

Danish Primary Laboratory of Acoustics

Short Report on Activities, September 2006

Organization

The Danish Primary Laboratory of Acoustics (DPLA) was established by the Department of Trade and Industry (EFS) in 1989 as a cooperation between the manufacturer Brüel & Kjær and the Acoustic Laboratory (now Oersted Institute, Acoustic Technology) at the Technical University of Denmark (DTU). From January 1, 2006 the responsibilities of Oersted Institute, Acoustic Technology has been transferred to Danish Fundamental Metrology, Ltd (DFM). On the same date DFM has become a limited company owned by DTU. The calibration facilities at Acoustic Technology has been moved to DFM's premises in building 307 on the DTU Campus and are now fully operational. This includes the facilities for free-field reciprocity and comparison calibration of microphones.

The activities of DPLA are supervised by a Steering Group consisting of:

Knud Rasmussen, Technical Manager, DFM;

Ole E. Sørensen, B&K

Kim Carneiro, DFM

Erling Frederiksen, B&K

Salvador Barrerra-Figuera, DFM

Torben R. Licht, B&K

Cooperation on research in acoustic metrology is maintained between the new organization of DPLA and the Oersted Institute, Acoustic Technology.

DPLA is an ordinary member of DANIAMET, which is an umbrella organization covering all primary and reference laboratories in Denmark.

Responsibilities

It is the responsibility of DPLA to maintain and disseminate the basic units in the field of Acoustics in gasses and solids and through research in the area to develop and improve methods for primary as well as secondary calibrations in this field. This responsibility is undertaken by the services offered on primary calibration of microphones by the reciprocity calibration technique and accelerometers by laser interferometry. DPLA holds an accreditation by DANAK for these services. Secondary calibrations by comparison methods, performance testing and verification of acoustical measuring instruments are all performed by other accredited calibration laboratories in Denmark and not by DPLA.

Calibration activities

The annual number of certificates issued to costumers over the last three years on primary pressure reciprocity calibration of microphones is about 70 and about 160 on laser-calibration of accelerometers. In addition to the calibrations for customers a large number of internal microphone calibrations are performed to maintain the unit of sound pressure and for research and development activities. For this purpose DPLA holds about 22 B&K Type 4160 and 28 B&K Type 4180 microphones, which generally are calibrated each year. DPLA further holds four sets of reference accelerometers, including the associated preamplifiers, which are maintained and used as transfer standards. The four sets are calibrated every month.

In the late autumn of 2006 DPLA will offer an accredited free-field reciprocity calibration service to customers. The service refers to microphones type BK 4160 and 4180 only.

Similar services for free-field comparison calibration of WS microphones and calibration of

pistonphones may be established during 2007.

Research activities

The major activities on acoustics in air are related to calibration of microphones by improving the calibration methods, extending the frequency range and the dynamic range of calibrations, through improved modelling of microphones to predict their behaviour etc. The activities on acoustics in solids have mainly been focused on implementing ISO16063-11 method 3 using off the shelf FFT analysers and extending the frequency range.

Examples on some recent activities are:

A project about the determination of the diffuse-field sensitivity of microphones is being carried out in co-operation with Oersted•DTU. The purpose of the project is to study the possibility of determining the sensitivity of measurement microphones in a diffuse field.

Three procedures are investigated:

- a) random-incidence measurements,
- b) reciprocity in a reverberant room, and
- c) a theoretical link between the radiation impedance and the diffuse-field sensitivity.

Numerical calculations using BEM supplement the experimental results.

An automatic free-field comparison technique for WS-microphones is under development based on the same equipment and technique as used for free-field reciprocity calibrations.

The low-frequency behaviour of LS-microphones has been investigated theoretically and experimentally using electrostatic actuators and reciprocity calibration in closed couplers. A technique has been developed to make a comparison calibration of microphones using a closed cavity driven by an external source in the frequency range of 0.1 Hz – 250 Hz.

ISO16063-11 method 3, have been implemented using quadrature output laser interferometers to cover low frequency vibration transducer calibration down to 0.1 Hz and high frequency calibration up to 100 kHz but limited by the mechanical properties of the exciters and transducers.

Double beam laser calibration is another field of interest, but this has not been pursued further recently. This is especially of interest due to the non-perfect vibration generation possible with present vibration exciters.

International cooperation

DPLA is an active player in the regional cooperation within EUROMET and some of the above-mentioned research activities make parts of EUROMET projects. Within the iMERA-project DPLA has successfully promoted free field calibration as a “special facility”.

Staff members of DPLA are active members of IEC TC29 and ISO 108/SC3 acting as specialists and project leaders for specific standards.

K. Rasmussen is the Chairman of IEC TC 29 and Torben R. Licht is chairman of ISO 108/SC3.

DPLA acted as pilot laboratory in COOMET.A-K3 on primary pressure reciprocity calibration of LS2 microphones in the frequency range 30 Hz – 25000 Hz in 2005-2006.