

National Unit Specification: general information

UNIT Wiring and Assembly Techniques (Intermediate 1)

NUMBER D9EP 10

COURSE Applied Practical Electronics (Intermediate 1)

SUMMARY

The purpose of this unit is to introduce and develop skills in connecting and assembling electrical and electronic systems

OUTCOMES

- 1 Prepare and connect conductors (wire/cable/stripboard).
- 2 Form a cable loom.
- 3 Assemble and test an electronic system.

RECOMMENDED ENTRY

While entry is at the discretion of the centre, candidates would normally be expected to have attained some previous experience in the use of hand tools in a technical context.

CREDIT VALUE

0.5 credits at Intermediate 1. (3 SCOTCAT Points at SCQF level 4).

*SCOTCAT 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 SCOTCAT points at an SCQF level. There are 12 SCQF levels, ranging from Access 1 to Doctorates.

Administrative Information

Superclass: XJ

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National Unit Specification: general information (cont)

UNIT Wiring and Assembly Techniques (Intermediate 1)

CORE SKILLS

There is no automatic certification of core skills or core skills components in this unit.

Additional information about core skills is published in the *Catalogue of Core Skills in National Qualifications* (SQA, 2001).

National Unit Specification: statement of standards

UNIT Wiring and Assembly 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

Prepare and connect conductors (wire/cable/stripboard).

Performance criteria

- a) The preparation of a range of cable types is correct.
- b) The connections to a range of connectors are applied correctly.
- c) A stripboard circuit is assembled correctly.
- d) Work methods and activities are in accordance with recognised procedures and safe practices.

Evidence requirements

A practical exercise in preparing and terminating wires and a cable from assembly instructions and wire lists.

A practical exercise in assembling a stripboard circuit from assembly instructions, a circuit diagram and a layout diagram.

OUTCOME 2

Form a cable loom.

Performance criteria

- a) The formation of cables is correct in accordance with given interconnection schedules.
- b) The loom is constructed correctly to given requirements.
- c) The loom is completed using fixing methods correctly.
- d) The stripboard circuit is connected to the loom correctly.

Evidence requirements

A practical exercise in forming a cable loom from assembly instructions and a layout diagram.

OUTCOME 3

Assemble and test an electronic system.

Performance criteria

- a) The terminations of the system are neat and correct according to a given system layout.
- b) Tests with a power supply and a digital non-auto-ranging multimeter are used to check the given layout and connections.
- c) System faults are analysed and connected.
- d) Work methods and activities are in accordance with recognised procedures and safe practices.

National Unit Specification: statement of standards (cont)

UNIT Wiring and Assembly Techniques (Intermediate 1)

Evidence requirements

A practical exercise in testing a cable loom and correcting faults. A checklist should be completed indicating that the:

- testing has been conducted safely
- system assembly is accurate to the given layout
- system has been fully tested and any faults corrected
- test equipment has been used correctly

National Unit Specification: support notes

UNIT Wiring and Assembly Techniques (Intermediate 1)

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 20 hours.

The purpose of this unit is to introduce and develop skills in connecting and assembling electrical and electronic systems.

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.

The electronic system produced should appeal to the candidates and provide challenge and stimulation as they work with methods and procedures common throughout electronics probably for the first time.

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 use hand tools and equipment, with a degree of independence, and it is essential that ground rules for acceptable standards are set and applied throughout this unit.

GUIDANCE ON THE CONTENT AND CONTEXT FOR THIS UNIT

Content:

- cable assembly: parts lists, tool lists, assembly instructions, wire lists, test instructions
- wire types: solid conductor, stranded conductor
- construction techniques: wire stripping, crimping, soldering, stripboard track cutting, wire identification, tie wrapping, spiral wrapping
- component identification: wires, terminals, stripboard, resistors, Light Emitting Diodes (LEDs), transistors, 4 mm plugs
- testing: continuity, resistance, voltage, current
- using test equipment: digital non-auto-ranging multimeter, low voltage dc power supply

