

National Unit Specification: general information

UNIT	Fabrication and Thermal Joining Techniques (Intermediate 2)
NUMBER	D180 11
COURSE	Engineering Craft Skills (Intermediate 2)

SUMMARY

This unit provides knowledge and skills in basic metal hot-forging, thermal joining and fabrication processes.

OUTCOMES

- 1 Apply hot-forging techniques to form and bend steel.
- 2 Apply thermal joining techniques.
- 3 Manufacture an artefact incorporating fabrication and thermal joining techniques from working drawings.
- 4 Use a range of fabrication and thermal joining tools and equipment

RECOMMENDED ENTRY

While entry is at the discretion of the centre, candidates would normally be expected to have previous experience of reading drawings and practical work. This may be evidenced by one of the following:

- Standard Grade Craft and Design
- Engineering Craft Skills at Intermediate 1 level

Administrative Information

Superclass:	XE
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National Unit Specification: general information (cont)

UNIT Fabrication and Thermal Joining Techniques (Intermediate 2)

CREDIT VALUE

1 credit at Intermediate 2.

CORE SKILLS

Information on the automatic certification of any core skills in this unit is published in *Automatic Certification of Core Skills in National Qualifications* (SQA, 1999).

National Unit Specification: statement of standards

UNIT Fabrication and Thermal Joining Techniques (Intermediate 2)

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 the Scottish Qualifications Authority.

OUTCOME 1

Apply hot-forging techniques to form and bend steel.

Performance criteria

- (a) Hot-forging techniques of forming and bending are demonstrated correctly.
- (b) Hardening and tempering is carried out successfully on carbon steel.

Evidence requirements

Performance evidence that the candidate can apply forging techniques to meet the performance criteria using both bending and forming techniques, and hardening and tempering.

OUTCOME 2

Apply thermal joining techniques.

Performance criteria

- (a) A weld deposit or a braze that is consistent in its width and form is produced.
- (b) Spot-welding equipment is operated successfully.

Evidence requirements

Performance evidence that the candidate can produce a weld deposit or a braze that is consistent in width and form over a minimum length of 50 mm. Spot welding equipment should be operated successfully to produce effective and well-formed joints.

OUTCOME 3

Manufacture an artefact incorporating fabrication and thermal joining techniques from working drawings.

Performance criteria

- (a) An artefact is produced in accordance with the working drawings.
- (b) The quality of thermal joining and fabrication meets specified standards.
- (c) Functional dimensions are within specified limits.

Evidence requirements

Performance evidence that the candidate can manufacture one artefact made from several components.

National Unit Specification: statement of standards (cont)

UNIT Fabrication and Thermal Joining Techniques (Intermediate 2)

OUTCOME 4

Use a range of fabrication and thermal joining tools and equipment.

Performance criteria

- (a) Hot-forging tools and equipment are used correctly.
- (b) Thermal joining equipment is used correctly.
- (c) All safety practices and procedures are observed correctly in the use of tools and equipment.

Evidence requirements

Performance evidence that the candidate is competent in the correct use of thermal joining and hot-forming equipment, with due regard to personal and colleagues' safety in line with safe working practices.

National Unit Specification: support notes

UNIT Fabrication and Thermal Joining Techniques (Intermediate 2)

This part of the unit specification is offered as guidance. The support notes are not mandatory.

While the time allocated to this unit is at the discretion of the centre, the notional design length is 40 hours.

This unit extends the range of metal craft skills to fabrication work and associated processes, including thermal joining and forging. It would normally be taken only by candidates who have had experience of previous units and who wish to extend their metalworking experience into more specialised areas.

Experience of reading drawings and basic marking-out is assumed.

