SQA Advanced Unit Specification

General information for centres

Unit title: Plant Systems: Utilities

Unit code: HV36 47

Unit purpose: This Unit is designed to provide candidates with a knowledge and understanding of mechanical plant systems found in many industrial, commercial and public buildings.

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

1 Describe the operation of pumps and fans.
2 Describe vapour refrigeration systems.
3 Investigate a boiler system and ancillary items.
4 Describe a typical commissioning process for a plant system.

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: Entry to the Unit is at the discretion of the centre however it would be an advantage if candidates had a basic knowledge and understanding of engineering principles, thermo fluids, engineering drawing, and engineering materials although this is not absolutely essential. Some of this knowledge and understanding may be evidenced by possession of the following SQA Advanced unit: Mechanical Engineering Principles (HV2V 47).

Core Skills: There are opportunities to develop the Core Skills of Written Communication and Critical Thinking at SCQF level 6 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.

Assessment: The assessments for Outcomes 1 and 2 will consist of two assessment papers, one for each outcome, lasting 30 minutes each. The assessment of Outcome 3 will comprise of an investigation on a practical boiler installation and the production of a report on the installation. The assessment of Outcome 4 will involve describing the commissioning process for a plant installation and producing a report describing this process. The boiler installation used in Outcome 3 may be used for the commissioning process in Outcome 4.

SQA Advanced Unit specification: statement of standards

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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.

Outcome 1

Describe the operation of pumps and fans

Knowledge and/or skills

- Working fluids
- Pump components and applications
- Fan components and applications
- Electrical motors
- Selection criteria
- Health and Safety requirements

Evidence Requirements

Evidence for the knowledge and/or skills items in Outcome 1 should be provided on a sample basis. The evidence may be provided in response to specific questions. Each candidate will need to demonstrate that she/he can answer correctly questions based on a sample of the items shown under the knowledge and/or skills items in Outcome 1. In any assessment of the Outcome **four out of six** knowledge and/or skills items should be sampled.

In order to ensure that candidates will not be able to for see what items they will be questioned on, a different sample of four out of six knowledge and/or skills items are required each time the Outcome is assessed. Candidates must provide a satisfactory response to the sampled items.

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

- described properties of working fluids relevant to pumping systems
- state a typical industrial application of a pumping system and pump components
- state a typical industrial application of a fan system and fan components
- described the maintenance requirements and applications of two electrical motors
- explain the use of relevant process parameters in order to select a pump or fan
- state the precautions and relevant health and safety legislation applicable to pumps and fans

The assessment for Outcome 1 should take the form of an assessment paper lasting 30 minutes conducted under controlled, supervised conditions. Assessment should be conducted under closed book conditions and as such candidates should not be allowed to bring any textbooks, handouts or notes to the assessment.

Assessment guidelines

The assessment paper should comprise of a suitable balance of short answer and restricted response questions.

Outcome 2

Describe vapour refrigeration systems

Knowledge and/or skills

- Refrigerants
- Compressor
- Condenser
- Evaporator
- Throttle
- Selection criteria
- Health and Safety requirements

Evidence Requirements

Evidence for the knowledge and/or skills items in Outcome 2 should be provided on a sample basis. The evidence may be provided in response to specific questions. Each candidate will need to demonstrate that she/he can answer correctly questions based on a sample of the items shown under the knowledge and/or skills items in Outcome 2. In any assessment of the Outcome **four out of seven** knowledge and/or skills items should be sampled.

In order to ensure that candidates will not be able to for see what items they will be questioned on, a different sample of four out of seven knowledge and/or skills items are required each time the Outcome is assessed. Candidates must provide a satisfactory response to the sampled items.

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

- state relevant properties of refrigerants
- describe the operation and component parts of a vapour compressor
- describe the operation and function of a vapour refrigeration condenser
- describe the operation and function of a vapour refrigeration evaporator
- explain the function of the throttle device
- explain relevant process parameters in order to select a refrigeration system
- state the precautions and relevant health and safety legislation applicable to refrigeration systems

The assessment for Outcome 2 should take the form of an assessment paper lasting 30 minutes conducted under controlled, supervised conditions. Assessment should be conducted under closed book conditions and as such candidates should not be allowed to bring any textbooks, handouts or notes to the assessment.

Assessment guidelines

The assessment paper should comprise of a suitable balance of short answer and restricted response questions.

Outcome 3

Investigate a boiler system and ancillary items

Knowledge and/or skills

- Boiler types
- Fuels
- Cooling
- Feed pumps
- Energy reduction
- Power generation
- Insulation
- Pressure relief
- Maintenance
- Symbol recognition
- Ancillary items
- Health and Safety

Evidence Requirements

All knowledge and/or skills items in this Outcome should be assessed.

The assessment for Outcomes 3 must comprise of an investigation on a practical boiler installation.

Candidates will need evidence to demonstrate their knowledge and/or skills by showing that they can for the boiler installation:

- state the fuel used
- describe the cooling system used
- describe the feed pump used and explain where it is used in the installation
- state at least two approaches to energy reduction in the installation
- describe how power is generated
- describe insulation arrangements
- describe the operation of the pressure relief valves used
- use current standard symbols
- state three ancillary items used
- State relevant health and safety legislation

Candidate evidence should be produced in the form of a report written in the candidates own time. Centres should make every reasonable effort to ensure the assignment solution is the candidate's own work. Where copying or plagiarism is suspected candidates may be interviewed to check their

knowledge and understanding of the subject matter. A checklist should be used to record oral evidence of the candidate's knowledge and understanding.

Assessment guidelines

Reports will normally be between 600 and 700 words in length plus diagrams. Candidates may work in teams when conducting the investigation on the practical boiler systems. Centres may wish to issue candidates with suitable guidance notes advising on the best way to structure their reports or leave it to candidates to structure their own reports.

