



education

Department:
Education
REPUBLIC OF SOUTH AFRICA

NATIONAL CERTIFICATES (VOCATIONAL)

ASSESSMENT GUIDELINES

ENGINEERING FABRICATION - BOILERMAKING

NQF Level 3

September 2007

ENGINEERING FABRICATION - BOILERMAKING – LEVEL 3

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SECTION A: PURPOSE OF THE SUBJECT ASSESSMENT GUIDELINES

This document provides the lecturer with guidelines to develop and implement a coherent, integrated assessment system for Engineering Fabrication / Boilermaking in the National Certificates (Vocational). It must be read with the *National Policy Regarding Further Education and Training Programmes: Approval of the Documents, Policy for the National Certificates (Vocational) Qualifications at Levels 2 to 4 on the National Qualifications Framework (NQF)*. This assessment guideline will be used for National Qualifications Framework Levels 2-4.

This document explains the requirements for the internal and external subject assessment. The lecturer must use this document with the *Subject Guidelines: Engineering Fabrication / Boilermaking* to prepare for and deliver Engineering Fabrication / Boilermaking. Lecturers should use a variety of resources and apply a range of assessment skills in the setting, marking and recording of assessment tasks.

SECTION B: ASSESSMENT IN THE NATIONAL CERTIFICATES (VOCATIONAL)

1 ASSESSMENT IN THE NATIONAL CERTIFICATES (VOCATIONAL)

Assessment in the National Certificates (Vocational) is 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 progression within education, training and career paths.
- Enhance the quality of education and training.
- Redress unfair discrimination and past imbalances and thereby accelerate employment opportunities.
- Contribute to the holistic development of the student by addressing:
 - social adjustment and responsibility;
 - moral accountability and ethical work orientation;
 - economic participation; and
 - nation-building.

The principles that drive these objectives are:

- **Integration**

To adopt a unified approach to education and training that will strengthen the human resources development capacity of the nation.

- **Relevance**

To be dynamic and responsive to national development needs.

- **Credibility**

To demonstrate national and international value and recognition of qualification and acquired competencies and skills.

- **Coherence**

To work within a consistent framework of principles and certification.

- **Flexibility**

To allow for creativity and resourcefulness when achieving Learning Outcomes, to cater for different learning styles and use a range of assessment methods, instruments and techniques.

- **Participation**

To enable stakeholders to participate in setting standards and co-ordinating the achievement of the qualification.

- **Access**

To address barriers to learning at each level to facilitate students' progress.

- **Progression**

To ensure that the qualification framework permits individuals to move through the levels of the national qualification via different, appropriate combinations of the components of the delivery system.

- **Portability**

To enable students to transfer credits of qualifications from one learning institution and/or employer to another institution or employer.

- **Articulation**

To allow for vertical and horizontal mobility in the education system when accredited pre-requisites have been successfully completed.

- **Recognition of Prior Learning**

To grant credits for a unit of learning following an assessment or if a student possesses the capabilities specified in the outcomes statement.

- **Validity of assessments**

To ensure assessment covers a broad range of knowledge, skills, values and attitudes (SKVAs) needed to demonstrate applied competency. This is achieved through:

- clearly stating the outcome to be assessed;
- selecting the appropriate or suitable evidence;
- matching the evidence with a compatible or appropriate method of assessment; and
- selecting and constructing an instrument(s) of assessment.

- **Reliability**

To assure assessment practices are consistent so that the same result or judgment is arrived at if the assessment is replicated in the same context. This demands consistency in the interpretation of evidence; therefore, careful monitoring of assessment is vital.

- **Fairness and transparency**

To verify that no assessment process or method(s) hinders or unfairly advantages any student. The following could constitute unfairness in assessment:

- Inequality of opportunities, resources or teaching and learning approaches
- Bias based on ethnicity, race, gender, age, disability or social class
- Lack of clarity regarding Learning Outcome being assessed
- Comparison of students' work with other students, based on learning styles and language

- **Practicability and cost-effectiveness**

To integrate assessment practices within an outcomes-based education and training system and strive for cost and time-effective assessment.

2 ASSESSMENT FRAMEWORK FOR VOCATIONAL QUALIFICATIONS

The assessment structure for the National Certificates (Vocational) qualification is as follows:

2.1 Internal continuous assessment (ICASS)

Knowledge, skills values, and attitudes (SKVAs) are assessed throughout the year using assessment instruments such as projects, tests, assignments, investigations, role-play and case studies. The internal continuous assessment (ICASS) practical component is undertaken in a real workplace, a workshop or a "Structured Environment". This component is moderated internally and externally quality assured by Umalusi. All internal continuous assessment (ICASS) evidence is kept in a Portfolio of Evidence (PoE) and must be readily available for monitoring, moderation and verification purposes.

