

ENGINEERING CRAFT SKILLS
Intermediate 1

Fifth edition – published October 2008

**NOTE OF CHANGES TO ARRANGEMENTS
FIFTH EDITION PUBLISHED OCTOBER 2008**

COURSE TITLE: Engineering Craft Skills (Intermediate 1)

COURSE NUMBER: C034 10

National Course Specification

Course Details: Course Outline Minor amendments to clarify Course structure

National Course Specification

ENGINEERING CRAFT SKILLS (INTERMEDIATE 1)

COURSE NUMBER C034 10

COURSE STRUCTURE

This Course comprises two mandatory Units and one optional unit as follows:

Mandatory units

<i>D178 10</i>	<i>Bench Skills – Metal (Int 1)</i>	<i>1 credit (40 hours)</i>
<i>D179 10</i>	<i>Machine Processes – Metal (Int 1)</i>	<i>1 credit (40 hours)</i>

Optional units

One selected from:

<i>D180 10</i>	<i>Fabrication and Thermal Joining Techniques (Int 1)</i>	<i>1 credit (40 hours)</i>
<i>D181 10</i>	<i>Practical Electronics (Int 1)</i>	<i>1 credit (40 hours)</i>

In common with all Courses, this Course includes 40 hours over and above the 120 hours for the component units. This may be used for induction, extending the range of learning and teaching approaches, support, consolidation, integration of learning and preparation for external assessment. This time is an important element of the Course and advice on its use is included in the Course details.

RECOMMENDED ENTRY

While entry is at the discretion of the centre, candidates would normally be expected to have had some previous experience in Craft Skills.

CORE SKILLS

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

Administrative Information

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National Course Specification: Course details

COURSE Engineering Craft Skills (Intermediate 1)

RATIONALE

Practical creativity exemplifies mankind's need to be able to control and utilise tools and materials. The sense of achievement that is experienced on the successful completion of a practical project is immense, and the value of this achievement to the development of the personal and social aspects of a candidate's education cannot be overstated. Practical creativity fosters qualities of self-esteem, technological confidence, self-discipline and maturity, all of which are essential attributes for candidates in post-16 education.

This Course will contribute to the knowledge, understanding and practical experience of candidates whose aspirations and abilities are towards practical work, or who are considering a career in the engineering industry in any capacity. Candidates may wish to extend skills developed in Standard Grade Craft and Design. They may wish to progress to education or training in engineering, through studies and practice focused on practical aspects of such work. They may wish to experience the rigorous standards which would apply if they were serving an apprenticeship or in employment in this field.

Candidates who are pursuing studies in other fields, but who sampled the workshop environment in early secondary education, may wish to come back to gain experience and skills which may be useful and worthwhile in general education and adult life. Such candidates are to be encouraged.

The Course is of a practical nature, is workshop-based and provides many skills which are appropriate to a wide range of applications. The Course will develop skills in marking-out, cutting, shaping, machining and materials. Apart from giving an insight into industrial practice, such studies help with the development of self-confidence, manual dexterity and control, perseverance, maturity and spatial awareness. The Practical Electronics option also extends the scope of the Course to include craft skills which interface with electronics in producing working systems.

The Intermediate 1 and Intermediate 2 Courses have similar learning outcomes and differ mainly in their assessment requirements; hence it is possible to teach two levels within the same class.

These are intended for use in both schools and colleges.

Differentiation

Teachers and lecturers offering the Intermediate 1 Course should be aware of the demands of the Intermediate 2 Course. These differences focus on:

- the degree of difficulty of practical tasks
- the quality of artefacts
- the accuracy achieved in producing functional aspects
- the range of tools and equipment used
- the degree of independence of working

National Course Specification: Course details (cont)

COURSE Engineering Craft Skills (Intermediate 1)

Course aims

This Course:

- fosters practical skills in the creation of artefacts
- develops knowledge, understanding and skills of general aspects of practical engineering activity
- encourages independence and the ability to make choices
- highlights the importance of safety and encourages responsible attitudes in the workshop environment
- contributes to personal development, in particular to practical capability

COURSE CONTENT

All of the Course content will be subject to sampling in the external assessment.

The Course consists of two mandatory units, each of 40 hours – *Bench Skills – Metal (Int 1)* and *Machine Processes – Metal (Int 1)*. There is a third unit chosen from *Fabrication and Thermal Joining Techniques (Int 1)*, which further extends metalworking skills, or *Practical Electronics (Int 1)*, which develops practical skills in constructing electronic circuits. For either option the Course assessment is based on a project which integrates the knowledge, understanding and skills of the selected units.

The Course is focused on practical work and takes place in a workshop environment. Whenever a new skill is to be introduced, this should be demonstrated to candidates and accompanied by the underpinning knowledge and understanding. Content is prescribed but the Course is intended to be candidate-centred as opposed to being wholly content-driven. For example, a candidate may be attracted to a particular project which requires experiences beyond the minimum competence and will require extended learning and teaching.

It is anticipated that varying degrees of support will be required for individual candidates throughout the Course with organisation of work and direct help with practical work.

