws. Entities and companies conduct their business in a manner inconsistent with the authorisations granted, resulting in the occurrence of all manner of irregularities within the economy. This, in turn, will result in losses for the state budget.</p>	<p>1. Lack of sufficient resources to exercise effective supervision and control</p> <p>2. Negative attitude of various groups towards the GUM as the controlling and supervising entity</p> <p>3. Absence of modern IT tools supporting the control and supervision system</p>	<p>1. Implementation of a staff policy encompassing an efficient recruitment system</p> <p>2. Introduction of government policies supporting an effective control system</p> <p>3. Increasing the prestige of the Office in its capacity of the controlling and supervising entity</p> <p>4. Full implementation of an IT system ensuring the effective performance of control and supervisory activities of the measurement and assay administration</p>

The risk factors indicated above result from financial, HR, legal and infrastructural factors. Despite the fact that the GUM does not have a direct influence on all of the risk factors specified above, it will continue to make efforts within the next few years which shall be aimed at an effective and efficient management of the risks identified for each individual objective

(see table above).

6. STRATEGY BUDGETING

The main source of financing for the implementation of the strategy shall be funds obtained from the state budget (part 64). Much like in the case of other domestic metrological institutions, state grants form the fundamental part of the budget of the Central Office of Measures.

Furthermore, the GUM also obtains – and will continue to obtain – funding for the implementation of various research programmes in the field of metrology within the framework of European research schemes such as EMPIR (European Metrology Programme for Innovation and Research), coordinated by the EURAMET.

Actions will also be taken in order to prospect for new sources of funding (EU funds and funds from the National Centre for Research and Development) intended to cover the development of the GUM, including the construction of a state-of-the-art laboratory campus consisting of various technologically advanced research and measurement laboratory facilities. It is assumed that the project will be implemented within approximately seven years, with the cost of construction and installation of laboratory facilities amounting to approximately PLN 300 million.

The implementation of the strategy requires a new “development budget” to be prepared, featuring an increased share of expenses related to the extension of measurement capabilities and improvement of the quality of human capital of the GUM.

At the present stage, the total amount of the development budget of the GUM is tentatively estimated at approximately PLN 850 million within a four-year perspective; this tentative estimate includes the cost of construction of the technological campus during the first four years of the project (approximately PLN 150 million).

The contemplated amount of funding presented in the table may be subject to change in the light of actual opportunities in terms of budget funding which may be available at the given time.

Source of financing	Base year 2017	Year 2018	Year 2019	Year 2020	Year 2021	Years 2018–2021 (total)
PLN						
State budget (part 64)	144,257,000.00	165,111,000.00	165,111,000.00	170,111,000.00	170,111,000.00	670,444,000.00
Public domestic funds	*)	*)	*)	*)	*)	*)
European Structural Funds	0.00	15,000,000.00	30,000,000.00	45,000,000.00	60,000,000.00	150,000,000.00
Other (EMPIR)	306,180.00	1,247,887.81	1,114,543.52	1,151,184.14		3,513,615.47
Public funds (TOTAL)	144,563,180.00	181,358,887.81	196,225,543.52	216,262,184.14	230,111,000.00	823,957,615.47

*) – amount of financing to be determined in the course of implementation of the strategic plan.

7. IMPLEMENTATION AND MONITORING OF THE STRATEGY

MONITORING

The Four-Year Strategic Action Plan of the Central Office of Measures (GUM) shall be implemented by means of annual operational plans prepared for both the GUM and local administration units.

The annual action plans shall include detailed objectives and associated actions conducive towards the implementation of the primary objectives of the Strategy.

The implementation of the plans will be centrally coordinated and systematically analysed and verified in annual reports.

The Metrology Council will play a crucial role in the process of monitoring the progress made in the course of implementation of the Strategic Plan; the main tasks of the Council shall include expressing opinions as to the contents of the annual plans of the GUM as well as of the reports on the implementation thereof.

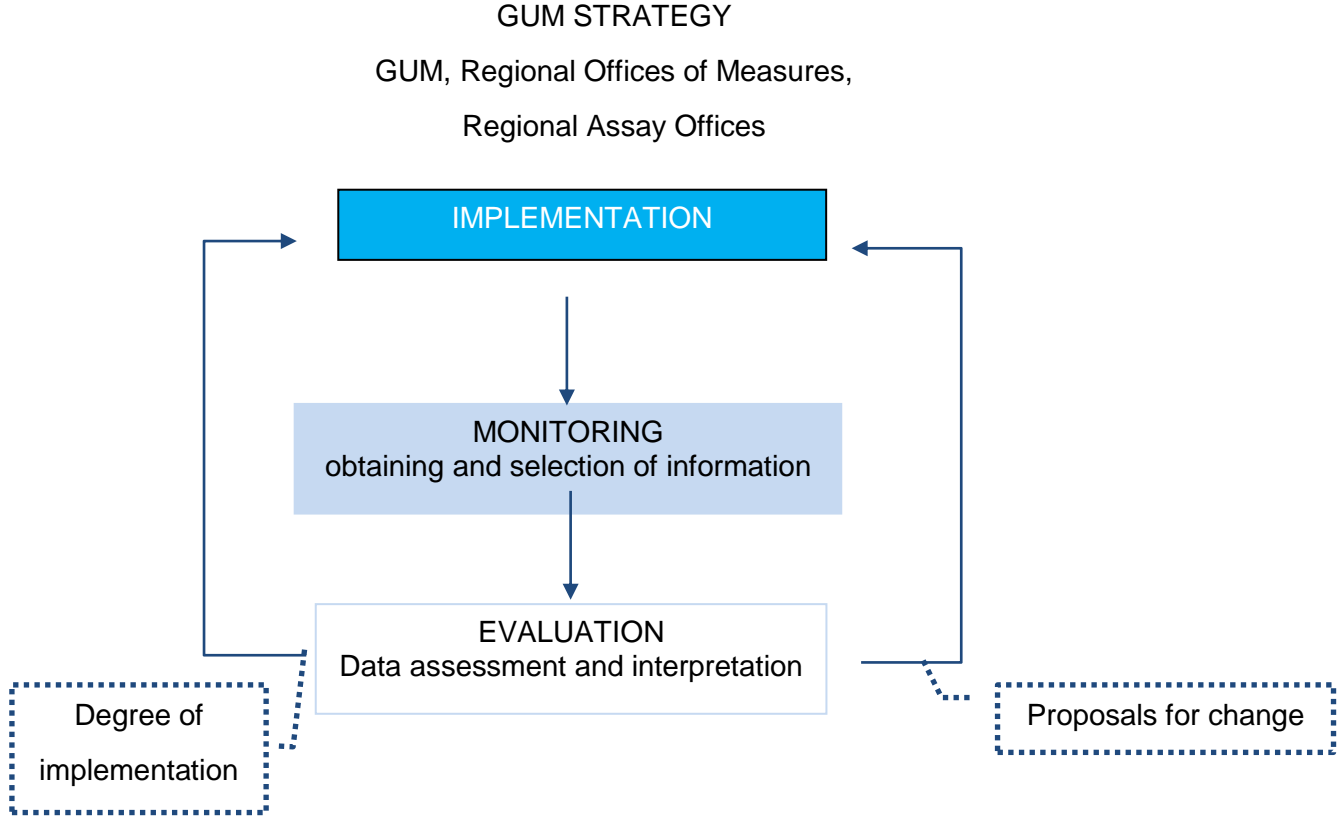


Fig. 18. GUM strategy

The report on the implementation of the Strategic Plan shall be prepared on an annual basis, by the end of March each year which follows immediately after the monitored period.

Based on the reports and opinions expressed by the Metrology Council, the President of the Central Office of Measures shall take actions intended to introduce the necessary updates to the Strategic Plan.

EFFECTS OF THE IMPLEMENTATION OF THE STRATEGIC ACTION PLAN

The implementation of the Plan will lead to the increase of the GUM's potential as well as to the intensification of relations between the GUM and various entrepreneurs and the scientific community.

The following objectives shall be achieved as a result:

- Improving the position of the Central Office of Measures within the national measurement infrastructure by providing users with new resources and measurement capabilities.



Increasing the involvement of the GUM in the process of building relations with the industry with the aim of ensuring the growth of the national economy.

- Transforming the GUM into a state-of-the-art institution operating from a new, specialised technological campus comprising various advanced research and measurement laboratory facilities, ensuring appropriate conditions for precise measurements.
- Increasing the quality of human capital, which affects the possibility of achievement of strategic goals in all areas of functioning of the institution. The GUM shall determine and implement a new HR management policy, based on various international programmes and internships aimed at ensuring that the personnel of the GUM acquires new abilities and that the overall quality of the available human capital is increased.
- Expanding the scope of activities, mostly with respect to the operations of the Consultative Committees of the International Committee for Weights and Measures (CIPM). At the present stage, Poland has representation as a member of four committees: the CCAUV – in the field of acoustics, ultrasounds and vibrations, the CCM – in the field of mass and related quantities, the CCRI – in the field of ionising radiation, the CCTG – in the field of time and frequency and the CCQM – in the field of metrology in biology and chemistry (in the capacity of an observer only). Our long-term vision is to obtain membership of all ten CIPM Consultative Committees.

Years	Acoustics, Ultrasounds and vibrations,	Electricity and magnetism	Length	Mass and Related Quantities	Photometry and radiometry	Amount of Substance – Metrology in Chemistry	Ionising Radiation	Temperature	Time and Frequency	Units
	CCAUV	CCEM	CCL	CCM	CCPR	CCQM	CCRI	CCT	CCTF	CCU
2017	√			√		(observer)	√		√	
2021	√	√	√	√	√	√	√	√	√	√

- Expanding the scope of cooperation with foreign NMIs through the participation in joint internships or research projects in the field of metrology or comparisons.
- Focusing the implementation of services on providing client support by providing

sources of traceability and solving technical problems with respect to measurements performed in difficult environmental conditions using the appropriate know-how methodology.

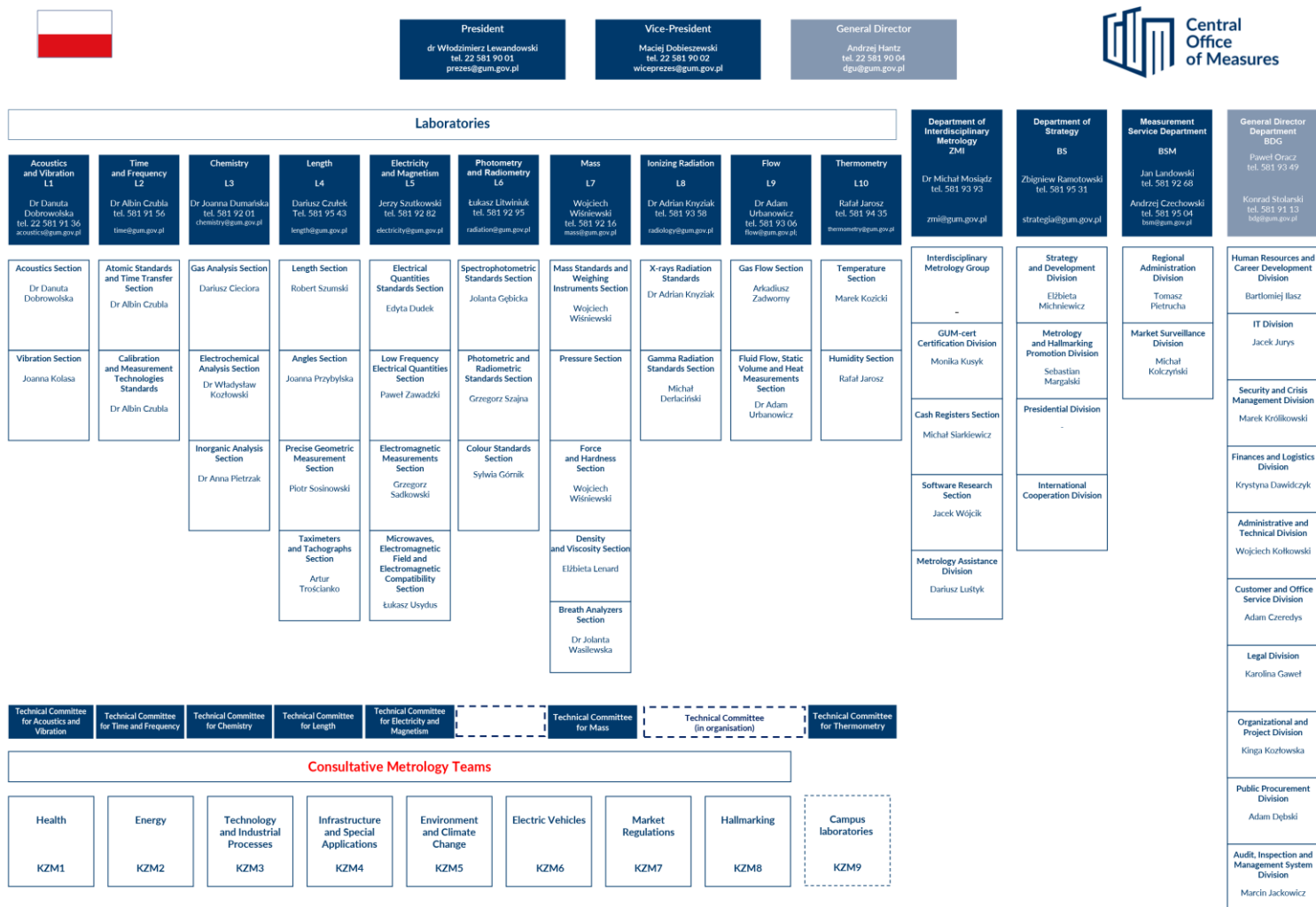
- Expanding the scope of certification and streamlining the process of research operations performed within the framework of compliance assessment.
- Rationalisation of the structure and functioning of regional measurement administration. The method of streamlining the operations of regional administration will be based on the concept of specialisation of Regional Offices of Measures (OUMs), which shall involve the development of the potential in the field of specific technical competences of the laboratories operated by the regional units in question. In addition, the implementation of an electronic customer communication platform (“e-administration”) is also planned.
- Using the potential of the Central Office of Measures for the benefit of Polish science and industry through active participation in joint research projects, including those involving technologically advanced, complex measurement systems.
- Increasing the number of publications in technical and scientific periodicals.
- Increasing the scope of science and research activities of the GUM, including in various European research projects such as the EMPIR. Continuing participation in initiatives of this kind presents the opportunity for expanding knowledge in the field of metrology and exchanging experiences with partners from other European NMIs by becoming acquainted with their laboratory facilities as well as measurement techniques and methods which they apply. Participation in the EMPIR programme will make it possible to acquire knowledge and experience in the field of research project management as well as to develop the research potential of the GUM itself.
- Introduction of changes in market regulations within the scope of metrology and assay which shall be conducive towards the development of domestic business and industry.
- Enhancement of the system for the protection of economic and technical security of the state as well as the interests of citizens through effective control.



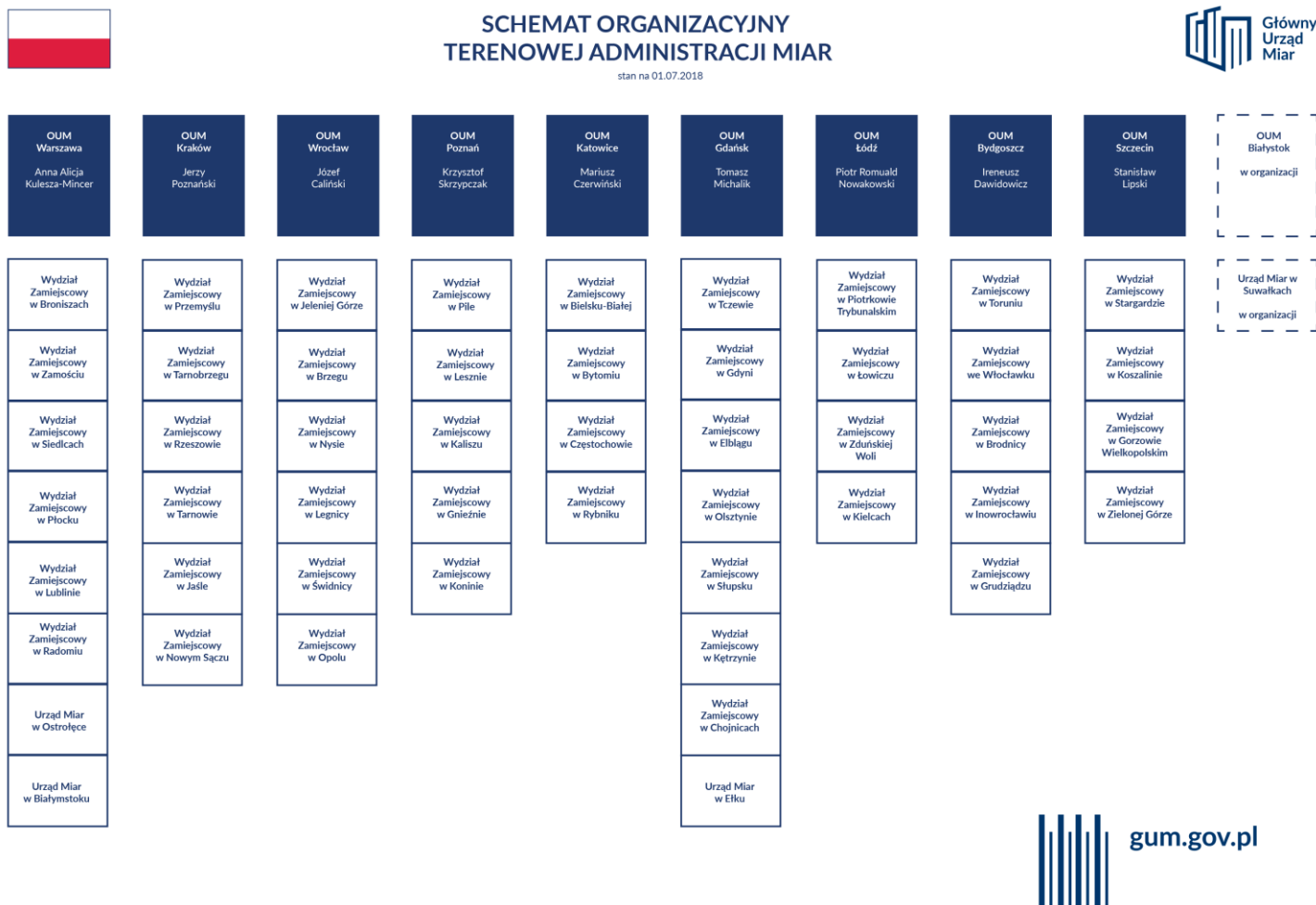
The objectives and actions specified under the present Strategy are designed to meet the challenges of contemporary metrology as well as the growing needs of the competitive, innovative economy and society. At the same time, they remain consistent with the Responsible Development Strategy (2017) and remain fine-tuned to the needs of the national economy.

Appendix no. 1 ORGANISATIONAL STRUCTURE OF THE GUM

GUM ORGANISATION CHART



Appendix no. 2 ORGANISATIONAL STRUCTURE OF REGIONAL MEASUREMENT ADMINISTRATION

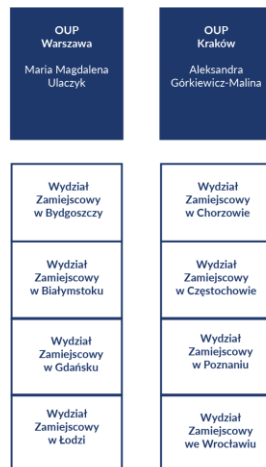


Appendix no. 3 ORGANISATIONAL STRUCTURE OF REGIONAL ASSAY ADMINISTRATION



SCHEMAT ORGANIZACYJNY TERENOWEJ ADMINISTRACJI PROBIERCZEJ

stan na 27.02.2018



Appendix no. 4: CONSULTATIVE TEAMS



STRUKTURA KONSULTACYJNYCH ZESPOŁÓW METROLOGICZNYCH

Zespół ds. Zdrowia	Zespół ds. Energii	Zespół ds. Technologii i Procesów Przemysłowych	Zespół ds. Infrastruktury i Zastosowań Specjalnych	Zespół ds. Środowiska i Zmian Klimatycznych	Zespół ds. Pojazdów o napędzie elektrycznym	Zespół ds. Regulacji Rynku	Zespół ds. Regulacji Rynku	Zespół ds. Kampusu Laboratoryjnego
KZM1	KZM2	KZM3	KZM4	KZM5	KZM6	KZM7	KZM8	KZM9
Łukasz Litwiński	Jerzy Szutkowski	Wojciech Wiśniewski	Dariusz Czulek	Rafał Jarosz		Monika Kusyk	Maria M. Ulaczyk	
GR1 ds. przyrządów stosowanych w medycynie i farmacji	GR2 ds. jakości i ilości energii elektrycznej prądu przemiennego	GR1 ds. wag elektronicznych	GR1 ds. pomiarów prędkości pojazdów	GR1 ds. pomiarów temperatury i wilgotności		GR1 ds. przeglądu przyrządów pomiarowych podlegających prawnej kontroli metrologicznej	GR1 ds. potrzeb producentów	
GR2 ds. wytycznych i promowania dobrych praktyk metrologicznych w ochronie zdrowia	GR3 ds. energii prądu stałego	GR2 ds. analizy strategicznej polskiego projektu wagi Watta	GR2 ds. technologii laserowych	GR2 ds. gazów i pyłów		GR2 ds. rozwiązań systemowych	GR2 ds. biżuterii unikatowej i kamieni jubilerskich	
GR3 ds. znaczenia promieniowania optycznego dla zdrowia	GR4 ds. inteligentnych sieci energetycznych	GR3 ds. HS-WIM	GR3 ds. wymiarów geometrycznych w gospodarce	GR4 ds. certyfikowanych materiałów odniesienia substancji czystych i matrycowych		GR3 ds. certyfikacji	GR3 ds. regulacji prawnych	
GR4 ds. akustyki podwodnej		GR5 ds. opracowania przewodników	GR4 ds. nanotechnologii			GR4 ds. rynku paliw	GR4 ds. technologii i metod badania stopów metali szlachetnych	
		GR6 ds. analizatorów wydechu	GR5 ds. czasu i częstotliwości			GR5 ds. bezpieczeństwa ruchu drogowego		
		GR7 ds. paliw płynnych i gazowych	GR6 ds. pomiarów przestrzennych, geodezyjnych, geofizycznych i zastosowań technik satelitarnych			GR6 ds. tachografów		
			GR7 ds. optycznych technologii pomiarowych			GR7 ds. przyrządów do pomiaru mediów ("utils")		
			GR8 ds. znakowania czasem			GR8 ds. nadzoru rynku		
						GR9 ds. kas rejestrujących		



KONSULTACYJNE ZESPOŁY METROLOGICZNE

Appendix no. 5 PROSPECTS FOR THE DEVELOPMENT OF AREAS OF MEASUREMENT COVERED BY THE CENTRAL OFFICE OF MEASURES

The activities of the GUM covers a wide spectrum of tasks, including both the performance of research and development works in the field of technologically advanced measurement standards and techniques and the provision of services to various economic operators. The offer of the GUM is intended for a wide variety of stakeholders, including, in particular, those in the industrial sector. The activities in question are performed in the following fields of measurement: acoustics and vibrations, time and frequency, chemistry, length, electricity and magnetism, photometry and radiometry, mass and related quantities, ionising radiation, flow measurement and thermometry as well as testing of taximeters and tachographs, fiscal cash registers and software used in measuring instruments.

The development in the various measurement areas covered by the Central Office of Measures will support the domestic industry, allowing it to increase its competitiveness and innovativeness through knowledge and technology transfer, while at the same time also upholding the national healthcare system, environmental protection and state security.

PRIMARY TASKS PERFORMED WITHIN THE FRAMEWORK OF ALL AREAS OF MEASUREMENT:

- 1) Maintenance and improvement of measurement standards.
2. Ensuring traceability of all national standards and reference standards to international standards as well as standards applied in other countries.
3. Organising domestic and international comparisons with the involvement of multiple laboratory facilities and participating in such comparisons.
4. Ensuring the transfer of measurement units from top-quality measurement standards to the standards applied in research, scientific and industrial laboratory facilities.
5. Conducting scientific research and development activities, taking into account their application and use for the purposes of fostering innovation within the economy.
6. Dissemination and popularisation of knowledge in the field of metrology.
7. Calibration, testing and evaluation of measuring instruments.
8. Cooperation with the industry as well as with domestic and international institutions in the field of metrology.
9. Transfer and popularisation of knowledge through the participation in conferences, seminars, trade shows and other specialist events.

Domain 1: Acoustics and vibrations

This domain encompasses issues related to the measurement of quantities which characterise audible sounds, ultrasounds, infrasounds and mechanical vibrations propagated in various types of environment: in the air, in water as well as through solid substances. Its interest lies with the measurement devices and standards applied, *inter alia*, for the purposes of protection of natural environment against noise, protection of work environment against noise and vibrations, diagnostics and certification of machinery and equipment within the scope of noise and mechanical vibrations, type approval of vehicles of various types, certification of aircraft within the scope of noise regulations as well as for the purposes of conducting research and assessment in the field of auditory perception, hearing protection and reconstruction and in the field of construction acoustics.

ACTIVITIES

1. Maintenance and improvement of the primary standard for acoustic pressure and the primary standard for mechanical vibrations as well as ensuring traceability of those standards to the standards applied in other countries through the participation in key comparisons.
2. Ensuring measurement traceability in Poland in the field of acoustics and mechanical vibrations.
3. Maintenance of the degree of competences required of the members of the Consultative Committee for Acoustics, Ultrasound and Vibration (CCAUV) of the International Committee for Weights and Measures (CIPM) in accordance with the membership criteria defined by the CIPM.
4. Conducting research and development works in the field of acoustics and mechanical vibrations and cooperation with the industry as well as various domestic and foreign institutions and organisations in this regard.
5. Calibration, testing and evaluation of measuring instruments in the field of acoustics and mechanical vibrations.
6. Type testing of sound level testers.
7. Participation in the works of the Polish Standardisation Committee, the International Electrotechnical Commission (IEC) and the International Organisation for Standardisation (ISO) in the field of development of regulations pertaining to measuring instruments and standards for the measurement of acoustics and mechanical vibrations.

PLANNED ACTIVITIES

1. Development of metrological infrastructure ensuring traceability in the field of measurement of mechanical vibrations for mechanical impacts. Development of a measurement stand for the calibration of mechanical impact transducers in accordance with the ISO 16063-22 standard.
2. Development of metrological infrastructure ensuring traceability in the conditions of an acoustic free field. Construction of an anechoic chamber and measurement stand for

- performing acoustic free field testing.
3. Modernisation and extension of the metrological infrastructure ensuring traceability in the field of audiometry.
 4. Development of metrological infrastructure and personnel competences in the field of ultrasounds applied in healthcare.
 5. Extension and modernisation of metrological infrastructure ensuring traceability in the field of acoustics (ultrasound frequencies).
 6. Modernisation of measurement stands intended to ensure the possibility of calibration of digital transducers applied in the field of acoustics and mechanical vibrations.
 7. Development of metrological infrastructure ensuring traceability with respect to large values of acoustic pressure.
 8. Development of metrological infrastructure ensuring traceability in the field of measurement of mechanical vibrations within the scope of seismic vibrations. Establishment of a measurement stand for the calibration of seismic transducers and geophones.
 9. Maintenance of the degree of competences required of the members of the Consultative Committee for Acoustics, Ultrasound and Vibration (CCAUV) of the International Committee for Weights and Measures (CIPM) in accordance with the membership criteria defined by the CIPM.

MEASUREMENT STANDARDS

NATIONAL STANDARD FOR ACOUSTIC PRESSURE / PRIMARY STANDARD	
CURRENT STATE	PLANNED DEVELOPMENT
<p>The national standard for acoustic pressure measurement unit is comprised of the following:</p> <ul style="list-style-type: none"> ▪ three LS1-class laboratory reference microphones and three LS2-class laboratory reference microphones compliant with the PN-EN 61094-1:2003 standard (Measurement microphones – Requirements for laboratory reference microphones), ▪ computer-controlled measurement stand for LS-class microphone calibration by reciprocity method, in accordance with PN-EN 61094-2:2010 standard (Measurement microphones – Base method for pressure calibration of laboratory reference microphones by reciprocity method) for the following frequencies: <ul style="list-style-type: none"> ○ from 2 Hz to 10 kHz – LS1-class microphones, ○ from 20 Hz to 25 kHz – LS2-class microphones, <p>Minimum expanded uncertainty for the determination of microphone effectiveness level:</p> <ul style="list-style-type: none"> ○ 0.03 dB (module) and 0.7 ° (phase) – LS1-class microphone, ○ 0.03 dB (module) and 0.6 ° (phase) – LS2-class microphone, <p>The characteristics of the standard have been confirmed in the course of the following key comparisons: CCAUV.A-K1,</p>	<p>Maintenance of national standard for calibration of LS1-class microphones by reciprocity method at the same level.</p> <p>Expanding the scope of frequency for the calibration of LS2-class microphones by reciprocity method through the inclusion the infrasound range between 2 Hz and 20 Hz (in preparation for the contemplated comparisons organised by the CCAUV).</p> <p>Updating the CMC values of the KCDB BIPM (wider frequency range, lower uncertainty values).</p>

CCAUV.A-K3, CCAUV.A-K5, EUROMET.AUV.A-K1, COOMET.A-K1, COOMET.A-K3, COOMET.A-K5, AFRIMETS.A-S1	
NATIONAL STANDARD FOR MECHANICAL VIBRATIONS / PRIMARY STANDARD	
CURRENT STATE	PLANNED DEVELOPMENT
<p>The national standard for mechanical vibrations is comprised of a computer-controlled measurement stand for the calibration of mechanical vibration transducers by absolute method, in accordance with the ISO 16063-11:1999 standard (Methods for the calibration of vibration and shock transducers – Part 11: Primary vibration calibration by laser interferometry (method 3: sine-approximation method)) in the frequency range between 0.25 Hz and 10 Hz.</p> <p>Minimum expanded uncertainty for the determination of sensitivity of mechanical vibration transducers:</p> <ul style="list-style-type: none"> ▪ 0.5% (module) and 0.6 ° (phase) – transducers with a mass of up to 100 g, 5 Hz ÷ 10 kHz, vertical vibrations, ▪ 0.3% (module) and 0.5 ° (phase) – transducers with a mass of up to 900 g, 0.25 Hz ÷ 160 kHz, vertical or horizontal vibrations, <p>The characteristics of the standard have been confirmed in the course of the following key comparisons: EUROMET.AUV.V-K1, COOMET.AUV.V-K1, CCAUV.V-K2, EUROMET.AUV.V-K3, CCAUV.V-K3.</p>	<p>Maintenance of the characteristics of the national standard within the scope of calibration of mechanical vibration transducers by absolute method at the present level (participation in the EURAMET comparisons scheduled for 2018 for the purposes of confirmation of the characteristics of the standard). Updating the CMC values of the KCDB BIPM (wider frequency range, lower uncertainty values).</p>

Domain 2: Time and Frequency

This domain encompasses time scales (physically realised and calculated), measurements of frequency and periods, measurement of time intervals. Measurements of time and frequency are applicable to many different areas, including in military technology, telecommunications, wired and wireless radio communications, science, satellite navigation and ground-based navigation (GPS, GALILEO, LORAN-C). Furthermore, measurements of this kind are also applied in the course of manufacture of devices, equipment and measurement systems for measuring time and frequency at the highest usable precision level as well as in other sectors of the economy such as the motoring industry, the energy sector, the transportation sector as well as many others, including medicine, banking, stock exchange operations, the financial markets and sports.

