National Unit Specification: general information

UNIT Land-based Engineering: Hydraulics (SCQF level 6)

CODE F91X 12

SUMMARY

This Unit may form part of a National Qualification Group Award or may be offered on a free standing basis.

The aim of this Unit is to allow candidates to develop a basic knowledge, understanding and skills to service and repair hydraulic systems.

They will develop the knowledge and skills on how to maintain, test, and repair hydraulic systems found on land-based vehicles and machinery. Candidates will also develop the skills to perform fault finding and repair techniques on hydraulic systems.

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

OUTCOMES

1 Identify hydraulic systems and their components.
2 Describe the construction, types and function of hydraulic components.
3 Dismantle, repair and reinstate hydraulic systems.
4 Service, test and adjust a hydraulic system.
5 Identify the symptoms and the causes of hydraulic system failure.

Administrative Information

Superclass: SK

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National Unit Specification: general information (cont)

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RECOMMENDED ENTRY

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

- Physics at SCQF level 4
- Technological Studies at SCQF level 4
- Mathematics at SCQF level 4
- Communication 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:

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

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

National Unit Specification: statement of standards

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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

Identify hydraulic systems and their components.

Performance Criteria

(a) Identify correctly hydraulic systems used in land-based vehicles and machinery.
(b) Identify correctly hydraulic components used in land-based vehicles and machinery.

OUTCOME 2

Describe the construction, types and function of hydraulic components.

Performance Criteria

(a) Describe correctly the construction and operating principles of hydraulic components.
(b) Read and correctly interpret hydraulic circuit diagrams including commonly used symbols.

OUTCOME 3

Dismantle, repair and reinstate hydraulic systems.

Performance Criteria

(a) Dismantle, repair, assemble and reinstate hydraulic components.
(b) Correctly identify hydraulic pipe and hose types and their fittings.

OUTCOME 4

Service, test and adjust a hydraulic system.

Performance Criteria

(a) Correctly service a hydraulic system.
(b) Correctly test and adjust a hydraulic system using appropriate methods and equipment.

National Unit Specification: statement of standards (cont)

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OUTCOME 5

Identify the symptoms and the causes of hydraulic system failure.

Performance Criteria

(a) Correctly identify the symptoms and the probable causes of hydraulic system failure.
(b) Correctly identify potential types and sources of oil contamination.
(c) Correctly identify causes of pump cavitation.
(d) Correctly identify the potential effects on an overloaded hydraulic system.

EVIDENCE REQUIREMENTS FOR THIS UNIT

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

Written and/or recorded oral, product and performance evidence supplemented with an assessor observation checklist(s) should be produced to demonstrate that a candidate has achieved all Outcomes and Performance Criteria.

Outcome 1

Outcome 1 must be assessed by a single assessment designed to ensure that candidates can generate sufficient evidence to satisfy the Outcome 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. Total assessment time for Outcome 1 must not exceed 45 minutes.

With regard to Outcome 1 candidates must be able to identify

(a) One open centre, one closed centre and one load sensing system.
(b) The main hydraulic components to be identified must include: oil reservoir, filter, pumps, direction control valves, pressure limiting valves, actuators, motor.

Outcome 2

Outcome 2 must be assessed by a single assessment designed to generate evidence of candidates' knowledge of hydraulic components, their function and operating principles.

This assessment must include the following components: oil reservoir, filter, pumps, direction control valves, pressure limiting valves, actuators, motor.

This assessment must be designed to ensure that candidates can generate sufficient evidence to satisfy the Outcome 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. Total assessment time for Outcome 2 must not exceed 45 minutes.

National Unit Specification: statement of standards (cont)

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Outcome 3

Outcome 3 must be supervised and assessed in the following way:

Candidate evidence must be in the form of product and performance evidence to generate evidence of a candidate's ability to dismantle, inspect, repair, assemble and adjust, where necessary, the hydraulic components listed below. An observation checklist and either completed service sheet(s) or candidate job card(s) must be used to record evidence of whether candidates have satisfied all the Performance Criteria in the Outcome.