Outcome 4

Describe a typical commissioning process for a plant system

Knowledge and/or skills

- Commissioning requirements
- Documents
- Commissioning procedure
- Verification procedure

All knowledge and/or skills items in this Outcome should be assessed.

Evidence Requirements

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

- describe at least three commissioning requirements for the selected plant system
- describe and explain two commissioning documents
- describe the commissioning procedure for the selected plant system
- describe and explain the verification procedure

Candidate evidence must be produced in the form of a report covering the knowledge and/or skills items shown on the previous page. Candidates should be produced their reports in their own time. Centres should make every reasonable effort to ensure the report is the candidate's own work. Where copying or plagiarism is suspected candidates may be interviewed to check their knowledge and understanding of the subject matter. A checklist should be used to record oral evidence of the candidate's knowledge and understanding.

Assessment guidelines

The commissioning process may be carried out on the boiler installation used for the assessment of Outcome 3 or on a different plant system. Where the boiler installation in Outcome 3 is used, the reports for Outcomes 3 and 4 can be combined. The combined report will normally be between 1,000 and 1,300 words in length plus diagrams. A separate report for this Outcome will normally be between 400 and 600 words in length.

Administrative Information

Unit code: HV36 47

Unit title: Plant Systems: Utilities

Superclass category: VG

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History of Changes:

Version	Description of change	Date

Source: SQA

SQA acknowledges the valuable contribution that Scotland's colleges have made to the development of SQA Advanced Qualifications.

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: Plant Systems: Utilities

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 has been written in order to allow candidates to develop knowledge, understanding and skills in the following areas:-

(1) **The operation of pumps and fans incorporating selection criteria**

Candidates will not require an in-depth knowledge and understanding of the topics listed in the knowledge and/or skills section of this Outcome. However, candidates will find it useful to develop an awareness of the significance of the items in relation to the operation and maintenance of pumps and fan systems. The suggested delivery and assessment time for this Outcome is eight hours.

(2) **The operation of vapour refrigeration systems incorporating selection criteria**

Candidates should be introduced to system components and the make up of an industrial chiller unit with a view to selecting one from a supplier catalogue. Emphasis should be placed on current European legislative requirements with regards to CFC'S and refrigerant selection. The suggested delivery and assessment time for this Outcome is eight hours.

(3) **The operation of boiler systems and ancillary items**

Candidates will not require an in-depth knowledge and understanding of the topics listed in the knowledge and/or skills section of this Outcome. However, candidates will find it useful to develop an awareness of the significance of the items in relation to the operation and maintenance of boiler plant. Emphasis should be placed on safety requirements and observations when working with boiler systems together with best practice maintenance procedures. The suggested delivery and assessment time for this Outcome is 14 hours.

(4) **Typical commissioning process for a plant system**

Candidates should be introduced to various commissioning requirements in order to develop a logical and consistent commissioning plan for a plant system. Various examples should be sourced using available resources such as the World Wide Web, supplier data, existing examples from workplaces and current legislation. Candidates should be encouraged to select an application with which they are familiar or have interest in from the delivery of the Unit. The suggested delivery and assessment time for this Outcome is 10 hours.

Guidance on the delivery and assessment of this Unit

When delivering this Unit emphasis should be placed on a 'hands on' approach whenever possible. Examples of systems and procedures should be related, where possible, to the candidate's work environment. Practical exercises could be copies of actual systems or parts of systems in operation at candidates' places of work. The use of computer models, simulation and /or design packages are useful in reinforcing learning and their use is encouraged.

Candidates should be provided with opportunities to develop the Written Communication Core Skill when preparing the reports or Outcomes 3 and 4. Candidates should be encouraged to develop critical thinking skills while solving formative assessment question on the various plant systems in this Unit and when developing their commissioning plan.

Information on Evidence requirements and Assessment guidelines is given after each Outcome in the SQA Advanced Unit specification: statement of standards section.

Open learning

This Unit could be offered as a distance learning package with respect to the knowledge and understanding components. However, there is likely to be some difficulty with the delivery of the practical aspects of the Unit unless candidates can utilise equipment at their place of work or elsewhere and arrangements for observation of their performance to meet the assessment requirements can be made. This would depend on the safety and security needs of the company involved and therefore it might be more practical to offer this part of the unit at a centre in a controlled laboratory environment.

For further information and advice, please see *Assessment and Quality Assurance of Open and Distance Learning* (SQA, February 2001 – publication code A1030).

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.

General information for candidates

Unit title: Plant Systems: Utilities

This Unit has been designed to provide you with the knowledge and understanding of range of mechanical plant equipment including pumps, fans, refrigeration systems and boilers. You will also be introduced to what is involved in commissioning an item of plant.

This Unit will normally be delivered by a combination of lectures, tutorial exercises, practical work and/or computer work. The tutorial exercises will be designed to develop your knowledge, skills and confidence in plant system problems. Practical work is particularly important as it will allow you to confirm theory in practice as well as learn more about the various plant systems. Please ask your lecturer what practical work you will do in this Unit. You will be expected to complement learning in all outcomes by referring to various information sources such as supplier journals/magazines, videos and supplier sites on the World Wide Web.

The assessments for Outcomes 1and 2 will consist of two 30 minute assessment papers, one for each outcome, conducted under closed book assessments conditions. You will not be allowed to bring notes or textbooks into either of these assessments. The assessment for Outcome 3 will take the form of an assignment in which you will investigate many of the features of a practical boiler installation and produce a report on the installation. Assessment of Outcome 4 will comprise of you undertaking a commissioning process for a plant installation and producing a report. The plant installation involved may be the boiler system you were assessed on in Outcome 3.