

M503 Module Syllabus

Noise – Measurement and Its Effects

Teaching Aims

This course aims to provide candidates with an appreciation of the nature of noise and vibration hazards in the workplace and the effects of noise, and vibration, on people.

It also details the approach in carrying out noise and vibration assessments in the workplace and in the general environment, and to determine the significance of measurement data in relation to the various standards for compliance.

Prior Knowledge and Understanding

There are no prerequisites required for this qualification, however, this course would be suitable for technicians and technologists who carry out measurements and testing in workplaces.

Candidates are also expected to be aware of the general contents of The Control of Noise at Work Regulations 2005 and Guidance on the Control of Noise at Work Regulations.

Learning Outcomes

On completion of this module, candidates will have a basic understanding of the following:

- Describe the consequences to health and wellbeing of excessive exposure to noise
- Understand the measurement (including dosimetry) of noise in relation to current standards
- Conduct surveys in the workplace to assess risks from noise
- Advise on the need and means of control including PPE
- Appreciate and advise on environmental noise assessment and concerns
- Understand current standards and good practice in these fields

Content

The syllabus is structured into seven sections:

1 Physics of Noise

**Time
Allocation
10%**

2	Human response to noise	10%
3	Machinery noise	10%
4	Assessment of noise risk	25%
5	Noise control and hearing protection	25%
6	Introduction to environmental noise	10%
7	Standards and good practice	10%

Note:

Reference is made in this syllabus to HSE guidance and other documentation. This list may not include the most up-to-date relevant publications from HSE and other sources and is intended as guidance for candidates only.

1 Physics of Noise (10%)

This section will provide candidates with suitable knowledge and training in the basic concepts and the definitions of the various terms that are used to measure noise and vibration.

In order to achieve this the candidate will be able to demonstrate both their knowledge and understanding in the following:

1.0.1 Properties of Sound:

- Propagation of sound by longitudinal wave motion
- Relationship between frequency, wavelength, and velocity
- Velocity of sound – dependence on temperature and bulk modulus
- Infra sound and ultrasound – definitions and common sources
- Simple harmonic motion

1.0.2 Definitions and measurements units – noise:

- Sound pressure and sound pressure level
- Sound intensity and intensity level, reference values
- Range of sound pressures in audio range
- Definition and application of decibel scale
- Relationship between sound pressure and sound power level
- Time varying sources, definition and use of equivalent continuous sound level
- Characteristics of impulse and impact noise
- Equivalent continuous sound level and usage
- Understanding of weighting scales, A and C, comparison with linear levels and awareness of other weighting scales
- Frequency characteristics of sound
- Octave, third octave and narrow band spectra
- Summation of sound pressure levels and calculation of sound power levels

2 Human Response to Noise (10%)

This section will provide candidates with suitable knowledge and training in the main effects on the body following excessive exposure to noise, and vibration.

This will include awareness of the various limits to noise, and vibration, exposure, and the role of health surveillance, including audiometry, in reducing risk.

In order to achieve this the candidate will be able to demonstrate both their knowledge and understanding in the following:

2.0.1 The ear and its response to sound:

- Structure of the ear - outer, middle, and inner ear
- Frequency selectivity and auditory filter, masking, stereo cilia, aural reflex
- Trauma, tinnitus, damage to hair cells
- Temporary threshold shift and recovery times and permanent threshold shift
- Noise induced hearing loss
- Relationship between hearing loss, noise exposure levels and exposure times
- Speech frequencies
- Speech interference levels, loudness, and Phon scales

2.0.2 Audiometry:

- The role of audiometry in industry,
- A Guide to audiometric testing programmes
- Audiometer types - screening, diagnostic, research
- Test signal frequencies, pure tone, and bone audiometry
- Audiogram accuracy - sources of error, ambient noise in audiometer booths
- Nonorganic hearing loss, organic hearing loss
- Presbycusis, Noise induced hearing loss - 4 kHz dip
- Understand the significance of hearing loss level

2.0.3 Noise exposure limits:

- Understand the significance of exposures for Daily and Weekly Personal Noise Exposures and the risks of hearing damage
- Understand the significance of exposures to infra sound and ultrasound

3 Machinery Noise (10%)

This section will provide candidates with suitable knowledge and training to gain a good understanding of the major sources of industrial noise and vibration, and community noise.

