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OCCUPATIONAL STANDARDS

Mechanical Technology

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NATIONAL OCCUPATIONAL STANDARD

Unit Standard Code: *GEN001 (Internal code)*	
Unit Standard Title: Apply workplace health, safety, environmental and emergency practices	
KNQF Level: 1	**Credits: 6**

Unit Standard Description

This unit standard has been developed to assist with the advancement of people who wish to gain paid employment or enter into self-employment in a variety of contexts. It specifies the competencies required to: Apply workplace health and safety practices; Perform basic fire-fighting techniques; Perform first aid practices; Adhere to site emergency plans; and Apply environmental integrity.

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Unit Standard Title	Apply occupational health, safety, environmental and emergency practices
Unit Scope	This unit standard requires the identification, selection and use of a range of personal protective equipment, classification of classes of fire, identification, selection and use of fire fighting equipment, fire-reporting procedures, determination of injuries and medical emergencies, contexts of injuries, incident reporting procedures, and interpretation of information on site emergency plans. Performance of all elements must comply with all relevant statutory, health, safety, environment, and worksite requirements.
Element 1	**Apply workplace health and safety practices**
Range	Personal Protective Equipment (PPE) may include but is not limited to safety boots; hard hat; safety gloves; safety glasses; high visibility vest; hearing protection; respiratory protection; and fall protection, where applicable.
Performance Criteria	
1.1 Factors affecting health and safety in the workplace are identified 1.2 General work site and employer safety rules are applied 1.3 Personal protective equipment (PPE) is identified, selected and used	
Element 2	**Perform basic fire-fighting techniques**
Range	Range of classes of fire includes, but is not limited to A, B, C, D and E. Range of equipment includes, but is not limited to fire extinguishers, fire hoses and hose reels. Report information includes location and time of fire, people involved, accident details, safety precautions that were/were not in place, machinery or substances involved, responses of emergency services.
Performance Criteria	
2.1 The type of fire encountered is classified 2.2 Fire-fighting equipment is identified and selected according to class of fire 2.3 The use of different fire-fighting equipment is demonstrated 2.4 Fire-fighting report is completed	

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Element 3	Perform first aid practices
Range	Injuries and medical emergencies include stopped heart and breathing (CPR), stopping bleeding, splinting and binding fractures, covering and calming, and dealing with epileptic fits, hyper ventilation, hypo/hyperthermia, chemical and fire burns, respiratory problems or suffocation, electrical and any other shock. Contexts of injuries include inaccessible places, places of extreme temperature, high risk areas. Report information includes location and time of injury/medical emergency, people involved, accident details, safety precautions that were/were not in place, machinery or substances involved, responses of emergency services.
Performance Criteria	
3.1 Nature and context of the injury and/or medical emergency are determined 3.2 First aid is applied 3.3 Injured and/or ill person is handed over to medical personnel 3.4 Incident and/or accident report is completed	
Element 4	**Adhere to site emergency plans**
Range	Information may include, but is not limited to evacuation routes; procedures; and contact protocol.
Performance Criteria	
4.1 Information on site emergency plans are interpreted 4.2 Instructions are followed and/or communicated 4.3 Risks are assessed and course of action determined 4.4 Emergency equipment and supplies are operated	
Element 5	**Apply environmental integrity**
Range	N/A
Performance Criteria	
5.1 General environmental impacts are described 5.2 Spill prevention, control and countermeasure (SPCC) techniques are applied 5.3 Work site techniques to minimise environmental damage are applied 5.4 Housekeeping procedures are applied in accordance with environmental control and worksite requirements	

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Underpinning Knowledge
The individual needs to demonstrate knowledge of: • Company policies and procedures, including site emergency plans • Manufacturers' specifications • Legislative requirements • Risks and consequences of HIV and AIDS, STDs and STIs to self and others • Personal Protective Clothing and Equipment • Causes and classes of fire • Range of fire fighting equipment • Basic first aid procedures and techniques • Gender parity issues, non-discrimination of women including raping • Environmental awareness, protection and enhancement
Generic Skills
The individual needs to demonstrate ability related to: • Communication • Team Work • Problem solving • Planning and Organising • Self-management • Technology

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NATIONAL OCCUPATIONAL STANDARD

Unit Standard Code: *GEN002 (Internal code)*	
Unit Standard Title: Apply workplace essential skills	
KNQF Level: 1	**Credits: 6**

Unit Standard Description

This unit standard has been developed to assist in the advancement of people who wish to gain paid employment or enter into self-employment in a variety of contexts. It specifies the competencies required to: Follow principles of work ethics; Resolve conflict with others; demonstrate effective speaking and listening skills; Read and interpret work document; Interact with team members; and Perform individual role in a team.

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Unit Standard Title	Apply workplace essential skills
Unit Scope/Range	This unit standard requires the demonstration of knowledge and application of common work ethic procedures, identification of different problems as part of conflict resolution at the work site, demonstration of the application of different languages and other means of communication, interpretation of different work documents, and identification of different team members. Performance of all elements must comply with all relevant statutory, health, safety, environment, and worksite requirements, contractual agreement and/or manufacturers' specifications.
Element 1	**Follow principles of work ethics**
Range	Work ethics may include, but are not limited to honesty; selflessness; consistency; moral; courage and respect.
Performance Criteria	
1.1 Integrity work ethics and expectations are identified 1.2 Open mind and flexibility is kept at the time 1.3 Conflicts are avoided whenever necessary 1.4 Company policies and procedures are operated as required 1.5 Self-assessment from time to time is carried out	
Element 2	**Resolve conflict with others**
Range	Problems may include, but are not limited to interpersonal problems; organisational problems; group problems; and inter organizational problems.
Performance Criteria	
2.1 Problem at the work site is identified and analysed 2.2 Company policies and procedures for solving the problem are applied 2.3 Problem and disagreement resolution are justified with applicable legislation 2.4 Conflict resolution techniques are formulated 2.5 Effectiveness of problem or conflict resolution is evaluated	

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Element 3	Demonstrate effective speaking and listening skills
Range	Language of communication may include, but is not limited to English, Kiswahili and sign language.
Performance Criteria	
3.1 Correct oral message to be communicated is identified 3.2 Clarity of the oral message to be communicated is determined 3.3 Appropriate means of oral communication is selected 3.4 Clear and accurate oral message is conveyed 3.5 Feedback on the message conveyed is obtained and interpreted 3.6 Corrective message communication measures are applied 3.7 Prepared documentation to keep record of communication is used	
Element 4	**Read and interpret work document**
Range	Work documents may include, but are not limited to work timesheets; attendance registers; job cards site maps; plans; inspection licenses; authority approvals documents, equipment inspection check sheets, and safe systems of work documents.
Performance Criteria	
4.1 Required work document are gathered and interpreted 4.2 Work document details are verified against actual work 4.3 Work document to correspond to actual work are reviewed	
Element 5	**Interact with team members**
Range	• Team members may include, but are not limited to core team members and support team members.
Performance Criteria	
5.1 Correct team members are identified according to task requirements 5.2 Capabilities of each team member are determined according to task requirements 5.3 Acceptable, non-offensive language and gestures are used 5.4 Relationships between members are maintained 5.5 Suitable corrective measures for deviating members are employed 5.6 Cross cultural diversities are accommodated	

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Element 6	**Perform individual role in a team**
Range	N/A
Performance Criteria	
6.1 Individual roles in a team are identified and described 6.2 Assigned roles to the individual are conveyed and monitored	
Underpinning Knowledge	
The individual needs to demonstrate knowledge of: • Concept of a team and team work • Multi cultural diversity • Team goals and motivation • Problem/conflict solving techniques	
Generic Skills	
The individual needs to demonstrate ability related to: • Communication • Team Work • Problem solving • Planning and Organising • Self-management • Technology	

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NATIONAL OCCUPATIONAL STANDARD

Unit Standard Code: *GEN003 (Internal code)*	
Unit Standard Title: Plan and organise work activities	
KNQF Level: 1	**Credits: 6**

Unit Standard Description

This unit standard has been developed to assist with the advancement of people who wish to gain paid employment or enter into self-employment in a variety of contexts. It specifies the competencies required to: Apply time management techniques; Apply quality improvement principles; and Apply productivity improvement measures.

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Unit Standard Title	Plan and organise work activities
Unit Scope	This unit standard requires the application and implementation of work-scheduling rules and productivity measures.
Element 1	**Apply time management techniques**
Range	Work-scheduling rules may include, but are not limited to daily and weekly working hours; break start and finish hours; and overtime.
Performance Criteria	
1.1 Prepared activity time plan is identified 1.2 Activity goals and action plan are set 1.3 Time allocated for each activity is monitored and reviewed 1.4 Activity management techniques are applied 1.5 Activity intervention strategies are applied when required	
Element 2	**Apply quality improvement principles**
Range	N/A
Performance Criteria	
2.1 Principles of quality control are identified 2.2 Suitable quality control principles are selected 2.3 Relevant quality management principles are applied 2.4 Appropriate control strategies are determined 2.5 Required quality improvement principles are applied 2.6 Effects of change of quality control strategies are assessed	

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Element 3	**Apply productivity improvement measures**
Range	Productivity measures may include, but are not limited to productivity data, cycles and targets.

Performance Criteria

3.1 Productivity cycle is identified and described

3.2 Challenges in production activities are determined

3.3 Possible solutions are formulated

3.4 Productivity measures are implemented

3.5 Productivity improvement measure is appraised

Underpinning Knowledge

The individual needs to demonstrate knowledge of:

- Quality requirements
- Time management concepts
- Team goals and motivation

Generic Skills

The individual needs to demonstrate ability related to:

- Communication
- Team Work
- Problem solving
- Planning and Organising
- Self-management
- Technology

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NATIONAL OCCUPATIONAL STANDARD

Unit Standard Code: *MEM001 (Internal code)*	
Unit Standard Title: Perform estimations, measurements and calculations	
KNQF Level: 2	**Credits: 2**

Unit Standard Description

This unit standard is intended for those who carry out mechanical engineering technology and maintenance operations. It specifies the competencies required to: Perform estimations of different dimensions of a range mechanical engineering components and materials; Apply different units and scales of measurement; Measure a range of mechanical engineering objects and materials; and Perform calculations.

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Unit Standard Title	Perform estimations, measurements and calculations
Unit Scope	The estimations, measurements and calculations include but are not limited to the length, quantity, weight, volume, perimeter, area, surface area, mass, weight, volume and pressure in relation to mechanical engineering objects and materials including solids, liquids and gases. Performance of all elements must comply with all relevant statutory, health, safety, environment, and worksite requirements, contractual agreement and/or manufacturers' specifications.
Element 1	**Perform estimations of different dimensions for a range of mechanical engineering components and materials**
Range	N/A
Performance Criteria	
1.1 The purpose and types of estimations are identified 1.2 Procedures for performing estimations are applied 1.3 Estimations are conducted according to standard conventions and procedures	
Element 2	**Apply different metric and imperial units and scales of measurement**
Range	Units and scales of measurement may include but are not limited to metric and imperial standard and derived units and scales of measurement for length, area, volume, weight, perimeter and quantity of a range of objects and materials used in mechanical engineering.
Performance Criteria	
2.1 Principles of measurement are applied in accordance with the units and scales of measurement 2.2 Common metric and imperial units of measurement of length, quantity, weight, volume, perimeter, area, surface area, mass, weight, volume, and pressure in relation to solids, liquids and gases are identified and manipulated in accordance with standard mathematical procedures 2.3 The conversion of metric to imperial units and vice versa is conducted 2.4 Procedures for the conversion and transfer of different scales of measurement are applied 2.5 Causes of measurement errors and errors on the conversion and transfer of scales of measurement are identified and the errors rectified according to standard procedures and the specifications for the different measuring tools 2.6 Tolerances are applied according to specifications on drawings	

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Element 3	**Measure a range of mechanical engineering objects and materials**
Range	• The element includes the measurement of length, quantity, weight, volume, perimeter, area, surface area, mass, weight, volume, and pressure in relation to solids, liquids and gases. • The measuring tools include micrometer, vernier calipers, feeler gauge, screw pitch protractors and dial indicators, straight hedges, height gauge, solid square, combination set, tape measures and optical equipment.
Performance Criteria	
3.1 The applications, limitations, principles of operation and measurement scales of different measuring tools are identified and applied according to manufacturers' specifications and job requirements 3.2 Measurement scales of different tools that are used for taking measurements are read according to manufacturers' specifications 3.3 Procedures for the use, handling, cleaning, maintenance and storage of different measuring tools are applied according to manufacturers' specifications and workplace procedures 3.4 Measurements are taken and recorded according to job specifications and workplace procedures 3.5 Measurement errors are identified and rectified according to workplace procedures	
Element 4	**Perform calculations**
Range	• Basic mechanical engineering problems are solved using a scientific calculator, whole numbers, common fractions, decimal fractions, ratios and proportions, percentages, algebra. • Calculations include but are not limited to length, area, volume, weight, perimeter, pressure, time.
Performance Criteria	
4.1 Basic mechanical engineering problems are solved through the calculation of the different dimensions in accordance with standard and manipulated formulae for length, area, volume, weight, pressure, perimeter, time and pressure 4.2 Calculations of area, perimeter, volume, weight of regular and irregular and shapes and calculations of pressure are carried out manually and using a calculator accordance with standard and manipulated formulae	

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Underpinning Knowledge
The individual needs to demonstrate knowledge of: • Estimating different dimensions of mechanical engineering components and materials • Principles of measurement • Units and scales of measurement of different measuring tools • Conversion of units of measurement (metric and imperial) • Reading measurement scales of different measuring tools • Causes and remedies of measurement errors and errors on conversion and transfer of scales of measurement • Use, handling, cleaning, maintenance and storage of different measuring tools • Basic calculations
Generic Skills
The individual needs to demonstrate ability related to: • Communication • Team Work • Problem solving • Planning and Organising • Self-management • Technology

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NATIONAL OCCUPATIONAL STANDARD

Unit Standard Code: *MEM002 (Internal code)*	
Unit Standard Title: Read and produce sketches and drawings	
KNQF Level: 2	**Credits: 2**

Unit Standard Description

This unit standard is intended for those who carry out mechanical engineering technology and maintenance operations. It specifies the competencies required to: Use and maintain drawing equipment and materials; Perform freehand sketching and geometrical constructions; Interpret drawings and sketches; Read and produce isometric sketches and drawings; Read and produce orthographic sketches and drawings; and Read and produce sketches and drawings of simple patterns.

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Unit Standard Title	Read and produce sketches and drawings
Unit Scope	The unit covers freehand sketching and geometrical constructions; reading and producing isometric and orthographic sketches and drawings; and reading sketches and drawings of simple patterns.
Element 1	**Use and maintain drawing equipment and materials according to manufacturers' specifications and workplace procedures**
Range	• Drawing tools, equipment and materials include but are not limited to pencils, ruler, rubber, curved rulers, ink bottle, ink pens, square, protractor, drawing table, drawing board. • Drawing paper sizes and their applications: A4, A3, A2, A1 and A0. • Different types of drawing sheets and their uses including but not limited to the following: ✓ Tracing paper ✓ Bristol board ✓ Normal sheets
Performance Criteria	
1.1 Different drawing equipment and materials are identified and selected in line with the requirements of the task and manufacturers' specifications 1.2 Drawing equipment and materials are handled, used, maintained and stored according to manufacturers' specifications and workplace procedures	
Element 2	**Perform freehand sketching and geometrical constructions according to standard conventions**
Range	• The different types of geometrical forms to be sketched and constructed include but are not limited to rectangles, squares, circles, arcs, triangles, polygons, cones, ellipses, triangles, different angles, dividing circles and diameter of semi-circle into equal parts, constructing a right angle using the 3-4-5 method, bisecting an angle. • The basic geometrical constructions include but are not limited to the construction of perpendicular lines from given points on a line and outside a line, dividing a line into equal parts, constructing a line at the end of a given line segment and a line parallel to a given line and at a given distance from the line, and bisecting a straight-line segment.

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Performance Criteria	
2.1 Characteristics of different types of geometric forms are identified from specifications 2.2 The characteristics and procedures for drawing different geometric forms are identified and applied according to standard drawing conventions 2.3 The freehand sketching and construction of different types of geometric forms is conducted according standard drawing conventions 2.4 Basic geometrical constructions are conducted according standard drawing conventions 2.5 The characteristics of different types of angles are identified according to the principles of trigonometry 2.6 Different types of angles are measured using appropriate measuring tools 2.7 Angles are bisected according to standard conventions	
Element 3	**Interpret drawings and sketches**
Range	• Types of drawings include isometric, orthographic, sectional, working, assembly, installation, and sketches. • Elements of a drawing include types of lines, dimensions (metric and imperial), views, notes and details, labelling, symbols, title blocks, material lists, and conventions. • Drawing information includes but is not limited to material requirements, fabrication requirements, machining requirements, tolerances and fitting requirements.
Performance Criteria	
3.1 Different types of drawings and their applications are identified according to standard drawing conventions for each type of drawing 3.2 Different elements of drawings are identified according to standard drawing conventions 3.3 Drawing information is interpreted according to standard drawing conventions for each type of drawing	
Element 4	**Read and produce isometric sketches and drawings**
Range	The reading and production of isometric sketches and drawings is conducted in line with the standard conventions of isometric drawings.

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Performance Criteria
4.1 The applications, principles, features, characteristics and components of isometric drawings are identified and applied in accordance with the standard conventions of isometric drawings 4.2 Different types of lines used in drawing and their meanings are identified according to standard drawing conventions 4.3 Different signs, symbols and abbreviations are identified and their meaning interpreted according to standard drawing conventions 4.4 Existing isometric sketches and drawings of mechanical engineering components are interpreted in accordance with the standard conventions of isometric drawings 4.5 Isometric sketches and drawings are produced in accordance with the standard conventions of isometric drawings conventions

Element 5	**Read and produce orthographic sketches and drawings**
Range	The reading and production of orthographic sketches and drawings is conducted in line with the standard conventions of first and third angle orthographic drawings.

Performance Criteria
5.1 The applications, principles, features, characteristics and components of first and third angle orthographic drawings are identified and applied in accordance with the standard conventions of first and third angle orthographic drawings 5.2 Different types of lines and their meanings are identified in accordance with standard drawing conventions 5.3 Different signs, symbols and abbreviations are identified and their meaning are interpreted according to standard drawing conventions 5.4 Existing basic first and third angle orthographic sketches and drawings of mechanical engineering components are interpreted in accordance with the standard conventions of first and third angle orthographic drawings 5.5 Basic first and third angle orthographic sketches and drawings are produced according to first and third angle orthographic drawing conventions

Element 6	**Read and produce basic pattern drawings**
Range	The element covers: • Development of patterns of square, rectangular and cylindrical shapes (prisms) using the parallel line method and techniques. • Development of conical shapes using radial line method and techniques.

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Performance Criteria
6.1 Sketches and drawings of simple patterns are interpreted according to the conventions of parallel and radial line development methods 6.2 Simple patterns are developed in accordance with parallel and radial line methods and techniques
Underpinning Knowledge
The individual needs to demonstrate knowledge of: • Drawing equipment and materials • Freehand sketching • Geometrical constructions • Types of drawings • Elements of a drawing • Drawing information • Isometric drawing conventions, features, characteristics, components • First and third angle orthographic drawing conventions, features, characteristics, components • Sketches and drawings of simple patterns
Generic Skills
The individual needs to demonstrate ability related to: • Communication • Team Work • Problem solving • Planning and Organising • Self-management • Technology

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NATIONAL OCCUPATIONAL STANDARD

Unit Standard Code: *MEM003 (Internal code)*	
Unit Standard Title: Apply the principles of engineering science	
KNQF Level: 4	**Credits: 2**

Unit Standard Description

This unit standard is intended for those who carry out mechanical engineering technology and maintenance operations. It specifies the competencies required to: Calculate the dimensions of different solids; Solve problems using trigonometry; Use graphs, charts and tables to solve problems; Calculate the strengths of materials; Calculate work and power; and Apply principles of the operation of simple machines.

