



National Unit Specification: general information

UNIT Land-based Engineering: Brakes, Steering and Traction
(SCQF level 6)

CODE F91W 12

SUMMARY

This Unit may form part of a national qualification or may be offered on a free standing basis.

This Unit is designed to provide candidates with knowledge and understanding of brakes, steering systems and traction improvement for land-based engineering tractors and equipment. They will also develop the knowledge and skills to perform fault-finding techniques, repair, testing of components and systems. Candidates will develop practical skills and safe working practices whilst removing, replacing and servicing braking, steering and traction improvement systems.

This Unit is suitable for candidates training to be land-based engineering technicians.

OUTCOMES

- 1 Describe the purpose of components, layout and operation of braking and steering systems found on land-based vehicles and equipment.
- 2 Overhaul braking and steering systems found on land-based vehicles and equipment.
- 3 Carry out routine maintenance and service adjustments on braking and steering systems found on land-based vehicles and equipment.
- 4 State the limitations of land-based vehicle traction and the methods of improving transfer of power to the ground.
- 5 Identify, remove, replace, adjust and maintain land-based vehicle wheel and track assemblies.

Administrative Information

Superclass: SK

Publication date: August 2010

Source: Scottish Qualifications Authority

Version: 01

© Scottish Qualifications Authority 2010

This publication may be reproduced in whole or in part for educational purposes provided that no profit is derived from reproduction and that, if reproduced in part, the source is acknowledged.

Additional copies of this Unit Specification can be purchased from the Scottish Qualifications Authority. Please contact the Customer Contact Centre, telephone 0845 279 1000.

National Unit Specification: general information (cont)

UNIT Land-based Engineering: Brakes Steering and Traction
(SCQF level 6)

RECOMMENDED ENTRY

While entry is at the discretion of the centre, candidates would normally be expected to have attained at least one of the following, or equivalent:

- ◆ Communication at SCQF level 4
- ◆ Numeracy at SCQF level 4

CREDIT VALUE

1 credit at SCQF level 6 (6 SCQF credit points at SCQF level 6*.)

**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 Access 1 to Doctorates.*

CORE SKILLS

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

The Unit provides opportunities for the candidate to develop aspects of the following Core Skills:

ICT	(SCQF level 5)
Communication	(SCQF level 5)
Numeracy	(SCQF level 4)
Working with Others	(SCQF level 4)
Problem Solving	(SCQF level 5)

These opportunities are highlighted in the Support Notes of this Unit Specification.

National Unit Specification: statement of standards

UNIT Land-based Engineering: Brakes Steering and Traction (SCQF level 6)

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.

OUTCOME 1

Describe the purpose of components, layout and operation of braking and steering systems found on land-based vehicles and equipment.

Performance Criteria

- (a) Describe correctly the purpose of land-based vehicle braking system components.
- (b) Describe correctly, with the aid of given diagrams, the layout and operation of land-based vehicle braking systems.
- (c) Describe correctly the purpose of land-based vehicle steering system components.
- (d) Describe correctly, with the aid of given diagrams, the layout and operation of land-based vehicle steering systems.

OUTCOME 2

Overhaul braking and steering systems found on land-based vehicles and equipment.

Performance Criteria

- (a) Inspect, assess and report correctly the condition of the machine's braking and steering component parts and replace any faulty parts.
- (b) Dismantle, overhaul and reassemble the braking system components in a logical sequence and in accordance with the manufacturer's manual/procedures.
- (c) Dismantle, overhaul and reassemble the steering system components in a logical sequence and in accordance with the manufacturer's manual/procedures.

OUTCOME 3

Carry out routine maintenance and service adjustments on braking and steering systems found on land-based vehicles and equipment.

Performance Criteria

- (a) Correctly complete routine/periodic maintenance on the braking and steering systems.
- (b) Make adjustments to the components of a braking system to ensure operation within manufacturer's specifications.
- (c) Make adjustments to the components of a steering system, including wheel alignment, to ensure operation within manufacturer's specifications.
- (d) Test the braking and steering systems correctly to ensure performance is within manufacturer's specifications.