In order to achieve this the candidate will be able to demonstrate both their knowledge and understanding in the following:

- Power sources - electrical motors
- Fluid movers - air movers, pumps, sources of noise generation, hydraulic noise
- Understanding valve noise, jet noise and duct noise
- Impact noise and sources
- Compressor types and characteristics
- Machine tools and handheld power tools, woodworking machinery
- Tonal components from rotating machinery, fan blade passage and gear meshing frequency
- Near field and far field and implications for sound measurements

4 Assessment of Noise Risk (25%)

This section will provide candidates with suitable knowledge and practical training in the use of sound pressure level meters/dosimeters to enable the undertaking of a basic noise survey and prepare a technical report.

In order to achieve this the candidate will be able to demonstrate both their knowledge and understanding in the following:

4.0.1 Sound level meters:

- Basic principle of operational components with consideration of simple digital processing techniques
- Understanding of different classifications of sound level meters, including an understanding of type and the accuracy at reference and in field conditions
- Microphone types; polarised, pre-polarised, piezoelectric and knowledge of others and limitations
- Directional characteristics of sound level meter and microphones
- Operational considerations e.g. battery checks, calibration, wind effects, body reflections

4.0.2 Frequency analysis:

- Octave band and third octave band analysis - characteristics and filter band widths
- Analogue and digital filters
- Narrow band analysis
- Current instrumentation for real time analysis.
- Uses of frequency analysis for noise source identification
- Time history analysis and techniques

4.0.3 Personal noise dosimetry:

- Principles of instrumentation operation, field accuracy and sources of error
- Importance of supporting dosimeter assessments with appropriate sound level meter measurements
- Instrument types and facilities, supporting software
- Sampling techniques and sources of error

4.0.4 Sound power and sound intensity measurements:

- Uses and significance of sound power and intensity
- Sound power - reference sources and field measurement
- Sound intensity - instrumentation for measurement

5 Noise Control and Hearing Protection (25%)

This section will provide candidates with suitable knowledge and training to gain an awareness of the standard noise control techniques, including their limitations and be able to select the appropriate ear defenders for specific situations.

In order to achieve this the candidate will be able to demonstrate both their knowledge and understanding in the following:

5.0.1 Controlling the noise generated at source by:

- Avoiding impacts
- Increasing damping and use of flexible material to reduce spread of sound through a machine/pipework
- Use of silencers to minimise air noise at exhausts
- Use of low noise air nozzles, pneumatic ejectors and cleaning guns
- Matching air supply pressure to needs of air powered equipment
- Optimising the design of fans, fan casings and compressors

Modification of the routes by which noise reaches workplaces:

- Reverberation
- Use of sound absorbing material to control reflections
- Use of silencers to reduce noise transmitted along pipes/ducts
- Use of anti-vibration mountings under machines and non-rigid couplings
- Use of full or partial enclosure of machines
- Local use of screens faced with sound-absorbing material
- Use of "noise refuge"

Use of distance and time to minimise noise exposure:

- Relocate noisy fans/exhausts/compressors away from people
- Use of remote control or automated equipment to minimise noise exposures
- Segregation of noisy areas and limit to essential personnel

5.0.2 Control of noise generated by administrative means:

- Good housekeeping
- Planning
- Maintenance
- General good management
- The necessity of noise reduction measures for machines, tools, plant and equipment to be considered at the design stage

- The preparation of a specification outlining acceptable noise levels generated by new equipment particularly where the noise may affect personnel

5.0.3 Hearing protection:

- Description of various types available
- Performance attenuation
- Individual variability in attenuation, mean attenuation, standard deviation and assumed protection including calculations
- Evaluation of performance against workplace noise spectra
- Selection of protection - weight, cost, comfort, adjustability
- Explanation of when and why protectors are necessary
- Limitations of ear protectors (partial use in noisy areas)

6 Introduction to Environmental Noise (10%)

This section will provide candidates with suitable knowledge and practical training to gain a basic understanding of environmental noise assessment, be aware of the errors and variations in environmental noise measurements and be cognisant of current instrumentation for environmental assessments.

