Higher National Unit Specification

General information for centres

Unit title: Jig and Fixture Design

Unit code: DT5W 35

Unit purpose: This Unit is designed to introduce candidates to jig and fixture design and enable them to understand how they are developed and used in a manufacturing process. The Unit allows the candidate to develop the necessary knowledge and skills to allow them to understand the basic principles and operations of jigs and fixtures.

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

1 Explain the theory of location and restraint.
2 Design a jig.
3 Design a fixture.
4 Design a simple indexing unit as part of a jig or fixture.

Credit points and level: 1 HN 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 Access 1 to Doctorates.*

Recommended prior knowledge and skills: Access to this Unit is at the discretion of the centre. However, candidates should possess a basic knowledge and understanding of machining techniques and a range of manufacturing processes. This may be evidenced by possession of the following HN Units: Engineering Skills, Process and Equipment Selection and Engineering Drawing.

Core Skills: There may be opportunities to gather evidence towards the following listed Core Skill components in this Unit, although there is no automatic certification of Core Skills or Core Skills components.

Reading Communication	Higher
Written Communication	Higher
Critical Thinking	Higher

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.

General information for centres (cont)

Assessment: This Unit should be assessed on an Outcome by Outcome basis. In Outcome 1 candidates should be assessed by means of a written assessment paper. This paper should be taken by candidates at one single assessment that should last no more than 30 minutes and should be conducted under controlled, supervised conditions.

Assessment for Outcomes 2, 3 and 4 should take the form of a design of a jig or fixture based on a given component for one operation only (gearwheel, connecting bracket, bearing housing etc). Candidates should present evidence in the form of a separate short report for each Outcome. Each report should contain detailed engineering drawings and relevant commentary on final design, materials and any calculations required in the selection process.

Higher National Unit specification: statement of standards

Unit title: Jig and Fixture Design

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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

Explain the theory of location and restraint

Knowledge and/or skills

- Six degrees of freedom
- Location methods
- Restraining methods
- Applications of jigs and fixtures

Evidence Requirements

Evidence for the knowledge and/or skills items in this Outcome will be provided on a sample basis. The evidence may be presented in response to specific questions. Each candidate will need to demonstrate that she/he can answer questions based on a sample of the items shown above. In any assessment of this Outcome **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 three out of four knowledge and/or skills items is required each time the Outcome is assessed. Candidates must provide a satisfactory response to all three items.

Where sampling takes place, a candidate's response can be judged to be satisfactory where evidence provided is sufficient to meet the requirements for each item by showing that the candidate is able to:

- explain the 'six degrees of freedom'
- distinguish between location and restraint and between positive and frictional restraint
- describe methods of locating and restraining simple components
- explain the applications of jigs and fixtures and the use of standard parts for location and restraining devices

Evidence must be generated by candidates taking a short written assessment paper lasting no more than 30 minutes and conducted under controlled, supervised conditions. The assessment should also be conducted under closed-book conditions and as such candidates must not be allowed to bring any textbooks, handouts or notes to the assessment.

Assessment guidelines

Questions used to elicit candidate evidence should take the form of an appropriate balance of short answer and restricted response questions.

The centre may supply the candidate with a minimum of four components and the feature to be machined (ie a round bar requiring a hole drilled radically).

Outcome 2

Design a jig

Knowledge and/or skills

- Applications of jigs
- Cost considerations of jigs
- Standard parts
- Restraint and location
- Design for a typical application

Evidence Requirements

Evidence for the knowledge and/or skills for this Outcome will be provided on a sample basis. Each candidate will need to demonstrate that he/she can produce correct responses based on a sample of the items shown under the knowledge and/or skills. In any assessment of the Outcome, the **last knowledge and skills item** is always assessed plus any **three out of the first four** knowledge and/or skills items.

Where sampling takes place, a candidate's response can be judged to be satisfactory where evidence provided is sufficient to meet the requirements for each item by showing that the candidate can:

- describe suitable applications of jigs
- provide a cost consideration for the jig
- select from a library of standard parts
- explain methods of restraint and location
- design and draw for a typical jig application

Candidate evidence must be provided in the form of a written report plus drawings. The report must include comments on materials, material properties, cost elements and standard parts.