National Unit Specification: statement of standards (cont)

UNIT Land-based Engineering: Brakes Steering and Traction
(SCQF level 6)

OUTCOME 4

State the limitations of land-based vehicle traction and the methods of improving transfer of power to the ground.

Performance Criteria

- (a) Correctly describe the implications of weight distribution/transfer traction and ballast aids on tractive performance.
- (b) Correctly fit, adjust, and remove aids designed to achieve stability and improved traction.
- (c) Correctly identify and rectify faults relating to traction aids
- (d) Correctly describe the legal aspects of traction and ballast aids.

OUTCOME 5

Identify, remove, replace, adjust and maintain land-based vehicle wheel and track assemblies

Performance Criteria

- (a) Correctly describe the types, construction and applications of land-based vehicle tyres.
- (b) Correctly adjust the wheel widths of land-based vehicles in accordance with the manufacturers' manual/procedures.
- (c) Correctly adjust track system components in accordance with the manufacturers' manual/procedures.
- (d) Correctly identify faults relating to wheels, tyres and tracks.
- (e) Correctly describe current legislation, size, profile, ECE type approval, speed rating and load index with regard to tyres.

EVIDENCE REQUIREMENTS FOR THIS UNIT

Evidence is required to demonstrate that candidates have achieved all of the Outcomes and Performance Criteria.

Outcome 1 — must be assessed by a single assessment designed to ensure that candidates can generate sufficient evidence to satisfy the Outcomes and Performance Criteria. Candidate evidence must be in the form of written and/or recorded oral evidence. Assessment must be conducted under supervised, closed-book conditions in which candidates are not allowed to bring their own notes, handouts, textbooks or other materials into the assessment. The assessment should holistically cover the commonly available braking and steering systems found on land-based vehicles and equipment. Total assessment time for Outcome 1 must not exceed 1 hour.

National Unit Specification: statement of standards (cont)

UNIT Land-based Engineering: Brakes Steering and Traction (SCQF level 6)

With regard to Outcome 1

- ◆ candidates must describe correctly the purpose and function of SIX land-based vehicle braking components from mechanical, hydraulic and pneumatic systems
- ◆ candidates must describe correctly with the aid of diagrams the operation of ONE named land-based vehicle braking system and correctly identify and state the function of TEN major components in the layout including the actuation mechanism.
- ◆ candidates must describe correctly the purpose of SIX land-based vehicle steering system components
- ◆ candidates must describe correctly with the aid of diagrams the operation of ONE named land-based vehicle steering system and correctly identify TEN major components in the layout
- ◆ candidates must correctly describe, identify and give the reason for the Ackerman layout, King Pin Inclination, Camber Angle and Castor Angle.

Outcome 2 — candidates must, in accordance with the manufacturer's recommendations, dismantle, assess, repair, re-assemble, and test the braking and steering sub assembly systems found in tractor units and land-based vehicles and equipment.

Evidence will be generated by a series of assessments designed to test candidates' abilities to dismantle, inspect, repair and/or adjust one brake and one steering system from tractor units and land-based equipment. Candidates must undertake assessment conducted under supervised conditions in small groups (2/3 persons) but each should be assessed individually. Candidate evidence must be in the form of performance and written and/or recorded oral evidence. An observation checklist must be used to record the evidence of candidates having satisfied all the Performance Criteria in the Outcome.

With regard to Outcome 2

- ◆ candidates must use appropriate tools and conform to convention in their use
- ◆ candidates to participate in the running, testing, fault diagnosis and where necessary replace any faulty components of the braking and steering systems of land-based vehicles and equipment
- ◆ candidates must produce an accurate job card describing the serviceability of **each system**
- ◆ observation checklist to be produced by the centre as evidence of the candidate's ability to follow instructions, correct use of tools, observe relevant/set safety requirements for the given tasks and carry out service and test procedures correctly and within realistic time scales
- ◆ candidates must dismantle, inspect, repair and/or adjust, re-assemble and test **ONE** braking system assembly from land-based vehicles and equipment in accordance with manufacturer's recommendations
- ◆ candidates must dismantle, inspect, repair and/or adjust, re-assemble and test **ONE** steering system assembly from land-based vehicles and equipment in accordance with manufacturer's recommendations

