OHTA Occupational Hygiene Training Association

BOHS British Occupational Hygiene Society
The Chartered Society for Worker Health Protection

Course Specification

Course title	**Noise – Measurement and Its Effects**
Code	**W503**
Level	**Intermediate**
Pre-requisites	**None**
Course material	**Available from OHTA Training.org**
Coordinating editors	**Bruce Gantner**
Approval date	**September 2009**
Review date	**September 2012**

Aims

The course aims to:
To provide the student with an appreciation of the nature of noise hazards in the workplace and the effects of noise on people. It also details the approach in carrying out noise 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.

Learning Outcomes

On successful completion of this module the student should be able to:-

- describe the consequences to health and well being 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

Course Format

Normally run as a 5 day taught course (Minimum 45 Hours including practical/demonstration sessions, lectures, tutorials, guided reading, overnight questions and examination).

There will be a 40 short answer question 'open book' examination with an allowed time of 120 minutes.

Content	Topic		Time Allocation
	1	**Physics of Noise**	**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 to standards and good practice documentation. This may not be the most up-to-date relevant publications and is intended as guidance for candidates only.

Detailed Course Content

1 Physics of Noise (10%)

1.1 Properties of sound

1.1.1 Propagation of sound by longitudinal wave motion

1.1.2 Relationship between frequency, wavelength and velocity

1.1.3 Velocity of sound – dependence on temperature and bulk modulus

1.1.4 Infra sound and ultra sound – definitions and common sources

1.1.5 Simple harmonic motion

1.2 Definitions and measurements units - noise

1.2.1 Sound pressure and sound pressure level

1.2.2 Sound intensity and intensity level, reference values

1.2.3 Range of sound pressures in audio range

1.2.4 Definition and application of decibel scale

1.2.5 Relationship between sound pressure and sound power level

1.2.6 Time varying sources, definition and use of equivalent continuous sound level

1.2.7 Characteristics of impulse and impact noise

1.2.8 Equivalent continuous sound level and usage

1.2.9 Understanding of weighting scales A and C, comparison with linear levels and awareness of other weighting scales

1.2.10 Frequency characteristics of sound

1.2.11 Octave, third octave and narrow band spectra

1.2.12 Summation of sound pressure levels and calculation of sound power levels

2 Human Response to Noise (10%)

2.1 The ear and its response to sound

2.1.1 Structure of the ear - outer, middle and inner ear

2.1.2 Frequency selectivity and auditory filter, masking, stereo cilia, aural reflex

2.1.3 Trauma, tinnitus, damage to hair cells

2.1.4 Temporary threshold shift and recovery times, Permanent threshold shift

2.1.5 Noise induced hearing loss

2.1.6 Relationship between hearing loss, noise exposure levels and exposure times

2.1.7 Speech frequencies

2.1.8 Speech interference levels, loudness and phon scales

2.2 Audiometry

2.2.1 The role of audiometry in industry,

2.2.2 A Guide to audiometric testing programmes

2.2.3 Audiometer types - screening, diagnostic, research

2.2.4 Test signal frequencies, pure tone and bone audiometry

2.2.5 Audiogram accuracy - sources of error, ambient noise in audiometer booths

2.2.6 Non organic hearing loss, organic hearing loss

2.2.7 Presbyacusis, Noise induced hearing loss - 4 kHz dip

2.2.8 Understand the significance of hearing loss level.

2.3 Noise exposure limits

2.3.1 Understand the significance of exposures for Daily and Weekly Personal Noise Exposures and the risks of hearing damage

2.3.2 Understand the significance of exposures to infra sound and ultra sound

3 Machinery Noise (10%)

3.0.1 Power sources - electrical motors

3.0.2 Fluid movers - air movers, pumps, sources of noise generation, hydraulic noise

3.0.3 Understanding valve noise, jet noise and duct noise

3.0.4 Impact noise and sources

3.0.5 Compressor types and characteristics

3.0.6 Machine tools and hand held power tools, wood working machinery

3.0.7 Tonal components from rotating machinery, fan blade passage and gear meshing frequency

3.0.8 Near field and far field and implications for sound measurements

4 Assessment of Noise Risk (25%)

4.1 Sound level meters

4.1.1 Basic principle of operational components with consideration of simple digital processing techniques

4.1.2 Understanding of different classifications of sound level meters, including an understanding of type and the accuracy at reference and in field conditions