Higher National Unit specification: statement of standards (cont)

Unit title: Jig and Fixture Design

Assessment guidelines

Reports, which should contain drawings, would normally be 250–300 words in length. Centres may wish to provide candidates with a format for the report. Candidates could use either manual drawing or appropriate CAD software to produce drawings.

Candidates may be supplied with a drawing or CAD file of a component requiring one or more drilled hole (eg cast link *two holes*, pipe flange *four or eight holes*) and candidates may be asked to design a drilling jig capable of locating and restraining the component while the holes are drilled to an acceptable tolerance.

Outcome 3

Design a fixture

Knowledge and/or skills

- Applications of fixtures
- Cost considerations of fixtures
- Standard parts
- Restraint and location
- Design for a typical application

Evidence Requirements

Evidence for the knowledge and/or skills for this Outcome will be provided on a sample basis. Each candidate will need to demonstrate that he/she can produce correct responses based on a sample of the items shown under the knowledge and/or skills. In any assessment of the Outcome, the **last knowledge and skills item** is always assessed plus any **three out of the first four** knowledge and/or skills items.

Where sampling takes place, a candidate's response can be judged to be satisfactory where evidence provided is sufficient to meet the requirements for each item by showing that the candidate can:

- describe suitable applications of fixtures
- provide a cost consideration for the fixture
- select from a library of standard parts
- explain methods of restraint and location
- design and draw for a typical fixture application

Candidate evidence must be provided in the form of a written report plus drawings. The report should include comments on materials, material properties, cost elements and standard parts.

Assessment guidelines

Reports, which should contain drawings, would normally be 250–300 words in length. Centres may wish to provide candidates with a format for the report. Candidates could use either manual drawing or appropriate CAD software to produce drawings.

Higher National Unit specification: statement of standards (cont)

Unit title: Jig and Fixture Design

Outcome 4

Design a simple indexing unit as part of a jig or fixture

Knowledge and/or skills

- Applications of indexing units
- Cost considerations of indexing units
- Standard parts
- Restraint and location
- Design for a typical application

Evidence Requirements

Evidence for the knowledge and/or skills for this Outcome will be provided on a sample basis. Each candidate will need to demonstrate that he/she can produce correct responses based on a sample of the items shown under the knowledge and/or skills. In any assessment of the Outcome, the **last knowledge and skills item** is always assessed plus any **three out of the first four** knowledge and/or skills items.

Where sampling takes place, a candidate's response can be judged to be satisfactory where evidence provided is sufficient to meet the requirements for each item by showing that the candidate can:

- describe suitable applications of an indexing unit
- provide a cost consideration for an indexing unit
- select from a library of standard parts
- explain methods of restraint and location
- design and draw an indexing unit for a typical jig or fixture application

Candidate evidence must be provided in the form of a written report plus drawings. The report must include comments on materials, material properties, cost elements and standard parts.

Assessment guidelines

Reports, which should contain drawings, would normally be 250–300 words in length. Centres may wish to provide candidates with a format for the report. Candidates could use either manual drawing or appropriate CAD software to produce drawings.

Administrative Information

Unit code: DT5W 35

Unit title: Jig and Fixture Design

Superclass category: VF

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SQA acknowledges the valuable contribution that Scotland's colleges have made to the development of Higher National qualifications.

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

Higher National Unit specification: support notes

Unit title: Jig and Fixture Design

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

It is recommended that the following times are adhered to in the delivery of the Outcomes.

1 Explain the theory of location and restraint – 4 hours.
2 Design a jig — 12 hours.
3 Design a fixture — 10 hours.
4 Design a simple indexing unit as part of a jig or fixture. 14 hours.

Guidance on the delivery and assessment of this Unit

The following list could be used as a checklist to confirm coverage of the Unit for assessment or teaching purposes.

