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QUALITY CONTROL IN ACOUSTIC TESTING

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INTRODUCTION

Clients are increasingly requiring independent evidence of competence from laboratories and test houses which offer a commercial service to measure the acoustical properties of building components (walls, floors, windows, doors, etc) or the noise emission from machinery; they are required to show that the quality of their work has been recognised by a reputable, disinterested agency. This is in line with established European practice for acoustical testing and, indeed, with existing UK practice in regard to many other kinds of testing. The requirement is now being given legislative backing, as recent European Economic Community Directives on noise emission of construction plant and equipment are implemented within the UK [1]. These Directives impose limits on sound power level, give a test procedure to be followed, and require national governments to approve certain bodies for the purpose of undertaking "type examinations".

QUALITY-CONTROL PROCEDURES

Assessment of competence to undertake particular kinds of test work is one of the aims of the National Measurement Accreditation Service (NAMAS) [2], operated by the National Physical Laboratory. In order to gain NAMAS accreditation, testing organisations are required to adopt quality-control procedures throughout their work. These procedures are reviewed and studied in detail by qualified specialist assessors, their practical implementation is observed, and accreditation is granted only if stringent criteria are met. The requirements, briefly, are as follows [3]:

1. A clear management structure for the organisation must be demonstrated, with defined lines of responsibility for the test work. A quality-control manager should be included within the structure, having free access to senior management.
2. The staff employed on the test work should be suitably qualified, arrangements should be made for staff training, and proper records of qualifications and experience must be kept.
3. The equipment and facilities of the laboratory must be suitable for the work, they should be maintained in good order and staff should be properly versed in their use.
4. Measuring instruments must be held in calibration, traceable to national standards.
5. Written test procedures must be held and maintained up-to-date, with provision for insertion of the latest amendments where national and international standard specifications are concerned.
6. Adequate record keeping must be demonstrated, in terms of receipt and labelling of test samples, test results and preparation of reports.

7. The level of uncertainty of the test results must be known.

8. Security provisions must be adequate to maintain the confidentiality of clients, their products (test samples) and test results.

All of the above find general application to different forms of test work, including acoustical tests. There are no absolute means whereby a laboratory is supposed to satisfy the requirements. Extensive guidance is published by NAMAS, but laboratories vary in size, structure and the scope of their activities and each needs to consider whether its existing arrangements match the expectations or whether changes are needed. In addition, specific considerations apply to items 3, 4 and 7 for acoustical tests.

The equipment and facilities required for the measurements are usually described in the standard specification concerned, but very often the description is open to interpretation. For example, in the case of an open, flat, horizontal test site, with a hard-paved surface and no reflecting obstacles, to be used for noise measurements from some kinds of machinery, practical questions arise as to permissible departures from "flat and horizontal", and what constitutes a "reflecting obstacle". The method which a laboratory uses to interpret such points, and the laboratory's estimation of the likely effect on test results of possible variations from the requirements of the standard, are aspects which arise in the assessment process. In other words, the capability of the laboratory's staff to make their own judgement of the requirements, while still claiming to meet the specification, has to be observed.

A basic programme for maintenance of the calibration of measuring instruments used in acoustical tests has been drawn up. It is possible for calibrations to be made by a standards laboratory, but these calibrations can be expensive and, unless an organisation is similarly equipped, they have no means of knowing whether the calibration is being maintained between times. An inexpensive, yet adequate, alternative has been found for sound level meters in the form of the current revision of the British Standard for vehicle noise meters [4], although some slight modifications were necessary [5]. It involves acoustical calibration by a laboratory within the National Measurement System of the microphone/extension cable/sound level meter chain at frequencies of 125 and 1000 Hz, together with electrical checks on time constants, weighting networks, linearity and the r.m.s. accuracy of the detector/indicator system. The performance of the associated acoustical calibrator also needs to be checked, so that it can be used as a calibration transfer device. Provided a laboratory has, in addition, an attenuator with a traceable calibration, it can readily check the performance of its other instruments, especially those used for sound transmission measurements where only difference of level have to be determined.

Machinery noise measurement specifications include one or more operating conditions for the machine itself, to which the measured noise levels relate. At least one operating parameter of the machine has to be measured, such as rate of air flow, current generated, speed of rotation, etc. The NAMAS requirement for calibrated instruments covers these measurements also, since they are used to classify the performance of the machine. NAMAS also requires all the instrumentation used in the tests to be fully under the control of the accredited laboratory, to ensure that it is not mistreated at any time.

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Measurement uncertainties arise from a number of causes, including the accuracy of instrument calibration, variability in the sound field to be measured and reproducibility of machine operating conditions. A laboratory should be able to assess, from its own accumulated experience of testing, the magnitudes of these uncertainties, so that a client can be assured of their nett effect on a particular set of test results.

CONCLUSION

There are few hard-and-fast definitions of quality-control procedure. The general requirements are published in NAMAS literature and it is for each laboratory either to show that its own procedures meet these, or to introduce new procedures for the purpose. The overriding requirement is for good practice to be observed throughout all stages of the laboratory's work. The realisation of this has to be shown in a manual describing the laboratory's procedures, then demonstrated to the assessor(s) when applying for accreditation and on subsequent surveillance visits. The aim is to bring acoustical testing in this country into line with testing elsewhere, as well as to satisfy commercial and regulatory pressures. Some laboratories will need only minor adjustments to their arrangements in order to comply, but the assistance given to others through the alterations they introduce will benefit their own trade and the acoustic testing industry as a whole.

REFERENCES

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