

# Status Report of the Central Office of Measures (GUM) for the 11<sup>th</sup> Meeting of CCAUV

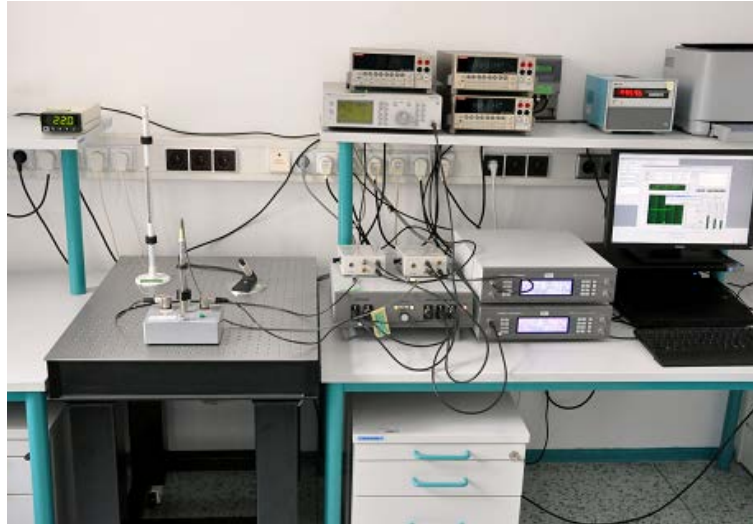
The Central Office of Measures (GUM) is the National Metrology Institute (NMI) for Poland, supervised by the Ministry of Development and Finance. The main objective of the GUM is to provide the sources of measurement traceability on the highest possible level for measurements in the area of industry, science and social life. This is realized through the development and maintenance of national measurement standards of legal units in compliance with the International System of Units (SI) and dissemination of the units from the standards to measuring instruments. The Central Office of Measures together with the Regional Offices performs also the tasks associated with legal metrology, e.g. type approval, verification, calibration and conformity assessment of measuring instruments. 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 employs 9 persons: 5 involved in sound in air and 4 in vibration measurements. Two persons have PhD degree, six - MSc degree and one is auxiliary technical.

## **1. Sound in Air**

The activity of the Laboratory in sound in air domain covers the maintenance and development of national standard of sound pressure unit, primary and secondary calibration of measurement microphones, calibration of sound calibrators, ear simulators, artificial mastoids and instrumentation used for infrasound and ultrasound measurements. The Laboratory is also responsible for pattern evaluation tests of sound level meters. Every year the Laboratory issues about 100 certificates for external customers. Periodic tests of instruments for acoustical measurements (sound level meters, personal sound exposure meters, band pass filters, audiometers) are performed mainly by 7 calibration laboratories accredited in accordance with Polish accreditation system. The role of the GUM is to provide the traceability for these laboratories, take part in proficiency testing and develop the procedures for new models of devices or measuring systems.

The national standard of sound pressure based on the reciprocity method is maintained at the GUM since 1998. It was developed by NPL, Great Britain and was significantly upgraded in 2009 (Fig. 1). The reciprocity setup fulfils the requirements of IEC 61094-2:2009 standard and enables the calibration of microphones (both for sensitivity magnitude and phase) in the frequency range 2 Hz to 10 kHz (LS1 microphones) and 20 Hz to 25 kHz (LS2 microphones). These capabilities were confirmed in key and supplementary comparisons organised both by CIPM and by RMOs. The last one were CCAUV.A-K5, AFRIMETS.AUV.A-S1 and COOMET.AUV.A-K5 where the GUM was the pilot and linking laboratory. The core elements

of the national standard are the LS microphones (18 pieces) with their histories. They are regularly calibrated and for the oldest ones the data registered for a period of almost 20 years is available. The reciprocity setup is used mainly for calibration of the GUM microphones however every year the Laboratory issues a few certificates for external customers including foreign ones. The work on the extension of the frequency range of LS2 microphone calibration down to 2 Hz is currently in progress.



*Fig. 1 The GUM setup for pressure calibration of LS microphones by the reciprocity method*

The setup used for sound calibrator calibration, including computer hardware and measurement controlling and data processing software running under MS DOS, became obsolete after over twenty years of use. In 2017 it was replaced by B&K Pulse system type 3560C. The procedure has been developed for determination of sound pressure level of sound calibrators from the measurement of FFT spectrum, using CIC technique and PULSE software. The procedure enables also the calculation of frequency and total distortion of calibrator signal according to IEC 60942.