National Unit Specification: statement of standards (cont)

UNIT Land-based Engineering: Brakes Steering and Traction (SCQF level 6)

Outcome 3 — Evidence will be generated by a series of assessments designed to test candidates' abilities, in accordance with the manufacturer's recommendations, to assess, adjust, maintain and test the braking and steering sub assembly systems found in land-based vehicles and equipment. Candidates must be assessed individually. Candidate evidence must be in the form of performance and written and/or recorded oral evidence. An observation checklist must be used to record the evidence of candidates having satisfied all the Performance Criteria in the Outcome.

With regard to Outcome 3

- ◆ candidates must use appropriate tools and conform to convention in their use
- ◆ candidates to participate in the running, testing, fault diagnosis and where necessary replace any faulty components of the braking and steering systems of a complete land-based vehicle and equipment
- ◆ candidates must produce an accurate job card describing the serviceability and maintenance carried out on **each system**
- ◆ observation checklist to be produced by the centre as evidence of the candidate's ability to follow instructions, correct use of tools, observe relevant/set safety requirements for the given tasks and carry out service and test procedures correctly and within realistic time scales
- ◆ candidates must complete routine/periodic maintenance on **ONE** braking system assembly from a land-based vehicle and equipment in accordance with manufacturer's recommendations.
- ◆ candidates must adjust and then test **ONE** braking system assembly from a land-based vehicle and equipment and **ONE** braking system from an item of trailed equipment in accordance with manufacturer's recommendations and specifications
- ◆ candidates must complete routine/periodic maintenance on **ONE** steering system assembly from a land-based vehicle and equipment in accordance with manufacturer's recommendations
- ◆ candidates must adjust and then test **ONE** steering system assembly from a land-based vehicle and equipment in accordance with manufacturer's recommendations and specifications

Outcomes 4 and 5 — evidence must be generated by assessments designed to ensure that candidates can provide sufficient evidence to satisfy the Outcomes and Performance Criteria. Evidence must be in the form of written and/or recorded oral evidence and during practical tests, in accordance with the manufacturer's recommendations to fit, adjust, and maintain traction aids found on land-based vehicles and equipment. Candidates must be assessed individually. Candidate evidence must be in the form of performance and written and/or recorded oral evidence. An observation checklist must be used to record the evidence. Written assessment must be conducted under supervised, closed-book conditions in which candidates are not allowed to bring their own notes, handouts, textbooks or other materials into the assessment. The assessment should holistically cover the commonly available braking and steering systems found on tractors and machines. The total assessment time for Outcome 4 and 5 must not exceed 1 hour.

National Unit Specification: statement of standards (cont)

UNIT Land-based Engineering: Brakes Steering and Traction (SCQF level 6)

With regard to Outcomes 4 and 5

- ◆ candidates must describe correctly the purpose and limitations of **FIVE** traction aids, which may be fitted to land-based vehicles and equipment.
- ◆ candidates must describe correctly the purpose and operation of a weight transfer system land-based vehicle.
- ◆ candidates must describe correctly the types, construction and application of tyres fitted to land-based tractors and equipment.
- ◆ candidates must correctly describe the legal responsibilities of fitting and using traction and ballast aids
- ◆ candidates must correctly describe the legislation for the fitting and use of tyres for land-based vehicles and equipment
- ◆ candidates must fit, adjust and remove **ONE** traction aid assembly from land-based vehicles and equipment in accordance with manufacturer's recommendations
- ◆ candidates must correctly adjust track system components in accordance with the manufacturer's manual/procedures
- ◆ candidates must correctly diagnose **TWO** faults on the traction aid assembly from land-based vehicles and equipment in accordance with manufacturer's specifications
- ◆ candidates must dismantle, adjust and refit **ONE** wheel assembly from a tractor to a specified wheel width setting in accordance with the manufacturer's recommendations
- ◆ candidates must correctly diagnose **TWO** faults on wheels and **TWO** faults on track assemblies and **FIVE** faults on tyres from land-based vehicles and equipment

National Unit Specification: support notes

UNIT Land-based Engineering: Brakes Steering and Traction (SCQF level 6)

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 forms part of the National Qualification Group Award in Land-Based Engineering.