National Course Specification: Course details (cont)

COURSE Engineering Craft Skills (Intermediate 1)

Bench Skills – Metal (Int 1)

This introductory unit deals with a range of metalwork hand skills, including bench-fitting work, basic sheet-metal work, measuring and marking-out. The general ability to read and interpret drawings and diagrams is fundamental to any craftwork and is developed in this unit. Each candidate should produce two small artefacts, one from sheet-metal and one utilising fitting skills and simple assembly. These artefacts should embody the prescribed content.

AREA OF STUDY	CONTENT
<p>Reading and interpretation of engineering drawings</p> <p>Practice in using:</p> <ul style="list-style-type: none">• Marking-out tools• Fitting tools and processes• Sheet-metal tools and processes• Measuring tools	<p>Simple dimensioned orthographic and pictorial drawings</p> <p>Scriber, rule, square, dividers, oddleg callipers, centre punch</p> <p>Hammers, chisels, files, saws, threading, riveting set, riveting</p> <p>Bending equipment, shears, notchers, mallets, hammers, safe edge, tin snips, pop riveter, spot welder</p> <p>Rule, engineer's square, inside callipers, outside callipers</p>

National Course Specification: Course details (cont)

COURSE Engineering Craft Skills (Intermediate 1)

Machine Processes – Metal (Int 1)

The purpose of this unit is to extend measuring and marking-out techniques and gain experience of common machines and equipment and related processes. Knowledge is gained of the features and use of machines and other items of equipment commonly found in workshops. This includes metalworking lathes, pedestal drills and bench grinders. The range of machines may be extended to utilise milling machines, and it is desirable that all candidates are aware of these through use or videos or by demonstration at another facility. Candidates should work with a range of metals appropriate to the applications.

Candidates are expected to manufacture artefacts from a given drawing. Where possible, the choice of artefact should reflect areas of interest to the candidates, while embodying the content of the unit. It is likely that some artefacts may be suitable for integration with work produced in the other units.

The recognition that the quality of work is partly dependent on the care and maintenance of tools and equipment should be incorporated. The effectiveness of planned maintenance on workplace efficiency could be mentioned.

AREA OF STUDY	CONTENT
<p>Knowledge and understanding of the applications for which machine tools are used:</p> <ul style="list-style-type: none"> • Centre lathe • Pedestal drill • Grinding machine • Machine tool equipment • Milling machine <p>Practical experience of:</p> <ul style="list-style-type: none"> • Centre lathe • Pedestal drill • Routine user checks 	<p>Plain turning, facing, chamfering, centre drilling Drilling, countersinking Sharpening a single-point tool Cutting and knurling tools, chucks, chuck keys, morse tapers, revolving centres, machine vices, safety equipment Slotting, surface levelling</p> <p>Plain turning, facing, chamfering, centre drilling, drilling Drilling, countersinking General condition of hand tools, position and condition of guards, position of cutting tools on machine tools, security of work holding</p>

National Course Specification: Course details (cont)

COURSE Engineering Craft Skills (Intermediate 1)

Optional unit: Fabrication and Thermal Joining Techniques (Int 1)

Fabrication implies the forming and joining of components. Thermal joining techniques employed are those such as manual metal arc (MMA), metal inert gas (MIG) or tungsten inert gas (TIG). These techniques are prescribed to allow an insight into methods commonly used in heavy fabrication work. Other thermal processes for joining metals, eg brazing or soldering, may also be covered.

Forging is another process related to fabrication. It might best be introduced by videos dealing with the related terminology, equipment and applications in an industrial context. However, each candidate needs to gain practical experience of basic forging procedures. This will provide an opportunity to consider the heat effects of carbon steels.

AREA OF STUDY	CONTENT
<p>Practical experience of:</p> <ul style="list-style-type: none">• Hot-forming techniques• Hot-bending techniques• Thermal joining techniques	<p>Twisting, drawing down, flattening Metal-bar bending, metal-strip bending (including on edge) Welding: preparation, clamping, single-weld bead, tack welding, resistance (spot) welding Brazing: preparation, clamping or wiring, fluxing, applying braze or spelter</p>

National Course Specification: Course details (cont)

COURSE Engineering Craft Skills (Intermediate 1)

Optional unit: Practical Electronics (Int 1)

This unit provides experience of building a range of simple electronic circuits, by non-permanent and permanent methods. Through this experience of assembling circuits, candidates learn to recognise and gain knowledge of the function of a range of electronic components. At Intermediate 1 level, candidates may work entirely from given layout diagrams. Completed circuits will undergo checking procedures for fault finding and, if necessary, rectification to ensure operation to specification. The culmination of this unit is the construction of an electronic system from a given circuit diagram.

AREA OF STUDY	CONTENT
Reading and interpreting layout diagrams	Five different types of component to be included
Selection and insertion of common components	Sensors, signal-processing devices, and output devices
Using various construction techniques	Solderless prototype board (non-permanent); soldering, ie stripboard (permanent); printed circuit board (PCB)
Inspection and testing	Multi-meter, logic probe

Course organisation

While the Course is integrative in nature, some sequential teaching will be required. This will apply mainly in the case of the metalworking path, where ideally the units would be approached in the following order:

- 1 Bench Skills – Metal (Int 1)
- 2 Machine Processes – Metal (Int 1)
- 3 Fabrication and Thermal Joining Techniques (Int 1)

However, for class organisation purposes, it is possible to deal with the general topics of reading drawings and marking-out before allowing candidates to be directed into two or three different activities. This type of approach should enable candidates to have adequate access to machines and equipment.

