



education

Department:
Education
REPUBLIC OF SOUTH AFRICA

NATIONAL CERTIFICATES (VOCATIONAL)

SUBJECT GUIDELINES

WELDING

NQF Level 4

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WELDING – LEVEL 4

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INTRODUCTION

A. What is Welding about?

This subject extends the welding knowledge and skills gained from completion of the National Certificate (Vocational): Level 3 Welding programme. The programmes at level 2 and 3 have attempted to expose students to a progressively wide range of welding technologies available within the Manufacturing and Engineering Industry.

Additional welding processes are again introduced at this level. They include Tungsten Inert Gas (TIG) Welding and Gas and Shielded Metal Arc (SMAW) Welding of pipe.

Due to the prevalence of skills shortages affecting the specialised welding industry sectors, the welding of stainless steel and aluminium using the Gas Metal Arc Welding (GMAW) process is included in this programme.

B. Why is Welding important in the Engineering and Related Design learning programme?

On the completion of the Further Education Certificate (Vocational) Level 4 programme, it is hoped that students are adequately prepared to choose a career as an artisan welder.

Alternatively, students may elect to continue to study at NQF Level 5. Potential programmes include, but are not limited to:

- Metallurgy
- Quality Assurance in Welding (Welding Inspection), and
- Structural Steel Detailing

Welding is regarded as a scarce skill in South Africa.

C. The link between the Learning Outcomes for Welding and the Critical and Developmental Outcomes

- **Identify and solve problems and make decisions using critical and creative thinking**
 - During planning and preparation procedures
 - Recognising of hazards and defects and responding appropriately
 - During inspection of completed welding procedure.
- **Work effectively with others as members of a team, group, organisation or community**
 - Welders are usually part of a team. Working with others is an important part of a career in engineering.
- **Organise and manage themselves and their activities responsibly and effectively**
 - Preparation of the welding equipment and the work environment
 - Planning the welding work by reading and interpreting the work instructions or welding procedure specifications.
- **Work with information, that is, collect, analyse organise and critically evaluate information**
 - Interpretation of engineering drawings, work instructions and welding procedure specifications
- **Communicate effectively using visual, symbolic and language skills in different modes**
 - Communication in a high noise-level environment
 - Completion of welding reports and task documentation
 - Verbal reports at work / site meetings
- **Use science and technology effectively and critically showing responsibility towards the environment and the health of others**
 - The laws of physics apply to all engineering occupations
 - Exposure to health, safety and environmental hazards demand a sound knowledge of science and technology.

- **Demonstrate and explain the world as a set of related systems, by recognising that problem solving contexts do not exist in isolation**
 - Welding is a single part of the manufacturing and engineering industry. Its role is integrated with occupations like fabricators (boilermakers or sheet-metalworkers), fitters, machinists, electricians, etc.
 - The design of engineered products or machines, integrates with various technologies. The welding task also integrates with various parts of the design and manufacturing process.

In so doing, students should also be able to:

- Reflect and explore a variety of strategies to learn more effectively
- Participate as responsible citizens in this life of local, national and global communities
- Be culturally and aesthetically sensitive across a range of social contexts
- Explore education and training opportunities
- Develop entrepreneurial opportunities.

D. Factors that contribute to achieving Welding Learning Outcomes

Students choosing to enter a career in welding, require:

- Mechanical technology orientation
- Associated hand skills (dexterity and mental alertness)
- The ability to work in a team
- Communication skills

1 DURATION AND TUITION TIME

This is a one-year instructional programme comprising 200 teaching and learning hours. The subject may be offered on a part-time basis provided the student meets all the assessment requirements.

Students with special education needs (LSEN) must be catered for in a way that eliminates barriers to learning.

2 SUBJECT LEVEL FOCUS

On completion of this subject the student will be able to:

- Explain and discuss the principles of arc welding with specific reference to pipe welding.
- Demonstrate an understanding and an ability to weld carbon steel pipe (grooves) using the Shielded Metal Arc Welding process.
- Demonstrate an understanding and an ability to weld Stainless and Aluminium Plate, using the Gas Metal Arc Welding process.
- Demonstrate an understanding and an ability to perform Gas Tungsten Arc Welding processes on carbon steel in the Flat /Horizontal /Flat Rotational positions.