ACTIVITIES

- 1) Generating the Polish atomic time scale (UTC(PL)) and determining the official time of the Republic of Poland as well as participation in the establishment of the Polish atomic time scale (TA(PL)).
- 2) participate in establishing the international atomic time scales (TAI and UTC).
3. Maintenance of the national standard of time and frequency units and related testing stands, including the performance of research and development works.
4. Development and improvement time transfer methods, maintain atomic time scales and analyse the results obtained while comparing atomic time and frequency

standards.

5. Dissemination of standard frequency signals.
- 6) Development and improvement of measurement methods, methods for the assessment of uncertainty of measurement results and performance of research and development works in the field of calibration and evaluation with respect to time and frequency.

PLANNED ACTIVITIES

1. Increasing the stability and precision of the realisation of the UTC(PL) scale and the time and frequency measurement units through various efforts, including the modernisation of the national standard stand through the acquisition of an active hydrogen maser with resonant cavity, inclusion of the primary frequency standard (cesium fountain) into the official time and frequency standard system, development of time scale prognostic methods as well as methods for the assessment of the operation of atomic clocks. Making efforts towards the acquisition of an optical clock.
2. Ensuring the continuity of functioning and reliability of the state time and frequency unit standard, including through securing DC and AC reserve power, replacement of expendable components (cesium tube) in 5071A Hp-class atomic clocks as well as conservation and replacement of time and frequency standard distribution systems.
3. Development of precise time transfer methods based on fibre-optic and satellite technology, including through the maintenance of existing connections and establishing new fibre-optic domestic and international connections for the precise distribution of time and frequency, short- and long-term analyses of comparison result stability and continuity, comparing the results obtained by various methods, development of calibration methods and reducing calibration uncertainty for time transfer connections.
4. Development of systems for official time distribution and verification of the synchronisation with official time, including the development of methods of synchronisation with official time with respect to electronic signatures, qualified time stamps and average speed measuring systems.
5. Supporting the development of techniques, systems and devices created and developed in Poland as well as other efforts which require the maintenance of traceability in the field of time and frequency, including through the performance of top-quality calibrations, calibration of atypical, niche or prototype devices and instruments, conducting metrology training courses as well as engaging in in-depth cooperation and technology and knowledge transfer (including, in particular, knowledge transfer to the industry), development of existing measurement methods and establishment of new ones.
6. Conducting inter-laboratory comparisons and expanding the scope of possibilities for conducting inter-laboratory comparisons in the field of time and frequency organised by the Central Office of Measures and encompassing the performance of constant, remote comparisons with the UTC(PL) standard, as well as the development and improvement of portable comparison objects and cyclical performance of comparisons with portable standards.

7. Developing methods of precise time interval and delay measurement, including through the assessment of the metrological characteristics of precise time period measures and measurement objects, decreasing measurement uncertainty, development and verification of new measurement systems as well as comparative analyses of the results obtained.
8. Making efforts directed at the development and control of ground-based time measurement infrastructure for the European GALILEO satellite navigation system, including, in particular, within the framework of the contracts of the European Space Agency (ESA) operating under the aegis of the European Commission.

MEASUREMENT STANDARDS

NATIONAL STANDARD FOR TIME AND FREQUENCY / PRIMARY STANDARD	
CURRENT STATE	PLANNED DEVELOPMENT
<p>A set of atomic frequency standards along with the associated systems for internal and external comparisons.</p> <p>Output signals:</p> <ul style="list-style-type: none"> ▪ 1 Hz – Rectangular pulses with duration of 20 μs, ▪ 100 kHz, 1 MHz, 5 MHz, 10 MHz – sinusoid signals. <p>Time and frequency:</p> <ul style="list-style-type: none"> ▪ relative standard uncertainty for realisation of time and frequency standards not exceeding $1,7 \cdot 10^{-14}$ for averaging time of 5 days <p>UTC(PL) time scale:</p> <ul style="list-style-type: none"> ▪ the time scale offset is maintained at a level between -200 ns and +200 ns, ▪ standard uncertainty for the determination of the present-day forecast of UTC(PL) time scale offset towards the UTC time scale: not exceeding 60 ns. 	<p>Inclusion of active hydrogen maser with resonant cavity autotuning as well as primary frequency standard (cesium fountain) into the national standard system will significantly improve the level of standard uncertainty for the realisation of time and frequency units, making it possible to attain the value of approximately $0,5 \cdot 10^{-14}$ for averaging time of 5 days. The scale stability for the UTC(PL) time will improve significantly, making it possible to maintain the scale within ± 10 ns towards the UTC time scale. Standard uncertainty for the determination of the present-day forecast of UTC(PL) time scale offset towards the UTC time scale should not exceed 10 ns.</p>

Domain 3: Chemistry

The activities performed by the Central Office of Measures within the scope of chemical metrology include analyses of gaseous substances, electrochemical analyses (ionometry/pH measurement, specific conductance of electrolytes as well as coulometry applied for the purposes of determining the content of chemical compounds in high-purity substances, analysis of inorganic substances in calibration solutions and in samples with a complex composition as well as measurement of IR wavenumbers and manufacture and certification of reference materials.

The aim of chemical metrology is to ensure the credibility, traceability and comparability of chemical analyses in nearly all areas of human activity. Chemical measurements remain particularly important insofar as environmental protection, healthcare and medicine are concerned. They are applied in many branches of industry, such as the chemical, pharmaceutical, food, mining & excavation and energy industry.

ACTIVITIES

Gas Analysis

1. Maintenance and development of gaseous reference standards for units of measure of the contents of gaseous mixtures.
2. Maintenance of measurement stands for the calibration of gaseous mixtures as well as gas analysers.
3. Ensuring traceability within the scope of gas analysis through calibration of gas mixtures, gas analysers and devices measuring the dissolved oxygen content of water.
4. Performance of research and development works in the field of gaseous substances.

Electrochemical analyses (ionometry/pH measurement, conductometry, amount of substance).

1. Maintenance and improvement of national standards for the realisation of pH measurement unit and specific electrical conductance measurement unit for electrolytes (standards involving primary methods).
2. Maintenance and improvement of measurement stand designed for precise determination of the content of chemical compounds in high-purity substances using the coulometric method (primary method).
3. Transfer of pH measurement unit, specific electrical conductance measurement unit for electrolytes and amount of substance unit (mole) using both primary and secondary methods.
4. Performance of research and development works related to the measurement of the acidity/basicity of solutions (pH), specific electrical conductance of electrolytes and amount of substance;

Inorganic Analysis

1. Maintenance and improvement of measurement stands for spectral analysis (reference standards for solution content measurement unit and wavenumber measurement unit) and chromatographic analysis.
2. maintain reference standards for units used to measure the content of given ingredient in a solution, and IR wave numbers (wavelength) in IR spectrum;
3. carry out research and development works concerning methods for determination of main and trace ions in high-purity inorganic substances, in calibration solutions and in complex samples;
4. develop and optimise analytical techniques in the field of inorganic analyses.

PLANNED ACTIVITIES

1. Recognition of the amount of substance measurement unit (mole) as an national standard.
The unit of measurement for amount of substance (mole) is one of the seven basic units of the International System of Units (SI). The aim of the establishment of national

standard for amount of substance is to ensure the realisation of this unit by primary method and to establish a source of traceability as well as increasing the degree of accuracy and comparability for many different analytical determinations made in virtually all areas of the economy as well as in environmental protection and healthcare.

2. Development of metrological infrastructure and personnel competences in the field of measurement of particulate matter (PM) content in atmosphere.

Action intended as a response to the domestic needs within the scope of environmental and climate change monitoring and healthcare. This is because the volume of particulate matter suspended in the atmosphere has a detrimental impact on both the environment and human health. Development of measurement methods in this area may allow for the designation of the most significant sources of air pollution and facilitate precise interventions intended to ensure improvement in air quality.

3. Development of new primary reference materials (high-purity substances).

Primary reference materials for the amount of substance measurement unit (the mole) will ensure measurement traceability between the quantitative chemical analysis results and the SI unit through the transfer of the unit from the national standard to the measurement systems applied by research and calibration laboratories.

4. Extension and modernisation of metrological infrastructure ensuring traceability in the field of inorganic analysis. Improvement of the GUM reference standard for abundance of constituents in solutions.

This activity (including, in particular, the analysis of toxic and ecotoxic elements) is intended to accommodate the needs within the scope of environmental monitoring and remains consistent with the strategic direction of the National Research Programme with respect to interdisciplinary scientific research and development scheme designated as “Natural Environment, Agriculture and Forestry”.

5. Development of metrological infrastructure and personnel competences in the field of spectral analysis. Development of a method for the manufacture and certification of new, multi-element matrix reference materials.

The action is intended as a response to the requirements of the National Smart Specialisation in the field of agricultural and environmental bio-economy (with regard to the monitoring of high-quality drinking water for the food industry and water pipe construction and maintenance business) as well as in the field of natural resources and waste management (with regard to research related to water processing and reclamation technologies as well as technologies reducing water consumption).

NATIONAL STANDARD FOR POTENTIAL OF HYDROGEN (PH) / PRIMARY STANDARD	
CURRENT STATE	PLANNED DEVELOPMENT
A set of thermostated hydrogen-silver chloride cells without ion transference (Harned cells), electromotive force measurement instruments and primary reference materials for the realisation of pH values in water solutions within a 1-11 range. Expanded uncertainty: from 0.002 to 0.007.	Enhancement of measurement capabilities (tracking technological progress in the area of measuring instruments, development directions laid down by the CCQM and EURAMET as well as the needs of the economy).
NATIONAL STANDARD FOR SPECIFIC ELECTRICAL CONDUCTANCE FOR ELECTROLYTES / PRIMARY STANDARD	
CURRENT STATE	PLANNED DEVELOPMENT

<p>A measurement system consisting of a thermostated, geometrically dimensioned two-electrode piston-type conductimetric vessel, a system for precise positioning of reciprocating piston electrode and for automatic measurement of distance changes between electrodes, RLC bridge for impedance measurement, instruments for precise temperature measurements as well as primary reference materials used for the realisation of specific electrical conductance values.</p> <p>Unit of measurement realisation range between $0.005 \text{ S}\cdot\text{m}^{-1}$ and $20 \text{ S}\cdot\text{m}^{-1}$.</p> <p>Expanded uncertainty for the determination of specific electrical conductance between 0.04% and 0.08%.</p>	<p>Enhancement of measurement capabilities (tracking technological progress in the area of measuring instruments, development directions laid down by the CCQM and EURAMET as well as the needs of the economy).</p>
MEASUREMENT STANDARD FOR ABUNDANCE OF CONSTITUENT IN GASEOUS MIXTURE / PRIMARY STANDARD	
CURRENT STATE	PLANNED DEVELOPMENT
<p>Reference standard for abundance of constituent in gaseous mixture consists of: six groups of standard gaseous mixtures with specified abundance of constituent/constituents, measurement stand for the production of gaseous mixtures using the gravimetric method, measurement stand for the calibration of mixtures using the chromatographic method, stand for the calibration of mixtures using gas analysers as well as stand for the testing of gas purity.</p> <p>Secondary standard The reference standard for abundance of constituent in gaseous mixture consists of: two groups of standard mixtures with a specific abundance of the given constituent (NO, NO₂) in the mixture, measurement stand for the production of gaseous mixtures using the gravimetric method and measurement stand for the calibration of gaseous mixtures using gas analysers.</p>	<p>Enhancement of measurement capabilities (following the development directions laid down by the CCQM and EURAMET as well as satisfying the needs of the economy).</p> <p>Extending the scope of measurements and decreasing measurement uncertainty for the reference standard through the modernisation of the mixture calibration stand based on the chromatographic method and the mixture calibration stand based on the use of gas analysers.</p>
MEASUREMENT STANDARD FOR ABUNDANCE OF CONSTITUENT IN SOLUTION / SECONDARY STANDARD	
CURRENT STATE	PLANNED DEVELOPMENT
<p>The reference standard for the measurement unit of mass concentration in solution is comprised of single-element mass concentration reference water solutions (33 chemical elements), produced using the gravimetric method.</p> <p>Abundance of constituent in solution: $1.00 \text{ g}/\text{dm}^3$.</p> <p>Expanded uncertainty: from $0.001 \text{ g}/\text{dm}^3$ to $0.002 \text{ g}/\text{dm}^3$.</p>	<p>The introduction of the Inductively Coupled Plasma – Optical Emission Spectrometer technique (ICP-OES) and the Inductively Coupled Plasma – Mass Spectrometer technique (ICP-MS) will make it possible to produce and certify single- and multi-element reference materials for the purposes of monitoring environment changes.</p>
MEASUREMENT STANDARD FOR INFRARED WAVENUMBER / SECONDARY STANDARD	

CURRENT STATE	PLANNED DEVELOPMENT
<p>The reference standard for the IR wavenumber is comprised of a polystyrene standard for wavenumbers along with a spectrophotometer operating in the infrared range.</p> <p>Scope of measurement: between 4000 cm⁻¹ and 400 cm⁻¹.</p> <p>Expanded uncertainty: from 0.2 cm⁻¹ to 0.6 cm⁻¹.</p>	<p>Maintenance of the standard at the current measurement level.</p>

Domain 4: Length

This domain encompasses the performance of tests and measurements of radiation of stabilised metrological lasers and spectral lamps, linear dimensions, plane angles, shapes, surface geometry, refractive index and optical rotation.

Measurements of geometric values are commonly applied in all sectors of the economy, including, in particular, the motoring, aviation, food, pharmaceutical, metallurgical, metalworking and machine industry as well as in geodesy and cartography, telecommunications, transportation and in the defence industry. This domain of metrology is concerned with measurement standards and devices applied, *inter alia*, for the purposes of controlling manufacturing quality, performing control and inspection activities as well as conducting scientific and research operations. The new challenges which the domain in question faces are related to the developments in the field of measurement stemming from the advent of nanotechnology (semiconductor technologies), nanomaterials (e.g. nanoparticles and nanostructures) as well as developments related to the measurement of large distances or objects.

ACTIONS

1. Maintenance and development of the national standards for units of length, units of plane angle, units of refractive index, units of angle of polarization of a flat-polarized light wave in the visible spectrum; ensuring that the standards in question are matched with standards applicable in other countries or with international standards;
2. Maintenance and improvement of reference standards and measurement stands in the field of length measurement.
3. Ensuring traceability and transferring units of length, units of plane angle, units of refractive index and units of angle of polarization (primarily to accredited calibration laboratories as well as to Polish businesses).
4. Initiating, defining directions and performance of scientific as well as research and development works in the field of measurement of length, plane angle, surface geometry as well as refractometry and polarimetry.
5. Production and certification of reference material for the liquid refractometric standard and polarimetric standard.
6. Participation in research, national and international projects in the field of metrology of geometric quantities.

PLANNED ACTIVITIES

1. Establishment of a new measurement stand based on a multi-sensor measuring machine.
2. Development of measurement capabilities in the field of nanometrology through the purchase or development of an AFM microscope.
3. Modernisation of the national standard for length – ensuring the continuity of realisation of the unit of length and enhancing measurement capabilities by increasing the scope of measurement of the national standard, ensuring the possibility of measurement of optical frequencies applied in the telecommunications sector.
4. Development of a measuring system based on a femtosecond laser, making it possible to compensate for environmental conditions in the course of interference measurements.
5. Participation in the project involving the development of a Polish compact laser length/frequency standard which could later form part of industrial interferometers.
6. Analysis and implementation of the method for the determination of the refractive index for liquid refractometric standards using the goniometric method.
7. Development of new measurement methods for the purposes of geodesy.
8. Participation in the project involving the use of electromechanical microsystems for the purposes of ensuring dimensional standards for the users of atomic force microscopes and electron microscopes.
9. Development of new small angle generator with an increased measurement range (above 1°) and higher resolution (0.001”).
10. Development of an interference measurement stand for the purposes of calibration of two-dimensional calibration standards.
11. Development of a system for the testing of quartz control plates (verification of optical purity, flatness, surface parallelism and optical axis errors).

MEASUREMENT STANDARDS

NATIONAL STANDARD FOR LENGTH / PRIMARY STANDARD	
CURRENT STATE	PLANNED DEVELOPMENT
Iodine-stabilised helium–neon laser and optical frequency synthesiser. Realisation of the laser radiation wave length values between 532 nm to 1064 nm, corresponding to the standard frequencies within the 281 THz – 563 THz range. Relative expanded uncertainty: 10 ⁻¹¹ .	Increasing the measurement scope through the addition of frequencies used in the telecommunications sector. Enhancement of measurement capabilities through the development of a measurement system based on an optical frequency synthesiser, used for long-distance measurement and air refractive index.
NATIONAL STANDARD FOR PLANE ANGLE / PRIMARY STANDARD	
CURRENT STATE	PLANNED DEVELOPMENT
Measurement stand with autocollimator and high-precision turntable. Realised value within the 0° – 360° range. Expanded uncertainty 0.08”.	Development of measurement methods currently applied on the stand equipped with an autocollimator and high-precision turntable (including, in particular, with respect to the calibration of autocollimators and precise angle encoders).

Small angle generator, realised value within the 0' – 40' range. Expanded uncertainty 0.11".	Development of a new small angle generator characterised by increase measurement range (above 1°) and increased resolution (0.001").
NATIONAL STANDARD FOR REFRACTIVE INDEX / PRIMARY STANDARD	
CURRENT STATE	PLANNED DEVELOPMENT
Goniometer-spectrometer with dispersive prisms. Realised value between 1.2 and 2.2. Expanded uncertainty between $3 \cdot 10^{-6}$ and $1 \cdot 10^{-5}$.	Analysis and implementation of the method for the determination of the refractive index for liquid refractometric standards using the goniometric method. Examining the possibility for the application of alternative light sources (such as laser light).
NATIONAL STANDARD FOR THE ANGLE OF POLARISATION OF A FLAT-POLARISED LIGHT WAVE IN THE VISIBLE SPECTRUM / SECONDARY STANDARD	
CURRENT STATE	PLANNED DEVELOPMENT
Set of five quartz control plates. Realised value within the -10° and 40° range. Expanded uncertainty: from 0.001° to 0.002°.	Development of a system for the testing of quartz control plates (verification of optical purity, flatness, surface parallelism and optical axis errors).
SURFACE ROUGHNESS STANDARD / PRIMARY STANDARD	
CURRENT STATE	PLANNED DEVELOPMENT
Consists of: – A2-type pit depth standard based on the PN-EN ISO 5436-1:2002 standard, with nominal depth (d) of 0.199 µm; 0.518 µm; 1.02 µm; 2.38 µm; 5.16 µm and 8.39 µm, expanded uncertainty between 0.015 µm and 0.035 µm, – C3-type surface roughness standard based on the PN-EN ISO 5436-1:2002 standard, with $R_a = 0.062$ µm, expanded uncertainty: 0.006 µm – standard in the form of a hemisphere with the radius of $R = 12.4721$ mm – E1-type standard based on the PN-EN ISO 5436-1:2002 standard. expanded uncertainty: 0.06 µm, – Form Talysurf surface roughness measurement device (Series 2): measurement scope between 0.1 µm and 100.0 µm, expanded uncertainty: For standard A according to ISO 5436-1: $Q[30; 0,5d]$ nm; d expressed in µm, For standard B according to ISO 5436-1: 0.08 µm, For standard C according to ISO 5436-1: $R_a, R_q: Q[15; 25R_a]$ nm; R_a in µm, $R_p, R_v, R_z, R_t: Q[40; 50R_p]$ nm; R_p in µm; For standard D according to ISO 5436-1: $R_a, R_q: Q[15; 30R_a]$ nm; R_a in µm, $R_p, R_v, R_z, R_t: Q[40; 80 R_p]$ nm; R_p in µm For standard D according to ISO 5436-1: between 0 and 400 µm	Expanding the measurement capabilities of the calibration stand through the acquisition and implementation of an ADM atomic force microscope as well as standards applied in the field of nanometrology.

SPHERICITY STANDARD / PRIMARY STANDARD	
CURRENT STATE	PLANNED DEVELOPMENT
Consists of: – a spherical standard in the form of a glass hemisphere, expanded uncertainty: 0.010 μm , – a sphericity standard in the form of a truncated cylinder, expanded uncertainty: 0.025 μm , – a TALYROND 210 sphericity measurement instrument, measurement scope $\pm 200 \mu\text{m}$, expanded uncertainty: 0.04 μm .	Maintenance of the standard at a level satisfactory for economic operators.
FLATNESS STANDARD / SECONDARY STANDARD	
CURRENT STATE	PLANNED DEVELOPMENT
Consists of: – two transmission mirrors with the diameter of 152 mm, – GPI XP laser interferometer with helium-neon laser. Measurement scope: up to 5.7 μm , expanded uncertainty: 15 nm.	Developing the current transmission mirror calibration method and making efforts towards elevating the status of the existing standard.

Domain 5: Electricity and magnetism

This domain encompasses the performance of measurements and testing in the field of various electrical and magnetic quantities. The aim of these efforts is to ensure the credibility, traceability and comparability of measurements in nearly all areas of human activity. The measurements of electrical and magnetic quantities are very important from the standpoint of economic growth, healthcare, environmental protection and the industry. These measurements are applied in many branches of industry, including the power generation sector as well as the broadly understood energy and electronic industry (telecommunications and IT technologies), in the defence industry, the motoring industry (manufacture of electric cars), the chemical industry, the pharmaceutical industry, the food industry, the manufacture of consumer goods as well as in all areas of activity which involve the generation of electricity.

Furthermore, the measurement of electrical quantities plays a vital role in the process of measurement of non-electrical quantities where any sensors which translate non-electrical into electrical quantities are involved, as is the case, for example, with temperature measurements performed using methods based on electricity.

ACTIVITIES

1. Maintenance, safekeeping, development and improvement of national measurement standards for direct voltage, resistance, alternating voltage, inductance and electrical capacitance, alternating voltage ratio with a frequency of up to 50 Hz as well as alternating current ratio with a frequency of 50 Hz.
2. Maintenance, safekeeping, development and improvement of national measurement standards for alternating current, power and energy of alternating current, power, attenuation and impedance for microwave frequencies as well as reference standards

- for electrical and magnetic fields.
3. Ensuring traceability of all national standards and reference standards with international standards as well as standards applied in other countries by participating in multilateral and bilateral international comparisons.
 4. Ensuring the transfer of measurement units from national standards and reference standards to the standards applied in research, scientific and industrial laboratory facilities.
 5. Conducting scientific and research and development works in the field of measurements of electrical quantities, taking into account their application and use for the benefit of innovation and economic growth.
 6. Participation in research projects on the national and international scale in the field of metrology of electrical quantities.
 7. Performing measurements and research in the field of electromagnetic compatibility for the military, the arms industry and for the business in general.
 8. Carrying out tests of alternating current meters for the purposes of compliance assessment.
 9. Organising and participating in domestic and international inter-laboratory comparisons.
 10. Dissemination and popularisation of knowledge and experience in the field of metrology of electrical quantities. Transfer of knowledge and experience in the field of application of good practices in electrical metrology to the laboratories operated by the regional measurement administration as well as by the industry.

PLANNED ACTIVITIES

1. Development of a quantum standard for the realisation of alternating voltage measurement unit will make it possible for this unit of measurement to be transferred to scientific, research and industrial laboratory facilities with a high degree of precision. Once the standard is developed through the provision of high-accuracy measurements, the Central Office of Measures will make a significant contribution towards the development of innovative, competitive economy.
2. Modernisation of the standard for alternating current power and energy (expanding the scope of the standard to include currents of up to 300 A). The industry – including the so-called small industry and the service industry (as well as, to an increasing extent, households, where electrical heating and air conditioning systems are being installed in growing numbers) necessitate a constant increase in the amount of power supply, which means that the quantities of electrical power being transmitted through the network keep on rising. For the above reason, all those end users of the power network require precise measurements of high-power electric current (above 100 A). At the present stage, the GUM can only provide direct electricity measurements for current of up to 100 A.
3. Construction of a laboratory for the measurement of quality parameters for alternating current. The energy sector and the associated sector of industry require the power supplied to be of the best possible quality. Inadequate qualitative parameters for energy result in power losses and the overall decline of power network safety levels through the disruption of the functioning of safety systems. By ensuring the accurate measurement of energy quality parameters, the level of energy loss may be brought down, thereby increasing the energy security of the entire society. An increase of the

qualitative parameters for energy will also ensure an improved functioning of household appliances, increasing their lifespan and allowing them to operate without interruptions. The construction of the new laboratory is necessary for both the energy sector and the enterprises which engage in the transmission of electricity. It will allow to ensure that the power being transmitted stays within the designated parameters, reducing losses and ensuring the proper operation of the power network.

4. Modernisation of the measurement stand for the national alternating current (AC) standard and the AC voltage standard. Measurements of electrical quantities for both current and voltage are being performed in all areas of modern life. The modernisation of the stand will result in an improved precision of the measurements performed, which shall in turn have an impact on the innovativeness of the industry, the economy and the defence sector.
5. Development of a new measurement stand for calibration and testing of instruments measuring the power and energy of direct current (DC power and energy meters used by the State Railway Company [PKP] and various urban transport operators). Locomotives and urban transport vehicles powered by electricity are equipped with DC power meters, which are currently in the process of calibration. However, the laboratories which perform the calibration of these devices have no reference standard to fall back upon. Once the GUM – the entity in charge of ensuring the reliability of measurements in Poland – finishes the development of the new stand, it will be able to ensure a reference standard for the energy of DC current for all calibration, scientific, research and industrial laboratory facilities all across the country. The reliable metering of the power consumed by railway vehicles and urban transportation will result in a better and more economical energy management, thereby having a positive impact on state finances and the national economy.
6. Development of a measurement system allowing for the extension of the measurement scope of the national resistance unit standard, allowing the resistance quantities to be transferred to both low- and high-ohm standards. The development of this measurement stand will ensure that all the needs of both the industry and the science community are duly catered for in this regard.
7. Adjustment of the measurement stand structure to the amended definition of the ampere, ensuring that electrical current measurements are carried out and expressed on the basis of the new definition.
8. Development of a measurement stand for the testing and calibration of capacitors at high voltage (automatic bridge with standard capacitors and the accompanying software). The energy industry has repeatedly expressed its demand for such testing to be carried out. Measurements in this regard are essential for both power stations and for the entire energy sector and the national economy.
9. Fitting out a laboratory for the purposes of testing alternating current meters used for the purposes of calculating the amount of power consumed during charging electric vehicles. Measurement instruments of this kind will come equipped with an electronic cash register or other payment processing device. It will be necessary to provide measurement stand for the control of measurement systems used in the course of settlements pertaining to the amount of energy used during charging electric vehicles.
10. Development of new magnetic field standards allowing for the measurement scope to be extended. The extension of the measurement scope will serve as a response to the needs of the economy, including the manufacturers of electrical and electronic devices. The measurements of the level of electromagnetic and magnetic field in an extended scope are essential for the functioning of the telecommunications industry, for the

- purposes of the broadly understood digitalisation efforts as well as for the defence sector.
11. Development of an active magnetic field background screen with a range of up to 10 kHz. The addition of the magnetic field screening is necessary to ensure a greater precision in the measurement of electrical and magnetic field. Active screening will allow the measurement station to be isolated from external interferences.
 12. Modernisation of the vector network analyser for the purposes of increasing the measurement scope for S- parameters up to 50 GHz. The need to perform measurements in the 50 GHz+ range stems from the requirements of the military and the telecommunications industry.
 13. Development of a set of electrical capacitance standards for the realisation of inductance values between 5 mH and 10 H for the frequency of 1 kHz. Developing such a set of standards will make it possible for impedance values to be transferred to working standards.
 14. Development and implementation of an AC-DC resistance standard of 12906.4 Ω for the purposes of ensuring the direct transfer of electrical capacitance units from resistance units within the scope of RLC. This shall be applicable when transferring units from the domain of RLC to military and industrial laboratory facilities.
 15. Development and implementation of $\pm 30^\circ$ and $\pm 60^\circ$ phase standards as well as standards for loss factor. These standards shall likewise be used for the purposes of the transfer of units to military and industrial laboratory facilities.
 16. Modernisation of the measurement stand equipped with RLC comparator (type 2100). This stand is used to ensure a source of traceability with respect to RLC impedance.
 17. Development of a stand for the measurement of alternating current characterised by very low power and energy. The addition of this stand is necessitated by the needs of the electrical and electronic industry, including, in particular, the manufacturing plants which produce devices equipped with built-in standby systems. This is caused by the need to test systems of this kind for compliance with the applicable regulations in the process of compulsory certification of products prior to their release on the market. The development of this stand will contribute towards the development of the economy by ensuring an increased production and sales of products equipped with stand-by systems.

