



education

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NATIONAL CERTIFICATES (VOCATIONAL)

ASSESSMENT GUIDELINES

ENGINEERING FABRICATION - BOILERMAKING

NQF Level 4

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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 and 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 and Boilermaking* to prepare for and deliver Engineering Fabrication and 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 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 be customised for students who experience barriers, to learning 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 be 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 and 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 and 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 at least should 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 include at least:

- 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 and Boilermaking Level 4:

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 EXAMPLES: <ul style="list-style-type: none">• A research project on subject-related current issues from different sources, e.g. the Internet, magazines and newspapers• Fabrication of tanks and transitional pieces in the boiler making industry.

**ASSESSMENT OF
ENGINEERING FABRICATION - BOILERMAKING
LEVEL 4**

3 INTERNAL ASSESSMENT OF SUBJECT OUTCOMES IN ENGINEERING FABRICATION - BOILERMAKING – LEVEL 4

Topic 1: Describe, explain and discuss pressure vessels

SUBJECT OUTCOME	
1.1 Explain and demonstrate the fabrication of pressure vessels.	
ASSESSMENT STANDARDS	LEARNING OUTCOMES
<ul style="list-style-type: none"> Welding symbols and terminologies are identified and explained Specifications identified, explained and applied as laid down in the design specifications according to the purpose of the pressure vessel. The grade of steel chosen conforms to drawing specifications. Explain and demonstrate welding specifications in accordance with engineering and pressure vessel specifications. 	<ul style="list-style-type: none"> Identify and explain various welding symbols as per Welding Institute. Explain and apply the calculations required for weld thicknesses as determined by the vessel specifications in order to facilitate the welding process. Explain various terminologies associated with the fabrication pressure vessels. Select the correct structural sections according to drawing specifications Correctly and comprehensively describe the marking out procedures using templates. Use the various calculations involved in the fabrication processes.
ASSESSMENT TASKS OR ACTIVITIES	
<ul style="list-style-type: none"> Assignment. Role play. Test/examinations. Demonstration. 	

SUBJECT OUTCOME	
1.2 Explain and demonstrate fabrication for dished-ends.	
ASSESSMENT STANDARDS	LEARNING OUTCOMES
<ul style="list-style-type: none"> Calculations performed conform to engineering practices. Chosen formulae are checked and are in accordance with engineering details and requirements. Cutting processes for the component are carried out in accordance with laid down procedures. Operation of machines to roll out the dished-end is in accordance with manufacturer's specifications. Accuracy of the final product is checked. 	<ul style="list-style-type: none"> Choose the correct formulae to produce the required cut-out for fabricating a dished-end. Demonstrate the establishing of datum points as well as setting out points (SOP) for fabrication of dished-ends. Select and use the correct marking off tools for fabricating a dished-end. Correctly operate the machine and equipments used to press a dished end. Assess the accuracy of the final product.
ASSESSMENT TASKS OR ACTIVITIES	
<ul style="list-style-type: none"> Assignment. Role play. Test/examinations. Demonstration. 	

SUBJECT OUTCOME 3	
1.3 Pressure testing of vessels.	
ASSESSMENT STANDARDS	LEARNING OUTCOMES
<ul style="list-style-type: none"> • Operation of testing equipment is in accordance with manufacturer's specifications. • Use of various testing equipment adheres to scientific principles of hydraulics. • All testing is done as per workplace safety requirements and OHS Act. 	<ul style="list-style-type: none"> • Interpret various actions and define correctly the terminologies associated with pressure testing. • Operate pressure testing equipment as per job specifications. • Prepare a report on the results of the test and hand to facilitator. • Explain the reasons for commonly using water as the medium for testing pressure.
ASSESSMENT TASKS OR ACTIVITIES	
<ul style="list-style-type: none"> • Assignment. • Role play. • Test/examinations. • Demonstration. 	

Topic 2: Erecting fabricated structural steel

SUBJECT OUTCOME	
2.1 Interpret erection drawings.	
ASSESSMENT STANDARDS	LEARNING OUTCOMES
<ul style="list-style-type: none"> • All interpretations conform to supervisor's check. • Planning and preparation is done in accordance with worksite procedures using previously gained competencies. 	<ul style="list-style-type: none"> • Examine erection drawings to gain an overview of the job. • Apply understanding of the drawing to create a mental picture. • Examine the drawings and interpret symbols, data and specifications in regard to gradients, levels and heights.
ASSESSMENT TASKS OR ACTIVITIES	
<ul style="list-style-type: none"> • Assignment. • Role play. • Test/examinations. • Demonstration. 	

