

Status Report of the Central Office of Measures (GUM) for the 12th Meeting of CCAUV

The Central Office of Measures (GUM) is the National Metrology Institute (NMI) for Poland, supervised by the Ministry of Entrepreneurship and Technology. The main objective of the GUM are:

- Maintaining and developing national measurement standards and providing their international equivalence through the participation in key comparisons
- Dissemination of SI units
- Legal metrological control and metrological supervision (conformity assessment, type approval, verification of measuring instruments) performed together with the Regional Offices,
- Representing Poland in international and regional metrological organisations and cooperation with Polish and foreign institutions operating in the field of metrology
- Research and development projects and cooperation with scientific entities in the field of metrology
- Supporting and inspiring the development of Polish industry (consulting and technical advice on measuring devices and measurement technologies, metrological trainings, initiating R&D projects and standardisation work)

The GUM building is located in the centre of Warsaw without any expansion possibilities. In 2018 the project to build a new metrology campus in Kielce (Świętokrzyskie Voivodeship) was launched.

The current structure of the GUM reflects the structure of EURAMET Technical Committees and includes the following laboratories: Acoustics and Vibration, Time and Frequency, Chemistry, Length, Electricity and Magnetism, Photometry and Radiometry, Mass, Ionising Radiation, Flow, Thermometry.

The Laboratory of Acoustics and Vibration consists of two sections: Acoustics (Sound in Air) Section and Vibration Section, established more than 45 years ago, and two sections under construction: Ultrasound Section and Underwater Acoustics Section (located in Gdynia on the Baltic Coast). Currently the laboratory employs 9 people, four persons have PhD degree, four - MSc degree and one is the technician.

SOUND IN AIR

The activity of the Laboratory in sound in air includes the maintenance and development of national standard of sound pressure, primary and secondary calibration of measurement microphones, calibration of sound calibrators, ear simulators, artificial mastoids, instruments used for infrasound and ultrasound measurements and pattern evaluation tests of sound level meters. Every year the Laboratory issues about 130 certificates for external customers.

Periodic tests of instruments for acoustical measurements: sound level meters, personal sound exposure meters, band pass filters, audiometers and instruments for the measurement of aural acoustic impedance/admittance are performed mainly by 7 laboratories accredited by Polish Centre for Accreditation. The role of the GUM is to provide the traceability, organize and take part in interlaboratory comparisons and support the development of measurement procedures for new devices.

The Laboratory supports the activity of two Polish producers of instruments used in acoustics and vibration (SVANTEK and SONOPAN), cooperates with Polish research institutes and universities involved in scientific activities in the field of acoustics, is actively involved in scientific conferences organized in Poland.

Recently, the following research and development projects have been conducted in the laboratory:

- **Modernization of metrological infrastructure ensuring measurement traceability in the field of audiometry.**

The project included the upgrading of instrumentation used for calibration of ear simulators and the extension of the scope of calibration by the measurement of acoustic transfer impedance of ear simulators according to IEC 60318-1. Additionally, in 2019 studies were conducted on a number of simulators used in Poland (the overall pressure sensitivity level of the ear simulator systems and acoustic transfer impedance of ear simulators were determined). The aim of these studies was to assess the condition of simulators and their impact on the calibration and testing of audiometers, and consequently on the assessment of hearing. The results were published in *Bezpieczeństwo Pracy (Occupational Safety)* issued by the Central Institute for Labour Protection (CIOP) and presented at the XVIII International Conference Noise Control'2019.

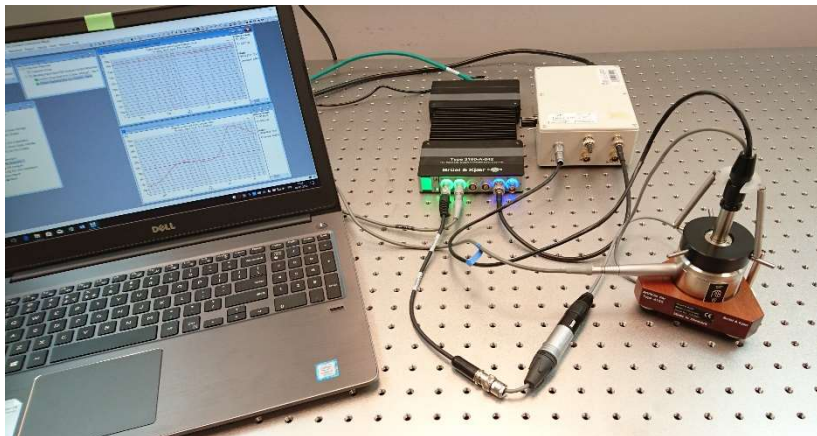


Fig. 1 Measuring set-up for determination of acoustical transfer impedance

The next stage of the project is the upgrading of the set-up and modification of the methodology and procedure of calibration of mechanical couplers (artificial mastoids) used in audiometry.

- **Development of metrological capability for calibration of measurement microphones in low frequency range**

The first stage of the project referred to the extension of frequency range of calibration of LS2 microphones by reciprocity method down to 2 Hz and ended with the participation of the GUM in CCAUV.A-K6 comparison in August 2019. The second stage has just started and concerns the development of the set up and methodology for traceable secondary calibration of microphones in the frequency range below 20 Hz.