With regard to Outcome 3 candidates must provide evidence for each of the following:

(a) Hydraulic pump.
(b) Direction control valve.
(c) Hydraulic pipe and hose with fittings.
(d) Pressure control valve.
(e) Hydraulic rams (single acting and double acting).
(f) Hydraulic motor.

Outcome 4

Outcome 4 must be assessed by a series of assessments designed to generate evidence of candidates' abilities to service, test and adjust hydraulic systems. Included in this assessment should be evidence of a basic understanding of hydraulic fluids and the manufacturer's recommended service requirements for land-based vehicle /machinery hydraulic systems.

Candidate evidence must be in the form of product and performance evidence. Candidates must undertake assessment on their own. Assessment must be conducted under supervised conditions. An observation checklist and either completed service sheet(s) or candidate job card(s) must be used to record evidence of whether candidates have satisfied all the Performance Criteria in the Outcome or not.

With regard to Outcome 4 candidates must be able to:

(a) Test hydraulic systems using appropriate methods and equipment including pressure and flow tests.
(b) Compare the test results with manufacturer's specification.
(c) Test solenoid operated valves for correct operation.
(d) Adjust pressures where appropriate.
(e) Adjust linkage to manufacturer's specification.

National Unit Specification: statement of standards (cont)

UNIT Land-based Engineering: Hydraulics (SCQF level 6)

Outcome 5

Outcome 5 must be assessed by a single assessment designed to ensure that candidates can generate sufficient evidence to satisfy the Outcome and Performance Criteria. Candidate evidence must be in the form of a practical exercise and written report. Assessment must be conducted under supervised, conditions.

Candidate evidence must be in the form of product and performance evidence. Candidates must undertake assessment on their own. Assessment must be conducted under supervised conditions.

With regard to Outcome 5 candidates must be able to:

(a) Identify potential types and sources of oil contamination.
(b) Identify causes of pump cavitation.
(c) Identify the potential cause and effect of hydraulic system overload.

The Assessment Support Pack for this Unit provides sample assessment material. Centres wishing to develop their own assessments should refer to the Assessment Support Pack to ensure a comparable standard.

National Unit Specification: support notes

UNIT Land-based Engineering: Hydraulics (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 at SCQF level 6, but may also be offered on a free standing basis.

The aim of this Unit is to allow candidates to develop a basic knowledge, understanding and skills to service and repair land-based vehicle and machinery hydraulic systems. On successful completion of the Unit candidates will be able to interpret hydraulic circuit diagrams and identify the symbols used. They will also have developed the knowledge to identify hydraulic components and their function. Candidates will have developed the knowledge and skills to be able to service/test hydraulic systems, identify faults, repair components and commission overhauled systems.

In Outcome 1 candidates should be introduced to the main constructional features and basic principles of hydraulic operation, the circuits used in land-based vehicles and machinery and the identification of the hydraulic components.

In Outcome 2 candidates should be introduced to the construction and function of hydraulic components. These should include: Filter; pumps and motors (fixed and variable); common pressure valves (pressure maintaining, relief valves, shock valves); control valves (directional, proportional, check, pilot operated, pressure differential, flow dividers, priority, orbital and restrictors); hydraulic rams (single and double acting); reservoirs; accumulators; solenoid valves.

To stimulate candidate interest further, a simple hydraulic circuit could be built using basic components and a circuit diagram. The circuit could include: a reservoir, pump, pressure relief valve, control valve (manual or solenoid), actuator or motor, filter. It is recommended, for reasons of safety, that this is operated at a low pressure.

In Outcome 3 candidates should be introduced to the knowledge and skills required to maintain, dismantle, repair, assemble and reinstate hydraulic system components. These should include: Filters; pumps and motors (fixed and variable); common pressure valves (relief valves,); control valves (directional); hydraulic rams (single and double acting); reservoirs; accumulators; solenoid valves.

In Outcome 4 candidates should be introduced to manufacturers' service data, test procedures and the recommended test equipment for use on land-based hydraulic systems. In addition candidates should successfully complete hydraulic system servicing/testing and be able to interpret test results to locate faults in hydraulic systems.

In Outcome 5 candidates should be introduced to causes of hydraulic system and component failure which could include low oil levels, pump cavitation, inappropriate oil or fluids, types and causes of oil contamination, system overload, electrical system or component failure. This Outcome could be incorporated into Outcome 3.

