



National Unit Specification: general information

UNIT Land-based Engineering: Welding 2 (SCQF level 6)

CODE F91P 12

SUMMARY

This Unit may form part of a National Qualification Group Award or may be offered as a free standing Unit to candidates who wish to enhance their skills in a welding environment. The Unit is also suitable for those who are studying the subject for the first time.

This largely practical Unit is designed to provide candidates with knowledge, understanding and skills to carry out the Metal Inert Gas (MIG) and Tungsten Inert Gas (TIG) welding processes.

During the delivery of this Unit candidates will use these skills to produce a range of welded joints. They will also be expected to work within the relevant industrial standards. Candidates will develop theoretical and practical skills in the safe working practices associated with MIG and TIG welding processes.

This Unit is suitable for candidates training to be land-based service engineers or technicians.

This Unit does not cover the repair of safety critical components.

OUTCOMES

- 1 Explain correctly the thermal joining processes of MIG and TIG.
- 2 Select, check and set up equipment prior to welding.
- 3 Produce a range of thermal fusion joints in MIG and TIG processes.
- 4 Identify faults in MIG and TIG welded joints.

Administrative Information

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RECOMMENDED ENTRY

Some knowledge and experience of working in a practical engineering environment where welding and cutting processes have been used would be an advantage. This would be evidenced by the possession of NC Unit: Land-based Engineering: Welding 1 or similar qualifications and experience.

CREDIT VALUE

1 credit at SCQF Level 6 (6 SCQF credit points at SCQF level 6*).

**SCQF credit points are used to allocate credit to qualifications in the Scottish Credit and Qualifications Framework (SCQF). Each qualification in the Framework is allocated a number of SCQF credit points at an SCQF level. There are 12 SCQF levels, ranging from Access 1 to Doctorates.*

CORE SKILLS

There are opportunities to develop the Core Skills of *Problem Solving, Working with Others, Numeracy* and *ICT* at SCQF level 5 in this Unit. There is no automatic certification of Core Skills or Core Skills components.

National Unit Specification: statement of standards

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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 SQA.

OUTCOME 1

Explain correctly the thermal joining processes of MIG and TIG.

Performance Criteria

- (a) Explain correctly the MIG processes.
- (b) Explain correctly the TIG processes.

OUTCOME 2

Select, check and set up equipment prior to welding.

Performance Criteria

- (a) Selection of the power source and ancillary equipment is correct.
- (b) Consumable selection is correct for the welding processes.
- (c) Check equipment is safe and serviceable prior to use.
- (d) Setting of process parameters and variables is correct in terms of the given joint.
- (e) Preparation and setting up of joints for welding is correct.

OUTCOME 3

Produce a range of thermal fusion joints in MIG and TIG processes.

Performance Criteria

- (a) Production of MIG welded joints in low carbon steel (LCS) are within the range of materials' thickness and dimensions are correct
- (b) Production of TIG welded joints in low carbon steel (LCS) are within the range of materials' thickness and dimensions are correct
- (c) Equipment is closed down and stored safely and correctly on completion of use.

OUTCOME 4

Identify faults in MIG and TIG welded joints.

Performance Criteria

- (a) Identification of faults is correct.
- (b) Explanation of the appropriate remedial measures for faults identified is correct.

National Unit Specification: statement of standards (cont)

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EVIDENCE REQUIREMENTS FOR THIS UNIT

Evidence is required to demonstrate that candidates have achieved all Outcomes and Performance Criteria.

The assessment of this Unit should be approached in an integrated way with documentation covering all Outcomes developed as an integrated whole. A single workbook covering Outcomes 1-3 for the candidate to record pre and post weld activities would be preferred, but at the centre's discretion.

Written and/or recorded oral, product and performance evidence supplemented with an assessor observation checklist(s) should be produced to demonstrate that a candidate has achieved all Outcomes and Performance Criteria.

Welds for each candidate must be retained for verification purposes.

Note: This Unit does not cover the repair of safety critical components.

Outcome 1

A minimum of six written restricted response questions relating to the theory of the processes for PC **(a)** and a minimum of six restricted response questions for PC **(b)**, is required. Twelve questions in total.

Outcomes 2

An observation checklist indicating that the candidate has achieved competence in the selection, checking and safe use of the process equipment.

