CERTIFICATE OF COMPETENCE IN ENVIRONMENTAL NOISE MEASUREMENTS

Entry Requirements

The Institute of Acoustics is committed to an open access policy. The main principle is to admit all who will benefit from the Certificate programmes. However students will need to be numerate and to be able to carry out scientific calculations. If the Certificate is used towards satisfying the educational requirements for Technician membership of the IOA (**TechIOA**) relevant passes at GCSE level may be necessary also.

Study Modes

Students take the Certificates at an Accredited Centre (see separate list). Attendance at the Centre is usually for four days, plus the examination day. Examinations for CCENM take place twice per year, usually on a Friday in April and September. It is important to check on the local arrangements for the examination.

Assessment

To obtain a Certificate, a candidate is required to;

1) Pass both parts of a written examination

2) Produce a competent report following a practical test.

The written examination papers are set by the Chief Examiner, who is responsible to the CCENM Committee. Members of the Committee review and moderate the marking of all papers at their meetings held shortly after each course.

The detailed logistical arrangements for the practical test and report submission are made by the Accredited Centre. However the requirements for the practical test and the report are overseen by the CCENM Committee.

Aims and Objectives

The aims of the course are to:

- provide candidates with a basic knowledge of the methodology of environmental noise measurement, including, in particular, the use and of sound level meters and analysers.
- provide candidates with an appreciation of the role of measurement data within the framework of standards and legislation for environmental noise.

After successfully completing the course, candidates should be able to:

- make reliable measurements of background noise and noise from a variety of sources, according to the requirements of the relevant British Standard or guidance document
- present and interpret measurement data in a form suitable for inclusion in a report
- identify in outline the principle methods of noise control to mitigate the impact of noise on the community
- explain measurement methodology and the data acquired, appreciate the measurement content of reports and environmental appraisals and comment on proposals for noise impact mitigation

Syllabus

I. Basic Concepts and Noise Units (6 hours)

Sound pressure and sound power. Pure tones, frequency, the audible range, broadband noise, octave and third-octave frequency analysis of noise. Sound pressure level, sound power level and the decibel scale. The range of decibel levels and the significance of level changes (3 dB, 10 dB, 20 dB etc) in terms of energy content and loudness. The procedure for combining and subtracting decibel levels, including background levels. - The variation of hearing sensitivity with frequency and level: the A-weighting scale. Steady and time-varying noise levels: L_{Aeq}, SEL and statistical levels L_{A10}, L_{A90} etc. Calculations involving L_{Aeq} and SEL. The effects of noise on people: hearing damage, annoyance, activity interference and sleep disturbance.

Notes

a) *The treatment of octave and third octave analysis of noise should be general and not include any calculations.*
b) *The conversion from sound pressure to sound pressure level should be taught but the calculation of sound pressure from sound pressure level is not required.*
c) *The variation in hearing sensitivity with frequency should be used to explain weighting scales, A and C but loudness levels are not part of the course content.*
d) *Simple averaging of L_{Aeq} and SEL is expected but students should be made aware that averaging of statistical levels is too advanced for this course.*

2. Instrumentation for Environmental Noise Measurement (6 hours)

Types of sound level meters for measurement of steady noise levels (BS EN 61672-1:2003). Integrating averaging sound level meters (BS EN 61672-1:2003) for the measurement of time-varying noise, and environmental noise analysers for L_{A10} and L_{A90} measurements and frequency analysis. Time weighting ('Fast', 'Slow', 'Impulse' averaging times) and frequency weighting: A-weighting, C-weighting and Linear. Peak level measurement. Types of microphone and their directionality. Accuracy of Class 1 and 2 instruments. Field and laboratory calibration of sound level meters, including traceability. Electronic noise floor. Electrical interference. Recording and presentation of time-varying noise levels. Practical methods for ensuring that microphones and meters remain accurate in use.

Notes

a) *Knowledge of the construction details of microphones is not required and will not be examined.*
b) *'Impulse' averaging time is included as an example of a specialist setting that may be required in some non-standard measurements i.e. clay pigeon shooting.*
c) *Practical methods for ensuring that microphones and meters remain accurate in use include avoiding extremes of temperature, handing with care, avoiding shocks and impact, keeping instruments dry, battery management.*

3. Noise Indices and Measurement Methodology for Environmental Noise Measurement (6 hours)

Standard methodology for the measurement of transportation, industrial, construction site noise and non-specific noise levels, according to BS 7445 Description and measurement of environmental noise. Part-1:2003, Guide to quantities and procedures. Part-2:1991 Guide to the acquisition of data pertinent to land use. Noise indices and specific measurement methodology, rating and assessment methods for:

- Industrial noise and BS 4142:1997, Method for rating industrial noise affecting mixed industrial and residential areas;

- Noise measurements appropriate to planning assessments;
- Road traffic noise — the measurement method in “Calculation of Road Traffic Noise” (CRTN) and its specific method of combining L_{A10} measurements;
- The measurement method in “Calculation of Rail Noise” (CRN);
- An elementary introduction to the measurement of Construction site noise - BS 5228-1:2009;
- Short time measurements such as used in the Noise Act 1996 (as amended)
- Overview of Noise from leisure activities and associated codes of practice.

4. Environmental Noise Measurement in Practice (10 hours including field work)

The use of sound level meters in typical practical environmental noise situations Choice of microphone position. The use of windshields, and the effect of wind and other environmental conditions on measurement accuracy. Measurement techniques and wind shields appropriate to wind farm noise measurement. The influence of screening and reflecting surfaces. The nature and causes of other uncertainties in measurement. Choice of sampling periods for time-varying signals - averaging of L_{Aeq} and the use of L_{A10}, L_{A90}, etc. Uncertainties associated with accuracy, tolerance limits and sampling. Monitoring of the noise climate during a measurement. Data interpretation and report preparation. Subjective impression. Comprehension of noise issues in environmental assessments and consultant’s reports.