MEASUREMENT STANDARDS

NATIONAL STANDARD FOR RESISTANCE / PRIMARY STANDARD	
CURRENT STATE	PLANNED DEVELOPMENT
<p>Measurement system based on the quantum Hall effect.</p> <p>Nominal resistance value realised on the basis of Hall effect: 12,906.4035 Ω and 6,453.20175 Ω; expanded relative uncertainty for realisation of measurement unit: $\geq 6.8 \cdot 10^{-10}$.</p>	<p>Modernisation of the stand for the national resistance standard. The modernisation efforts will ensure the continuing operation of the stand. In addition, the costs of transfer of the measurement unit from the existing quantum standard will be significantly reduced. The implementation of the project will ensure more convenient access to high-precision measurements. The metrological parameters will also be improved.</p> <p>Modernisation of the stand designed for compatibility with the national standard for the</p>

	purposes of calibration of high-ohm resistors.
NATIONAL STANDARD FOR DIRECT VOLTAGE / PRIMARY STANDARD	
CURRENT STATE	PLANNED DEVELOPMENT
Measurement system consisting of a primary standard based on the Josephson effect, equipped with connector with a rated voltage of 10 V and a measurement system for performing calibrations and verification of characteristics. Relative expanded uncertainty for measurement unit realisation: $5 \cdot 10^{-9}$.	
NATIONAL STANDARD FOR ELECTRICAL CAPACITY / SECONDARY STANDARD	
CURRENT STATE	PLANNED DEVELOPMENT
Four standard quartz capacitors with nominal value of 10 pF. Relative expanded uncertainty for measurement unit realisation with respect to group standard at the 1000 Hz and 1592 Hz frequencies amounts to $5 \cdot 10^{-7}$.	The development of the standard with regard to the possibility of transferring the unit of measurement to lower-tier standards through the assembly of a set of new, thermostated electrical capacity standards equipped with a ceramic dielectric. This will make it possible to ensure a direct reference to the quantum standard for AC resistance. The new set will also enable the modernisation of the capacitor calibration method with respect to capacitors forming part of the national electrical capacity standard. The new set will make it possible to introduce a new service which meets the demands of the electric power industry. The standard will be developed in-house by laboratory employees.
NATIONAL INDUCTANCE STANDARD / SECONDARY STANDARD	
CURRENT STATE	PLANNED DEVELOPMENT
Four standard inductors with nominal value of 10 mH. Relative expanded uncertainty for measurement unit realisation with respect to group standard at the 1000 Hz frequency amounts to $4 \cdot 10^{-5}$.	Modernisation of the national inductance standard. Installation of single standard inductors sensitive to temperature changes in individual thermostats. Improvement of temperature stability of the standard and of its parameters.
NATIONAL STANDARD FOR ALTERNATING VOLTAGE / SECONDARY STANDARD	
CURRENT STATE	PLANNED DEVELOPMENT
A set of thermal AC/DC voltage transducers along with range resistors and AC/DC voltage transfer standard. Scope of measurement: from 2 mV to 1000 V and from 10 Hz to 1000 kHz. Relative expanded uncertainty: from $1 \cdot 10^{-6}$ to $120 \cdot 10^{-6}$.	Modernisation of the stand for the AC voltage national standard as well as of the system for measurement unit transfer. The acquisition of new equipment will facilitate the full transfer of alternating voltage and alternating current units by reference to direct voltage and current, using thermal AC/DC transducers with improved level of measurement uncertainty. In addition, it will also make it possible to attain the highest degree of

	precision in the course of transfer of direct voltage measurement units from the national standard to calibrators and multimeters within the requisite wide range of voltage levels. Modernisation of the stand for the national standard for alternating voltage (ACV) measurement unit. The acquisition of the device will facilitate the transfer of the ACV unit by reference to direct voltage (DCV), using thermal AC/DC transducers with improved level of measurement uncertainty, within the measurement system commonly applied by other NMIs. The implementation of the project will expand the functionality of the measurement stand, making it possible to perform calibrations and testing of ACV calibrators with no DCV measurement function, which has not been possible so far.
NATIONAL STANDARD FOR ALTERNATING VOLTAGE RATIO AT 50HZ FREQUENCY / SECONDARY STANDARD	
CURRENT STATE	PLANNED DEVELOPMENT
A divider consisting of a gas capacitor and a pair of air capacitors. Measurement scope for primary voltages: from 100 $\sqrt{3}$ V to 400000 $\sqrt{3}$ V Expanded uncertainty: 0.003% and 0.3'.	The acquisition of a stand for the calibration of capacitors at high voltage will make it possible to perform calibrations of capacitors forming part of the national standard for alternating voltage ratio, while at the same time facilitating the introduction of a new service which shall meet the requirements of the electric power industry (so far, no laboratory facility in Poland has been able to provide this service).
NATIONAL STANDARD FOR ALTERNATING CURRENT RATIO AT 50HZ FREQUENCY / SECONDARY STANDARD	
CURRENT STATE	PLANNED DEVELOPMENT
A set of two comparators and a current transformer. Measurement scope for primary currents: from 0.1 A to 2 A Expanded uncertainty: 0.008% and 0.5'. Measurement scope for primary currents: from 2 A to 10000 A Expanded uncertainty: 0.004% and 0.2'.	Acquisition of a new current comparator for primary currents of up to 5000 A (type 4764, manufactured by Haefely-Hipotronics), Acquisition of an electronic load device for current transformers, Acquisition of a Type 2767 bridge for the measurement of errors occurring in current transformers.

Domain 6: Photometry and radiometry

This domain encompasses works performed in the field of high-precision measurements of luminous intensity, illuminance, light luminance, spectral sensitivity of radiation receivers, colour temperature, trichromatic components values and chromaticity coordinates of radiation released by light sources, gloss, spectral transmittance, optical density of spectral transmittance, wavelength of transmitted radiation, trichromatic components and chromaticity coordinates of transmitted radiation, spectral reflectance, spectral luminance coefficient as well as tristimulus values and chromaticity coordinates of reflected radiation. The presently

discussed area of metrology focuses on standards, measuring instruments and measurement methods applied by environmental protection labs such as the Provincial Inspectorates for Environmental Protection or the Provincial Sanitary and Epidemiological Stations, by the pharmaceutical and cosmetics industry, the metallurgical and metalworking industry, the mining industry, by analytical laboratories (healthcare sector), by work hygiene institutions, chemical and agricultural stations, sugar plants, artificial fertiliser manufacturing plants, meat production plants, breweries, heat and power plants, waterworks, sewage treatment plants as well as by scientific and educational institutions, trade inspection authorities, customs offices and authorities and in the road and marine transport sector, the aviation sector, the offices for the protection of competition and consumers, the police, the military and various ministries.

ACTIVITIES

1. Development, implementation and improvement of measurement methods ensuring traceability with the units of measurement of the International System of Units (SI) for photometric and radiometric measurements of the highest metrological quality;
2. Performance of scientific research in the field of metrology of photometric and radiometric quantities, supporting various areas of the Polish economy;
3. Dissemination and popularisation of knowledge in the field of metrology of photometric and radiometric quantities;
4. International cooperation in the field of metrology of photometric and radiometric quantities, including, in particular, with the CIPM CCPR (Consultative Committee for Photometry and Radiometry of the International Committee for Weights and Measures) and the Technical Committee "Photometry and Radiometry" (TC PR) of the European Association of National Metrology Institutes (EURAMET e.V.) as well as with the International Organisation of Legal Metrology (OIML).

PLANNED ACTIVITIES

1. Development of metrological infrastructure ensuring traceability in the field of spectrophotometry in transmitted light. Development of measurement methods and measurement stand for the calibration of next-gen spectrophotometers.
2. Development of new methods in the field of photometric measurement. Development of a method for the calibration of photometric and colorimetric devices used for the purposes of measurements of the parameters of road lighting, illumination of various objects, monitors and LED advertisements – matrix light luminance testers.
3. Establishment of measurement infrastructure for the purposes of the printing industry. Development of a measurement method and stand for the calibration of densitometers and spectral density meters used in the course of printing quality control.
4. Making preliminary (working) versions of spectrophotometric standards available to domestic entities. Expanding the offer of available spectrophotometric standards, characterised by a wider spectral and photometric range; expanding of offer of colour standards with a clearly-defined absorption edge.
5. Development of measurement structure for the purposes of national defence as well as to accommodate the needs of the manufacturers of evacuation signs in Poland. Development of the methods for the measurement of low luminance value for photopic and scotopic vision.
6. Development of new methods in the field of gloss measurement. Development of a

method for the determination of metrological characteristics of measuring instruments used for the purposes of objective assessment of the physical properties correlating with visual perception – defining gloss value on the basis of the measurement of the refractive index.

7. Development of metrological infrastructure ensuring traceability in the field of colorimetry. Development of a measurement stand for measuring spectral reflectance using the spectrogoniophotometric method within the UV – VIS – NIR range.
8. Modernisation of the measurement infrastructure in the field of colour standards. Introduction of a stand for the production of achromatic and coloured standards used for the purposes of measuring spectral reflectance and luminance as well as for the purposes of calibration of reflective spectrophotometers and colorimeters.

MEASUREMENT STANDARDS

NATIONAL STANDARD FOR LUMINOUS FLUX / SECONDARY STANDARD	
CURRENT STATE	PLANNED DEVELOPMENT
Group of five photometric incandescent lamps with 100 V nominal voltage and 200 W power Expanded relative uncertainty: 0.01.	Acquisition of a goniophotometer (2021) – ensuring the absolute realisation of the national standard for the luminous flux measurement unit. Maintenance of the systems for the transfer of measurement units from national standards for measurement units and reference standards applied by the Central Office of Measures (standard for colour temperature). The technical solutions offered by the goniophotometer will make it possible to realise the measurement unit for luminous flux (the lumen). Acquisition of photometric lamps (2019) – the lamps currently used at the laboratories are already worn out and require gradual replacement. The design of the new photometric lamps and their technical parameters should satisfy the requirements for photometric standards of the highest quality. The photometric standards currently used are the only standards offering this degree of precision available to the measurement administration in Poland.
NATIONAL STANDARD FOR DIRECTIONAL LUMINOUS INTENSITY / SECONDARY STANDARD	
CURRENT STATE	PLANNED DEVELOPMENT
Group of five photometric incandescent lamps with 100 V nominal voltage and 200 W power Expanded relative uncertainty: 0.012.	Acquisition of a system enabling position readout and determination on a 4-metre bench (including the installation thereof) – 2019. Modernisation of the stand for the measurement of the national directional luminous intensity standard. Maintenance of the systems for the transfer of measurement units from national standards and reference standards applied by the Central Office of Measures; in the view of GUM metrologists performing calibration tasks, the current positioning

	system is in poor technical condition and may have a substantial impact on the results of both calibrations and research and development operations. The proposed technical solution will ensure a precise positioning of the lamps forming part of the directional luminous intensity standard as well as of the measuring head, ensuring precise readouts on photometric bench with the length of 4 m and uncertainty not exceeding 1 mm.
STANDARD FOR SPECTRAL TRANSMITTANCE / PRIMARY STANDARD	
CURRENT STATE	PLANNED DEVELOPMENT
<p>The reference standard for the measurement unit of transmittance is comprised of a standard spectrophotometer ensuring the realisation of the definition of spectral transmittance.</p> <p>Spectral scope: between 210 nm and 900 nm, realised values: between 0.001 and 1.000.</p> <p>Expanded uncertainty: $0.0011 \cdot D^6 - 0.0057 \cdot D^5 + 0.0129 \cdot D^4 - 0.0135 \cdot D^3 + 0.0069 \cdot D^2 + 0.001 \cdot D + 0.0013$ spectral transmittance $\tau = 10^{-D}$</p> <p>Spectral scope: between 900 nm and 2500 nm, realised values: between 0.001 and 1.000.</p> <p>Expanded uncertainty: $0.0016 \cdot D^5 - 0.0054 \cdot D^4 + 0.0079 \cdot D^3 - 0.0043 \cdot D^2 + 0.0014 \cdot D + 0.0066$ spectral transmittance $\tau = 10^{-D}$</p>	<p>Ongoing maintenance of the standard.</p> <p>Participation in the EURAMET international comparison (Project no. 1412 – “EURAMET.PR-K6 2015 Key Comparison Spectral Regular Transmittance” (2015-2018)).</p> <p>Development of a domestic source of traceability for the users of next-generation spectrophotometers for the purposes of diagnostic testing, as well as quality control standards thereof (Q2 2017 – Q4 2020).</p> <p>Establishment of an national spectral standard for transmittance which also encompasses the calibration of next-gen spectrophotometers and the quality control standards thereof on the domestic market.</p>
SPECTRAL STANDARD FOR DIFFUSE REFLECTANCE / SECONDARY STANDARD	
CURRENT STATE	PLANNED DEVELOPMENT
<p>The reference standard for the measurement unit of diffuse reflectance is a Spectralon (PTFE) standard with the diameter of 50 mm, thickness of 10 mm, nominal value of $\beta(\lambda)$ 0.99 and measurement geometry of $d : 8^\circ$:</p> <p>Measurement scope: from 380 Nm to 1400 Nm (measurement in 5 nm intervals), from 1400 nm to 2400 nm (measurement in 100 nm intervals) (380 ÷ 390) nm; expanded uncertainty: 0.004, (390 ÷ 1850) nm; expanded uncertainty: 0.002, (1850 ÷ 2200) nm; expanded uncertainty: 0.005, (2200 ÷ 2300) nm expanded uncertainty: 0.008, (2300 ÷ 2400) nm expanded uncertainty: 0.017.</p>	<p>International comparisons.</p> <p>Ensuring the highest metrological standard quality.</p> <p>Acquisition of new spectrophotometer is planned.</p>
SPECTRAL STANDARD FOR SPECTRAL LUMINANCE / SECONDARY STANDARD	
CURRENT STATE	PLANNED DEVELOPMENT
<p>The reference standard for the spectral luminance measurement unit is a white, square-shaped enamelled plate (side length: 108 nm), with nominal value of $\beta(\lambda)$ 0.84.</p>	<p>Ensuring the highest metrological standard quality</p> <p>Performing a standard stability test</p>

Measurement scope: from 400 Nm to 700 Nm (measurement geometry: 0°:45°a). Expanded uncertainty 0.0076.	
STANDARD FOR THE L*, A* AND B* COLORIMETRIC PARAMETERS / SECONDARY STANDARD	
CURRENT STATE	PLANNED DEVELOPMENT
Reference standard for the L*, a* and b* colorimetric parameter measurement unit consists of a set of 10 square-shaped ceramic plates (side length: 102 nm, thickness: 9 mm), colours: Pale Grey, Mid Grey, Deep Grey, Deep Pink, Red, Orange, Bright Yellow, Green, Cyan, Deep Blue. The L*, a* and b* colorimetric parameters for these plates have been defined for two colorimetric observers and three illuminators (A, C, D65). For the Green standard (measurement geometry 8°: d), the expanded uncertainty for the L*, a*, b* parameters is 0.2, 0.15 and 0.2 respectively.	Ensuring the highest metrological standard quality Performing a standard stability test
SPECTRAL SENSITIVITY STANDARD FOR INCOHERENT RADIATION / SECONDARY STANDARD	
CURRENT STATE	PLANNED DEVELOPMENT
The reference standard for the measurement unit of spectral sensitivity for incoherent radiation is a group of three photodiodes (silicon photodiode, germanium photodiode, InGaAs photodiode). For spectral scope between 400 nm and 800 nm – measurement in 25 nm intervals, For spectral scope between 800 nm and 950 nm – measurement in 10 nm intervals, For spectral scope between 950 nm and 1000 nm – measurement in 5 nm intervals, For spectral scope between 1000 nm and 1600 nm – measurement in 50 nm intervals, realised value between 0.05 A/W and 1 A/W. Expanded relative uncertainty: 0.003.	Acquisition of QED trap receivers (2019) Modernisation of laserometry and spectroradiometry stand and rebuilding the measurement equipment on the stand designed for the realisation of the reference standard for spectral sensitivity. The acquisition of new equipment will facilitate the adjustment of the technical condition of the measurement stand to the current requirements, thereby making it possible for the Central Office of Measures to comply with its duties in the field of: – calibration of spectral sensitivity standards and radiometers; – transferring the spectral sensitivity units which form reference standards for accredited laboratories; – calibration of the equipment used for the purposes of measurement of optical radiation hazards at work in accordance with the EU directives implemented into the Polish legal system. Acquisition of a monochromator along with the necessary equipment and software (2020) Modernisation of measurement stand – rebuilding the measurement equipment on the stand designed for the realisation of the reference standard for spectral sensitivity. – calibration of spectral sensitivity standards and radiometers; – transferring the spectral sensitivity units which form reference standards for accredited laboratories; – calibration of the equipment used for the purposes of measurement of optical radiation hazards at work in accordance with the EU directives implemented into the Polish legal system.

	A state-of-the-art monochromator will make it possible for the GUM to participate in measurements carried out at the highest possible level of accuracy, allowing it to ensure a point of reference for measurements taken at accredited laboratories as well as at military metrology laboratories.
SPECTRAL SENSITIVITY STANDARD FOR COHERENT RADIATION / SECONDARY STANDARD	
CURRENT STATE	PLANNED DEVELOPMENT
The reference standard for the measurement unit of spectral sensitivity for coherent radiation is a group of three photodiodes (silicon photodiode, germanium photodiode, InGaAs photodiode). For spectral scope between 400 nm and 800 nm – measurement in 12.5 nm intervals, for spectral scope between 800 nm and 1000 nm – measurement in 5 nm intervals, realised value between 0.3227 A/W and 0.6041 A/W, expanded uncertainty between 0.00097 A/W and 0.0054 A/W. For spectral scope between 900 nm and 1700 nm – measurement in 10 nm intervals, realised value between 0.3624 A/W and 0.9155 A/W, expanded uncertainty between 0.0013 A/W and 0.0076 A/W For spectral scope between 200 nm and 400 nm – measurement in 10 nm intervals, odtwarzane wartości od 0,1000 A/W do 0,18035 A/W, niepewność rozszerzona od 0,00040 A/W do 0,0014 A/W. Group of photoreceptors (silicon photodiode, light-trapping detectors). For laser radiation: wavelength 488 nm, realised value 0.3937 A/W; wavelength 514 nm, realised value 0.4147 A/W; wavelength 632.8 nm, realised value 0.5105 A/W. Expanded relative uncertainty: 0.004.	See item “spectral sensitivity standard for incoherent radiation”
COLOUR TEMPERATURE STANDARD / SECONDARY STANDARD	
CURRENT STATE	PLANNED DEVELOPMENT
The reference standard for the colour temperature measurement unit is comprised of a set of three photometric incandescent lamps with 100 V nominal voltage and 200 W power. Colour temperature: 2042 K, 2353 K, 2600 K, 2856 K. Expanded uncertainty: 14 K.	Acquisition of a stabilised direct current power supply (2019) – modernisation of the measurement stand – rebuilding the stand for the colour temperature reference standard. These efforts will ensure the improved implementation of the requirements of the ISO 17025 standard.
HIGH GLOSS STANDARD / SECONDARY STANDARD	
CURRENT STATE	PLANNED DEVELOPMENT
The reference standard for the high gloss measurement unit consists of a set of four	Conducting studies intended to develop a method for the determination of the metrological

<p>standard plates made of black glass as well as of a laboratory glossmeter.</p>	<p>characteristics of measuring instruments applied for the purposes of objective assessment of the physical properties correlating with visual perception – defining gloss value on the basis of the measurement of the refractive index (optical properties of materials). Acquisition (years 2019 – 2020) of a dedicated refractometer for the purposes of determination of the refractive index for gloss standards (black glass).</p>
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Domain 7: Mass and related quantities

This domain encompasses the standards for weight and mass, standard bulk density of grain, force, torque, density, viscosity and alcohol content in the air. The measurements performed in this domain of metrology are applied in all sectors of the industry, in the agricultural sector and in commercial exchange; they are also used to improve quality of life (healthcare, protection of the natural environment, the work environment and the home environment) as well as to ensure public safety.

ACTIVITIES

1. maintain and improve the national standard of the measurement unit for mass and the national standard for density as well as ensure that they are compatible with standards applied in other countries through the participation in international comparisons.
2. Maintenance and enhancement of the national standard of grain density meter (20 L) and ensuring that it is traceable to the standard European Union grain density meter.
3. Maintenance and improvement of reference standards: the measurement unit for pressure, the measurement unit for force, the measurement unit for torque, the measurement unit for hardness, the measurement unit for kinematic viscosity as well as the the measurement unit for mass concentration of alcohol in the air.
4. Transferring mass units within the scope of the domains covered by the Autonomous Mass Laboratory.
5. Manufacture and certification of the reference materials for density, surface tension and viscosity.
6. Performance of tasks in the field of regulatory metrological control.
7. Performing the tasks of research laboratory facilities for module B of compliance assessment – type testing for non-automatic weighing instruments (the NAWI directive) and automatic weighing instruments (the MID directive).
8. Domestic and international cooperation in research projects and operations in the field of metrology of mass and related quantities.
9. Support and development of the industry in the field of measurements which remain within the scope of competences of the mass laboratory.

PLANNED ACTIVITIES

1. Development of metrological infrastructure ensuring traceability in the field of mass, following the redefinition of the kilogramme. Acquisition of an automated vacuum mass

- comparator with external adjustment.
2. Development of metrological infrastructure ensuring traceability in the field of testing electrical interference affecting the results of measurements taken using various weighing instruments, including the interference caused by automotive installations (the so-called automotive testing).
 3. Performance of joint research encompassing the size of moving vehicles, the „HS-WIM” (High Speed Weighing in Motion) project, currently known as the eMIM (electronic measuring in motion) project, in cooperation with the Main Inspectorate Of Road Transport (GITD) and General Directorate for National Roads and Motorways (GDDKiA). Another project is also being implemented within the framework of the Consultative Metrological Team for Technology and Industrial Processes (in the field of dynamic measurements of aggregate mass and axis load of road vehicles).
 4. Modernisation and extension of the metrological infrastructure ensuring traceability in the field of density – automation and computerisation of measurement stands.
 5. Introduction of next-generation certified reference materials to the market – the so-called multi-parameter materials, characterised by lower uncertainty levels and capable of realisation of other physical properties in addition to density (viscosity, light refractive index, surface tension).
 6. Development of metrological infrastructure ensuring traceability in the field of measurement of the viscosity of non-Newtonian fluids. Establishing a national standard for the measurement unit for viscosity. Acquisition of a rotational viscometer (reference instrument).
 7. Development of metrological infrastructure ensuring traceability in the field of measurement of pressure values. Establishing a national standard for the measurement unit of pressure. Acquisition of piston-cylinder sleeve measurement sets with large active cross section for the purposes of development of a primary standard for pressure unit. Development of a measurement stand for micromanometric measurements. Development of a measurement stand for the measurement of dynamic pressure.
 8. Modernisation and extension of the metrological infrastructure ensuring traceability in the field of hardness. Development of a Rockwell hardness reference standard for N and T scales, purchase or development of stands for testing microhardness, nanohardness, Leeb hardness and Shore hardness (following the completion of an internship at the National Institute of Metrology in Germany by the employee).
 9. Modernisation and extension of the metrological infrastructure ensuring traceability in the field of force. Development of a new standard/measurement stand – a deadweight force machine with amplification lever as well as automation of deadweight force machine control in order to streamline the calibration process.
 10. Development of the metrological infrastructure ensuring traceability in the field of breath analysers. Development of a breath analyser with the lowest instrumental measurement uncertainty (the best metrological parameters industrial accordance with recommendation OIML R126 – Evidential breath analyzers) within the framework of the Consultative Team for Technology and Industrial Processes. Manufacture of certified reference materials for ethanol content in water for the purposes of breath analyser calibration – participation in the EMPIR „ALCOREF” project (16RPT02).

MEASUREMENT STANDARDS

NATIONAL MASS STANDARD / SECONDARY STANDARD	
CURRENT STATE	PLANNED DEVELOPMENT
<p>The national mass measurement unit standard consists of a prototype of the kilogramme no. 51 in the form of a platinum-iridium cylinder with a mass of $1 \text{ kg} + 227 \cdot 10^{-9} \text{ kg}$ (combined standard uncertainty $- 2,3 \cdot 10^{-9} \text{ kg}$).</p>	<p>In order to maintain and improve the national standard for the measurement unit of mass as well as to ensure that this standard remains matched with the standards applicable in other countries, it shall be necessary to acquire an automatic vacuum mass comparator with external adjustment; this will allow the GUM to participate in research and implementation works prior and after the redefinition of the measurement unit for mass as well as to become an equal partner in international key comparisons (BIPM, EURAMET) as well as supplementary and bilateral comparisons. Furthermore, this step will also allow the Polish system of measures to remain independent from other countries insofar as mass and related quantities are concerned, while the GUM retains a measurement capacity at the current level (CMC), thus avoiding the risk of deterioration of technical competences of staff in the field of mass measurement. The stand will include:</p> <ul style="list-style-type: none"> – a mass comparator, – a set of mass standards (15 standard replicas for 1 kilogramme: 2 steel cylinders, 10 cylinders with headers, 2 complex sets ranging from 100 g to 500 g as well as one silicon sphere), – a high vacuum measurement module, – a measurement module for the measurement of mass in a gas-shielded environment (inert gases: argon and nitrogen), – a measurement module for the measurement of magnetic properties of mass standards. <p>In addition, development in the following areas must be ensured:</p> <ul style="list-style-type: none"> – testing electrical interference affecting the results of measurements taken using various weighing instruments, including the interference caused by automotive installations (the so-called automotive testing) – cooperation in the field of dynamic measurement of aggregate mass and axis load of road vehicles.
NATIONAL DENSITY STANDARD / SECONDARY STANDARD	
CURRENT STATE	PLANNED DEVELOPMENT
<p>The national measurement unit standard for density is a cuboid silicon monocrystalline solid designated as WASO 9.2, having the density of</p>	<p>In order to maintain and improve the national standard for the measurement unit for density as well as to ensure that this standard remains</p>

<p>2329.0889 kg/m³ in the temperature of 20 °C. The standard allows the realisation and transfer of density values on the hydrostatic weighing station (range of density measurement between 600 kg/m³ and 22000 kg/m³, scope of temperature between 5 °C and 60 °C).</p> <p>Expanded uncertainty: 2·10⁻³ kg/m³.</p> <p>The Central Office of Measures is also in possession of a spherical silicon monocrystalline solid (mass: 0.99730841±0.00000030 kg, diameter: 93.6 mm approx.), which was twice calibrated: in 2003 and in 2013, using the pressure floatation method and based on the PTB primary standards. The density of the SILO2 sphere in the temperature of 20 °C and pressure of 10⁵ Pa amounts to 2329.11453 kg/m³, with expanded uncertainty of 1.52×10⁻³ kg/m³.</p> <p>The silicon-based standards allow for the realisation and transfer of density values on the hydrostatic weighing station (range of density measurement between 600 kg/m³ and 22000 kg/m³, scope of temperature between 5 °C and 60 °C).</p>	<p>matched with the standards applicable in other countries, the following actions need to be taken:</p> <ul style="list-style-type: none"> – automation and computerisation of density measurement stand, – participation in international comparisons: steel standards for mass (EURAMET), oscillation density meter calibration (CCM), fluid surface tension measurement (EURAMET, pilot), – measurement of mass standard density (including large standards), – Introduction of next-generation certified reference materials to the market – the so-called multi-parameter materials, characterised by lower uncertainty levels and capable of realisation of other physical properties in addition to density (viscosity, light refractive index, surface tension). – development of preliminary tenets for the installation of new measurement stand (pressure floatation method, magnetic float method).
VISCOSITY STANDARD / PRIMARY STANDARD	
CURRENT STATE	PLANNED DEVELOPMENT
<p>The reference standard for the measurement unit of kinematic viscosity consists of: a set of standard viscometers (30 units), K = (0,003 ÷ 100) mm²·s⁻², along with a stand for viscometric measurements in the field of kinematic viscosity (1 ÷ 150000) mm²·s⁻¹, temperature: (20 ÷ 80) °C.</p> <p>Relative expanded uncertainty: from 4·10⁻⁴ to 3·10⁻³.</p>	<p>In order to maintain and improve the reference standard for the measurement unit for viscosity as well as to ensure that this standard remains matched with the standards applicable in other countries, an national standard for the measurement unit of viscosity needs to be established. In order to achieve this objective, the following actions will also need to be taken:</p> <ul style="list-style-type: none"> – measurement of non-Newtonian fluids at the GUM with the minimum level of uncertainty (acquisition of a rotational viscometer – reference instrument). – ensuring domestic traceability in the field of measurement of non-Newtonian fluids, – development of reference materials for the measurement of viscosity of non-Newtonian fluids, – introduction of the new generation of viscosity standards based on non-Newtonian fluids to the market.
PRESSURE STANDARD / PRIMARY STANDARD	
CURRENT STATE	PLANNED DEVELOPMENT
<p>The reference standard for the measurement unit for pressure consists of:</p> <ol style="list-style-type: none"> 1. A hydrostatic micromanometer with 	<p>In order to maintain and improve the reference standard for the measurement unit for pressure as well as to ensure that this standard remains</p>