For the unit Practical Electronics (Int 1), the stage at which it is introduced is not critical, but this introduction should be dealt with on a group rather than an individual basis.

National Course Specification: Course details (cont)

COURSE Engineering Craft Skills (Intermediate 1)

ASSESSMENT

When the units are taken as component parts of a Course, candidates will have the opportunity to achieve at levels beyond those required to attain each of the unit outcomes. This attainment may, where appropriate, be recorded and used to contribute towards Course estimates and to provide evidence for appeals. Further information on the key principles of assessment is provided in the paper *Assessment*, published in May 1996.

As this Course is predominantly practical in nature, the majority of the features contained within the additional 40 hours must also be practical. Hence the Course assessment is based entirely on a practical project. It is anticipated that this project will require between 20 and 30 hours and will be tackled near the end of the Course or in part towards the end of each unit.

The project allows integration of the knowledge, understanding and skills gained in the selected units of the Course. It is proposed that candidates will be able to select projects from a range approved by their teacher/lecturer. This range should be graded according to degree of difficulty so that each candidate tackles work at an appropriate level, ie to suit his/her performance in the units.

The project will be manufactured to a given working drawing. The role for the Course project should be introduced at an early stage, to allow candidates to develop and integrate their Course experiences towards their final assessment.

Candidates will not be assessed on the ability to design a product, though designing should be encouraged and developed as part of effective learning and teaching and motivation.

The integrative nature of the final project has several advantages. Depth of understanding can be consolidated and there are opportunities for additional, integrated or applied learning. The additional time allowed for project work encourages more complex artefacts to be manufactured, and hence provides an opportunity to achieve good-quality work and a useful product. In addition, the project is based on some earlier experience, so candidates will be able to approach their work with confidence.

DETAILS OF THE INSTRUMENTS FOR EXTERNAL ASSESSMENT

External assessment will be based on the outcome of the project. An overall grade (A, B or C) will be determined by assessment of each candidate's performance in planning and producing a project. This assessment will be subject to external moderation. To gain the Course award, the candidate must pass all three unit assessments, as well as the project assessment.

National Course Specification: Course details (cont)

COURSE Engineering Craft Skills (Intermediate 1)

There are four aspects to be considered in determining the grade of award at Intermediate 1:

- 1 The range of working practices demonstrated.
- 2 The level of difficulty of the project.
- 3 The overall quality of the finished artefact.
- 4 The degree of independence and the amount of practical assistance required.

1 *The range of working practices demonstrated*

The range of working practices will extend from covering a limited number of processes to covering the majority of processes and skills from the units. These notional levels are explained within the assessment criteria. In general, Intermediate 2 candidates will cover approximately 80% of the skills and processes from the units and Intermediate 1 candidates, approximately 60%.

2 *The level of difficulty of the project undertaken*

Normally a project will have options which cover various levels of difficulty. These will reflect the range of difficulties demonstrated in the units and the limits for accurate working at Intermediate 1 and 2. Candidates will attempt to reproduce and extend the skills previously produced within the units. There will be clear differences between the manufacturing options that can be attempted in the manufacture of the Course project. There will be definitive projects for Intermediate 1 and Intermediate 2.

3 *The overall quality of the finished artefact*

The levels of skill and accuracy will be linked to individual projects but will be based on:

- quality of manufacture
- quality of finish
- functionality of the artefact

4 *The degree of independence and the amount of practical assistance required*

This will be summarised and reported on a checklist. It is anticipated that most candidates will require some guidance to proceed with the project. Some practical assistance may be required to maintain progress.

Suitable limits for accurate working have been stated in the Unit specifications. These provide the notional levels for assessment of accuracy in the Course project. In Course projects that are substantially larger than unit artefacts, manufacturing tolerances can be adjusted accordingly.

National Course Specification: Course details (cont)

COURSE Engineering Craft Skills (Intermediate 1)

GRADE DESCRIPTIONS

Grade C

For performance at Grade C, the candidate, with a fair degree of guidance and showing due regard for safety procedures and practices, has produced work which demonstrates attainment of a modest but acceptable standard of craftsmanship.

In this work there is evidence of:

- basic skill levels in the use of hand tools, machine tools and equipment
- meeting minimal tolerances in fitting, sheet-metal work and hot forming
- acceptable level of neatness and consistency in the finish
- a fair degree of assistance in organisation and selection of processes

Grade B

For performance at Grade B, the candidate, with some guidance and showing due regard for safety procedures and practices, has produced work which demonstrates attainment of a fair standard of craftsmanship.

In this work there is evidence of:

- reasonable skill levels in the use of hand tools, machine tools and workshop equipment
- tolerances in fitting, sheet-metal work and hot forming are generally in line with those demanded by the component units at Intermediate 1
- reasonable level of neatness and consistency in the finish
- some guidance and direction in completing the project

Grade A

For performance at Grade A, the candidate, with occasional guidance in organisation and execution and with due regard for safety procedures and practices, has produced work which demonstrates attainment of a good standard of craftsmanship.