In June 2019, in the framework of the EURAMET Capacity Building Programme, the GUM organized one-week Training Course on Acoustic Measurements. Four participants from EIM (Greece), AS METROSERT (Estonia), BOM (North Macedonia) and CEM (Spain) took part in the training.

VIBRATION

In the field of vibration the Laboratory is focused on the maintenance and development of national standard of vibration and shock quantities (acceleration, velocity, displacement), primary and secondary calibration of vibration transducers (mainly accelerometers) and acceleration measuring chains, calibration of vibration calibrators and vibration meters including calibration (verification) of human vibration meters (HVM) according to *EN ISO 8041-1:2017, chapter 14: Periodic verification*.

Last year, in response to the needs of Polish stakeholders interested in measuring vibrations and impacts of very high accelerations, the measurement set-up for comparison calibration of shock transducers acc. ISO 16063-22 was installed in the GUM. It was the SPEKTRA CS18 LMS system (Low-Medium Shock) that allows for the calibration of transducers at shock excitation with acceleration from 200 m/s^2 to 100 km/s^2 . Half-sinusoidal pulses of time duration from 0,1 ms to 5 ms are generated by the impact of a pneumatically controlled projectile on the anvil. The method is based on the measurement of the time history of the acceleration.

The system was validated by performing a series of tests and comparing the results obtained with sine-vibration and shock excitation.

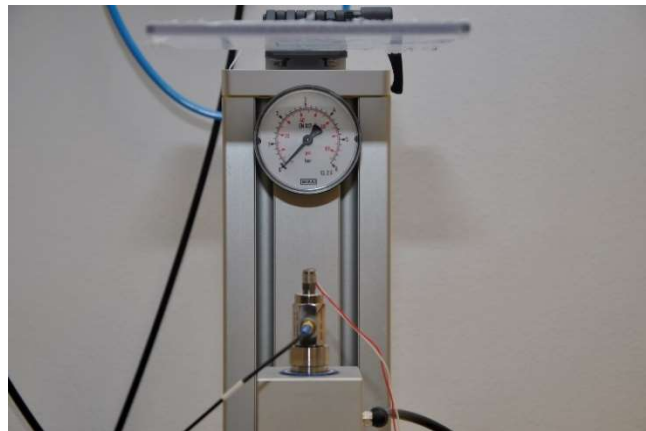


Fig. 2 CS18 LMS measuring set-up for secondary shock calibration

The national standard of vibration quantities is the CS 18 P primary calibration system developed by SPEKTRA (Germany), which enables the absolute magnitude and phase calibration of accelerometers and acceleration measuring chains according to ISO 16063:11 (method 3) in the frequency range from 0,2 Hz to 20 kHz. Calibration capabilities in the frequency range from 10 Hz to 10 kHz have been confirmed in the CCAUV.V-K2 key comparison and from 0,25 Hz to 40 Hz - in the CCAUV.V-K3 key comparison. Based on the results of the above comparisons the Laboratory has amended and extended the CMCs that are currently under interregional review. In 2020 the Laboratory will participate in the ongoing EURAMET.AUV.V-K5 comparison.

In the frame of cooperation between European NMIs, GUM has participated in the following projects:

- EURAMET TC-Q Project No. 1208 (peer review): in 2018 the GUM expert reviewed the technical competence of BIM (Bulgarian Institute of Metrology) in the field of vibration.
- EURAMET Project No. 1464: in 2019 GUM organized and conducted the EURAMET.AUV.V-K2 comparison (bilateral comparison between BIM and GUM), providing a comparison objects.
- EURAMET Capacity building programme: in June 2019, GUM organized one-week Training Course on Vibration Measurements for 4 participants from BIM (Bulgaria), (EIM) Greece, SIQ (Slovenia), CEM (Spain).

ULTRASOUND

The GUM has not provided traceability in the field of medical ultrasound so far. In 2017 the decision was made to build metrological infrastructure in this area. The project was to be supported by the EMPIR Call 2017 Research Potential. Unfortunately, the project was not implemented at that time.

The topic was revisited in 2019. The Potential Research Topic titled “Development of expanded metrological capability for medical ultrasound” was submitted once again in the frame of EMPIR Call 2019 Research Potential programme. The PRT was selected and registered as SRT-r01. The project will be focused mainly on the training of personnel and some research activities.

Currently, the procedure of purchase of appropriate equipment for the GUM Laboratory is in progress.

UNDERWATER ACOUSTICS

In recent years, there has been a growing need in Poland to ensure credibility and reliability of measurements in the field of underwater acoustics, both in military and civil applications (e.g. Directive 2008/56 / EC - Marine Strategy Framework Directive). In order to meet this need, the Central Office of Measures has undertaken the task of building an appropriate metrological infrastructure and creating in Gdynia the Underwater Acoustics Section, operating within the Acoustics and Vibration Laboratory of the GUM. In the first stage, a Working Group on Underwater Acoustics was established, a forum bringing together experts from various institutions related to activities in this field. The result of the meetings and discussions held so far within the Working Group is identification of metrological needs in this area, and a preliminary road map on how to meet these needs.