The Unit covers the principles and practice required to maintain and repair braking, steering and wheel assemblies in a safe serviceable condition where employed on tracked and wheeled land-based engineering vehicles and machinery.

Braking systems refer to systems used to retard speed, to bring vehicles and machinery to a halt, to retard or stop component rotation as in skid and slew steer systems and to secure vehicles from moving away when stopped. Reference should be made to the construction, function, operation, repair and reinstatement of braking systems and their components. Reference to brake fluid specification should include viscosity, DoT gradings, mineral and silicon based, factors affecting brake fluid performance and potential hygroscopic problems. The systems covered should include wet/dry disc, drum/band, induction/exhaust or overrun brakes along with their actuation systems — mechanical, hydraulic, pneumatic or hydro-pneumatic. Braking aids servo, accumulator, pressurised, anti-lock braking systems [ABS] and trailer braking systems.

Candidates should be familiar with the function of the Ackerman layout, king pin inclination, and camber angle/caster angle. The identification of steering system components (mechanical and hydrostatic) fitted to land-based tractors and equipment. Function and operation of system components along with areas of potential failure and wear, the need for settings, adjustment and torque settings, removal, inspection and replacement procedures. Methods used to check steering units and mechanisms, identify areas of potential failure or wear, implications of incorrect wheel alignment relating to toe-in/toe-out. Identification of the need for lubrication of the steering box, centre pivot, track rod ends, king pins and hubs.

Fault diagnosis in steering and braking systems is an important part of this Unit. These should incorporate common faults such as brake grabbing/binding/bias/snatching, fade/failure/soft pedal or uneven braking/poor efficiency. Potential hazards associated with high-pressure fluids, dust, heat and disposal of fluids. Methods used to check braking system units and mechanisms, identify areas of potential failure or wear, implications of incorrect brake operation/balance.

This Unit covers the comprehension of the tyre types, construction, function and operation of land-based equipment employing tyres and tracks to transfer power to the ground or ground drive system. It also covers adjustment to track system components in accordance with the manufacturer's manual/procedures but not total dismantling and reassembling. Tyre materials, construction and tread patterns, identification codes, radial and crossply design, tube and tubeless type fitments, load carrying capacities and speed symbols may be considered. Construction and use regulations relating to off road and agricultural vehicles, especially in relation to mixing tyres, acceptable tyre wear/damage and operating widths may be highlighted.

Safe working practices as laid down in the health and safety codes of practice, to include lifting and handling, should be followed.

National Unit Specification: support notes (cont)

UNIT Land-based Engineering: Brakes Steering and Traction (SCQF level 6)

Traction and the transfer of tractive power to the ground through tyres or tracks including traction aids, ballasting, weight transfer, slip control, dual and cage wheels. The maintenance and repair, the capabilities and limitations of each and how traction can be improved in a variety of local soil conditions.

GUIDANCE ON LEARNING AND TEACHING APPROACHES FOR THIS UNIT

This Unit should be delivered by a combination of teaching and learning approaches which could include:

- ◆ lecturing
- ◆ case studies
- ◆ practical activities working in sub groups
- ◆ group discussions
- ◆ tutorials
- ◆ directed study
- ◆ investigation including the use of ICT
- ◆ site visits
- ◆ audio visual
- ◆ guest speaker

Candidates may work in sub groups but must be assessed individually.

The candidates could be given the opportunity to examine steering systems (mechanical and hydrostatic) to identify the main components, layout and principle of operation of the system and components including the following: steering boxes (worm and peg and recirculating ball); orbital/ 'Danfoss' units; pump/reservoir/PRV; actuator; drag links; track rods; kingpins; steering arm(s); wheel hubs; track-rod ends. The principles of Ackerman, King Pin Inclination, Camber Angle and Castor Angle with reference to: true rolling motion, centre-point steering and self-centring action.