<p>measurement range between 100 Pa and 3500 Pa. Relative pressure, medium: gas. Expanded uncertainty: from 0.14 Pa to 0.31 Pa</p> <p>2. Two measurement sets based on the use of a dead-weight piston-type manometer with combined measurement range of between $3.5 \cdot 10^{-3}$ MPa and 7.0 MPa. Absolute and relative pressure, medium: gas. Expanded uncertainty: $(0,2 \text{ Pa} + 2,5 \cdot 10^{-5}p) \div (3,0 \cdot 10^{-5}p)$</p> <p>3. Three measurement sets based on the use of a dead-weight piston-type manometer with combined measurement range of between 0.2 MPa and 250 MPa. Relative pressure, medium: oil. Expanded uncertainty: $(6 \text{ Pa} + 3,0 \cdot 10^{-5}p) \div (2,0 \text{ Pa} \cdot 10^{-4}p)$.</p>	<p>matched with the standards applicable in other countries, a national standard for the measurement unit of pressure needs to be established. In order to achieve this objective, piston-cylinder sleeve measurement sets with large active cross section need to be acquired. This will make it possible to determine the value of active cross-section using geometric measurements. Other necessary measures:</p> <ol style="list-style-type: none"> 1. extending measurement range both for high pressure and micropressure, 2. design and development of a designated stand for dynamic pressure measurement, 3. improving the method for the calibration of dead-weight piston-type manometers (the so-called cross-floating method), 4. automation of measurement stands.
ROCKWELL HARDNESS STANDARD / PRIMARY STANDARD	
CURRENT STATE	PLANNED DEVELOPMENT
<p>The reference standard for Rockwell hardness measurement unit (scales A, B, C, D, F, G, H and K) consists of the following components:</p> <ol style="list-style-type: none"> 1) primary hardness tester, 2) laser interferometer based on a helium-neon laser with wavelength of 632.991 nm which makes it possible to take measurements of constant gain of imprint depth with measurement errors not exceeding 0.08 μm, 3) a set of three diamond indenter pins for scales A, C and D, 4) ball indenters with ball diameter of: <ul style="list-style-type: none"> – (1,5875 \pm 0,002) mm for B, F, G scales – (3,155 \pm 0,003) mm for the E, H, K scales. <p>Measurement ranges for Rockwell hardness scales: A, C, D. Expanded uncertainty 0.3 HR, Measurement ranges for Rockwell hardness scales: B, E, F, G, H, K. Expanded uncertainty 0.4 HR</p>	<p>In order to maintain and improve the reference standard for the measurement unit of hardness as well as to ensure that this standard remains matched with the standards applicable in other countries, the following actions need to be taken:</p> <ul style="list-style-type: none"> – development of a Rockwell hardness reference standard (scales N, T) in cooperation with the Warsaw University of Technology (introduction of the Rockwell hardness standard calibration and Rockwell hardness measurement services for scales N and T in order to meet the demands of the industry and the military), – measurement of microhardness at the level below HV0.05 as well as measurement of nanohardness (acquisition of the appropriate measurement equipment in order to perform measurements for the industry and the military), – Leeb hardness: development or acquisition of a Leeb hardness stand for the calibration of standards for Leeb hardness testers used in the industry, – Shore hardness: development or acquisition of a Shore hardness stand for the calibration of rubber hardness standards used in the industry (in cooperation with the Institute of Rubber Industry), – measurement of hardened layer thickness to meet the demands of the industry.
VICKERS HARDNESS STANDARD / PRIMARY STANDARD	
CURRENT STATE	PLANNED DEVELOPMENT
The reference standard for the Vickers hardness	as above

<p>measurement unit consists of:</p> <ol style="list-style-type: none"> 1) primary hardness meter within the HV0.05 – HV0.5 range, 2) NBEV 10 primary hardness meter within the HV1 – HV10 range, 3) primary hardness meter within the HV30 – HV100 range, 4) digital microscope with a camera, equipped with interchangeable lens with total magnification of 100x, 200x and 500x (for the measurement of diagonal lines of up to 0.5 mm), 5) measurement microscope with interchangeable lens with total magnification of 100x, 200x (for the measurement of diagonal lines of more than 0.5 mm), <p>Measurement ranges for Vickers hardness scales:</p> <ul style="list-style-type: none"> – between HV0.05 and HV0.1 – expanded relative uncertainty: $[1.2 + 0.07 / d(\text{mm})]$ %, – between HV0.2 and HV0.5 – expanded relative uncertainty: $[1.9 + 0.05 / d(\text{mm})]$ %, – between HV1 and HV10 – expanded relative uncertainty: $[1.2 + 0.02 / d(\text{mm})]$ %, – between HV30 and HV100 – expanded uncertainty of 2%. 																					
BRINELL HARDNESS STANDARD / PRIMARY STANDARD																					
CURRENT STATE	PLANNED DEVELOPMENT																				
<p>The reference standard for the Brinell hardness measurement unit consists of:</p> <ol style="list-style-type: none"> 1) hardness meter with integrated measurement microscope and ball indenters (ball diameter between 1 mm and 2.5 mm) – for Brinell hardness scales with loads between 98.07 N and 1839 N, 2) hardness meter with ball indenters (ball diameter between 10 mm and 5 mm) – for Brinell hardness scales with loads between 2452 N and 29420 N 3) digital microscope with camera 4) Measurement ranges for Brinell hardness and expanded uncertainty <table border="1" data-bbox="229 1655 751 2018"> <thead> <tr> <th>Brinell hardness scale</th> <th>Uncertainty (%)</th> </tr> </thead> <tbody> <tr><td>HBW 10/3000</td><td>0.7</td></tr> <tr><td>HBW 5/750</td><td>1.0</td></tr> <tr><td>HBW 2.5/187.5</td><td>0.8</td></tr> <tr><td>HBW 1/30</td><td>1.0</td></tr> <tr><td>HBW 10/1000</td><td>0.7</td></tr> <tr><td>HBW 5/250</td><td>1.0</td></tr> <tr><td>HBW 2.5/62.5</td><td>0.8</td></tr> <tr><td>HBW 1/10</td><td>1.0</td></tr> <tr><td>HBW 10/500</td><td>0.8</td></tr> </tbody> </table>	Brinell hardness scale	Uncertainty (%)	HBW 10/3000	0.7	HBW 5/750	1.0	HBW 2.5/187.5	0.8	HBW 1/30	1.0	HBW 10/1000	0.7	HBW 5/250	1.0	HBW 2.5/62.5	0.8	HBW 1/10	1.0	HBW 10/500	0.8	<p>as above</p>
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HBW 10/500	0.8																				

HBW 5/125		1.2	
HBW 2.5/31.25		1.0	
FORCE STANDARD / PRIMARY STANDARD			
CURRENT STATE		PLANNED DEVELOPMENT	
<p>The reference standard for the measurement unit of force consists of:</p> <ol style="list-style-type: none"> 1. Dead-weight force machine, load values: (10, 20,..., 100) N, 120 N, 140 N, 150 N, 160 N, 180 N, 200 N, 220 N, (250, 300,..., 500) N. Expanded relative uncertainty: $6 \cdot 10^{-5}$ 2. Dead-weight force machine, load values:(100, 150,..., 500) N, (600, 700,..., 1000) N, (1250, 1500,..., 3000) N, (3500, 4000,..., 5000) N; additional load values: 6.25 N, 12 N, 24 N, 50 N, 122 N. Relative expanded uncertainty: $6 \cdot 10^{-5}$ 3. Dead-weight force machine, load values: (1.2,..., 10) kN, 12 kN, 15 kN, 18 kN, 20 kN, 21 kN, 24 kN, 25 kN, 27 kN, (30, 35,..., 55) kN; additional load values: 129.2 N, 225.8 N, 387 N, 451.7 N. Relative expanded uncertainty: $1 \cdot 10^{-4}$ 4. Dead-weight force machine, load values: (10, 20,..., 60) kN, (110, 160,..., 460) kN; (10, 20,..., 70) kN, (120, 170,..., 470) kN; (10, 20,..., 80) kN, (130, 180,..., 480) kN; (10, 20,..., 90) kN, (140, 190,..., 490) kN; (10, 20,..., 100) kN, (150, 200,..., 500) kN. Relative expanded uncertainty: $6 \cdot 10^{-5}$ <p>Secondary standard</p> <ol style="list-style-type: none"> 1. Hydraulic machine with build-up reference system. Measurement range between 100 kN and 3000 kN. Expanded relative uncertainty: $5 \cdot 10^{-4}$ 		<p>In order to maintain and improve the reference standard for the measurement unit of force as well as to ensure that this standard remains matched with the standards applicable in other countries, the following actions need to be taken:</p> <ol style="list-style-type: none"> 1. Establishment of a new measurement/standard stand: <ul style="list-style-type: none"> – dead-weight force machine with amplification lever, measurement range between 1 kN and 1000 kN (for the purposes of maintenance of existing measurement capacity), 2. acquisition of specialistic software, 3. automation of the control of deadweight force machines in order to streamline the calibration process. 	
TORQUE STANDARD / SECONDARY STANDARD			
CURRENT STATE		PLANNED DEVELOPMENT	
<p>The torque measurement unit reference standard consists of a dedicated stand with reference system. Measurement scope: from 5 Nm to 5000 Nm. Relative expanded uncertainty measured using torque meters: $8 \cdot 10^{-4}$ within measurement range between 5 N·m and 10 N·m, $4 \cdot 10^{-4}$ within measurement range between 10 N·m and 5000 Nm. Expanded relative uncertainty for the calibration of reference torque wrenches: $2 \cdot 10^{-3}$ within measurement range between 5 N·m and 10 N·m, $1 \cdot 10^{-3}$ within measurement range between 10 N·m</p>		<p>as above</p>	

and 5000 Nm.	
STANDARD FOR THE MASS CONCENTRATION OF ETHANOL IN AIR / PRIMARY STANDARD	
CURRENT STATE	PLANNED DEVELOPMENT
<p>The reference standard for the measurement unit of mass concentration of ethanol in air is comprised of liquid ethanol standards made using the gravimetric method, along with the stand for the production of standards for ethanol content in air.</p> <p>Ethanol content in air: mass concentration of ethanol from 0.05 mg/l to 3.00 mg/l. expanded uncertainty: from 0.001 mg/l to 0.030 mg/l.</p>	<p>In order to maintain and improve the reference standard for the measurement unit of mass concentration of ethanol in air as well as to ensure that this standard remains matched with the standards applicable in other countries, the following actions need to be taken:</p> <p>development of a breath analyser with the lowest instrument measurement uncertainty (the best metrological parameters in accordance with recommendation OIML R126 – Evidential breath analyzers) within the framework of the Consultative Team for Technology and Industrial Processes.</p> <ol style="list-style-type: none"> 1. determination of measurement capability of stand for calibration of breath analysers with respect of mass concentration of ethanol of up to 2 mg/l as well as above that value, 2. organising inter-laboratory comparisons within the entire measurement range for breath analysers both domestically and abroad, 3. verification of the stand for breath analyser testing, 4. assessment of the uniformity and stability of liquid standard solutions of ethanol.

Domain 8: Ionising radiation

This domain encompasses issues related to the measurement and calculation of ionising radiation doses as well as other quantities related to the influence of ionising radiation on matter (including, in particular, living matter). These measurements are mostly used in the healthcare sector (medical diagnostics and radiotherapy) as well as in radiological protection (environmental protection, nuclear energy sector, the military).

ACTIVITIES

1. Maintenance and improvement of X-ray and gamma ray air kerma primary standards and ensuring that they are compatible with standards applied in other countries through the participation in international comparisons.
2. Transfer of the unit of measure for air kerma while maintaining traceability:
 - calibration of radiological protection dosimeters with ionisation chambers,
 - calibration of measurement benches,
 - irradiation of substances with X-ray and gamma ray standard doses,
 - preparation of expert reports with respect to ionising radiation measuring instruments.
3. Maintenance and improvement of GUM reference standards for gamma ray dose absorbed in water as well as participation in international comparisons.

4. Transferring the measurement unit for absorbed dose while maintaining traceability:
 - calibration of therapeutic dosimeters with ionisation chambers,
 - preparation of expert reports with respect to ionising radiation measuring instruments.
5. cooperate with international metrological organisations and national metrological institutes from other countries.

PLANNED ACTIVITIES

1. Development of primary standard for dose absorbed in water (ionisation chamber, water calorimeter, graphite calorimeter).
2. Extension of the stand for the measurement of the quantity of X-ray air kerma to enable the calibration of instruments used in medical diagnostics (mammography, radiography, computed tomography).
3. Development of a reference standard for brachytherapy.

MEASUREMENT STANDARDS

STANDARD FOR GAMMA RAY AIR KERMA / PRIMARY STANDARD	
CURRENT STATE	PLANNED DEVELOPMENT
Graphite ionisation chamber Energy range: 660 keV (¹³⁷ Cs) 1250 keV (⁶⁰ Co) Expanded uncertainty 1.0%	<ol style="list-style-type: none"> 1. Development of a new standard – graphite ionisation chamber 2. Decreasing the level of expanded uncertainty to 0.5%
STANDARD FOR X-RAY AIR KERMA / PRIMARY STANDARD	
CURRENT STATE	PLANNED DEVELOPMENT
Set of ionisation chambers with air-equivalent walls Voltage range for X-ray tube: from 10 kV to 50 kV from 40 kV to 300 kV Expanded uncertainty 1.0%	<ol style="list-style-type: none"> 1. Extension of the stand to enable the calibration of instruments used in medical diagnostics (mammography, radiography, computed tomography). <ul style="list-style-type: none"> – measurement of absorbed dose, – non-invasive voltage measurement for X-ray tubes, – exposure time measurement. 2. Construction of primary standard of absorbed dose in water 3. Decreasing measurement uncertainty to the level of 0.5%
STANDARD FOR DOSE ABSORBED IN WATER / SECONDARY STANDARD	
CURRENT STATE	PLANNED DEVELOPMENT
Graphite ionisation chamber Energy range: 1250 keV (⁶⁰ Co) Expanded uncertainty 1.3%	<ol style="list-style-type: none"> 1. Development of primary standard: <ul style="list-style-type: none"> – ionisation chamber, – water calorimeter, – graphite calorimeter.

	2. Decreasing the level of expanded uncertainty to 0.8%
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Domain 9: Flow

This domain encompasses issues related to the measurement of flow rate for utilities such as water, gas, fuel, consumable liquids, cryogenic fluids, special application fluids, sewage and even heat. The tasks implemented are associated with the measurement of flow rate and volumetric flow rate for both gas and liquids as well as with measurements of heat flows and static volume for various instruments and with gas flow speed measurements.

The measurements performed in this domain accommodate the needs of the national economy, science and administration insofar as traceable and reliable measurements in the following areas are concerned:

healthcare (metrology in biomedical applications), protection of natural environment and human life, safety and public order, consumer rights protection, settlements of public charges and receivables, business transactions and trade, energy consumption optimisation and reduction as well as new sources of energy.

ACTIVITIES

Gas flow

1. Maintenance and performance of research and development activities related to the reference standard for the measurement unit of gas flow volume and volumetric flow rate – performance of works intended to ensure that the existing standard attains the status of national measurement unit standard.
2. Performance of scientific and research and development works pertaining to the measurement of gas flow, development and improvement of measurement methods. Conducting works associated with ensuring the possibility for calibration of various atypical measuring instruments and the methods of calibration thereof.
3. Transfer of measurement unit for flow volume and volumetric flow rate for gas.
4. Ensuring the compatibility of the aforementioned standard (ensuring traceability) with standards applied in other countries through the participation in international comparisons.
5. Participation in domestic and international research projects in the field of gas flow metrology.
6. EU type testing – compliance assessment of conversion rates for gas meter.

Liquid flow

1. Maintenance and performance of research and development activities related to the reference standard for the measurement unit of water flow volume and volumetric flow rate – performance of works intended to ensure that the existing standard attains the status of national measurement unit standard.
2. Performance of research and development works related to measurements of liquid flow (water and liquids other than water) as well as development and improvement of

measurement methods. Conducting works associated with ensuring the possibility for calibration of various atypical measuring instruments and the methods of calibration thereof.

3. Determination of the development directions for domestic metrology in the field of liquid flow.
4. Transfer of unit of measure for flow volume and volumetric flow rate of water.
5. Ensuring the compatibility of the aforementioned standard (ensuring traceability) with standards applied in other countries through the participation in international comparisons.
6. Participation in domestic and international research projects in the field of liquid flow metrology.
7. EU type testing – compliance assessment of water meters, flow transducers for heat meters as well as for measuring systems for continuous and dynamic measurement of volume of liquids other than water.

Heat measurements

1. Maintaining and carrying out research and development activities related to the measurement stand for heat measurement.
2. Performance of scientific and research and development works pertaining to the measurement of heat flow, development and improvement of measurement methods.
3. Determination of the development directions for domestic metrology in the field of heat measurements.
4. Participation in domestic and international research projects in the field of heat measurement metrology.
5. EU type testing – compliance assessment of heat meters as well as calculator devices and paired temperature sensors (heat meter components).

Static volume

1. Maintaining and carrying out research and development activities related to the GUM reference standard for the unit of static volume.
2. Performance of scientific and research and development works pertaining to the measurement of static volume (weight-based measurement method), development and improvement of measurement methods.
3. Determination of the development directions for domestic metrology in the field of static volume measurements.
4. Transfer of unit of measure for static volume.
5. Ensuring the compatibility of the aforementioned standard (ensuring traceability) with standards applied in other countries through the participation in international comparisons.
6. Participation in domestic and international research projects in the field of static volume metrology.

7. EU type testing – compliance assessment of capacity serving measures.

Gas flow speed – new domain for the laboratory

1. Extension of measurement capabilities of the Central Office of Measures through the addition of a new sub-domain: gas flow speed.
2. Transfer of measurement unit for gas flow speed.
3. Conducting research and development works associated with ensuring the possibility for calibration of various atypical measuring instruments and the methods of calibration thereof.
4. Participation in domestic and international research projects in the field of gas flow rate metrology.

PLANNED ACTIVITIES

Gas flow

The activities in the field of measurement of gas flow will concentrate mostly on the performance of research and development works in the field of small and medium gas flows, based on the identified needs of the Polish industry. Other significant actions to be taken include the preparation of the tenets for the development of new measurement standards for high volumetric flow rate and high pressure (to be operated at the new laboratory campus of the GUM). In particular, the following activities are planned:

1. Maintaining the measurement unit for flow volume and volumetric flow rate for gas as well as ensuring the possibility for the transfer of the said measurement unit. Acquisition of a stand equipped with a standard bell-type gas holder (replacement of the existing stand which is now 35 years old).

Rebuilding of the standard measurement stand and replacement of the existing stand forming part of the reference standard for gas flow volume and volumetric flow rate (the current stand is 35 years old).

Objective: Improvement of metrological characteristics and modernisation of the existing standard within the scope of volumetric flow rate – (1–250) m³/h.

2. Increase of measurement capabilities for microflows and gas flow measurements at high pressure.

Supply of stands with piston-type gauges for testing gas meters and gas flow meters at both atmospheric pressure and high pressure (up to 6 bar) – new area of activity (high pressure) of the laboratory arising from the increasing needs of the industry. (Implementation possible following the completion of action no. 1).

Stage I: piston-type standard operating in the micro-flow range (volumetric flow rate from 6 cm³/h to 6000 cm³/h – extension of measurement capabilities of the laboratory by two orders of magnitude in the field of low pressure (current standard only enables measurement within the range of up to 600 cm³/h).

Stage II: piston-type standard with volumetric flow rate ranging from 16 dm³/h to 16000 dm³/h.

Objective: Extending the measurement capacity of the laboratory. Introducing the

possibility of testing gas meters and gas flow meters at high pressure. Support and development of economic operators.

3. Modernisation of the obsolete equipment and measurement standards. Modernisation and automation of the system for collecting and processing measurement data. Extension of the existing measurement stand through the addition of new measurement sections (pipes, cones).

Objective: Decreasing measurement uncertainty

4. Performance of works associated with the extension of the measurement range to include high volumetric flow rates of gas through the preparation of tenets for the development of an appropriate measurement standard (to be assembled and operated on the new GUM laboratory campus).

Objective: Extension of measurement capacity for the purposes of calibration of gas meters and gas flow meters with volumetric flow rate of at least 10000 m³/h.

Liquid flow

The activities in the field of measurement of water flow will concentrate mostly on the performance of research and development works in the field of micro, small and medium water flows, based on the identified needs of the Polish industry. Other significant actions to be taken include the preparation of the tenets for the development of new measurement standards for high flow volume (to be operated at the new laboratory campus of the GUM). In particular, the following activities are planned:

1. Extending measurement capacity in the field of micro-flows with respect to the reference standard unit of water flow volume and volumetric flow rate.

Extension of the measurement stand for the testing and calibration of water meters, flow transducers for heat meters as well as flow meters for cold and hot water (low flow values).

Stage I: Extension of the low measurement range for volumetric flow rate (0.1 dm³/h – 3.0 dm³/h).

Stage II: Extension of the low measurement range below 0.1 dm³/h.

2. Modernisation of the transfer device assembly of the measurement stand for the testing and calibration of water meters, flow transducers for heat meters as well as flow meters for cold and hot water.

Objective: Decreasing measurement uncertainty with respect of the measurement of volumetric flow rate resulting from synchronisation errors occurring in transfer devices.

3. Installation of an outflow assembly forming part of the measurement stand for the testing and calibration of water meters, flow transducers for heat meters as well as flow meters for cold and hot water (high flow values).

Objective: expanding the volume measurement scope in order to reach the contemplated limit defined by the existing weighing device (1500 kg) as well as decreasing the volumetric flow rate measurement uncertainty caused by synchronisation errors occurring in the transfer device.

4. Ensuring the possibility for the transfer of measurement unit for flow volume and

volumetric flow rate for water (high flow volume).

Objective: Preparing the tenets for the development of a new measurement stand for the testing and calibration of water meters, flow transducers for heat meters as well as cold and hot water flow meters with respect to flow values ranging between 50 dm³/h and 2000 dm³/h (to be operated on the new GUM laboratory campus).

5. Enabling the performance of conceptual and R&D works pertaining to the quantitative measurements of modern energy sources (e.g. LNG, CNG, hydrogen). Analysis of factors influencing measurement uncertainty. Preparing the tenets and developing a standard measurement stand for LNG flow volume and volumetric flow rate testing (weight measurement stand). Providing support to the Polish industry in this regard.

Objective: Development of measurement methods applied for the purposes of LNG, CNG and hydrogen flow testing.

6. Development of measurement methods making it possible to increase the class ratings of installations used on the fuel market (change of class rating from 0.5 to 0.3 with respect to fuel distribution installations at fuel depots, installations used for tank trucks as well as in fuel dispensers (oil, petroleum, aviation fuel)).

Objective: Increasing the degree of accuracy in fuel sale transactions will make it possible to ensure the closer monitoring of the entire trading process as well as the make the tax calculations relating to fuel quantities more closely linked to the actual volume of fuel.

7. Identification of the needs of the Polish industry within the scope of the measurement of liquid flow in open channels.

Heat measurements

1. Modernisation of the S03 measurement stand for the purposes of EU type testing of hybrid heat meters (testing of calculators with paired temperature sensors) through the extension of the measurement range to 200 °C (acquisition of 60 l of the THERM 240 liquid manufactured by LAUDA (Germany)) as well as changing the method for the measurement of electrical resistance in standard sensors – decreasing measurement uncertainty (modernisation of computer software).
2. Development and implementation of a method for automated measurement of resistance in temperature sensor simulators using high-stability standard resistors and a digital multimeter.
3. Development of measurement methods for devices designed to measure the amount of heat absorbed from the environment (cooling meters). Supply of two high-quality thermostats with cooling function.

Objective: Ensuring the possibility of testing various devices in the event that the increasingly popular cooling meters are covered by regulatory metrological control.

Static volume

1. Development and improvement of measurement methods for medical and laboratory applications associated with the measurement of micro-volumes.

Stage I: Modernisation of the stand for the determination of piston-type micropipettes using a micro-balance with steam trap (maximum load – 22 g, read-out accuracy – 1 µg).

Stage II: Modernisation and automation of the system for collecting and processing measurement data (e.g. temperature measurements) as well as improvement of the environmental conditions in laboratory facilities (addition of a windless air conditioning installation with automatic sensors measuring air temperature, pressure and humidity).

Objective: Enhancement of measurement methods. Expansion of the scope of works in the field of micro-volumes. Decreasing measurement uncertainty.

2. Development of solutions for medical and laboratory applications pertaining to volume measurements, including measurement methods and uncertainty assessment methods pertaining to:
 - calibration of burettes and piston dosing dispensers (automatic) with nominal capacity between 1 µl and 10000 µl,
 - calibration of multi-channel pipettes.

Objective: Enhancement of measurement methods. Decreasing measurement uncertainty.

Flow speed – new domain for the laboratory

1. Performance of a comprehensive analysis of the needs in the field of air flow measurement (anemometry) and flow measurement for other liquids – both with respect to laboratory facilities and personnel:
 - performing an analysis of the laboratory needs with respect to the necessary equipment for flow speed research,
 - establishing contact with specialists from other NMIs with experience in the field of measurements of this type,
 - establishing contact with domestic accredited laboratories,
 - defining the needs of the Polish manufacturers and users of flow speed measurement devices

GAS FLOW VOLUME AND VOLUMETRIC FLOW RATE MEASUREMENT UNIT STANDARD / PRIMARY STANDARD	
CURRENT STATE	PLANNED DEVELOPMENT
Three bell-type standards: $V = (0.2 \div 65) \text{ m}^3$, $Q = (0.016 \div 7000) \text{ m}^3/\text{h}$. Two bell-type standards: $V = (0.2 \div 12) \cdot 10^{-3} \text{ m}^3$, $Q = (0.0007 \div 0,7) \text{ m}^3/\text{h}$. Relative expanded uncertainty: $(1.2 \div 2.5) \cdot 10^{-3}$ for flow volume $(1.3 \div 3.0) \cdot 10^{-3}$ for volumetric flow rate	Maintaining the highest metrological standard quality, ongoing verification of declared measurement uncertainty values. Participation in international, key and regional comparisons. Ensuring the standard becomes a national measurement standard. Expanding the scope of volumetric flow rate
MEASUREMENT UNIT FOR FLOW VOLUME AND VOLUMETRIC FLOW RATE OF WATER /PRIMARY STANDARD	
CURRENT STATE	PLANNED DEVELOPMENT

<p>Three weight-based standards with water tanks: $V = (0.025 \div 6.0) \text{ m}^3$, $Q = (0.006 \div 150) \text{ m}^3/\text{h}$. Relative expanded uncertainty: $(1,0 \div 4,0) \cdot 10^{-3}$ for flow volume, $(1,0 \div 4,0) \cdot 10^{-3}$ for volumetric flow rate</p>	<p>Maintaining the highest metrological standard quality, ongoing verification of declared measurement uncertainty values. Participation in international, key and regional comparisons. Ensuring the standard becomes a national measurement unit standard. Expanding the scope of volumetric flow rate</p>
STATIC VOLUME STANDARD / SECONDARY STANDARD	
CURRENT STATE	PLANNED DEVELOPMENT
<ol style="list-style-type: none"> 1. stand for gravimetric measurements, including non-automated electronic balances with max load of 303 g and 0.1 mg scale interval as well as with max load of 8200 g and 0.01 g scale interval. Measurement range for glass measuring instruments: $V = (0.0005 \div 5) \text{ l}$. Expanded uncertainty: $(0.2 \div 0.01) \%$, 2. stand for gravimetric measurements, including non-automated electronic balance with max load of 8200 g and 0.01 g scale interval Measurement range for metal flasks: $V = (2 \div 5) \text{ l}$. Expanded uncertainty: $(0.01 \div 0.05) \%$, 3. stand for gravimetric measurements, including non-automated electronic balance with max load of 21 g and 0.001 mg scale interval. Measurement range for piston-type pipettes: $V = (1 \div 10,000) \mu\text{l}$. Expanded uncertainty: $(0.025 \div 15) \mu\text{l}$. 	<p>Maintaining the highest metrological standard quality, ongoing verification of declared measurement uncertainty values. Participation in international, key and regional comparisons. Expanding the scope of volumetric flow rate</p>

Domain 10: Thermometry

This domain encompasses the realisation of the International Temperature Scale (MST-90) as well as temperature and humidity measurement. The measurements are taken for the benefit of numerous areas of the economy, including in the course of manufacturing processes in the food, pharmaceutical and chemical industry, in the heavy industry (aviation, transportation, smelting industry etc.) as well as in the services sector (medical, cosmetic, catering, transportation services and many others). The measurements in question pertain both to the monitoring of temperature and humidity in the course of performance of individual stages of technological processes and to the environmental temperature and humidity monitoring related to the storage and transportation of products (in hospitals, in restaurants and canteens, in laboratory facilities and in warehouses)

ACTIVITIES

Temperature

1. Realisation of the MST-90 International Temperature Scale.
2. Maintenance of the national measurement unit standard for temperature as well as the

- appropriate reference standard.
3. Development and improvement of the methods for temperature measurement, analysis of the results of such measurement, estimating measurement uncertainty, maintenance of measurement stands and performance of research and development works.
 4. Transfer of the temperature measurement unit to accredited laboratories and other entities within the Polish economy through the calibration of fixed point cells, SPRT and IPRT-class platinum resistance sensors, thermocouples and thermometers (including both electrical and liquid-in-glass thermometers). Carrying out interlaboratory comparisons.

Humidity

1. Realisation of frost/dew point temperature within the range between $-80\text{ }^{\circ}\text{C}$ and $+95\text{ }^{\circ}\text{C}$ as well as of relative humidity within the range between 10% and 98% for temperatures ranging from $-40\text{ }^{\circ}\text{C}$ to $+95\text{ }^{\circ}\text{C}$.
2. Maintenance of the reference standard – temperature generator for dew/frost point and relative humidity as well as of the related testing stands, including the performance of research and development works.
3. Development and improvement of measurement methods, measurement uncertainty estimation analysis, performance of comparisons in the field of humidity.
4. Ensuring traceability for accredited calibration laboratories, research laboratories as well as industrial laboratory facilities.