2.2 External summative assessment (ESASS)

The external summative assessment is either a single or a set of written papers set to the requirements of the Subject Learning Outcomes. The Department of Education administers the theoretical component according to relevant assessment policies.

A compulsory component of external summative assessment (ESASS) is the **integrated summative assessment task (ISAT)**. This assessment task draws on the students' cumulative learning throughout the year. The task requires **integrated application of competence** and is executed under strict assessment conditions. The task should take place in a simulated or "Structured Environment". The integrated summative assessment task (ISAT) is the most significant test of students' ability to apply their acquired knowledge.

The integrated assessment approach allows students to be assessed in more than one subject with the same integrated summative assessment task (ISAT).

External summative assessments will be conducted annually between October and December, with provision made for supplementary sittings.

3 MODERATION OF ASSESSMENT

3.1 Internal moderation

Assessment must be moderated according to the internal moderation policy of the Further Education and Training (FET) college. Internal college moderation is a continuous process. The moderator's involvement starts with the planning of assessment methods and instruments and follows with continuous collaboration with and support to the assessors. Internal moderation creates common understanding of Assessment Standards and maintains these across vocational programmes.

3.2 External moderation

External moderation is conducted by the Department of Education, Umalusi and, where relevant, an Education and Training Quality Assurance (ETQA) body according to South African Qualifications Authority (SAQA) and Umalusi standards and requirements.

The external moderator:

- monitors and evaluates the standard of all summative assessments;
- maintains standards by exercising appropriate influence and control over assessors;
- ensures proper procedures are followed;
- ensures summative integrated assessments are correctly administered;
- observes a minimum sample of ten (10) to twenty-five (25) percent of summative assessments;
- gives written feedback to the relevant quality assessor; and
- moderates in case of a dispute between an assessor and a student.

Policy on inclusive education requires that assessment procedures for students who experience barriers to learning be customised and supported to enable these students to achieve their maximum potential.

4 PERIOD OF VALIDITY OF INTERNAL CONTINUOUS ASSESSMENT (ICASS)

The period of validity of the internal continuous assessment mark is determined by the *National Policy on the Conduct, Administration and Management of the Assessment of the National Certificates (Vocational)*.

The internal continuous assessment (ICASS) must be re-submitted with each examination enrolment for which it constitutes a component.

5 ASSESSOR REQUIREMENTS

Assessors must be subject specialists and should ideally be declared competent against the standards set by the ETDP SETA. If the lecturer conducting the assessments has not been declared a competent assessor, an assessor who has been declared competent may be appointed to oversee the assessment process to ensure the quality and integrity of assessments.

6 TYPES OF ASSESSMENT

Assessment benefits the student and the lecturer. It informs students about their progress and helps lecturers make informed decisions at different stages of the learning process. Depending on the intended purpose, different types of assessment can be used.

6.1 Baseline assessment

At the beginning of a level or learning experience, baseline assessment establishes the knowledge, skills, values and attitudes (SKVAs) that students bring to the classroom. This knowledge assists lecturers to plan learning programmes and learning activities.

6.2 Diagnostic assessment

This assessment diagnoses the nature and causes of learning barriers experienced by specific students. It is followed by guidance, appropriate support and intervention strategies. This type of assessment is useful to make referrals for students requiring specialist help.

6.3 Formative assessment

This assessment monitors and supports teaching and learning. It determines student strengths and weaknesses and provides feedback on progress. It determines if a student is ready for summative assessment.

6.4 Summative assessment

This type of assessment gives an overall picture of student progress at a given time. It determines whether the student is sufficiently competent to progress to the next level.

7 PLANNING ASSESSMENT

An assessment plan should cover three main processes:

7.1 Collecting evidence

The assessment plan indicates which Subject Outcomes and Assessment Standards will be assessed, what assessment method or activity will be used and when this assessment will be conducted.

7.2 Recording

Recording refers to the assessment instruments or tools with which the assessment will be captured or recorded. Therefore, appropriate assessment instruments must be developed or adapted.

7.3 Reporting

All the evidence is put together in a report to deliver a decision for the subject.

8 METHODS OF ASSESSMENT

Methods of assessment refer to who carries out the assessment and includes lecturer assessment, self-assessment, peer assessment and group assessment.

| | |
|----------------------------|---|
| LECTURER ASSESSMENT | The lecturer assesses students' performance against given criteria in different contexts, such as individual work, group work, etc. |
| SELF-ASSESSMENT | Students assess their own performance against given criteria in different contexts, such as individual work, group work, etc. |
| PEER ASSESSMENT | Students assess another student's or group of students' performance against given criteria in different contexts, such as individual work, group work, etc. |
| GROUP ASSESSMENT | Students assess the individual performance of other students within a group or the overall performance of a group of students against given criteria. |

9 INSTRUMENTS AND TOOLS FOR COLLECTING EVIDENCE

All evidence collected for assessment purposes is kept or recorded in the student's PoE.