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Unit Standard Title	Apply the principles of engineering science
Unit Scope	This unit covers the application of engineering science to solve mechanical engineering problems.
Element 1	**Calculate the dimensions of different solids**
Range	• The solids include but are not limited to prisms, cones, pyramids, spheres. • The dimensions to be calculated include but are not limited to surface area and volume.
Performance Criteria	
1.1 The properties of the different solids are identified from manuals and specifications 1.2 Calculations of the different dimensions of the different solids are conducted using appropriate mathematical formulae and standard and derived metric and imperial units of measurement	
Element 2	**Solve problems using trigonometry**
Range	The trigonometrical calculations include but are not limited to sine, cosine and tangent functions.
Performance Criteria	
2.1 The relationship of the different functions is determined 2.2 Problems are solved using trigonometry including the use of sine, cosine and tangent functions	
Element 3	**Use graphs, charts and tables to solve problems**
Performance Criteria	
3.1 The different types of graphs, charts and tables are identified from manuals 3.2 The applications, limitations and advantages and disadvantages of graphs, charts and tables are identified and applied according to specifications 3.3 Graphs, charts and tables are interpreted according to standard statistical conventions	
Element 4	**Calculate the strengths of materials**
Range	The strengths of different materials to be calculated include but are not limited to tensile strength, shear strength, compressive strength, and bearing load.

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Performance Criteria	
4.1 The formulae for the calculation of tensile strength, shear strength, compressive strength, bearing load are determined and manipulated according to standard mathematical and scientific conventions 4.2 Calculation of the strengths of different materials, including hoisting/lifting equipment, are conducted using appropriate formulae and standard and derived metric and imperial units of measurement	
Element 5	**Calculate work and power**
Range	N/A
Performance Criteria	
5.1 Formulae for the calculation of work and power are determined and manipulated according to standard mathematical and scientific conventions 5.2 Calculations involving work and power are conducted using appropriate formulae and standard and derived metric and imperial units of measurement	
Element 6	**Apply principles of the operation of simple machines**
Range	• Simple machines include but are not limited to levers, wheels and axles, pulleys, inclined planes, screw jacks and compound machines. • Forces associated with simple machines include but are not limited to turning moments and mechanical.
Performance Criteria	
6.1 Different simple machines are identified 6.2 The applications and operating principles of the different machines are identified and applied in accordance with manufacturers' specifications 6.3 Forces associated with simple machines are identified and their applications determined according to the principles of vectors 6.4 Problems involving simple machines are solved using appropriate formulae and standard and derived metric and imperial units of measurement	

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Underpinning Knowledge
The individual needs to demonstrate knowledge of: • Calculations involving solids • Trigonometry: sine, cosine and tangent functions • Use and interpretation of charts, tables and graphs • Calculation of strengths of materials: tensile strength, shear strength, compressive strength, bearing load • Calculation of work and powers
Generic Skills
The individual needs to demonstrate ability related to: • Communication • Team Work • Problem solving • Planning and Organising • Self-management • Technology

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NATIONAL OCCUPATIONAL STANDARD

Unit Standard Code: *MEM004 (Internal code)*	
Unit Standard Title: Handle and use common metallic and non-metallic materials	
KNQF Level: 2	**Credits: 2**

Unit Standard Description

This unit standard is intended for those who carry out mechanical engineering technology and maintenance operations. It specifies the competencies required to: Identify the characteristics, properties and applications of common ferrous and non-ferrous metals used in mechanical engineering; Perform the heat treatment of metal; Perform the testing of metals; Identify common non-metallic materials used in mechanical engineering and their characteristics, properties and applications.

A mechanical engineering technology and maintenance technician deals with various materials required for cutting tools, dies, gears, bearings and many other applications. Skills and knowledge of the selection and use of ferrous and non-ferrous materials and the heat treatment of some ferrous materials are essential.

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Unit Standard Title	Handle and use common metallic and non-metallic materials
Unit Scope	• Common ferrous metals used in mechanical engineering include but are not limited to like plain carbon steel, low carbon steel, medium carbon steel, high carbon steel; grey cast iron, low alloy steel, high alloy steel, tools steel, stainless steel, magnetic materials (permanent magnets and temporary magnets), special cutting tool materials (diamond, stelites, tungsten carbide), and High speed Steels (HSS). • Common non-ferrous metals used in mechanical engineering include but are not limited to copper alloys (Naval brass, Muntz metal, Gun metal and bronzes), aluminum alloys (Y-alloy & duralumin) and bearing materials like white metals, leaded bronzes and copper lead alloys. • Common non-metallic materials include but are not limited to rubber; plastics; epoxy resins; ceramics; abrasive, adhesive and insulating materials such as cork, asbestos, Thermocol and glass wool; laminated and fibre reinforced materials. • Performance of all elements must comply with all relevant statutory, health, safety, environment, and worksite requirements, contractual agreement and/or manufacturers' specifications.
Element 1	**Identify the characteristics, properties and applications of common ferrous and non-ferrous metals used in mechanical engineering**
Range	The characteristics and properties of metals include but are not limited to density, melting point, strength, elasticity, ductility, malleability, plasticity, toughness, hardness, hardenability, brittleness, fatigue, thermal conductivity, electrical conductivity, thermal coefficient of linear expansion, tension, compression, torsion, bending, shearing, safe load, yield point, and failure point.
Performance Criteria	
1.1 The characteristics, properties and applications of ferrous and non-ferrous metals used in mechanical engineering are identified from manuals and specifications for the different metals 1.2 The process and methods of manufacturing iron and steel are outlined 1.3 The methods of manufacture, characteristics, properties and applications of common alloys used in mechanical engineering are identified from manuals and specifications 1.4 The effect of various alloying elements such as chromium, nickel, manganese, molybdenum, tungsten, vanadium are identified from manuals and specifications	
Element 2	**Perform the heat treatment of metal**
Range	Heat treatment processes include but are not limited to annealing, normalizing, hardening (case hardening, flame hardening, induction hardening, nitriding, carburizing) and tempering.

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Performance Criteria
2.1 The principles, advantages, limitations and applications of the different methods of heat treatment are identified from manuals and specifications for the different methods and materials 2.2 Safety requirements associated with heat treatment are identified and observed in accordance with relevant safety rules and regulations 2.3 The tools, equipment and materials used for heat treatment are selected, handled, used, maintained and stored according to manufacturers' specifications and workplace procedures 2.4 Procedures for the annealing, normalizing, hardening and tempering of common metals are applied according to standard mechanical engineering and workplace procedures

Element 3	**Perform the testing of metals**
Range	• Causes of failure of ferrous metals include fatigue, oxidation, stress cracking, corrosion, and brittleness. • Methods of testing common metals include but are not limited to destructive, non-destructive and chemical testing.

Performance Criteria
3.1 The causes of the failure of ferrous metals are identified from manuals and specifications 3.2 Methods of destructive, non-destructive testing and chemical testing are demonstrated in accordance with manuals and specifications for the different methods and materials

Element 4	**Identify common non-metallic materials used in mechanical engineering and their characteristics, properties and applications**
Range	Common non-metallic materials used in mechanical engineering include but are not limited to rubber; plastics; epoxy resins; ceramics; abrasive, adhesive and insulating materials such as cork, asbestos, thermocol and glass wool; laminated and fibre reinforced materials.

Performance Criteria
4.1 Common non-metallic materials used in mechanical engineering are identified according to their characteristics and properties and manufacturers' specifications 4.2 The characteristics, properties and applications of the non-metallic materials are identified from manuals and specifications for the different materials 4.3 No-metallic materials are selected for different applications, handled, used and stored according to manufacturers' specifications

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Underpinning Knowledge
The individual needs to demonstrate knowledge of: • Characteristics, propertied and uses of common ferrous and non-ferrous metals • Manufacture of iron and steel • Manufacture, characteristics, properties and uses of common alloys used in mechanical engineering • Testing of metals • Hardening and tempering of metals • Causes of the failure of ferrous metals • Heat treatment of metals • Characteristics, propertied and uses of common non-metallic materials used in mechanical engineering
Generic Skills
The individual needs to demonstrate ability related to: • Communication • Team Work • Problem solving • Planning and Organising • Self-management • Technology

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TVET CURRICULUM DEVELOPMENT, ASSESSMENT AND CERTIFICATION COUNCIL (TVET CDACC)

NATIONAL OCCUPATIONAL STANDARD

Unit Standard Code: *MEM005 (Internal code)*	
Unit Standard Title: Use and maintain hand tools	
KNQF Level: 2	**Credits: 2**

Unit Standard Description

This unit standard is intended for those who carry out mechanical engineering technology and maintenance operations. It specifies the competencies required to: Prepare for work; Measure and layout work pieces; Perform metal cutting using hand tools; and Maintain and store hand tools.

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Unit Standard Title	Use and maintain hand tools
Unit Scope	Hand tools include but are not limited to the following: bench vice, C-clamp, chisels, taps and dies, files, hammers (ball peen , claw, mallet, shaping sledge, soft faces mallet), machinist clamp, packing pullers, pliers, side cutters, reamers, hacksaws, scrappers, screw drivers, shears, snips, thread chasers, thread files, torque wrenches, universal wrenches (metric/imperial), Allen keys , box end spanner, adjustable square, angle gauge, angle plate, ball gauge, bench marks, bevel protractor, combination set, depth micrometer, dial bore gauge, dial indicator, dividers, feeler gauges, flat bottom gauge, framing square, gauge blocks, gauges, Go-no-go gauge, grease guns, hole gauges, inside and outside calipers, inside and outside micrometer, laser alignment equipment, laser level, magnetic bases, measuring tape, prick punches, center punches, protractors, scribers, straight edges, surface plate, taper gauge, telescope gauge, thread gauges, thread micrometer, Trammels, V-blocks, vernier caliper, vernier height gauge, wire gauge.
Element 1	**Prepare for work**
Range	• Work instructions may include but are not limited to plans; specifications; quality requirements; traffic control requirements; task risk assessment forms; and operational details. • Worksite safety includes but is not limited to personal protective clothing and equipment; working at heights; barricades, warning, informative and/or prohibitive signs.

Performance Criteria

1.1 Work instructions, including plans, specifications, quality requirements and operational details are obtained, confirmed and applied in line with workplace procedures

1.2 Sequence of operations is determined by interpreting drawings and job instructions

1.3 Hand, measuring and layout tools and instruments, equipment, accessories and materials are selected appropriate to the task and manufacturers' specifications

1.4 Pre-operational checks are carried out in line with manufacturers' specifications and workplace procedures

1.5 Safety requirements are followed in line with workplace procedures

1.6 Sign and barricade requirements are identified and implemented in line with workplace procedures

1.7 Material quantity requirements are calculated in accordance with plans and/or specifications

1.8 Materials appropriate to the work application are identified, obtained, prepared, safely handled and located ready for use in line with workplace procedures

1.9 Environmental protection requirements are identified and applied in line with environmental plans and regulatory obligations

1.10 Lubrication and oiling are performed in line with manufacturers' specifications and

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workplace procedures	
Element 2	**Measure and layout work pieces**
Range	N/A
Performance Criteria	
2.1 Measuring and layout tools and instruments are identified and selected in line with job requirements 2.2 The applications, methods of operation and limitations of the tools are identified from specifications, standards and manufacturers' instructions 2.3 Measuring and layout tools and instruments are checked for accuracy, adjusted and set according to manufacturers' specifications 2.4 Safety requirements for measuring and layout tools and instruments are identified and applied in line with workplace procedures 2.5 Personal protective equipment is used in line with regulatory and workplace requirements 2.6 Tools are used safely and effectively according to manufacturers' recommendations and workplace procedures 2.7 Layout operations are performed according to task requirements 2.8 Measurements are performed including measuring diameter, concentricity, parallelism, depth and size in line with job requirements 2.9 Measurement errors and their causes are identified and rectified according to standard procedures 2.10 Measurements are recorded in line with task requirements	
Element 3	**Perform metal cutting using hand tools**
Range	N/A
Performance Criteria	
3.1 Hand tools and accessories are identified and selected in line with job requirements 3.2 The applications, methods of operation and limitations of the tools are identified from specifications, standards and manufacturers' instructions 3.3 Hand tools are checked for accuracy, adjusted and set in line with manufacturers' specifications 3.4 Safety requirements for hand tools are identified and applied in line with workplace procedures 3.5 Personal protective equipment is used in line with regulatory and workplace requirements 3.6 Hand tools are used safely and effectively according to manufacturers' recommendations and workplace procedures 3.7 Different operations are performed using hand tools including striking, cutting work pieces to	

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size, filing, cutting internal and external threads in line with drawings and specifications	
Element 4	**Maintain and store hand tools**
Range	N/A
Performance Criteria	
4.1 Hand tools and instruments are checked for faults and serviceability in line with manufacturers' specifications and workplace procedures 4.2 Unsafe and faulty tools are identified and marked or repaired in line with workplace procedures 4.3 Tools are cleaned in line with manufacturers' recommendations and workplace procedures 4.4 Tools are stored in line with manufacturers' recommendations 4.5 Work is completed and appropriate personnel notified in line with workplace procedures	
Underpinning Knowledge	
The individual needs to demonstrate knowledge of: • Hand tools and accessories • Checking the accuracy of hand tools • Adjusting and setting measuring and layout tools and instruments • Use of hand tools • Maintenance of hand tools	
Generic Skills	
The individual needs to demonstrate ability related to: • Communication • Team Work • Problem solving • Planning and Organising • Self-management • Technology	

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TVET CURRICULUM DEVELOPMENT, ASSESSMENT AND CERTIFICATION COUNCIL (TVET CDACC)

NATIONAL OCCUPATIONAL STANDARD

Unit Standard Code: *MEM006 (Internal code)*	
Unit Standard Title: Use and maintain portable power tools	
KNQF Level: 2	**Credits: 1**

Unit Standard Description

This unit standard is intended for those who carry out mechanical engineering technology and maintenance operations. It specifies the competencies required to: Prepare for work; Perform metal cutting operations using portable power tools; and Maintain portable power tools.

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Unit Standard Title	Use and maintain portable power tools
Unit Scope	Portable power tools include but are not limited to the following: angle grinder, portable drilling machine, hammer drilling machine, chain saw, cut-off saws, riveting gun, electric wrenches, hydraulic wrenches, pneumatic wrenches, portable milling machine, portable roll grinder, portable threader, threading machine, and bench grinder. Performance of all elements must comply with all relevant statutory, health, safety, environment, and worksite requirements, contractual agreement and/or manufacturers' specifications.
Element 1	**Prepare for work**
Range	• Work instructions may include but are not limited to plans; specifications; quality requirements; traffic control requirements; task risk assessment forms; and operational details. • Worksite safety includes but is not limited to personal protective clothing and equipment; working at heights; barricades, warning, informative and/or prohibitive signs.

Performance Criteria

1.1 Work instructions, including plans, specifications, quality requirements and operational details are obtained, confirmed and applied in line with workplace procedures

1.2 Sequence of operations is determined by interpreting drawings and job instructions

1.3 Portable power tools are selected appropriate to the task and manufacturers' specifications

1.4 Pre-operational checks are carried out according to manufacturers' specifications

1.5 Safety requirements are followed in line with workplace procedures

1.6 Sign and barricade requirements are identified and implemented in line with workplace procedures

1.7 Material quantity requirements are calculated in accordance with plans and/or specifications

1.8 Materials appropriate to the work application are identified, obtained, prepared, safely handled and located ready for use in line with workplace procedures

1.9 Environmental protection requirements are identified and applied in line with environmental plans and regulatory obligations

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Element 2	**Perform metal cutting operations using portable power tools**
Range	The metal cutting operations include but are not limited to grinding, screwing, drilling, and thread cutting.
Performance Criteria	
2.1 Portable power tools are selected according to job requirements 2.2 Correct power drilling tool size and drill bits are selected according to task requirements 2.3 Taps and dies are selected according to task requirements 2.4 Cutting tools including grinding wheels are selected and mounted according to manufacturers' specifications 2.5 Cutting, filing, grinding, screwing, drilling, thread cutting and other operations are performed according to drawings and specifications	
Element 3	**Maintain portable power tools**
Range	N/A
Performance Criteria	
3.1 Portable power tools are checked for faults and serviceability in line with manufacturers' specifications and workplace procedures 3.2 Unsafe and faulty tools are identified and marked or repaired in line with workplace procedures 3.3 Tools are safely handled, used, maintained, cleaned, lubricated and stored in line with manufacturers' recommendations and workplace procedures	
Underpinning Knowledge	
The individual needs to demonstrate knowledge of: • Portable power tools, their applications, principles of operation and limitations • Inspecting, using, and caring for the different tools • Different types and sizes of cutting tools used for the different portable power tools and their applications • Procedures for filing, grinding, screwing, drilling, thread cutting and other operations performed using portable power tools • Procedures for the maintenance of the different portable power tools	

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Generic Skills
The individual needs to demonstrate ability related to: • Communication • Team Work • Problem solving • Planning and Organising • Self-management • Technology

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TVET CURRICULUM DEVELOPMENT, ASSESSMENT AND CERTIFICATION COUNCIL (TVET CDACC)

NATIONAL OCCUPATIONAL STANDARD

Unit Standard Code: *MEM007 (Internal code)*	
Unit Standard Title: Use and maintain lifting equipment, ladders, scaffolding and work platforms	
KNQF Level: 3	**Credits: 1**

Unit Standard Description

This unit standard is intended for those who carry out mechanical engineering technology and maintenance operations. It specifies the competencies required to: Use lifting equipment; Work from ladders; and Work on scaffolding and work platforms.

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Unit Standard Title	Use and maintain lifting equipment, ladders, scaffolding and work platforms
Unit Scope	Different types of lifting and mobile access equipment and materials. Performance of all elements must comply with all relevant statutory, health, safety, environment, and worksite requirements, contractual agreement and/or manufacturers' specifications.
Element 1	**Use lifting equipment**
Performance Criteria	
1.1 The different lifting equipment is identified including fork lifts, chain blocks, scissor lifts, basket lifts and slings 1.2 Regulations and certification requirements for forklifts and other lifting equipment are identified and followed 1.3 Pre-use inspections are conducted according to manufacturers' specifications 1.4 The causes, effects, causes and methods of control and prevention of safety hazards are identified from equipment manuals 1.5 Safety and environmental requirements and precautions are followed in line with occupational and environmental regulatory requirements and manufacturers' specifications 1.6 Lifting equipment is used according to manufacturers' specifications and workplace procedures 1.7 Lifting equipment is maintained and stored according to manufacturers' specifications and workplace procedures 1.8 Maintenance records are kept	
Element 2	**Work from ladders**
Range	The different types of ladders include but are not limited to single and extension ladders, step ladders, and trestle ladders.
Performance Criteria	
2.1 The different types of ladders, their construction and uses are identified from manufacturers' specifications 2.2 Pre-use inspections are conducted according to manufacturers' specifications and workplace procedures 2.3 Three points of contact are maintained whilst climbing up and down ladders in line with safety requirements and workplace procedures 2.4 The safe use, maintenance and storage of the different types of ladders are demonstrated in line with workplace procedures	

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Element 3	Work on scaffolding and work platforms
Range	• Hazards associated with working on scaffolds and work platforms may include but are not limited to falls, overloading, electrocution, and faulty components. • Tools and equipment include but are not limited to limited to height timber scaffolding, putlog scaffolding, metal scaffolding, independent scaffolding, mobile scaffolding and work platforms.