3 ASSESSMENT REQUIREMENTS

3.1 Internal assessment (50 percent)

3.1.1 Theoretical component

The theoretical component forms 40 percent of the internal assessment mark.

Internal assessment of the theoretical component in Welding Level 4 takes the form of observation, class questions, group work, informal group competitions with rewards, individual discussions with students, class, topic and semester tests and internal examinations. Lecturers can observe students when marking exercises from the previous day and asking class questions.

Assignments, case studies and tests can be completed at the end of a topic. Tests and internal examinations must form part of the internal assessment.

3.1.2 Practical component

The practical component forms 60 percent of the internal assessment mark.

Practical components include applications and exercises. All practical components must be indicated in a Portfolio of Evidence (PoE).

Internal assessment of the practical component in Welding Level 4 takes the form of assignments, practical exercises, case studies and practical examinations in a simulated business environment. Students may complete practical exercises daily. Assignments and case studies can be completed at the end of a topic. Practical examinations can form part of internal practical assessment.

- **Some examples of practical assessments include, but are not limited to:**
 - A. Presentations (lectures, demonstrations, group discussions and activities, practical work, observation, role-play, independent activity, synthesis and evaluation)
 - B. Exhibitions by students
 - C. Visits undertaken by students based on a structured assignment task
 - D. Research
 - E. Task performance in a “Structured Environment”

• **Definition of the term “Structured Environment”**

For the purposes of assessment, “Structured Environment” refers to a simulated workplace or workshop environment. Activities in the simulated workplace or environment must be documented in a logbook with a clear listing of the competencies to be assessed. The following information must be contained in the logbook:

- Nature of department or environment in which practical component was achieved
- Learning Outcomes
- Activities in the environment with which to achieve the Learning Outcomes
- Time spent on activities
- Signature of facilitator or supervisor and student

For the logbook to be regarded as valid evidence, it must be signed by an officially assigned supervisor.

• **Evidence in practical assessments**

All evidence pertaining to evaluation of practical work must be reflected in the student’s PoE. The assessment instruments used for the purpose of conducting these assessments must be part of the evidence contained in the PoE.

3.1.3 Processing of internal assessment mark for the year

A year mark out of 100 is calculated by adding the marks of the theoretical component and the practical component of the internal continuous assessment (ICASS).

3.1.4 Moderation of internal assessment mark

Internal assessment is subjected to internal and external moderation procedures as set out in the *National Examinations Policy for FET College Programmes*.

3.2 External assessment (50 percent)

A national examination is conducted annually in October or November by means of a paper(s) set and moderated externally. A practical component will also be assessed.

External assessment details and procedures are set out in the *Assessment Guidelines: Welding Level 4*.

4 WEIGHTED VALUES OF TOPICS

| TOPICS | WEIGHTED VALUE |
|--|----------------|
| 1 Principles of arc welding (pipe) | 10% |
| 2. Shielded metal arc welding (pipes) | 20% |
| 3. Gas metal arc welding (stainless steel) | 25% |
| 4. Gas metal arc welding (aluminium) | 25% |
| 5. Gas tungsten arc welding (down hand position) | 20% |
| TOTAL | 100 |

5 CALCULATION OF FINAL MARK

Internal assessment mark: Student’s mark/100 x 50 = a mark out of 50 (a)

Examination mark: Student’s mark/100 x 50 = a mark out of 50 (b)

Final mark: (a) + (b) = a mark out of 100

All marks are systematically processed and accurately recorded to be available as hard copy evidence for, amongst others, reporting, moderating and for verification purposes.

6 PASS REQUIREMENTS

A student must obtain fifty (50) percent in ICASS and fifty (50) percent in the examination.

7 SUBJECT AND LEARNING OUTCOMES

On completion of Welding Level 4, the student should have covered the following topics:

- Topic 1: Principles of arc welding (pipe)
- Topic 2: Shielded metal arc welding (pipes)
- Topic 3: Gas metal arc welding (stainless steel)
- Topic 4: Gas metal arc welding (aluminium)
- Topic 5: Gas tungsten arc welding

7.1 Topic 1: Principles of arc welding (pipe)

7.1.1 Subject Outcome 1: Identify and describe welded joints in pipes.

Learning Outcomes

The student should be able to:

- Identify joint preparations
- Identify and draw tube to plate welds and branch connections
- Describe the methods of joint preparation of pipes

7.1.2 Subject Outcome 2: Explain welding problems associated with alloyed steels.

Learning Outcomes

The student should be able to:

- Describe the processes when making steel
- Explain the influence of welding on steel.
- Discuss the differences between non-alloy, stainless steels and other alloy steels.
- Briefly explain the influence of alloying elements on the properties of steel.