The following table summarises a variety of methods and instruments for collecting evidence. A method and instrument is chosen to give students ample opportunity to demonstrate the Subject Outcome has been attained. This will only be possible if the chosen methods and instruments are appropriate for the target group and the Specific Outcome being assessed.

| | METHODS FOR COLLECTING EVIDENCE | | |
|-------------------------------|--|--|--|
| | Observation-based (Less structured) | Task-based (Structured) | Test-based (More structured) |
| Assessment instruments | <ul style="list-style-type: none"> • Observation • Class questions • Lecturer, student, parent discussions | <ul style="list-style-type: none"> • Assignments or tasks • Projects • Investigations or research • Case studies • Practical exercises • Demonstrations • Role-play • Interviews | <ul style="list-style-type: none"> • Examinations • Class tests • Practical examinations • Oral tests • Open-book tests |
| Assessment tools | <ul style="list-style-type: none"> • Observation sheets • Lecturer's notes • Comments | <ul style="list-style-type: none"> • Checklists • Rating scales • Rubrics | <ul style="list-style-type: none"> • Marks (e.g. %) • Rating scales (1-7) |
| Evidence | <ul style="list-style-type: none"> • Focus on individual students • Subjective evidence based on lecturer observations and impressions | <p>Open middle: Students produce the same evidence but in different ways.</p> <p>Open end: Students use same process to achieve different results.</p> | Students answer the same questions in the same way, within the same time. |

10 TOOLS FOR ASSESSING STUDENT PERFORMANCE

Rating scales are marking systems where a symbol (such as 1 to 7) or a mark (such as 5/10 or 50%) is defined in detail. The detail is as important as the coded score. Traditional marking, assessment and evaluation mostly used rating scales without details such as what was right or wrong, weak or strong, etc.

Task lists and **checklists** show the student what needs to be done. These consist of short statements describing the expected performance in a particular task. The statements on the checklist can be ticked off when the student has adequately achieved the criterion. Checklists and task lists are useful in peer or group assessment activities.

Rubrics are a hierarchy (graded levels) of criteria with benchmarks that describe the minimum level of acceptable performance or achievement for each criterion. Using rubrics is a different way of assessing and cannot be compared to tests. Each criterion described in the rubric must be assessed separately. Mainly, two types of rubrics, namely holistic and analytical, are used.

11 SELECTING AND/OR DESIGNING RECORDING AND REPORTING SYSTEMS

The selection or design of recording and reporting systems depends on the purpose of recording and reporting student achievement. **Why** particular information is recorded and **how** it is recorded determine which instrument will be used.

Computer-based systems, for example spreadsheets, are cost and time effective. The recording system should be user-friendly and information should be easily accessed and retrieved.

12 COMPETENCE DESCRIPTIONS

All assessment should award marks to evaluate specific assessment tasks. However, marks should be awarded against rubrics and not be simply a total of ticks for right answers. Rubrics should explain the competence level descriptors for the skills, knowledge, values and attitudes (SKVAs) that a student must demonstrate to achieve each level of the rating scale.

When lecturers or assessors prepare an assessment task or question, they must ensure that the task or question addresses an aspect of a Subject Outcome. The relevant Assessment Standard must be used to create the rubric to assess the task or question. The descriptions must clearly indicate the minimum level of attainment for each category on the rating scale.

13 STRATEGIES FOR COLLECTING EVIDENCE

A number of different assessment instruments may be used to collect and record evidence. Examples of instruments that can be (adapted and) used in the classroom include:

13.1 Record sheets

The lecturer observes students working in a group. These observations are recorded in a summary table at the end of each project. The lecturer can design a record sheet to observe students' interactive and problem-solving skills, attitudes towards group work and involvement in a group activity.

13.2 Checklists

Checklists should have clear categories to ensure that the objectives are effectively met. The categories should describe how the activities are evaluated and against what criteria they are evaluated. Space for comments is essential.

SECTION C: ASSESSMENT IN ENGINEERING FABRICATION / BOILERMAKING

1 SCHEDULE OF ASSESSMENT

At NQF levels 2, 3 and 4, lecturers will conduct assessments as well as develop a schedule of formal assessments that will be undertaken in the year. All three levels also have an external examination that accounts for 50 percent of the total mark. The marks allocated to assessment tasks completed during the year, kept or recorded in a PoE account for the other 50 percent.

The PoE and the external assessment include practical and written components. The practical assessment in Engineering Fabrication / Boilermaking must, where necessary, be subjected to external moderation by Umalusi or an appropriate Education and Training Quality Assurance (ETQA) body, appointed by the Umalusi Council in terms of Section 28(2) of the *General and Further Education and Training Quality Assurance Act, 2001 (Act No. 58 of 2001)*.

2 RECORDING AND REPORTING

Engineering Fabrication - Boilermaking, as is the case for all the other Vocational subjects, is assessed according to five levels of competence. The level descriptions are explained in the following table.