PLANNED ACTIVITIES

Temperature

1. Increasing the temperature scale realisation accuracy through the modernisation of the national standard stand, especially through the acquisition of new fixed point cells and resistance bridges as well as the development or acquisition of a new argon triple point stand ($-189.3442\text{ }^{\circ}\text{C}$) which shall make it possible to improve both the realisation capacity and stability of the aforementioned triple point. Improvement of the highest-level measurement capabilities through participation in international, key and regional comparisons
2. Ensuring the continuity of functioning of measurement stand through the acquisition of new thermostats, SPRT sensors and resistance bridges as well as through the installation of a backup power system.
3. Inclusion of the temperature reference standard in the national standard, allowing its measurement range to be extended up to $1\ 084.62\text{ }^{\circ}\text{C}$.
4. Development of a measurement stand for radiation thermometry.
5. Ensuring the transfer of knowledge by developing guides for the calibration and measurement of temperature, organising training courses in the field of metrology and engaging in enhanced cooperation with various entities in the Polish economy, for example by participating in joint research projects. Support for the development of measurement techniques and instruments being developed in Poland.
6. Continued efforts aimed at the development of the existing measurement methods through the development of measurement stand and decreasing measurement uncertainty.

Humidity

1. Modernisation of the reference standard for dew/frost point temperature – development of a dew/frost point temperature generator.
2. Development of a mobile humidity and temperature standard designed to serve as a portable working standard used, among others, for the purposes of performing fast checks.
3. Testing the metrological characteristics of capacitive probes in order to determine the recommendations and guidelines for the documents governing the requirements applicable to the transportation and storage of pharmaceutical products.
4. Developing the methodology, procedure and uncertainty estimation methods for the purposes of calibration of climate chambers.
5. Extending the CMC range for the dew/frost point temperature reference standard.
6. Ensuring the transfer of knowledge by conducting specialist training programmes for accredited calibration laboratories, research laboratories and industrial laboratories as well as by engaging in enhanced cooperation with various entities in the Polish economy, for example by participating in joint research projects. Support for the development of measurement techniques and instruments being developed in Poland.
7. Continued efforts aimed at the development of the existing measurement methods through the development of measurement stands and decreasing measurement uncertainty.

NATIONAL STANDARD FOR TEMPERATURE / PRIMARY STANDARD	
CURRENT STATE	PLANNED DEVELOPMENT
<p>A set of temperature fixed-point cells ensuring a specific state of thermodynamic balance as well as platinum resistance sensors used as interpolation instruments, in accordance with the International Temperature Scale (1990).</p> <p>Realised fixed-points and best measurement capabilities:</p> <p>triple point of water 0.01 °C – 0.11 mK triple point of argon -189.3442 °C – 0.9 mK triple point of mercury -38.8344 °C – 0.7 mK freezing point of gallium 29.7646 °C – 0.6 mK freezing point of indium 156.5985 °C – 1.75 mK freezing point of tin 231.928 °C – 1.3 mK</p> <p>freezing point of zinc 419.527 °C – 1.5 mK freezing point of aluminium 660.323 °C – 3.8 mK freezing point of silver 961.78 °C – 4.6 mK</p>	<p>Expanding the scope of the national measurement unit standard for temperature through the inclusion of the existing reference standard. The current range will be extended through the addition of two fixed points:</p> <p>freezing point of gold 1064.18 °C – 0.20 mK freezing point of copper 1084.62 °C – 0.20 mK</p> <p>Maintenance of measurement capabilities at least at the current level, likely improvement with respect to certain aspects of measurement.</p>
NATIONAL STANDARD FOR DEW/FROST POINT TEMPERATURE / PRIMARY STANDARD	
CURRENT STATE	PLANNED DEVELOPMENT
<p>The dew/frost point temperature generator designed at the GUM and validated through international comparisons, along with the temperature measurement system based on an SPRT sensor and a temperature stabilisation and heating system, constitutes the reference standard for the realisation of temperature range from frost</p>	<p>Modernisation of the standard through the development of a dew/frost point temperature generator.</p> <p>Expanding the range of the presented CMC values on the basis of the KCDB.</p> <p>Maintenance of measurement capabilities at least</p>

point (from – 80 °C) to dew point (+95 °C). Realised dew/frost point temperatures with optimum measurement uncertainty between 0.03 °C and 0.1 °C for the temperature range between – 50 °C and +95 °C and between 0.1 °C and 0.3 °C for the temperature range between – 80 °C and – 50 °C.	at the current level, likely improvement with respect to certain areas of measurement scope.
RELATIVE HUMIDITY STANDARD / PRIMARY STANDARD	
CURRENT STATE	PLANNED DEVELOPMENT
Climate chamber along with a temperature stabilisation system designed at the GUM, equipped with an air temperature and dew/frost point temperature measurement system, constitutes the reference standard for relative humidity, ranging from 10 % and 98 % for air temperatures between -40 °C and +95 °C. The best measurement capacity attainable in the above range is between 0.3 % and 1%.	Modernisation of the existing stand – development of a relative humidity generator in order to enhance the current metrological parameters. Development of a new stand for the purposes of ensuring traceability within the scope of calibration of climate chambers for accredited and industrial laboratories. Maintenance of measurement capabilities at least at the current level, likely improvement with respect to certain aspects of measurement.

Taximeters and Tachographs

This domain includes activities which encompass the testing of taximeters, tachographs and road speed measurement devices, along with various works pertaining to the documents accompanying the use of such devices in Poland.

ACTIVITIES

1. Taximeter testing.
2. Performance of functionality tests of digital tachographs, tachograph charts and transducers used for the purposes of tachograph type approval.
3. Performance of type approval testing for road speed measurement devices (radar and laser-based devices, speed cameras).

PLANNED ACTIVITIES

Implementation of a new measurement method based on the use of real time clock for the testing of average speed measuring cameras installed along a fixed route.

Software and cash registers

This domain encompasses issues related to the software used for measurement devices, measurement stands and cash registers, within the scope of testing of software and cash registers, defining and developing requirements for the same as well as developing metrological software intended to accommodate the development needs of GUM laboratory facilities.

ACTIVITIES

1. cash register testing,
2. testing software for measuring instruments for the purposes of compliance assessment and type approval,
3. development and maintenance of testing methodology for cash registers and measuring instrument software,
4. development of requirements for cash registers and measuring instrument software,
5. development and maintenance of metrological software for GUM laboratory facilities, supporting the operations of the GUM within the scope of maintenance of electronic documentation and numerical analysis.

PLANNED ACTIVITIES

1. Measuring instrument and cash register software testing team
Cash register testing
Testing software for measuring instruments to be used in the process of compliance assessment and type approval
2. Software engineering team
Development of the methodology for the testing of cash registers
Development of the methodology for testing software for measuring instruments
Development of requirements for cash registers
Improvement and standardisation of requirements for software to be used in measuring instruments
Popularisation of issues related to the requirements applicable to metrological software
3. Software and calculation methods development team
Development of metrological software intended to accommodate the needs of the GM laboratory facilities
Improvement of numerical calculation and analytical methods
Development of methods for the simulation of physical effects and measurement processes.

CURRENT STATE	PLANNED DEVELOPMENT
<p>The existing Software Research and Development Laboratory (LBRO), forming part of the GUM, performs tasks in the following areas:</p> <ul style="list-style-type: none"> - testing of cash registers, - testing software for measuring instruments, - development of the methods for the testing of cash registers and measuring instruments, - development of requirements for cash registers and measuring instrument software, - development of metrological software for GUM laboratory facilities. <p>Due to the substantial amount of effort devoted to</p>	<p>Ultimately, according to the current plan, a total of 3 teams/sections will be formed within the framework of the LBRO, performing tasks in the following areas:</p> <ul style="list-style-type: none"> ▪ testing of software for measuring instruments and cash registers ensuring the attainment of the expected efficiency of the tested instruments, ▪ software engineering – performance of works in the field of development, standardisation and popularisation of issues related to the testing methodology and requirements for cash registers and for the software used for measuring instruments,

<p>cash register testing and the limited human resources available, the tasks performed remain focused on verifying whether the cash register tests are up-to-date.</p>	<ul style="list-style-type: none"> ▪ development of software and calculation methods – realising the needs in the field of preparation and improvement of metrological software. <p>This development programme will make it possible to ensure an active participation in the works associated with the improvement of testing methodology as well as with the designation of standards for metrological software keeping up with the constant technological progress, while at the same time ensuring that the needs of both the GUM and the economy pertaining to advanced software for the automation of measurement stands and data analysis are satisfied.</p> <p>The proposed structure will facilitate the optimisation of the competences and resources, thus making it possible to ensure the implementation of the designated tasks as well as the participation in the ongoing works programme.</p>
TESTING SOFTWARE FOR MEASURING INSTRUMENTS AND CASH REGISTERS	
CURRENT STATE	PLANNED DEVELOPMENT
<p>Cash registers and measuring instrument software are tested on the basis of the testing methodology devised by the GUM, updated on an ongoing basis in order to take the changing regulations in the field of tested requirements as well as technological progress into account.</p> <p>The testing of cash registers and software used in measuring instruments involves the performance of various tasks inherent in cash register operation at both user and service level, the simulation of the requisite emergency situations as well as the analysis of the structure, configuration, operation and safety measures of the given cash register. In order to perform these tasks, the operator needs to possess the necessary knowledge in the field of operation of the tested devices (including at service level) as well as the ability to perform an analysis of electronic systems and software, operating system configuration and data transmission security in telecommunication networks.</p> <p>At the present stage, the testing of cash registers and measuring instrument software is carried out by 10 full-time employees (including two who are still at recruitment stage).</p> <p>The developed and implemented methodology for the testing of software for measuring instruments encompasses the following:</p> <ul style="list-style-type: none"> - testing the safety of software in built-in 	<p>At the present stage, the cash register testing system is undergoing an overhaul. Once the appropriate legislative measures are implemented, the existing testing methodology will need to be modified and developed (extension of the substantive scope of testing due to the introduction of new mandatory functions in cash registers, including cooperation with external ICT systems). The quantity of tests of cash registers is likewise expected to increase, including due to the possibility of cash register software updates about to be introduced. All these factors may result in increased staff requirements in order to satisfy the needs of the economy insofar as timely completion of testing operations is concerned, resulting in the need to employ between 5 and 10 new staff members.</p> <p>At the present stage, the exact needs of the economy for testing operations – and the associated human resources demands – cannot be precisely determined.</p>

<p>systems,</p> <ul style="list-style-type: none"> - testing the safety of software and operating systems in general application systems, - testing data security, - testing the safety of communication interfaces (both local and network-based), <p>the methodology of cash register testing, on the other hand, encompasses the following actions:</p> <ul style="list-style-type: none"> ▪ testing the structure and security of hardware (electronic) data safety measures, ▪ verifying computational and formal accuracy of documents, ▪ testing the functions and safety levels of control protocols, ▪ analysing the way in which the given device handles emergency situations and data security, ▪ testing software update security, ▪ verifying whether the given device correctly cooperates with the requisite accompanying devices and systems (e.g. fiscal repository, payment terminals), ▪ analysing the cash register software source code. 	
SOFTWARE ENGINEERING	
CURRENT STATE	PLANNED DEVELOPMENT
<p>At the present stage, the LBRO team is involved in operations related to the following tasks:</p> <ul style="list-style-type: none"> ▪ development of methods for the testing of software for measuring instruments and cash registers, ▪ improvement of requirements for cash registers, ▪ development of requirements for measuring instrument software within the framework of cooperation with WELMEC and the PKN (Polish Committee for Standardisation). <p>A total of 3 employees are periodically involved in the works in the aforementioned areas; these employees are simultaneously tasked with the performance of actions related to ongoing cash register and measuring instrument testing.</p>	<p>The rapid progress of computerisation in the field of metrology is clearly reflected in the structure of the tested measuring instruments. The manufacturers thereof wish to make their offer more appealing by implementing state-of-the-art technologies. This situation requires the ability to rapidly react to technological progress in order to ensure the accuracy and correctness of measurements performed using the most recent technological solutions. In order to achieve this goal, the GUM needs to participate in activities aimed at:</p> <ul style="list-style-type: none"> ▪ preparation and standardisation of requirements for measuring instrument software in a manner which ensures the promotion of state-of-the-art technologies and fosters innovation, ▪ ongoing development of software testing methodology in order to ensure the expected testing efficiency ▪ while at the same time maintaining the high substantive quality thereof and taking into account the testing of state-of-the-art technologies,

	<ul style="list-style-type: none"> ▪ popularisation of issues related to quality and requirements for metrological software among the metrological community (including the manufacturers of measuring instruments), - supporting Polish entrepreneurs at the stage of measuring instrument design insofar as software requirements are concerned. <p>The current regulations make is necessary for detailed, technologically up-to-date requirements pertaining to the security of digital data and software to be taken into account. The current regulations in this regard frequently hinders innovation. Based on the feedback received from both the market and from the metrological community, it has been concluded that actions need to be taken which shall ensure the achievement of the following objectives:</p> <ul style="list-style-type: none"> - popularisation of issues related to metrological software requirements, - improvement of legal and standardisation regulations pertaining to the security of digital data and software in measuring instruments. <p>In order to achieve these goals, plans have been drawn up for the designation of a team of 4 employees whose competences would be divided according to the areas defined in the WELMEC WG7.2 guidebook.</p>
CURRENT STATE	PLANNED DEVELOPMENT
<p>The LBRO is currently performing tasks related to the development of specialised metrological software according to the needs of the metrological departments of the GUM (so far, this has resulted in the implementation of about 2-4 programmes per annum). The activities in question are performed on an ongoing basis by a single employee, with further 2 employees providing their support on an ad-hoc basis in the field of the preparation of requirements and testing. At the same time, these employees also perform tasks in the field of ongoing cash register and measuring instrument testing.</p> <p>So far, about 10 programmes commissioned by the GUM have been implemented, in the following areas:</p> <ul style="list-style-type: none"> ▪ automation of the operation of measurement stands, ▪ support of the analysis and processing of measurement data, ▪ support of the decision-making processes 	<p>Based on the available data pertaining to the needs of both the GUM and the economy, it has been concluded that a permanent team of 4 employees tasked exclusively with the performance of works in this regard may have to be formed. The tasks performed shall be related to the following areas:</p> <ul style="list-style-type: none"> - preparation of specific software facilitating the automation of measurement operations, - preparation of specific software for the analysis and processing (computation) of measurement data, - selection of optimum software for numerical simulations and digital processing, - analysis and development of measurement methods applied by the GUM for the purposes of the processing of measurement results and measurement uncertainty estimation,

<p>pertaining to work organisation within the GUM.</p>	<ul style="list-style-type: none"> - formation of an extended database of cash registers operating on the market in order to satisfy the needs of the treasury administration in this regard (task to be performed in cooperation with the Ministry of Finance). <p>The team will also become involved in R&D works performed in individual GUM laboratories and shall actively present its achievements to the domestic and international metrological community. The computerisation and development of analytical methods will make it possible for the GUM laboratory to achieve the work level and quality corresponding to that of the leading foreign NMIs; as a result, the laboratory facilities of the GUM will set the standards for work in the field of metrology and inspire the economy to make efforts to enhance its own work methodology and organisation.</p>
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Appendix no. 6 PROSPECTS FOR THE DEVELOPMENT OF REGIONAL MEASUREMENT AND ASSAY ADMINISTRATION

INTRODUCTION

The performance of tasks in the field of legal metrology (such as validation or compliance assessment) as well as in the field of calibration and evaluation or supervision of measuring instruments or packaged goods and the performance of testing and marking of goods made of precious metals forms the basic set of objectives performed by the regional measurement and assay administration. The type and scope of services rendered focuses on satisfying the needs of local stakeholders, including domestic economic operators, many of which operate in the healthcare or environmental protection sectors.

The regional administration consists of nine Regional Offices of Measures as well as two Regional Assay Offices along with their respective Branch Offices. The aim of these institutions is to safeguard the interests of the state and individual citizens; throughout their operations, they are willing and ready to accommodate the needs of stakeholders and to respond rapidly to any expectations they may have.

REGIONAL OFFICES OF MEASURES

Regional measurement administration units perform tasks for the benefit of domestic stakeholders in the field of authorisation of measuring instruments for marketing and use as well as in the field of supervision thereof throughout the entire duration of their service life. The calibrations and expert opinions prepared for the benefit of the manufacturers and users of measuring instruments provide a significant support to their operations.

The basic tasks performed by regional administration of measures include the following:

- Performance of tasks in the field of regulatory metrological control.
- control of entities authorised to engage in the initial or repeated verification of measuring instruments as well as of entrepreneurs which hold certificates allowing them to perform business activities in the field of installation or repair of traffic measurement instruments used in road transport (tachographs) as well as in the field of verification of compliance of such devices;
- supervision in the field of product packaging and the manufacture of measuring bottles,
- performance of calibration services, expert evaluation of measuring instruments,
- performance of tasks in the field of market surveillance.

REGIONAL ASSAY OFFICES

The regional assay administration remains responsible for the performance of tasks for the benefit of domestic stakeholders within the scope of labelling of alloys or products with the appropriate assay marks. The obligatory assay system currently in place in the Republic of Poland provides that any entity which engages in the marketing of products made of precious metals shall be subject to certain statutory obligations pertaining to the use of assay marks on

such products.

The basic tasks performed by assay offices include the following:

- Testing and marking products made of precious metals or containing such metals,
- Supervision of the application of the provisions of the Assay Law,
- Maintenance of the list of registered marks.

PLANNED ACTIVITIES

An efficient measurement and assay administration strives to ensure reliable measurements and analyses, building confidence in the obtained measurement results – an essential precondition for economic growth – while at the same time ensuring the protection of the interests of both the state and its citizens.

The increasing needs of the economy in the field of advanced manufacturing technologies or energy (the production, storage and transmission of energy or the manufacture of electric cars) require the measure administration to constantly develop its metrological infrastructure, create new solutions and initiate actions aimed at supporting domestic enterprises.

On the other hand, the requirements of the market with respect to jewellery trade, the constantly developing technologies for the manufacture of precious metal alloys as well as new techniques for the production of items of this kind have resulted in the need for constant improvement in the field of both analytical methods and product marking. The need for the implementation and improvement of non-destructive testing methods and expansion of the scale of laser product marking also keeps increasing.

Having regard to the need to ensure that the regional administration units perform the tasks entrusted to them, serving the state and its citizens in an effective and efficient manner, plans have been drawn up for the performance of a number of actions which are aimed, among others, at the achievement of the following objectives:

- development of a consistent policy for the entire measure administration with regards to the services rendered,
- unification of the procedures for action, including the determination of requirements as to both equipment and structures,
- introduction of specialisations in designated fields of activity,
- engaging in cooperation between the regional measurement and assay administration and the business and expert communities within the framework of Consultative Metrological Teams and Consultative Assay Teams,
- formation of a modern measure service operating in accordance with the expectations of both the economy and society (i.e. capable of meeting these expectations).
- development of a consistent policy for calibration and testing for the measurement administration.

One of the activities aimed at streamlining the operations of the regional measurement administration in accordance with the amended Law on Measures of 2017 and in a manner consistent with the needs of the market is the reform of measurement administration structure currently being implemented.

In addition, a concept for the specialisation of individual regional units is also being drawn up in cooperation with the Central Office of Measures; according to this new concept, the regional measurement offices would perform the role of leading metrological centres in their respective domains of metrology. According to the accepted concept, a maximum of two centres

(regional offices) shall specialise in their respective field of metrology in the regions of their operations. The allocation of specific domains to the individual units shall be achieved through an in-depth evaluation of the available human and technical resources in the context of the needs of local entrepreneurs insofar as specific metrological services are concerned.

Following preliminary analyses it has been concluded that the following selected laboratories of regional administration units present the greatest technical and human resources potential from the standpoint of stakeholders operating in the individual regions:

AREAS OF SPECIALISATION	REGIONAL UNIT
Acoustics and vibrations	OUM in Łódź, OUM in Gdańsk, Branch Office in Białystok
Chemistry	OUM in Łódź, OUM in Bydgoszcz (glucometers)
Electricity and magnetism	OUM in Cracow, OUM in Poznań
Mass	Branch Office in Siedlce and Branch Office in Piła (large mass standards) OUM in Katowice
Ionising radiation	OUM in Warsaw (aerosol testing)
Flows and volume	OUM in Łódź, Branch Office in Leszno Branch Office in Jasło (capacity serving measures)
Pressure	OUM in Szczecin

The plans for the development of regional measurement administration and assay administration have been outlined below:

Regional Office of Measures in Warsaw

ACTIVITIES

1. Validation of measuring instruments.
2. Calibration of measuring instruments.
3. Compliance assessment of measuring instruments.
4. Market surveillance.
5. Control of packaged goods.
6. Auditing of users of measuring instruments.

PLANNED ACTIVITIES

1. Establishment of a measurement stand for the calibration of individual noise exposure testers. Calibration of noise exposure meters shall ensure the effective provision of services to clients from all around the country without the needs for the equipment to be transported to the headquarters of the Office.
2. Extending the scope of laboratory services through the addition of generator, frequency counter and chronograph calibration services.
3. Improving the measurement capabilities of the Temperature Measurement Laboratory and the Density Measurement Laboratory.
4. Establishment of a measurement stand for the calibration of instruments for the

- measurement of optical values – photometric calibrators and luminance testers.
5. Extension of the scope of competences of the large mass workshop through the addition of a service involving the calibration of 5000 kg and 1000 kg standards in the M₁ class (services to be rendered on customer premises) – Branch Office in Siedlce.
 6. Modernisation of the stand for the calibration and validation of non-automatic weighing instruments (checkweighers) at the Branch Office in Siedlce.
 7. Introduction of a new service in the form of aerosol container testing (X-ray testing), which will have an impact on the improvement of the control efficiency of the manufacturers of packaged goods. The new service shall only be provided by the Regional Office of Measures (OUM) in Warsaw and will be available to stakeholders from all across the country.
 8. Modernisation of the thermometry measurement stand involving the introduction of a visualisation and control system for thermostats and measurement bridge. The credibility of the temperature measurement results obtained will be increased as a result. The scope of the calibrations performed will be extended, while the lowest measurement capabilities (the so-called CMCs) will experience an improvement.

Regional Office of Measures in Cracow

ACTIVITIES

1. Performance of tasks in the field of regulatory metrological control (including validation).
2. Performance of calibrations both within the scope of accreditation and beyond.
3. NAWI and MID compliance assessment – EC validation
4. Performance of checks, preparation of expert reports.
5. Type approval testing (at the request of the GUM).
6. Supervision of the application of the provisions of the Act on Measures (including the auditing of users of measuring instruments).
7. Supervision of the application of the provisions of the Act on packaged goods.
8. Performing audits of workshops specialising in digital tachographs as well as audits of entities authorised to instal, repair and test automotive tachographs. Performance of audits of entities authorised to engage in validation and testing within the framework of tasks allocated by the President of the GUM.

PLANNED ACTIVITIES

1. Extending the scope of services offered by the Regional Office of Measures (OUM) in Cracow to include calibrations necessary in various branches of industry for instruments such as feeler gauges, sensors, external micrometers or micrometer heads.
2. Development of a stand for taximeter testing following compliance assessment in order to provide verification opportunities for taximeters following compliance assessment, protecting consumer (citizen) interests.
3. Development of a mobile transformer calibration stand.
4. Development of competences in the field of hardness and resilience measurements.
5. Extending the scope of service involving the examination of universal testing machines to include extensometer testing.

6. Development of a stand for torque wrench measurement.
7. Extension of the scope of service involving the compliance assessment of capacity serving measures. The Regional Office of Measures (OUM) in Cracow and in Łódź are the only administrative bodies in Poland which engage in the performance of tests of this kind.
8. Extension of the scope of temperature measurement through the addition of thermometer and resistance sensor testing in response to the needs of the industry.

Regional Office of Measures in Wrocław

ACTIVITIES

1. Calibration of testing road sections within the framework of accreditation activities.
2. Calibration and testing AC electricity meters within the framework of market surveillance as well as calibration and testing of devices used for the purposes of testing of the aforementioned electricity meters.
3. Performance of calibrations, validations and compliance assessments of automated weighing instruments.
4. Verification of underground measurement tanks for liquid fuels (e.g. tanks located in mining facilities) from the standpoint of their validation and calibration.

PLANNED ACTIVITIES

1. Developing the service involving the calibration of testing road sections in connection with the significant increase in the number of control speedometer validations based on the average speed measurement system.
2. Modernisation of the measurement stand used for the purposes of calibration of electricity meters in order to enable the automated testing of samples consisting of a maximum of 10 electricity meters.
3. Extending the scope of the service involving metrological testing of underground measurement tanks for liquid fuels due to the developments taking place in the copper mining sector.

Regional Office of Measures in Poznań

ACTIVITIES

1. Performance of tasks in the field of regulatory metrological control of measuring instruments.
2. Supervision of the application of the provisions of the Act on Measures.
3. Supervision of the process of packaging of goods and the manufacture of measurement bottles in accordance with the act on packaged goods.
4. Market surveillance within the scope of measuring instruments approved for trading or use (in accordance with the provisions of the Act on Compliance Assessment and Market Surveillance Systems).
5. Calibration and evaluation of measuring instruments.
6. Implementation of the compliance assessment procedures in accordance with the scope of the notification provided.

7. Consultations regarding selection and use of measuring instruments.
8. Auditing entities authorised to operate workshops engaging in the maintenance and repairs of installations, including activation, repair or testing digital tachographs for compliance with the applicable requirements

PLANNED ACTIVITIES

1. Developing the competences of personnel and the capabilities of metrological infrastructure in order to ensure the possibility of performing compliance assessment and metrological testing of liquid propane-butane (LPG) gas installations with reference to the regulations currently in force.
2. Development of metrological infrastructure in order to ensure traceability in the field of gas flow in order to ensure the protection of the interests of citizens (calibration of flow meters applied by measurement administration units and businesses providing services in the field of LPG meter and installation testing).
3. Development of infrastructure and technical competences in the field of calibration of photometric calibrators.
4. Modernisation of the stand for luxometer calibration (modernisation of the photometric darkroom).
5. Establishment of a storage facility for large mass standards in order to ensure the presence of a technical facility supporting the operations of the measurement administration in the field of metrological supervision.
6. Extension and modernisation of the measurement stand for the calibration of mass standards (class F2, M1 and M2, range: 1 mg – 25 kg).
7. Extension and modernisation of the measurement stand for the calibration of equipment used for the purposes of measurement of electricity parameters and testing the quality of power transmission networks.
8. Maintenance of technical infrastructure and staff competences at a level which ensures the performance of calibrations within the existing scope while at the same time maintaining traceability in the field of length.
9. Extension of infrastructure within the scope of gauge calibration in order to extend the scope of services offered and reduce measurement uncertainty.
10. Expanding the existing technical infrastructure within the scope of calibration of long gauge blocks (100–500 mm) in order to obtain PCA accreditation in this regard.

Regional Office of Measures in Katowice

ACTIVITIES

Validation of measuring instruments:

1. Compliance assessment of measuring instruments.
2. Calibration, evaluation and testing of measuring instruments.
3. Audits performed under the provisions of the Law on Measures.
4. Audits performed under the provisions of the Act on Compliance Assessment and Market Surveillance Systems.
5. Conducting training courses.

PLANNED ACTIVITIES

In case of the new headquarters of the Regional Office of Measures (OUM) in Katowice, a state-of-the-art laboratory shall be constructed in order to meet the requirements associated with the functioning of an innovative economy.

1. Development of a stand for testing cryogenic fluid installations in order to make it possible for such installations to be validated and calibrated for the benefit of the economy.

Regional Office of Measures in Gdańsk

ACTIVITIES

1. Performance of tasks in the field of regulatory metrological control, including the validation of measuring instruments.
2. Other metrological activities: calibration – within the scope of accreditation and beyond – as well as testing and evaluation of measuring instruments.
3. Supervision of the application of the provisions of the *Act on Measures*.
4. Supervision of the process of packaging of goods and the manufacture of measurement bottles in a manner specified in the act on packaged goods and in accordance with the provisions thereof.
5. Performance of other tasks entrusted by the President of the Central Office of Measures, including the performance of type approval testing with respect to measuring instruments as well as evaluation of measurement stands.
6. Performance of compliance testing with respect to measuring instruments (according to the MID directive) and non-automatic weighing instruments (according to the NAWI directive) under the provisions of the Act of April 13, 2016 on Compliance Assessment and Market Surveillance Systems.
7. Tasks stemming from the Act on the Digital Tachograph System.

PLANNED ACTIVITIES

1. Introduction of a new service: calibration of laser rangefinders.
2. Development of a laser stand for length measurement.
3. Development of a stand for testing and calibration of non-automatic weighing instruments with small bridges, designed for heavy loads; introduction of a new service.
4. Development of a measurement stand for the calibration of torque wrenches and introduction of a new service.
5. Development of measurement methods and improvement of measurement performance by extending the scope of automation and expanding the existing measurement stand through the addition of sound level testers.
6. Analysing the needs of the market with respect to ultrasound and infrasound measurement; extending the scope of sound level measurements offered in response to the positive results of the surveys distributed among the stakeholders of the OUM.

7. Development of a stand for breath analyser calibration/validation.
8. Implementation of new measurement methods for the purposes of pH measurement and conductimetry, based on certified reference materials.
9. Analysing the needs of the market and development of technical competences as well as ensuring the existence of an appropriate formal and legal framework for the calibration of drug testers, such as the ones used by criminal investigators.
10. Development of a stand for the calibration, validation and compliance assessment of electricity meters (activity to be performed in response to the needs of local entrepreneurs).
11. Establishment of a stand for kilovoltmeter calibration.
12. Expanding the scope of calibration of electrical network parameter calibrators.

District Office of Measures in Łódź

ACTIVITIES

1. Verification, calibration, evaluation, manufacture of reference materials and auditing of users of measuring instruments which are subject to regulatory metrological control as well as auditing of entities holding authorisations and permits for engaging in their respective activities which were issued by the President of the Central Office of Measures (based on the provisions of the Law on Measures).
2. Compliance assessment, auditing activities performed within the scope of market surveillance (Act on Compliance Assessment and Market Surveillance Systems).
3. Registration of entities which engage in the packaging of goods, performing audits of entities which engage in the packaging of goods or in the manufacture of measurement bottles (Act on Packaged Goods).
4. Auditing entities which hold authorisations issued by the President of the Central Office of Measures (Act on the Digital Tachograph System).