In this work there is evidence of:

- good skill levels in the use of hand tools, machine tools and workshop equipment
- many tolerances in fitting, sheet-metal work and hot forming are in line with those demanded by the component units at Intermediate 1
- a fairly good level of neatness and consistency in the finish
- occasional support in completing the project

National Course Specification: Course details (cont)

COURSE Engineering Craft Skills (Intermediate 1)

APPROACHES TO LEARNING AND TEACHING

Where appropriate, arrangements should be made to ensure that there will be no artificial barriers to learning and assessment. The nature of a candidate's special needs should be taken into account when planning learning experiences and selecting assessment instruments. Alternative arrangements can be made as necessary.

Induction

The Course will commence with some time from the additional 40 hours being spent on setting the scene for the Course, including:

- a tour of the workshop facilities and equipment
- matters of general safety and expectations of acceptable conduct and attitudes in a workshop environment
- the structure of the Course
- how the Course relates to previous experiences
- an outline of the Course content and the units
- the role of the optional units
- the assessment requirements for the Course
- advice for candidates on how to access knowledge for themselves
- progression available beyond successful completion
- perhaps an industrial visit (an additional two hours would be required)

Appropriate videos to introduce engineering processes and safety aspects might be useful at this stage.

Bench Skills – Metal (Int 1) should be regarded as the introductory unit of the Course. The unit includes developing experience of reading and interpreting drawings and diagrams, marking-out, and manufacturing two artefacts – one requiring sheet-metal skills and one requiring fitting skills.

It would be advisable to complete the sheet-metalwork artefact first, thus establishing some of the basic skills, knowledge, discipline, and housekeeping procedures associated with the workshop facility. The second artefact should be used to reinforce and further develop these skills. This second artefact should also provide scope for introducing some of the activities from the other units of the Course, such as the use of the pedestal drill or perhaps hot-bending.

After establishing the necessary skills and information to ensure that safe working practices are adhered to, the class group may be organised into smaller working groups to tackle the remainder of the Course and to make the best use of access to machines and equipment.

Each new operation, process or stage will need to be demonstrated or discussed, possibly with reference to video material, on a need-to-know basis. This should enable candidates to proceed with some confidence and safety. Teaching inputs should be kept as brief as possible to allow the main activity of 'hands-on' practical work. Likewise, assessment should be kept as brief as possible, mainly by noting successful achievement on checklists.

National Course Specification: Course details (cont)

COURSE Engineering Craft Skills (Intermediate 1)

The learning and teaching involved in each unit is a means to an end, and leads to the manufacture of one or more artefacts. Candidates need to be made aware that their performance throughout the Course will determine the level of difficulty of their prescribed project and hence influence their final grade. They should be encouraged to aim high in this respect. Within the Course, from the additional 40 hours, there is time and opportunity for additional learning and practice of skills, to try to achieve enhanced grades.

Candidates should be thinking at an early stage about the demands that the project will make and relating their Course experiences to what will be expected in the project.

SPECIAL NEEDS

This Course 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).

SUBJECT GUIDES

A Subject Guide to accompany the Arrangements documents has been produced by the Higher Still Development Unit (HSDU) in partnership with the Scottish Consultative Council on the Curriculum (SCCC) and Scottish Further Education Unit (SFEU). The Guide provides further advice and information about:

- support materials for each Course
- learning and teaching approaches in addition to the information provided in the Arrangements document
- assessment
- ensuring appropriate access for candidates with special educational needs

The Subject Guide is intended to support the information contained in the Arrangements document. The SQA Arrangements documents contain the standards against which candidates are assessed.

National Unit Specification: general information

UNIT	Bench Skills – Metal (Intermediate 1)
NUMBER	D178 10
COURSE	Engineering Craft Skills (Intermediate 1)

SUMMARY

This unit develops the candidates' abilities in reading simple working drawings and producing products using metalworking tools.

OUTCOMES

- 1 Use marking-out tools and equipment to mark out simple components.
- 2 Demonstrate knowledge of common bench tools and equipment.
- 3 Use a range of metalworking hand tools and equipment.
- 4 Manufacture artefacts from working drawings.

RECOMMENDED ENTRY

While entry is at the discretion of the centre, candidates would normally be expected to have attained some previous experience of Craft Skills.

CREDIT VALUE

1 credit at Intermediate 1.

Administrative Information

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National Unit Specification: general information (cont)

UNIT Bench Skills – Metal (Intermediate 1)

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 Bench Skills – Metal (Intermediate 1)

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

Use marking-out tools and equipment to mark out simple components.

Performance criteria

- (a) Datums are located correctly.
- (b) Workpiece is marked out correctly.
- (c) Functional dimensions are marked out correctly within prescribed limits of accuracy.

Note on range for the outcome

Equipment: scribe, rule, square, dividers, oddleg callipers, centre punch.

Evidence requirements

Performance and observed evidence that the candidate can use tools and equipment to mark out a workpiece to meet the performance criteria. Evidence should show a minimum of three functional sizes, with tolerances of ± 1 mm on two linear sizes.

OUTCOME 2

Demonstrate knowledge of common bench tools and equipment.

Performance criterion

- (a) Identification of common bench tools and equipment is correct.

Evidence requirements

Written and/or oral evidence to demonstrate that the candidate can correctly identify at least 12 items from a selection of bench tools and equipment.

OUTCOME 3

Use a range of metal-working hand tools and equipment.

Performance criteria

- (a) Common bench tools and equipment are selected correctly.
- (b) Hand tools and equipment are used correctly.