Scale of Achievement for the Vocational component

| RATING CODE | RATING | MARKS % |
|-------------|-------------------|---------|
| 5 | Outstanding | 80-100 |
| 4 | Highly competent | 70-79 |
| 3 | Competent | 50-69 |
| 2 | Not yet competent | 40-49 |
| 1 | Not achieved | 0-39 |

The programme of assessment should be recorded in the Lecturer's Portfolio of Assessment for each subject. The following should at least be included in the Lecturer's Assessment Portfolio:

- A contents page
- The formal schedule of assessment
- The requirements for each assessment task
- The tools used for each assessment task
- Recording instrument(s) for each assessment task
- A mark sheet and report for each assessment task

The college must standardise these documents.

The student's PoE must at least include:

- A contents page
- The assessment tasks according to the assessment schedule

- The assessment tools or instruments for the task
- A record of the marks (and comments) achieved for each task

Where a task cannot be contained as evidence in the PoE, its exact location must be recorded and it must be readily available for moderation purposes.

The following units guide internal assessment in Engineering Fabrication / Boilermaking Level 3:

| NUMBER OF UNITS | ASSESSMENT | COVERAGE |
|------------------------|-----------------------|---|
| 2 | Formal written tests | One or more completed topics |
| 1 | Internal written exam | All completed topics |
| 3 | Practical assessments | Must cover the related Subject Outcomes |

**ASSESSMENT OF
ENGINEERING FABRICATION - BOILERMAKING
LEVEL 3**

3 INTERNAL ASSESSMENT OF SUBJECT OUTCOMES IN ENGINEERING FABRICATION - BOILERMAKING - LEVEL 3

Topic 1: Structural Steel Fabrication

| SUBJECT OUTCOME | |
|--|---|
| 1.1 Explain and demonstrate various aspects of structural steel fabrication. | |
| ASSESSMENT STANDARD | LEARNING OUTCOME |
| <ul style="list-style-type: none"> Welding symbols are correctly identified according to SABS welding charts. Structural steel sections are correctly identified and named in accordance with IPE hot rolled steel section booklets. All calculations relating to structural steel fabrication must be explained and accepted in accordance with mathematical principles. Marking out processes conform to workshop requirements. | <ul style="list-style-type: none"> Identify and explain various welding symbols. Explain various terminologies associated with the fabrication of structural steel. Demonstrate an ability to select the correct structural sections according to drawing specifications. Correctly and comprehensively describe the marking out procedures using templates. Explain and use the various calculations involved in the fabrication processes. |
| ASSESSMENT TASKS OR ACTIVITIES | |
| <ul style="list-style-type: none"> Students are given charts containing welding symbols and hot rolled structural steel section booklets. Each type of welding symbol on their drawing must be identified and the steel section they will require for the tasks ahead must be correctly selected and identified paying attention to the properties as contained in the booklet. Students to calculate lengths and angles of rafters, struts and ties applying correct mathematical principles. Students to make templates to mark out of flanges and webs of channel irons, angle iron and rolled steel joists / beams. | |

| SUBJECT OUTCOME | |
|---|--|
| 1.2 Laying out and marking off structural steel sections. | |
| ASSESSMENT STANDARD | LEARNING OUTCOME |
| <ul style="list-style-type: none"> Selection and use of marking out tools in accordance with worksite procedures. | <ul style="list-style-type: none"> Correctly select and use marking off tools for structural steel. |
| <ul style="list-style-type: none"> Datum points must be established by adhering to engineering drawing principles. | <ul style="list-style-type: none"> Demonstrate the establishing of datum points as well as setting out points (SOP) for fabrication of roof trusses, girders and gussets. |
| ASSESSMENT TASKS OR ACTIVITIES | |
| <ul style="list-style-type: none"> Students to lay out a roof truss Make templates for gusset plates Draw up a comprehensive cutting and material list to fabricate the roof truss | |

| SUBJECT OUTCOME | |
|--|---|
| 1.3 Fabricate structural steel. | |
| ASSESSMENT STANDARD | LEARNING OUTCOME |
| <ul style="list-style-type: none"> The purpose and advantages of jigs are correctly explained. | <ul style="list-style-type: none"> Explain the use of a jig where one is required. |
| <ul style="list-style-type: none"> Tacked pieces of steel conformed to worksite standards. | <ul style="list-style-type: none"> Demonstrate the ability to tack pieces of steel together to form sections of a structure. |
| <ul style="list-style-type: none"> Measuring tools correctly selected and used. | <ul style="list-style-type: none"> Correctly select and use measuring tools to fabricate sections. |
| <ul style="list-style-type: none"> The fabricated structure checked for accuracy and compliance to drawings. | <ul style="list-style-type: none"> Correctly select and use checking tools after fabrication. |
| <ul style="list-style-type: none"> Check dimensions correctly calculated. | <ul style="list-style-type: none"> Correctly perform necessary calculations to the product to ensure accuracy at all times. |
| <ul style="list-style-type: none"> Fabrication process completed as per job instruction and specifications. Documentation completed and readiness for welding clearly communicated. | <ul style="list-style-type: none"> Complete the fabrication process and indicate its readiness for welding. |
| ASSESSMENT TASKS OR ACTIVITIES | |
| <ul style="list-style-type: none"> Students will need to fabricate a column, rafter, cleated purlin and bracing these being the main members in structures. The column, rafter, purlin and brace will be made from a 152x89 I beam, 102x64I beam, 80x45 channel and 50x50x5mm angle iron respectively. Sketches must be provided so as to enable students to read, understand, select and mark off required items for fabrication. Fabrication must be done taking into all competencies acquired. | |