PLANNED ACTIVITIES

1. Introduction of a new service – tympanometer calibration, stand prepared for PCA accreditation.
2. Modernisation of the stand for the calibration of universal testing machines.
3. Modernisation of the stand for the calibration of gauge blocks.
4. Equipping Branch Offices with both stationary and portable stands for taximeter testing (testing compliance with the requirements of the MID directive).
5. Modernisation of the stand for the testing of installations used in the process of the manufacture of beer and other consumable fluids through the addition of a “moveable start-stop system”.
6. Modernisation of the stand for the calibration of control gauges which serve as reference standards in the process of validation of LPG meters through the addition of a new reference standard – a piston-type “Prover” stand (volumetric flow rate range:

- (1,5 – 100) dm³/min).
7. Development of two stands equipped with a mass flow meter, designed for the validation and testing of liquid propane-butane gas (LPG) meters.
 8. Development of four stands equipped with a mass flow meter, designed for the validation of measurement tanks.
 9. Expanding measurement capabilities of the stand for pyrometer testing through the acquisition of an additional black body intended to serve as a reference standard with measurement range exceeding 500 °C.
 10. Modernisation of the stand for the testing of resistance thermometers (RTDs) and expanding the measurement range thereof through the acquisition of SPRT thermometers and thermostats capable of accommodating fixed point cells (range: -40÷1100) °C.
 11. Modernisation of the stand for frequency counters, chronometers as well as generators and tachometers in order to increase the accuracy of the services rendered in connection with the constant developments taking place in various fields of metrology.
 12. Modernisation of the stand for direct current meters through the addition of an 8.5 digit multimeter.
 13. Modernisation of the stand for the measurement and quality assessment of electricity and shock protection through the addition of a multi-function electrical calibrator.
 14. Development of measurement stands for the manufacture of the following certified reference materials:
 - pH metering standards.
 - conductimetric standards.

Regional Office of Measures in Bydgoszcz

ACTIVITIES

1. Performance of tasks in the field of legal metrology, including the validation of the following measuring instruments:
 - a) mass and related quantities,
 - b) movement parameters,
 - c) volume, liquid flow and heat,
 - d) measurement of length and related quantities,
 - e) measurement of vehicle tyre pressure,
 - f) utility grain density meters.
2. Performance of calibrations within the scope of:
 - a) geometric quantities: length and angle,
 - b) pressure,
 - c) electrical and non-electrical thermometry,
 - d) mass: weighing instruments and mass standards,
 - e) chemical quantities: pH measurement, conductimetry,
 - f) electrical quantities,

- g) time,
 - h) spectrophotometry,
 - i) liquid volume and flow as well as heat measurement,
 - j) movement parameters,
 - k) hardness and force.
3. Evaluation of the measuring instruments referred to in item 1.
 4. Performance of compliance assessment – verification of products within the following scope:
 - a. Directive of the European Parliament and of the Council no. 2014/31/EU dated February 26, 2014 on the harmonisation of the laws of the Member States relating to the making available on the market of non-automatic weighing instruments (the NAWI directive).
 - b. Directive of the European Parliament and of the Council no. 2014/32/EU dated February 26, 2014 on the harmonisation of the laws of the Member States relating to the making available on the market of measuring instruments (the MID directive).
 5. Performance of the tasks of market surveillance authority, i.e. controlling measuring instruments for compliance with the requirements of the implementing regulations for the aforementioned Directive.
 6. Manufacture of validation stickers and stamps.

PLANNED ACTIVITIES

1. Development of a stand (calibrator) for calibration of sensorless thermometers (radiation pyrometers) in response to the needs of external clients.
2. Development of a climate chamber stand along with temperature and humidity standards, ensuring comprehensive customer service within the scope of thermometers with external and internal sensors as well as thermo-hygrometers (which also ensure the possibility of performing humidity measurements).
3. Development of stand for calibration of thermometers on the client's premises.
4. Maintenance of measurement capacity for the verification, compliance assessment, calibration and evaluation of measuring instruments for the measurement of length, tape materials, textiles, wires, cables, bandaging products and paper products as well as for the calibration and evaluation of gauges (with no limits as to the length thereof).
5. Expanding the scope of authorisation and notification through the addition of module D for instruments designed for length measurement.
6. Installation of Poland's only measurement stand which enables the concurrent verification of more than 10 water meters for automatic measurement of cold and hot water at the Branch Office in Toruń. The aforementioned stand will also make it possible to perform evaluation for the purposes of judicial proceedings as well as for consumer protection authorities. A total of 20 household water meters will be installed and tested at the same time, allowing up to 150 water meters of flow transducers to be tested throughout an 8-hour business day (up to 38 thousand units of measuring instruments to be tested per annum).
7. Development of metrological infrastructure ensuring traceability in the field of hygrometry and dynamic pressure measurements.
8. Establishment of a measurement stand for the measurement of surface geometry (roughness). Takeover of the stand and service package from the Central Office of

Measures.

9. Development of a measurement stand for exhaust gas analyser validation.
10. Development of measurement stand for calibration of audiometers and glucose meters.
11. Knowledge transfer to units operating in the field of defence within the scope of humidity measurements as well as of dynamic atmospheric pressure measurements.
12. Transferring the manufacture of validation certificate carriers (validation stamps) from the Branch Office in Brodnica to the Branch Office in Toruń; establishment of a specialist chemical section at the Branch Office in Brodnica which shall perform various tests that cannot be carried out elsewhere due to the requirement of maintaining safe distance from inhabited areas.

Regional Office of Measures in Szczecin

ACTIVITIES

1. Performance of tasks in the field of regulatory metrological control of measuring instruments.
2. Supervision of the application of the provisions of the *Act on Measures*.
3. Supervision of the process of packaging of goods and the manufacture of measurement bottles.
4. Performance of calibration of various types of measuring instruments.
5. Preparation of expert opinions on measuring instruments.
6. Auditing entities authorised to operate workshops engaging in the installation (including activation), maintenance or testing of digital tachographs for compliance with the applicable requirements (within the scope specified by the President of the Central Office of Measures).
7. Compliance assessment within the scope of the Directive of the European Parliament and of the Council no. 2014/31/EU dated February 26, 2014 on the harmonisation of the laws of the Member States relating to the making available on the market of non-automatic weighing instruments (the NAWI directive).
8. Compliance assessment within the scope of the Directive of the European Parliament and of the Council no. 2014/32/EU dated February 26, 2014 on the harmonisation of the laws of the Member States relating to the making available on the market of measuring instruments (recast) – the MID directive.
9. Performance of the tasks of market surveillance authority, i.e. controlling measuring instruments for compliance with the requirements of the implementing regulations for the aforementioned Directives of the European Parliament and of the Council (the NAWI and MID directives).

PLANNED ACTIVITIES

1. Modernisation and extension of the metrological infrastructure ensuring traceability in the field of pressure:
 - development of a low pressure measurement stand at the laboratory operated by the Regional Office of Measures (OUM) in Szczecin. This laboratory is the only laboratory facility in the entire measurement administration which holds PCA accreditation for the calibration of pressure transducers,

- modernisation of the pressure measurement stand at the District Office of Measures in Zielona Góra.
- 2. Establishment of an environmental measurement stand (temperature, humidity).
- 3. Development of a measurement stand for the calibration of torque wrenches.
- 4. Development of a stand for taximeter testing following compliance assessment in order to provide legalisation opportunities for taximeters – protecting consumer interests.
- 5. Modernisation and extension of the metrological infrastructure ensuring traceability in the field of volume:
 - development of a portable measurement stand equipped with a mass flow meter for the calibration of measurement containers using petroleum-based products.
 - development of a portable measurement stand with a mass flow meter for the calibration of measurement containers using water,
 - development of a portable measurement stand with a mass flow meter for the testing of measurement installations designed for liquid propane-butane gas.

Regional Assay Offices in Warsaw and in Cracow

ACTIVITIES

1. Testing alloys and jewellery products for precious metal content and the associated product marking:
 - application of Polish hallmarks to the products, allowing such products to be traded both in Poland and in numerous EU Member States,
 - application of the marks specified under the Convention on the Control & Marking of Articles of Precious Metals to the products, allowing for the products in question to be traded in the 18 states which remain parties to the Convention.
2. Labelling of tested products.
3. Evaluation of precious metal alloys and products.
4. Maintenance of the list of registered marks.
5. Maintaining assay supervision at facilities which engage in the processing and trade in articles of precious metals.
6. Collecting and transferring information on the principles governing the trade in articles of precious metals within the EU to any entities interested in obtaining such information.
7. International cooperation in the field of assay.

PLANNED ACTIVITIES

1. Improvement of research methods.
2. Modernisation of testing instrumentation
3. Preparation of assay laboratories for accreditation (Warsaw and Cracow, followed by Gdańsk and Wrocław).
4. Expanding the scale of comparative research performed in Poland and in other countries.
5. Increasing the number of standards applied for non-destructive methods.
6. Expanding the scale of application of certified reference materials.
7. Continuing the cooperation within the framework of the Workgroup for Technologies and Research Methods, enabling the OUP personnel to exchange their experiences

with the craftsmen and representatives of the jewellery industry as well as with employees of scientific institutions.

8. Increasing the accuracy of the research performed, making it possible to expand the scale of operations performed by the OUP as well as to present an offer aimed at a new group of potential customers, e.g. entrepreneurs operating in the hi-tech industry sector.
9. Participation in the works of the Technical Workgroup operating within the framework of the Convention on the Control & Marking of Articles of Precious Metals, thereby facilitating access to technical knowledge and allowing Polish authorities to directly influence the decisions adopted within the framework of the Convention.

Appendix no. 7 LIST AND SCHEDULE OF THE PRIMARY ACTIVITIES OF THE CENTRAL OFFICE OF MEASURES

The appendix covers only selected main tasks which are necessary to implement the strategic GUM action plan which assumes the institution's continuing growth. Miscellaneous basic actions resulting from the ongoing activities of the Central Office of Measures (GUM) as well as their sources of financing will be included in annual GUM business plans, based on the budget plan (part 64).

- Objective 1. Technologically advanced measurement standards which ensure the efficient functioning of the Polish economy and which satisfy the needs of society as well as ensure an appropriate quality of life.
- Objective 2. Respectable status in international organisations.
- Objective 3. In-depth cooperation as well as knowledge and technology transfer arising from the increasing needs of the Polish industry and society.
- Objective 4. Extensive offer and high service quality
- Objective 5. A competent, growth-oriented and well-motivated personnel, prepared for the implementation of tasks for the benefit of an innovative, competitive economy.
- Objective 6. A well-organised network of specialised branch offices, equipped with the technical facilities, infrastructure and personnel capable of meeting their designated objectives.
- Objective 7. Consistent market regulations conducive towards the development of domestic industry and business
- Objective 8. An efficient system for the protection of economic and technical security of the state as well as the interests of citizens

Item no.	OBJECTIVE	ACTION	TIME OF COMMENCEMENT	TIME OF COMPLETION	RESPONSIBLE UNIT	PARTNERS	EXPENDITURE	MATERIAL	INVESTMENTS	PLN	SOURCE OF FINANCING
	NO.		COMMENCEMENT				2018	2019	2020	2021	
1	1	Construction of a state-of-the-art campus – a complex of technologically advanced research and measurement laboratory facilities in order to ensure appropriate conditions for the performance of precise and accurate measurements. Completion of phase I of the construction project.	2018	2021	BDG	- Ministry of Development - Ministry of Finance	15,000,000.00	30,000,000.00	45,000,000.00	60,000,000.00	European Structural Funds Central Office of Measures (GUM)
2	1	Modernisation and extension of the metrological infrastructure ensuring traceability in the field of audiometry. Intended purpose of the action: • Increasing the quality of audiological research in Poland by lending metrological support to institutions and laboratories which focus on hearing tests and hearing protection or which engage in the testing and verification of audiometric devices. • Supporting the Polish manufacturer of audiometers in the process of compliance assessment of audiometers (verifying compliance with the requirements of the directive on medical devices) • Ensuring the credibility and safety of audiological testing while at the same time ensuring traceability. • The activity pertains to the modernisation and extension of the stand for the calibration of standards applied in the field of audiometry – ear simulators and mechanical couplers; the activity in question will involve the acquisition of state-of-the-art devices for signal analysis, the extension of the scope of calibration through the inclusion of acoustic impedance measurements performed in accordance with the PN-EN 60318-1 standard (Simulators of human head and ear) which entered into force in 2010, as well as the modification of the calibration methodology for mechanical couplers (artificial mastoids).	2017	2019	L1	- VIDEOMED (Polish manufacturer) - laboratories offering services in the field of testing and verification of audiometric equipment (accredited laboratories, service laboratories) - research institutes conducting research in the field of audiology	-	-	-	-	Central Office of Measures (GUM)
3	1	Development of metrological infrastructure ensuring traceability in the field of measurement of mechanical vibrations for mechanical impacts (shock). Development of a measurement stand for the calibration of mechanical impact transducers in accordance with the ISO 16063-22 standard. Intended purpose of the action: • Metrological support for the industry and institutions interested in the measurement of vibrations and shocks with very large accelerations that can be encountered in automotive industry, transport, mining, military, construction (crash-testing, monitoring of machines and devices, firing in mines or quarries). • Metrological support for organisations and laboratories involved in security and health protection, including in the work environment – in order to ensure reliability and accuracy of shock measurements carried out in Poland.	2017	2020	L1	- research institutes and universities conducting research in the field of mechanical vibrations and shocks, i.a. CIOP, UDT, GIG, military institutes - accredited laboratories	-	-	-	-	Central Office of Measures (GUM)
4	1	Development of metrological infrastructure ensuring traceability in the conditions of an acoustic free field. Construction of an anechoic chamber and measurement stand for performing acoustic free field testing. Intended purpose of the action: • Support of Polish manufacturers of acoustic equipment (SVANTEK, SONOPAN) by providing them with the possibility of cooperation in the field of studies on acoustic instruments in free field and the possibility of carrying out tests of sound testers to a full extent, in accordance with the current regulation. • Metrological support for organisations and laboratories involved in protection of natural environment and work environment against noise – in order to ensure reliability and accuracy of noise measurements carried out in Poland.	2018	2020	L1	- Polish manufacturers: SVANTEK, SONOPAN, - research institutes and universities conducting research in the field of acoustics, i.a. CIOP, IOŚ, IMP, GIG, ITB, PW, PWr, UAM, AGH - accredited laboratories	350,000.00	350,000.00	-	-	Central Office of Measures (GUM)

		<ul style="list-style-type: none"> Participation in research projects associated with the protection of natural environment and work environment against noise, including the projects managed by EMPIR (SRT-n04: "Establishing standards for calibration of digital sensing systems for acoustics and vibration"). 									
5	1/2	<p>Development of metrological infrastructure and personnel competences in the field of ultrasounds applied in healthcare</p> <p>Intended purpose of the action:</p> <ul style="list-style-type: none"> Ensuring traceability in the field of medical ultrasounds in Poland – development of measurement standards: the primary standard for ultrasound power and secondary standard for acoustic pressure in water. Support of Polish manufacturers of ultrasound equipment (ECHO SON, Dramiński, OPTEL, SONOMED) by ensuring possible cooperation and tests of ultrasonic medical devices in line with standards harmonized with the EU Medical Directive. Metrological support for institutions and laboratories involved in the study of ultrasonic medical devices remaining in active use – reliability and safety of ultrasound examinations and treatment. Support of scientific and research institutions (e.g. Institute of Fundamental Technological Research, Polish Academy of Sciences – IPPT PAN) conducting advanced studies on medical application of ultrasounds. Participation in research projects, including those implemented by EMPIR (2017: SRT-r03 – Development of expanded metrological capability for medical ultrasound) 	2018	2021	L1	<ul style="list-style-type: none"> Polish manufacturers of ultrasound diagnostic and therapeutical equipment: ECHO SON, Dramiński, OPTEL, SONOMED science and research institutes and universities conducting research in the field of ultrasounds, including IPPT PAN, PWR, UAM, PW, laboratories offering services in the field of testing and verification of the parameters of ultrasound devices 	1,000,000.00	200,000.00	–	–	GUM/EMPIR
6	1	<p>Extension and modernisation of metrological infrastructure ensuring traceability in the field of acoustics (infrasound frequencies)</p> <p>Intended purpose of the action:</p> <ul style="list-style-type: none"> Support of Polish manufacturers of acoustic equipment by ensuring infrasound frequency traceability. Ensuring reliable and accurate measurements of infrasound occurring in the natural environment or resulting from human activity. Support of research and scientific institutions conducting research in the field of infrasound noise, both at work and in the natural environment. <p>Action related to employment of personnel at the Acoustics Workshop: 1 person (full-time).</p>	2018	2021	L1	<ul style="list-style-type: none"> Polish manufacturers: SVANTEK, SONOPAN, research institutes and universities conducting research in the field of acoustics, i.a. CIOP, IOŚ, IMP, GIG, ITB, PW, PWR, UAM, AGH accredited laboratories 	–	250,000.00	–	–	Central Office of Measures (GUM)
7	1/3	<p>Modernisation of measurement stand intended to ensure the possibility of calibration of digital transducer systems applied in the field of acoustics and mechanical vibrations</p> <p>Digital transducer systems are and will be more frequently used for measurements in the field of acoustics, ultrasound and mechanical vibrations. Due to the lack of access to an analogue signal in such systems, it can only be treated as a "black box" with an output in the form of a digital data stream. This issue has been noted at the European level, as evidenced by the introduction of an EMPIR research project entitled "SRT-n04: Establishing standards for calibration on digital sensing system for acoustics and vibration", with the GUM being amongst the co-authors thereof. The aim is to modernise the currently used analogue measurement systems so that it will be possible to calibrate digital transducers and devices equipped with such transducers using the comparative method. The action will ensure substantial support for Polish manufacturers of acoustic equipment and devices for measuring mechanical vibrations (shock), who will cooperate with the GUM in the course of implementation of the programme.</p> <p>Action related to employment of personnel at the Acoustics Section: 1 person (full-time).</p>	2018	2021	L1	<ul style="list-style-type: none"> Polish manufacturers: SVANTEK, SONOPAN, accredited laboratories organisations involved in the protection of natural environment and work environment 	–	50,000.00	–	–	GUM/EMPIR
8	1	<p>Development of metrological infrastructure ensuring traceability with respect to large values of acoustic pressure.</p> <p>The goal is to ensure reliability of measurements at very large values of acoustic pressure related mainly to impulse noise accompanying the activities performed by the military. This activity fits in with the wider range of issues related to hearing protection in the military, including hearing impairment and loss prevention. The action involves the construction of a measuring station that allows for the calibration of microphones for very large acoustic pressure, the study of the linearity range of microphones and sound level testers as well as the study of non-linear distortions.</p>	2020	2022	L1	<ul style="list-style-type: none"> Polish manufacturers: SVANTEK, SONOPAN, military science and research institutes and universities conducting research in the field of acoustics accredited laboratories 	–	–	500,000.00	–	Central Office of Measures (GUM)
9	1	<p>Development of metrological infrastructure ensuring traceability in the field of measurement of mechanical vibrations within the scope of seismic vibrations. Establishment of a measurement stand for the calibration of seismic transducers and geophones.</p>	2020	2022	L1	<ul style="list-style-type: none"> science and research institutions and higher education institutions conducting research in the 	–	–	1,010,000.00	–	Central Office of Measures (GUM)

		Intended purpose of the action: • Providing metrological support to both industry and various institutions which engage in the measurement of very low frequency vibrations in areas such as mining, the construction industry, railway transportation, geology (e.g. mining damage, impact of construction of underground rapid transit systems on the surrounding buildings, seismic activity) • Ensuring reliable and credible vibration measurement of seismic activity in Poland.				field of seismic activity, such as GIG, AGH, the Railway Institute, Rail Vehicles Institute and various military institutes - accredited laboratories					
10	1/2/3	Modernisation and maintenance of the continued operation of technical infrastructure for the national time and frequency standard. This activity is necessary to ensure the traceability of official time determination and distribution (administration, state services, the transportation sector, the financial sector, society at large), to provide support for the realisation of the national standards for length as well as for AC and DC voltage (the industry, smart factories, development of new technologies) and to ensure the development of fibre-optic technologies for the precise transfer of time and frequency (telecommunications, satellite technologies, the military).	2018	2021	L2		1,250,000.00	440,000.00	190,000.00	300,000.00	Central Office of Measures (GUM)
11	1/2/3	Development of fibre-optic and satellite time transfer methods. Activities necessary to maintain Poland's important role in this regard, to provide support to the sector which commercialised and develops the existing solutions (high-quality products sold globally), to avoid the middle income trap, to provide support to the telecommunications, satellite, defence and financial industry (ensuring a source of credible time synchronisation independent of the GNSS).	2017	2021	L2	AOS CBK PAN, AGH, PCSS, Orange, PikTime, Institute of Telecommunications, WAT (Military University of Technology)	-	-	-	-	
12	3/4/8	Development of official time distribution and synchronisation systems. The activity must be implemented in order to ensure the security and integrity of state data collection and sharing systems (application of reliable, trusted timestamps in the course of data collection and processing), to ensure the integrity of the data collected by state services (the Police, the Road Transport Inspectorate, the Treasury Office) as well as to increase the level of security of electronically supplied services and operations (the "e-State" programme).	2017	2021	L2	Institute of Telecommunications, Elpoma, PikTime, AOS CBK PAN, NBP	-	70,000.00	-	-	NCBR, GUM
13	1	Development of a stand to measure particulate matter content in atmosphere. Action intended as a response to the domestic needs within the scope of environmental and climate change monitoring and healthcare. This is because the volume of particulate matter suspended in the atmosphere has a detrimental impact on both the environment and human health. Development of measurement methods in this area may allow for the designation of the most significant sources of air pollution and facilitate precise interventions intended to ensure improvement in air quality. Project implemented within the framework of the CMT for Environment and Climate Change	2018	2021	L3	Photon Institute, producers of measuring equipment (KμK, NGLab); Inspectorates for Environmental Protection (GIOŚ, WIOŚ)	300,000.00	300,000.00	300,000.00	-	Central Office of Measures (GUM)
14	1	Development of new primary reference materials (high-purity substances). Primary reference materials for the amount of substance measurement unit (the mole) will ensure traceability between the quantitative chemical analysis results and the SI unit through the transfer of the unit in question from the national standard to the measurement systems applied by research and calibration laboratories.	2018	2021	L3		-	50,000.00	50,000.00	50,000.00	Central Office of Measures (GUM)
15	1	Development of a method for the manufacture and certification of new, multi-element reference matrix reference materials. The action is intended as a response to the requirements of the National Smart Specialisation in the field of agricultural and environmental bio-economy (with regard to the monitoring of high-quality drinking water for the food industry and water pipe construction and maintenance business) as well as in the field of natural resources and waste management (with regard to research related to water processing and reclamation technologies as well as technologies reducing water consumption).	2018	2021	L3		150,000.00	-	50,000.00	50,000.00	GUM/NCBR (?)
16	1	Establishment of a new measurement stand based on a multi-sensor measurement device. Following the analysis of requests for quotation from various clients from the industrial sector, it has been concluded that a demand exists on the Polish market for a stand designed for the measurement of components and calibration of very small standards used e.g. to calibrate CCD cameras as well as calibration standards for industrial CT scanners used in the machinery, automotive and aviation industry.	2018	2018	L4		650,000.00	-	-	-	Central Office of Measures (GUM)
17	1	Development of measurement capabilities in the field of nanometrology. The activity is expected to involve the acquisition or construction of an AFM microscope. At the present stage, the interest in surface nanostructure measurement and analysis (shape, surface roughness) remains very high in the medical industry	2019	2020	L4	Wrocław University of Technology	-		1,400,000.00	-	Central Office of Measures (GUM)

		(e.g. medical implants), the electronic industry (e.g. graphene) as well as in the automotive industry.									
18	1	Modernisation of the national length standard. Performing the action in question will ensure the continuity of realisation of the unit of length and enhance measurement capabilities by increasing the scope of measurement of the national standard, ensuring the possibility of measurement of optical frequencies being applied in the telecommunications sector. The changes taking place in the telecommunications industry necessitate the modernisation of the national standard for the measurement unit of length. The laser radiation frequencies used in the telecommunications industry require a broader measurement range in order to ensure that the growing needs of the said industry are satisfied.	2018	2021	L4		-	50,000.00	-	2,000,000.00	Central Office of Measures (GUM)
19	1	Participation in the project involving the development of a Polish compact laser length/frequency standard which could later form part of industrial interferometers. The project is intended to provide support to the Polish hi-tech manufacturing industry (e.g. the manufacture of stabilised metrological lasers). Activity performed in the course of works of the CMT for Infrastructure and Special Applications.	2018	2020	L4	Polish manufacturer – Lasertex; Military University of Technology	-	20,000.00	-	-	GUM/NCBR
20	1	Development of new measurement methods for the purposes of geodesy. The increasing demands in the geodesic sector necessitates the development of new measurement systems. The increasing accuracy of interference surveying measurements and the need to conduct them in non-laboratory setting make it necessary to develop and implement measuring systems that compensate for changing environmental conditions.	2018	2021	L4	Polish surveying enterprises, e.g. WPG SA, GUGIK, Institute of Geodesy and Cartography, Warsaw University of Technology	-	-	-	-	Central Office of Measures (GUM)
21	1	Participation in the project involving the use of electromechanical microsystems for the purposes of ensuring dimensional standards for the users of atomic force microscopes and electron microscopes. The project is aimed at supporting the users of atomic force microscopes. Activity performed in the course of works of the CMT for Infrastructure and Special Applications.	2018	2020	L4	Wrocław University of Technology, Institute of Electron Technology	-	-	-	-	National Centre for Research and Development (NCBR)
22	1	Development of an interference measurement stand for the purposes of calibration of two-dimensional calibration standards. The development project is intended to enable the measurement of 2D line standards, commonly used in the medical, aviation and automotive industry. The need for the establishment of a new measurement stand is dictated by the increase in the number of clients requests pertaining to the possibility of calibration of this type of standards.	2020	2021	L4		-	-	500,000.00	-	Central Office of Measures (GUM)
23	1	Analysis and implementation of the method for the determination of the refractive index for liquid refractometric standards using the goniometric method. Technological developments enables the manufacture of refractometers characterised by increasingly high resolution parameters. As a result, the need arises for the calibration of refractometric standards with a degree of accuracy amounting to at least 1×10^{-6} . Refractometers are commonly used in the food industry, the chemical industry, the cosmetics and pharmaceutical industry as well as in numerous inspection and testing laboratories. The possibility of performing more accurate measurements will translate, among others, into an increase in the quality of the manufactured food and medical products.	2018	2021	L4		-	-	-	-	Central Office of Measures (GUM)
24	1 and 8	Participation in the construction of a laboratory for the measurement of quality parameters for alternating current. The laboratory for energy quality measurement is indispensable for the energy industry and enterprises trading in transmission of electricity, allowing them to ensure the appropriate parameters of the transmitted electricity, to reduce losses and to ensure the proper functioning of the electrical grid. Constant monitoring of energy quality in transmission networks will ensure a continuous failure-free delivery and will protect against possible extensive power failures (blackouts). The laboratory is to be established at the National Institute for Telecommunications following the completion of the research and development works being performed by the Consultative Metrological Team for Energy.	2017	2020	L5	AGH, Poznań University of Technology, Electrotechnology Institute, Tauron Dystrybucja S.A.	-	200,000.00	-	-	200,000.00 GUM The remaining funds are to be provided by the National Centre for Research and Development.
25	1 and 8	Development of a stand for the measurement of alternating current characterised by very low power and energy levels. The addition of this stand is necessitated by the needs of the electrical and electronic industry, including, in particular, the manufacturing plants which produce devices equipped with built-in standby systems. This is caused by the need to test systems of this kind for compliance with the applicable regulations for the purposes of certification of products prior to their release on the market. The development of this stand will contribute towards the development of the economy by ensuring an increased production and sales of products equipped with stand-by systems.	2017	2018	L5		100,000.00	-	-	-	100,000.00 GUM