Performance Criteria
3.1 The different types of scaffolding and their applications, advantages and limitations are identified from manufacturers' manuals
3.2 Regulatory requirements are followed
3.3 The causes, effects, causes and methods of control and prevention of safety hazards are identified from manufacturers' manuals
3.4 Safety and environmental requirements and precautions are followed in line with occupational and environmental regulatory requirements and manufacturers' specifications
3.5 Pre-use inspections are conducted according to manufacturers' specifications
3.6 Scaffolding is assembled and disassembled according to manufacturers' specifications and workplace procedures
3.7 Scaffolding is used according to manufacturers' specifications and workplace procedures
3.8 Scaffolding is maintained and stored according to manufacturers' specifications and workplace procedures
3.9 Maintenance records are kept

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Underpinning Knowledge
The individual needs to demonstrate knowledge of: • Different types of lifting equipment, ladders, scaffolding and work platforms and their applications • Occupational and hazards associated with lifting equipment, ladders, scaffolding and work platforms, their causes, effects and methods of control and prevention • Safety requirements • Regulations and certification requirements for forklifts and other lifting equipment • Regulatory requirements for use of ladders, scaffolding and work platforms • Pre-use inspections for ladders, scaffolding and work platforms • Assembly and disassembly of scaffolding • Common faults on the different stationary power tools, their causes, effects and methods of control and prevention • Repair and maintenance of the different power tools
Generic Skills
The individual needs to demonstrate ability related to: • Communication • Team Work • Problem solving • Planning and Organising • Self-management • Technology

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TVET CURRICULUM DEVELOPMENT, ASSESSMENT AND CERTIFICATION COUNCIL (TVET CDACC)

NATIONAL OCCUPATIONAL STANDARD

Unit Standard Code: *MEM008 (Internal code)*	
Unit Standard Title: Use and maintain stationary power tools	
KNQF Level: 3	**Credits: 2**

Unit Standard Description

This unit standard is intended for those who carry out mechanical engineering technology and maintenance operations. It specifies the competencies required to: Use stationary power tools; and Maintain and repair stationary power tools.

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Unit Standard Title	**Use and maintain stationary power tools**
Unit Scope	Stationary power tools include but are not limited to power saw, pedestal grinding machines, drilling machines, lathe machines, milling machines, surface grinding machines cylindrical grinding machines, and tool grinders.
Element 1	**Use stationary power tools and equipment**
Range	N/A
Performance Criteria	
1.1 The different stationary power tools and equipment and their accessories are identified 1.2 The causes, effects, methods of control and prevention of occupational and environmental hazards associated with the different stationary power tools are identified from occupational and environmental safety regulations 1.3 Tools and equipment and their accessories are selected for different applications and job requirements 1.4 The procedures for the setting up and use of the different stationary power tools are applied according to manufacturers' manuals and workplace procedures	
Element 2	**Maintain and repair stationary power tools**
Range	N/A
Performance Criteria	
2.1 The causes and effects common faults on the different stationary power tools are identified from manufacturers' manuals and safety regulations 2.2 The methods of controlling and preventing common faults on the different stationary power tools are identified from manufacturers' manuals and applied 2.3 The proper care and upkeep of power tools and equipment including the lubrication of moving parts and the maintenance of fluid levels are conducted according to manufacturers' specifications and workplace procedures 2.4 Machines are inspected for defects and identified defects rectified according to manufacturers' specifications and workplace procedures 2.5 Machine tools are cleaned and lubricated according to manufacturers' specifications and workplace procedures	

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Underpinning Knowledge
The individual needs to demonstrate knowledge of: • Different stationary power tools, their principles of operation, applications and limitations • Occupational and environmental hazards associated with the use of the different power tools • Safety requirements • Setting up the different stationary power tools including calculation and determination of speeds and feeds • Procedures for the use of the different machines • Common faults on the different stationary power tools, their causes, effects and methods of control and prevention • Repair and maintenance of the different power tools
Generic Skills
The individual needs to demonstrate ability related to: • Communication • Team Work • Problem solving • Planning and Organising • Self-management • Technology

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TVET CURRICULUM DEVELOPMENT, ASSESSMENT AND CERTIFICATION COUNCIL (TVET CDACC)

NATIONAL OCCUPATIONAL STANDARD

Unit Standard Code: *MEM009 (Internal code)*	
Unit Standard Title: Use mechanical fasteners and locking devices	
KNQF Level: 2	**Credits: 1**

Unit Standard Description

This unit standard is intended for those who carry out mechanical engineering technology and maintenance operations. It specifies the competencies required to: Use fasteners and locking devices for different applications; Use tools used for the installation of mechanical fasteners and locking devices.

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Unit Standard Title	Use mechanical fasteners and locking devices
Unit Scope	Fasteners and locking devices include but are not limited to bolts, screws, studs, retaining rings, retaining pins, and rivets. Performance of all elements must comply with all relevant statutory, health, safety, environment, and worksite requirements, contractual agreement and/or manufacturers' specifications.
Element 1	**Use fasteners and locking devices for different applications**
Range	N/A
Performance Criteria	
1.1 Mechanical fasteners are classified according to manufacturers' specifications 1.2 Mechanical fasteners and locking devices are identified and selected used for different applications according to drawings and specifications and workplace procedures	
Element 2	**Use tools used for the installation of mechanical fasteners and locking devices**
Range	The tools include but are not limited to wrenches, torque wrenches, hydraulic wrenches, impact wrenches, slug wrenches, snap-ring pliers, and riveting devices.
Performance Criteria	
2.1 Tools are selected according to job requirements 2.2 Procedures for the safe handling, use, maintenance and storage of the different tools are demonstrated according to manufacturers' specifications and workplace procedures 2.3 The strengths of fasteners are calculated using appropriate formulae	
Underpinning Knowledge	
The individual needs to demonstrate knowledge of: • Different mechanical fasteners and locking devices and their applications • Tools used for the installation of mechanical fasteners and devices • Calculation of strengths of mechanical fasteners	

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Generic Skills
The individual needs to demonstrate ability related to: • Communication • Team Work • Problem solving • Planning and Organising • Self-management • Technology

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TVET CURRICULUM DEVELOPMENT, ASSESSMENT AND CERTIFICATION COUNCIL (TVET CDACC)

NATIONAL OCCUPATIONAL STANDARD

Unit Standard Code: *MEM010 (Internal code)*	
Unit Standard Title: Perform sheet metal work	
KNQF Level: 2	**Credits: 2**

Unit Standard Description

This unit standard is intended for those who carry out mechanical engineering technology and maintenance operations. It specifies the competencies required to: Prepare for sheet metal work; Cut work pieces to size; Fabricate work pieces; and Observe housekeeping.

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Unit Standard Title	Perform sheet metal work
Unit Scope	• Tools and equipment may include but are not limited to bending machine, rolling machine, jenny and swing machine, tin snips, divider, scriber, centre punch, pop rivet gun, vice, grooving tool, steel tape, large steel combination square, hammer, twist drill, counter sink bit, wheel brace, electric drill, drill press, rivet set and snap, tin man's rivet, pop rivet, guillotine, file, sliding bevels, and protractors. • Materials may include but are not limited to sheet metal, flat sheet copper, rivets, silicon and other sealants. • Performance of all elements must comply with all relevant statutory, health, safety, environment, and worksite requirements, contractual agreement and/or manufacturers' specifications.

Element 1	Prepare for sheet metal work
Range	N/A

Performance Criteria

1.1 Tools and equipment used in sheet metal work are selected, handled, used, maintained and stored according to task requirements and manufacturers' specifications

1.2 The principles of operation of the different tools and equipment are applied according to manufacturers' recommendations

1.3 Different types of ferrous and non-ferrous materials are identified, handled, used and stored according to workplace procedures

1.4 Correct thickness of sheet metal is selected in line with job requirements

1.5 Safety and environmental hazards associated with sheet metal work are identified and prevented in accordance with occupational and environmental regulatory requirements

Element 2	Cut work pieces to size
Range	N/A

Performance Criteria

2.1 Procedures for the safe handling, use, maintenance and storage of the different measuring and marking out tools, equipment and materials are demonstrated according to manufacturers' recommendations and workplace procedures

2.2 Positions are marked and angles read with sliding bevels and protractors in line with job requirements

2.3 Angles are bisected and cut in line with job requirements

2.4 Cutting tools, equipment and materials are selected, handled, used, maintained and stored according to task requirements and manufacturers' specifications

2.5 Work pieces are cut to size according to drawings and specifications

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Element 3	Fabricate work pieces
Range	• Fabrication procedures include but are not limited to reading and interpreting work instructions; implementing safety requirements; selecting tools, equipment and materials; marking out, cutting and deburring sheet metal; shaping sheet metal; forming and making joints; cleaning and inspecting joints. • The fabrication of work pieces includes but is not limited to bending, folding, rolling and forming sheet metal. • Geometrical shapes include but are not limited to circles, arcs, triangles, polygons, cones, and ellipses. • Types of joints to include but are not limited to lap joints, grooved seam, Pittsburg joints, grooved joints: longitudinal seam on round, square and rectangular work, and longitudinal corner joint.
Performance Criteria	
3.1 The procedure for fabricating work pieces is demonstrated according to job requirements 3.2 Bending, folding and rolling of sheet metal is performed according to drawings and job specifications 3.3 Sheet metal is shaped into different geometrical forms according to drawings and specifications 3.4 Different joints are formed according to drawings and specifications 3.5 The cleaning and visual inspection of joints is conducted and faults rectified	
Element 4	**Observe housekeeping**
Range	N/A
Performance Criteria	
4.1 Working area is cleared and cleaned according to workplace procedures 4.2 Tools are cleaned and stored according to manufacturers' specifications and workplace procedures	

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Underpinning Knowledge
The individual needs to demonstrate knowledge of: • Tools, equipment and materials used in sheet metal work • Different types of joints and their applications • Safety and environmental hazards related to sheet metal and methods of their control and prevention • Procedures for marking out and cutting work pieces • Procedures for fabrication of work pieces
Generic Skills
The individual needs to demonstrate ability related to: • Communication • Team Work • Problem solving • Planning and Organising • Self-management • Technology

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TVET CURRICULUM DEVELOPMENT, ASSESSMENT AND CERTIFICATION COUNCIL (TVET CDACC)

NATIONAL OCCUPATIONAL STANDARD

Unit Standard Code: *MEM011 (Internal code)*	
Unit Standard Title: Perform basic oxy-fuel welding and cutting	
KNQF Level: 3	**Credits: 2**

Unit Standard Description

This unit standard is intended for those who carry out mechanical engineering technology and maintenance operations. It specifies the competencies required to: Prepare for work; Prepare materials for welding; Assemble and set up welding equipment and materials; Perform routine welding using fuel gas process; Perform oxy-fuel cutting; and Complete work and clean up.

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Unit Standard Title	Perform basic oxy-fuel welding and oxy-fuel cutting
Unit Scope	• The prescribed procedure is limited to vertical and flat welding. • Materials to be welded are limited to mild steel. • Performance of all elements must comply with all relevant statutory, health, safety, environment, and worksite requirements, contractual agreement and/or manufacturers' specifications.
Element 1	**Prepare for work**
Range	• Planning and preparation may include but are not limited to workplace inspection, equipment defect identification, assessment of conditions and hazards and determination of work requirements. • Tools and equipment may include but are not limited to gas cylinders, regulators, welding hoses, check valves (non-return valves), flash back arrestors, welding torches, welding tips and filler rods. • Materials are to include but are not limited to low carbon steel and sheet metal.
Performance Criteria	
1.1 Work instructions, including repair order forms, plans, specifications, quality requirements and operational details are obtained, confirmed and applied in line with workplace procedures 1.2 Sequence of operations is determined by interpreting drawings and job instructions 1.3 Safety requirements are followed in line with safety plans and policies including the wearing of PPE in accordance with regulatory requirements 1.4 Sign and barricade requirements are identified and implemented in line with workplace procedures 1.5 Environmental protection requirements are identified and applied in line with environmental plans and regulatory obligations 1.6 Tools and equipment selected to carry out tasks that are consistent with the requirements of the job, are safely handled, used, maintained, stored, and checked for serviceability and any faults rectified or reported prior to commencement of work in line with manufacturers' specifications and workplace procedures 1.7 Material quantity requirements are calculated in accordance with plans and/or specifications 1.8 Materials appropriate to the work application are identified, obtained, prepared, safely handled and located, ready for use according to workplace procedures	
Element 2	**Prepare materials for welding**
Range	Preparation of materials may include but is not limited to preheating, setting up jigs, fixtures, and clamps.

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Performance Criteria	
2.1 Weld requirements are determined in line with job specifications 2.2 Material is cleaned and prepared using appropriate tools and techniques in line with standard operating procedures	
Element 3	**Assemble and set up welding equipment and materials**
Range	• Setting up may include the correct connection of hoses, blowpipes, regulators, cylinder valves, pressure regulators, flashback arrestors, welding tips and correct settings of gas mixtures. • Welding joints include but are not limited to bead welds and butt welds.
Performance Criteria	
3.1 Welding equipment including cylinders and regulators are identified 3.2 Welding equipment is assembled and set up in line with standard operating procedures 3.3 Different types of welding joints and their applications are identified 3.4 Welding tips, settings and consumables are selected in accordance with workplace procedures	
Element 4	**Perform routine welding using fuel gas process**
Range	N/A
Performance Criteria	
4.1 Flame settings are adjusted for different applications 4.2 Welding is undertaken safely and in line with prescribed procedures 4.3 Welds are cleaned in line with standard operating procedures 4.4 Welds are inspected for faults and identified faults are rectified according to standard procedures	
Element 5	**Perform oxy-fuel cutting**
Range	N/A

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Performance Criteria
5.1 The applications of oxy-fuel cutting are identified
5.2 Oxy-fuel cutting tools, equipment and materials including gas cylinders are safely handled, used, maintained, stored, assembled and set up according to manufacturers' specifications and workplace procedures
5.3 Flame settings are adjusted for different applications
5.4 Oxy-fuel cutting operations are conducted according to specifications including the operation of motorised portable oxy-fuel cutting machine

Element 6	**Complete work and clean up**
Range	Work completion details may include but are not limited to work schedule or appointment sheet and sign-out form for equipment.

Performance Criteria
6.1 Work is completed and appropriate personnel notified in line with workplace procedures
6.2 Work area is cleared of waste, cleaned, restored and secured in line with workplace procedures
6.3 Reusable material is collected and stored in line with workplace procedures
6.4 Tools and equipment are cleaned, checked, maintained and stored in line with workplace procedures.
6.5 Work completion details are finalised in line with workplace procedures

Underpinning Knowledge

The individual needs to demonstrate knowledge of:

- Applications of oxy-acetylene gas welding and oxy-fuel cutting
- Operating principles of oxy-acetylene gas welding and oxy-fuel cutting plant components
- Different types of welding joints
- Occupational and environmental hazards associated with oxy-acetylene gas welding and oxy-fuel cutting, their causes and methods of control and prevention
- PPE used in oxy-acetylene gas welding and oxy-fuel cutting
- Procedure for preparing materials for welding
- Procedure for assembly and setting up oxy-acetylene gas welding and oxy-fuel cutting plant
- Adjusting flame settings
- Oxy-acetylene gas welding and oxy-fuel cutting procedures

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Generic Skills
The individual needs to demonstrate ability related to: • Communication • Team Work • Problem solving • Planning and Organising • Self-management • Technology

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TVET CURRICULUM DEVELOPMENT, ASSESSMENT AND CERTIFICATION COUNCIL (TVET CDACC)

NATIONAL OCCUPATIONAL STANDARD

Unit Standard Code: *MEM012 (Internal code)*	
Unit Standard Title: Perform basic manual arc welding	
KNQF Level: 3	**Credits: 2**

Unit Standard Description

This unit standard is intended for those who carry out mechanical engineering technology and maintenance operations. It specifies the competencies required to: Prepare for work; Assemble and set up welding components and equipment; Perform welding using the manual arc welding process; and Complete work and clean up.

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Unit Standard Title	Perform basic manual arc welding
Unit Scope	• The prescribed procedure is limited to flat and vertical welding. • Materials to be welded include but are not limited to steels. • Performance of all elements must comply with all relevant statutory, health, safety, environment, and worksite requirements, contractual agreement and/or manufacturers' specifications.
Element 1	**Prepare for work**
Range	• Planning and preparation may include but are not limited to workplace inspection, equipment defect identification, assessment of conditions and hazards and determination of work requirements. • Tools and equipment may include but are not limited to acetylene and oxygen cylinders, regulators, welding hoses, check valves (non-return valves), flash back arrestors, welding torches, welding tips and filler rods. • Materials are to include but are not limited to low carbon steel and sheet metal.
Performance Criteria	
1.1 Work instructions, including repair order forms, plans, specifications, quality requirements and operational details are obtained, confirmed and applied in line with workplace procedures 1.2 Sequence of operations is determined by interpreting drawings and job instructions 1.3 Safety requirements are followed in line with safety plans and policies including the wearing of PPE in accordance with regulatory requirements 1.4 Sign and barricade requirements are identified and implemented in line with workplace procedures 1.5 Environmental protection requirements are identified and applied in line with environmental plans and regulatory obligations 1.6 Tools and equipment selected to carry out tasks that are consistent with the requirements of the job, are safely handled, used, maintained, stored, and checked for serviceability and any faults rectified or reported prior to commencement of work in line with manufacturers' specifications and workplace procedures 1.7 Material quantity requirements are calculated in accordance with plans and/or specifications 1.8 Materials appropriate to the work application are identified, obtained, prepared, safely handled and located, ready for use according to workplace procedures	

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Element 2	**Assemble and set up welding components and equipment**
Range	• Tools and equipment may include but are not limited to hand tools, welding equipment including manual metal arc welding machine, safety equipment, measuring and marking out equipment. • Materials are to include but are not limited to welding rods/electrodes and cleaning materials.
Performance Criteria	
2.1 Welding machine equipment, accessories and consumables are identified 2.2 Welding equipment is assembled and set up according manufacturers' specifications and workplace procedures 2.3 Welding machine is set to correct welding current in line with type and thickness materials	
Element 3	**Perform welding using the manual arc welding process**
Range	N/A
Performance Criteria	
3.1 Welding is undertaken safely and in line with prescribed procedures 3.2 Current settings are adjusted for different applications and types and thickness of materials 3.3 Manual metal arc welding is completed using approved methods and equipment in line with type of materials 3.4 Welds are cleaned in line with standard operating procedures 3.5 Welds are inspected for faults and identified faults are rectified in line with standard procedures	
Element 4	**Complete work and clean up**
Range	Work completion details may include but are not limited to work schedule or appointment sheet and sign-out form for equipment.