Outcome 3

Welded Joints

MIG

- ◆ A Butt joint in LCS using the MIG process. The joint should be a minimum of 100mm long and have a maximum thickness of 10 mm.
- ◆ A Lap joint in LCS using the MIG process. The joint should be a minimum of 100mm long and have a maximum thickness of 10 mm.
- ◆ A 'T' fillet joint in LCS using the MIG process. The joint should be a minimum of 100mm long and have a maximum thickness of 10 mm.

Note:

At least one of the above MIG joints should be completed as a multi run weld.

At least one of the above MIG joints should be completed as a vertical joint.

National Unit Specification: statement of standards (cont)

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TIG

- ◆ A Butt joint in low carbon steel (LCS) using the TIG process. The joint should be a minimum of 100mm long and have a preferred thickness of 1.6mm or maximum thickness of 3mm.
- ◆ A Lap joint in low carbon steel (LCS) using the TIG process. The joint should be a minimum of 100mm long and have a preferred thickness of 1.6mm or maximum thickness of 3mm.
- ◆ A Fillet joint in low carbon steel (LCS) using the TIG process. The joint should be a minimum of 100mm long and have a preferred thickness of 1.6mm or maximum thickness of 3mm.

Outcome 4

Written/oral evidence for each of the joints is required for PC (a) and PC (b). The candidate is required to state the weld faults and how he/she would rectify the identified fault.

Note on the range of faults: incorrect profile; insufficient cleaning; lack of penetration; porosity; lack of fusion; spatter; undercut.

National Unit Specification: support notes

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This part of the Unit Specification is offered as guidance. The support notes are not mandatory.

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

GUIDANCE ON THE CONTENT AND CONTEXT FOR THIS UNIT

The Unit forms part of the National Qualification Group Award (NQGA) in Land-based Engineering but it may also be taken as a free-standing Unit.

On completion of this Unit the candidate will be aware of the statutory health and safety regulations applicable to MIG and TIG welding processes. The candidate will know the factors which affect and control the making of quality welds and will have developed the manual skills to make a selection of quality welds in low carbon steel and, at the centre's discretion, stainless steels and non-ferrous metals.

The candidate will have visually inspected her/his own welds using criteria laid down in the relevant International (ISO), European (BS EN) and British (BS) standards and thus have a good basic foundation to enhance skills in other metals and/or other welding positions.

Although Health and Safety is assessed as part of the Land-Based Engineering Health, Safety and the Environment Unit it should be emphasized in all its aspects, e.g. filter glass grades and the use of auto-darkening welding helmets, fumes and gases, the correct use of welding fume extraction equipment etc.

Candidates should be instructed and be able to identify materials and their suitability for thermal joining processes and be able to prepare materials and joints for thermal joining.

Joints

All joint configurations should be taught in both processes. Joints should be practised in various material thicknesses. In the TIG welding process various material thicknesses should be practised with 16 swg-1.6 mm being the preferred assessment thickness.

In the MIG process various material thicknesses should be practised with 6mm being the preferred assessment thickness up to 10mm maximum.

Centres may wish to demonstrate the processes on non-ferrous materials in both MIG and TIG in particular Aluminium and Stainless Steel materials. Note the assessment evidence **only** requires Low Carbon Steel weld assessments.

Consumables

Selection of gas types for process and material variations; cylinder sizes; gas regulators; working gas flows and pressures. Methods of assembling; cracking/purging and leak testing gas cylinders. Gas pressures and flow volumes for both MIG and TIG. TIG electrode types and uses and MIG wire control components.

National Unit Specification: support notes (cont)

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Health, Safety and the Environment

As Outcomes 2-4 require candidates to practically service and repair equipment either onsite or in workshop situations, it is strongly recommended that candidates are inducted into current legislation, regulation and safe working procedures and practices before starting practical work.

A safe system of work should be established in line with the Health, Safety and the Environment Unit guidelines while taking cognisance of the candidate's previous experience and abilities prior to the commencement of practical activities. The storage and handling of materials and methods of disposal of waste materials produced during the servicing of land-based equipment should comply with current legislation and good practice. Health, safety and environmental issues associated with this Unit **should be taught with the subject topics and not separately** in the Land-based Engineering Health, Safety and the Environment Unit.

National Unit Specification: support notes (cont)

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GUIDANCE ON LEARNING AND TEACHING APPROACHES FOR THIS UNIT

A Unit induction will be required to inform candidates of the requirements of the Unit and the assessment procedure and requirements. A safety induction will be necessary on the workshop practices and the safe use of MIG and TIG welding equipment, preparation equipment, finishing equipment and welding shop extraction and ventilation equipment in compliance with PUWER 1998. Candidates should be supplied with safety support materials to reinforce the inductions. It would be helpful if the candidate could be supplied with weld procedures for each of the joints and cuts. A pro-forma inspection report could also be supplied along with information on the defect types and acceptance limits for imperfections/defects and guidance on the defect types that may be encountered.