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

- adhering to safe working practices at all times
- reading and interpreting parts lists, tool lists, assembly instructions, wire lists, circuit diagrams, layout diagrams and test instructions
- wire stripping and soldering
- using hand tools such as wire strippers, soldering irons, solder suckers, pointed nosed pliers, electricians' pliers, crimping tools, craft knives and screwdrivers
- assembling simple electronic circuits while taking into account component pin connections
- testing and fault-finding and taking appropriate remedial action
- constructing a fully functioning electronic system and confirming its operation to a specification

National Unit Specification: support notes (cont)

UNIT Wiring and Assembly Techniques (Intermediate 1)

GUIDANCE ON LEARNING AND TEACHING APPROACHES FOR THIS UNIT

The Practical Activities

This is a practical unit. It is probable that the allocated time of 20 hours will be taken up by three main areas of activity:

1. staff demonstrations of techniques such as soldering, crimping and wire stripping (approximately 10% of available time)
2. candidate practice in unfamiliar techniques (10% of available time)
3. candidate activity making cables, harnesses and testing (80% of time available)

As can be seen from the outcomes there are three stages to the candidate activity:

- making cable assemblies
- forming the cable assemblies into a loom or harness
- testing the completed loom or harness.

Since the cable types are the same for Outcomes 1 and 2 it is entirely practical to use the cables made for Outcome 1 in the loom for Outcome 2. This loom can then be used as the basis for the system test of Outcome 3. This is the integrative approach taken in this unit. It has the advantage that candidates have one clear overall objective and a clear result for their efforts.

Before delivering the unit, the main issues to be addressed are:

- the provision of tools and materials
- the secure retention of the evidence, particularly whilst the unit is underway.

The individual cable assemblies may be made in any order. Where tooling is limited, it may be desirable for groups of candidates to be engaged on different activities at the same time, though note that not all the cables take the same amount of time to make.

Outcome 1

Cable: solid wire; stranded wire.

Stripboard circuit: resistors; diodes; transistor; pins.

Connectors: screw terminal: 4mm plug; terminal block.

Single connector crimp: ring terminal; blade terminal and receptacle.

Discrete wire solder connection: solder pad.

Methods: wire stripping; crimping; clamping; soldering.

Outcome 2

Cables: solid wire; stranded wire.

Methods: tie wrap; spiral wrap; continuous sleeving; cable markers.

Requirements: three breakouts; one bend; three cables.

Outcome 3

System: low voltage power supplies; the loom; the stripboard circuit.

Test: continuity; voltage; current; function.

National Unit Specification: support notes (cont)

UNIT Wiring and Assembly Techniques (Intermediate 1)

When checking the candidates' work, make sure that:

- all the conductor strands are present in the crimp - no strands have been cut in the stripping of the insulation
- the crimp has crimped on the insulation as well as the conductor
- the crimp pins are held in the housing by the retaining spring

Note that it is not essential that you use a specific connector system provided that crimp terminations are employed. You may already have an alternative crimping tool.

Cable 1 - LED driver cable

One problem with this cable is the crimping tool for the specified connector. Cheap hand tools are available. However, an easier and more reliable crimp is made with the more expensive ratchet tool since the crimps are made on the wire and on the insulation at the same time.

Cable 2 - Ring terminal cable

Note that when fitting cable markers to cables, the convention is that the more significant digit is always towards the end of the cable. To bring home this fact, a two digit marker is specified, whereas one would be quite sufficient for four wires.

When checking the candidates' work, make sure that:

- all the conductor strands are present in the crimp - no strands have been cut in the stripping of the insulation
- the crimp has crimped on the insulation as well as the conductor
- the correct markers are the right way round

Cable 3 - Solid conductors

This is the simplest set of cables to make up. At this stage, no soldering or special tooling is required, just wire strippers and a small screwdriver.

Continuous Sleeving- cable 2

It is not possible to push the wires through the continuous sleeving with the cable markers attached. Candidates will firstly need to insert the wires into the sleeving, then to buzz through the wires to identify which is which, then lastly to apply the cable markers.