SUBJECT OUTCOME	
2.2 Planning and preparing for erection.	
ASSESSMENT STANDARDS	LEARNING OUTCOMES
<ul style="list-style-type: none"> • The importance of planning and preparing for the erection of the steelwork is correctly explained. • The various sections of the steelwork are correctly separated. • Members of the steelwork are correctly examined for stamped marks in accordance with the drawings. • Steelwork is correctly set according to primary and secondary erection list. • The erection sequencing is correctly explained. 	<ul style="list-style-type: none"> • Explain the importance of planning and preparing the steelwork for erection. • Separate the various sections from each other to differentiate between columns, rafters, bracings and other members. • Examine each member to see if it is stamped or marked according to the drawing. • Set the steelwork according to primary and secondary erection lists. • Explain the reasons for erecting columns first followed by ties.
ASSESSMENT TASKS OR ACTIVITIES	
<ul style="list-style-type: none"> • Assignment. • Role play. • Test/examinations. • Demonstration. 	

SUBJECT OUTCOME	
2.3 Erecting the steelwork.	
ASSESSMENT STANDARDS	LEARNING OUTCOMES
<ul style="list-style-type: none"> • Rigging signals demonstrated according to laid down procedures. • Safety in conformance with the OHS Act strictly adhered to. • Instructions to the crane driver correctly communicated • Steelwork correctly placed in position. • Fasteners selected as per job/drawings specifications. • Process inspected to ensure correct materials and procedures are used. • Completed sections are marked off on the drawing according to work site procedures • Worksite is left neat and hazard free. 	<ul style="list-style-type: none"> • Apply all safety knowledge gained prior to erection. • Explain and demonstrate basic rigging hand signals. • Use basic rigging hand signals to direct the crane operators to lift the required steelwork and place in position. • Choose the correct lifting equipment in accordance with the job requirements. • Constantly make reference to the drawing to sequentially place the correct steelwork in the respective positions. • Correctly choose the fasteners required as per the job/drawings specifications. • Inspect the process to ensure that the correct steel and procedures are used • Mark off the completed sections on the drawing to obviate duplication and confusion • Leave the worksite neat and devoid of safety hazards
ASSESSMENT TASKS OR ACTIVITIES	
<ul style="list-style-type: none"> • Assignment. • Role play. • Test/examinations. • Demonstration. 	

Topic 3: Pipe work fabrication and assembly

SUBJECT OUTCOME	
3.1 Explain and demonstrate various aspects of pipe work fabrication.	
ASSESSMENT STANDARDS	LEARNING OUTCOMES
<ul style="list-style-type: none"> • All relevant drawings and flow sheet diagram are correctly interpreted. • Symbols and abbreviations used in pipe work fabrication are correctly identified and explained according to SABS code of practice. • Terminologies associated with pipe work fabrication and assembly are correctly explained. • Fittings, components and supports are selected according to job requirements. • Specifications are correctly and comprehensively interpreted and explained from flow sheet diagrams according to job requirements. 	<ul style="list-style-type: none"> • Read and interpret isometric, orthographic, general arrangement drawings and flow sheet diagrams. • Identify and explain various symbols and abbreviations used in pipe work. • Explain terminologies associated with pipe work fabrication and assembly. • Demonstrate the ability to describe the functions, and select correctly the fittings, components and supports used in pipe work systems. • Correctly and comprehensively interpret pipe work specifications from flow sheet diagrams.
ASSESSMENT TASKS OR ACTIVITIES	
<p>Theory</p> <ul style="list-style-type: none"> • Written tests on symbols, abbreviations and terminologies used in pipe work. • Write a summary on pipe work specifications from flow sheet diagrams. <p>Practical</p> <ul style="list-style-type: none"> • Produce pipe isometric drawings and flow sheet diagrams. • Produce component list from isometric drawings and flow sheet diagrams. • Identify and describe the functions of fittings and components used in pipe work fabrication. 	

