

## SQA Advanced Unit Specification

### General information for centres

**Unit title:** Railway Permanent Way Engineering

**Unit code:** HR62 48

**Unit purpose:** The purpose of this Unit is to enable the candidate to explain and apply the theory of permanent way design and procedures.

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

- 1 Prepare setting out data for plain line curve realignment.
- 2 Apply the theory of gauging and clearances design.
- 3 Design switches and crossings.
- 4 Describe track-bed and drainage design processes.

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

*\*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 recommended that candidates undertaking this Unit will have prior knowledge and skills as evidenced by completion of the following Units:

- ◆ Construction Site Surveying A
- ◆ Construction Site Surveying B
- ◆ Railway Civil Engineering: An Introduction

**Core Skills:** There are opportunities to develop the Core Skills of Communication, Numeracy, IT 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 could be composed of an appropriate balance of short answer, restricted response and structured questions, or alternatively a mini project assessment. Assessment should be conducted under supervised, controlled (and generally open-book) conditions. A single assessment covering all Outcomes should not exceed three 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 8.

## **SQA Advanced Unit specification: statement of standards**

**Unit title:** Railway Permanent Way Engineering

**Unit code:** HR62 48

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, the impact on the environment of not implementing sustainability, and the legislation promoting sustainability.

### **Outcome 1**

Prepare setting out data for plain line curve realignment

#### **Knowledge and/or skills**

- ◆ UK design rules for railway curve realignment design
- ◆ Setting out data for transition curves
- ◆ Setting out data for circular curves
- ◆ Setting out data for vertical curves

#### **Evidence Requirements**

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

- ◆ design and prepare setting out data for railway plain curve alignment

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, or a mini project integrating all Unit Outcomes may be used.

Assessment should be conducted under open-book conditions.

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### Outcome 2

Apply the theory of gauging and clearances design

#### Knowledge and/or skills

- ◆ Reasons for different gauges
- ◆ Permanent way design for tunnels
- ◆ Gauging assessment calculations
- ◆ Throw and wriggle

#### Evidence Requirements

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

- ◆ explain concepts pertinent to railway permanent way design clearances and gauge
- ◆ calculate factors for permanent way design

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 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, or a mini project integrating all Unit Outcomes may be used.

Assessment should be conducted under open-book conditions.

### Outcome 3

Design switches and crossings

#### Knowledge and/or skills

- ◆ Switches and crossings
- ◆ Manual setting out
- ◆ Total station setting out
- ◆ Switches and crossings alignment
- ◆ Switches and crossings in tramway systems and guided transit systems

#### Evidence Requirements

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

- ◆ design and prepare setting out data for switches and crossings

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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 five** 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 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, or a mini project integrating all Unit Outcomes may be used.

Assessment should be conducted under open-book conditions.

## Outcome 4

Describe track-bed and drainage design processes

### Knowledge and/or skills

- ◆ Destructive assessment
- ◆ Non destructive assessment
- ◆ Track-bed structure
- ◆ Ride comfort
- ◆ Avoidance of land slip
- ◆ Drainage and maintenance

### Evidence Requirements

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

- ◆ describe and explain available track-bed structures and methods for improvement

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 **four out of six** 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 four 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, or a mini project integrating all Unit Outcomes may be used.

Assessment should be conducted under open-book conditions.

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### Administrative Information

<b>Unit code:</b>	HR62 48
<b>Unit title:</b>	Railway Permanent Way Engineering
<b>Superclass category:</b>	VF
<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](#).

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### SQA Advanced Unit specification: support notes

#### Unit title: Railway Permanent Way Engineering

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 the candidate with the basic knowledge of the theory and practice of railway track permanent way design, and is suitable for practitioners or engineers in other specialisms seeking a career in Railway Engineering both in the 'client' and 'contractor/designer' perspectives.

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 Prepare setting out data for plain line curve realignment (10 hours)

UK design rules for railway curve realignment design: empirical and scientific approaches

Setting out data for transition, circular, and vertical curves: sines and versines, hallade, centre line, cant, cant deficiency

##### 2 Apply the theory of gauging and clearances design (10 hours)

Vehicle construction gauge, static load gauge, kinematic load gauge, kinematic envelope, structure gauge, UK and UIC standards, end and centre throw, articulation, wriggle theory.

##### 3 Design switches and crossings (10 hours)

Tangential, straight planed heel, inclined, vertical timbering, bearers, manual stringing, hallade, off set, total station, flange bearing, turnouts.

Inclined common crossings, standard leads, obtuse crossings, switch diamonds, swing nose crossings

##### 4 Describe track-bed and drainage design (10 hours)

Types of structure, destructive and non destructive assessment, whole life costs, land slip avoidance.

Embedded slab track installation using concrete slip-forming methods, non ballasted track railway tracks in tunnels,

The difference between monolithic construction and direct support systems, the advantages and disadvantages of 'top down' versus 'bottom up' forms of construction. The development of asphalt based systems.

#### Guidance on the delivery and assessment of this Unit

Since this Unit relies in part on the candidate's knowledge from previously completed Units, the Unit should be studied in the second year of a two-year programme. Case studies could usefully be

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employed to illustrate the practical working context of the material delivered. This might involve practitioners to deal with some aspects of the content or site visits where these are possible. In addition, where the centre has access to appropriate software, this might be used to allow a broader application of the concepts.

Candidates would normally work individually but should be encouraged to participate in group work and discussion in relation to their own studies or experiences. Assessment may be formative and summative and both may feature as part of the process. Although assessment must be focussed on the individual achievement of each candidate, group work may contribute as appropriate. Integrative project work might assist in linking this Unit with other related Units. Appropriate attention must be given to health and safety arrangements in relation to the topics covered.

The volume of evidence required for each Outcome should take into account the overall number of assessments being contemplated within this Unit and the design of the overall delivery programme. In designing the assessment instrument(s) opportunities should be taken to generate appropriate evidence to contribute to the development of Core Skills elements.

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

### *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			
Oral					
<b>2 Numeracy</b>					
Using Number			3	3	
Using Graphical Information			3	3	
<b>3 IT</b>					
Using Information Technology			3		
<b>4 Problem Solving</b>					
Critical Thinking			3	3	
Planning and Organising		3	3	3	
Reviewing and Evaluating				3	
<b>5 Working with Others</b>					

## Open learning

This Unit could be undertaken with open and flexible learning and could be underpinned by internet resources.



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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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On completion of this Unit you should be able to:

- 1 Prepare setting out data for plain line curve realignment.
- 2 Apply the theory of gauging and clearances design.
- 3 Design switches and crossings.
- 4 Describe track-bed and drainage design.

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