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Performance Criteria
4.1 Work is completed and appropriate personnel notified in line with workplace procedures 4.2 Work area is cleared of waste, cleaned, restored and secured in line with workplace procedures 4.3 Reusable material is collected and stored in line with workplace procedures 4.4 Tools and equipment are cleaned, checked, maintained and stored in line with workplace procedures. 4.5 Work completion details are finalised in line with workplace procedures
Underpinning Knowledge
The individual needs to demonstrate knowledge of: • Applications of manual arc welding • Purpose and operating principles of manual arc welding plant components • Different types of welding joints • Occupational and environmental hazards associated with manual arc welding, their causes and methods of control and prevention • PPE used in manual arc welding • Procedure for preparing materials for welding • Procedure for assembly and setting up welding plant • Adjusting current settings • Manual arc welding procedures
Generic Skills
The individual needs to demonstrate ability related to: • Communication • Team Work • Problem solving • Planning and Organising • Self-management • Technology

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TVET CURRICULUM DEVELOPMENT, ASSESSMENT AND CERTIFICATION COUNCIL (TVET CDACC)

NATIONAL OCCUPATIONAL STANDARD

Unit Standard Code: *MEM013 (Internal code)*	
Unit Standard Title: Perform basic TIG welding with various metal work pieces	
KNQF Level: 3	**Credits: 1**

Unit Standard Description

This unit standard is intended for those who carry out mechanical engineering technology and maintenance operations. It specifies the competencies required to: Observe safety rules, regulations and precautions; Apply the principles of housekeeping to the welding work area; Prepare tools, equipment, consumables and work pieces for TIG welding processes; Weld work pieces in accordance with national and international specifications and procedures; and Inspect finished product quality against national and international specifications and procedures.

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Unit Standard Title	Perform basic TIG welding with various metal work pieces
Unit Scope	• The prescribed procedure is limited to forehand welding (flat position welding and vertical position welding). • Materials to be welded are limited to mild steel and carbon steels. • Performance of all elements must comply with all relevant statutory, health, safety, environment, and worksite requirements, contractual agreement and/or manufacturers' specifications.
Element 1	**Prepare for work**
Range	Planning and preparation may include but are not limited to workplace inspection, equipment defect identification, assessment of conditions and hazards and determination of work requirements.

Performance Criteria

1.1 Work instructions, including repair order forms, plans, drawings and specifications, quality requirements and operational details are obtained, confirmed and applied in line with workplace procedures

1.2 Sequence of operations is determined by interpreting drawings and job instructions

1.3 Hazards, incidents and accidents are identified and reported in line with workplace procedures

1.4 Safety requirements are followed in line with safety plans and policies including the wearing of PPE in accordance with regulatory requirements

1.5 Sign and barricade requirements are identified and implemented in line with workplace procedures

1.6 Environmental protection requirements are identified and applied in line with environmental plans and regulatory obligations

1.7 Tools and equipment selected to carry out tasks that are consistent with the requirements of the job, are safely handled, used, maintained, stored, and checked for serviceability and any faults rectified or reported prior to commencement of work in line with manufacturers' specifications and workplace procedures

1.8 Material quantity requirements are calculated in accordance with plans and/or specifications

1.9 Materials appropriate to the work application are identified, obtained, prepared, safely handled and located, ready for use according to workplace procedures

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Element 2	**Prepare tools, equipment, consumables and work pieces for TIG welding processes**
Range	N/A
Performance Criteria	
2.1 Consumables, materials, tools and equipment are obtained consistent with job requirements 2.2 Work station is cleaned and prepared in line with workplace procedures 2.3 Work pieces are prepared in line with prescribed procedures 2.4 Equipment is set up according to manufacturers' specifications	
Element 3	**Weld work pieces in accordance with national and international specifications and procedures**
Range	Prescribed welding procedure is limited to forehand welding (flat position welding and vertical position welding).
Performance Criteria	
3.1 Work pieces are measured, marked, cut and prepared according to specifications 3.2 Welding is conducted according to drawings and specifications 3.3 All relevant safety aspects are adhered to during the welding process in line with safety regulatory requirements and workplace procedures 3.4 Accidents and incidents are reported according to workplace procedures	
Element 4	**Inspect finished product quality against national and international specifications and procedures**
Range	N/A
Performance Criteria	
4.1 The weld joint is complete (full coverage) in accordance with workplace specifications 4.2 Weld appearance, quality and integrity is in accordance with workplace specifications 4.3 Weld is dressed as required by workplace specifications 4.4 Defects are identified and reported according to workplace procedures	

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Element 5	**Complete work and clean up**
Range	Work completion details may include but are not limited to work schedule or appointment sheet and sign-out form for equipment.

Performance Criteria

5.1 Work is completed and appropriate personnel notified in line with workplace procedures

5.2 Work area is cleared of waste, cleaned, restored and secured in line with workplace procedures

5.3 Waste disposal is conducted in accordance with workplace procedures

5.4 Reusable material is collected and stored in line with workplace procedures

5.5 Tools and equipment are cleaned, checked, maintained and stored in line with workplace procedures

5.6 Work completion details are finalised in line with workplace procedures

Underpinning Knowledge

The individual needs to demonstrate knowledge of:

- Different weld positions F1, F2, F3, F4, 1G, 2G, 3G, 4G, 5G, 6G
- Different types of metals
- Types of welding rods and their applications
- Correct amperage for the type and thickness of steel to be welded and electrode selected
- Weld finishes and methods
- 5S principles and their application in housekeeping
- Safety rules and regulations applicable to the job

Generic Skills

The individual needs to demonstrate ability related to:

- Communication
- Team Work
- Problem solving
- Planning and Organising
- Self-management
- Technology

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TVET CURRICULUM DEVELOPMENT, ASSESSMENT AND CERTIFICATION COUNCIL (TVET CDACC)

NATIONAL OCCUPATIONAL STANDARD

Unit Standard Code: *MEM014 (Internal code)*	
Unit Standard Title: Perform basic MIG welding with various metal work pieces	
KNQF Level: 3	**Credits: 1**

Unit Standard Description

This unit standard is intended for those who carry out mechanical engineering technology and maintenance operations. It specifies the competencies required to: Observe safety rules, regulations and precautions; Apply the principles of housekeeping to the welding work area; Prepare tools, equipment, consumables and work pieces for MIG welding processes; Weld work pieces in accordance with national and international specifications and procedures; and Inspect finished product quality against national and international specifications and procedures.

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Unit Standard Title	Perform basic MIG welding with various metal work pieces
Unit Scope	• The prescribed procedure is limited to forehand welding (flat position welding and vertical position welding). • Materials to be welded are limited to mild steel and carbon steels. • Performance of all elements must comply with all relevant statutory, health, safety, environment, and worksite requirements, contractual agreement and/or manufacturers' specifications.
Element 1	**Prepare for work**
Range	Planning and preparation may include but are not limited to workplace inspection, equipment defect identification, assessment of conditions and hazards and determination of work requirements.

Performance Criteria

1.1 Work instructions, including repair order forms, plans, drawings and specifications, quality requirements and operational details are obtained, confirmed and applied in line with workplace procedures

1.2 Sequence of operations is determined by interpreting drawings and job instructions

1.3 Hazards, incidents and accidents are identified and reported in line with workplace procedures

1.4 Safety requirements are followed in line with safety plans and policies including the wearing of PPE in accordance with regulatory requirements

1.5 Sign and barricade requirements are identified and implemented in line with workplace procedures

1.6 Environmental protection requirements are identified and applied in line with environmental plans and regulatory obligations

1.7 Tools and equipment selected to carry out tasks that are consistent with the requirements of the job, are safely handled, used, maintained, stored, and checked for serviceability and any faults rectified or reported prior to commencement of work in line with manufacturers' specifications and workplace procedures

1.8 Material quantity requirements are calculated in accordance with plans and/or specifications

1.9 Materials appropriate to the work application are identified, obtained, prepared, safely handled and located, ready for use according to workplace procedures

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Element 2	**Prepare tools, equipment, consumables and work pieces for MIG welding processes**
Range	N/A
Performance Criteria	
2.1 Consumables, materials, tools and equipment are obtained consistent with job requirements 2.2 Work station is cleaned and prepared in line with workplace procedures 2.3 Work pieces are prepared in line with prescribed procedures 2.4 Equipment is set up according to manufacturers' specifications	
Element 3	**Weld work pieces in accordance with national and international specifications and procedures**
Range	The prescribed procedure is limited to forehand welding (flat position welding and vertical position welding).
Performance Criteria	
3.1 Work pieces are measured, marked, cut and prepared according to specifications 3.2 Welding is conducted according to drawings and specifications 3.3 All relevant safety aspects are adhered to during the welding process in line with safety regulatory requirements and workplace procedures 3.4 Accidents and incidents are reported according to workplace procedures	
Element 4	**Inspect finished product quality against national and international specifications and procedures**
Range	N/A
Performance Criteria	
4.1 The weld joint is complete (full coverage) in accordance with workplace specifications 4.2 Weld appearance, quality and integrity is in accordance with the specifications 4.3 Weld is dressed as required by workplace specifications 4.4 Defects are identified and reported according to workplace procedures	

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Element 5	Complete work and clean up
Range	Work completion details may include but are not limited to work schedule or appointment sheet and sign-out form for equipment.

Performance Criteria

5.1 Work is completed and appropriate personnel notified in line with workplace procedures

5.2 Work area is cleared of waste, cleaned, restored and secured in line with workplace procedures

5.3 Reusable material is collected and stored in line with workplace procedures

5.4 Waste disposal is conducted in accordance with workplace procedures

5.5 Tools and equipment are cleaned, checked, maintained and stored in line with workplace procedures.

5.6 Work completion details are finalised according to workplace specifications

Underpinning Knowledge

The individual needs to demonstrate knowledge of:

- Different weld positions F1, F2, F3, F4, 1G, 2G, 3G, 4G, 5G, 6G
- Different types of metals
- Types of welding rods and their applications
- Correct amperage for the type and thickness of steel to be welded and electrode selected
- Weld finishes and methods
- 5S principles and their application in housekeeping
- Safety rules and regulations applicable to the job

Generic Skills

The individual needs to demonstrate ability related to:

- Communication
- Team Work
- Problem solving
- Planning and Organising
- Self-management
- Technology

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TVET CURRICULUM DEVELOPMENT, ASSESSMENT AND CERTIFICATION COUNCIL (TVET CDACC)

NATIONAL OCCUPATIONAL STANDARD

Unit Standard Code: *MEM015 (Internal code)*	
Unit Standard Title: Perform drilling operations	
KNQF Level: 3	**Credits: 2**

Unit Standard Description

This unit standard is intended for those who carry out mechanical engineering technology and maintenance operations. It specifies the competencies required to: Prepare for drilling operations; Drill work pieces; Quality check machined work; and Complete work and clean up.

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Unit Standard Title	Perform drilling operations
Unit Scope	• Performance of all elements must comply with all relevant statutory, health, safety, environment, and worksite requirements, contractual agreement and/or manufacturers' specifications. • Materials may include but are not limited to ferrous and non-ferrous metals and alloys. • Drilling operations include but are not limited to cylindrical drilling, countersinking, counter boring, spot facing and reaming.
Element 1	**Prepare for drilling operations**
Range	Planning and preparation may include but are not limited to workplace inspection, equipment defect identification, assessment of conditions and hazards and determination of work requirements.

Performance Criteria

1.1 Sequence of operations is determined by interpreting drawings and job instructions

1.2 Tools and equipment used in drilling operations are selected, handled, used, maintained and stored according to task requirements and manufacturers' specifications

1.3 The different parts of a drilling machine are identified

1.4 The uses of the different parts of a drilling machine are identified from manufacturers' manuals and specifications

1.5 The principles of operation of different drilling machines are applied in line with manufacturers' manuals

1.6 Different types of ferrous and non-ferrous materials and alloys are identified, handled, used and stored according to manufacturers' specifications and workplace procedures

1.7 Safety and environmental hazards associated with the drilling machine and drilling machine operations are identified and prevented in line with regulatory requirements and workplace procedures

1.8 Safety precautions related to the drilling machine and drilling machine operations are observed in line with regulatory requirements

1.9 Drilling machine is prepared for operation including lubrication, routine maintenance and pre-operational checks in line with manufacturers' specifications and workplace procedures

1.10 Work and tool holding fixtures and devices are selected and installed in line with manufacturers' specifications and workplace procedures

1.11 Work pieces and drilling tools are secured according to manufacturers' specifications and workplace procedures

1.12 Materials are prepared and marked out according to drawings and specifications

1.13 Cutting speeds and feeds are selected and set in accordance with type of materials and size of drilling tool

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1.14 Drilling machine start-up and shut-down procedures are demonstrated in line with manufacturers' manuals	
Element 2	**Drill work pieces**
Range	N/A
Performance Criteria	
2.1 Drilling operations are carried out according to drawings and specifications 2.2 Routine dimension control is conducted in accordance with drawings and specifications 2.3 The operation of the drilling machine is monitored and adjustments to speeds and feeds made where required in line with standard procedures 2.4 Machined component is removed on completion of drilling process	
Element 3	**Quality check machined work**
Range	N/A
Performance Criteria	
3.1 Measuring tools and equipment are selected and prepared in accordance with task requirements 3.2 Work is measured against specifications 3.3 Non-conforming components are reported to appropriate personnel in line with workplace procedures	
Element 4	**Complete work and clean up**
Range	Work completion details may include but are not limited to work schedule or appointment sheet and sign-out form for equipment.
Performance Criteria	
4.1 Work is completed and appropriate personnel notified in line with workplace procedures 4.2 Work area is cleared of waste, cleaned, restored and secured in line with workplace procedures 4.3 Reusable material is collected and stored in line with workplace procedures 4.4 Waste disposal is conducted in accordance with workplace procedures 4.5 Tools and equipment are cleaned, checked, maintained and stored in line with workplace procedures 4.6 drilling machine is cleaned and lubricated in line with manufacturers' specifications and workplace procedures 4.7 Work completion details are finalised in line with workplace procedures	

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Underpinning Knowledge
The individual needs to demonstrate knowledge of: • Different parts of a drilling machine and their uses • Operating principles of a drilling machine • Safety and environmental hazards associated with drilling machine and drilling machine operations • Safety requirements and precautions • Drilling machine set up, start-up and shut-down procedures • Drill bits and other cutting tools used on a drilling machine • Cutting speeds and feeds • Different types and uses of coolants • Procedures for different drilling machine operations • Basic maintenance of a drilling machine
Generic Skills
The individual needs to demonstrate ability related to: • Communication • Team Work • Problem solving • Planning and Organising • Self-management • Technology

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TVET CURRICULUM DEVELOPMENT, ASSESSMENT AND CERTIFICATION COUNCIL (TVET CDACC)

NATIONAL OCCUPATIONAL STANDARD

Unit Standard Code: *MEM016 (Internal code)*	
Unit Standard Title: Perform surface and tool grinding operations	
KNQF Level: 3	**Credits: 2**

Unit Standard Description

This unit standard is intended for those who carry out mechanical engineering technology and maintenance operations. It specifies the competencies required to: Prepare for surface and tool grinding operations; perform surface grinding; Perform tool and cutter grinding; and Complete work and clean up.

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Unit Standard Title	Perform surface and tool grinding operations
Unit Scope	• Performance of all elements must comply with all relevant statutory, health, safety, environment, and worksite requirements, contractual agreement and/or manufacturers' specifications. • Surface grinding operations include but are not limited to the surface grinding of different types of metals including mild steel, medium carbon steels and aluminium. • Tool and cutter grinding includes but is not limited to drill bits, lathe tools, reamers, and milling cutters.
Element 1	**Prepare for surface and tool grinding operations**
Range	Planning and preparation may include but are not limited to workplace inspection, equipment defect identification, assessment of conditions and hazards and determination of work requirements.

Performance Criteria

1.1 Sequence of operations is determined by interpreting drawings and job instructions

1.2 Tools and equipment used in grinding operations are selected, handled, used, maintained and stored according to task requirements and manufacturers' specifications

1.3 The different parts of grinding machines are identified

1.4 The uses of the different parts of grinding machines are identified from manufacturers' manuals and specifications

1.5 The principles of operation of grinding machines are applied in line with manufacturers' manuals

1.6 Different types of ferrous and non-ferrous materials and alloys are identified, handled, used and stored according to manufacturers' specifications and workplace procedures

1.7 Safety and environmental hazards associated with the grinding machines and grinding machine operations are identified and prevented in line with regulatory requirements and workplace procedures

1.8 Safety precautions related to grinding machines and grinding machine operations are observed in line with regulatory requirements

1.9 Grinding machine is prepared for operation including lubrication, routine maintenance and pre-operational checks in line with manufacturers' specifications and workplace procedures

1.10 Work and tool holding fixtures and devices are selected and installed in line with manufacturers' specifications and workplace procedures

1.11 Grinding wheels are dressed and balanced in accordance with manufacturers' specifications and workplace procedures

1.12 Materials are prepared and marked out according to drawings and specifications

1.13 Work pieces and grinding wheels are mounted and secured according to manufacturers'

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specifications and workplace procedures 1.14 Grinding machine start-up and shut-down procedures are demonstrated in line with manufacturers' manuals 1.15 Cutting speeds and feeds are selected and set in accordance with type of materials and size of grinding wheel	
Element 2	**Perform surface grinding**
Range	N/A
Performance Criteria	
2.1 Surface grinding operations are performed according to drawings and specifications 2.2 Work pieces are measured and checked against work specifications and remedial actions undertaken 2.3 Housekeeping is observed including cleaning of working areas, cleaning of grinding machine and maintaining a clean and tidy work environment	
Element 3	**Perform tool and cutter grinding**
Range	N/A
Performance Criteria	
3.1 Tool and cutter grinding operations are performed according to work specifications 3.2 Work pieces are checked against work specifications and remedial action undertaken	
Element 4	**Complete work and clean up**
Range	Work completion details may include but are not limited to work schedule or appointment sheet and sign out form for equipment.
Performance Criteria	
4.1 Work is completed and appropriate personnel notified in line with workplace procedures 4.2 Work area is cleared of waste, cleaned, restored and secured in line with workplace procedures 4.3 Reusable material is collected and stored in line with workplace procedures 4.4 Waste disposal is conducted in accordance with workplace procedures 4.5 Tools and equipment are cleaned, checked, maintained and stored in line with workplace procedures 4.6 Grinding machine is cleaned and lubricated in line with manufacturers' specifications and workplace procedures 4.7 Work completion details are finalised in line with workplace procedures	

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Underpinning Knowledge
The individual needs to demonstrate knowledge of: • Reading and interpreting working drawings • Occupational and environmental health and safety • Selection, handling, use, maintenance and storage of tools, equipment and materials • Grinding tools • Setting up and operating surface and tool grinding machines • Measuring and testing
Generic Skills
The individual needs to demonstrate ability related to: • Communication • Team Work • Problem solving • Planning and Organising • Self-management • Technology

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TVET CURRICULUM DEVELOPMENT, ASSESSMENT AND CERTIFICATION COUNCIL (TVET CDACC)

NATIONAL OCCUPATIONAL STANDARD

Unit Standard Code: *MEM017 (Internal code)*	
Unit Standard Title: Produce components on a lathe	
KNQF Level: 3	**Credits: 4**

Unit Standard Description

This unit standard is intended for those who carry out mechanical engineering technology and maintenance operations. It specifies the competencies required to: Prepare for lathe machine operations; Perform lathe operations; Quality check machined work; Report lathe machine malfunctions, and Complete work and clean up.

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Unit Standard Title	Produce components on a lathe machine
Unit Scope	• Performance of all elements must comply with all relevant statutory, health, safety, environment, and worksite requirements, contractual agreement and/or manufacturers' specifications. • Materials include but are not limited to ferrous and non-ferrous materials and alloys. • Centre lathe operations include but are not limited to internal and external thread cutting, turning, knurling, facing, center drilling, boring and chamfering.
Element 1	**Prepare for lathe machine operations**
Range	Planning and preparation may include but are not limited to workplace inspection, equipment defect identification, assessment of conditions and hazards and determination of work requirements.