In 2016 the procedure and measurement setup for calibration and periodic tests of instruments for measurement of aural acoustic impedance was developed at the GUM. The outcomes of this work has been used to extend the scope of services provided by accredited calibration laboratories in Poland.

## **2. Vibration**

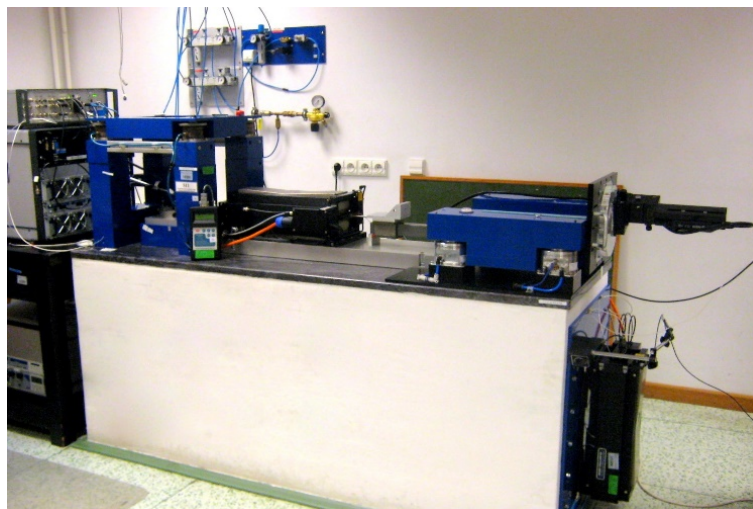
In the field of vibration the Laboratory is focused on the maintenance and development of national standard of mechanical vibration quantities (acceleration, velocity, displacement), primary and secondary calibration of vibration transducers (mainly accelerometers) and acceleration measuring chains, calibration of vibration calibrators, vibration meters including calibration (verification) of human vibration meters (HVM) according to ISO 8041:2005, chapter 13: Verification and primary calibration of laser vibrometers. Every year the Laboratory issues about 150 certificates for external customers.

The national standard of vibration quantities is the CS 18 P primary calibration system developed by SPEKTRA (Germany), installed in Laboratory in 2002 and upgraded several times (Fig. 2). The last upgrading of the system took place in 2013 – 2014 and included the following:

- two low frequency APS exciters, APS113AB and APS500, have been equipped with zero position controllers and angular adjustments and involved into the system,
- APS113AB exciter has been mounted vertically to enable the calibration of heavy transducers in vertical direction,
- the software for primary calibration has been updated,
- the obsolete instruments have been replaced by the new models (e.g. power amplifiers).

The complete system 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. The system involved two measurement set-up configurations:

- with Endevco 2911 exciter generating vertical vibration from 5 Hz to 20 kHz,
- with APS exciters generating horizontal (APS 500) and vertical (APS 113 AB) vibration from 0,2 Hz to 200 Hz.



*Fig. 2 The GUM measurement setup for primary vibration calibration*

Calibration capabilities have been confirmed in the CCAUV.V-K2 key comparison for the frequency range from 10 Hz to 10 kHz and in the CCAUV.V-K3 key comparison for the range from 0,25 Hz to 40 Hz. Laboratory has submitted its interest in the participation in the upcoming EURAMET.AUV.V-K5 comparison.

Recently Laboratory has upgraded the measurement systems for secondary calibration of vibration instruments in the frequency range from 5 Hz to 10 kHz and from 0,5 Hz to 100 Hz as follows

- the analogue preamplifiers have been replaced by the digital ones,
- new A/D converters (PCI-9527) and new software have been used in the measurements for the secondary calibration of accelerometers and vibration calibrators.

Taking into account the needs of Polish stakeholders the decision was taken to extend the Laboratory activity into the field of shock calibration. The system for secondary calibration of shock transducers according to ISO 16063-22 is going to be built by the end of this year.

### **3. Ultrasound**

In 2017 the decision was taken to develop at GUM the measurement and research expertise in the field of medical ultrasound. In order to speed up this project the Potential Research Topic titled “Development of expanded metrological capability for medical ultrasound” was submitted by the GUM and co-authors in the frame of EMPIR Call 2017 Research Potential programme. The PRT was selected and registered as SRT-r03. The project will be focused mainly on the training of personnel and some research activities. The financial recourses for infrastructure and measuring equipment are provided in the GUM budget for 2018.