education

Department:
Education
REPUBLIC OF SOUTH AFRICA

NATIONAL CERTIFICATE (VOCATIONAL)

SUBJECT GUIDELINES

ENGINEERING

FABRICATION - SHEET METAL WORK

NQF Level 3

September 2007

CONTENTS

INTRODUCTION

A. What is the subject about?

Engineering Fabrication and Sheet Metal Work deals with the various processes involved in making or producing steel components required in the manufacturing, engineering and technological environments. Students are trained to take factors such as safety, planning and preparation for fabricating, choice of tools and equipment and various other factors into account.

B. Why is Engineering Fabrication - Sheet Metal Work important in the Engineering and Related Design learning programme?

In this programme, students will be expected to make or produce steel components relating to the requirements of industry. Therefore, Engineering Fabrication and Sheet Metal Work will prepare students with the required confidence levels to fabricate components to a high degree of accuracy and efficiency. Students will be required to understand fully the principles of drawing that are critical to the fabrication processes.

In the South African context, sugar mills, oil refineries, mines, harbours and ports and agricultural industries all require steel components for various manufacturing, experimental, maintenance and storage purposes at all times. Consequently, students must be trained to fabricate and produce components.

C. The link between the learning Outcomes for Engineering Fabrication - Sheet Metal Work and the Critical and Developmental Outcomes

The Learning Outcomes addressed in Engineering Fabrication and Sheet Metal Work address many of the Critical and Developmental Outcomes as follows:

- Identify and solve problems showing responsible decisions have been taken.
- Working effectively with others in a group or team.
- Organising oneself in a responsible and effective manner.
- Collect, analyse and evaluate information.
- Realise the world is a set of interrelated systems by showing solutions of problems do not exist in isolation.

D. Factors that contribute to achieving Engineering Fabrication - Sheet Metal Work Learning Outcomes

Students who show an interest in the interpretation of engineering drawings, and appreciate analytical and critical evaluation of processes and systems do well in this subject. Also, students who have a developed sense of creativity will enjoy this subject. Problem-solving skills are an advantage when achieving the Learning Outcomes. Students who have managerial and leadership qualities will also be likely to succeed.

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

The student should be able to:

- Produce components using fabrication processes.
- Join components using a variety of welding techniques to produce steel tanks and transition pieces to specifications.
- Select and apply fabrication procedures to evaluate the end products and ensure conformance to specifications.

3 ASSESSMENT REQUIREMENTS

The purpose of assessment is to determine the student's progress in learning and to make a judgement about the student's work. The judgement should be based on sufficient evidence in respect of the Learning Outcomes being considered. Evidence can be collected at different times and places and with the use of various methods, instruments, modes and media. Assessment of learning for promotion or certification in the National Certificate (Vocational) comprises two components. A comprehensive Portfolio of Evidence (PoE) of achievements gathered during the year and an external assessment in the form of a theoretical examination are used to assess students.

Assessment should take place within a framework of good assessment principles that are underpinned by the objectives of the National Qualifications Framework (NQF). These objectives are to:

- Create an integrated national framework for learning achievements.
- Facilitate access to and mobility and progression within education, training and career paths.
- Enhance the quality of education and training.
- Contribute to the full personal development of each student and the social and economic development of South Africa.

3.1 Internal assessment (50 percent)

All assessment must be moderated according to the internal moderation policy of the Further Education and Training (FET) college. Assessment is a continuous process from planning the assessment methods and instruments to providing continuous support to the assessors.

Before a lecturer assesses students, it is crucial that the purpose of the assessment is clearly and unambiguously established. The purpose of the assessment must be understood to ensure that an appropriate match exists between the purpose and method of assessment, in order that decisions and conclusions based on the assessment are fair and appropriate for the particular purpose.

3.1.1 Theoretical component

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

Internal assessment of the theoretical component in Engineering Fabrication and Sheet Metal Work NCV Level 3 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 PoE.

Internal assessment of the practical component in Engineering Fabrication and Sheet Metal Work Level 3 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:**
  - Presentations (lectures, demonstrations, group discussions and activities, practical work, observation, role-play, independent activity, synthesis and evaluation)
  - Exhibitions by students
  - Visits undertaken by students based on a structured assignment task
  - Research
  - 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 tools and instruments constructed and used to conduct these assessments must be clear from 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: Engineering Fabrication and Sheet Metal Work* (Level 3).

4 WEIGHTED VALUES OF TOPICS

TOPICS	WEIGHTED VALUE
1. Fabricate sheet metal components	60%
2. Join metals with the oxy-acetylene welding process	20%
3. Install and erect sheet metal components for air-conditioning, dust extraction and ventilation systems	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, moderation and verification purposes.

6 PASS REQUIREMENTS

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

7 SUBJECT AND LEARNING OUTCOMES

On completion of Engineering Fabrication and Sheet Metal Work Level 3, the student should have covered the following topics:

Topic 1: Fabricate sheet metal components
Topic 2: Join metals with the oxy-acetylene welding process
Topic 3: Install and erect sheet metal work components for air-conditioning, dust extraction and ventilation systems

7.1 Topic 1: Fabricate sheet metal components

7.1.1 Subject Outcome 1: Explain and demonstrate various aspects of sheet metal fabrication.

Learning Outcomes

The student should be able to:

- Explain various terminologies specific to sheet metal work.
- Identify and describe the physical properties of metals and alloys used in sheet metal work.
- Operate hand and power tools and equipment specific to the trade.
- Make various self secured joints used in sheet metal work.
- Perform swaging, joggling, crimping and edge stiffening operations used in sheet metal work.

