Acoustics, Ultrasonics and Vibration
National Measurement Institute, Australia (NMIA)
Brief Report

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The Acoustics, Ultrasonics and Vibration group at the NMIA faced a number of challenging resourcing issues over the past two years. Despite these, services have been maintained to our clients, and over the period July 2013 to June 2105 the group performed approximately 309 calibrations during the period July 2012 to June 2013. These comprised 53% microphones, 14% accelerometers, 20% acoustic and vibration calibrators and pistonphones, and 13% other instruments such as geophones, charge amplifiers, ultrasonic power meters, artificial mastoids, etc.

The NMIA also underwent a technical assessment through the Australian accreditation body, the National Association of Testing Authorities (NATA), which represents ILAC and APLAC in Australia. A number of new and improved services were assessed and passed. Two papers have been published: one describing distortion effects measured during calibration of low-frequency accelerometers and the effects of different primary methods of measuring the sensitivity of these accelerometers; the other on traceable calibration of impedance heads and artificial mastoids.

Vibration

Over the last couple of years the AUV group at the NMIA has worked towards reducing the uncertainty of many of our vibration calibration services. These include, for primary calibrations using interferometry, the reduction of our low-frequency uncertainties from 0.5% to 0.3% at frequencies down to 0.5 Hz. The measurement of phase has also been introduced with uncertainties of 0.5 degrees for frequencies below 5 kHz and 1.0 degree for frequencies up to 10 kHz. The corresponding uncertainties for our calibration by comparison service have also been reduced. For very low frequency calibrations (at 9.8 m/s^2) uncertainties of down to 0.2% are now possible.

The work done by the NMIA on laser vibrometers, reported to the CCAUV in 2013, has led to the introduction of a service for the calibration of these devices, with similar uncertainties to those for primary calibration of standard accelerometers. The introduction of phase measurement as well as reductions in our uncertainties in the calibration of vibration measuring systems and analysers have also followed.

To support the introduction of the traceable calibration of artificial mastoids, a service for the calibration of impedance heads, devices which simultaneously measure the acceleration and dynamic force applied to an object, has been developed.

Ultrasound

Although demand for ultrasound calibrations in Australia is small, the NMIA continues to provide traceable calibrations of ultrasonic power meters and transducers to a small clientele. The NMIA's recently refurbished six-axis scanning system for ultrasound was recently used to help an Australian company develop a new range of therapeutic ultrasonic heads for physiotherapy. These measurements will be used to ensure compliance with medical regulators in the United States which is their initial target market.

Acoustics

In November 2014, Dr Zhong Bo of the National Institute of Metrology, China, visited NMIA for three months to study various aspects of the calibration of artificial mastoids and to study NMIA's methods of traceable calibration of impedance heads. Of particular interest was the dependence of artificial mastoids, especially of the type

described in IEC 60318-6, on the environmental conditions in which they are operated. The dependence of the force sensitivity and the mechanical impedance of the devices on temperature and humidity (and the consequent changing of the visco-elastic properties which must be within the tolerances specified in the Standard) was measured using a climate-controlled chamber. The results of these measurements showed that temperature changes had a greater effect on the properties of the artificial mastoids than humidity. This has important consequences for users of such devices. In Australia companies providing calibrated audiometric services often use artificial mastoids to calibrate audiometric equipment around the country, and so need to know how soon after the transport of these devices that reliable measurements may be made. A paper on this work is being prepared.

International intercomparisons

CCAUV.V-K3 Low-Frequency Vibration

Measurements at the NMIA were made in late May 2015. Complex sensitivity was measured over the frequency range 0.1 Hz to 40 Hz, with uncertainties of 0.2% in magnitude and 0.3 degrees in phase.

Publications

Plangsangmas, V., Leeudomwong, S., Scott, A., Zhong, B. and Huang, Y., 2014, 'Final report on the regional supplementary comparison APMP.AUV.A-S1', *Metrologia*, vol. 51, 0026-1394 Technical Supplement 09004.

Scott, D. A. and Dickinson, L. P., 2014, 'Distortion effects in primary calibration of low-frequency accelerometers, *Metrologia*, vol. 51, no. 3, pp. 212-224.

Scott, D. A., Dickinson, L. P. and Bell, T. J., 2015, 'Traceable calibration of impedance heads and artificial mastoids', *Measurement Science and Technology*, vol. 26, 125013 (10pp).