



## Higher National Unit specification

### General information

**Unit title:** Acoustics 1 (SCQF level 8)

**Unit code:** DJ1W 35

**Superclass:** RC

**Publication date:** December 2015

**Source:** Scottish Qualifications Authority

**Version:** 04

### Unit purpose

This Unit is designed to provide candidates with an understanding of the nature of sound, how the human hearing system receives sound and how sound behaves in certain environments. It will provide underpinning knowledge of the nature of sound for candidates who expect to be involved within the field of audio. It may also be relevant to those already involved in the field of audio.

### Outcomes

On successful completion of the Unit the learner will be able to:

- 1 Describe the physical properties of sound.
- 2 Explain the human hearing mechanism.
- 3 Analyse the acoustic properties of enclosed spaces.

### Credit points and level

1 Higher National Unit credit at SCQF level 8: (8 SCQF credit points at SCQF level 8)

### Recommended entry to the Unit

Candidates should have good communication and mathematical skills. These may be demonstrated by the achievement of Core Skill Communication at Higher level or by possession of Higher Mathematics and English/Communication or a suitable Communication Unit (SCQF level 5/6).

## **Higher National Unit Specification: General information (cont)**

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### **Core Skills**

Opportunities to develop aspects of Core Skills are highlighted in the Support Notes for this Unit specification.

There is no automatic certification of Core Skills or Core Skill components in this Unit.

### **Context for delivery**

This is a mandatory Unit in the frameworks for the HNC/HND Sound Production Group Awards. If this Unit is delivered as part of a Group Award, it is recommended that it should be taught and assessed within the subject area of the Group Award to which it contributes.

### **Equality and inclusion**

This Unit specification has been designed to ensure that there are no unnecessary barriers to learning or assessment. The individual needs of learners should be taken into account when planning learning experiences, selecting assessment methods or considering alternative evidence.

Further advice can be found on our website [www.sqa.org.uk/assessmentarrangements](http://www.sqa.org.uk/assessmentarrangements).

## Higher National Unit specification: Statement of standards

### Unit title: Acoustics 1 (SCQF level 8)

Acceptable performance in this Unit will be the satisfactory achievement of the standards set out in this part of the Unit specification. All sections of the statement of standards are mandatory and cannot be altered without reference to SQA.

Where evidence for Outcomes is assessed on a sample basis, the whole of the content listed in the Knowledge and/or Skills section must be taught and available for assessment. Learners should not know in advance the items on which they will be assessed and different items should be sampled on each assessment occasion.

### Outcome 1

Describe the physical properties of sound.

#### Knowledge and/or Skills

- ◆ Properties of sound waves — frequency; wavelength; amplitude; velocity; phase, constructive and destructive interference; envelope and pressure
- ◆ Propagation of sound waves — distance; humidity; temperature; atmospheric pressure; reflection; absorption; diffraction and refraction
- ◆ Measurement of sound waves — frequency; sound intensity; acoustic power; sound pressure level; loudness and the decibel

### Outcome 2

Explain the human hearing mechanism.

#### Knowledge and/or Skills

- ◆ Anatomy of the human ear
- ◆ Human perception of loudness
- ◆ Human perception of pitch
- ◆ Masking and placement of frequencies on the critical bands
- ◆ Human perception of the directivity of sounds — level; frequency response; inter-aural time difference; phase and comb filtering
- ◆ Human hearing loss and damage and related legislative requirements

### Outcome 3

Analyse the acoustic properties of enclosed spaces.

#### Knowledge and/or Skills

- ◆ Causes of reverberation
- ◆ Absorption properties of materials
- ◆ Acoustic properties (including defects) of enclosed spaces, eg control room; studio; concert hall; anechoic chamber and domestic listening environment
- ◆ Treatments to improve the acoustic properties of rooms
- ◆ Criteria for the desirable acoustics of rooms

## Higher National Unit specification: Statement of standards (cont)

**Unit title:** Acoustics 1 (SCQF level 8)

### Evidence Requirements for this Unit

#### Outcome 1

Learners will need to provide evidence to demonstrate their Knowledge and/or Skills across all Outcomes by showing that they can:

- ◆ describe the physical characteristics of a sound wave using correct terminology.
- ◆ describe the way in which sound propagates from source, and how certain physical and atmospheric factors affect this.
- ◆ describe the measurement of sound waves.