Tie-wraps and Spiral wrap - cables 1, 2 and 3

There are no special considerations to be addressed in this activity.

Assemble and test the system

The system should be assembled using the skills developed within this unit. It should be tested using the skills developed in the Electronic Simulation and Testing (Intermediate 1) unit.

National Unit Specification: support notes (cont)

UNIT Wiring and Assembly Techniques (Intermediate 1)

It is intended that the completion of a working system is the end product of the unit. This provides a target for the candidates, helps with motivation and delivers a reward in the form of the completed task. If centre circumstances permit it may be helpful to release candidates from the activity once they have completed it satisfactorily. This has been found, with similar units, to yield the combined benefits of a reward for the candidates and more time for the lecturer/teacher to work with those remaining in the class.

Material, tool, test instrument and exercise management

Materials are best stored in shallow trays or drawers. These should be easy to access at the start of a lesson and easy to put away at the end. Secure storage should be considered as much of the material can be desirable to candidates for day-to-day electronic repair and construction work. Trays should be loaded with adequate material cut to size as appropriate for current class use bearing in mind the inevitable wastage. Bulk supplies such as reels of wire or bags of terminals should not be made available to candidates as this tends to result in high wastage and damage to the materials. Similarly items such as solder should be dispensed on demand.

Tools are attractive to most people and tend to be desirable items particularly for anyone who is interested in the skills delivered by this unit. Similarly test equipment such as multimeters are frequently seen as an attractive addition to a candidate's personal possessions. This inevitably results in there being a constant security problem with both tools and test equipment. Normal tool management disciplines, however, can be applied to this as follows:

- warn candidates of likely disciplinary action if tools or test equipment are removed from the workshop
- keep tools and test equipment in sets or on marked boards
- check all tools and test equipment at the conclusion of every class

The management of the exercises is very dependent on the type of candidate, the class size and the prevalent attendance cultures in the centre. In general group teaching can be used for unit induction, safety training and initial tool use demonstrations. One or two exercises may then be demonstrated and the candidates encouraged to proceed at their own pace. This should enable the teacher/lecturer to devote time to systematically moving around the workshop advising candidates and checking connection quality. Care should be taken to cultivate a "self help" culture amongst the candidates who should also be encouraged to await the teacher/lecturer's arrival to have their work reviewed. This is necessary to ensure that adequate attention is devoted to all of the candidates.

As ability and motivation will vary within candidate groups it is generally unhelpful to attempt to keep all candidates working on the same exercises at the same time. Inevitably some candidates will complete exercises before others. This should be encouraged and their completed and checked work labelled with their name and either stored in individual boxes or in the original material tray bearing in mind the need for security. If possible the more able candidates should be allowed to proceed to the loom construction and system testing stage as fast as they can without jeopardising practising their skills or the quality of their work. This will spread the load on scarce resources such as special tools and teacher/lecturer attention. Early finishers can be motivated by their success and released from the activity. Normally this will free teaching and equipment resources to be concentrated on the remaining candidates.

National Unit Specification: support notes (cont)

UNIT Wiring and Assembly Techniques (Intermediate 1)

There is a progressive learning process in this unit, and this is best achieved in a laboratory or workshop environment. The recommended approach is that outcomes are addressed entirely through the building of the electronic system consisting of a wire loom and stripboard circuit. If necessary candidates should start by practising with simple exercises containing only a few components, by a range of methods, before attempting more demanding circuits.

GUIDANCE ON APPROACHES TO ASSESSMENT FOR THIS UNIT

Whenever possible, the dynamic nature of this unit 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 the finished electronic system will be tested against the stated criteria for accuracy and quality.

Candidates must work alone so that the work produced is the result of the candidate's own efforts. It is expected, however, that discussions will take place between candidates regarding working methods which may extend in some situations to a skill being demonstrated.

Evidence for the unit assessment is provided by the completed electronic system including the loom and the stripboard circuit and a checklist of test results.

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 special alternative outcomes for units. For information on these, please refer to the SQA document *Guidance on Special Assessment Arrangements* (SQA, publication code AA0645).