7.1.2 Subject Outcome 2: Laying out and marking out complex patterns for fabrication.

Learning Outcomes

The student should be able to:

- Develop patterns for regular and irregular shapes that lie between parallel and inclined planes using different methods of development.
- Apply isometric and orthographic projections.
- Select and use measuring and marking out equipment as per job requirement.
- Perform basic pattern calculations.
- Determine allowances for cutting, bending and self secured joints.
- Apply the fundamental principles of laying out i.e. establish datum lines and set out points.
- Produce cutting and material lists for mass production.

7.1.3 Subject Outcome 3: Shape and assemble parts.

Learning Outcomes

The student should be able to:

- Interpret and follow job instructions and specifications.
- Apply different shaping techniques used in sheet metal work.
- Select and use tools and equipment for shaping and assembly of parts.
- Shape and assemble parts as per drawing and specifications.
- Adhere to safe working practices during the shaping and assembly process.

7.2 Topic 2: Join metals with the oxy-acetylene welding process

7.2.1 Subject Outcome 1: Prepare for the work activity.

Learning Outcomes:

The student should be able to:

- Explain general safety precautions and fire prevention measures applicable to the oxy-acetylene welding process.
- Identify and describe the functions of the main components for oxy-acetylene welding.
- Assemble oxy-acetylene equipment according to manufacturer's specifications.
- Carry our pre-operational checks and tests on oxy-acetylene equipment.
- Demonstrate start-up and shut down procedures.

7.2.2 Subject Outcome 2: Weld work pieces.

Learning Outcomes:

The student should be able to:

- Prepare the work area (provide for ventilation, fume extraction and fire hazards).
- Explain and interpret welding symbols.
- Identify different types of joints.
- Adjust the welding flame to suit the type and thickness of metal that is to be welded.
- Set the gas pressures to suit the type and thickness of metal that is to be welded.
- Select the correct welding nozzle to weld the work pieces.
- Weld metal in a down hand position using knowledge and skills acquired.
- Identify the correct personal protective clothing that is to be worn.

7.2.3 Subject Outcome 3: Apply quality checks on welded work pieces.

Learning Outcomes:

The student should be able to:

- Clean welded joints in accordance with job instructions and specifications.
- Explain the nature and causes of oxy-acetylene welding defects.
- Determine whether welded joints comply with welding specified procedures (WSP) and drawing specifications.

7.2.4 Subject Outcome 4: Care and store oxy-acetylene welding equipment and consumables.

Learning Outcomes:

The student should be able to:

- Explain caring and storing procedure for tools and equipment according to worksite procedure.
- Dismantle oxy-acetylene equipment as per worksite procedure.
- Store tools and equipment according to worksite practices.
- Store gas cylinders safely in accordance with safety regulations.

7.3 Topic 3: Install and erect sheet metal work component for air-conditioning, dust extraction and ventilation systems

7.3.1 Subject Outcome 1: Interpret plant layout and component drawings.

Learning Outcomes:

The student should be able to:

- Examine plant layout and component drawings to gain an overview of the job.
- Apply understanding of the drawing to create a mental visual picture.
- Interpret symbols, data and specification in regard to gradients, levels and heights.

7.3.2 Subject Outcome 2: Plan and prepare to install system.

Learning Outcomes:

The student should be able to:

- Explain the importance of planning and preparing.
- Separate components to differentiate between inlet ducts, discharge ducts, cyclones and hopper boxes.
- Examine components to see if it is marked/ stamped according to the drawing.
- Identify and select tools, equipment personal protective equipment for the installation.
- Explain the importance of sequencing the job correctly.

7.3.3 Subject Outcome 3: Install system.

Learning Outcomes:

The student should be able to:

- Work safely at all times, complying with health and safety regulations.
- Explain and demonstrate basic rigging hand signals.
- Communicate with crane drivers using hand signals.
- Select the correct lifting equipment as per job requirement.
- Refer to drawings to sequentially place the correct components in the respective positions.
- Choose fasteners and brackets as per job/drawing specifications.
- Inspect the process at regular intervals to ensure that the correct components and procedures are used.
- Check that the system is installed to the required specification.
- Leave the worksite neat and devoid of safety hazards.
- Complete all relevant documentation.

1 RESOURCE NEEDS FOR THE TEACHING OF ENGINEERING FABRICATION - SHEET METAL WORK - LEVEL 3

8.1 Physical resources

- Light steel fabrication workshops
- Guillotine and bending break
- Partitioned room adjacent to workshops to serve as templating or drawing loft/office
- Computer-equipped drawing rooms
- Computer with internet networks
- Hand and power tools
- Marking and measuring tools
- Cutting equipment
- AC or DC welding machines
- Gantries with heavy duty slings and chain and block tackles

8.2 Human resources

- Certificated educators with at least a National Professional Diploma in Education
- Preferably a trade tested educator with competencies in this field
- Assessor and Moderator competencies
- Workshops, courses and other upskilling activities

8.3 Other resources

- 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)
- Principles of developments (handbook for boilermakers)