GUIDANCE ON CONTENT AND CONTEXT FOR THE UNIT

Content:

- forming techniques: twisting, drawing down, flattening
- bending techniques: metal-bar bending, metal-strip bending (including on edge)
- heat-treatment methods: annealing, hardening, tempering
- allowances when marking out: expansion, bending, stretching, trimming
- thermal joining techniques: tack welding and brazes, short runs over a minimum of 50 mm; spot welding
- specified limits: accuracy depends on the process as described below:
Marking-out: ± 0.5 mm
Forged limits: ± 5 mm

This unit is practical in nature and requires the candidate to develop skills in:

- using hot-forging techniques to form shapes and components as an alternative to material removal
- knowing, understanding and applying simple thermal joining techniques to join materials
- marking-out, with appropriate allowances for fabrication and thermal joining techniques to be used
- using fabrication and thermal joining techniques to manufacture an artefact
- adhering to safe working practices at all times (with particular reference to thermal joining techniques, a clear understanding of the need for eye protection). Ventilation, protective clothing, circuit polarity and work holding will be required

National Unit Specification: support notes (cont)

UNIT Fabrication and Thermal Joining Techniques (Intermediate 2)

GUIDANCE ON LEARNING AND TEACHING APPROACHES FOR THIS UNIT

Using hot-forging techniques to form shapes and components as an alternative to material removal

Forging is related to fabrication. It might best be introduced by a video showing the terminology, equipment and applications in an industrial context. Advantages in creating shapes by hot-forging rather than removing material should be discussed and applications provided. Candidates should have practical experience of basic hot-forging shaping processes, such as hot-bending of the strip on the flat surface or on edge, drawing down and twisting. The forging process would naturally lead on to the observation of effects of heat on carbon steels, and this might be best studied through the manufacture of a cold chisel or screwdriver, the latter having the advantage of providing scope for several integrative skills across the course.

Knowing, understanding and applying simple thermal joining techniques to join materials

This aspect of the unit would be best undertaken in isolation from other practical activities in the course, as a learning process, and then applied in a larger context.

The joining of components by manual metal arc (MMA), metal inert gas (MIG) or tungsten inert gas (TIG) and by resistance (spot) welding are prescribed to allow an insight into a permanent method common in steel fabrication work, and to give some practice in using one of the techniques. Other thermal processes for joining other metals, for example brazing and soldering, could also be covered if required.

Using fabrication and thermal joining techniques to manufacture an artefact

One or two artefacts could be produced to incorporate most of the skills required for this unit, which could also provide the opportunity to revisit skills from other areas of the course if required.

A screwdriver would feature forging, heat treatment and several integrative skill experiences. Similarly, decorative ironwork would apply unit content and provide scope for integrative experiences.

Adhering to safe working practices at all times

Thermal joining and forging have their own safety practices and procedures, including safety-wear, ventilation, equipment checks and work holding. These should be fully covered and firmly enforced.

National Unit Specification: support notes (cont)

UNIT Fabrication and Thermal Joining Techniques (Intermediate 2)

GUIDANCE ON APPROACHES TO ASSESSMENT FOR THIS UNIT

Whenever possible, the dynamic nature of this course should not be hindered by overburdening assessment of the candidate.

The candidate should be aware that certain performances are being monitored constantly and recorded on an observation checklist, and that finished artefacts will be tested against the stated criteria for accuracy and quality. Lengthy written tests are not required for tool, process or equipment recognition and use. Short-answer tests that are mainly of a visual nature will be provided. Another technique would be to display the tools and equipment, and ask the candidates to write or state their names and uses.

Approaches to generating evidence

Examples of artefacts that could be produced only for this unit might be a curved boot-scraper with welded legs, to stand outside a front door. An example of an integrative artefact dealing with areas from elsewhere in the course might be a horseshoe door-knocker. The actual knocker could be a forged horseshoe shape fixed to shaped lugs, which in turn would be thermally joined on to a shaped back-plate. The back-plate would require countersunk screw holes. The knocker could be attached to the back-plate with a turned and threaded pivot arrangement and perhaps a turned handle to be fixed to the face of the knocker. The scale of work in this unit will vary according to the needs of the candidate and, if time permits, larger, more repetitive projects may be undertaken.

This approach could serve any or all of the following three purposes:

- as a rehearsal for the course assessment project, during which the candidate is expected to work independently, with the minimum of assistance
- as a means of re-testing certain performances from other areas of the course
- as a means of employing a holistic approach to assessment, whereby much of the evidence for the other two units of the course could be found in the artefact as it is described

SPECIAL NEEDS

This unit specification is intended to ensure that there are no artificial barriers to learning or assessment. Special 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 Special Assessment and Certification Arrangements for Candidates with Special Needs/Candidates whose First Language is not English* (SQA, 1998).