Evidence requirements

Performance evidence that the candidate can select and use a minimum of four fitting tools, two sheet-metal tools and two measuring tools.

National Unit Specification: statement of standards (cont)

UNIT Bench Skills – Metal (Intermediate 1)

OUTCOME 4

Manufacture artefacts from working drawings.

Performance criteria

- (a) Artefacts are produced in accordance with given working drawings.
- (b) Functional dimensions are within prescribed limits.
- (c) The quality of the finish complies with stated standards.
- (d) All safety practices and procedures are observed correctly in the use of tools and in the manufacture of the artefacts.

Note on range for the outcome

Artefacts: one artefact from sheet-metal, one artefact using fitting skills.

Evidence requirements

Performance evidence that the candidate can manufacture an artefact to meet the PCs (a), (b) and (c).
Observed adherence to safe working practices for PC (d).

The artefact should show evidence of three functional sizes within tolerances of ± 1 mm for two linear dimensions in fitting work, and ± 2 mm for sheet-metal work and ± 3 mm for bending.

National Unit Specification: support notes

UNIT Bench Skills – Metal (Intermediate 1)

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 develops knowledge and skills in reading and interpreting working drawings, hand-fitting skills and some basic sheet-metalworking.

Candidates attempting this unit will mainly be in post-16 education, although it may also be undertaken by some adult returners and perhaps some candidates in the 14 to 16 curriculum.

Candidates require little prior experience, but will be expected to produce good practical work. Artefacts produced should have a personal appeal to the client group, but must provide challenge and stimulation.

Apart from developing basic engineering hand skills, this unit should emphasise the need for safe working practices and a disciplined approach to achieving quality work. As part of a Course in the post-16 curriculum, the candidates should be required to act and perform as adults and, accordingly, the tasks set should be challenging to the candidates at the level at which they are working. As the Course develops, the candidates will be required to operate machinery and equipment to a code of practice, with a degree of independence, and it is essential that ground rules for acceptable standards are set and applied throughout this unit.

GUIDANCE ON CONTENT AND CONTEXT FOR THIS UNIT

Content:

- simple engineering drawings: orthographic, pictorial, assembly drawings
- measuring tools to include rules, squares and callipers, and centre punches
- common bench tools: fitting tools, sheet-metal tools, measuring tools
- fitting tools to include hammers, chisels, files, saws, taps and dies, and riveting sets
- sheet-metal tools to include folding bars, hide mallets, tin snips, pop riveters and spot welders

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

- reading and interpreting simple workshop drawings
- using basic marking-out tools to mark out one simple sheet-metal and one fitting artefact
- using a range of sheet-metal tools to manufacture a sheet-metal artefact
- using a range of fitting tools to manufacture a fitting-type artefact
- adhering to safe working practices at all times

National Unit Specification: support notes (cont)

UNIT Bench Skills – Metal (Intermediate 1)

GUIDANCE ON LEARNING AND TEACHING APPROACHES FOR THIS UNIT

Using basic marking-out tools

The marking-out of a model sports pitch could serve to introduce datums in a familiar context. On metal the datums would first be established by filing two adjacent edges straight and at 90° and using basic marking-out equipment – rule, square, oddlegs, scriber, centre punch, dividers – to achieve the required accuracy. More sophisticated apparatus such as scribing blocks and surface tables might be introduced if applications warrant them, although their use would only be assessed at Intermediate 2 level.

Using a range of sheet-metal tools to manufacture a sheet-metal artefact

Depending on the experience of the candidates some practice work will normally be carried-out. This may take the form of a cardboard mock-up or the manufacture of an introductory artefact. This will help the candidates appreciate the finer points and problems involved in manufacturing in sheet-metal. By doing this, candidates should develop the necessary personal experience to manufacture the unit artefact.

At this stage it will be necessary to amply cover all stages by demonstration and constantly supervise activities. Safety in general, and that specific to the unit, must be stressed and firmly enforced.

Using a range of fitting tools to manufacture an artefact

Emphasis should be given to the desire for accuracy and quality rather than speed in manufacturing this item.

The type of artefact produced could require the candidates to use equipment and processes from other units in the Course.

Drilling, though generally a machine process, would most likely be covered at this time. Accuracy would be determined by rule in conjunction with callipers if necessary, but there is no reason why devices such as digital vernier callipers cannot be used at this time. Assembly/joining methods should be covered, as should finishing with no major flaws, though there is scope here for additional support.

Candidates should have practice of reading and interpreting drawings containing the required range of features. It would assist candidates at this level if orthographic and pictorial views were provided together. Candidates should be aware of the importance of datums, and references for BS PP7308 should be provided for candidates to use as required.

Adhering to safe working practices at all times

Safe working practices will be demonstrated and highlighted by the teacher/lecturer throughout the Course, but the opportunity should be taken here to ensure that the candidates are aware that their approach to this topic is being monitored and will continue to be monitored throughout the Course.

Care of tools and the recognition of the dangers of tool defects with regard to quality of work and possible hazard will be a recurrent theme in the Course, and the topic should be broached in this unit.

National Unit Specification: support notes (cont)

UNIT Bench Skills – Metal (Intermediate 1)

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.

Approaches to generating evidence

Assessment evidence for this unit should be able to be drawn from the manufacture of two artefacts – one sheet-metal and one fitting artefact. In situations where candidates fail to achieve the required standard of performance in one area, this weakness can be targeted in the next part of the Course, when the next artefact is manufactured.

