

## SQA Advanced Unit Specification

### General information for centres

**Unit title:** Railway Civil Engineering: An Introduction

**Unit code:** HR4W 47

**Unit purpose:** This Unit is designed to enable candidates to understand the historical development of the railways and also the complexity in the designing, building, maintaining, and operational timetabling all in the light of the economic factors.

On completion of the Unit the candidate should be able to:

- 1 Explain the historical **development** of railways.
- 2 Explain the **interactions** of civil engineering factors in operations and safety.
- 3 Explain the **principles** of inspection and maintenance.
- 4 Describe the **applications** of renewal and installation technology.

**Credit points and level:** 1 SQA Credit at SCQF level 7: (8 SCQF credit points at SCQF level 7\*)

*\*SCQF credit points are used to allocate credit to qualifications in the Scottish Credit and Qualifications Framework (SCQF). Each qualification in the Framework is allocated a number of SCQF credit points at an SCQF level. There are 12 SCQF levels, ranging from National 1 to Doctorates.*

**Recommended prior knowledge and skills:** It is considered that candidates undertaking this Unit require no prior knowledge and skills as the Unit is designed as an introduction to a specialist civil engineering area. The Unit would be of interest to candidates employed within the railway industry or candidates seeking to gain employment in the railway industry.

**Core Skills:** There are opportunities to develop the Core Skills of Communication, Numeracy and Problem Solving in this Unit, although there is no automatic certification of Core Skills or Core Skills components.

**Context for delivery:** 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.

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**Assessment:** It is possible to assess candidates either on an individual Outcome basis, combinations of Outcomes or by a single holistic assessment combining all Outcomes. The assessment paper/s should be composed of an appropriate balance of short answer, restricted response and structured questions. Assessment should be conducted under supervised, controlled (and generally open-book) conditions. A single assessment covering all Outcomes should not exceed two hours duration.

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. Candidates should not know in advance the items on which they will be assessed and different items should be sampled on each assessment occasion.

The sections of the Unit stating Outcomes, knowledge and/or skills, and Evidence Requirements are mandatory.

An exemplar instrument of assessment and marking guidelines have been produced to provide an example of the type of evidence required to demonstrate achievement of the aims of this Unit and to indicate the national standard of achievement at SCQF level 7.

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### SQA Advanced Unit specification: statement of standards

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**Unit code:** HR4W 47

The sections of the Unit stating the Outcomes, knowledge and/or skills, and Evidence Requirements are mandatory.

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. Candidates should not know in advance the items on which they will be assessed and different items should be sampled on each assessment occasion.

Throughout the Unit emphasis will be placed where appropriate on the application of Health & Safety and Sustainability. Safe working practices should be looked at in accordance with current safety codes of practice and regulations. Sustainability should include reference to criteria affecting sustainability, impact of not implementing sustainability on the environment and the legislation promoting sustainability.

#### Outcome 1

Explain the historical development of railways

##### Knowledge and/or skills

- ◆ Geographical and historical factors
- ◆ Technological developments
- ◆ Railway terminology
- ◆ Management models

##### Evidence Requirements

Candidates will need to provide evidence to demonstrate their knowledge and/or skills by showing that they can:

- ◆ describe and explain the historical development of railways

Evidence for the knowledge and/or skills for this Outcome will be provided on a sample basis. In any assessment of this Outcome, a minimum of **three out of four** knowledge and/or skills items should be sampled. In order to ensure that candidates will not be able to foresee what items they will be questioned on, a different sample of knowledge and/or skills items is required each time the Outcome is assessed. Candidates must provide satisfactory responses to all three items.

Evidence should be generated through assessment undertaken in controlled supervised conditions.

##### Assessment guidelines

Questions used to elicit candidate evidence should take the form of an appropriate balance of short answer, restricted response and structured questions.

Assessment should be conducted under closed-book conditions.

## Outcome 2

Explain the **interactions** of civil engineering factors in operations and safety

### Knowledge and/or skills

- ◆ Railway control systems
- ◆ Civil Engineering works
- ◆ Engineering track possessions and speed restrictions

### Evidence Requirements

Candidates will need to provide evidence to demonstrate their knowledge and/or skills by showing that they can:

- ◆ identify and explain the basic components of railway control systems and safety measures for trackside works

Evidence for the knowledge and/or skills for this Outcome will be provided on a sample basis. In any assessment of this Outcome, a minimum of **two out of three** knowledge and/or skills items is should be sampled. In order to ensure that candidates will not be able to foresee what items they will be questioned on, a different sample of knowledge and/or skills items is required each time the Outcome is assessed. Candidates must provide satisfactory responses to both items.