4.1.3 Microphone types; polarised, pre-polarised, piezoelectric and knowledge of others and limitations

4.1.4 Directional characteristics of sound level meter and microphones

4.1.5 Operational considerations e.g. battery checks, calibration, wind effects, body reflections

4.2 Frequency analysis

4.2.1 Octave band and third octave band analysis - characteristics and filter band widths

4.2.2 Analogue and digital filters

4.2.3 Narrow band analysis

4.2.4 Current instrumentation for real time analysis.

4.2.5 Uses of frequency analysis for noise source identification

4.2.6 Time history analysis and techniques

4.3 Personal noise dosimetry

4.3.1 Principles of instrumentation operation, field accuracy and sources of error

4.3.2 Importance of supporting dosimeter assessments with appropriate sound level meter measurements

4.3.3 Instrument types and facilities, supporting software

4.3.4 Sampling techniques and sources of error

4.4 Sound power and sound intensity measurements

4.4.1 Uses and significance of sound power and intensity

4.4.2 Sound power - reference sources and field measurement

4.4.3 Sound intensity - instrumentation for measurement.

4.5 Noise measurements and assessments

4.5.1 Observation of work practices and processes

4.5.2 Types of noise measurements eg. sound level meter, dosimeter, octave bands

4.5.3 Survey and sampling techniques

4.5.4 Role and application of noise dosimetry

4.5.5 Significance of measurement periods

4.5.6 Use and significance of terms dB(A), dB(C), $dB(_{lin})$, SPL, L_{eq},, L_{max}, $L_{Epd,}$ L_{Epw}

4.5.7 Measurement and calculation of daily exposures

4.5.8 Role and application of octave band analysis

4.5.9 Calculation of dB (A) values from octave band analysis

4.5.10 Interpretation of noise measurements eg. source identification, noise contouring, hearing protection zones

4.5.11 Report requirements and presentation

5 Noise Control and Hearing Protection (25%)

5.1 Engineering control of noise

Controlling the noise generated at source by:

5.1.1 Avoiding impacts

5.1.2 Increasing damping and use of flexible material to reduce spread of sound through a machine/pipework

5.1.3 Use of silencers to minimise air noise at exhausts

5.1.4 Use of low noise air nozzles, pneumatic ejectors and cleaning guns

5.1.5 Matching air supply pressure to needs of air powered equipment

5.1.6 Optimising the design of fans, fan casings and compressors

Modification of the routes by which noise reaches workplaces:

5.1.7 Reverberation

5.1.8 Use of sound absorbing material to control reflections

5.1.9 Use of silencers to reduce noise transmitted along pipes/ducts

5.1.10 Use of anti-vibration mountings under machines and non- rigid couplings

5.1.11 Use of full or partial enclosure of machines

5.1.12 Local use of screens faced with sound-absorbing material

5.1.13 Use of “noise refuge”

Use of distance and time to minimise noise exposure:

5.1.14 Relocate noisy fans/exhausts/compressors away from people

5.1.15 Use of remote control or automated equipment to minimise noise exposures

5.1.16 Segregation of noisy areas and limit to essential personnel

5.2 Control of noise generated by administrative means

5.2.1 Good housekeeping

5.2.2 Planning

5.2.3 Maintenance

5.2.4 General good management

5.2.5 The necessity of noise reduction measures for machines, tools, plant and equipment to be considered at the design stage

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

5.3 Hearing protection

5.3.1 Description of various types available

5.3.2 Performance attenuation

5.3.3 Individual variability in attenuation, mean attenuation, standard deviation and assumed protection including calculations