Candidates can be given the opportunity in practical locations to examine braking systems (mechanical, hydraulic and pneumatic) and identify layouts, principles of operation of the system and the main components. They should demonstrate knowledge of layouts and principles of operation could be further developed in a classroom situation including mechanical, hydraulic, pneumatic, dry disc, oil immersed, single disc, multi-disc, drum, band, simultaneous trailer braking brake shoe arrangements could include leading and trailing.

Identification of wheel types and applications, tyre materials, tyre construction (crossply and radial) types and uses of tread patterns for different applications, identification codes, tube and tubeless fitments, load carrying capacity and speed symbols. Methods of increasing the tractive effort could include traction control, aids, weight distribution, tyre pressure and selection. The current legislation on construction and use relating to land-based vehicles and equipment travelling on public roads. Tyre damage/wear, mixing of crossply and radial tyres and vehicle/equipment width limitations. Wear patterns associated with incorrect tyre selection, incorrect use, tyre pressures, incorrect overloading and damage due to chemical contamination. Use of jacks and axle stands may be demonstrated, ensuring correct siting of the vehicle/equipment to carry out the work in safety.

National Unit Specification: support notes (cont)

UNIT Land-based Engineering: Brakes Steering and Traction (SCQF level 6)

HEALTH, SAFETY AND THE ENVIRONMENT

As Outcomes 2, 3, 4 and 5 require candidates to practically service and repair equipment either onsite or in a workshop situation, it is strongly recommended that candidates be inducted into current legislation, regulations and safe working procedures and practices before starting practical work.

A safe system of work should be established in line with the Health Safety and Environment Unit guidelines while taking cognisance of the candidate's previous experience and abilities prior to the commencement of practical activities. The storage and handling of materials and methods for disposal of waste materials produced during the servicing of land-based equipment should comply with current legislation and good practice. Health safety and environmental issues associated with this Unit **should be taught together with the subject topics and not separately** in the Land-Based Engineering Health Safety and the Environment Unit.

OPPORTUNITIES FOR CORE SKILL DEVELOPMENT

Elements of the Core Skill *Information and Communication Technology* at SCQF level 5 may be developed in Outcomes 1 and 4 where candidates could research and report on the layouts and traction types and principles, their constructional features and servicing requirements on a range of land-based equipment. In Outcomes 2 and 3 reports covering the serviceability and dismantling, assessing, repair and testing of braking and steering systems could be processed

Elements of *Communication* at SCQF level 5 may be developed in Outcomes 2 and 3 where report/job card writing is specified. This may further be developed in Outcomes 2 and 3 when they investigate, apply techniques and communicate detailed written conclusions regarding overall condition of land-based vehicle steering and braking systems and their servicing and routine maintenance. As candidates are required to produce and respond to detailed and complex written communication in Outcomes 1, 4 and 5 they will investigate and apply techniques and communicate detailed written conclusions about the servicing, routine maintenance and overall condition of land-based vehicle steering and braking systems.

Elements of *Numeracy* at SCQF level 4 may be developed in Outcomes 2 and 3 where various aspects of steering system geometry set up are determined during the final assembly. Using Graphical Information at SCQF level 5 may be developed in Outcome 3 as candidates are given steering data and use this to practically set up the steering Unit they are servicing.

Elements of the Core Skill of *Problem Solving* at SCQF level 5 — Critical Thinking, Planning/Organising and Reviewing/Evaluating components will be developed as candidates undertake practical workshop activities in Outcomes 2, 3, 4 and 5 and when candidates are dismantling, assessing condition, re-assembling, setting up and testing vehicles. The Critical Thinking component of Problem Solving may be developed particularly in Outcomes 2 and 3. Here candidates may be involved in analysing results and deciding the most economic use of resources to practically complete the servicing and repair of steering and braking assemblies on a range of land-based vehicles and equipment. The Planning and Organisation component may be developed in Outcomes 2 and 3 where candidates are involved with group practical tasks and organising the allocation of resources to produce a plan to repair steering and braking systems. Reviewing and Evaluating may be developed in Outcomes 2 and 3 after candidates have completed the group practical task, as they could evaluate the effectiveness of the work plan, drawing conclusions and offer more suitable solutions to complete the

task.