The candidate should also, be able to, with guidance, undertake simple environmental studies. However, where Abatement Notices have been served under EPA 1990, reports by the candidate may have to be reviewed until experience has been acquired.

In order to achieve this the candidate will be able to demonstrate both their knowledge and understanding in the following:

6.0.1 Propagation of sound:

- Sources of environmental noise e.g. factory and machinery emissions, traffic, trains, aircraft
- Attenuation with distance, spherical wavefronts and point sources, inverse square law, free field radiation
- Propagation of noise from line source
- Effects of wind, temperature gradients, humidity and precipitation, absorption by natural features - ground absorption, air absorption and absorption by vegetation

6.0.2 Instrumentation:

- Sound level meters with Ln facility
- Noise data loggers, environmental analysers
- Tape recorders - data recorders and analogue, dynamic range
- Frequency analysis octave, third octave, narrow band
- Protection of instrumentation, temperature, wind, humidity. calibration requirements

6.0.3 Measurement and assessment:

- Understand appropriate techniques for assessing environmental noise

- Selection of measurement locations
- Understanding specific noise level LAeq and background noise LA90
- Measurement periods. Sources of errors and variation in measured levels
- Influence of environmental conditions. Consideration of tonal components
- Reporting protocol and presentation

7 Standards and Good Practice (10%)

This section will provide candidates with suitable knowledge and training to gain a basic understanding of the measurement and control of vibration, including what instruments are used and the relevant exposure limits. However, they need not have the practical experience to enable them to carry out a vibrations survey.

In order to achieve this the candidate will be able to demonstrate both their knowledge and understanding in the following:

7.0.1 Noise:

Understand the relevant exposure standards for noise, all aspects of a good hearing conservation management programme (including assessment, control, training, hearing protection inspection, audit, audiometry and how they combine to provide effective employee protection) and the specification of equipment at design and purchase to limit the impact on the noise levels in a working environment.

7.0.2 Environmental Noise:

Understand how to interpret environmental noise measurements, including the impacts of intermittent or tonal components in the noise.

Suggested References and Further Reading

- (1) Monitoring for health hazards at work
- (2) Principles of Occupational Health and Hygiene
- (3) Protection of Workers Against Noise and Vibration in the Working Environment. ILO code of practice
- (4) The Occupational Environment – Its Evaluation and Control (the “White Book”)
- (5) Noise Control in Industry: A Basic Guide
- (6) HSE Guidance Note MS26, A Guide to Audiometric Testing Programmes
- (7) BS EN 61672-1:2003 Electroacoustics. Sound Level Meters. Specifications
- (8) BS EN 61252:1997 Electroacoustics. Specifications for personal sound exposure meters
- (9) BS 7580:1997 Specification for the Verification of Sound Level Meters
- (10) HSE Guidance Note HSG138. Sound Solutions. Techniques to Reduce Noise at Work
- (11) BS 4142:1997 Method of Rating Industrial Noise Affecting Mixed Residential and Industrial Areas
- (12) BS 5228:1997 Parts 1-4 Code of Practice for Noise Control on Construction and Open Sites

Course Length

This course will require at least **45** hours of study time, of which at least **37** hours will be taught (teaching and practical assessments) and **8** hours will be independent (in the candidates' own time).

Examinations and Assessment

Candidates are required to pass all of the following parts (A and B below) to be awarded this qualification.

A Practical Assessment

The practical assessment is conducted by the Tutor during the relevant parts of the course for all candidates. This is to ensure that each candidate can demonstrate their individual ability and correct method.

The practical exercises will involve:

- The setting up of a noise meter and readings from several noise sources from differing positions
- The set up and use of individual noise dose meters
- The measurement of octave band levels of a noisy environment

Further information about the formative practical assessment is published in the following documents:

Practical Evaluation Report which is available from www.bohs.org

B Written Examination (Update as necessary)

This is an open-book examination comprising of **40 (160 marks)** short-answer questions illustrated by photographs and diagrams as appropriate to be answered in **2** hours. Each question is worth 4 marks.

The examination covers all sections of the syllabus and is overseen by an invigilator.

The pass mark for this examination is 50 %

Certification

Candidates who pass all the parts (A and B) within 12 months will be awarded the: **'M503 - Noise – Measurement and Its Effects'**