26	1	<p>Development of a quantum standard for the realisation of alternating voltage measurement unit</p> <p>The development of the standard is one of the most important strategic objectives of the Central Office of Measures. Will make it possible for traceability to be transferred to scientific, research and industrial laboratory facilities with a high degree of accuracy and very low uncertainty. Once the standard is developed, the Central Office of Measures will make a significant contribution towards the development of innovative, competitive economy.</p>	2017	2022	L5	Silesian University of Technology, KrioSystem (a company based in Wrocław), Wrocław University of Technology	350,000.00	500,000.00	650,000.00		GUM budget There is also a possibility of obtaining funds from the National Centre for Research and Development. Composition of the established consortium: 1. Central Office of Measures (GUM) 2. Silesian University of Technology 3. KrioSystem (a company based in Wrocław) 4. Wrocław University of Technology
27	1	<p>Modernisation of the standard for alternating current power and energy (expanding the scope of the standard to include currents of up to 300 A).</p> <p>The development of the standard will provide scientific, research and industrial laboratories with the requisite traceability for the measurements of energy and power within the scope of high electrical current values; at the present stage, the Central Office of Measures is able to ensure traceability in this filed within the range of up to 100 A. The development of the standard is necessary to ensure accurate measurement within the scope of power and energy within the scope of high electrical current values and will contribute towards decreasing the losses in the volume of electricity produced, which is of great importance due to the ever-increasing demand for electricity. This shall also have an impact on the pace of economic growth.</p>	2019	2020	L5		-	700,000.00	-	-	
28	1	<p>Adjustment of the measurement stand structure to the modified definition of the ampere.</p> <p>The laboratory should be prepared for the performance of measurements and testing associated with the measurement of electrical quantities when the new definition of the ampere enters into force. All measurement stands and procedures must be amended so as to become adjusted to the new definition of the measurement unit for electric current.</p>	2018	2020	L5		10,000.00	10,000.00	10,000.00		
29	8	<p>Development of a new measurement stand for calibration and testing of instruments measuring the power and energy of direct current (DC power and energy meters used by the State Railway Company [PKP] and various urban transport operators).</p> <p>The trading in DC electricity also requires reliable measurements to be made. Locomotives and urban transport vehicles powered by electricity come equipped with DC power meters which are in the process of calibration. Currently, the laboratories which perform the calibration of these devices have no reference standard to fall back upon. Once the GUM finishes the development of the new stand, it will be able to ensure a reference standard for the energy of DC current. The reliable metering of the power consumed by railway vehicles and urban transportation will result in a better and more economical energy management, thereby having a positive impact on state finances and the national economy.</p>	2018	2020	L5		150,000.00	-	0.00	-	
30	1	<p>Development of measurement methods and measurement stand for the calibration of ELISA readers and control standards thereof.</p> <p>The project is intended to ensure the establishment of a domestic source of traceability for the users of next-gen spectrophotometers which are utilised for diagnostic purposes and shall provide direct support to the clients of the GUM, i.e. the users of spectrophotometers of this kind operating, <i>inter alia</i>, in the pharmaceutical industry, in the food industry (food testing, e.g. identification of cultivars in horticultural grafting, detection of fungal contamination in foodstuffs) as well as by diagnostic laboratories operated by organisations such as the Sanitary and Epidemiological Station (SANEPID), the Provincial Inspectorate for Environmental Protection, the Provincial Sanitary and Epidemiological Stations (WSSE), the Provincial Veterinary Inspectorates (WIW) (e.g. within the scope of contamination monitoring) and by various scientific institutions and universities.</p>	2018	2021	L6	-	50,000.00	50,000.00	-	-	1
31	1	<p>Development of a method for the calibration of photometric and colorimetric devices used for the purposes of measurements of the parameters of road lighting, illumination of various objects, monitors and LED advertisements – matrix light luminance testers.</p> <p>The project is intended to ensure the establishment of a designated position at the GUM which would be tasked with the calibration of matrix luminance measurement instruments. It will ensure metrological support for innovative photometric measuring instruments manufactured by Polish companies which specialise in the manufacture of measuring instruments in the field of photometry</p>	2018	2021	L6	-	200,000.00	125,000.00	370,000.00	-	1

		and radiometry. These instruments are designed for the performance of measurements for the electronic industry (television sets, computer monitors) with particular emphasis on the application thereof in the course of measurement of luminance of the display monitors used for medical diagnostics. Optical measurement instruments are used by small and medium manufacturing and service companies, government institutions, smelting plants, shipyards and mining facilities. They are commonly used by accredited laboratories, Sanitary and Epidemiological Stations, Inspectorates for Environmental Protection as well as by companies offering certified measurements which often serve as the basis for various administrative decisions. The instruments manufactured by the Polish manufacturers of photometric and radiometric equipment which receive support from the Central Office of Measures are exported to various European countries.									
32	1	Development of measurement method and measurement stand for the calibration of density meters and spectral density meters used for the purposes of print quality control. The project is intended to ensure the expansion of the scope of measurement activities performed by the Central Office of Measures by providing the possibility of calibration of density meters and spectral density meters – devices which are commonly used in the printing industry.	2018	2021	L6	-	50,000.00	-	-	-	1
33	1	Development of a method for the determination of metrological characteristics of measuring instruments used for the purposes of objective assessment of the physical properties correlating with visual perception – defining gloss value on the basis of the measurement of the refractive index The project is intended to ensure the establishment of a national measurement unit standard for high gloss, with reference to the national refractive index standard; the new standard is intended to serve as the source of traceability for the laboratory facilities operated by the Polish industry (the automotive, chemical, household appliance, pharmaceutical, paint and coatings, furniture and timber industry) as well as by various research institutes (e.g. the Institute for Engineering of Polymer Materials and Dies or the Institute for Construction Technologies).	2019	2021	L6	-	175,000.00	50,000.00	50,000.00	50,000.00	1
34	1	Development of a measurement stand for measuring spectral reflectance using the spectrogoniophotometric method within the UV – VIS – NIR range. The project is intended to allow the GUM to become independent from the calibrations performed by foreign NMIs by ensuring the possibility of measurement of reflectance using the absolute method within the measurement geometries recommended by the CIE (International Commission on Illumination). This effort constitutes a direct form of support for entities such as research laboratories as well as industrial laboratories operating within the automotive, paint and coatings, construction materials, textile, pharmaceutical, chemical, printing and food industries as well as for research laboratories of various scientific institutes (Institute for Biotechnology and Antibiotics, Military Institute for Engineering Technology, the MORATEX Institute for Security Technology, the Institute for Construction Technology, the Textile Research Institute, the Institute of Leather Industry, the Automotive Industry Institute or the Research Institute for Roads and Bridges).	2019	2022	L6	-	-	500,000.00	500,000.00	50,000.00	1 – 90 % 2 – 10 % ?
35	1	Development of a modular measurement stand for the 1 kilogramme prototype no. 51 – the national mass measurement unit standard. The action encompasses the acquisition of a mass comparator, which will allow the GUM to participate in research and implementation works prior and after the redefinition of the measurement unit for mass as well as to become an equal partner in international key comparisons (BIPM, EURAMET) as well as supplementary and bilateral comparisons. Furthermore, this step will also allow the Polish system of measures to remain independent from other countries insofar as mass and related quantities are concerned, while the GUM retains a measurement capacity at the current level (CMC), thus avoiding the risk of deterioration of technical competences in the field of mass measurement in Poland.	2017	2019	L7		1,350,000.00	2,000,000.00	2,000,000.00	-	Central Office of Measures (GUM)
36	1	Development and construction of the measurement stand for the national standard of the unit of measurement for pressure. The activity consists in the acquisition of three measurement units (piston-sleeve type) of a dead-weight, piston-type pressure gauge with very large collision cross-section. This will allow for determining the national standard of the unit of measure for pressure – values will be derived from geometric quantities, without the need to refer them to other pressure standards. The implementation of this project shall ensure the improvement of measurement capabilities in the field of pressure, allowing the Polish institutions to become independent from calibrations performed by foreign entities.	2018	2019	L7	The PRESS authorised service	110,000.00	30,000.00	-	-	Central Office of Measures (GUM)
37	1	Development of the metrological infrastructure ensuring traceability in the field of breath analysers.	2017	2020	L7	Universities: WAT, UMK in Toruń; private companies and	1,000,000.00	250,000.00	250,000.00	-	All sources of funding

		As breath analysers are planned to be subjected to regulatory metrological control and in connection with growing needs of manufacturers and users, it is necessary to construct a prototype device characterised by the best possible metrological parameters, in accordance with recommendation OIML R126 – Evidential breath analyzers. The device is necessary to determine measurement capability of stand for calibration of breath analysers and interlaboratory comparisons. Development of the breath analyser shall take place within the framework of the Consultative Team for Technology and Industrial Processes.				partnerships: AWAT from Warsaw, TransCom Int. from Paczkowo, LabStand from Poznań, INTECH from Gdańsk, measurement administration: OUM in Gdańsk					
38	1	Modernisation and extension of the metrological infrastructure ensuring traceability in the field of hardness. Development of a Rockwell hardness reference standard for N and T scales, purchase or development of stand for testing microhardness, nanohardness, Leeb hardness and Shore hardness (following the completion of an internship at the National Institute of Metrology in Germany by the employee).	2020	2020	L7		-	-	650,000.00	-	Central Office of Measures (GUM)
39	1	Modernisation and extension of the metrological infrastructure ensuring traceability in the field of density. Automation of measurement stand for hydrostatic weight measurement and development of new measurement stand.	2019	2021	L7		-	100,000.00	100,000.00	100,000.00	All sources of funding
40	1	Design and development of a measurement stand for ensuring traceability in the course of non-Newtonian fluid measurements. Acquisition of a rotational viscometer	2018	2021	L7		-	450,000, 00	-	-	All sources of funding
41	3	Development of a metrological methodology for the mass and dimension measurement system; implementation of domestic regulations. Activity performed within the framework of the Consultative Metrological Team for Technology and Industrial Processes (in the field of dynamic measurements of aggregate mass and axis load of road vehicles).	2017	2019	L7		100,000.00	100,000.00	-	-	All sources of funding
42	3	Launch of vehicle mass and dimension measurement system on a nationwide scale. The testing of devices for measuring the dimensions of vehicles in motion, previously referred to as High-Speed Weighing in Motion, currently eMEM (electronic Measuring in Motion) is performed by the Central Office of Measures in cooperation with the General Directorate for National Roads and Motorways (GDDKiA) and the Main Inspectorate for Road Transport (GITD). The aim of the cooperation is to ensure the introduction of a new type of measuring instruments which are currently beyond the scope of metrological supervision. Similar works are being performed both in the EU and beyond, since this new type of instruments are intended to keep overloaded trucks off the public roads. Tasks performed within the framework of the CMT for Technology and Industrial Processes	2019	2022	L7	Main Inspectorate of Road Transport (GITD) General Directorate of National Roads and Motorways (GDDKiA)	-	3,000,000.00	200,000.00	200,000.00	All sources of funding
43	1	Development of primary standard for dose absorbed in water. The measurement stand will allow for more accurate determination of doses of ionising radiation in treatment of neoplastic diseases with external sources (radiotherapy). The primary effect of the project shall be an increase in the safety of both medical personnel and patients undergoing radiotherapy. Tasks performed by the Consultative Metrological Team for Healthcare.	2017	2021	L8	Warsaw University of Technology	144,000.00	450,000.00	100,000.00	10,000,000.00	Central Office of Measures (GUM)
44	1	Extension of the stand for the measurement of the quantity of X-ray air kerma to enable the calibration of instruments used in medical diagnostics (mammography, radiography, computed tomography). Calibration of medical radiodiagnostics instruments will contribute to more accurate control of X-ray devices used in medical diagnostics, mammography and computed tomography. It will ensure the protection of health of technical staff handling the X-ray machines as well as the health of the patients themselves. Tasks performed by the Consultative Metrological Team for Healthcare.	2017	2020	L8	Warsaw University of Technology	1,399,000.00	76,000.00	100,000.00	100,000.00	Central Office of Measures (GUM)
45	1	Construction of a brachytherapy stand Such a stand will contribute to improving the accuracy and precision in treatment of neoplastic diseases with ionising radiation inside the patient's body (brachytherapy) and ensure traceability on a nationwide scale. It will also affect the effectiveness of radiotherapy in cancer treatment. The task forms part of the GUM strategy in the field of healthcare.	2018	2020	L8	Warsaw University of Technology	323,000.00	0.00	100,000.00	0.00	Central Office of Measures (GUM)
46	1, 5	Rebuilding the stand for measurement unit of gas flow volume and volumetric flow rate. The activity encompasses the acquisition of a measurement stand equipped with a standard bell-type gas container (replacement of the existing stand which is now 35 years old) with flow rate of up to 250 m ³ /h – maintenance of the measurement units for flow volume and volumetric flow rate for gas as well as ensuring the possibility for the transfer of the said measurement unit. The replacement of the existing standard will make it possible to increase the quality of gas flow measurement on a nationwide scale with respect to small and medium gas flows, based on the most recent technological developments.	2018	2018	L9		1,700,000.00	-	-	-	CENTRAL OFFICE OF MEASURES (GUM)

		Furthermore, it will also make it possible to satisfy the needs of the Polish industry and society (consumer protection with respect to charges for gas) through the support of high-precision measurements of gas flow performed by calibration laboratories, allowing the manufacturers of gas meters and gas flow meters to become more competitive as a consequence.									
47	1, 3, 5, 8	<p>Increase of measurement capabilities for microflows and gas flow measurements at high pressure. Supply of measurement stand with piston-type gauges for testing gas meters and gas flow meters at both atmospheric pressure and high pressure (up to 6 bar) – new area of activity (high pressure) of the laboratory arising from the increasing needs of the industry. A reference standard for a cubic meter of natural gas at pressure above 8 bar will be prepared for development. Stage I: piston-type standard operating in the micro-flow range (volumetric flow rate from 6 cm³/h to 6000 cm³/h – extension of measurement capabilities of the laboratory by two orders of magnitude in the field of low pressure (current standard only enables measurement within the range of up to 600 cm³/h). Stage II: piston-type standard with volumetric flow rate ranging from 16 dm³/h to 16000 dm³/h. Stage III: Development of a method for the calibration of gas meters at elevated pressure. Preparation for the development of solutions for the measurement problems affecting economic operators which engage in the transmission and supply of gas.</p> <p>The planned activities shall be conducive towards satisfying the needs of the Polish industry and society (consumer protection – payment of water supply fees) within the scope of the provision of measuring instruments which satisfy the designated legal requirements.</p>	2019	2021	L9	Gaz-System (selected issues)	–	400,000.00	950,000.00	100,000.00	Central Office of Measures (GUM)
48	1, 5, 8	<p>Extending measurement capacity in the field of micro-flows with respect to the reference standard unit of water flow volume and volumetric flow rate. Stage I: Extension of the measurement stand for the testing and calibration of water meters, flow transducers for heat meters as well as flow meters for cold and hot water no. S03 (low flow values within the (0,1 ÷ 3,0) dm³/h range). Stage II: Development of a new measurement stand for the testing and calibration of flow meters within the scope of micro-flows (below 0,1 dm³/h). The aim of the laboratory facility is to expand the measurement capacity and technical competences with respect to the flow volume standard and the volumetric flow rate standard for water (expanding the range of measurement to include small water flows) with particular emphasis on the application of such standards in the medical and pharmaceutical industry, as well as the development of measurement methods with respect to small flows.</p>	2018	2021	L9		50,000.00	150,000.00	150,000.00	150,000.00	Central Office of Measures (GUM)
49	1, 5, 8	<p>Modernisation and extension of measurement capabilities with respect to the reference standard for water flow volume and volumetric flow rate for the purposes of satisfying the needs of the Polish industry and society (consumer protection – payment of water supply fees) within the scope of the provision of measuring instruments which satisfy the designated legal requirements.</p> <p>Stage I: - – Acquisition and implementation of a computerised system for collecting and processing measurement data from the stand, - – design and development of a mobile measurement stand for the testing of water meters and flow transducers for heat meters in the conditions of normalised climate and electromagnetic disturbances, - – modernisation of the transfer device assembly Stage II: Installation of an outflow assembly forming part of the measurement stand for the testing and calibration of water meters, flow transducers for heat meters as well as flow meters for cold and hot water no. S02 (high flow values). Expanding the volume measurement scope in order to reach the contemplated limit defined by the existing weighing device (1500 kg) as well as decreasing the volumetric flow rate measurement uncertainty caused by synchronisation errors occurring in the transfer device.</p>	2018	2020	L9		210,000.00	450,000.00	100,000.00	–	Central Office of Measures (GUM)
50	1, 2	<p>Development and improvement of measurement methods for medical and laboratory applications associated with the measurement of micro-volumes. Stage I: Modernisation of the stand for the determination of piston-type micropipettes using a micro-balance with steam trap (maximum load – 22 g, read-out accuracy – 1 µg) – task to be implemented in 2017. Stage II: Modernisation and automation of the system for collecting and processing measurement data (e.g. temperature measurements) as well as improvement of the environmental conditions in laboratory facilities (addition of a</p>	2017	2020	L9		–	80,000.00	80,000.00	–	Central Office of Measures (GUM)

		windless air conditioning installation with automatic sensors measuring air temperature, pressure and humidity). The aim of the laboratory is to ensure the presence of appropriate research facilities for high-precision measuring instruments used in the healthcare sector, e.g. for piston-type micropipettes.									
51	1	Modernisation of the stand for the national temperature standard within the range between - 189°C and +961°C. The redefinition of the kelvin does not necessitate the development of a brand new national standard stand, since the method for the realisation of temperature scale is unlikely to change in the foreseeable future. However, the existing stand needs to be modernised and equipped with new systems in order to ensure measurement accuracy at the level dictated by the modified definition. In order to ensure the modernisation of the existing stand, the following items need to be acquired: - fixed point cells (4 units) - SPRT sensors (3 units) - water-alcohol thermostat, - heat-pipe high-temperature oven, - modernisation of the stand to ensure the realisation of triple point for argon.	2017	2021	L10		300,000.00	300,000.00	300,000.00	300,000.00	Central Office of Measures (GUM)
52	3	Construction of a mobile humidity generator The use of a mobile humidity generator (MHG) aims at regulating relative humidity from a few percent to 98%. The MHG (mobile humidity generator) shall be used as a portable working standard for ongoing testing and calibration of relative humidity measurement devices which cannot be transported to the calibration laboratory. The activity was designed to meet the needs of the Polish industry and is based on the works performed by the CMT for Environment and Climate Change.	2018	2021	L10	LAB-EL, Geneza	-	60,000.00	40,000.00	40,000.00	Central Office of Measures (GUM)
53	1	Development of a stand ensuring traceability within the scope of radiation thermometry. Contactless temperature measurement methods have become increasingly common in recent years. The development of a radiation thermometry stand will make it possible to ensure traceability for domestic accredited laboratories. The existing domestic calibration laboratories are forced to perform comparisons with other NMIs in Europe, since this is the only way to ensure traceability in the field of radiation thermometry. The Polish economy needs its own reference laboratory in this particular field of metrology.	2018	2021	L10		-	300,000.00	300,000.00	300,000.00	Central Office of Measures (GUM)
54	3	Regulations and metrological guides for industry, research laboratories and calibration laboratories – testing metrological characteristics This task is related to the needs of the Polish industry, including, first and foremost, the pharmaceutical industry, as well as of the Polish manufacturers of measuring instruments. Monitoring metrological parameters – temperature and relative humidity in the course of transportation and storage of medical products – has a significant impact on human and animal health. Enhancing the existing infrastructure through the addition of a set of temperature and relative humidity sensors and other devices will allow for the testing of metrological characteristics to be performed, leading to the formation of recommendations and guidelines for measuring instruments for temperature and humidity.	2017	2021	L1-L10, BS		-	-	-	-	Central Office of Measures (GUM)
55	4	Development of a stand designed for inter-laboratory comparisons as well as for ensuring traceability for climate chambers This task is associated with the current needs of Polish accredited calibration and research laboratories. Due to the increasing pace of development of thermostatic and humidity testing performed in climate chambers by the automotive and pharmaceutical industry, the need has emerged for inter-laboratory comparisons of climate chambers. The development of the new stand shall involve the modernisation of the existing infrastructure, including the multimeter with scanner designed for the measurement of temperature distribution, as well as the development of a set of associated documentation and recommendations and conducting pilot programmes in the field of inter-laboratory comparisons.	2018	2021	L10		-	120,000.00	120,000.00	25,000.00	Central Office of Measures (GUM)
56	1	Development of a stand for the testing of control speedometers (average speed measurement devices installed along a fixed route) based on the use of real-time clock. The implementation of the task will involve the acquisition of a real-time clock and the implementation of the measurement method used for the purposes of type approval of average speed measurement devices installed on long stretches of road.	2017	2018	ZMI		65,000.00				Central Office of Measures (GUM)
57	3	Preparation and development of principles, norms and regulations within the scope of application of IT solutions in measuring instruments (including mobile technologies, smart grid, smart meters, cloud data processing, measurement virtualisation, distributed measurement systems) in a manner which satisfies the needs related to the design and manufacture of state-of-the-art measurement devices and systems by scientific institutions and economic	2017	2021 (ongoing implementation)	ZMI	Ministry of Development, Polish Committee for Standardisation, manufacturers of measuring instruments, WELMEC	20,000.00	20,000.00	-	-	GUM – acquisition of the software necessary to ensure task implementation

		operators – task implemented through the establishment of a dedicated software engineering department.									
58	3, 6	Development of proposals for the amendment of the Law on Measures Tasks performed by the Consultative Metrological Team for Market Regulation.	2017	2019	BSM		-	-	-	-	
59	7	Preparation of a proposal for amending the provisions on the types of measuring instruments subject to regulatory metrological control Tasks performed by the Consultative Metrological Team for Market Regulation.	2017	2019	BSM	Ministry of Development, manufacturers of measuring devices, associations of the users of measuring devices	-	-	-	-	
60	7	Preparation of a proposal for amending the provisions on regulatory metrological control	2017	2019	BSM	Ministry of Development, manufacturers of measuring devices, associations of the users of measuring devices	-	-	-	-	
61	7	Verification and development of test methods and legal regulations related to cash registers, taking technological progress into account.	2017	2020	BSM	Ministry of Development, Ministry of Finance, FROB, manufacturers of cash registers associated in SDFUR, KI-GEiT	-	-	-	-	
62	4	Amendment of the operating procedures with respect to type approval, compliance assessment and certification	2017	2018	BSM		-	-	-	-	
63	7	Preparation of proposals for legislative change within the scope of requirements for measuring instruments as well as the scope and methods for the testing (verification) thereof	2017	2018	BSM		-	-	-	-	
64	6	Increasing the effectiveness of supervision over the units of regional measurement and assay administration.	2017	2020	BSM		-	-	-	-	
65	8	Development of uniform principles for the control of usage areas of measuring instruments with a complex formal and legal status (such as taximeters, LPG meters, velocity measuring instruments) Tasks performed by the Consultative Metrological Team for Market Regulation.	2017	2020	Measurement Service Department (BSM) in cooperation with Regional Office of Measures (OUM)	Government institutions, associations of users of measuring devices	-	-	-	-	
66	6	Developing a rational and efficient system for the use of control and measurement equipment owned by the regional measurement administration (including large mass standards and aerosol product testing stands).	2017	2020	Measurement Service Department (BSM) in cooperation with Regional Office of Measures (OUM)		-	-	-	-	
67	6	Development of the “IT support system for regional measurement administration services” (the “e-administration” system).	2017	2020	Measurement Service Department (BSM) in cooperation with BDG, OUM		-	-	-	-	Structural programmes and designated provisions
68	6	Delivery and implementation of a financial and accounting system for the regional measurement administration and assay administration which is compatible with the main administrator’s system for the purposes of integration of financial data within the framework of supervisory activities.	2017				2,037,500.00	-	-	-	

SUM – one year			28,593,500.00	41,801,000.00	56,120,000.00	73,815,000.00
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SUM – 4 years			200,329,500.00	PLN
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Appendix no. 8 List and schedule of primary activities of regional administration units

The appendix covers only selected main tasks which are necessary to implement the strategic GUM action plan which assumes the institution's continuing growth. Miscellaneous basic actions resulting from the ongoing activities of the Central Office of Measures (GUM) as well as their sources of financing will be included in annual GUM business plans, based on the budget plan (part 64).

OBJECTIVE 1 Technologically advanced measurement standards which ensure the efficient functioning of the Polish economy and satisfy the needs of society as well as ensure an appropriate quality of life.

OBJECTIVE 2 Respectable status in international organisations

OBJECTIVE 3 In-depth cooperation as well as knowledge and technology transfer arising from the increasing needs of the Polish industry and society.

OBJECTIVE 4 Extensive offer and high service quality

OBJECTIVE 5 A competent, growth-oriented and well-motivated personnel, prepared for the implementation of tasks for the benefit of an innovative, competitive economy.

OBJECTIVE 6 A well-organised network of specialised branch offices, equipped with the technical facilities, infrastructure and personnel capable of meeting their designated objectives.

OBJECTIVE 7 Consistent market regulations conducive towards the development of domestic industry and business

OBJECTIVE 8 An efficient system for the protection of economic and technical security of the state as well as the interests of citizens

Item no.	OBJECTIVE NO.	ACTION	TIME OF COMMENCEMENT	TIME OF COMPLETION	RESPONSIBLE UNIT	MATERIAL EXPENDITURE/INVESTMENTS /PLN				Source of financing
						2018	2019	2020	2021	
1	4, 6	Development of a stand for household water meter and flow transducer testing in order to make it possible for the validation of cold and warm water meters as well as flow transducers for water heat meters to be performed at the Regional Office of Measures in Toruń (multi-point stand). This project was devised in response to the needs of the local market, in order to satisfy the needs of the local businesses.	2018	2018	Regional Office of Measures (OUM) in Bydgoszcz	940,000.00				Central Office of Measures (GUM)
2	4, 6	Modernisation of the stand for the calibration of dead-weight piston-type pressure gauges (acquisition of a dead-weight piston-type pressure gauge set – class: 0.005, measurement range: -1+10 bar) in order to extend the existing measurement capabilities in response to the need of the local market.	2018	2018	Regional Office of Measures (OUM) in Bydgoszcz				450,000.00	Central Office of Measures (GUM)
3	4, 6	Modernisation of the stand for the calibration of gauge blocks with nominal length of 100 - 500 mm (modernisation of the two-sensor comparator for the calibration of gauge blocks). Activity performed for the purposes of enhancing measurement competences and ensuring competitiveness on the local market.	2019	2019	Regional Office of Measures (OUM) in Bydgoszcz		80,000.00			Central Office of Measures (GUM)
4	4, 6	Modernisation of the stand for the calibration of ceramic gauge blocks (addition of class 0 of ceramic gauge blocks in order to ensure the completeness of the range) in order to ensure full measurement range in response to the needs of the market.	2019	2019	Regional Office of Measures (OUM) in Bydgoszcz		6,000.00			Central Office of Measures (GUM)
5	4, 6	Modernisation of the stand for the calibration of electrical quantities measurement devices (acquisition of a three-phase power calibrator). Modernisation and extension of the stand in response to local market needs.	2019	2019	Regional Office of Measures (OUM) in Bydgoszcz		90,000.00			Central Office of Measures (GUM)
6	4, 6	Extension of the stand for the calibration of pH meters and conductimeters (acquisition of equipment for calibration using certified reference materials). Activity performed for the purposes of enhancing measurement competences and ensuring competitiveness on the local market.	2019	2019	Regional Office of Measures (OUM) in Bydgoszcz		25,000.00			Central Office of Measures (GUM)
7	4, 6	Extension of the stand for the calibration of electrical installation testers (acquisition of a high-voltage 10 kV decade box). Activity performed for the purposes of enhancing measurement competences and ensuring competitiveness on the market.	2019	2019	Regional Office of Measures (OUM) in Bydgoszcz		45,000.00			Central Office of Measures (GUM)
8	4, 6	Development of a stand for the validation and control of LPG meters (acquisition of a stand with a mass flow meter for LPG). Activity aimed at increasing the measurement competences and ensuring effective consumer rights protection through the exercise of metrological control.	2020	2020	Regional Office of Measures (OUM) in Bydgoszcz			120,000.00		Central Office of Measures (GUM)
9	4, 6	Modernisation of the stand for the calibration of time and frequency measurement devices (acquisition of a new frequency standard and distribution amplifier). Activity performed for the purposes of enhancing measurement competences and ensuring competitiveness on the local market.	2020	2020	Regional Office of Measures (OUM) in Bydgoszcz			65,000.00		Central Office of Measures (GUM)
10	4, 6	Modernisation of the stand for the calibration of RLC devices (acquisition of an RLC bridge). Activity performed for the purposes of enhancing measurement competences and ensuring competitiveness on the local market.	2020	2020	Regional Office of Measures (OUM) in Bydgoszcz			8,000.00		Central Office of Measures (GUM)
11	4, 6	Development of a stand for the calibration of sensor-less thermometers and thermal hygrometers (acquisition of a climate chamber) – activities aimed at fostering the development of this field of measurement in the light of increasing market demand for the testing of instruments of this type.	2020	2020	District Office of Measures (OUM) in Bydgoszcz			120,000.00		Central Office of Measures (GUM)
12	4, 6	Development of a stand for the re-validation of taximeters following compliance assessment at the Branch Office in Grudziądz (acquisition of both stationary and mobile sets for taximeter validation). Expanding legalisation opportunities following compliance assessment in order to ensure greater user access to the services offered.	2020	2020	Regional Office of Measures (OUM) in Bydgoszcz			80,000.00		Central Office of Measures (GUM)
13	4, 6	Modernisation of the stand for the validation and calibration of mass standards and E2, F1, F2 and M1-class weights (acquisition of a mass comparator equipped with a computer with weighing software). Activity performed for the purposes of enhancing measurement competences.	2020	2020	Regional Office of Measures (OUM) in Bydgoszcz			120,000.00		Central Office of Measures (GUM)
14	4, 6	Development of a length measurement stand equipped with a laser. This stand will also enable the performance of bilateral inter-laboratory comparisons for the measurement administration as well as for other interested laboratory facilities. Compliance assessment of material length measures would likewise be available.	2018	2019	Regional Office of Measures (OUM) in Gdańsk	170,000.00	150,000.00			Central Office of Measures (GUM)