SUBJECT OUTCOME	
3.2 Laying out and marking off pipe work sections.	
ASSESSMENT STANDARDS	LEARNING OUTCOMES
<ul style="list-style-type: none"> Marking off tools are correctly selected for the pipe layout. Correct use of drawing and measuring tools is clearly explained and demonstrated. Setting out points and datum line are established in accordance with sound engineering drawing principles. Layout is checked for squareness, overall dimensions and accuracy. Material and cutting list is produced with all the necessary instructions and information for pipe work fabrication. 	<ul style="list-style-type: none"> Correctly select marking off tools for pipe work layout. Explain and demonstrate the correct use of all relevant drawing equipment and measuring tools. Establish setting out points and datum line. Lay out pipe work sections by applying correct laying out techniques. Produce material and cutting list for fabrication.
ASSESSMENT TASKS OR ACTIVITIES	
<p>Theory</p> <ul style="list-style-type: none"> Questionnaire on pipe layouts. <p>Practical</p> <ul style="list-style-type: none"> Layout a pipe work assembly. Produce material and cutting list for the pipe work assembly. 	

SUBJECT OUTCOME	
3.3 Perform calculations for pipe work fabrication.	
ASSESSMENT STANDARDS	LEARNING OUTCOMES
<ul style="list-style-type: none"> Dimensions and angles for pipe work assembly are calculated using trigonometric concepts. Pipe lengths are correctly calculated making allowances for pipe elbows, fittings and welding gaps. Capacities and pressures are correctly calculated using correct formulae. Conversion factors are correctly used. 	<ul style="list-style-type: none"> Apply elementary trigonometric concepts in pipe work calculations. Calculate lengths of piping, making necessary allowances for fittings. Calculate tank capacities and pressures under different heads of water. Correctly use conversion factors.
ASSESSMENT TASKS OR ACTIVITIES	
<p>Theory</p> <ul style="list-style-type: none"> Written test on trigonometric calculations (formula sheets to be supplied). Do conversions making use of conversion tables and factors. <p>Practical:</p> <ul style="list-style-type: none"> Given different shapes and sizes of tanks, calculate capacities and pressures. Calculate lengths of pipe from pipe lay-out. Calculate lengths of pipe from flow sheet diagrams. 	

SUBJECT OUTCOME	
3.4 Set up, align and tack weld pipes and fittings for pipe work assembly.	
ASSESSMENT STANDARDS	LEARNING OUTCOMES
<ul style="list-style-type: none"> • All safety aspects adhered to in terms of workplace procedure and the OHS Act. • Personal protective clothing worn in conformance with safety regulations and the OHS Act. • Welding preparation on pipes and fittings complied with job specifications. • Tack welding and selection of electrodes conformed with job specifications. • Selection and use of measuring and checking tools conformed to worksite practices. • Completed pipe work assembly conformed to job specifications and worksite quality standards. • All relevant documentation completed and signed. 	<ul style="list-style-type: none"> • Select and use measuring tools for pipe work assembly. • Select and use checking tools at completion of pipe work assembly. • Set up, align and tack weld short and long lengths of pipe in position. • Complete the pipe work assembly and indicate readiness for welding. • Explain the importance of completing and signing off documentation.
ASSESSMENT TASKS OR ACTIVITIES	
<p>Theory</p> <ul style="list-style-type: none"> • Write a report on problems experienced during the fabrication process and make recommendations. <p>Practical</p> <ul style="list-style-type: none"> • Assemble pipe work as per flow sheet diagram and drawing specifications. 	

Topic 4: Computer Numerical Control (CNC) fabrication

SUBJECT OUTCOME	
4.1 Explain and demonstrate various aspects of CNC technology.	
ASSESSMENT STANDARDS	LEARNING OUTCOMES
<ul style="list-style-type: none"> • Different types of CNC machines and controls are used in industry are correctly identified and described. • Working principles of conventional machine operation are compared to that of CNC machine operation and understood. • Appropriate method for production is selected. • Operating cost is established prior to selecting particular method. 	<ul style="list-style-type: none"> • Identify and describe different types of CNC machines and controls used in industry. • Compare conventional machine operation methods with CNC machine operations. • Choose between conventional method or CNC method. • Explain the cost difference between the different operating systems.
ASSESSMENT TASKS OR ACTIVITIES	
<p>Theory</p> <ul style="list-style-type: none"> • Written test on the advantages and disadvantages of conventional versus CNC machine operation. • Assignment on the different types of CNC machines used in a sheet metal fabrication workshop. <p>Practical</p> <ul style="list-style-type: none"> • Students to conduct a survey on CNC production cost versus conventional production cost. 	