Topic 2: Perform basic welding or joining of metals

| SUBJECT OUTCOME | |
|---|---|
| 2.1 Prepare for work activity. | |
| ASSESSMENT STANDARD | LEARNING OUTCOME |
| <ul style="list-style-type: none"> Job instructions are read and sequence of operations is determined. Required heat-related welding or joining equipment and consumables are selected. | <ul style="list-style-type: none"> Select tools and equipment required for welding or joining of metals. |
| <ul style="list-style-type: none"> Pre-operational checks are carried out on equipment. | <ul style="list-style-type: none"> Check whether tools and equipment are in good working condition. |
| <ul style="list-style-type: none"> Unsafe or worn parts, defective equipment or potential hazards are reported. | <ul style="list-style-type: none"> Check whether the machine is in good working condition. |
| <ul style="list-style-type: none"> Materials for welding or joining are prepared. | <ul style="list-style-type: none"> Practice workshop safety. |
| ASSESSMENT TASKS OR ACTIVITIES | |
| <ul style="list-style-type: none"> The sequence of operation is determined. The appropriate welding equipment is selected. Welding material is prepared to suit the job. | |

| SUBJECT OUTCOME | |
|---|---|
| 2.2 Weld or join metals. | |
| ASSESSMENT STANDARD | LEARNING OUTCOME |
| <ul style="list-style-type: none"> • Work area is prepared for welding or joining process. • Work area is secured. • Appropriate weld or join process is used. | <ul style="list-style-type: none"> • Select the electrode size (welding rod). • Set the desired amperage. • Adjust the shielding gas flow. • Adjust the rate of electrode feed. • Control the torch movement and electrode extension. • Wear welder's clothing. • Ventilate welding area. • Clean metals before welding or joining. |
| ASSESSMENT TASKS OR ACTIVITIES | |
| <ul style="list-style-type: none"> • The working area is prepared for welding. • The appropriate welding process is used. | |

| SUBJECT OUTCOME | |
|---|---|
| 2.3 Apply quality checks on completed weld or joint. | |
| ASSESSMENT STANDARD | LEARNING OUTCOME |
| <ul style="list-style-type: none"> • Weld or join is cleaned. • Visual checks for quality finishes are conducted. | <ul style="list-style-type: none"> • Examine weld for defects. • Determine whether the weld conforms to the drawing specifications. • Identify values to be checked. • Check for warping and twisting of work piece. • Check dimensions against drawing. |
| ASSESSMENT TASKS OR ACTIVITIES | |
| <ul style="list-style-type: none"> • Welding material is tidy. • Finishes are checked. | |

| SUBJECT OUTCOME | |
|---|---|
| 2.4 Perform finishing activities. | |
| ASSESSMENT STANDARD | LEARNING OUTCOME |
| <ul style="list-style-type: none"> • Scrap material is disposed of. • Surplus materials are stored. • Equipment is cleaned and stored. | <ul style="list-style-type: none"> • Clean surplus weld and spatter. • Clean work piece surface and apply required surface coating. |
| ASSESSMENT TASKS OR ACTIVITIES | |
| <ul style="list-style-type: none"> • Scrap material is disposed of. • Equipment is cleaned and stored. • Surplus material is stored. | |

| SUBJECT OUTCOMES | |
|---|--|
| 2.5 Report incompliant or unsafe conditions while working. | |
| ASSESSMENT STANDARD | LEARNING OUTCOME |
| <ul style="list-style-type: none"> • Problems with materials and equipment are reported. | <ul style="list-style-type: none"> • Inspect the working conditions. • Identify any problems. |
| <ul style="list-style-type: none"> • Unsafe conditions recorded and reported. | <ul style="list-style-type: none"> • List the unsafe conditions. • Prepare a report on incompliant or unsafe conditions. |
| ASSESSMENT TASKS OR ACTIVITIES | |
| Students to write a detail report on their findings and to make recommendations | |

| SUBJECT OUTCOME | |
|--|---|
| 2.6 Work safely with care for self, fellow workers, machines, equipment, materials and environment. | |
| ASSESSMENT STANDARD | LEARNING OUTCOME |
| <ul style="list-style-type: none"> Unsafe conditions, acts and equipment are reported and corrective action is taken. | <ul style="list-style-type: none"> Apply worksite health and safety practices. Clean equipment, materials and machines after use. Wear safety clothes. |
| <ul style="list-style-type: none"> Work area is restored to a safe and serviceable condition after activity. | <ul style="list-style-type: none"> Clean work area after completion of the task. Apply good housekeeping. |
| ASSESSMENT TASKS OR ACTIVITIES | |
| Workshop safety is practiced. | |