Performance Criteria

1.1 Sequence of operations is determined by interpreting drawings and job instructions

1.2 Tools and equipment used in lathe operations are selected, handled, used, maintained and stored according to task requirements and manufacturers' specifications

1.3 The uses of the different parts of a lathe machine are recognized from manufacturers' specifications

1.4 The principles of operation of a lathe machine are applied in line with manufacturers' manuals

1.5 Different types of ferrous and non-ferrous materials and alloys are identified, handled, used and stored according to manufacturers' specifications and workplace procedures

1.6 Safety and environmental hazards associated with a lathe machine and lathe operations are identified and prevented in line with regulatory requirements and workplace procedures

1.7 Safety precautions related to lathe machines and lathe operations are observed in line with regulatory requirements

1.8 Lathe machine is prepared for operation including lubrication, routine maintenance and pre-operational checks in line with manufacturers' specifications and workplace procedures

1.9 Work and tool holding fixtures and devices are selected and installed in line with manufacturers' specifications and workplace procedures

1.10 Lathe tools are ground in line with tool geometry

1.11 Materials are prepared and marked out according to drawings and specifications

1.12 Work pieces and lathe tools are mounted and secured according to manufacturers' specifications and workplace procedures

1.13 Lathe machine start-up and shut-down procedures are demonstrated in line with manufacturers' manuals

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1.14 Cutting speeds and feeds are selected and set in accordance with type and size of materials	
Element 2	**Perform lathe operations**
Range	N/A
Performance Criteria	
2.1 Lathe operations are carried out according to drawings and specifications 2.2 Routine dimension control is conducted in accordance with drawings and specifications 2.3 The operation of the lathe machine is monitored and adjustments to speeds and feeds made where required in line with standard procedures 2.4 Machined component is removed on completion of lathe operations	
Element 3	**Quality check machined work**
Range	N/A
Performance Criteria	
3.1 Measuring tools and equipment are selected and prepared in accordance with task requirements 3.2 Work is measured and checked against specifications and remedial measures undertaken 3.3 Non-conforming components are recorded and reported to appropriate personnel in line with workplace procedures	
Element 4	**Report lathe machine malfunctions**
Range	N/A
Performance Criteria	
4.1 Problems or malfunctions are detected in line with manufacturers' specifications 4.2 Malfunctions are recorded and reported to appropriate personnel in line with workplace procedures	
Element 5	**Complete work and clean up**
Range	Work completion details may include but are not limited to work schedule or appointment sheet and sign-out form for equipment.

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Performance Criteria
5.1 Work is completed and appropriate personnel notified in line with workplace procedures 5.2 Work area is cleared of waste, cleaned, restored and secured in line with workplace procedures 5.3 Reusable material is collected and stored in line with workplace procedures 5.4 Tools and equipment are cleaned, checked, maintained and stored in line with workplace procedures 5.5 Lathe machine is cleaned and lubricated in line with manufacturers' specifications and workplace procedures 5.6 Work completion details are finalised in line with workplace procedures
Underpinning Knowledge
The individual needs to demonstrate knowledge of: • Different parts of a lathe machine and their uses • Operating principles of a lathe machine • Safety and environmental hazards associated with lathe machine and lathe machine operations • Safety requirements and precautions • Lathe machine set up, start-up and shut-down procedures • Lathe tools • Cutting speeds and feeds • Different types and uses of coolants • Procedures for different lathe operations • Basic maintenance of lathe machine
Generic Skills
The individual needs to demonstrate ability related to: • Communication • Team Work • Problem solving • Planning and Organising • Self-management • Technology

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TVET CURRICULUM DEVELOPMENT, ASSESSMENT AND CERTIFICATION COUNCIL (TVET CDACC)

NATIONAL OCCUPATIONAL STANDARD

Unit Standard Code: *MEM018 (Internal code)*	
Unit Standard Title: Produce components on a milling machine	
KNQF Level: 3	**Credits: 4**

Unit Standard Description

This unit standard is intended for those who carry out mechanical engineering technology and maintenance operations. It specifies the competencies required to: Prepare for milling machine operations; Perform milling machine operations; Quality check machined work; Report milling machine malfunctions, and Complete work and clean up.

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Unit Standard Title	Produce components on a milling machine
Unit Scope	• Performance of all elements must comply with all relevant statutory, health, safety, environment, and worksite requirements, contractual agreement and/or manufacturers' specifications. • Materials include but are not limited to ferrous and non-ferrous materials and alloys. • Milling machine operations include but are not limited to cubical, end, straddle and gang milling; slotting; and gear cutting using vertical, horizontal and universal milling machines.
Element 1	**Prepare for milling machine operations**
Range	Planning and preparation may include but are not limited to workplace inspection, equipment defect identification, assessment of conditions and hazards and determination of work requirements.

Performance Criteria

1.1 Sequence of operations is determined by interpreting drawings and job instructions

1.2 Tools and equipment used in milling operations are selected, handled, used, maintained and stored according to task requirements and manufacturers' specifications

1.3 The different parts of milling machines are identified

1.4 The uses of the different parts of a milling machine are recognized from manufacturers' specifications

1.5 The principles of operation of a milling machine are applied in line with manufacturers' manuals

1.6 Different types of ferrous and non-ferrous materials and alloys are identified, handled, used and stored according to manufacturers' specifications and workplace procedures

1.7 Safety and environmental hazards associated with a milling machine and milling operations are identified and prevented in line with regulatory requirements and workplace procedures

1.8 Safety precautions related to milling machines and milling operations are observed in line with regulatory requirements

1.9 Milling machine is prepared for operation including lubrication, routine maintenance and pre-operational checks in line with manufacturers' specifications and workplace procedures

1.10 Work and tool holding fixtures and devices are selected and installed in line with manufacturers' specifications and workplace procedures

1.11 Milling cutters are ground in line with tool geometry

1.12 Materials are prepared and marked out according to drawings and specifications

1.13 Work pieces and milling cutters are mounted and secured according to manufacturers' specifications and workplace procedures

1.14 Milling machine start-up and shut-down procedures are demonstrated in line with

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manufacturers' manuals 1.15 Cutting speeds and feeds are determined, selected and set in accordance with type and size of materials and milling cutters	
Element 2	**Perform milling machine operations**
Range	N/A
Performance Criteria	
2.1 Milling operations are carried out according to drawings and specifications 2.2 Routine dimension control is conducted in accordance with drawings and specifications 2.3 The operation of the milling machine is monitored and adjustments to speeds and feeds made where required in line with standard procedures 2.4 Machined component is removed on completion of milling operations	
Element 3	**Quality check machined work**
Range	N/A
Performance Criteria	
3.1 Measuring tools and equipment are selected and prepared in accordance with task requirements 3.2 Work is measured and checked against specifications and remedial measures undertaken 3.3 Non-conforming components are recorded and reported to appropriate personnel in line with workplace procedures	
Element 4	**Report milling machine malfunctions**
Range	N/A
Performance Criteria	
4.1 Problems or malfunctions are detected in line with manufacturers' specifications 4.2 Malfunctions are recorded and reported to appropriate personnel in line with workplace procedures	

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Element 5	**Complete work and clean up**
Range	Work completion details may include but are not limited to work schedule or appointment sheet and sign-out form for equipment.

Performance Criteria

5.1 Work is completed and appropriate personnel notified in line with workplace procedures

5.2 Work area is cleared of waste, cleaned, restored and secured in line with workplace procedures

5.3 Reusable material is collected and stored in line with workplace procedures

5.4 Tools and equipment are cleaned, checked, maintained and stored in line with workplace procedures

5.5 Milling machine is cleaned and lubricated in line with manufacturers' specifications and workplace procedures

5.6 Work completion details are finalised in line with workplace procedures

Underpinning Knowledge

The individual needs to demonstrate knowledge of:

- Different parts of a milling machine and their uses
- Operating principles of a lathe machine
- Safety and environmental hazards associated with lathe machine and lathe machine operations
- Safety requirements and precautions
- Milling machine set up, start-up and shut-down procedures
- Milling tools
- Cutting speeds and feeds
- Different types and uses of coolants
- Procedures for different milling operations
- Basic maintenance of a milling machine

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Generic Skills
The individual needs to demonstrate ability related to: • Communication • Team Work • Problem solving • Planning and Organising • Self-management • Technology

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TVET CURRICULUM DEVELOPMENT, ASSESSMENT AND CERTIFICATION COUNCIL (TVET CDACC)

NATIONAL OCCUPATIONAL STANDARD

Unit Standard Code: *MEM019 (Internal code)*	
Unit Standard Title: Install and service lubrication systems, seals and bearings	
KNQF Level: 4	**Credits: 2**

Unit Standard Description

This unit standard is intended for those who carry out mechanical engineering technology and maintenance operations. It specifies the competencies required to: Plan and prepare for work; Apply knowledge of different types of friction; Use lubricants for specific applications; Maintain lubrication systems; Use seals, gaskets and packing for specific applications; and Use different types of bearings for specific applications.

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Unit Standard Title	Install and service lubrication systems, seals and bearings
Unit Scope	• Lubrication systems include but are not limited to automatic, pressure, gravity, reservoir, splash, flinger, manual, and capillary. • Classes of sealing include but are not limited to external and internal sealing: positive and non-positive; static and dynamic. • Mechanical seals include but are not limited to balanced, unbalanced, internal, external, tandem, duplex, and piston rings. • Contact seals include but are not limited lip seals (felt, finger, others). • Non-contact seals include but are not limited to labyrinth, annulus and grease injected. • Packing include but is not limited to O-rings, V-packing, U-section packing, cup packing, jam packing, and compression packing. • Types of gaskets include but are not limited to pipe gaskets, rubber gaskets, non-asbestos gaskets, cork gaskets, and spiral wound gaskets. • Bearings include friction and anti-friction bearings. • Performance of all elements must comply with all relevant statutory, health, safety, environment, and worksite requirements, contractual agreement and/or manufacturers' specifications.
Element 1	**Plan and prepare for work**
Range	Planning and preparation may include but are not limited to workplace inspection, equipment defect identification, assessment of conditions and hazards and determination of work requirements.
Performance Criteria	
1.1 Job requirements are determined from workplace instructions 1.2 Plans are developed to eliminate, avoid/neutralize all identified risks in accordance with safety regulations, legislation and site specific instructions 1.3 Sequence of operations is determined according to site operational requirements 1.4 Required tools, equipment and materials are selected according to job specifications 1.5 Work area is inspected and prepared according to site operational requirements 1.6 Occupational and environmental health and safety requirements are followed according to statutory requirements and work place procedures 1.7 Personal protective equipment is used according to work place and statutory requirements	
Element 2	**Apply knowledge of different types of friction**

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Range	Different types of friction include but are not limited to rolling, sliding fluid, and starting.
Performance Criteria	
2.1 Different types of friction are identified from specifications 2.2 Causes and effects of friction are identified from manuals and specifications 2.3 Methods for the control of friction are identified and applied according to standard procedures	
Element 3	**Use lubricants for specific applications**
Range	Different types of lubricants include but are not limited to grease, oil and synthetic oils.
Performance Criteria	
3.1 The properties, characteristics and applications of different types of lubricants are identified from manufacturers' manuals 3.2 Lubricants are selected for different applications 3.3 Lubricants are safely handled, used and stored in accordance with occupational and environmental health and safety regulations and manufacturers' specifications	
Element 4	**Maintain lubrication systems**
Range	N/A
Performance Criteria	
4.1 Different types of lubrication systems are identified from manuals and specifications 4.2 Lubrication systems are maintained and serviced according to workplace procedures	
Element 5	**Use seals, gaskets and packing for specific applications**
Range	N/A
Performance Criteria	
5.1 Different types of seals, gaskets and packing and their applications are identified from manufacturers' specifications 5.2 Seals, gaskets and packing are installed according to manufacturers' specifications and workplace procedures 5.3 Use, handle and store seals, gaskets and packing in accordance with occupational and environmental health and safety regulations and manufacturers' specifications	
Element 6	**Use different types of bearings for specific applications**

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Range	Types of bearings include friction and non-friction bearings.

Performance Criteria

6.1 Knowledge of the various types of friction and load conditions associated with bearings is applied

6.2 The constructional features, principles of operation, applications, advantages and limitations of different types of bearings are identified from manufacturers' specifications

6.3 Bearings are installed and removed according to manufacturers' specifications and workplace procedures

6.4 Bearings are repaired and maintained according to manufacturers' specifications and workplace procedures

Underpinning Knowledge

The individual needs to demonstrate knowledge of:

- Properties, characteristics and applications of different types of lubricants
- Safe use, handling and storage of lubricants
- Different types of lubrication systems
- Types of seals such as static, dynamic, mechanical, contact and non-contact
- Seal faults such as leaking, deterioration and improper installation
- Seal materials' compatibility with medium
- Different types of gaskets and packing and their applications
- Types of bearings: anti-friction and friction; anti-friction split bearings
- Types of bearing fits such as press, slide and interference
- Types of bearing housings such as pillow blocks, split and flange
- Style of bearings such as radial and axial
- Types of arrangements of bearings such as fixed and floating
- Anti-friction (rolling element-type) bearing installation and removal tools and equipment such as taper locks, cam locks and pullers
- Bearing faults such as loss of clearance, overheating, excessive lubrication and lack of lubrication
- Bearing fits and tolerances
- Earing materials such as new alloys and advanced plastics
- Initial, installed and running bearing clearances according to manufacturers' specifications

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Generic Skills
The individual needs to demonstrate ability related to: • Communication • Team Work • Problem solving • Planning and Organising • Self-management • Technology

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TVET CURRICULUM DEVELOPMENT, ASSESSMENT AND CERTIFICATION COUNCIL (TVET CDACC)

NATIONAL OCCUPATIONAL STANDARD

Unit Standard Code: *MEM020 (Internal code)*	
Unit Standard Title: Perform preventive and predictive maintenance on mechanical machinery	
KNQF Level: 4	**Credits: 2**

Unit Standard Description

This unit standard is intended for those who carry out mechanical engineering technology and maintenance operations. It specifies the competencies required to: Prepare for work; Perform preventive maintenance activities; Perform predictive maintenance activities; and Schedule preventive and predictive maintenance.

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Unit Standard Title	Perform preventive and predictive maintenance on mechanical machinery
Unit Scope	Performance of all elements must comply with all relevant statutory, health, safety, environment, and worksite requirements, contractual agreement and/or manufacturers' specifications. This unit of competence includes but is not limited to the following: • Fans and Blowers: impellers, rotors, bearings, shafts, seals, bearing housings, fixing rings, gears, couplings, belts, louvers, and safety guards. • Compressors: air dryers, bearings, shafts, seals, gears, couplings, belts, and safety guards. • Pumps: impellers, bearings, shafts, seals, packings, shim packs, lantern rings, mechanical seals, wear rings, couplings, belts, face plates, and safety guards. • Conveying Systems: couplings, pulleys, clutches, rollers, bearings, sprockets, chains, belts, buckets, screws, piping, gear boxes, drive systems, ploughs, chutes, screens, filters, and safety guards. • Process Tanks and Containers: agitators, filters, mechanical seals, packings, level and temperature indicators, pumps, valves, liners, and venting systems.
Element 1	**Prepare for work**
Range	Planning and preparation may include but are not limited to workplace inspection, equipment defect identification, assessment of conditions and hazards and determination of work requirements.

Performance Criteria

1.1 Work instructions, including plans, specifications, quality requirements and operational details are obtained, confirmed and applied

1.2 Sequence of operations is determined by interpreting drawings and job instructions

1.3 Tools and equipment are selected, handled, used, maintained and stored according to task requirements and manufacturers' specifications

1.4 Plant, tools and equipment selected to carry out tasks are consistent with the requirements of the job, checked for serviceability and any faults are rectified or reported prior to commencement of work in accordance with workplace procedures

1.5 Materials appropriate to the work application are identified, obtained, prepared, safely handled and located ready for use in accordance with job requirements and workplace procedures

1.6 Safety and environmental hazards are identified and prevented in accordance with regulatory requirements

1.7 Safety requirements are followed in accordance with safety regulatory requirements, plans and policies

1.8 Sign and barricade requirements are identified and adhered to in accordance with regulatory

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requirements 1.9 Environmental protection requirements are identified and applied in line with environmental plans and regulatory obligations	
Element 2	**Perform preventive maintenance activities**
Range	N/A
Performance Criteria	
2.1 Sensory inspections of machinery, equipment and components are performed at predetermined times to determine any malfunction in line with manufacturers' specifications and workplace procedures 2.2 Measurements, level and temperature of fluids are checked and maintained according to manufacturers' recommendations 2.3 Components are greased and lubricated according to site and manufacturers' specifications 2.4 Tension on components such as belts, chains and tie rods are adjusted according to manufacturers' specifications 2.5 Information for future equipment evaluation and eventual repair are recorded in accordance with workplace procedures	
Element 3	**Perform predictive maintenance activities**
Range	Specialised tools and equipment include but are not limited to vibration monitoring equipment, thermographic testing equipment, airflow meters, and tachometers.
Performance Criteria	
3.1 Specialized tools and equipment are used based on their applications and limitations in line with manufacturers' specifications 3.2 Faults or defects in the machinery or equipment are detected and rectified in accordance with workplace procedures 3.3 Information for future equipment evaluation and eventual repair is recorded in accordance with workplace procedures	
Element 4	**Schedule preventive and predictive maintenance**
Range	N/A

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Performance Criteria
4.1 Lockout tag out are conducted for safety purposes in line with workplace procedures 4.2 Equipment's criticality, its failure history and its life expectancy are determined in line with manufacturers' specifications and workplace procedures 4.3 Collected data is reviewed and suitable maintenance schedules determined in line with workplace procedures
Underpinning Knowledge
The individual needs to demonstrate knowledge of: • Benefits of RCM methodology • Specialized predictive maintenance tools such as data collectors and computerized maintenance management systems (CMMS) • Safe operating temperatures and pressures for different equipment • Safe use and operation of specialized tools and equipment • Maintenance history and life expectancy of equipment • Manufacturers' specifications for different equipment • Condition-based monitoring technologies and tools such as strobe lights, stethoscope, vibration data collectors, infrared cameras and temperature guns • Procedures for preventive and predictive maintenance
Generic Skills
The individual needs to demonstrate ability related to: • Communication • Team Work • Problem solving • Planning and Organising • Self-management • Technology

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TVET CURRICULUM DEVELOPMENT, ASSESSMENT AND CERTIFICATION COUNCIL (TVET CDACC)

NATIONAL OCCUPATIONAL STANDARD

Unit Standard Code: *MEM021 (Internal code)*	
Unit Standard Title: Diagnose and repair faults on machinery during production and operation	
KNQF Level: 4	**Credits: 2**

Unit Standard Description

This unit standard is intended for those who carry out mechanical engineering technology and maintenance operations. It specifies the competencies required to: Prepare for work; Monitor the performance of equipment and machinery during operation; and Perform minor repairs on line.