Notes

a) *Although measurement methods appropriate to wind farms are included, the assessment of wind farm noise is not part of this course.*
b) *The treatment of errors and accuracy should be general and not require statistical calculations.*
c) *Monitoring of the noise climate requires continual recording of the noise that the observer hears throughout the measurement and how any noise event may affect the accuracy of the measurement.*

5. Basic Aspects of Noise Propagation (2 hours)

Propagation from point, line and planar noise sources, idealised and actual. General overview of the effects of distance, reflection, air absorption, ground effects, wind and temperature gradients. Simple estimation of the attenuation by barriers, earth banks, vegetation.

Note

Although awareness of the effects of various environmental factors upon noise level measurements are included, detailed calculations of propagation effects are not required.

Structure of Assessment

The practical examination
The CCENM is essentially a practical qualification and a good performance in the practical examination is critical. The practical examination includes (a) an objective measurement of an environmental noise source to demonstrate the use of suitable instrumentation (b) an assessment of the noise using an appropriate methodology and (c) generation of a report on the measurements and noise assessment.

- The practical exam scenario must be realistic, clearly defined and reported
- There are separate assessments of the conduct of the measurement and the reporting of results

You will be examined on the ability to undertake the test competently, to record all the essential information about the test conditions and to present the results of measurements reliably and accurately.

The practical examination is not an assessment of knowledge of the contents of documents such as BS4142, PPG24 (or other guidance such as in PAN56/PPN11 etc), CRN or CRTN but of measurement practice in the field. So if a convenient industrial noise source (e.g. a plant room) is not available then nearby transport sources may be used instead. Ideally the scenario will involve the opportunity to measure a real noise, following any specific measurement protocol in the relevant standard, and to apply the results to a hypothetical outcome so that an element of extrapolation is required (e.g. a road traffic noise assessment for a planning proposal in respect of houses yet to be built; an industrial noise assessment in respect of a proposed change of hours of working).
Emphasis is placed on measurement uncertainty issues. Often sound levels are quoted to an unrealistic degree of “accuracy” which fails to recognise the key factors that will affect the reliability or repeatability of measurements. An understanding of the issues involved, rather than a detailed knowledge of “uncertainty budgets”, is expected.

Weather contingency

Centres will have a contingency plan to cope with severe adverse weather conditions.

The Assessment

Examiners observe and assess the practical examination using their own procedures.
The examiner (one of the Centre Tutors) will check

* Competence in setting up the sound level meter (e.g. calibration, selection of range, parameter, time constant, frequency weighting etc.)
* Competence in choice of measurement location/meter orientation
* Competence in understanding of appropriate measurement or sampling time and duration
* Competence in reading off and recording appropriate parameters
* Competence in qualitative understanding of appropriate precision and accuracy and sampling uncertainty
* Competence in clear, complete reporting of field procedure and results: the test is ‘could a third party use the report alone to repeat the measurement and secure comparable results?’

The measurement component is examined and marked with reference to the examiner’s checklist. At most Centres these have been developed and refined by the course tutors and examiners. Further guidance can be given by the Institute if required. Preferably Candidates should prepare their own measurement checklist before the examination. Candidates should be encouraged to refer to published measurement check lists such as in BS4142 and

BS7445 Part 2. A copy of each candidate's checklist will be sent with the candidates' scripts to the Institute for moderation.

The second component of the assessment is the report on the practical examination which is to be written after the measurements have been undertaken.
Both the measurement protocol and the report are marked at the Centre and moderated at the Institute. The marking balance is 60% for field performance assessed according to the checklist and 40% for the written report.

A suggested marking scheme showing the importance attached to the various elements of the practical examination and report is at Appendix A.

Report generation and submission

Reference may be made to the example list of report contents provided later in the this section of the Handbook but candidates should be expected to provide their own interpretations The report must contain a declaration that it represents the student's own work and it must identify the source of any other information that is included.

The expected length of the written report is no more than three or four sides of A4. It should include a statement of the objective(s) of the measurements and an outline of scenario. If a bad-weather contingency was deployed the artificial scenario should be described and related to the conventional scenario that it represents. The report must include the following: purpose of report, date/time of measurement, description of noise source, subjective impression, prevailing environmental conditions, instrumentation used and calibration, measurement location and proximity to noise source, measurement procedure, results, uncertainties and estimated precision of measurements, interpretation of results and conclusions. In reporting the precision of their measurements candidates should be able to distinguish between precision (a quality of the instrumentation) and accuracy (a quality of the person doing the measurements). A suggested marking scheme is appended showing the relative importance attributed to the various components of the test by the CCENM Committee.

Preferably the report should be written on the day of the test and submitted at the end of the session. However some Centres allow submissions at a later date within a week of the test. The timing of the report submission will have implications for the expected quality and content of the report. The quality of presentations and the amount of supporting information included with a reported submitted later than the day of the test should be superior. On the other hand, a write-up in the form of a twenty page 'draft technical report' is excessive and unacceptable.

Summary of key learning and teaching elements

The candidate should

- Develop a check list
- Demonstrate in-the-field competence with regard to the intended measurement and assessment objectives
- Present a report consistent with these outcomes

The written paper

The written paper consists of two parts. Part 1 contains up to 12 short answer questions all of which are to be attempted and Part 2 requires a choice of two out of three longer questions. Past papers will be available from each Centre.