National Unit Specification: support notes (cont)

UNIT Land-based Engineering: Hydraulics (SCQF level 6)

GUIDANCE ON LEARNING AND TEACHING APPROACHES FOR THIS UNIT

It is recommended that the Unit is delivered in the same sequence the Outcomes are presented in the National Unit Specification: statement of standards section of the Unit. The Unit may be delivered largely by a combination of lectures, computer simulation and practical work. The use of software for simulation will be required.

HEALTH, SAFETY AND THE ENVIRONMENT

As Outcomes 3, 4 and 5 require the candidate to practically service and repair equipment either on-site or in a workshop situation, it is strongly recommended that the candidates are 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 the Environment Unit guidelines while taking cognisance of the candidate's previous experience and abilities prior to the commencement of the practical activities. The storage and handling of materials and methods of 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.

Manufacturers' data should be available for system testing to enable the candidate to compare test figures with that of the data. Simulation for fault finding is to be encouraged to enable the candidate to develop confidence and skills although some work must be carried out on real equipment so that they can experience some of the problems associated with hydraulic failures.

OPPORTUNITIES FOR CORE SKILL DEVELOPMENT

Problem Solving
The Critical Thinking component of *Problem Solving* at SCQF level 5 may be developed in Outcomes 3, 4 and 5 while candidates are involved in, inspecting components, comparing component condition and system performance with manufacturers' specifications and fault finding in land-based vehicle hydraulic systems.

The Planning and Organising component of *Problem Solving* at SCQF level 5 may be developed in Outcomes, 3, 4 and 5 while candidates are involved with practical tasks, as they may need to organise how the required resources will be allocated.

The Reviewing and Evaluating components will be addressed during report writing at the conclusion of practical activities undertaken in Outcomes 4 and 5.

Working with Others
The *Working with Others* Core Skill at SCQF level 5 may be developed in Outcomes 4 and 5 while candidates carry out the testing and diagnosis of faults in hydraulic circuits and systems.

The Reviewing Co-operative Contribution component at SCQF level 5 may be developed in Outcomes 3, 4 and 5 while candidates engage in practical work as they 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 plan and completion of the intended testing, diagnosing and replacement of components on hydraulic systems.

National Unit Specification: support notes (cont)

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Communication
The *Communication* Core Skill at SCQF level 4 may be developed in Outcome 1 through assessments and Outcomes, 3, 4 and 5 through written and oral instructions, together with group interaction while candidates are engaged in practical work. Candidates will also be expected to present written reports and diagrams to support the practical work they have carried out.

Numeracy
The Using Number Core Skill component at SCQF level 5 may be addressed in Outcomes 4 and 5 through calculation involved in the principles of hydraulics, using measurements and assessing the flow rates or load capacity of hydraulic systems.

Using Graphical Information Core Skill component at SCQF level 5 may be presented using flow, pressure or temperature data in Outcomes 4 and 5.

ICT
The Accessing Information Core Skill component at SCQF level 5 may be developed in Outcomes 4 and 5 through the retrieval of manufacturers' data and the use of diagnostic equipment.

The Processing Information Core Skill component at SCQF level 5 may be developed in Outcomes 3, 4 and 5 through the presentation of assessments and reports.

GUIDANCE ON APPROACHES TO ASSESSMENT FOR THIS UNIT

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.

A single, holistic assessment paper of short answer, multiple choice or restricted response may assess Unit knowledge in Outcomes 1 and 2. Alternately assessment of individual parts of the Outcome may be carried out at appropriate points during Unit delivery. Candidate evidence must be in the form of performance and written and/or recorded oral evidence.

Formative assessment exercises involving candidates in workshop inspections and repair skills acquisition will play an important role in building candidate knowledge, understanding, skills and confidence of Unit content. Candidates would be expected to complete an appropriate written job card/inspection report associated with Outcomes 3, 4 and 5.

An observation checklist must be used to record the evidence of candidates having satisfied all the Performance Criteria in Outcomes 3, 4 and 5.

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 Communication 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).*

National Unit Specification: support notes (cont)

National Unit Specification: support notes

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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**