Candidates should be made aware of the methods for testing welds. Both destructive and non-destructive testing methods could be covered to show penetration faults and the heat affected zones in and around the processes welds. The effect on material property changes, post welding, could be stressed to candidates.

Since this is mainly a practical workshop based Unit, demonstrations will be required. At first this may be group demonstrations and as the Unit progresses the demonstrations will be more individual to support the needs of each of the candidates.

Sustainability

Candidates could be encouraged to work in an efficient manner throughout the Unit. Consideration should be given in instruction to the efficient use of materials and consumables, their economical use and avoidance of unnecessary waste.

The candidate could be encouraged to develop an understanding of the monetary cost comparison for each process when choosing a process.

The environmental effects of welding could be highlighted to the candidate.

OPPORTUNITIES FOR CORE SKILL DEVELOPMENT

Problem Solving

The Critical Thinking component of *Problem Solving* at SCQF level 5 may be developed in Outcomes 1-4 while candidates assess the safe condition of process equipment, set up equipment, produce a range of thermal joints and weld fault identification.

The Planning and Organisation component of *Problem Solving* at SCQF level 5 may be developed in Outcomes 1-4 while candidates are involved with practical thermal process tasks, task organisation and resource allocation.

The Reviewing and Evaluating components will be addressed during weld fault identification in Outcome 4.

National Unit Specification: support notes (cont)

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Working with Others

The *Working with Others* Core Skill at SCQF level 5 may be developed in Outcomes 2-4 while candidates work in teams/pairs in equipment checking and materials preparation. Eg gas cylinder logistics steel manhandling and cutting/sizing prior to MIG and TIG welding.

The Reviewing Co-operative Contribution element at SCQF level 5 may be developed in Outcomes 2, 3 and 4 while candidates engage in practical work as they have to interact with their lecturers, support staff and other candidates, for example; while sharing welding workshop areas, MIG and TIG welding equipment and consumables.

Numeracy

The Using Number Core Skill element at SCQF level 5 may be addressed in Outcome 3 with calculation when candidates measure MIG and TIG welded joint materials.

The Using Graphical Information Core Skill element at SCQF level 5 may be covered in Outcome 4 when candidates produce weld hardness graphs for MIG and TIG destructive testing methods.

ICT

The Accessing Information Core Skill element at SCQF level 5 may be developed in Outcome 1 through the accessing of MIG and TIG manufacturer welding equipment websites.

The Processing Information Core Skill element at SCQF level 5 may be developed in Outcome 1 through the presentation of assessments and reports.

GUIDANCE ON APPROACHES TO ASSESSMENT FOR THIS UNIT

Health and Safety and Environment Regulation Compliance.

Assessment of health, safety and environmental issues associated with this Unit should be cross matched and assessed in the Land-Based Engineering: Health, Safety and the Environment Unit.

Opportunities for the use of e-assessment

E-assessment may be appropriate for some assessments in this Unit. By e-assessment we mean assessment which is supported by information and communications technology (ICT), such as e-testing or the use of e-portfolios or e-checklists. Centres which wish to use e-assessment must ensure that the national standard is applied to all candidate evidence and that conditions of assessment as specified in the Evidence Requirements are met, regardless of the mode of gathering evidence. Further advice is available in *SQA Guidelines on Online Assessment for Further Education (AA1641, March 2003)*, *SQA Guidelines on e-assessment for Schools (BD2625, June 2005)*.

Evidence of safe working practice/s should be recorded on a safety checklist. The checklist could be used to record non-compliance with safe working practice and procedures. No entries would confirm the candidate has achieved this part of the required assessment.

National Unit Specification: support notes (cont)

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DISABLED CANDIDATES AND/OR THOSE WITH ADDITIONAL SUPPORT NEEDS

The additional support needs of individual candidates should be taken into account when planning learning experiences, selecting assessment instruments, or considering whether any reasonable adjustments may be required. Further advice can be found on our website www.sqa.org.uk/assessmentarrangements

History of changes:

Version	Description of change	Date
02	'and soldered joints' removed from Outcome 3 pc a)	18/11/2010