Candidates should respond to a minimum of 25 multiple choice questions covering each of the three Knowledge and/or Skills. However, questions will be based on a sample of the Knowledge and/or Skills areas as follows:

- ◆ Properties of sound waves — 5 out of 9 knowledge/skills
- ◆ Propagation of sound waves — 5 out of 8 knowledge/skills
- ◆ Measurement of sound waves — 5 out of 6 knowledge/skills

The assessment must cover all of the above points and candidates must provide a satisfactory response to at least 5 questions in each section if using 25 questions to achieve 60% of the assessment.

If a centre is using more than 25 questions, the instrument of assessment must be designed to sample the minimum number of knowledge/skills as well as achieving 60% of the assessment.

Assessment should be carried out under controlled closed-book conditions.

#### Outcome 2

Learners will need evidence to demonstrate their Knowledge and/or Skills by showing that they can:

- ◆ describe the operation and anatomy of the human hearing mechanism.
- ◆ explain the human perception of loudness in relation to the linear response characteristics of the ear.
- ◆ describe the hearing mechanism's perception of pitch, relating frequency to pitch and using simple and complex waveforms.
- ◆ describe the process of masking for sound waves with regard to placement of frequencies on the critical bands.
- ◆ explain the factors that affect the human perception of the directivity of sound.
- ◆ explain how hearing loss can and will occur, with relation to over-exposure to loud sounds and age.
- ◆ explain the current legislative guidelines for preventing damage to the hearing mechanism, making reference to time of exposure and sound levels.

Evidence for the Knowledge and/or Skills in this Outcome will be provided on a sample basis.

## Higher National Unit specification: Statement of standards (cont)

### Unit title: Acoustics 1 (SCQF level 8)

A sample of four of the six Knowledge and/or Skills items is required each time the Outcome is assessed. Candidates must provide a satisfactory written response to questions on all four items being assessed.

The following Knowledge and/or Skills must be assessed each time the Outcome is assessed:

- ◆ Human perception of loudness
- ◆ Human perception of the directivity of sounds

Evidence should be generated through assessment under open-book controlled conditions. Learners may prepare and only refer to two sides of A4 notes during the assessment of this Outcome.

### Outcome 3

Evidence for the Knowledge and/or Skills in this Outcome will be provided on a sample basis.

Candidates will need evidence to demonstrate their Knowledge and/or Skills by showing that they can:

- ◆ explain the causes of reverberation.
- ◆ describe the absorption properties of materials with relation to reverberation and frequency response.
- ◆ describe the acoustic properties of enclosed spaces and identify defects in the acoustics of spaces — standing waves; flutter echo; frequency response and sound field.
- ◆ describe treatments to improve the acoustics of rooms — non-parallel walls; diffusers; helmholtz resonators and sound reinforcement systems.
- ◆ describe the criteria for desirable acoustics of rooms — room dimension ratios and optimum reverb time for enclosed spaces.

Candidates will be required to demonstrate their Knowledge and/or Skills by preparing a response to a given case study/studies, covering four from the five areas listed in Knowledge and/or Skills. Candidates must provide a satisfactory response to all four items.

The following Knowledge and/or Skills areas must be assessed each time the Outcome is assessed:

- ◆ Explain the causes of reverberation.
- ◆ Describe the absorption properties of materials with relation to reverberation and frequency response.

Evidence should be generated through assessment under open-book controlled conditions. Learners may prepare and only refer to two sides of A4 notes during the assessment of this Outcome.



## Higher National Unit Support Notes

**Unit title:** Acoustics 1 (SCQF level 8)

Unit Support Notes are offered as guidance and are not mandatory.

While the exact time allocated to this Unit is at the discretion of the centre, the notional design length is 40 hours.