In situations where candidates fail to achieve the required standard of performance in more than one area, it may be necessary to provide tasks aimed specifically at the areas to be reassessed.

Some candidates may require additional support and help to ensure success in the manufacturing process, but candidates must also be aware that the overall Course assessment takes into account the amount of practical assistance given by the teacher/lecturer and that ultimately a degree of independence is expected from the candidate.

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).

National Unit Specification: general information

UNIT	Machine Processes – Metal (Intermediate 1)
NUMBER	D179 10
COURSE	Engineering Craft Skills (Intermediate 1)

SUMMARY

Candidates will learn how to operate a range of machine tools and manufacture an artefact involving their use.

OUTCOMES

- 1 Use marking-out tools and equipment.
- 2 Demonstrate knowledge of common machine tools and equipment.
- 3 Perform basic operations on a pedestal drill and a centre lathe.
- 4 Manufacture an artefact from a working drawing.

RECOMMENDED ENTRY

While entry is at the discretion of the centre, candidates would normally be expected to have had some previous experience of practical skills, including reading engineering drawings.

CREDIT VALUE

1 credit at Intermediate 1.

Administrative Information

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National Unit Specification: general information (cont)

UNIT Machine Processes – Metal (Intermediate 1)

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 Machine Processes – Metal (Intermediate 1)

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

Use marking-out tools and equipment.

Performance criteria

- (a) The construction of datums is correct.
- (b) The workpiece is marked out correctly in accordance with the given working drawing.
- (c) Three functional dimensions are within the permitted limits.

Evidence requirements

Performance evidence that the candidate can mark out a workpiece to meet the performance criteria, on three functional sizes, with tolerances of ± 1 mm on two linear sizes.

OUTCOME 2

Demonstrate knowledge of common machine tools and equipment.

Performance criteria

- (a) Identification of common machine tools and their related equipment is correct.
- (b) Machines and equipment are matched correctly to applications.

Note on range for the outcome

Machine tools: centre lathe, grinding machine, pedestal drill, milling machine.

Evidence requirements

Written and/or oral evidence that the candidate can score a minimum of 11/20 in identifying types of machine equipment and processes associated with them.

National Unit Specification: statement of standards (cont)

UNIT Machine Processes – Metal (Intermediate 1)

OUTCOME 3

Perform basic operations on a pedestal drill and a centre lathe.

Performance criteria

- (a) Drilling and countersinking on the pedestal drill meets specified requirements.
- (b) The centre lathe operations of parallel turning, facing and chamfering are performed to specified standards.

Evidence requirements

Performance evidence that the machines have been operated to meet the requirements of the performance criteria.

OUTCOME 4

Manufacture an artefact from a working drawing.

Performance criteria

- (a) An artefact is produced in accordance with the working drawing.
- (b) Appropriate machines and equipment are used correctly.
- (c) The accuracy achieved is within specified tolerances.
- (d) The quality of the machined finish complies with stated standards.
- (e) All safety practices and procedures are observed correctly in the use of machine tools and in the manufacture of an artefact.

Evidence requirements

Performance evidence that the candidate can manufacture an artefact to meet the performance criteria. For PC (c) the accuracy should be achieved on at least three functional sizes to tolerances of ± 0.5 mm on diameter and ± 1 mm on linear. Compliance with safe practices and procedures should be recorded from observation.

National Unit Specification: support notes

UNIT Machine Processes – Metal (Intermediate 1)

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 develops knowledge and skills in common metalworking machines and equipment, and their uses.

Candidates attempting this unit will mainly be in post-16 education, although it may also be undertaken by some adult returners and perhaps some candidates in the 14 to 16 curriculum.

Candidates require little prior experience, but will be expected to produce good practical work. Artefacts produced should have personal appeal to candidates, but must also provide challenge and stimulation.

Apart from developing basic machining skills, this unit should emphasise the need for safe working practices and a disciplined approach to achieving quality work. As part of a Course in the post-16 curriculum, the candidates should be required to act and perform as adults and, accordingly, the tasks set should be challenging to the candidates at the level at which they are working. The candidates will be required to operate machinery and equipment to a code of practice – with a degree of independence – and it is essential that a mature and responsible approach is taken by the candidate.

Artefacts will be produced to working drawings and should where possible involve integration of previous experience, for example Bench Skills – Metal (Int 1).

Prior knowledge of reading simple drawings is assumed.

GUIDANCE ON CONTENT AND CONTEXT FOR THIS UNIT

Content:

- equipment: knowledge of cutting tools, knurling tools, chucks, chuck keys, morse tapers, revolving centres, machine vices and safety equipment
- applications: knowledge of parallel turning, facing, chamfering, drilling, countersinking, centre drilling, grinding

This unit balances practical activity with knowledge and understanding that can be transferred to more complex machinery in industrial situations at a later date. The context should relate to industrial applications whenever possible.

National Unit Specification: support notes (cont)

UNIT Machine Processes – Metal (Intermediate 1)

GUIDANCE ON LEARNING AND TEACHING APPROACHES FOR THIS UNIT

Using special marking-out techniques

The need for special marking-out techniques for certain precision work and irregular components should be discussed. Marking-out of larger products and repetitive marking-out should also be discussed.