SUBJECT OUTCOME	
4.2 Prepare and write CNC programme.	
ASSESSMENT STANDARDS	LEARNING OUTCOMES
<ul style="list-style-type: none"> • Drawings are correctly interpreted and tool-path geometry correctly calculated. • Tool path co-ordinates are correctly calculated. • Programme elements and machine codes are clearly defined. • Appropriate tools for the CNC operation are correctly selected. • Programme is correctly written and simulated. 	<ul style="list-style-type: none"> • Interpret drawings and define tool-path geometry calculations. • Calculate tool path co-ordinates. • Define programme elements and machine codes. • Select appropriate tools for CNC operation. • Write and simulate the programme.

ASSESSMENT TASKS OR ACTIVITIES
<p>Theory</p> <ul style="list-style-type: none"> • Students to write a manual programme to produce components effectively and efficiently. • Calculate the time it would take to produce a single component. <p>Practical</p> <ul style="list-style-type: none"> • Students to simulate the programme and determine whether programme editing is required.

SUBJECT OUTCOME	
4.3 Prepare and set machine.	
ASSESSMENT STANDARDS	LEARNING OUTCOMES
<ul style="list-style-type: none"> • Free hand sketches are correctly produced. • Engineering drawings are correctly interpreted. • Tools are correctly set up. • Pre-operational checks are correctly carried out • Clamping pressures are correctly selected and adjusted. 	<ul style="list-style-type: none"> • Produce freehand sketches. • Interpret engineering drawings. • Set up tools. • Prepare, lubricate and perform pre-operational checks on the machine. • Check, select and adjust clamping pressures appropriate for the task.
ASSESSMENT TASKS OR ACTIVITIES	
<p>Practical demonstration</p> <ul style="list-style-type: none"> • Students to prepare and set the CNC machine in accordance with manufacturer's instruction manuals and job specifications and requirements. 	

SUBJECT OUTCOME	
4.4 Programme machine.	
ASSESSMENT STANDARDS	LEARNING OUTCOMES
<ul style="list-style-type: none"> • Basic geometry for CNC machining is correctly applied. • G-Codes and M-Codes and their functions are clearly and comprehensively understood. • Programme is correctly transferred from PC to CNC machine. • Machine control panel is thoroughly understood. • Programme is correctly edited. 	<ul style="list-style-type: none"> • Apply basic geometry for CNC machining (axis directions, co-ordinate systems, zero and reference points). • Explain and apply G-codes and M-codes and their functions. • Transfer programme from PC to the machine. • Read and understand the machine control panel. • Edit programme.
ASSESSMENT TASKS OR ACTIVITIES	
<p>Theory</p> <ul style="list-style-type: none"> • Written test on basic CNC geometry and the functions of G-Codes and M-Codes. <p>Practical demonstration</p> <ul style="list-style-type: none"> • Students to programme CNC machine in accordance with manufacturer's instruction manuals and job specifications and requirements. 	

SUBJECT OUTCOME	
4.5 Operate CNC machine.	
ASSESSMENT STANDARDS	LEARNING OUTCOMES
<ul style="list-style-type: none"> • Tools are correctly selected as per job requirements. • Worn/damaged tools are identified and replaced. • Components are measured for compliance to drawing specifications. • Lubricants and coolants are correctly identified and used for machine maintenance. • Machine is cleaned in accordance with worksite cleaning procedures. 	<ul style="list-style-type: none"> • Select the correct tools for a specific job. • Monitor, adjust and replace worn or damaged tooling. • Remove and measure components. • Identify lubricants and coolants needed to maintain machine. • Clean the machine.

ASSESSMENT TASKS OR ACTIVITIES

Theory

- Written test on tool-wear interventions.
- Oral test on component removal procedure.

Practical demonstration

- Students to operate the machine in accordance with manufacturer's instruction manuals and job specifications and requirements.
- Students to clean the machine in accordance with worksite cleaning procedures.

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

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 during 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 during the year but the competencies are assessed cumulatively in a single assessment or examination session at the end of the year.

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 I suggested:

LEVEL 4	KNOWLEDGE AND COMPREHENSION	APPLICATION	ANALYSIS, SYNTHESIS AND EVALUATION
	30%	50%	20%