

-SQA-SCOTTISH QUALIFICATIONS AUTHORITY

HIGHER NATIONAL UNIT SPECIFICATION

GENERAL INFORMATION

Unit Number	D3PX 04
Unit Title	GAS TURBINES
Superclass Category	XH
Date of publication (month and year)	
Originating Centre for Unit	Cleveland Open Learning Unit

DESCRIPTION

Demonstrating an understanding of the principles of construction, operation and applications of gas turbines.

OUTCOMES:

1. appraise the mechanical design principles of gas turbines;
2. appraise gas turbine thermodynamic cycles;
3. describe the compression stage of gas turbines;
4. describe the combustion stage of gas turbines;
5. appraise the performance and control of gas turbines;
6. evaluate environmental problems.

CREDIT VALUE: 1 HN Credit

ACCESS STATEMENT:

Access to this unit is at the discretion of the centre. However, it would be beneficial if the candidate possessed competence in Mathematics, Physics and Engineering Principles. This may be evidenced by the successful completion of modules at National Certificate level or their equivalent.

Additional copies of this unit can be obtained from: The Administrative Services Unit, SQA, Hanover House, 24 Douglas Street, Glasgow G2 7NQ (Tel: 0141-242 2166).

At the time of publication, the cost is £2.50 (minimum order £5.00)

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STATEMENT OF STANDARDS

Unit number:

Unit title: GAS TURBINES

Acceptable performance in this Unit will be the satisfactory achievement of the standards set out in this part of the specification. All sections of the statement of the standards are mandatory and cannot be altered without reference to SQA.

OUTCOME

1. APPRAISE THE MECHANICAL DESIGN PRINCIPLES OF GAS TURBINES

PERFORMANCE CRITERIA

- (a) Descriptions of gas turbine layout are related to design purpose.
- (b) Consideration of construction materials is related to machine and component function and maintenance aspects.

RANGE STATEMENT

Turbine layout: open and closed cycle design; aero and industrial designs; single and twin shaft machines; combined heat and power generation.
Component function: compressor stage; combustion stage; turbine stage.

EVIDENCE REQUIREMENTS

Written and graphical evidence showing ability to relate gas turbine layout to design purpose.
Written evidence showing ability to relate component function to construction material.

OUTCOME

2. APPRAISE GAS TURBINE THERMODYNAMIC CYCLES

PERFORMANCE CRITERIA

- (a) Turbine cycles are correctly represented on property diagrams.
- (b) Parameters relating to turbine cycles are correctly determined.

RANGE STATEMENT

Turbine cycles: the Joule (Brayton) cycle; cycle with intermediate heat exchanger; re-heat cycle.

Diagrams: pressure – volume diagrams; temperature – entropy diagrams.
Parameters: compressor outlet temperature; compression volume; work done; work ratio; cycle efficiency.

EVIDENCE REQUIREMENTS

Written and graphical evidence showing ability to represent turbine cycles on property diagrams.
Written evidence showing ability to determine turbine cycle parameters as listed in the range.

OUTCOME

3. DESCRIBE THE COMPRESSION STAGE OF GAS TURBINES

PERFORMANCE CRITERIA

- (a) Descriptions are sufficient to explain the operating principles.
- (b) Identification of compressor characteristics relates to type and design.

RANGE STATEMENT

Compressor types: centrifugal; axial; mixed flow.
Characteristics: surging; choking; pressure ratio; velocity diagrams.

EVIDENCE REQUIREMENTS

Written and graphical evidence showing ability to describe the compression stage of a gas turbine.
Written and graphical evidence showing ability to identify compressor characteristics.

OUTCOME

4. DESCRIBE THE COMBUSTION STAGE OF GAS TURBINES

PERFORMANCE CRITERIA

- (a) Descriptions are sufficient to explain the operating principles.
- (b) Combustion process is related to turbine requirements.

RANGE STATEMENT

Combustion stage: industrial turbines; aviation turbines.
Turbine requirements: fuels; fuel-air ratio; combustion rates; chamber design; ignition.

EVIDENCE REQUIREMENTS

Unit No

Continuation

Written and graphical evidence showing ability to describe the combustion stage of gas turbines.
Written evidence showing ability to relate the combustion process to turbine requirements.

OUTCOME

5. APPRAISE THE PERFORMANCE AND CONTROL OF GAS TURBINES

PERFORMANCE CRITERIA

- (a) Descriptions of turbine control functions are clear in terms of performance requirements.
- (b) Identification of turbine performance characteristics are correct in terms of turbine parameters.

RANGE STATEMENT

Control functions: ignition and flame control; fuel control; part load conditions; automatic control.

Characteristics: air temperature/power output curve; pressure ratio/mass flow curve; surge line; working line; constant efficiency curves; degree of reaction.

EVIDENCE REQUIREMENTS

Written evidence showing ability to describe turbine control functions.

Written and graphical evidence showing ability to correctly identify turbine performance characteristics as listed in the range.

OUTCOME

6. EVALUATE ENVIRONMENTAL PROBLEMS

PERFORMANCE CRITERIA

- (a) Assessment of environment effect is correct in terms of turbine operation and performance.

RANGE STATEMENT

Environment effects: atmospheric contamination; 'nox'; 'sox'; noise pollution.

EVIDENCE REQUIREMENTS

Written evidence showing ability to relate environmental effects to turbine operation and performance.

MERIT

To gain a pass in this unit, a candidate must meet the standards set out in the outcomes, performance criteria, range statements and evidence requirements.

To achieve a merit in this unit, a candidate must demonstrate a superior or more sophisticated level of performance. In this unit this might be shown in the following way:

- (a) demonstrating an ability to use a number of performance criteria in an integrative way (e.g. to supply answers that are more complex than are necessary to demonstrate the achievement of the individual performance criteria).
- (b) using the performance criteria in a creative way to, for example, suggest possible developments in turbine design.

ASSESSMENT

In order to achieve this unit, candidates are required to present sufficient evidence that they have met all the performance criteria for each outcome within the range specified. Details of these requirements are given for each outcome. The assessment instruments used should follow the general guidance offered by the SQA assessment model and an integrative approach to assessment is encouraged. (See references at the end of support notes.)

Accurate records should be made of the assessment instruments used showing how evidence is generated for each outcome and giving marking schemes and/or checklists, etc. Records of candidates' achievements should be kept. These records will be available for external verification.

SPECIAL NEEDS

Proposals to modify outcomes, range statements or agreed assessment arrangements should be discussed in the first place with the external verifier.

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SUPPORT NOTES

Unit Number

Unit Title

GAS TURBINES

SUPPORT NOTES:

This part of the unit specification is offered as guidance. None of the sections of the support notes is mandatory.

NOTIONAL DESIGN LENGTH:

SQA allocates a notional design length to a unit on the basis of time estimated for achievement of the stated standards by a candidate whose starting point is as described in the access statement. The notional design length for this unit is 40 hours. The use of notional design length for programme design and timetabling is advisory only.

REFERENCES

1. Guide to unit writing.
2. For a fuller discussion on assessment issues, please refer to SQA's Guide to Assessment.
3. Information for centres on SQA's operating procedures is contained in SQA's Guide to Procedures.
4. For details of other SQA publications, please consult SQA's publications list.

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