Performing routine user checks on tools and machinery prior to their use

The candidate should be responsible for ensuring that the machinery to be used is set up appropriately, with all safety equipment in place prior to use. Similarly, the inspection of hand tools and reporting of defects should become a routine event in this Course.

Operating common machine tools in accordance with safe working practice

The candidate should use as many machines and items of equipment as possible (a minimum of two), and artefacts that are produced to given working drawings should embody as wide a range as possible.

Drilling-machine operations should involve at least one activity whereby the machine vice is clamped to the table. This will ensure that the candidates have practical experience of workholding of this type.

Morse tapers should be used to hold larger drills, rather than the ‘Jacobs’ chuck. Use of morse tapers to locate lathe centres should be identified.

Centre lathe operations could include: parallel turning, facing, taper turning using a compound slide, drilling and knurling, although this range might well be extended according to needs. Machined finishes should be without significant defects and probably best gauged against exemplar pieces, visually and by thumbnail check.

Adhering to safe working practices at all times

Safe working practices will be demonstrated and highlighted by the teacher/lecturer throughout the Course, but the opportunity should be taken here to ensure that the candidates are aware that their approach to this topic is being monitored and will continue to be monitored throughout the Course.

Care of tools and recognition of the hazards of tool defects with regard to quality of work and possible hazards to the user will be a recurrent theme in the Course, and the topic should be further reinforced in this unit.

National Unit Specification: support notes (cont)

UNIT Machine Processes – Metal (Intermediate 1)

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

Assessment evidence for this unit should be able to be drawn from the manufacture of one or two artefacts that perhaps also include reinforcement and additional evidence for other units in the Course. Examples of this might be additional practice and evidence in reading drawings, measuring and marking-out and fitting skills. A manufacturing plan could also be produced as a matter of good practice, but would not be required for assessment purposes in this unit. In situations where candidates fail to achieve the required standard of performance in one area, this weakness can be targeted in the next part of the Course when the next artefact is manufactured, or perhaps in the Course assessment project itself.

In situations where candidates fail to achieve the required standard of performance in more than one area, it may be necessary to provide tasks aimed specifically at the areas to be reassessed.

Some candidates may require additional support and help to ensure success in the manufacturing process. However, candidates must also be aware that the overall Course assessment takes into account the amount of practical assistance given by the teacher/lecturer and that a degree of independence is ultimately expected from the candidate.

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).

National Unit Specification: general information

UNIT	Fabrication and Thermal Joining Techniques (Intermediate 1)
NUMBER	D180 10
COURSE	Engineering Craft Skills (Intermediate 1)

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 to 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.

CREDIT VALUE

1 credit at Intermediate 1.

Administrative Information

Superclass:	XE
Publication date:	December 2005
Source:	Scottish Qualifications Authority
Version:	01

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National Unit Specification: general information (cont)

UNIT Fabrication and Thermal Joining Techniques (Intermediate 1)

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 1)

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 criterion

- (a) Hot-forging techniques of forming and bending are demonstrated correctly.

Evidence requirements

Performance evidence that the candidate can apply forging techniques to meet the performance criteria. One example each of bending and forming techniques.

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 to a minimum length of 30 mm. Spot welding equipment should be operated successfully to form effective joints.

OUTCOME 3

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

Performance criteria

- (a) An artefact is produced in accordance with the working drawing.
- (b) The quality of thermal joining and fabrication meet 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 1)

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 1)

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 should extend the range of metalcraft 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)
- thermal joining: using either manual metal arc (MMA) or metal inert gas (MIG) or tungsten inert gas (TIG); spot welding

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 and applying simple thermal joining techniques to join materials
- 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 1)

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 material removal should be discussed and applications provided. Candidates should have practical experience of basic hot-forging shaping processes, such as hot-bending of strips on the flat 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 the 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 1)

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 for only 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.

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 with a degree of independence
- 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).

National Unit Specification: general information

UNIT	Practical Electronics (Intermediate 1)
NUMBER	D181 10
COURSE	Engineering Craft Skills (Intermediate 1)

SUMMARY

The purpose of this unit is to recognise electronic components, and how they are assembled into electronic circuits. Electronic construction in this context would be aimed at integrating with an engineering construction to provide a working electronics device.

OUTCOMES

- 1 Construct an electronic circuit using a prototype circuit board.
- 2 Construct an electronic circuit using stripboard.
- 3 Construct an electronic system using a Printed Circuit Board (PCB) from a given specification and using individual components.

RECOMMENDED ENTRY

While entry is at the discretion of the centre, candidates would normally be expected to have had some experience in reading and interpreting working drawings, as well as some experience in using hand tools.

CREDIT VALUE

1 credit at Intermediate 1.

Administrative Information

Superclass:	XL
Publication date:	December 2005
Source:	Scottish Qualifications Authority
Version:	03

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National Unit Specification: general information (cont)

UNIT Practical Electronics (Intermediate 1)

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 Practical Electronics (Intermediate 1)

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

Construct an electronic circuit using a prototype circuit board.

Performance criteria

- (a) The components are selected correctly from stock.
- (b) The circuit is constructed correctly to given layout diagram.
- (c) The circuit diagram is interpreted correctly.
- (d) Pre-power-up checks are carried out.
- (e) The circuit is verified to operate to a given specification.