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Unit Standard Title	Diagnose and repair faults on machinery during production and operation
Unit Scope	• The unit includes the monitoring of performance of machinery and equipment and the repair of faults during production and operation. • Performance of all elements must comply with all relevant statutory, health, safety, environment, and worksite requirements, contractual agreement and/or manufacturers' specifications.
Element 1	**Prepare for work**
Range	Planning and preparation may include but are not limited to workplace inspection, equipment defect identification, assessment of conditions and hazards and determination of work requirements.
Performance Criteria	
1.1 Work instructions, including plans, specifications, quality requirements and operational details are obtained, confirmed and applied 1.2 Sequence of operations is determined by interpreting drawings and job instructions 1.3 Tools and equipment are selected, handled, used, maintained and stored according to task requirements and manufacturers' specifications 1.4 Plant, tools and equipment selected to carry out tasks are consistent with the requirements of the job, checked for serviceability and any faults are rectified or reported prior to commencement of work in accordance with workplace procedures 1.5 Materials appropriate to the work application are identified, obtained, prepared, safely handled and located ready for use in accordance with job requirements and workplace procedures 1.6 Safety and environmental hazards are identified and prevented in accordance with regulatory requirements 1.7 Safety requirements are followed in accordance with safety regulatory requirements, plans and policies 1.8 Sign and barricade requirements are identified and adhered to in accordance with regulatory requirements 1.9 Environmental protection requirements are identified and applied in line with environmental plans and regulatory obligations	
Element 2	**Monitor the performance of equipment and machinery during operation**
Range	N/A

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Performance Criteria
2.1 Recurrent equipment and machinery faults and their root causes are identified in line with workplace procedures 2.2 Documentation on major repair requirements is completed in line with workplace procedures 2.3 Major repair requirements are reported in line with workplace procedures 2.4 Production time schedule is maintained in line with specifications and workplace procedures 2.5 Potential operational and maintenance problems in the plant are documented in line with workplace procedures

Element 3	**Perform minor repairs on line**
Range	N/A

Performance Criteria
3.1 Equipment and machinery are dismantled and components requiring major repair dispatched to workshop in line with manufacturers' specifications and workplace procedures 3.2 Minor repairs on equipment and machinery are conducted in line with manufacturers' specifications and workplace procedures 3.3 The repairs are documented and reported to appropriate personnel in line with workplace procedures

Underpinning Knowledge
The individual needs to demonstrate knowledge of: • Safety, health and environmental protection legislation and standards • Recurrent faults on equipment and machinery, causes and effects, and possible corrective action • Common conditions leading to equipment and machinery component failure and methods of prevention • Procedures for identifying potential production and maintenance problems • Causes and effects of defects and worn/damaged parts on equipment and machinery and maintenance and repair procedures • Replacement parts and materials • Procedures for performing minor repairs on line

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Generic Skills
The individual needs to demonstrate ability related to: • Communication • Team Work • Problem solving • Planning and Organising • Self-management • Technology

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TVET CURRICULUM DEVELOPMENT, ASSESSMENT AND CERTIFICATION COUNCIL (TVET CDACC)

NATIONAL OCCUPATIONAL STANDARD

Unit Standard Code: *MEM022 (Internal code)*	
Unit Standard Title: Maintain fans, blowers and compressors	
KNQF Level: 4	**Credits: 4**

Unit Standard Description

This unit standard is intended for those who carry out mechanical engineering technology and maintenance operations. It specifies the competencies required to: Prepare for work; Install fans and blowers; Diagnose faults on fans and blowers; Repair fans and blowers; Service fans and blowers; Install compressors; Diagnose faults on compressors; Repair compressors; and Service compressors.

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Unit Standard Title	Maintain fans, blowers and compressors
Unit Scope	Performance of all elements must comply with all relevant statutory, health, safety, environment, and worksite requirements, contractual agreement and/or manufacturers' specifications. This unit of competence includes but is not limited to the following: • Servicing fans and blowers: impellers, rotors, lobes, sheaves, bearings, shafts, seals, bearing housings, fixing rings, couplings, belts, louvers, and safety guards. • Servicing compressors: screws check valves, pressure relief valves, pressure regulators, air dryers, accumulators, filters, lubrication and cooling systems, sheaves, bearings, shafts, seals, couplings, belts, and safety guards.
Element 1	**Prepare for work**
Range	Planning and preparation may include but are not limited to workplace inspection, equipment defect identification, assessment of conditions and hazards and determination of work requirements.

Performance Criteria

1.1 The different types, components and principles of operation of fans, blowers and compressors are identified in line with manufacturers' specifications

1.2 Work instructions, including plans, specifications, quality requirements and operational details are obtained, confirmed and applied

1.3 Sequence of operations is determined by interpreting drawings and job instructions

1.4 Tools and equipment are selected, handled, used, maintained and stored according to task requirements and manufacturers' specifications

1.5 Plant, tools and equipment selected to carry out tasks are consistent with the requirements of the job, checked for serviceability and any faults are rectified or reported prior to commencement of work in accordance with workplace procedures

1.6 Materials appropriate to the work application are identified, obtained, prepared, safely handled and located ready for use in accordance with job requirements and workplace procedures

1.7 Safety and environmental hazards are identified and prevented in accordance with regulatory requirements

1.8 Safety requirements are followed in accordance with safety regulatory requirements, plans and policies

1.9 Sign and barricade requirements are identified and adhered to in accordance with regulatory requirements

1.10 Environmental protection requirements are identified and applied in line with environmental plans and regulatory obligations

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Element 2	Install fans and blowers
Range	N/A
Performance Criteria	
2.1 Location and elevation for installation are determined according to engineered drawings 2.2 Foundations for blowers and fans are prepared according to engineered drawings 2.3 Fans and blowers are aligned, levelled and secured in line with specifications and standard procedures 2.4 Delivery and suction pipe are connected in line with manufacturers' specifications 2.5 Safety guards are installed according to manufacturers' specifications and OH&S Regulations 2.6 Direction of rotation, static and dynamic balance, and vibration are checked and faults rectified in line with manufacturers' specifications and workplace procedures	
Element 3	**Diagnose faults on fans and blowers**
Range	Specialised tools and equipment include but are not limited to vibration monitoring equipment, thermographic testing equipment, airflow meters, and tachometers.
Performance Criteria	
3.1 Information on the descriptions and symptoms of the problem is obtained and analysed in line with workplace procedures 3.2 The sensory inspection of components is performed in line with manufacturers' specifications and workplace procedures 3.3 Specialized equipment are used in line with manufacturers' specifications 3.4 Conditions that led to failure or breakdown of fans and blowers are identified in line with workplace procedures 3.5 The type of repair required is determined according to inspection and vibration analysis results in line with manufacturers' specifications and workplace procedures	
Element 4	**Repair fans and blowers**
Range	N/A
Performance Criteria	
4.1 Imbalances are rectified in line with manufacturers' specifications and workplace procedures 4.2 Defective fan and blower components are replaced in line with manufacturers' specifications and workplace procedures	

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Element 5	**Service fans and blowers**
Range	N/A
Performance Criteria	
5.1 Maintenance requirements are verified against manufacturers' specifications 5.2 Components of fans and blowers are inspected in line with manufacturers' specifications and workplace procedures 5.3 Fan blades are cleaned in line with workplace procedures 5.4 Bearings and couplings are lubricated in line with manufacturers' specifications and workplace procedures 5.5 Fan and blower components are re-aligned and adjusted in line with manufacturers' specifications and workplace procedures	

Element 6	**Install compressors**
Range	N/A
Performance Criteria	
6.1 Tools, equipment and materials are selected in line with job requirements 6.2 Required pressure is confirmed according to engineered drawings and plant demand 6.3 Location and elevation for installation are determined according to engineered drawings 6.4 Foundations for compressors are prepared according to engineered drawings 6.5 Grout is applied to distribute load and minimize vibration in accordance with workplace procedures 6.6 Direction of rotation and vibrations are monitored and faults rectified in line with manufacturers' specifications and workplace procedures 6.7 Delivery and suction pipes are connected in line with manufacturers' specifications 6.8 Accessories are installed including silencers, filters, air dryers, lubricators and scrubbers in line with manufacturers' specifications 6.9 Compressors are connected and aligned to prime mover through couplings, sheaves and belts according to specifications 6.10 Vibration analysis of coupled system is conducted according to workplace procedures 6.11 Safety guards are installed according to manufacturers' specifications and OH&S Regulations	

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Element 7	**Diagnose faults on compressors**
Range	N/A
Performance Criteria	
7.1 Information on descriptions and symptoms of the problem is obtained and analysed in line with workplace procedures 7.2 Sensory inspection of components is performed in line with manufacturers' specifications and workplace procedures 7.3 Specialized equipment and procedures are used in accordance with manufacturers' specifications 7.4 Conditions that led to failure or breakdown of compressors are identified in line with workplace procedures 7.5 Type of repair required is determined according to inspection and vibration analysis results in line with manufacturers' specifications and workplace procedures	
Element 8	**Repair compressors**
Range	N/A
Performance Criteria	
8.1 Tools and equipment are selected and used according to job requirements 8.2 Defective compressor components are refurbished according to manufacturers' specifications and workplace procedures 8.3 Defective compressor components are replaced in line with manufacturers' specifications and workplace procedures	
Element 9	**Service compressors**
Range	N/A

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Performance Criteria
9.1 Maintenance requirements are verified according to manufacturers' specifications 9.2 Compressor components are inspected in line with workplace procedures 9.3 Bearings and couplings are lubricated in accordance with specifications 9.4 Prime movers are aligned to compressor in line with standard procedures 9.5 Oil filters and air filters are cleaned and replaced in accordance with manufacturers' specifications 9.6 Fluid levels, temperatures and pressures are checked and maintained in line with manufacturers' specifications 9.7 Drive couplings are re-aligned and loading and unloading set points adjusted in line with manufacturers' specifications 9.8 Moisture is drained from compressors, coolers and receivers in line with manufacturers' specifications 9.9 Operation of relief valves, check valves and auto drain valves are verified in line with in line with manufacturers' specifications
Underpinning Knowledge
The individual needs to demonstrate knowledge of: • Types of fan systems including induction and forced draft • Types of fans including centrifugal and axial flow fans • Types of blowers including radial and axial • Components of fans and blowers including couplings, belts, shafts and sheaves • Fan and blower faults including imbalance, improper lubrication and bearing failure • Fan and blower specifications such as cubic feet per minute (CFM), horsepower, speeds, volumes and clearances • Compressor accessories including air dryers, filters, regulators, lubricators, pressure relief valves, intercoolers and after coolers • Compressor components including pistons, screws, vanes, impellers and valves • Compressor applications including air supply, gas supply and process control • Compressor faults including lack of pressure, and excessive loading and unloading • Compressor specifications including CFM, horsepower, pressure and volumes • Cooling and lubrication systems • Drive components including couplings and belts • Manufacturers' specifications for fans, blowers and compressors

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Generic Skills
The individual needs to demonstrate ability related to: • Communication • Team Work • Problem solving • Planning and Organising • Self-management • Technology

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TVET CURRICULUM DEVELOPMENT, ASSESSMENT AND CERTIFICATION COUNCIL (TVET CDACC)

NATIONAL OCCUPATIONAL STANDARD

Unit Standard Code: *MEM023 (Internal code)*	
Unit Standard Title: Service conveying systems	
KNQF Level: 4	**Credits: 4**

Unit Standard Description

This unit standard is intended for those who carry out mechanical engineering technology and maintenance operations. It specifies the competencies required to: Plan and prepare for work; Identify the constructional features and components of different types of conveyors; Identify methods of loading and unloading conveyors and types of process tanks and containers; Install conveyor systems; Diagnose faults on conveying systems and process tanks and containers; Maintain conveying systems; and Repair and service process tanks and containers.

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Unit Standard Title	Service conveying systems
Unit Scope	• Conveying systems include but are not limited to bulk loading (belt, screw, bucket, pneumatic. chain, elevator) and solid material or package loads (chain, roller, roll cases, transfer tables, elevator, belt, monorail). • The unit includes installation, diagnosis, repair and maintenance of conveying systems limit switches, gear reduction units, emergency stops, couplings, magnets, pulleys, rollers, bearings, sprockets, chains and belts cyclones, bag shakers, screens and precipitators bearings, couplings, idlers, conveyor belts, mechanical splices, and rotary valve replacement. • Performance of all elements must comply with all relevant statutory, health, safety, environment, and worksite requirements, contractual agreement and/or manufacturers' specifications.
Element 1	**Plan and prepare for work**
Range	Planning and preparation may include but are not limited to workplace inspection, equipment defect identification, assessment of conditions and hazards and determination of work requirements.

Performance Criteria

1.1 The different types, components and principles of operation of conveying systems are identified in line with manufacturers' specifications

1.2 Work instructions, including plans, specifications, quality requirements and operational details are obtained, confirmed and applied

1.3 Sequence of operations is determined by interpreting drawings and job instructions

1.4 Tools and equipment are selected, handled, used, maintained and stored according to task requirements and manufacturers' specifications

1.5 Plant, tools and equipment selected to carry out tasks are consistent with the requirements of the job, checked for serviceability and any faults are rectified or reported prior to commencement of work in accordance with workplace procedures

1.6 Materials appropriate to the work application are identified, obtained, prepared, safely handled and located ready for use in accordance with job requirements and workplace procedures

1.7 Safety and environmental hazards are identified and prevented in accordance with regulatory requirements

1.8 Safety requirements are followed in accordance with safety regulatory requirements, plans and policies

1.9 Sign and barricade requirements are identified and adhered to in accordance with regulatory requirements

1.10 Environmental protection requirements are identified and applied in line with environmental plans and regulatory obligations

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Element 2	**Identify the constructional features and components of different types of conveyors**
Range	N/A
Performance Criteria	
2.1 Different types of conveyors and their applications are identified from manufacturers' manuals 2.2 The functions of the components of different types of conveyors are identified from manufacturers' manuals	
Element 3	**Identify methods of loading and unloading conveyors and types of process tanks and containers**
Range	N/A
Performance Criteria	
3.1 Methods of loading and unloading conveyors are identified and applied in line with specifications and workplace procedures 3.2 Types and functions of process tanks and storage containers are identified 3.3 Standard operating procedures for tanks and process vessels for confined space entry are followed	
Element 4	**Install conveyor systems**
Range	N/A
Performance Criteria	
4.1 Location and elevation for installation are determined according to engineered drawings 4.2 Base or mounting brackets are prepared according to design specifications and type of installation 4.3 Foundation is prepared according to engineered drawings 4.4 Conveying system is assembled according to design specifications. 4.5 Conveyor components such as bearings, pulleys, rollers, gear reduction units and take-ups are installed in accordance with manufacturers' specifications 4.6 Conveying system is positioned in place using rigging, hoisting/lifting and moving equipment in line with standard procedures 4.7 Conveying system is aligned, levelled and secured in line with manufacturers' specifications 4.8 Load is distributed and vibration minimized by grouting in line with workplace procedures 4.9 Clearances are set according to manufacturers' specifications. 4.10 Direction of rotation is checked in line with manufacturers' specifications	

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4.11 In-feed and discharge are connected in line with manufacturers' specifications	
Element 5	**Diagnose faults on conveying systems and process tanks and containers**
Range	N/A
Performance Criteria	
5.1 Information on the descriptions and symptoms of the problem is obtained and analysed in line with workplace procedures 5.2 The sensory inspection of components is performed in line with manufacturers' specifications and workplace procedures 5.3 Condition-based monitoring routine procedures are performed to detect underlying defects not identified through sensory inspection in line with standard procedures 5.4 Conditions that led to failure or breakdown of conveying systems and process tanks and containers are identified in line with workplace procedures 5.5 The type of repair required is determined according to results of inspection and condition based monitoring in accordance with workplace procedures	
Element 6	**Maintain conveying systems**
Range	N/A
Performance Criteria	
6.1 Defective components are replaced or repaired in line with manufacturers' specifications 6.2 Bearings and couplings lubricated in line with manufacturers' specifications 6.3 Prime mover is aligned to conveyor system in line with manufacturers' specifications 6.4 Belts and chains are connected using appropriate methods in line with in line with manufacturers' specifications and standard procedures 6.5 Belt tracking issues are corrected, energized and returned to operation in line with standard procedures 6.6 Maintenance requirements are verified according to manufacturers' specifications 6.7 Lubricant levels are checked in line with manufacturers' specifications 6.8 Temperatures are measured and compared against specifications 6.9 Drive coupling is re-aligned in line with manufacturers' specifications 6.10 Clearances are checked against manufacturers' specifications 6.11 Cleanliness levels in the system are maintained in line with in line with manufacturers' specifications 6.12 Drive components and accessories are tensioned in line with manufacturers' specifications 6.13 Tracking of mechanical conveying systems is adjusted in line with manufacturers'	

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specifications	
Element 7	**Repair and service process tanks and containers**
Range	N/A

Performance Criteria

7.1 Defective components are refurbished or replaced in line with manufacturers' specifications

7.2 Dimensions of components are measured and compared to specifications

7.3 Components are adjusted and lubricated in line with manufacturers' specifications

7.4 Filters and strainers are cleaned or replaced in line with manufacturers' specifications

7.5 Fluid levels, temperatures, pressures, vacuum and flow rates are checked against specifications

7.6 Pressure relief valves and holes are adjusted in line with manufacturers' specifications

7.7 Component clearances are set according to manufacturers' specifications

7.8 Liners are changed in line with manufacturers' specifications

7.9 Ventilation systems are cleared for blockages in line with workplace procedures

Underpinning Knowledge

The individual needs to demonstrate knowledge of:

- Types of mechanical conveying systems including belt, chain, screw, roller and
- bucket
- Types of pneumatic and hydraulic conveying systems such as low pressure
- and high pressure
- Conveying system accessories such as trippers, ploughs, chutes, screens, skirt
- boards and flights
- Conveying system faults such as belt tracking, worn components and
- improper tension
- Conveying system specifications such as speed, distance travelled and load
- weight
- Conveyor components such as scrapers, bearings, sprockets, chains, belts and
- counter-weight assemblies
- Types of filters such as cyclones, bag shakers and precipitators
- Types of pulleys and rollers such as crowned, tail, take-up, tracking, idler and
- snub
- Types of gear boxes

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- Manufacturers' specifications
- Materials to be conveyed
- Condition-based monitoring technologies such as vibration analysis, UT, fluid analysis, infrared thermography and motor current analysis
- Condition-based monitoring tools such as strobe lights, stethoscope, vibration data collectors, infrared cameras and temperature guns
- Diagnostic procedures using appropriate condition-based monitoring technology(ies) and tools

Generic Skills

The individual needs to demonstrate ability related to:

- Communication
- Team Work
- Problem solving
- Planning and Organising
- Self-management
- Technology

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TVET CURRICULUM DEVELOPMENT, ASSESSMENT AND CERTIFICATION COUNCIL (TVET CDACC)

NATIONAL OCCUPATIONAL STANDARD

Unit Standard Code: *MEM024 (Internal code)*	
Unit Standard Title: Install and maintain pumps	
KNQF Level: 4	**Credits: 3**

Unit Standard Description

This unit standard is intended for those who carry out mechanical engineering and maintenance operations. It specifies the competencies required to: Plan and prepare for work; Identify the constructional features and operating principles of different types of pumps; Install positive and non-positive displacement pumps; Diagnose faults on positive and non-positive displacement pumps; and Maintain positive and non-positive displacement pumps.