Outcome 1

Explain the theory of location and restraint

- the six degrees of freedom (linear and rotational freedom).
- methods of components location
- the use of relieve pins to allow for component tolerance
- positive and frictional restraint
- describe methods of restraining a range of simple components
- the benefits of jigs and fixtures (repeatability, orientation, speed)

Outcome 2

Design a jig

Establish sequence of operations

- the means of establishing datums (from centre lines and faces) of castings forgings and prefabricated parts.
- the use of pre-machined features (for secondary operations)
- location and restraint of the component within the jig
- the use of standard parts (base plates, drill bushes, clamps)
- fool proofing of the jig, allowing the component only to be loaded in the correct manner
- drill clearance (through baseplate)

- operator safety and rigidity of design
- ease of operation and handling

Outcome 3

Design a fixture

- the means of establishing datums (from centre lines and faces) of castings forgings and prefabricated parts
- the use of pre-machined features (for secondary operations)
- location components within the fixture
- restraint of components within the fixture protecting against distortion of the part
- the use of relieve pins to allow for component tolerance
- the use of standard parts (base plates, drill bushes, clamps, location pins)
- tenon location or datum faces incorporated on base plate to allow setting on milling machine
- fool proofing of the fixture, allowing the component only to be loaded in the correct manner
- tool clearance and operator safety, ease of operation and handling, rigidity of design and operator safety

Outcome 4

Design a simple indexing unit as part of a jig or fixture

- the means of establishing datums (from centre lines and faces) of castings forgings and prefabricated parts
- the use of pre-machined features (for secondary operations)
- location and restraint of components within the fixture
- the use of standard parts (base plates, drill bushes, clamps location pins)
- trigger or cam location to index part
- tenon location or datum faces incorporated on base plate to allow setting on milling machine
- fool proofing of the fixture, allowing the component only to be loaded in the correct manner
- cutter setting block
- tool clearance and operator safety
- ease of operation and handling
- rigidity of design

Opportunities for developing Core Skills

There may be opportunities to gather evidence towards the following listed Core Skill components in this Unit, although there is no automatic certification of Core Skills or Core Skills components.

Reading Communication	Higher
Written Communication	Higher
Critical Thinking	Higher

Higher National Unit specification: support notes (cont)

Unit title: Jig and Fixture Design

Open learning

This Unit could be delivered by distance learning, which might incorporate some degree of online 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 written assessment for Outcome 1 was conducted under controlled, supervised conditions

For information on normal open learning arrangements, please refer to the SQA guide *Assessment and Quality Assurance of Open and Distance Learning* (SQA 2000).

Candidates with additional support needs

This Unit specification is intended to ensure that there are no artificial barriers to learning or assessment. The additional support needs of individual candidates should be taken into account when planning learning experiences, selecting assessment instruments or considering alternative Outcomes for Units. For information on these, please refer to the SQA document *Guidance on Assessment Arrangements for Candidates with Disabilities and/or Additional Support Needs,* which is available on the SQA website **www.sqa.org.uk.**

General information for candidates

Unit title: Jig and Fixture Design

This Unit has been developed to introduce you to restraint and location techniques and the application of jigs and fixtures to aid production. You may go on industrial visits to local companies to enhance your knowledge and understanding of jigs and fixtures. Your lecturer may also show you videos and ask you to solve hands-on problems to enhance your knowledge and skills. You may also participate in group projects.

In Outcome 1 you will be made aware of the six degrees of freedom principle, apply it to simple component set-ups and identify methods of locating and restraining (positive or frictional) in the six degrees prior to a simple machining process. The centre may supply you with a minimum of four components and the feature to be machined (ie a round bar requiring a hole drilled radically). You will sketch the restraint method using standard tolling (vee-blocks, vices, clamps etc) and identify whether each direction is frictionally or positively restrained.

In Outcome 2 you may be supplied with a drawing or CAD file of a component requiring one or more drilled hole (eg cast link *two holes*, pipe flange *four or eight holes*) and you could be asked to design a drilling jig capable of locating and restraining the component while the holes are drilled to an acceptable tolerance.

In Outcome 3 you may use the same component as in Outcome 2 to produce a milling fixture capable of locating and restraining the component to allow one milling operation (facing, slotting etc.)

In Outcome 4 you will be supplied with a component requiring two or more identical features to be generated (gear cutting, side and face cutter, round bar to hexagonal or square etc). The developed fixture should allow the component to be accurately indexed then secured to enable you to repeat the machined feature.

To assist you in the design of the jigs and fixtures in Outcomes 2, 3 and 4 a comprehensive catalogue of standard parts will be at your disposal. These catalogues can also be sourced online at the discretion of the centre. A modified catalogue of standard parts (location pins, base plates, clamps etc.) may be created by your centre in the form of a CAD library, which will enable you to source parts with variations of each component.