### Guidance on the content and context for this Unit

This Unit is intended to provide underpinning knowledge of the nature of sound for candidates who expect to be involved within the field of audio. Candidates should be able to relate this knowledge to a number of applications, eg the use of microphones and loudspeakers.

Where possible, the knowledge contained within the Unit should be related to a context that is familiar to the candidates.

In Outcome 1 the physical properties of sound are described. The properties of sound waves that should be covered are: frequency; wavelength; amplitude; velocity; phase; constructive and destructive interference; envelope and pressure. Candidates should use the correct terminology when describing the properties of sound. For the knowledge of propagation of sound waves, the physical and atmospheric factors that affect sound waves should include: distance; humidity; temperature; atmospheric pressure; reflection; absorption; diffraction and refraction. The measurements of sound waves should include; frequency; sound intensity; acoustic power; sound pressure level; loudness and the decibel. In this section candidates should be made aware of the use of the decibel and the reasons for use of the decibel.

Outcome 2 covers the nature of sound on the human hearing mechanism. The operation of the hearing system should be described as a process of transduction. The anatomy should be described using the correct terminology. The perception of loudness should be based on the non-linearity of the human hearing response. Reference could be made to the work of Fletcher/Munson or Robinson/Dobson and their work on equal-loudness perception. Candidates should be made aware of the subjectivity of loudness and the Units of measurement used (phon/sone). Perception of pitch should include the relationship between frequency and pitch and how harmonics added to simple waveforms form complex waveforms. The different levels of pitch recognition by the hearing mechanism should also be covered. Reference could be made in this section to musical scales and frequency ranges of musical instruments.

For masking, reference should be made to a tone, narrow band noise and wide band noise, and the effect on hearing due to their placement on the critical bands of the basilar membrane. Masking could be contextualised with the mixing and balancing of sounds. The factors affecting the perception of the directivity of sound should include: level; frequency response; inter-aural time difference; phase and comb filtering.

## Higher National Unit Support Notes (cont)

**Unit title:** Acoustics 1 (SCQF level 8)

Outcome 3 analyses the acoustic properties of enclosed spaces. Candidates should analyse the acoustic properties of the following enclosed spaces: control room; studio; concert hall; anechoic chamber and domestic listening environment. For each enclosed space, the causes of reverberation should be explained in relation to the shape, size and materials of the space with a description of the absorption properties of materials in relation to the reverberation characteristics and frequency response of the space. Reference could be made to the work of Sabin/Eyring on reverberation time versus absorption.

Defects in the acoustics of spaces should include: standing waves; flutter echo; frequency response and sound field. Again the relationship between shape, size and materials should be made. Treatments to improve the acoustics of spaces should include: non-parallel walls; diffusers; helmholtz resonators and sound reinforcement systems. The criteria for desirable acoustics that the candidates describe should include: room dimension ratios and optimum reverb time for enclosed spaces. For room dimension ratios, reference could be made to the work of Bolt. For all cases involving reverberation time, candidates should be aware of the use of  $RT_{60}$ .

### Guidance on approaches to delivery of this Unit

The Unit is one of two Acoustics Units delivered as part of HNC/HND Sound Production. The Unit provides underpinning knowledge of sound, that can be related to a number of Units delivered as part of the Group Award in particular Units based on sound reinforcement and sound recording/mixing. Where possible, attempts should be made to contextualise the theoretical knowledge to a practical audio application, eg optimum listening position for mixing audio, related to the perception of the direction of sound.

The Outcomes should be delivered in sequence to provide the candidate with a logical progression as to the nature of acoustics. Candidates should be given the opportunity to evaluate their progress through each Outcome by means of formative assessment and feedback.

In Outcome 1, the Multiple Choice instrument of assessment should contain a minimum of 25 questions to adequately cover the Knowledge/Skills.

The assessment for Outcome 2 should be in the form of restricted response questions.

The case studies used for assessment in Outcome 3, should be based on the analysis of at least two enclosed spaces, eg control room and concert hall.

Where possible, audio examples, for all Outcomes, should be used in the delivery of the Unit, to reinforce learning.