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Unit Standard Title	Install and maintain pumps
Unit Scope	• Pumps include but are not limited to: positive displacement pumps; non-positive displacement pumps; multi stage and single stage pumps. • Performance of all elements must comply with all relevant statutory, health, safety, environment, and worksite requirements, contractual agreement and/or manufacturers' specifications.
Element 1	**Plan and prepare for work**
Range	Planning and preparation may include but are not limited to workplace inspection, equipment defect identification, assessment of conditions and hazards and determination of work requirements.
Performance Criteria	
1.1 Job requirements are determined from workplace instructions 1.2 Plans are developed to eliminate, avoid/neutralize all identified risks in accordance with safety regulations, legislation and site specific instructions 1.3 Sequence of operations is determined according to site operational requirements 1.4 Required tools, equipment and materials are selected according to job specifications 1.5 Affected parties are informed and liaised with according to workplace procedures 1.6 Work site is inspected and prepared according to site operational requirements 1.7 Occupational and environmental health and safety requirements are followed according to statutory requirements and work place procedures 1.8 Personal protective equipment is used according to site and statutory requirements	
Element 2	**Identify the constructional features and operating principles of different types of pumps**
Range	The operating principles of pumps include but are not limited to positive displacement, non-positive displacement and relationship of pressure and flow.
Performance Criteria	
2.1 Different types of pumps are identified from manufacturers' manuals including positive displacement pumps such as gear, vane and piston pumps, non-positive displacement pumps such as centrifugal and axial pumps, multi-stage and single stage pumps 2.2 The operating principles and theory of the different types of pumps are identified and applied in accordance with manufacturers' specifications 2.3 The advantages, disadvantages and applications of the different types of pumps are identified from manufacturers' specifications including the advantages and applications of multi stage and single stage centrifugal pumps 2.4 The functions of the major components of positive displacement and non-positive	

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displacement pumps and are identified from manufacturers' manuals 2.5 The uses, advantages and disadvantages of different types of pump materials are recognized from manufacturers' specifications 2.6 Pump specifications are interpreted including pump curves, volumes, pressures, flow and clearances 2.7 Cooling and lubrication systems are identified and applied in line with manufacturers' specifications and workplace procedures 2.8 The functions of drive components such as couplings, sheaves and belts are identified from manufacturers' manuals 2.9 Pumps are selected for different applications in line with job requirements and manufacturers' specifications

Element 3	**Install positive and non-positive displacement pumps**
Range	N/A

Performance Criteria
3.1 Location and elevation for installation is determined according to engineered drawings 3.2 Base for pump is cleaned 3.3 Rough-up foundation is prepared according to engineered drawings 3.4 Pump is placed in position using rigging, lifting and moving equipment in line with standard procedures 3.5 Pump is levelled, aligned and secured in line with workplace procedures 3.6 Load distribution is conducted and vibration minimized by grouting in line with manufacturers' specifications and workplace procedures 3.7 Pump clearances are set according to manufacturers' specifications 3.8 Components are installed including seals manufacturers' specifications and workplace procedures 3.9 Components are adjusted including packings in accordance with standard procedures 3.10 Inlet and outlet are connected in line with manufacturers' specifications 3.11 Stress on pump is eliminated by relieving pipe strain in accordance with specifications

Element 4	**Diagnose faults on positive and non-positive displacement pumps**
Range	N/A

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Performance Criteria
4.1 Information on the descriptions and symptoms of the problem is obtained and analysed in line with workplace procedures
4.2 The sensory inspection of components is performed in accordance with manufacturers' specifications and workplace procedures
4.3 Condition-based monitoring routine procedures are performed to detect underlying defects not identified through sensory inspection in accordance with standard procedures
4.4 Conditions that led to failure or breakdown of pumps are identified in line with workplace procedures
4.5 The type of repair required is determined according to results of inspection and condition based monitoring in accordance with workplace procedures

Element 5	**Maintain positive and non-positive displacement pumps**
Range	N/A

Performance Criteria
5.1 Maintenance requirements are verified according to manufacturers' specifications
5.2 Defective pump components are replaced according to manufacturers' specifications including bearings, seals, packings, valves, filters and strainers
5.3 Strainers are cleaned in line with workplace procedures
5.4 Fluid levels such as coolant, oil and grease are checked and maintained in accordance with specifications
5.5 Temperatures, vacuum, pressure and flow rates are checked and the necessary repairs and adjustments made in accordance with specifications
5.6 Drive coupling is re-aligned in line with standard procedures
5.7 The operation of valves is verified against specifications
5.8 Packings are adjusted in accordance with specifications
5.9 Mechanical seals are monitored in accordance with workplace procedures
5.10 Clearances are checked against manufacturers' specifications and adjustments made
5.11 Bearings and couplings are lubricated in line with manufactures' specifications
5.12 Component dimensions are measured against specifications

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Underpinning Knowledge
The individual needs to demonstrate knowledge of: • Pump terminology such as static head, suction head and suction lift • Positive displacement pumps such as gear, vane and piston • Non-positive displacement pumps, such as centrifugal and axial • Pump components and their functions such as bearings, mechanical seals, impellers, sleeves, lantern rings and packings • Pump specifications such as pump curves, volumes, pressures, flow and clearances • Cooling and lubrication systems • Drive components such as couplings, sheaves and belts • Common faults such as low and excessive flows, cavitation and insufficient pressures • Manufacturers' specifications • Products being pumped • Piping and tubing sizing and schematics • Prime movers • Condition-based monitoring technologies such as vibration analysis, UT, fluid analysis, infrared thermography and motor current analysis • Condition-based monitoring tools such as strobe lights, stethoscope, vibration data collectors, infrared cameras and temperature guns • Fault diagnosis procedures using appropriate condition-based monitoring technology(ies) and tools
Generic Skills
The individual needs to demonstrate ability related to: • Communication • Team Work • Problem solving • Planning and Organising • Self-management • Technology

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TVET CURRICULUM DEVELOPMENT, ASSESSMENT AND CERTIFICATION COUNCIL (TVET CDACC)

NATIONAL OCCUPATIONAL STANDARD

Unit Standard Code: *MEM025 (Internal code)*	
Unit Standard Title: Install and maintain hydraulic systems	
KNQF Level: 4	**Credits: 4**

Unit Standard Description

This unit standard is intended for those who carry out mechanical engineering technology and maintenance operations. It specifies the competencies required to: Prepare for work; Install hydraulic system components; Diagnose faults on hydraulic systems; Maintain and repair hydraulic systems.

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Unit Standard Title	Install and maintain hydraulic systems
Unit Scope	• Hydraulic systems include but are not limited to: basic hydraulic system, open-centre hydraulic systems, closed-centre hydraulic systems, and hydraulic power pack. • Installation includes but is not limited to the positioning and alignment components of hydraulic systems and the installation fittings in accordance with design specifications. • Maintenance of hydraulic systems includes but is not limited to diagnosis of faults through sensory inspection and condition-based monitoring and planned preventive maintenance and corrective maintenance.
Element 1	**Prepare for work**
Range	Work preparation includes but is not limited to observing safety and environmental requirements and precautions; determination of work requirements; and determination of the sequence of work operations.
Performance Criteria	
1.1 Safety and environmental regulatory requirements related to the installation, repair and maintenance of hydraulic systems are followed in accordance with workplace procedures 1.2 Technical and/or calibration requirements for tools and equipment are implemented in line with manufacturers' specifications 1.3 Tools, equipment and materials are selected consistent with the requirements of the job 1.4 Tools and equipment are checked for serviceability and faults rectified and/or reported in line with manufacturers' specifications and workplace procedures 1.5 The sequence of operations is determined from drawings and work instructions	
Element 2	**Install hydraulic system components**
Range	Hydraulic system components include but are not limited to hydraulic pumps, hydraulic motors, reservoirs, pipes, hoses, filters, pressure receivers, actuators, boosters and other fittings
Performance Criteria	
2.1 Hydraulic pumps, motors and reservoirs are positioned and aligned according to design specifications 2.2 Pipes and hoses are connected to hydraulic pumps, reservoirs and other fittings according to the design 2.3 System is test run (operation of system from start-up to full operating pressure) and fine-tuned in accordance with design specifications	

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Element 3	**Diagnose faults on hydraulic systems**
Range	Fault diagnosis includes but is not limited to sensory inspection and condition-based monitoring.
Performance Criteria	
3.1 Sensory inspection of systems and components is conducted in line with manufacturers' specifications and workplace procedures 3.2 Condition-based monitoring of systems and components is conducted in accordance with manufacturers' specifications and workplace procedures 3.3 Diagnostic data is recorded in line with workplace procedures 3.4 The types of faults in the system are determined from diagnostic data 3.5 Fluid levels are verified according to manufacturers' specifications 3.6 System pressure, temperature and flow are adjusted according to manufacturers' specifications 3.7 Filters and working fluid are replaced according to manufacturers' specifications 3.8 The cleanliness of hydraulic systems and components is maintained in line with workplace procedures 3.9 The overall performance of the system is assessed against performance specifications 3.10 The corrective maintenance of hydraulic systems and components is conducted in line with manufacturers' specifications and workplace procedures	
Element 4	**Maintain and repair hydraulic systems**
Range	N/A
Performance Criteria	
4.1 Filters and other fittings are replaced according to manufacturers' specifications 4.2 The cleanliness of hydraulic system components is maintained in line with workplace procedures 4.3 The overall performance of the system is assessed against performance specifications 4.4 Planned preventive and corrective maintenance of hydraulic systems and components are conducted in line with manufacturers' specifications and workplace procedures	

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Underpinning Knowledge
The individual needs to demonstrate knowledge of: • Safety and environmental requirements related to the installation, repair and maintenance of hydraulic systems and components • Tools, equipment and materials used in the installation, repair and maintenance of hydraulic systems and components • Calibration of tools and equipment • Installation of hydraulic systems and components • Diagnosis of faults on hydraulic systems and components • Planned preventive and corrective maintenance of hydraulic systems and components
Generic Skills
The individual needs to demonstrate ability related to: • Communication • Team Work • Problem solving • Planning and Organising • Self-management • Technology

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TVET CURRICULUM DEVELOPMENT, ASSESSMENT AND CERTIFICATION COUNCIL (TVET CDACC)

NATIONAL OCCUPATIONAL STANDARD

Unit Standard Code: *MEM026 (Internal code)*	
Unit Standard Title: Install and maintain pneumatic and vacuum systems	
KNQF Level: 4	**Credits: 4**

Unit Standard Description

This unit standard is intended for those who carry out mechanical engineering and maintenance operations. It specifies the competencies required to: Prepare for work; Install pneumatic and vacuum system components; Diagnose faults on pneumatic and vacuum systems; and Repair and maintain pneumatic and vacuum systems.

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Unit Standard Title	Install and maintain pneumatic and vacuum systems
Unit Scope	• Installation includes but is not limited to the positioning and alignment of components of pneumatic and vacuum systems and the installation fittings in accordance with design specifications. • Maintenance of pneumatic and vacuum systems includes but is not limited to diagnosis of faults through sensory inspection and condition-based monitoring and planned preventive maintenance and corrective maintenance.
Element 1	**Prepare for work**
Range	Work preparation includes but is not limited to observing safety and environmental requirements and precautions; determination of work requirements; and determination of the sequence of work operations.
Performance Criteria	
1.1 Safety and environmental regulatory requirements related to the installation, repair and maintenance of pneumatic systems are followed in accordance with workplace procedures 1.2 Technical and/or calibration requirements for tools and equipment are implemented in line with manufacturers' specifications 1.3 Tools, equipment and materials are selected consistent with the requirements of the job 1.4 Tools and equipment are checked for serviceability and faults rectified and/or reported in line with manufacturers' specifications and workplace procedures 1.5 The sequence of operations is determined from drawings and work instructions	
Element 2	**Install pneumatic and vacuum system components**
Range	N/A
Performance Criteria	
2.1 Pressure receivers, actuators and boosters are positioned and aligned according to design specifications 2.2 Pipes and hoses are connected to pressure receivers and other fittings according to design specifications 2.3 System is test run (operation of system from start-up to full operating pressure) and fine-tuned in accordance with design specifications to ensure that all control devices are operating according to design specifications	

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Element 3	Diagnose faults on pneumatic and vacuum system components
Range	N/A

Performance Criteria

3.1 Sensory inspection of systems and components is conducted in line with manufacturers' specifications and workplace procedures

3.2 Condition-based monitoring of systems and components is conducted in accordance with manufacturers' specifications and workplace procedures

3.3 Diagnostic data is recorded in line with workplace procedures

3.4 The types of faults in the system are determined from diagnostic data

3.5 The overall performance of the system is assessed against performance specifications

Element 4	Maintain and repair pneumatic and vacuum system components
Range	N/A

Performance Criteria

4.1 Filters and other fittings are replaced according to manufacturers' specifications

4.2 The cleanliness of pneumatic and vacuum system components is maintained in line with workplace procedures

4.3 The overall performance of the system is assessed against performance specifications

4.4 The planned preventive and corrective maintenance of pneumatic and vacuum systems and components is conducted in line with manufacturers' specifications and workplace procedures

Underpinning Knowledge

The individual needs to demonstrate knowledge of:

- Safety and environmental requirements related to the installation, repair and maintenance of pneumatic and vacuum systems and components
- Tools, equipment and materials used in the installation, repair and maintenance of pneumatic and vacuum systems and components
- Calibration of tools and equipment
- Installation of pneumatic and vacuum system components
- Diagnosis of faults in hydraulic, pneumatic and vacuum systems and components
- Planned preventive maintenance and corrective maintenance of pneumatic and vacuum systems and components

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Generic Skills
The individual needs to demonstrate ability related to: • Communication • Team Work • Problem solving • Planning and Organising • Self-management • Technology

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TVET CURRICULUM DEVELOPMENT, ASSESSMENT AND CERTIFICATION COUNCIL (TVET CDACC)

NATIONAL OCCUPATIONAL STANDARD

Unit Standard Code: *MEM027 (Internal code)*	
Unit Standard Title: Service transmission systems	
KNQF Level: 4	**Credits: 4**

Unit Standard Description

This unit standard is intended for those who carry out mechanical engineering and maintenance operations. It specifies the competencies required to: Plan and prepare for work; Apply power transmission theory; Service drive shafts; Service couplings, clutches and brakes; Service gear drives; Service belt drives; and Service chain drives.

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Unit Standard Title	Service transmission systems
Unit Scope	• Performance of all elements must comply with all relevant statutory, health, safety, environment, and worksite requirements, contractual agreement and/or manufacturers' specifications. • Transmission systems include but are not limited to drive shafts, clutches, couplings, brakes, belt drives, gear drives, chain drives, pulleys and sprockets.
Element 1	**Plan and prepare for work**
Range	Planning and preparation may include but are not limited to workplace inspection, equipment defect identification, assessment of conditions and hazards and determination of work requirements.
Performance Criteria	
1.1 Job requirements are determined from workplace instructions 1.2 Plans are developed to eliminate, avoid/neutralize all identified risks in accordance with safety regulations, legislation and site specific instructions 1.3 Sequence of operations is determined according to site operational requirements 1.4 Required tools, equipment and materials are selected according to job specifications 1.5 Affected parties are informed and liaised with according to work place procedures 1.6 Work site is inspected and prepared according to site operational requirements 1.7 Occupational and environmental health and safety requirements are followed according to statutory requirements and work place procedures 1.8 Personal protective equipment is used according to site and statutory requirements	
Element 2	**Apply power transmission theory**
Range	N/A
Performance Criteria	
2.1 The relationship between speed, torque and horsepower as related to power transmission is determined 2.2 Calculations related to power transmission and motion control devices are conducted	

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Element 3	**Service drive shafts**
Range	N/A
Performance Criteria	
3.1 Different types of keys are identified and installed in accordance with standard procedures 3.2 The applications, advantages and disadvantages of the different types of keys are identified from specifications 3.3 Different types and sizes of shafts are selected for different applications in line with workplace procedures 3.4 Shafts and shaft attachments are installed in line with standard procedures 3.5 Shaft and shaft attachments are serviced in line with standard procedures	
Element 4	**Service couplings, clutches and brakes**
Range	N/A
Performance Criteria	
4.1 The constructional features, operating principles, applications, advantages and disadvantages of different types of couplings, clutches and brakes are identified form manufacturers' manuals 4.2 Couplings, clutches and brakes are assembled and installed in line with manufacturers' specifications and workplace procedures 4.3 Safety guards installed according to OH&S regulations 4.4 Faults on couplings, clutches and brakes are diagnosed and rectified in line with specifications and workplace procedures 4.5 Condition-based monitoring routine procedures are performed to detect underlying defects in line with workplace procedures 4.6 Couplings and clutches reconditioned according manufacturers' specifications 4.7 Couplings, clutches and brakes are maintained in line with manufacturers' specifications 4.8 Contact parts (rubber buffers) are replaced in line with standard procedures 4.9 Couplings are aligned and lubricated according to manufacturers' specifications	
Element 5	**Service gear drives**
Range	N/A

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Performance Criteria
5.1 Gear terminology is applied
5.2 The characteristics and uses of different types of gears are recognized from manufacturers' specifications
5.3 Shaft positions for different gears are determined in line with standard procedures
5.4 Gear materials are identified from specifications
5.5 Gear calculations are conducted in line with standard procedures
5.6 Calculations of speeds and ratios of simple and compound gear drives are undertaken
5.7 Gear drives and reduction units are selected, installed and aligned according to manufacturer's specifications
5.8 Safety guards installed according to OH&S regulations
5.9 Gear drives, including sprockets, are inspected, repaired and maintained in line with manufacturers' specifications and workplace procedures
5.10 Clearance, backlash and tooth contact of gear systems are measured and adjusted according to manufacturers' specifications
5.11 Gears are lubricated according to manufacturers' specifications
5.12 Bearings and seals are replaced in accordance with standard procedures
5.13 Gear systems cleaned, inspected, modified and aligned according to maintenance schedule

Element 6	**Service belt drives**
Range	N/A

Performance Criteria
6.1 Terminology related to belt drives is applied
6.2 The constructional features, principles of operation, applications, advantages and disadvantages of different types of belt drives are identified from manufacturers' manuals
6.3 Belt drive calculations are conducted in accordance with standard procedures
6.4 Belt drive systems are assembled, installed, aligned and maintained in line with manufacturers' specifications and workplace procedures
6.5 Belt drive systems are cleaned, inspected, modified and adjusted according to maintenance schedule
6.6 Abnormalities on parts and components are identified through visual inspection in accordance with standard procedures
6.7 Condition-based monitoring routine procedures are performed to detect underlying defects in line with workplace procedures

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6.8 Faulty belt drive systems repaired according to manufacturers' specifications

6.9 Belt drive tension is adjusted according to manufacturers' specifications

6.10 Rollers are greased in line with standard procedures

6.11 Pulleys are installed, adjusted and maintained in line with workplace procedures

6.12 Different types of variable speed drives are identified, installed and maintained in line with manufacturers/ specifications

Element 7	**Service chain drives**
Range	N/A

Performance Criteria

7.1 Terminology related to drive chains is applied

7.2 The constructional features, principles of operation, applications, advantages and disadvantages of different types of drive chains are identified from manufacturers' manuals

7.3 Calculations involving chain drive problems are conducted

7.4 Chain drives are assembled, installed and aligned according to manufacturer's specifications

7.5 Chain drives are inspected and maintained according to manufacturer's specifications

7.6 Chain drive tension is adjusted according to manufacturers' specifications

7.7 Abnormalities on parts and components are identified through visual inspection in accordance with standard procedures

7.8 Condition-based monitoring routine procedures are performed to detect underlying defects in line with workplace procedures

7.9 Faulty chain drive systems repaired according to manufacturers' specifications

7.10 Chain drive systems are lubricated according to manufacturers' specifications

7.11 Chain drive systems cleaned, inspected, modified and adjusted according to maintenance schedule

Underpinning Knowledge

The individual needs to demonstrate knowledge of:

- Power transmission theory and calculations
- Identification and installation of different types of keys
- Different types and sizes of shafts and shaft attachments
- Installation, servicing and restoration/recondition of shafts and shaft attachments
- Constructional features, operating principles, applications, advantages and disadvantages of different types of couplings, clutches and brakes
- Assembling, installation and maintenance of couplings, clutches and brakes

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- Common faults on couplings, clutches and brakes and methods of their prevention and rectification
- Gear terminology and gear calculations
- Characteristics and uses of different types of gears
- Gear materials
- Installation, alignment and maintenance of gear drives and reduction units
- Belt drive terminology and calculations
- Constructional features, principles of operation, applications, advantages and disadvantages of different types of belt drives
- Assembly, installation, alignment and maintenance of belt drive systems
- Drive chain terminology and calculations
- Constructional features, principles of operation, applications, advantages and disadvantages of different types of drive chains
- Assembly, installation, alignment and maintenance of chain drive

Generic Skills

The individual needs to demonstrate ability related to:

- Communication
- Team Work
- Problem solving
- Planning and Organising
- Self-management
- Technology

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TVET CURRICULUM DEVELOPMENT, ASSESSMENT AND CERTIFICATION COUNCIL (TVET CDACC)

NATIONAL OCCUPATIONAL STANDARD

Unit Standard Code: *MEM028 (Internal code)*	
Unit Standard Title: Maintain prime movers	
KNQF Level: 4	**Credits: 4**

Unit Standard Description

This unit standard is intended for those who carry out mechanical engineering and maintenance operations. It specifies the competencies required to: Plan and prepare for work; Apply prime mover theory; Install prime movers; Service electric motors; Install and maintain internal combustion engines; and Maintain turbines.