Evidence requirements

A practical exercise in interpreting a diagram, selecting components and constructing a working circuit using a prototype circuit board.

OUTCOME 2

Construct an electronic circuit using stripboard.

Performance criteria

- (a) The components are selected correctly from stock.
- (b) The components (including connections) are soldered into position neatly and to layout diagram.
- (c) The circuit diagram is interpreted correctly.
- (d) Pre-power-up checks are carried out.
- (e) The circuit is verified to operate to a given specification.

Evidence requirements

A practical exercise in interpreting a diagram, selecting and soldering of components on a strip board and producing a working circuit.

National Unit Specification: statement of standards (cont)

UNIT Practical Electronics (Intermediate 1)

OUTCOME 3

Construct an electronic system using a Printed Circuit Board (PCB) from a given specification and using individual components.

Performance criteria

- (a) The system is constructed correctly.
- (b) Pre-power-up checks are carried out.
- (c) The system operates to specification.

Evidence requirements

A practical exercise in interpreting a diagram, selecting components and constructing a working electronic system using a PCB.

National Unit Specification: support notes

UNIT Practical Electronics (Intermediate 1)

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.

The purpose of this unit is to branch out into an associated area of engineering practical work: electronic-circuit construction.

Candidates attempting this unit will mainly be in post-16 education, although it may also be undertaken by some adult returners and perhaps some candidates in the 14 to 16 curriculum.

Candidates require little prior experience, but will be expected to produce good practical work. Artefacts produced should have personal appeal to the candidates, but must provide challenge and stimulation.

Apart from developing basic electronic manufacturing hand skills, this unit should emphasise the need for safe working practices and a disciplined approach to achieving quality work. As part of a Course in the post-16 curriculum, the candidates should be required to act and perform as adults and, accordingly, the tasks set should be challenging to the candidates at the level at which they are working. As the Course develops, the candidates will be required to operate machinery and equipment to a code of practice, with a degree of independence, and it is essential that ground rules for acceptable standards are set and applied throughout this unit.

GUIDANCE ON CONTENT AND CONTEXT FOR THE UNIT

Content:

- simple diagrams: electronic circuit diagrams, layouts and connection lists
- common components: sensors, signal-processing devices, and output devices
- construction techniques: solderless prototype board (non-permanent); soldering, on stripboard (permanent); printed circuit board (PCB)

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

- reading and interpreting simple electronic-circuit and layout diagrams and selecting components from a listing
- assembling simple electronic circuits while taking into account component pin connections and polarity
- applying pre-power-up checks and fault-finding techniques and taking appropriate remedial action
- constructing a fully functioning electronic system and confirming its operation to specifications
- adhering to safe working practices at all times

National Unit Specification: support notes (cont)

UNIT Practical Electronics (Intermediate 1)

The range of electronic components is extensive but could include:

- Sensors such as moisture, light, temperature
- Process devices such as resistors, capacitors, transistors, ICs
- Output devices such as loudspeakers, buzzers, relays, motors, LEDs, lamps
- Polarity-conscious devices electrolytic capacitors, diodes, transistors, ICs
- Multi-pin devices transistors, ICs, relays, variable resistors, thyristors

GUIDANCE ON LEARNING AND TEACHING APPROACHES FOR THIS UNIT

There is a progressive learning process in this unit, and this is best achieved in a concentrated manner, preferably in a laboratory. The recommended approach is that outcomes would be addressed entirely through the building of circuits. Candidates should start by practising on simple circuits containing only a few components, by a range of methods, before attempting more demanding circuits. Candidates should be directed to consider the circuit as being interfaced with metalwork structures or simple mechanisms to provide an operational system in the project.

Reading and interpreting circuit diagrams and selecting components

Candidates should be introduced to colour coding of resistors, and know how to recognise values of other components such as capacitors. Identification of components in the initial stages would be aided greatly by suitable, clearly marked storage systems, for example small drawer units.

Assembling simple electronic circuits, while taking into account component pin connections and polarity

Candidates with no experience of electronic circuit construction should initially be provided with layout diagrams having only a few components, and should build circuits from these, starting with a prototype board followed by soldering on stripboard and wire wrapping. In the early stages, candidates could be guided as to which technique would be appropriate for a particular circuit.

Applying pre-power-up checks and fault-finding techniques and taking appropriate remedial action

An important routine in building circuits is the pre-power-up checking, fault-finding and rectification procedures, before testing for operation to specifications.

Constructing a fully functioning electronic system and confirming its operation to specification

A full electronic 'system' should be constructed from a given circuit diagram or series of diagrams, using a permanent construction technique. More demanding work is envisaged at this time, and this aspect of the Course provides ample opportunity to integrate other areas of the Course.

Adhering to safe working practices at all times

Electronics and soldering 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 Practical Electronics (Intermediate 1)

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 an alarm system where all aspects of the artefact are electronic. An example of an integrative artefact dealing with areas from elsewhere in the Course might be an electronic system housed in a sheet-metal enclosure manufactured during the *Bench Skills – Metal (Int 1)* unit. Similarly, calibration dials or spindles and bearings could be turned on the lathe during the *Machine Processes – Metal (Int 1)* unit and used in the integrative artefact.

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

- as a rehearsal for the Course assignment project, during which the candidate is expected to work with a degree of independence
- 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).