5.3.4 Evaluation of performance against workplace noise spectra

5.3.5 Selection of protection - weight, cost, comfort, adjustability

5.3.6 Explanation of when and why protectors are necessary

5.3.7 Limitations of ear protectors (partial use in noisy areas)

6 Introduction to Environmental Noise (10%)

6.1 Propagation of sound

6.1.1 Sources of environmental noise e.g factory and machinery emissions, traffic, trains, aircraft

6.1.2 Attenuation with distance, spherical wavefronts and point sources, inverse square law, free field radiation

6.1.3 Propagation of noise from line source

6.1.4 Effects of wind, temperature gradients, humidity and precipitation, absorption by natural features - ground absorption, air absorption and absorption by vegetation

6.2 Instrumentation

6.2.1 Sound level meters with L_n facility

6.2.2 Noise data loggers, environmental analysers

6.2.3 Tape recorders - data recorders and analogue, dynamic range

6.2.4 Frequency analysis octave, third octave, narrow band

6.2.5 Protection of instrumentation, temperature, wind, humidity. calibration requirements.

6.3 Measurement and assessment

6.3.1 Understand appropriate techniques for assessing environmental noise

6.3.2 Selection of measurement locations

6.3.3 Understanding specific noise level L_{Aeq} and background noise L_{A90}

6.3.4 Measurement periods. Sources of errors and variation in measured levels

6.3.5 Influence of environmental conditions. Consideration of tonal components

6.3.6 Reporting protocol and presentation

7 Standards and Good Practice (10%)

7.1 Noise

7.1.1 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 these 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

7.2 Environmental Noise

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

Learning and Teaching Activities

Learning Time

Scheduled contact hours: (Note these timings are indicative only)	Lectures	16
	Seminars	2
	Practical Sessions	8
	Tutorials	8
	Examinations (including preparation)	3
	Other Scheduled Time	
Guided independent study Note: include in guided independent study preparation for scheduled sessions, follow up work, wider reading or practice, revision	Independent Coursework	8
	Independent Laboratory Work	
	Other Non-scheduled Time	
Total Hours		**45**

Assessment Details

Methods of Assessment	**Practical Assessment**	**Open Book Examination**
Grading Mode	Formative	Summative
Weighting %	NR	100%
Pass Mark	NR	Set by Examining Body
Outline Details	All candidates must participate in the practical studies and demonstrate the required skills. The exercises must, therefore, 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 Full details of the practical requirements and the individual candidate reporting forms etc are available in document JA.2 Practical Evaluation Report which is available from www.bohs.org and ohtatraining.org	40 short answer questions to be answered in 120 minutes. The questions require candidates to write short answers which will require no more than the box provided but may include multiple answers. Some questions may require calculations. Students can only refer to the W503 student manual during the examination.

Is the student required to pass ALL elements of assessment in order to pass the course? Yes

Indicative Course Materials and Reading

ISBN Number	Author	Date	Title	Publisher
			W503 Noise – Measurement and its Effects Student Manual **Downloadable for free from www.ohtatraining.org**	OHTA
978-1-4051-5962-3	John Cherrie, Robin Howie and Sean Semple	2010	Monitoring for health hazards at work	Wiley - Blackwell
9781741750584	Chrilyn Tillman (ed)	2007	Principles of Occupational Health and Hygiene	Allen & Unwin
ISDN 92-2-101709-5			Protection of Workers Against Noise and Vibration in the Working Environment. ILO code of practice	ILO
			The Occupational Environment – Its Evaluation and Control (the "White Book")	AIHA Press
ISBN: 0-660-18151-7			Noise Control in Industry: A Basic Guide	Canadian Centre for Occupational Health & Safety
			HSE Guidance Note MS26, A Guide to Audiometric Testing Programmes	HSE
			BS EN 61672-1:2003 Electroacoustics. Sound Level Meters. Specifications	BS
			BS EN 61252:1997 Electroacoustics. Specifications for personal sound exposure meters	BS
			BS 7580:1997 Specification for the Verification of Sound Level Meters	BS
		1995	HSE Guidance Note HSG138 (1995). Sound Solutions. Techniques to Reduce Noise at Work	HSE
			BS 4142:1997 Method of Rating Industrial Noise Affecting Mixed Residential and Industrial Areas	BS
			BS 5228:1997 Parts 1-4 Code of Practice for Noise Control on Construction and Open Sites	BS