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Unit Standard Title	Maintain prime movers
Unit Scope	• Prime movers include electric motors, internal combustion engines and turbines. • Performance of all elements must comply with all relevant statutory, health, safety, environment, and worksite requirements, contractual agreement and/or manufacturers' specifications.
Element 1	**Plan and prepare for work**
Range	Planning and preparation may include but are not limited to workplace inspection, equipment defect identification, assessment of conditions and hazards and determination of work requirements.
Performance Criteria	
1.1 Job requirements are determined from workplace instructions 1.2 Plans are developed to eliminate, avoid/neutralize all identified risks in accordance with safety regulations, legislation and site specific instructions 1.3 Sequence of operations is determined according to site operational requirements 1.4 Required tools, equipment and materials are selected according to job specifications 1.5 Affected parties are informed and liaised with according to work place procedures 1.6 Work site is inspected and prepared according to site operational requirements 1.7 Occupational and environmental health and safety requirements are followed according to statutory requirements and work place procedures 1.8 Personal protective equipment is used according to site and statutory requirements	
Element 2	**Apply prime mover theory**
Range	N/A
Performance Criteria	
2.1 The relationship between speed, torque and horsepower related to power movers is determined and applied in line with standard procedures 2.2 The energy conversions associated with the different prime movers are identified from manufacturers' manuals	
Element 3	**Install prime movers**
Range	N/A

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Performance Criteria
3.1 Tools are selected and used according to manufacturers' specifications and job requirements including torque wrenches, dial indicators, precision levels and optical or laser alignment equipment
3.2 Location and elevation for installation are determined according to engineered drawings
3.3 Foundations are prepared according to engineered drawings
3.4 Bases for prime movers cleaned and roughed up using methods such as filing, sandblasting and buffing in line with workplace procedures
3.5 Prime movers are positioned manually or using rigging, hoisting/lifting and moving equipment in line with workplace procedures
3.6 Prime movers aligned, secured and levelled with driven equipment according to manufacturers' and site specifications and engineered drawings
3.7 Prime movers are connected to driven equipment using components such as couplings, sheaves, sprockets and gear boxes according to engineered specifications and drawings
3.8 Auxiliary systems such as lube pumps, over-speed trip and governors are installed according to manufacturers' specifications
3.9 The rotation bump of the prime mover is conducted prior to coupling up in accordance with standard procedures
3.10 Safety guards installed according to manufacturers' specifications and Occupation Health and Safety (OH&S) regulations.
3.11 Equipment and start-up/return energized to operation in line with specifications and workplace procedures

Element 4	**Service electric motors**
Range	N/A

Performance Criteria
4.1 The constructional features, applications, advantages and disadvantages of the different types of AC and DC motors used in industrial settings are identified from manufacturers' manuals
4.2 The principles of operation of different types of electric motors are identified from manufacturers' manuals
4.3 Conductors, protective devices and other equipment and devices associated with electric motors are identified from manufacturers' specifications and engineering drawings
4.4 Electric motors are maintained and serviced in line with manufacturers' specifications and workplace procedures

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Element 5	Install and maintain internal combustion engines
Range	• The different types of internal combustion engines include spark ignition, compression ignition, two stroke and four stroke. • Spark ignition motor components include but are not limited to fuel system; ignition system; motor components (valves, pistons, cylinders, crank shafts, motor blocks); and exhaust mechanisms. • Compression motor ignition components include but are not limited to fuel system; ignition system (valves, pistons, cylinders, crank shafts, motor blocks, air intake mechanisms, exhaust mechanisms); and filters (air and fuel).
Performance Criteria	
5.1 The constructional features, principles of operation, applications, advantages and limitations of the different types of internal combustion engines are identified from manufacturers' manuals 5.2 The functions of air, fuel, ignition, reciprocating to rotary motion and compression are identified from manufacturers' specifications 5.3 The functions of the different spark ignition motor components are identified from manufacturers' manuals 5.4 The functions of compression ignition motor components are identified from manufacturers' manuals 5.5 Internal combustion engines are installed and operated in line with manufacturers' specifications and workplace procedures 5.6 Faults are diagnosed in line with manufacturers' specifications and workplace procedures 5.7 Internal combustion engines are repaired and maintained in line with manufacturers' specifications and workplace procedures	

Element 6	Maintain turbines
Range	N/A
Performance Criteria	
6.1 The constructional features, operating principles, applications, advantages and disadvantages of different types of turbines are identified from manufacturers' manuals 6.2 The principles of operation of different types of turbines are identified from manufacturers' manuals 6.3 Tools and equipment used for the maintenance of turbines are identified, safely handled, used and stored in line with manufacturers' specifications and workplace procedures 6.4 Turbines are diagnosed and maintained in line with manufacturers' specifications and workplace procedures 6.5 The operation and theory of turbine power units are identified from manufacturers' manuals	

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6.6 The components of turbine power units and their functions are identified from manufacturers' specifications

6.7 Turbine power units are maintained and serviced in line with manufacturers' specifications and workplace procedures

Underpinning Knowledge

The individual needs to demonstrate knowledge of:

- Prime mover theory
- Types, constructional features, principles of operation of prime movers: electric motors, internal combustion engines, turbines
- Installation of prime movers: positioning, alignment, securing and levelling with driven equipment
- Theory and principles of operation of different types of electric motors, internal combustion engines, turbines
- Conductors, protective devices and other equipment and devices associated with electric motors
- AC and DC electric motors and their specific applications
- Maintenance and servicing of electric motors, internal combustion engines and turbines

Generic Skills

The individual needs to demonstrate ability related to:

- Communication
- Team Work
- Problem solving
- Planning and Organising
- Self-management
- Technology

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TVET CURRICULUM DEVELOPMENT, ASSESSMENT AND CERTIFICATION COUNCIL (TVET CDACC)

NATIONAL OCCUPATIONAL STANDARD

Unit Standard Code: *MEM029 (Internal code)*	
Unit Standard Title: Commission mechanical equipment	
KNQF Level: 4	**Credits: 3**

Unit Standard Description

This unit standard is intended for those who carry out mechanical engineering and maintenance operations. It specifies the competencies required to: Interpret reports and data required for commissioning equipment, Perform commissioning procedures; and Perform tests and trials.

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Unit Standard Title	Commission mechanical equipment
Unit Scope	• Performance of all elements must comply with all relevant statutory, health, safety, environment, and worksite requirements, contractual agreement and/or manufacturers' specifications. • This unit includes the start-up, assessment, adjustment and the determination of the baseline operating specifications of mechanical equipment.
Element 1	**Interpret reports and data required for commissioning equipment**
Range	Reports and data include but are not limited to blueprints, service manuals and commissioning reports.
Performance Criteria	
1.1 Reports and data are obtained in line with workplace procedures 1.2 Reports and data are analysed and results documented in line with workplace procedures	
Element 2	**Perform commissioning procedures**
Range	Commissioning procedures include but are not limited to checking equipment and systems; checking safety equipment and devices; starting-up and running equipment in pre-determined order; monitoring activities including packing adjustments and alignments; re-torqueing bolts; alignment of motors and pumps after run-in period; and performance of tests and trials.
Performance Criteria	
2.1 Rotational checks and all other procedures are completed according to engineering and manufacturers' specifications 2.2 Equipment and systems are checked in line with manufacturers' specifications and workplace procedures including fuel, lube oil, electricity, air, cooling systems, safety equipment and devices 2.3 Start-up and running of equipment is conducted in predetermined order according to type and design of system 2.4 Monitoring activities like packing adjustments and alignments are performed 2.5 Bolts such as anchor, base, flanges and cylinder heads are re-torqued after manufacturers' recommended run-in period in line with manufacturers' specifications and standard procedures 2.6 Alignment of motors and pumps is conducted after manufacturers' recommended run-in period	

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Element 3	Perform tests and trials
Range	Purpose of tests and trials involve the comparison of performance against specifications in relation to, among others, safety, guards and emergency stops; noise levels; and defects.

Performance Criteria

3.1 Tests and trials are conducting in accordance with manufacturers' specifications and standard procedures

3.2 Baseline readings of the results of preliminary tests on key parameters such as such as vibration, temperature and flow are performed in line with standard testing procedures

3.3 Key parameters are compared with expected values

3.4 Required changes are documented in line with workplace procedures

Underpinning Knowledge

The individual needs to demonstrate knowledge of:

- Reports and data required for commissioning equipment
- Manufacturers' specifications, recommendations and operating parameters
- Intended machine operation
- Engineers' intended operating design
- Schematics
- Mechanical troubleshooting techniques
- Commissioning checklists, sequence and procedures
- Different tests and trials
- Baseline readings of results of tests
- Documentation of results of tests and trials and required changes to systems and equipment

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Generic Skills
The individual needs to demonstrate ability related to: • Communication • Team Work • Problem solving • Planning and Organising • Self-management • Technology

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TVET CURRICULUM DEVELOPMENT, ASSESSMENT AND CERTIFICATION COUNCIL (TVET CDACC)

NATIONAL OCCUPATIONAL STANDARD

Unit Standard Code: *CMEM030 (Internal code)*	
Unit Standard Title: Cut work pieces using shaping and planing machines	
KNQF Level: 3	**Credits: 2**

Unit Standard Description

This unit standard is intended for those who carry out mechanical engineering technology and maintenance operations. It specifies the competencies required to: Prepare for shaping and planing machine operations; perform shaping and planing machine operations; Quality check machined work; Report shaping and planing machine malfunctions, and Complete work and clean up.

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Unit Standard Title	Cut work pieces using shaping and planing machines
Unit Scope	• Performance of all elements must comply with all relevant statutory, health, safety, environment, and worksite requirements, contractual agreement and/or manufacturers' specifications. • Materials include but are not limited to ferrous and non-ferrous materials and alloys. • Shaping and planing machine operations include but are not limited to the generation of accurate flat surfaces and cutting slots and keyways.
Element 1	**Prepare for shaping and planing machine operations**
Range	Planning and preparation may include but are not limited to workplace inspection, equipment defect identification, assessment of conditions and hazards and determination of work requirements.

Performance Criteria

1.1 Sequence of operations is determined by interpreting drawings and job instructions

1.2 Tools and equipment used in shaping and planing operations are selected, handled, used, maintained and stored according to task requirements and manufacturers' specifications

1.3 The applications, similarities, differences, advantages and limitations of shaping, planing and milling machines are recognised

1.3 The different parts of shaping and planing machines are identified

1.4 The uses of the different parts of shaping and planing machines are recognized from manufacturers' specifications

1.5 The principles of operation of shaping and planing machines are applied in line with manufacturers' manuals

1.6 Different types of ferrous and non-ferrous materials and alloys are identified, handled, used and stored according to manufacturers' specifications and workplace procedures

1.7 Safety and environmental hazards associated with shaping and planing machines and shaping and planing operations are identified and prevented in line with regulatory requirements and workplace procedures

1.8 Safety precautions related to shaping and planing machines and shaping and planing operations are observed in line with regulatory requirements

1.9 Shaping and planing machines are prepared for operation including lubrication, routine maintenance and pre-operational checks in line with manufacturers' specifications and workplace procedures

1.10 Work and tool holding fixtures and devices are selected and installed in line with manufacturers' specifications and workplace procedures

1.11 Shaping and planing tools are selected and ground in line with tool geometry

1.12 Materials are prepared and marked out according to drawings and specifications\

1.13 Work pieces and shaping and planing tools are mounted and secured according to manufacturers'

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specifications and workplace procedures 1.14 Shaping and planing machine start-up and shut-down procedures are demonstrated in line with manufacturers' manuals 1.15 Cutting speeds and feeds are determined, selected and set in accordance with type and size of materials and shaping and planing tools

Element 2	**Perform shaping and planing machine operations**
Range	N/A
Performance Criteria	
2.1 Shaping and planing operations are carried out according to drawings and specifications 2.2 Routine dimension control is conducted in accordance with drawings and specifications 2.3 The operation of shaping and planing machines is monitored and adjustments to speeds and feeds made, where required, in line with standard procedures 2.4 Machined components are removed on completion of shaping and planing operations	

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Element 3	Quality check machined work
Range	N/A
Performance Criteria	
3.1 Measuring tools and equipment are selected and prepared in accordance with task requirements 3.2 Work is measured and checked against specifications and remedial measures undertaken 3.3 Non-conforming components are recorded and reported to appropriate personnel in line with workplace procedures	

Element 4	Report shaping and planing machine malfunctions
Range	N/A
Performance Criteria	
4.1 Problems or malfunctions are detected in line with manufacturers' specifications 4.2 Malfunctions are recorded and reported to appropriate personnel in line with workplace procedures	

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Element 5	Complete work and clean up
Range	Work completion details may include but are not limited to work schedule or appointment sheet and sign-out form for equipment.

Performance Criteria
5.1 Work is completed and appropriate personnel notified in line with workplace procedures
5.2 Work area is cleared of waste, cleaned, restored and secured in line with workplace procedures
5.3 Reusable material is collected and stored in line with workplace procedures
5.4 Tools and equipment are cleaned, checked, maintained and stored in line with workplace procedures
5.5 Shaping and planing machine is cleaned and lubricated in line with manufacturers' specifications and workplace procedures
5.6 Work completion details are finalised in line with workplace procedures

Underpinning Knowledge

The individual needs to demonstrate knowledge of:

- Different parts of a shaping and planing machine and their uses
- Operating principles of a lathe machine
- Safety and environmental hazards associated with lathe machine and lathe machine operations
- Safety requirements and precautions
- Shaping and planing machine set up, start-up and shut-down procedures
- Shaping and planing tools
- Cutting speeds and feeds
- Different types and uses of coolants
- Procedures for different shaping and planing operations
- Basic maintenance of a shaping and planing machine

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TVET CURRICULUM DEVELOPMENT, ASSESSMENT AND CERTIFICATION COUNCIL (TVET CDACC)

NATIONAL OCCUPATIONAL STANDARD

Unit Standard Code: *MEM031 (Internal code)*	
Unit Standard Title: Perform cylindrical grinding	
KNQF Level: 3	**Credits: 2**

Unit Standard Description

This unit standard is intended for those who carry out mechanical engineering technology and maintenance operations. It specifies the competencies required to: Prepare for cylindrical grinding; Perform cylindrical grinding; and Complete work and clean up.

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Unit Standard Title	Perform cylindrical grinding
Unit Scope	• Performance of all elements must comply with all relevant statutory, health, safety, environment, and worksite requirements, contractual agreement and/or manufacturers' specifications. • Cylindrical grinding operations include but are not limited to the cylindrical grinding of different types of metals including mild steel, medium carbon steels and aluminium.
Element 1	**Prepare for cylindrical grinding**
Range	Planning and preparation may include but are not limited to workplace inspection, equipment defect identification, assessment of conditions and hazards and determination of work requirements.

Performance Criteria

1.1 Sequence of operations is determined by interpreting drawings and job instructions

1.2 Tools and equipment used in cylindrical grinding operations are selected, handled, used, maintained and stored according to task requirements and manufacturers' specifications

1.3 The different types of cylindrical grinding machines, their applications are identified

1.4 The constructional features and uses of the different parts of cylindrical grinding machines are identified from manufacturers' manuals and specifications

1.5 The principles of operation of cylindrical grinding machines are identified and applied in line with manufacturers' manuals

1.6 Different types of ferrous and non-ferrous materials and alloys are identified, handled, used and stored according to manufacturers' specifications and workplace procedures

1.7 Safety and environmental hazards associated with the cylindrical grinding machines and cylindrical grinding machine operations are identified and prevented in line with regulatory requirements and workplace procedures

1.8 Safety precautions related to cylindrical grinding machines and cylindrical grinding machine operations are observed in line with regulatory requirements including the use of lubricants

1.9 Cylindrical grinding machine is prepared for operation including lubrication, routine maintenance and pre-operational checks in line with manufacturers' specifications and workplace procedures

1.10 Work and tool holding fixtures and devices are selected and installed in line with manufacturers' specifications and workplace procedures

1.11 Grinding wheels are selected for different applications according to manufacturers' specifications and workplace procedures

1.12 Grinding wheels are dressed and balanced in accordance with manufacturers' specifications and workplace procedures

1.13 Materials are prepared and marked out according to drawings and specifications

1.14 Work pieces and grinding wheels are mounted and secured according to manufacturers'

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specifications and workplace procedures

1.15 Cylindrical grinding machine start-up and shut-down procedures are demonstrated in line with manufacturers' manuals

1.16 Cutting speeds and feeds are selected and set in accordance with type of materials and size of grinding wheel

Element 2	**Perform cylindrical grinding**
Range	N/A
Performance Criteria	
2.1 Cylindrical grinding operations are performed according to drawings and specifications 2.2 Work pieces are measured and checked against work specifications and remedial action undertaken 2.3 Housekeeping is observed including cleaning of working areas, cleaning of cylindrical grinding machine, and maintaining a clean and tidy work environment	

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Element 3	Complete work and clean up
Range	Work completion details may include but are not limited to work schedule or appointment sheet and sign-out form for equipment.

Performance Criteria

3.1 Work is completed and appropriate personnel notified in line with workplace procedures

3.2 Work area is cleared of waste, cleaned, restored and secured in line with workplace procedures

3.3 Reusable material is collected and stored in line with workplace procedures

3.4 Waste disposal is conducted in accordance with workplace procedures

3.5 Tools and equipment are cleaned, checked, maintained and stored in line with workplace procedures

3.6 Cylindrical grinding machine is cleaned and lubricated in line with manufacturers' specifications and workplace procedures

3.7 Work completion details are finalised in line with workplace procedures

Underpinning Knowledge

The individual needs to demonstrate knowledge of:

- Reading and interpreting working drawings
- Occupational and environmental health and safety
- Selection, handling, use, maintenance and storage of tools, equipment and materials
- Cylindrical grinding wheels
- Setting up and operating cylindrical grinding machines
- Measuring and testing

Generic Skills

The individual needs to demonstrate ability related to:

- Communication
- Team Work
- Problem solving
- Planning and Organising
- Self-management
- Technology

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