Evidence should be generated through assessment undertaken in controlled supervised conditions.

### Assessment guidelines

An exercise requiring a demonstration by the candidate of the minimisation of the disruption impacts by engineering works should be conducted in open-book supervised conditions.

## Outcome 3

Explain the **principles** of inspection and maintenance

### Knowledge and/or skills

- ◆ **Manual** and **automated** maintenance methods and processes
- ◆ Maintenance management **principles**
- ◆ Permanent way maintenance **technology**
- ◆ Optimisation of **maintenance cycles** and **renewal**

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### Evidence Requirements

Candidates will need to provide evidence to demonstrate their knowledge and/or skills by showing that they can:

- ◆ explain systems for the management and implementation of planned maintenance
- ◆ identify key components and factors for consideration in the development of maintenance and track renewal programmes

Evidence for the knowledge and/or skills for this Outcome will be provided on a sample basis. In any assessment of this Outcome, a minimum of **three out of four** knowledge and/or skills items is should be sampled. In order to ensure that candidates will not be able to foresee what items they will be questioned on, a different sample of knowledge and/or skills items is required each time the Outcome is assessed. Candidates must provide satisfactory responses to all three items.

Evidence should be generated through assessment in controlled supervised conditions. A series of short answer questions may be used or alternatively, candidates may give presentations to the peer group on set topics.

### Assessment guidelines

Assessment should be conducted under open-book conditions.

## Outcome 4

Describe the **applications** of renewal and installation

### Knowledge and/or skills

- ◆ Available railway plant and machinery for renewals
- ◆ Materials for renewals
- ◆ Possessions working
- ◆ Green field working

### Evidence Requirements

Candidates will need to provide evidence to demonstrate their knowledge and/or skills by showing that they can:

- ◆ explain and describe track renewals for both continuously welded rail (CWR) and jointed track situations
- ◆ identify correct plant and machinery for given track renewal situations

Evidence for the knowledge and/or skills for this Outcome will be provided on a sample basis. In any assessment of this Outcome, a minimum of **three out of four** knowledge and/or skills items is should be sampled. In order to ensure that candidates will not be able to foresee what items they will be questioned on, a different sample of knowledge and/or skills items is required each time the Outcome is assessed. Candidates must provide satisfactory responses to all three items. Evidence should be generated through assessment in controlled (open-book) supervised conditions.

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### **Assessment guidelines**

A series of short answer questions may be used and additionally, candidates may be asked to identify given plant and machinery and orally describe how the plant and/or machinery might be utilised in a given situation.

Assessment should be conducted under open-book conditions.

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### Administrative Information

<b>Unit code:</b>	HR4W 47
<b>Unit title:</b>	Railway Civil Engineering: An Introduction
<b>Superclass category:</b>	TL
<b>Date of publication:</b>	August 2017
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**FURTHER INFORMATION:** Call SQA's Customer Contact Centre on 44 (0) 141 500 5030 or 0345 279 1000. Alternatively, complete our [Centre Feedback Form](#).

## **SQA Advanced Unit specification: support notes**

### **Unit title: Railway Civil Engineering: An Introduction**

This part of the Unit specification is offered as guidance. The support notes 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 provides a general introduction to railway civil engineering, and mainly permanent way engineering. The Unit therefore introduces the candidate to specialist terminology and systems. On successful completion of the Unit the candidate can progress to two further Units in this specialist area.

Recommended class time allocations to each Outcome are given as guidance towards the depth of treatment that might be applied to each topic. This guidance has been used in the design of the assessment exemplar material for this Unit.

#### **1 Historical Development of railways (8 hours)**

*Geographical and historical factors:* Role in socio/economic development, technological development of basic components, legislative requirements through history, constraints imposed by location and adjoining developments.

*Technological developments:* Design of track, components, materials, and plant through time.

*Railway terminology:* Origin of terms such as ‘four foot’, ‘six foot’, up and down line, ballast, sleepers, bullhead rail, flat bottom rail, gauge, cant and hallade.