National Unit Specification: support notes (cont)

UNIT Land-based Engineering: Brakes Steering and Traction (SCQF level 6)

Elements of *Working with Others* Core Skill at SCQF level 5 may be developed in Outcomes 2, 3, 4 and 5 in team working during practical situations co-operatively with others sharing service engineering workshop areas, tools and equipment. This could be discussed in terms of the nature and scope of team goals, roles and responsibilities.

Working Co-operatively with Others and Reviewing the Co-operative Contribution at SCQF level 5 may be developed in Outcome 3. Candidates engage in practical work, have to interact with their lecturers, support staff and other candidates. For example, while sharing engineering workshop areas, tools and equipment or in developing a servicing plan and completing the routine maintenance of land-based vehicle steering and braking systems, candidates could be given constructive feedback to encourage the review and evaluation of their approaches to practical work including their contribution to team working.

GUIDANCE ON APPROACHES TO ASSESSMENT FOR THIS UNIT

Opportunities for the use of 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 communications technology (ICT), such as e-testing or the use of e-portfolios or e-checklists. Centres which wish to use e-assessment must ensure that the national standard is applied to all candidate evidence and that conditions of assessment as specified in the Evidence Requirements are met, regardless of the mode of gathering evidence. Further advice is available in *SQA Guidelines on Online Assessment for Further Education (AA1641, March 2003)*, *SQA Guidelines on e-assessment for Schools (BD2625, June 2005)*.

HEALTH SAFETY AND THE ENVIRONMENT

Assessment of health, safety and environmental issues within this Unit could be cross-matched and assessed in the associated Land-Based Engineering: Health Safety and the Environment Unit.

Outcome 1

Assessment may comprise of an assessment paper consisting of short answer and structured questions. Partly completed or blank diagrams may be used as part of the assessment. The balance of the assessment should be equally weighted between brake and steering systems. This assessment may be suitable for on-line delivery.

Outcome 2

The assessment of practical activity may comprise of a series of observation checklists designed to test the candidate's ability and suit the equipment and systems available. This Outcome may be conducted in small practical groups (of 2/3 persons) but each candidate must be assessed individually.

National Unit Specification: support notes (cont)

UNIT Land-based Engineering: Brakes Steering and Traction (SCQF level 6)

Task instruction sheets, manufacturer's product literature and job cards/record forms should be made available to candidates. Assessments may be integrated with the Health Safety and the Environment Unit. This assessment is not suitable for on-line delivery.

Outcome 3

Assessment should comprise of practical exercises designed to ensure candidates can service and test braking and steering systems and gather sufficient evidence to satisfy the Outcome and Performance Criteria. Task instruction sheets, manufacturer's product literature and job cards/record forms should be made available to candidates. Assessments may be integrated with the Health Safety and the Environment Unit. This assessment is not suitable for on-line delivery.

Outcomes 4 and 5

These Outcomes are part theory and part practical exercise.

The theory assessment may comprise of an assessment paper consisting of short answer and structured questions. Partly completed or blank diagrams may be used as part of the assessment. This part of the assessment may be suitable for on-line delivery.

The assessment of practical activity part may consist of observation checklists designed to test the candidate's ability and to suit the equipment available. This Outcome may be conducted in small practical groups (of 2/3 persons) but each candidate must be assessed individually.

GUIDANCE ON APPROACHES TO ASSESSMENT FOR THIS UNIT

Task instruction sheets, manufacturers' product literature and job cards/record forms should be made available to candidates. Assessment of health, safety and environmental issues associated with this Unit should be cross-matched and assessed in the Land-based Engineering: Health Safety and the Environment Unit.

This assessment is not suitable for on-line delivery

DISABLED CANDIDATES AND/OR THOSE WITH ADDITIONAL SUPPORT NEEDS

The additional support needs of individual candidates should be taken into account when planning learning experiences, selecting assessment instruments, or considering whether any reasonable adjustments may be required. Further advice can be found on our website www.sqa.org.uk/assessmentarrangements