7.1.3 Subject Outcome 3: Explain the consequences of weld failures

Learning Outcomes

The student should be able to:

- Explain examples of failures and their consequences
- Explain the role of the welder in avoiding failures

7.1.4 Subject Outcome 4: Explain the harmonized system of international standards

Learning Outcomes

The student should be able to:

- Explain the important international and national standards for welding

7.2 Topic 2: Shielded metal arc welding (pipe)

7.2.1 Subject Outcome 1: Explain the shielded metal arc welding (SMAW) process

Learning Outcomes

The student should be able to:

- Explain the terminologies associated with shielded metal arc welding procedures.
- Explain the actual chemical and mechanical processes that take place during welding.
- Explain the shielded metal arc welding (SMAW) process
- Identify the various welding parameters, in relation to the thickness of materials (steel) being welded.
- Demonstrate setting up procedures

7.2.2 Subject Outcome 2: Plan and prepare for the welding process

Learning Outcomes

The student should be able to:

- Explain the safety aspects of Shielded Metal Arc Welding (SMAW) in the fabrication workshop.
- Prepare the shielded metal arc welding (SMAW) equipment
- Prepare the pipe prior to the welding process
- Prepare the welding environment.

7.2.3 Subject Outcome 3: Weld materials

Learning Outcomes

The student should be able to:

- Adhere to all safety precautions according to workshop requirements and OHS Act
- Demonstrate the shielded metal arc welding (SMAW) process, using knowledge and skills attained.
- Inspect welded work-piece for defects and apply quality checks on process.

7.2.4 Subject Outcome 4: Care for and store welding equipment

Learning Outcomes

The student should be able to:

- Explain the care and storage procedures for tools and equipment in accordance with worksite practices and specifications.
- Dismantle and store the welding equipment in accordance with manufacturer's specifications and requirements.

7.3 Topic 3: Gas metal arc welding (stainless steel)

7.3.1 Subject Outcome 1: Describe the gas metal arc welding (GMAW) process

Learning Outcomes

The student should be able to:

- Explain the terminologies associated with gas metal arc welding procedures.
- Explain the actual chemical and mechanical processes that take place during welding.
- Explain the gas metal arc welding (GMAW) process for stainless steel
- Identify the various welding parameters, in relation to the thickness of materials (steel) being welded.
- Demonstrate setting up procedures

7.3.2 Subject Outcome 2: Plan and prepare for the welding process

Learning Outcomes

The student should be able to:

- Explain the safety aspects of gas metal arc welding (GMAW) in the fabrication workshop
- Prepare the gas metal arc welding (GMAW) equipment for welding stainless steel
- Prepare the stainless steel work-piece prior to the welding process
- Prepare the welding environment

7.3.3 Subject Outcome 3: Weld materials

Learning Outcomes

The student should be able to:

- Adhere to all safety precautions according to workshop requirements and OHS Act
- Demonstrate the gas metal arc welding (GMAW) process, using knowledge and skills attained by welding the stainless steel work-piece
- Inspect the welded work-piece for defects and apply quality checks on process.

7.3.4 Subject Outcome 4: Care for and store welding equipment

Learning Outcomes

The student should be able to:

- Explain the care and storage procedures for tools, equipment in accordance with work site practices and specifications.
- Dismantle and store the welding equipment in accordance with manufacturer's specifications and requirements.