*Management models:* Nationalisation, privatisation, Chief Civil Engineers and District Engineers models through to present day.

#### **2 Factors in operations and safety (10 hours)**

*Railway control systems:* warning and protection systems-automatic warning system (AWS), train protection and warning System (TPWS), automatic warning system (AWS), signals passed at danger (SPAD), single line working, moving block systems

*Railway Civil Engineering works:* Earthworks, formation, platforms, line-side drainage over-bridges and under-bridges, clearances.

*Engineering track possessions speed restrictions:* arrangements and safety measures, position of lookouts, detonators, flags, single line working, clearances, and notices in relation to track possessions



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### 3 Principles of inspection and maintenance (12 hours)

*Manual and automated maintenance methods and processes:* plain line tampers, liners, ballast regulators, rail integrity measurer, rail side wear recorders, ride comfort and vehicle monitors, logistics vehicles, manual and mechanical inspection.

*Maintenance management principles:* rolling contact fatigue, gauge corner fatigue, service life of jointed and continuous welded track, track standards, labour utilisation.

*Permanent way maintenance technology:* ultrasonic, rail grinders, ballast cleaners.

*Optimisation of maintenance cycles and renewal:* relationship between maintenance and performance, supervision of contractors, technical benchmarking, balance between cost and performance, life cycles and budgets.

### 4 Applications of renewal and installation technology (10 hours)

*Available railway plant and machinery for renewals:* Ballast cleaner, relaying train, sleeper pickup units, drotts, and cranes.

*Materials for renewals:* ballast, rails, sleepers, fixings/clips

*Possessions working:* Access problems, rail based versus road based work, existing services and safety

*Green field working:* Pre-assembly and prefabrication, solum treatment.

## Guidance on the delivery and assessment of this Unit

Assessment guidelines are provided for each individual Outcome.

It is recommended that evidence for learning Outcomes is achieved through an integrated balance of well-planned course work and assessments. Assessment may be formative and summative and both may feature as part of the process. Although assessments must be focused on the individual achievement of each student, group work and role-play activities may contribute to the assessment. Integrative assignments and project work will help to link this Unit with other related Units.

The volume of evidence required for each assessment should take into account the overall number of assessments being contemplated within this Unit and the design of the overall teaching programme.

In designing the assessment instrument/s, opportunities should be taken to generate appropriate evidence to contribute to the assessment of Common Skills Units.

Where available, evidence from the workplace can also be incorporated to enhance the learning Outcomes, provided that this evidence is appropriate and authenticated as the student's own work.

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### *Opportunities for developing Core Skills*

The following grid provides a general guide to opportunities for the development of Core Skills in this Unit. Opportunities for the development of Core Skills at the output level are more fully identified in the Core Skills Signposting Guide.

Core Skill	Outcome 1	Outcome 2	Outcome 3	Outcome 4	Outcome 5
<b>1 Communication</b>					
Reading	3	3	3	3	
Writing	3	3	3	3	
Oral	3	3	3	3	
<b>2 Numeracy</b>					
Using Number			3	3	
Using Graphical Information			3	3	
<b>3 IT</b>					
Using Information Technology					
<b>4 Problem Solving</b>					
Critical Thinking		3	3	3	
Planning and Organising		3	3	3	
Reviewing and Evaluating			3	3	
<b>5 Working with Others</b>					

## Open learning

For candidates in appropriate employment this Unit could be undertaken by open and flexible learning and can be underpinned by internet resources.

Given that appropriate learning materials exist this Unit could be delivered by distance learning, which may incorporate some degree of on-line support. However, with regard to assessment, planning would be required by the centre concerned to ensure the sufficiency and authenticity of candidate evidence. Arrangement would be required to be put in place to ensure that the assessment was conducted under controlled, supervised conditions.

For information on normal open learning arrangements, please refer to SQA guide Assessment and Quality Assurance of Open and Distance Learning (SQA 2000)

## 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).

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### General information for candidates

**Unit title:** Railway Civil Engineering: An Introduction

On completion of this Unit you should be able to:

- 1 Explain the **development** of railways through history.
- 2 Explain and apply the **key** factors in operations and safety.
- 3 Explain the **principles** of maintenance and performance.
- 4 Explain the **applications** of renewal and installation technology.

Evidence that you can satisfy the knowledge and skill elements of this Unit will be obtained by assessment in controlled supervised conditions.