Topic 3: Steel tank fabrication

| SUBJECT OUTCOME | |
|--|---|
| 3.1 Explain and demonstrate various aspects of steel tank fabrication. | |
| ASSESSMENT STANDARD | LEARNING OUTCOME |
| <ul style="list-style-type: none"> Calculations involving circumferential and thickness considerations must be checked against mathematical principles as well as principles of marking out. | <ul style="list-style-type: none"> Explain the necessary calculations and templates required for fabricating including circumferential and thickness of material considerations when performing calculations. |
| <ul style="list-style-type: none"> Tack welds and choice of electrodes must conform to workshop standards and SA Institute of Welding. | <ul style="list-style-type: none"> Demonstrate the ability to tack pieces of steel together to form sections of a tank using the correct type and gauge of electrodes. |
| <ul style="list-style-type: none"> Cutting and fabrication tools and equipment must conform to safety standards as per Occupational Health and Safety (OHS) Act. | <ul style="list-style-type: none"> Correctly select and use cutting equipment and tools including amongst others a straight line cutter and a profile cutter. Correctly select and use measuring tools to fabricate the tank. Correctly select and use checking tools after fabrication. Correctly perform necessary calculations to the product to ensure accuracy at all times. Complete the fabrication process and indicate its readiness for welding. |
| ASSESSMENT TASKS OR ACTIVITIES | |
| <ul style="list-style-type: none"> An electrode chart from the SAIW must be made available to students so as to identify and select the correct electrodes as well as identify welding symbols. A 3mm x 2000mmx1000mm plate must be marked, cut and rolled to the following specifications <ul style="list-style-type: none"> Inside dia-500mm. Height—1000mm. Students must do the following <ol style="list-style-type: none"> Do all the necessary calculation to fabricate the tank. List all the tools that would be required for measuring marking and checking. Describe the correct fabrication sequence. Identify and list all the fittings that must be fitted to the tank. | |

| SUBJECT OUTCOME | |
|--|--|
| 3.2 Laying out and marking off the shell. | |
| ASSESSMENT STANDARD | LEARNING OUTCOME |
| <ul style="list-style-type: none"> Lifting equipment must be correctly chosen and safely used in accordance with worksite practices. | <ul style="list-style-type: none"> Identify and use lifting equipment correctly in order to transport the steel for rolling. |
| <ul style="list-style-type: none"> Maintenance of a safe environment must be performed in accordance with laid down procedures. | <ul style="list-style-type: none"> Prepare the workplace for rolling out the shell by ensuring hazards are eliminated and a safe working distance is maintained all around the steel. |
| <ul style="list-style-type: none"> The calculated diameter, using the correct formulae must be marked out and checked by supervisor before rolling begins. | <ul style="list-style-type: none"> Perform the necessary calculations to mark out the shell using correct formulae. Correctly mark off the floor according to the diameter of the tank in order to fabricate the required strakes. |
| ASSESSMENT TASKS OR ACTIVITIES | |
| <ul style="list-style-type: none"> A 3mm x 2000mmx1000mm plate must be marked, cut and rolled to the following specifications: <ul style="list-style-type: none"> Inside dia-500.mm Height—1000mm Students must mark out the shell plate including the positions of all the fittings. | |

| SUBJECT OUTCOME | |
|---|---|
| 3.3 Using the plate rolls. | |
| ASSESSMENT STANDARD | LEARNING OUTCOME |
| <ul style="list-style-type: none"> The rolls are set in accordance with manufacturers specifications. | <ul style="list-style-type: none"> Set up the rolling machine according to job specifications. |
| <ul style="list-style-type: none"> Rolling templates must be made using techniques of templating as per workplace procedures | <ul style="list-style-type: none"> Make a rolling template by using the outside and inside diameters of the tank. |
| <ul style="list-style-type: none"> All safety aspects must be adhered to in terms of workplace procedures and the OHS Act. | <ul style="list-style-type: none"> Correctly feed the plate into the rolls by controlling the overhead crane accordingly. |
| <ul style="list-style-type: none"> Operation of all lifting equipment is in accordance with safety and manufacturers specifications. | <ul style="list-style-type: none"> Use clamping tools correctly to maintain the shape of the shell once rolling is complete. |
| <ul style="list-style-type: none"> A tolerance of 3mm over a diameter of 1000mm must be maintained. | <ul style="list-style-type: none"> Safely remove the shell and place on marked out floor for fabrication. |
| ASSESSMENT TASKS OR ACTIVITIES | |
| <ul style="list-style-type: none"> Students discuss the safe use of the plate rolls. Identify unsafe conditions and list them. Roll the shell plate to given specifications. | |

