No. 1185 **20 September 2002**

SOUTH AFRICAN QUALIFICATIONS AUTHORITY (SAQA)

In accordance with regulation 24(c) of the National Standards Bodies Regulations of 28 March 1998, the Standards Generating Body (SGB) for

Manufacturing and Assembly

Registered by NSB 06, Manufacturing, Engineering and Technology, publishes the following qualifications and unit standards for public comment.

This notice contains the titles, fields, sub-fields, NQF levels, credits, and purpose of the qualification and unit standards upon which qualifications are based. The full qualification and unit standards can be accessed via the SAQA web-site at **www.saqa.org.za**. Copies may also be obtained from the Directorate of Standards Setting and Development at the SAQA offices, 659 Pienaar street, Brooklyn, Pretoria.

Comment on the unit standards should reach SAQA at the address ***below and no later than 21 October 2002.*** All correspondence should be marked **Standards Setting – SGB for Manufacturing and Assembly** and addressed to

The Director: Standards Setting and Development
SAQA
Attention: Mr. D Mphuthing
Postnet Suite 248
Private Bag X06
Waterkloof
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or faxed to 012 – 482 0907

SAMUEL B.A. ISAACS
EXECUTIVE OFFICER

NATIONAL CERTIFICATE IN MECHANICAL ENGINEERING (FITTING) NQF LEVEL 2
UNIT STANDARDS ON NQF LEVEL 2

CORE

Title 1: Identify engineering materials, their characteristics and applications and common metal tests and treatments used in engineering

Title 2: Select, use and care for engineering measuring equipment

Title 3: Select, use and care for engineering power tools

Title 4: Select, use and care for engineering hand tools

Title 5: Perform basic welding / joining of metals

Title 6: Mark off basic engineering shapes

Title 7: Read, interpret and produce basic engineering drawings

Title 8: Maintain static seals in machines and / or equipment

Title 9: Maintain indirect drives

Title 10: Maintain pipe systems

Title 11: Perform routine maintenance

Title 12: Sling loads

ELECTIVE

Title 13: Operate and monitor a drilling machine to produce simple components

Title 14: Operate and monitor a surface grinding machine to produce simple components

Title 15: Operate and monitor a milling machine to produce simple components

Title 16: Operate and monitor a lathe to produce simple components

UNIT STANDARDS AND SPECIFIC OUTCOMES IN
NATIONAL CERTIFICATE IN MECHANICAL ENGINEERING (FITTING) NQF LEVEL 2

Title 1: Identify engineering materials, their characteristics and applications and common metal tests and treatments used in engineering

Specific outcome 1.1: Identify materials used in common engineering applications

Specific outcome 1.2: Discuss the physical properties of engineering materials used in common engineering applications

Specific outcome 1.3: Explain the common applications and methods of processing and manufacturing using engineering materials

Specific outcome 1.4: Demonstrate an understanding of the common metal tests used in engineering

Specific outcome 1.5: Demonstrate an understanding of heat treatment processes

Specific outcome 1.6: Explain the effects external factors have on engineering materials

Title 2: Select, use and care for engineering measuring equipment

Specific outcome 2.1: Explain and discuss basic units of measure and symbols

Specific outcome 2.2: Select and use engineering measuring equipment

Specific outcome 2.3: Care for and maintain measuring equipment

Specific outcome 2.4: Recognise and report problems, changes and/or malfunctions while working

Specific outcome 2.5: Work safely with due care for self, fellow workers, equipment, materials and the environment

Title 3: Select, use and care for engineering power tools

Specific outcome 3.1: Select and use engineering power tools

Specific outcome 3.2: Care for and maintain engineering power tools

Specific outcome 3.3: Check on power supply connections to equipment

Specific outcome 3.4: Recognise and report problems, changes and/or malfunctions while working

Title 4: Select, use and care for engineering hand tools

Specific outcome 4.1: Select and use engineering hand tools

Specific outcome 4.2: Care for and maintain hand tools

Specific outcome 4.3: Recognise and report problems, changes and/or malfunctions while working

Specific outcome 4.4: Work safely with due care for self, fellow workers, equipment, materials and the environment

Title 5: Perform basic welding / joining of metals

Specific outcome 5.1: Prepare for work activity

Specific outcome 5.2: Weld/join metals

Specific outcome 5.3: Apply quality checks on completed weld/joint

Specific outcome 5.4: Perform finishing activities

Specific outcome 5.5: Report out of compliance or unsafe conditions while working