## Higher National Unit Support Notes (cont)

**Unit title:** Acoustics 1 (SCQF level 8)

### Guidance on approaches to assessment of this Unit

Evidence can be generated using different types of assessment. The following are suggestions only. There may be other methods that would be more suitable to learners.

Should there be ambiguity regarding a candidate's response, oral questioning may be used to eliminate any doubt as to the candidate's understanding. The lecturer should note questions and responses.

Assessment for Outcomes 1, 2 and 3 should not be combined. Each Outcome should be assessed separately.

Candidates may prepare and only refer to a maximum of two sides of A4 notes during the assessment of each Outcome.

Centres are reminded that prior verification of centre-devised assessments would help to ensure that the national standard is being met. Where learners experience a range of assessment methods, this helps them to develop different skills that should be transferable to work or further and higher education.

#### Outcome 2

The instrument of assessment for this Outcome should be in the form of restricted response questions.

#### Outcome 3

The instrument of assessment for this Outcome should be in the form of case studies, based on two enclosed spaces.

For all cases involving reverberation time, candidates should be aware of the use of  $RT_{60}$ .

### Opportunities for e-assessment

E-assessment may be appropriate for some assessments in this Unit. By e-assessment we mean assessment which is supported by Information and Communication Technology (ICT), such as e-testing or the use of e-portfolios or social software. Centres which wish to use e-assessment must ensure that the national standard is applied to all learner evidence and that conditions of assessment as specified in the Evidence Requirements are met, regardless of the mode of gathering evidence. The most up-to-date guidance on the use of e-assessment to support SQA's qualifications is available at [www.sqa.org.uk/e-assessment](http://www.sqa.org.uk/e-assessment).



## Higher National Unit Support Notes (cont)

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### **Opportunities for developing Core and other essential skills**

Opportunities for developing Core Skills will be dependent on the learning and teaching approaches for this Unit. Candidates undertaking research and practical activities associated with developing the knowledge and skills, particularly through well-structured practical formative exercises, could allow elements of *Problem Solving*, *Working with Others*, *Communication* and *Information and Communication Technology (ICT)* to be developed.

## History of changes to Unit

Version	Description of change	Date
04	The evidence requirements for Outcomes 1 and 3 have been clarified. The general information for learners sections has also been updated to remove details about the duration of assessments.	02/12/2015
03	The assessment conditions have been revised for Outcomes 2 and 3. Evidence should be generated through controlled open-book conditions. Learners may prepare and only refer to two sides of A4 notes during the assessment of each Outcome.	25/08/14
02	Removal of Presentation Length.	02/06/11

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## General information for learners

### Unit title: Acoustics 1 (SCQF level 8)

This section will help you decide whether this is the Unit for you by explaining what the Unit is about, what you should know or be able to do before you start, what you will need to do during the Unit and opportunities for further learning and employment.

This Unit is designed to provide you with knowledge of acoustics in relation to the understanding of the nature of sound. You will study how the human hearing system receives sound and how sound behaves in certain environments. The Unit will provide you with the underpinning knowledge of the nature of sound within the field of audio. It may also be relevant if you are already involved in the field of audio.

The Unit covers initially, the physical properties of sound, followed by the nature of sound on the human hearing mechanism. Finally, you will analyse the acoustic properties of enclosed spaces. The knowledge and skills from the Unit may help you in aspects of sound reinforcement/performance and sound recording.

In order to complete the Unit successfully, you will be required to achieve a satisfactory level of performance in three assessments. There will be three individual assessments. The assessment for Outcome 1 will be in the form of a multiple choice response to questions on the physical properties of sound. For Outcome 2, you will be asked to provide restricted responses to questions on the nature of sound on the human hearing mechanism, and in Outcome 3 you will respond to questions based on case studies of the acoustics of two enclosed spaces.

All assessments will be carried out under supervised, controlled conditions.

**For Outcome 1**, you will not be permitted to bring any textbooks, handouts or notes to the assessment events.

**For Outcome 2 and 3**, you may prepare and only refer to, two sides of A4 notes during the assessment of each Outcome.