| SUBJECT OUTCOME | |
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| 3.4 Fabricating the tank. | |
| ASSESSMENT STANDARD | LEARNING OUTCOME |
| <ul style="list-style-type: none"> • Fittings selected as per drawing specifications. | <ul style="list-style-type: none"> • Correctly select the required fittings as per the drawing's specifications. |
| <ul style="list-style-type: none"> • Shell correctly tack welded. | <ul style="list-style-type: none"> • Tack weld the shell onto the marked out area. |
| <ul style="list-style-type: none"> • Shell correctly brazed to maintain diameter. | <ul style="list-style-type: none"> • Brace the shell with spider legs and measure the diameter to maintain the specifications. |
| <ul style="list-style-type: none"> • Completed tank comply with job specification and drawings. | <ul style="list-style-type: none"> • Complete all necessary developments required for the fittings such as pipes, conical hoods, transition pieces etc. • Complete the tank with all its fittings for welding. • Ensure that the drawings specifications together with the engineering designs are maintained at all times. |
| <ul style="list-style-type: none"> • Irregularities identified and corrected prior to welding. | <ul style="list-style-type: none"> • Identify and correct any irregularities before welding begins. |
| ASSESSMENT TASKS OR ACTIVITIES | |
| <ul style="list-style-type: none"> • Students to assemble parts of tank in accordance with drawing specifications and engineering design. • Write a report on learning experience with tank fabrication. • Students to research companies involve in tank fabrication. | |

Topic 4: Transition piece fabrication

| SUBJECT OUTCOME | |
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| 4.1 Understand, explain and demonstrate various aspects of transition pieces fabrication. | |
| ASSESSMENT STANDARD | LEARNING OUTCOME |
| <ul style="list-style-type: none"> • The differences between mild steel and stainless steel are explained • The correct grade of stainless steel required for the fabrication is identified and selected. • Calculations involving bend lines and true lengths as well as thickness considerations must be checked against mathematical principles as well as principles of marking out. • Tack welds and choice of electrodes must conform to workshop standards and SA Institute of Welding. • Cutting and fabrication tools and equipment must conform to safety standards as per OHS Act. | <ul style="list-style-type: none"> • Explain the differences between mild steel and stainless steel. • Identify and select the correct grade of stainless steel required for the fabrication. • Explain the necessary calculations and templates required for fabricating including true length calculations and thickness of material considerations when performing calculations. • Demonstrate the ability to tack pieces of steel together to form sections of the transition piece using the correct type and gauge of electrodes. • Correctly select and use cutting equipment and tools including amongst others a straight line cutter and a hand-held cutting torch and plasma cutting. • Correctly select and use measuring tools to fabricate the transition piece. • Correctly select and use checking tools after fabrication • Correctly perform necessary calculations to the product to ensure accuracy at all times. |

ASSESSMENT TASKS OR ACTIVITIES

- Students to calculate true lengths for a mild steel square to round transition piece
- Students to develop pattern for a stainless steel ellipse- to- round transition piece
- Students to make a list of all the tools that would be required to mark out and fabricate the transition pieces

NOTE:

- The square-to-round transition piece has the following dimensions:
 - Base is 1200mm square, true height is 1000mm and the top diameter is 900mm. True lengths are to be calculated on actual dimensions. Fabrication could be scaled down to 1:5. Plate thickness 3mm
- The ellipse to round transition piece has the following dimensions:
 - Major axis 900mm, minor axis 600 mm, true height 800mm and top diameter is 400mm. The pattern is to be developed on actual dimensions. Fabrication could be scaled down to 1:2,5. Plate thickness 3mm.

| SUBJECT OUTCOME | |
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| 4.2 Laying out and marking off the transition piece. | |
| ASSESSMENT STANDARD | LEARNING OUTCOME |
| <ul style="list-style-type: none"> Lifting equipment must be correctly chosen and safely used in accordance with worksite practices. Maintenance of a safe environment must be performed in accordance with laid down procedures. The calculated true lengths using the correct formulae must be marked out and checked by supervisor before bending operations begin. Marking out of the floor for assembly of the panels/plate must be done as in accordance with fabrication principles. | <ul style="list-style-type: none"> Perform the necessary calculations to mark out the shell using correct formulae including true length calculations and bend line calculations. Identify and correct use lifting equipment in order transport the steel for bending. Prepare the workplace for bending the shell by ensuring hazards are eliminated and a safe working distance is maintained all around the steel. |
| ASSESSMENT TASKS OR ACTIVITIES | |
| <ul style="list-style-type: none"> Students to mark-out pattern for the square to round transition piece using dimensions calculated Students to transfer pattern for oval to round transition piece onto grade 304 stainless steel plate Students to carry out pre-operational safety checks and list findings | |