15	4, 6	Expanding the scope of activities within the scope of length and angle measurement. This activity will make it possible to ensure measurement traceability with respect to the measurement of length and angles through the calibration of multiple types of material length and angle standards in the form of cylinders, cones and angle standards; activity performed due to the increasing demand among calibration laboratories, research laboratories and the machine industry.	2019	2021	Regional Office of Measures (OUM) in Gdańsk		20,000.00	100,000.00	1,000,000.00	Central Office of Measures (GUM)
16	4, 6	Modernisation of the ISTRON universal testing machine – in order to ensure the traceability with respect to the calibration of universal testing machines, concrete presses and various technological devices, it has become necessary to acquire tensometric transducers for tensile and compressive strength with a range between 10 kN and 3 MN. In addition, calibration of measuring instruments is also performed for the benefit of other Regional Offices of Measures, accredited calibration laboratories and other entities (such as the Technical Supervision Office [UDT] in Poznań, Białystok and other locations, the General Directorate for National Roads and Motorways, the Skanska company and various shipyards), in each case in order to ensure the requisite traceability.	2018	2019	Regional Office of Measures (OUM) in Gdańsk	237,000.00	134,000.00			Central Office of Measures (GUM)
17	4, 6	Maintenance and development of length measurements - acquisition of fastenings for gauge blocks with the following dimensions: (0 ÷ 50) mm; (0 ÷ 100) mm; (100 ÷ 200) mm – 1,05; (100 ÷ 300) mm; (300 ÷ 500) mm, (500 ÷ 800) mm; (800 ÷ 1000) mm. The acquisition of the fastenings will make it possible to ensure traceability in the course of transfer of measurement unit from the national standard to utility instruments and devices.	2018	2021	Regional Office of Measures (OUM) in Gdańsk	1,800.00	2,300.00	3,600.00	2,850.00	Central Office of Measures (GUM)
18	4, 6	Fostering development in the field of calibration of precise standards for shape, length and angle through the acquisition of a universal measurement microscope; a notebook computer for transmitting calibration data – extension of measurement range.	2020	2021	Regional Office of Measures (OUM) in Gdańsk			100,000.00	4,000.00	Central Office of Measures (GUM)
19	4, 6	Maintenance and development in the field of mass measurements – the necessary acquisition of mass comparators (along with accompanying notebook computers) within the following measurement range: 1 mg ÷ 5 g; 100 mg ÷ 100 g; 1 kg ÷ 10 kg; 2 kg ÷ 20 kg; 20 kg ÷ 50 kg; these shall also be accompanied by newly acquired mass standards along with the appropriate fastenings – accuracy scale: E1, measurement range: 1 mg – 1 kg; accuracy scale: E2, measurement range: 1 kg – 20 kg. The activity is necessary in order to ensure the possibility of rendering various services to the manufacturers of weighing instruments (e.g. AXIS, EWP) on the basis of annual contracts, which would make it possible to negotiate the option to perform calibrations at short notice.	2018	2021	Regional Office of Measures (OUM) in Gdańsk	59,000.00	50,500.00	54,000.00	132,000.00	Central Office of Measures (GUM)
20	4, 6	Development of specialisations in the field of length measurement – calibration of measurement plates and other flatness standards through the acquisition of digital levels along with accompanying wiring and software; notebook for transmitting calibration data.	2019	2020	Regional Office of Measures (OUM) in Gdańsk		55,000.00	4,000.00		Central Office of Measures (GUM)
21	4, 6	Development of a stand for the calibration of platform scales. The acquisition of the stand is necessary in order to ensure traceability at the requisite level according to the projected needs of the measurement administration as well as the current needs of other (non-administrative) entities. The existing platform scales are currently being used for the purposes of calibration of automatic conveyor scales at the AP. The scales which are to be purchased will serve the needs of the control and supervision of the automatic weighing instruments market as well as support the operations of the Mass Laboratory of the Central Office of Measures in the course of research performed within the framework of the EMPIR project.	2018	2019	Regional Office of Measures (OUM) in Gdańsk	180,000.00	4,000.00			Central Office of Measures (GUM)
22	4, 6	Ensuring the availability for calibration of gas analysers (CO, CO₂, NO, NO₂ SO₂), air quality meters and chimney smoke analysers – development – transfer of the calibration process from the Central Office of Measures; the annual cost for gas amounts to PLN 25 thousand; the current stand may be extended through the addition of a dynamic gas dilution system (PLN 130 thousand), making it possible to ensure the level of specialisation allowing for services to be rendered to clients from all across the country.	2019	2021	Regional Office of Measures (OUM) in Gdańsk		25,000.00	25,000.00	155,000.00	Central Office of Measures (GUM)
23	4, 6	Maintenance and development of the stand for alcohol tester calibration/validation – acquisition of a new alcolock stand; acquisition of an analytical weighing instrument and oscillating densitometer; acquisition of a control breath analyser. Today, more than 1200 breath analysers are calibrated each year.	2018	2021	Regional Office of Measures (OUM) in Gdańsk	20,000.00	15,000.00	100,000.00	250,000.00	Central Office of Measures (GUM)
24	4, 6	Ensuring the possibility of calibration and testing of electricity meters for market surveillance purposes , according to the requirements of the Act on Compliance Assessment and Market Surveillance Systems. Acquisition of a stand for the calibration of electricity meters; currently, our institution has in its possession a standard electricity meter characterised by the highest degree of measurement accuracy. Expanding calibration range (currently, only calibration stations are covered). We have received a customer enquiry concerning the calibration of more than 3800 electricity meters.	2018	2019	Regional Office of Measures (OUM) in Gdańsk	50,000.00	100,000.00			Central Office of Measures (GUM)
25	4, 6	Maintenance of specialisation in the field of electrical quantities – activity encompassing the periodical adjustment of the Guildline HV 6622A resistance comparator (bridge) by its manufacturer in Canada; acquisition of a high-precision thermometer for the calibration of resistance standards; ensuring the presence of a complete set of resistance standards (1 ppm accuracy) through the acquisition of missing standards; acquisition of a power supply (type 6623A) for the Guildline HV 6622A resistance comparator (bridge); acquisition of a megohmmeter, microohmmeter and ultrathermostat for standard resistors.	2018	2021	Regional Office of Measures (OUM) in Gdańsk	65,000.00	100,000.00	39,000.00	70,000.00	Central Office of Measures (GUM)
26	4, 6	Ensuring and maintaining the continued operation of accredited calibration laboratory in the field of temperature – acquisition (replacement) of the temperature standard sensor; adjustment of temperature and humidity testers currently owned by the measurement administration – acquisition of appropriate software. The development scheme is also expected to involve the extension of the scope of accreditation through the addition of a service involving the calibration of temperature meters and temperature data loggers on the client's premises. The contemplated activity requires the acquisition of a temperature calibrator as well as the calibration of climate chambers, thermostatic cabinets and chambers – acquisition of four temperature and humidity sensors and a measurement module.	2018	2020	Regional Office of Measures (OUM) in Gdańsk	24,000.00	35,000.00	55,000.00		Central Office of Measures (GUM)

27	4, 6	Maintenance of continued calibration of multimeters and multi-function calibrators for voltage, current and resistance (within the framework of specialisation) – acquisition of a standard multimeter and multi-function calibrator. Calibration of multimeters and multi-function calibrators within the scope of resistance and capacity – acquisition of decade standards. Calibration of power network parameter testers and bridges for RLC testers – acquisition of a resistance decade box (range: 1M Ω – 1 T Ω).	2019	2021	Regional Office of Measures (OUM) in Gdańsk	97,000.00	60,000.00	380,000.00	90,000.00	Central Office of Measures (GUM)
28	4, 6	Maintenance of the calibration of pH-meters and conductimeters using liquid reference materials – acquisition of a laboratory water bath. Within the framework of specialisation – extension of the scope of spectrophotometric calibrations through the addition of calibrations within the IR range (acquisition of an IR standard); so far, the regional measurement administration has not been able to perform calibrations of this type.	2018	2019	Regional Office of Measures (OUM) in Gdańsk	16,000.00	6,000.00			Central Office of Measures (GUM)
29	4, 6	Within the framework of specialisation – extension of the scope of calibration of power network parameter calibrators (inclusion of all types of measurements, including RCD) – acquisition of a broadband digital oscilloscope with signal analysis functionality. Development of a stand for the calibration of kilovoltmeters – acquisition of a voltage transformer.	2019	2020	Regional Office of Measures (OUM) in Gdańsk		45,000.00	39,000.00		Central Office of Measures (GUM)
30	4, 6	Ensuring the possibility of the calibration of solarimeters – UV radiation (irradiance) testers used by the Trade Inspection Authority to measure radiation levels of sunbeds.	2019	2021	Regional Office of Measures (OUM) in Gdańsk		16,000.00			Central Office of Measures (GUM)
31	4, 6	Ensuring the security of measurement equipment and the uninterrupted operation of the laboratory power supply network – acquisition of UPS (uninterrupted power supply) devices. Maintenance of the appropriate environmental conditions inside the laboratory – acquisition of air conditioning units for existing laboratory facilities; acquisition of power supply stabilisers for high-precision measurements. Maintenance of accreditation – participation in inter-laboratory comparisons in the field of AC resistance (ground resistance testers) as well as in the field of electrical and time measurements (residual-current device safety testers).	2018	2020	Regional Office of Measures (OUM) in Gdańsk	12,000.00	22,000.00	40,000.00		Central Office of Measures (GUM)
32	4, 6	Development of technical competences in the field of determination of the length of road sections necessary for the validation of traffic control measuring instruments – application of an innovative method based on satellite navigation (the Galileo system); Galileo-disciplined time and frequency standard;	2018	2020	Regional Office of Measures (OUM) in Gdańsk	100,000.00				Central Office of Measures (GUM)
33	4, 6	Development of a stand for the validation and evaluation of water meters at the Branch Office in Słupsk – acquisition of the stand presently used at the validation facility, refurbishment of laboratory facilities. The activity is intended to ensure greater availability of services on the local market.	2018	2019	Regional Office of Measures (OUM) in Gdańsk	30,000.00	20,000.00			Central Office of Measures (GUM)
34	6	New headquarters of the OUM – construction of a new building or adaptation of an existing one – preparing the design, acquisition of funds, determination of location of the contemplated building (plot of land where the building may be built) and commencement of the project. Ensuring the presence of an appropriate construction infrastructure for the metrological activities performed.	2018	2020	Central Office of Measures/ Regional Office of Measures in Katowice					Central Office of Measures (GUM)
35	4, 6	Modernisation and development of control and measurement equipment (including the calibrator for multimeters and mass comparators with a 1 mg – 50 kg range) designed for the calibration of mass standards, weights and ballasts as well as of a set of mass standards (E1 class) with mass range between 1 mg and 200 g. Extension of calibration capabilities through the addition of E2 standards within the 1 mg – 200 g range. Activity intended to enhance measurement competences and boost service competitiveness on the local market.	2018	2020	Regional Office of Measures (OUM) in Katowice		540,000.00	200,000.00		Central Office of Measures (GUM)
36	4, 6	Accommodating the needs of the manufacturers of measuring instruments from the surrounding district in the field of testing of digital testers, power analysers, power testers and transformers – acquisition of a calibrator.	2019	2019	Regional Office of Measures (OUM) in Cracow		85,000.00			Central Office of Measures (GUM)
37	4, 6	Extension of measurement capabilities within the scope of the temperature measurement instrument testing services rendered on a nationwide scale – salt thermostat.	2018	2018	Regional Office of Measures (OUM) in Cracow	135,000.00				Central Office of Measures (GUM)
38	4, 6	Maintenance and extension of measurement capabilities within the scope of flow measurement – flow meter, laboratory flasks.	2018	2018	Regional Office of Measures (OUM) in Cracow	100,000.00		40,000.00		Central Office of Measures (GUM)
39	4, 6	Expanding legalisation opportunities for taximeters following compliance assessment in order to ensure greater user access to the services offered – stationary and mobile stand for taximeter testing (following compliance assessment).	2018	2019	Regional Office of Measures (OUM) in Cracow	60,000.00	60,000.00			Central Office of Measures (GUM)
40	4, 6	Expanding the scope of measurement and enhancing the level of measurement uncertainty with respect to the measurement of force, length as well as electrical and radiation thermometry.	2018	2020	Regional Office of Measures (OUM) in Łódź	86,000.00	27,000.00	201,000.00		Central Office of Measures (GUM)
41	4, 6	Modernisation and development of measurement stand (including for the calibration of direct current meters and shunts as well as for the manufacture of reference materials – pH standards and conductimetric standards). Activity aimed at ensuring the enhancement of measurement competences.	2018	2019	Regional Office of Measures (OUM) in Łódź	280,500.00	95,000.00			Central Office of Measures (GUM)
42	4, 6	Expanding the scope of measurement and enhancing the level of measurement uncertainty with respect to the measurement of force, length as well as electrical and radiation thermometry.	2018	2020	Regional Office of Measures (OUM) in Łódź	86,000.00	27,000.00	201,000.00		Central Office of Measures (GUM)
43	4, 6	Extending the scope of services offered through the development of measurement stand for the calibration of photometric calibrators and torque wrenches in order to accommodate the needs and expectations of the clients. - The development of a stand for the calibration of photometric calibrators will make it possible to extend the scope of calibration services through the introduction of a new service (calibration of photometric	2018	2020	Regional Office of Measures (OUM) in Poznań	25,000.00		40,000.00		Central Office of Measures (GUM)

		calibrators) according to the needs of the market. This service shall be aimed at the users of luxometers, i.e. mostly entities engaging in the performance of lighting intensity measurements in the work environment. This activity is also in line with the contemplated measurement specialisation of the OUM in Poznań (calibration of photometric calibrators). - The development of a stand for the calibration of torque wrenches will make it possible to extend the scope of calibration services through the introduction of a new service (calibration of torque wrenches) according to the needs of the market. This service shall be aimed primarily at the numerous manufacturing and service companies operating in the automotive sector.								
44	4, 6	Ensuring high-quality metrological services through the modernisation of the measurement stands for the performance of metrological activities in the following fields: electrical quantities, time, photometry, length, force, mass, volume, flows and pressure. This activity is intended to ensure high service quality and uninterrupted provision of metrological services rendered to numerous businesses, most of which are returning customers of the institution. The activity in question is also in line with the measurement specialisation of the OUM in Poznań (the calibration of equipment used for the purposes of electricity measurement and power network quality testing, including, in particular, instruments such as non-linear distortion testers within the THD range as well as devices for the measurement of fault loop resistance and isolation quality. The services involving the calibration of non-linear distortion testers operating within the THD range are mostly aimed at power stations, renewable energy suppliers as well as research and measurement laboratories.	2018	2021	Regional Office of Measures (OUM) in Poznań	29,000.00	140,000.00	114,000.00	323,000.00	Central Office of Measures (GUM)
45	6	Ensuring the presence of technical facilities supporting the activities of the measurement administration in the field of metrological supervision through the establishment of a storage facility for large mass standards (acquisition of large mass standards – 25 tonnes, acquisition of a forklift, refurbishment of the available premises and leasing of vehicles for the transportation of standards); project to be implemented in the city of Kalisz. Activity aimed at ensuring the enhancement of measurement competences. The contemplated activity is intended to address the needs of the market in the area in question.	2020	2021	Regional Office of Measures (OUM) in Poznań	-		205,000.00	225,000.00	Central Office of Measures (GUM)
46	6	Development of the transportation depot supporting the performance of metrological activities (acquisition of cars for the OUM according to the investment plan) in order to attain the following objectives: – intensify the supervisory activities within the scope of control of packaged goods as well as general surveillance and market surveillance, so that the number of audits performed can be maintained at an appropriate level and that entities operating in the field of market surveillance may increasingly be included within the ambit of activities of the Office; – secure the performance of activities within the scope of regulatory metrological control, compliance assessment, calibration and evaluation insofar as the technical capacity of the Office permits. The replacement of the existing fleet (many vehicles are now more than 10 years old) will make it possible to ensure the continued availability of the vehicles through the elimination of downtime caused by repairs and maintenance; combined with GPS monitoring and driver identification, this contemplated scheme will ensure the optimum usage of vehicles as well as adequate transport conditions for both the auditing teams and the measurement devices which they use.	2018	2021	Regional Office of Measures (OUM) in Poznań	70,000.00	72,000.00	75,000.00	80,000.00	Central Office of Measures (GUM)
47	6	Development of IT and office facilities (including the acquisition of an electronic bulletin board – in accordance with the investment plan – as well as of computer network components). In the light of the contemplated establishment of a set of on-line measurement administration services (e-administration), the condition of the existing technical infrastructure makes it necessary to ensure that the following actions are performed on an ongoing basis: – the acquisition of IT systems in order to ensure the requisite organisational and technical conditions for the functioning of the Office; – the modernisation of the existing computer network (established back in 2004) through the acquisition, among others, of switches which shall enhance connectivity between the users of the network, thus ensuring a rapid transfer of data. The acquisition of an electronic bulletin board (serving as an electronic service for the publication of information and announcements of the OUM in Poznań), on the other hand, is necessary to enable the dissemination of public information at the OUM building in a universally accessible location according to the provisions of applicable laws, including Article 61 of the Constitution of the Republic of Poland (Dz. U. [the Journal of Laws] for 1997, no. 78, item 483), the Act of 06.09.2001 on access to public information (Dz. U. [the Journal of Laws] for 2016, item 1764), the Labour Code (consolidated text – Dz. U. [the Journal of Laws] for 2016, item 1666), the Act of November 21, 2008 on the civil service (consolidated text: Dz. U. [the Journal of Laws] for 2016, item 1345), the Act of January 29, 2004 – Public Procurement Law (consolidated text: Dz. U. [the Journal of Laws] for 2015, item 2164, as amended). The acquisition of an electronic bulletin board will make the process of obtaining public information more effective, comprehensible and user-friendly for the clients; the information and announcements, managed by the system administrator, will be displayed in multiple folders (e.g. tenders, disposal of redundant property, training courses, recruitment, work opportunities etc.). The photocopying equipment used for the purposes of implementation of the tasks of the Office has now become obsolete, having served for 12 years and undergoing numerous repairs. This equipment, designed for photocopying of A3/A4 format documents, needs to be replaced and connected to a restricted access network (currently, this equipment is accessible to everyone).	2018	2021	Regional Office of Measures (OUM) in Poznań	25,000.00	16,000.00		32,000.00	Central Office of Measures (GUM)
48	6	Ensuring the presence of an appropriate construction infrastructure for the metrological activities performed through the necessary repair works – the repair works planned for the next few years take into account the order of facilities and interiors the renovation of which shall have a direct impact on the performance of metrological activities as well as on ensuring the appropriate quality of customer service. The necessary works shall be performed inside the building in Poznań (adaptation of the interiors to serve as a workshop, reorganisation of customer service, ensuring controlled access to common areas) as well	2018	2021	Regional Office of Measures (OUM) in Poznań	307,244.00	167,000.00	175,000.00	210,000.00	Central Office of Measures (GUM)

		as inside the facility in Kalisz, which has not been refurbished ever since its construction back in the 1970s and the 1980s. The programme of renovation works shall also extend to the facilities in Leszno. The above works are necessary in order to ensure the requisite and appropriate work conditions and technical infrastructure consistent with the mission of the OUM as defined in its organisational documents as well as with the needs of the Office insofar as the performance of tasks related to metrological activities are concerned; moreover, the works in question are also intended to ensure compliance with the provisions of applicable laws in the field of real estate management and administration, including the Construction Law, the Act on energy performance of buildings, the regulation of the Minister of Infrastructure on the technical conditions applicable to buildings and locations thereof, the regulation of the Minister of Internal Affairs and Administration on the protection of buildings against fire hazards as well as with the recommendations and conclusions contained in the reports on mandatory annual inspections of the facilities of the OUM.								
49	6	Ensuring appropriate environmental conditions for the performance of measurements and research (equipping the OUM facilities with an air conditioning system).	2019	2021	Regional Office of Measures (OUM) in Poznań		14,000.00		14,000.00	Central Office of Measures (GUM)
50	8	Preparation, publication and distribution of educational materials concerning the applicable legal regulations and the correct use of measuring instruments by the users thereof (brochures, training videos) in order to secure the interests of citizens and the national economy.	2018	2020	Regional Office of Measures (OUM) in Poznań	5,000.00	4,000.00	4,000.00		Central Office of Measures (GUM)
51	4, 6	Modernisation of stand and control and measurement equipment (including the stand for the testing of LPG installation testing, the measurement stand for taximeter testing following compliance assessment, the measurement stand equipped with mass flow meter designed for the calibration of measurement tanks using petroleum-based products, the measurement stand equipped with mass flow meter designed for the calibration of measurement tanks using water as well as the measurement stand for the calibration of torque wrenches). Expanding legalisation opportunities following compliance assessment in order to ensure greater user access to the services offered.	2018	2021	Regional Office of Measures (OUM) in Szczecin	132,000.00	160,000.00	100,000.00	45,000.00	Central Office of Measures (GUM)
52	4, 6	Development of an environmental measurement section (temperature and humidity measurements – acquisition of devices such as a climate chamber, thermostat, SPRT and dew point sensors). Enhancement of competences in the field of measurement.	2018	2020	Regional Office of Measures (OUM) in Szczecin	150,000.00	80,000.00	40,000.00	-	Central Office of Measures (GUM)
53	4, 6	Modernisation of the pressure measurement laboratories at the OUM in Szczecin and at the Branch Office in Zielona Góra (including the acquisition of a low-pressure calibrator and dead-weight piston-type manometers). The OUM in Szczecin is the only Regional Office of Measures in Poland which holds a PCA accreditation for the calibration of pressure transducers. Developing and focusing the offer of metrological services within the scope of pressure measurements will make it possible to cut organisational, technical and economic costs associated with ensuring traceability in this area (cost reduction on a nationwide scale) as well as to free up the resources of the Central Office of Measures hitherto allocated to routine low-level calibration activities.	2018	2020	Regional Office of Measures (OUM) in Szczecin		50,000.00	80,000.00	40,000.00	Central Office of Measures (GUM)
54	4, 6	Transfer of the process of calibration of utility measuring instruments from the Central Office of Measures with respect to instruments designed for the measurement of electrical quantities (calibrators, digital multimeters, transformers) as well as to optical measuring instruments – photometric calibrators and luminance testers; various companies engaging in the manufacture and servicing of optical instruments have their registered offices within the area of operations of the Branch Office in Białystok. The takeover of the calibration process will ensure a more effective customer service, allowing the instruments in question to be calibrated without the need to transport them to Warsaw.	2018	2020	Regional Office of Measures (OUM) in Warsaw	350,000.00	400,000.00	1,000,000.00		Central Office of Measures (GUM)
55	4, 6	Enhancing the measurement capabilities and expanding the scope of accreditation of the Temperature Measurement Laboratory and the Density Measurement Laboratory – validated and calibrated hydrometers, densometers and thermometers are used, among others, at alcohol distillation plants (for the purposes of measurement of alcohol content in order to calculate the applicable amount of excise tax payable) at chemical processing plant (manufacture of various products such as engine oils and transmission fluids with specific chemical parameters) as well as by the manufacturers of packaged goods (for the purposes of determining fluid density in order to ensure that the goods are sold in the declared quantity and volume). The implementation of this task requires one individual to be employed on a part-time basis.	2018	2021	Regional Office of Measures (OUM) in Warsaw	230,000.00	205,000.00	250,000.00	180,000.00	Central Office of Measures (GUM)
56	4, 6	Expanding the calibration range for universal testing machines up to the value of 6000 kN – the calibrated universal testing machines are used, among others, for the purposes of testing the quality of concrete used in road and building construction. Concrete quality testing is of key importance to ensure the appropriate quality and durability of the erected structures.	2018	2019	Regional Office of Measures (OUM) in Warsaw	32,000.00				Central Office of Measures (GUM)
57	4, 6	Modernisation of the stand for the calibration of electricity meters. Acquisition of a standard meter along with power supply, stand and scanning head; this device is used at the validation facilities for the purposes of calibration of electricity meter testing stand. The acquisition of a control meter will ensure the protection of consumer rights by making it possible for entrepreneurs to validate their electricity meters, the readouts of which form the basis for the calculation of electricity fees. The implementation of this task requires an additional individual to be employed.	2018	2020	Regional Office of Measures (OUM) in Warsaw	140,000.00	200,000.00	90,000.00		Central Office of Measures (GUM)
58	4, 6	Modernisation of the control and measurement equipment at the Siedlce Branch Office through the addition of a set of non-automatic weighing instruments (checkweighers) used in the process of calibration and validation of automated belt scales; belt scales are used, among others, at heating plants (for the purposes of determining coal consumption in order to calculate the amounts of the applicable CO ₂ emission fees), at solid waste disposal plants (for the purposes of calculation of the fees for waste disposal or incineration), at concrete manufacturing plants (for the purposes of determining the mass of components used to produce concrete mixes characterised by specific qualities) etc.	2019	2021	Regional Office of Measures (OUM) in Warsaw		40,000.00	30,000.00	30,000.00	Central Office of Measures (GUM)
59	4, 6	Extension of the scope of competences of the large mass section through the acquisition of a hook	2019	2021	Regional Office of		45,000.00	42,000.00	800,000.00	Central Office

		weight comparator for the calibration of 500 kg and 1000 kg standards in the M₁ class (services to be rendered on customer premises) as well as of a dedicated cargo vehicle – Branch Office in Siedlce. The acquisition of the aforementioned equipment will make it possible for customers to perform calibrations of large mass standards on the premises of the customer, eliminating the need to transport those items to the headquarters of the Office. The transportation of 30-tonne mass standards is a time-consuming and difficult task. The mass standards in question are used for the purposes of the validation of vehicle and railway scales (weighbridges) in order to ensure the precise measurement of the mass of transported goods, which is of immense significance, for example, for the purposes of determining the amount of tax payable, the protection of consumer rights, the calculation of the price for the goods sold etc. The implementation of this task requires an additional individual to be employed.			Measures (OUM) in Warsaw					of Measures (GUM)
60	8	Increasing the auditing efficiency with respect to the manufacturers of packaged goods and users of measuring instruments through the acquisition of cars for the transportation of instruments for the control of goods as well as employees tasked with the performance of auditing activities.	2018	2021	Branch Offices of Measures in Zamość, Lublin, Białystok and Radom	80,000.00	80,000.00	80,000.00	80,000.00	Central Office of Measures (GUM)
61	8	Increasing auditing efficiency with respect to the users of LPG measuring equipment through the acquisition of a testing stand (mass flow meter).	2018	2021	Branch Offices of Measures in Płock and Ostrołęka		90,000.00	90,000.00	90,000.00	Central Office of Measures (GUM)
62	4.6	Ensuring the possibility of calibration and testing of electricity meters for market surveillance purposes according to the requirements of the Act on Compliance Assessment and Market Surveillance Systems – stand for the calibration of electricity meters.	2020	2020	Regional Office of Measures (OUM) in Wrocław			160,000.00		Central Office of Measures (GUM)
63	4, 6	Development (acquisition) of a measurement stand for the calibration of torque wrenches Activity intended to enhance measurement competences and boost service competitiveness by increasing implementation quality.	2021	2021	Regional Office of Measures (OUM) in Wrocław				40,000.00	Central Office of Measures (GUM)
64	4, 6	Development of control and measurement stand – extending mass measurement capabilities through the acquisition of mass standards in the F1 and F2 accuracy range (F1: for the Branch Office in Jelenia Góra – 10 sets, for the Branch Office in Świdnica, 10 sets; F2: for the Branch Office in Świdnica – 10 sets, for the Branch Office in Brzeg – 10 sets).	2021	2021	Regional Office of Measures (OUM) in Wrocław				106,000.00	Central Office of Measures (GUM)
65	4.6	Modernisation of the available equipment – extension of pressure measurement capabilities through the acquisition of dead-weight hydraulic piston manometer with measurement range between 1 and 60 bar and 10 and 700 bar, accuracy class: 0.006.	2021	2021	Regional Office of Measures (OUM) in Wrocław				135,000.00	Central Office of Measures (GUM)
66	4, 6	Modernisation of the available equipment – extension of length measurement capabilities through the acquisition of a set of gauge blocks (“K” accuracy class, 122 units)	2018	2018	Regional Office of Measures (OUM) in Wrocław	50,000.00				Central Office of Measures (GUM)
67	4, 6	Modernisation of high-accuracy control measurement stand for mass measurements – acquisition of a non-automatic weighing instrument and mass standards for validation and calibration. Activity intended to enhance measurement competences and boost service competitiveness by increasing implementation quality.	2020	2020	Regional Office of Measures (OUM) in Wrocław			28,000.00		Central Office of Measures (GUM)
68	4, 6	Modernisation of the stand for the calibration of fixed and adjustable resistors, acquisition of a Thomson bridge and a Wheatstone bridge.	2019	2019	Regional Office of Measures (OUM) in Wrocław		220,000.00			Central Office of Measures (GUM)
69	4, 6	Modernisation of technical equipment facilitating the performance of tests of articles of precious metals in accordance with the applicable standards and expectations of customers.	2018	2021	OUP	500,000.00	1,300,000.00	1,200,000.00	1,200,000.00	Central Office of Measures (GUM)
70	8	Development of recommendations for solutions capable of improving the level of consumer protection within the scope of trade in goods which contain hazardous substances (such as nickel)	2018	2021	OUP					Central Office of Measures (GUM)
71	8	Creating a design for a system of state supervision of the trade in precious stones used in jewellery products	2018	2021	OUP					Central Office of Measures (GUM)
72	3, 7	Maintenance of interpretative consistency with respect to assay law in the Republic of Poland	2018	2021	OUP					Central Office of Measures (GUM)
73	4,5,7	Verification of the legal regulations in the field of assay performed in accordance with the suggestions of entrepreneurs submitted within the framework of cooperation in the Consultative Team for Assay.	2018	2021	GUM/BSM/OUP					Central Office of Measures (GUM)
74	8	Participation in the process of formation of an effective system of assay supervision in order to ensure that transactions concerning precious metals concluded within the Polish territory remain safe and secure.	2018	2021	GUM/BSM/OUP					Central Office of Measures (GUM)
75	2	Developing international cooperation with the view towards expanding the knowledge on the trade in precious metals on various markets as well as exchanging experiences in the field of assay.			OUP	40,000.00	50,000.00	50,000.00	60,000.00	Central Office of Measures (GUM)
76	4, 6	Accreditation of testing laboratories	2018	2019	OUP			260,000.00	260,000.00	Central Office of Measures (GUM)
77	4.6	Increasing the level of innovativeness in the field of marking of articles of precious metals	2018	2019	OUP	150,000.00	300,000.00	320,000.00	320,000.00	Central Office

										of Measures (GUM)	
78	4.6	Increasing accessibility of OUPs	2018	2021	OUP	150,000.00	250,000.00	500,000.00	250,000.00	Central Office of Measures (GUM)	
79	4.6	Introduction of enhanced customer service procedures	2018	2021	OUP		30,000.00	30,000.00	30,000.00	Central Office of Measures (GUM)	
80	2.4	Maintaining accuracy and correctness of research results in the course of international programmes	2018	2021	OUP	10,000.00	10,000.00	10,000.00	10,000.00	Central Office of Measures (GUM)	
						SUM – one year		5,224,544.00	5,862,800.00	7,067,600.00	6,713,850.00

SUM – 4 years		24,868,794.00	PLN
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