

THE ACOUSTICAL METROLOGY PROGRAMME AT NPL (UNITED KINGDOM)

The Programme at NPL is split into four Themes: Standards for Air-borne Sound; Standards for Noise; Standards for Underwater Acoustics and Standards for Medical and Industrial Ultrasonics. The Programme runs in three-year cycles, with the 2001-2004 Programme beginning a year ago, October 2001. Key new metrological developments in each of the four Thematic areas will be briefly highlighted.

1 Airborne Acoustics

1.1 Primary standards for sound pressure

- Improve facilities for primary calibration of microphone by pressure and free-field reciprocity
- Complete key comparison CCAUV.A-K1 and take part in other CCAUV and EUROMET comparisons
- Contribute to the development of IEC standards on measurement microphones and their calibration
- Assess the feasibility of using optical methods such as laser doppler anemometry to measure particle velocity in acoustical fields

1.2 Secondary calibration of measurement microphones

- Improve facilities for pressure and free-field calibration of working standard microphones
- Assessment of methods for the testing of free-field rooms, to enable better benchmarking and comparison of such facilities.

1.3 Sound calibrators

- Establish data to enable a range of sound calibrators from various manufacturers to be used interchangeably
- Complete the revision of IEC & OIML standards on the performance of sound calibrators

1.4 Sound level meters

- research and development necessary to underpin the new IEC standards on sound level meters

1.5 Audiometric standards and ear simulators

- Maintain and develop standards for air- and bone-conduction audiometry, to underpin calibration services for ear simulators
- Research to provide new standards for audiometric methods using short-duration stimuli.
- Development of finite-element models of the standardised ear simulators to support these developments
- Research to underpin IEC standards for the ear simulators

2 Noise

2.1 Machinery and Product Noise

- Improve the usability of international standards for measurement of machinery noise, to support manufacturers in meeting the requirements of EC noise directives for machinery
- Ensure that the end results of complex noise evaluations, used in determining the emissions of industrial and consumer products, are presented in a form that will benefit the product specifier/ user

2.2 Acoustic Emission

- Research to begin addressing the need for national measurement standards for acoustic emission

3 Underwater Acoustics

The 2001-2004 programme of work undertaken by NPL in the area of underwater acoustics may be divided into three areas.

3.1 Low frequency standards

This area covers standards for the frequency range 20 Hz to 2 kHz. Specific projects include:

- Improved primary standard for hydrophone calibration at low frequencies (20 Hz to 2 kHz) by the method of coupler reciprocity. Calibrations are possible over a range of applied static pressures and water temperatures.
- Feasibility study into the use of the coupler to determine the dynamic bulk modulus of materials.

3.2 Free-field standards

This covers free-field standards in the frequency range 1 kHz to 1 MHz. Specific projects include:

- Key Comparison CCAUV-W-K1 – free-field calibration of hydrophones in the frequency range 1 kHz to 500 kHz.
- Contributions to international standards (eg IEC).
- Investigation of the use of near-field methods to characterise acoustic transducers, predicting the far field response from measurements made in the acoustic near-field.
- Assessment of rapid methods for assessing radiated acoustic noise from underwater vehicles (e.g. ROVs) with a view to possible longer-term development of new specification standards.

3.3 Standards for simulated ocean conditions

This area covers the provision of standards for simulated ocean conditions using the NPL Acoustic Pressure Vessel. Specific projects include:

- Development of capability to characterise materials for echo reduction and transmission loss under simulated ocean conditions using a parametric array technique.
- Characterisation of a range of commercial hydrophones for variation in sensitivity with temperature and depth.
- Extension of the usable frequency range of the APV downward in frequency by use of novel techniques.

4 Medical and Industrial Ultrasonics

4.1 Ultrasonic pressure standards

- Complete the establishment of a new NPL primary standard interferometer and validate performance up to a frequency of 60 MHz.
- Establish a relative phase calibration service for hydrophones covering the frequency range 1 to 20 MHz.
- Complete EUROMET high frequency hydrophone comparison (up to 40 MHz).

4.2 Ultrasonic power standards

- Develop a low-cost, easily applied means of providing physiotherapists with traceable ultrasonic power measurements by developing a solid-state power meter.

4.3 Standards for ultrasound dose.

- Contribute to the development of international safety standards and guidelines.

4.4 Ultrasonic characterisation and field measurements

- Complete implementation and dissemination of the developed membrane hydrophone-amplifier model.
- Develop, evaluate and commission new 0.1 mm and 0.2 mm active element hydrophones for use in the acoustic output measurement service.
- Establish a measurement facility for determining propagation speed in liquids with an uncertainty of $\pm 0.2 \text{ m s}^{-1}$ or better.

4.5 High power ultrasound and acoustic cavitation

- Enhance the capability of the reference ultrasonic cleaning vessel facility.
- Investigate potential calibration techniques for newly developed sensors.
- Undertake feasibility study investigating potential of new cavitation sensors in assessing cleaning effectiveness.

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