| SUBJECT OUTCOME | |
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| 4.3 Using the bending brake. | |
| ASSESSMENT STANDARD | LEARNING OUTCOME |
| <ul style="list-style-type: none"> The machine is set in accordance with manufacturers specifications. | <ul style="list-style-type: none"> Set up the machine according to job specifications. |
| <ul style="list-style-type: none"> bending templates must be made using techniques of templating as per workplace procedures | <ul style="list-style-type: none"> Make a bending template by using the outside and inside angles/slopes of the transition piece. |
| <ul style="list-style-type: none"> All safety aspects must be adhered to in terms of workplace procedures and the OHS Act. | <ul style="list-style-type: none"> Correctly feed the plate into the bending machine by controlling the overhead crane accordingly. |
| <ul style="list-style-type: none"> Operation of all lifting equipment is in accordance with safety and manufacturers specifications. All dimensions to be within a tolerance of 2mm. All angles within 1.5 degrees over lengths of 350mm. | <ul style="list-style-type: none"> Use clamping tools correctly to maintain the shape of the shell once bending is complete. Safely remove the shell and place on marked out floor for fabrication. |
| ASSESSMENT TASKS OR ACTIVITIES | |
| <ul style="list-style-type: none"> Students to carry out pre-operational checks on bending brake and report any irregularities. Students to form the transition pieces on the bending brake. | |

| SUBJECT OUTCOME | |
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| 4.4 Fabricating the transition piece | |
| ASSESSMENT STANDARD | LEARNING OUTCOME |
| <ul style="list-style-type: none"> • Fittings selected as per drawing specifications. | <ul style="list-style-type: none"> • Correctly select the required fittings as per the drawing's specifications. |
| <ul style="list-style-type: none"> • Segments correctly tack welded. | <ul style="list-style-type: none"> • Tack weld the segments onto the marked out area. |
| <ul style="list-style-type: none"> • Segments correctly brazed to maintain shape. | <ul style="list-style-type: none"> • Brace the shell with spider legs and measure the diameters/angles/slopes to maintain the specifications. |
| <ul style="list-style-type: none"> • Completed transition piece comply with job specification and drawings. | <ul style="list-style-type: none"> • Complete all necessary developments required for the fittings such as pipes, conical hoods, flanges etc. • Complete the transition piece with all its fittings for welding. • Ensure that the drawing's specifications together with the engineering designs are maintained at all times. |
| <ul style="list-style-type: none"> • Irregularities identified and corrected prior to welding. | <ul style="list-style-type: none"> • Identify and correct any irregularities before welding begins. • Oversee the cleaning, pickling and passivating process. |
| ASSESSMENT TASKS OR ACTIVITIES | |
| <ul style="list-style-type: none"> • Students to assemble parts of the transition pieces in accordance with drawing specifications and engineering design. • Students to perform cleaning pickling and passivating process on the stainless steel transition piece. • Students to write a summary on learning experience with transition piece fabrication. | |

4. SPECIFICATIONS FOR EXTERNAL ASSESSMENT IN ENGINEERING FABRICATION - BOILERMAKING - LEVEL 3

4.1 Integrated summative assessment task (ISAT)

A compulsory component of the external assessment (ESASS) is the **integrated summative assessment task (ISAT)**. The integrated summative assessment task (ISAT) draws on the students' cumulative learning achieved throughout the year. The task requires **integrated application of competence** and is executed and recorded in compliance with assessment conditions.

Two approaches to the integrated summative assessment task (ISAT) may be as follows:

- The students are assigned a task at the beginning of the year which they will have to complete in phases throughout the year to obtain an assessment mark. A final assessment is made at the end of the year when the task is completed.

OR

- Students achieve the competencies throughout the year but the competencies are assessed cumulatively in a single assessment or examination session at the end of the year.

It is suggested that at this level students should be assessed throughout the year with regard to the practical aspects of this level. This will effectively develop the knowledge and skills of students and will build their confidence to approach the next level of practical activities at the same level.

It will also eliminate year end assessment congestion and will help in creating valid and authentic assessments because assessments would not be rushed.

The integrated summative assessment task (ISAT) is set by an externally appointed examiner and is conveyed to colleges in the first quarter of the year.

The integrated assessment approach enables students to be assessed in more than one subject with the same integrated summative assessment task (ISAT).

4.2 National Examination

A national examination is conducted annually in October or November by means of a paper(s) set and moderated externally. The following distribution of cognitive application is suggested.

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|----------------|------------------------------------|--------------------|---|
| LEVEL 3 | KNOWLEDGE AND COMPREHENSION | APPLICATION | ANALYSIS, SYNTHESIS AND EVALUATION |
| | 30% | 50% | 20% |