7.4 Topic 4: Gas metal arc welding (aluminium)

7.4.1 Subject Outcome 1: Describe the gas metal arc welding (GMAW) process

Learning Outcomes

The student should be able to:

- Explain the terminologies associated with gas metal arc welding procedures.
- Briefly explain the actual chemical and mechanical processes that take place during welding.
- Explain the gas metal arc welding (GMAW) process for aluminium material types
- Identify the various welding parameters, in relation to the thickness of materials (steel) being welded.
- Demonstrate setting up procedures

7.4.2 Subject Outcome 2: Plan and prepare for the welding process

Learning Outcomes

The student should be able to:

- Explain the safety aspects of gas metal arc welding (GMAW) in the fabrication workshop
- Prepare the gas metal arc welding (GMAW) equipment for the welding process
- Prepare the aluminium work-piece prior to welding
- Prepare the welding environment

7.4.3 Subject Outcome 3: Weld materials

Learning Outcomes

The student should be able to:

- Adhere to all safety precautions according to workshop requirements and OHS Act
- Demonstrate the gas metal arc welding (GMAW) process, using knowledge and skills attained by welding the aluminium work-piece
- Inspect welded work-piece for defects and apply quality checks on process.

7.4.4 Subject Outcome 4: Care for and store welding equipment

Learning Outcomes

The student should be able to:

- Explain the care and storage procedures for tools and equipment in accordance with worksite practices and specifications.
- Dismantle and store the welding equipment in accordance with manufacturer's specifications and requirements.

7.5 Topic 5: Gas tungsten arc welding (down hand position)

7.5.1 Subject Outcome 1: Describe the gas tungsten arc welding (GTAW) process

Learning Outcomes

The student should be able to:

- Use and explain the terminologies associated with the gas tungsten arc welding process.
- Explain the actual chemical and mechanical processes that take place during welding.
- Explain the down-hand - gas tungsten arc welding (GTAW) method (down hand position)
- Identify the various welding parameters, in relation to the thickness of materials (steel) being welded.
- Demonstrate setting up procedures

7.5.2 Subject Outcome 2: Plan and prepare for the gas tungsten arc welding (GTAW) process

Learning Outcomes

The student should be able to:

- Explain and implement the safety aspects of gas tungsten arc welding (GTAW) in the fabrication workshop.
- Prepare the gas tungsten arc welding (GTAW) equipment for the welding process
- Prepare the work-piece/s for gas tungsten arc welding
- Prepare the welding environment.

7.5.3 Subject Outcome 3: Weld materials using the gas tungsten arc process

Learning Outcomes

The student should be able to:

- Adhere to all safety precautions according to workshop requirements and OHS Act
- Demonstrate the gas tungsten arc welding (GTAW) process, using knowledge and skills attained by welding the work-piece
- Inspect welded work-piece for defects and apply quality checks on process.

7.5.4 Subject Outcome 4: Care for and store welding equipment

Learning Outcomes

The student should be able to:

- Explain the care and storage procedures for tools and equipment in accordance with worksite practices and specifications.
- Dismantle and store the gas tungsten arc welding equipment in accordance with manufacturer's specifications and requirements.

8 RESOURCE NEEDS FOR THE TEACHING OF WELDING LEVEL 4

8.1 Physical resources

- A classroom environment with necessary teaching aids (includes but not limited to black/white-board; tables, chairs, OHP and/or data-projector, video/DVD machine and including audio-visual learning materials)
- A workshop dedicated to welder training, which is able to accommodate separated arc-welding and oxy-acetylene welding and cutting facilities.
- Hand and power tools,
- Marking-off and measuring tools,
- Metal cutting machine
- AC or DC welding machines for shielded metal arc welding, metal inert gas welding (MIG/GMAW), tungsten inert gas welding (TIG)
- Shielding gases (argo-CO5 /CO2 – MIG); (pure argon /helium – TIG)
- Oxygen and acetylene gas cylinders; Welding electrodes (2mm/ 12 gauge wire for 3mm plate); Cutting nozzles (0.8 mm nozzles); Extension cables (20 metre); Grinding discs (115mm and 230mm); Steel cutting discs (115mm and 230 mm)
- Adequate equipment for implementation of safety measures: Protective sight screens; personal protective equipment; suitably ventilated workspace

8.2 Human resources

- Welder training educator/instructors (trade tested educator and adequately prepared/trained in NCV / OBE vocational learning programmes and methodology).

8.3 Other resources

- Learning material for NCV: Welding Level 4
- Non-destructive test materials (dye-penetrant) for assessing weld-quality.
- Adequate ventilation or an extraction system is important health and safety factor.
- Fire extinguishers