Specific outcome 5.6: Work safely with due care for self, fellow workers, equipment, materials and the environment

Title 6: Mark off basic engineering shapes

Specific outcome 6.1: Plan and prepare materials for marking off

Specific outcome 6.2: Mark off materials

Specific outcome 6.3: Apply quality checks on completed work

Specific outcome 6.4: Care for and store marking off equipment

Title 7: Read, interpret and produce basic engineering drawings

Specific outcome 7.1: Discuss and explain basic engineering drawing concepts and material lists

Specific outcome 7.2: Interpret basic engineering drawings

Specific outcome 7.3: Produce drawing

Title 8: Maintain static seals in machines and / or equipment

Specific outcome 8.1: Plan and prepare for seal replacement

Specific outcome 8.2: Prepare site and equipment for seal replacement

Specific outcome 8.3: Maintain static seals

Specific outcome 8.4: Check equipment for compliance with operational requirements

Specific outcome 8.5: Record information on work done

Specific outcome 8.6: Discuss and explain incidents and problems related to replacing static seals

Specific outcome 8.7: Work safely with due care for self, fellow workers, machines, equipment, materials and the environment

Title 9: Maintain indirect drives

Specific outcome 9.1: Plan and prepare for indirect drive maintenance

Specific outcome 9.2: Prepare site and equipment for indirect drive maintenance

Specific outcome 9.3: Maintain indirect drive

Specific outcome 9.4: Align indirect drives

Specific outcome 9.5: Apply quality checks on completed work

Specific outcome 9.6: Conduct post-maintenance activities

Title 10: Maintain pipe systems

Specific outcome 10.1: Plan and prepare for pipe system maintenance

Specific outcome 10.2: Prepare site and equipment for pipe system maintenance

Specific outcome 10.3: Maintain pipe system

Specific outcome 10.4 Apply quality checks on completed work

Specific outcome 10.5 Conduct post-repair activities

Title 11: Perform routine maintenance

Specific outcome 11.1: Plan and prepare for routine maintenance

Specific outcome 11.2: Monitor the condition of machinery and equipment

Specific outcome 11.3: Perform routine maintenance

Specific outcome 11.4 Apply quality checks on completed work

Title 12: Sling loads

Specific outcome 12.1: Plan and prepare for load slinging activity

Specific outcome 12.2: Prepare site and equipment for load slinging

Specific outcome 12.3: Sling load

Specific outcome 12.4: Signal the lifting equipment operator

Specific outcome 12.5: Conduct post-slinging activities

Specific outcome 12.6: Care for and store load slinging equipment

Title 13: Operate and monitor a drilling machine to produce simple components

Specific outcome 13.1: Prepare for work activity

Specific outcome 13.2: Set drilling machine

Specific outcome 13.3: Perform drilling operations

Specific outcome 13.4: Apply quality checks on machined component

Title 14: Operate and monitor a surface grinding machine to produce simple components

Specific outcome 14.1: Prepare for work activity

Specific outcome 14.2: Set grinding machine

Specific outcome 14.3: Set grinding machine

Specific outcome 14.4: Apply quality checks on machined component

Title 15: Operate and monitor a milling machine to produce simple components

Specific outcome 15.1: Prepare for work activity

Specific outcome 15.2: Set milling machine

Specific outcome 15.3: Perform milling operations

Specific outcome 15.4: Apply quality checks on machined component

Title 16: Operate and monitor a lathe to produce simple components

Specific outcome 16.1: Prepare for work activity

Specific outcome 16.2: Set lathe

Specific outcome 16.3: Perform turning operations

Specific outcome 16.4: Apply quality checks on machined component

Specific outcome 16.5: Recognise and report problems, changes and/or malfunctions while operating

National Certificate in Mechanical Engineering (Fitting) NQF Level 3

UNIT STANDARDS ON NQF LEVEL 3

CORE

Title 1: Grind tools and drill bits

Title 2: Maintain bearings in machines and equipment

Title 3: Maintain pumps

Title 4: Maintain heat exchangers and pressure vessels

Title 5: Maintain direct drives

Title 6: Maintain dynamic seals in machines and / or equipment

Title 7: Maintain brakes and clutches

Title 8: Maintain lubricating systems

ELECTIVE

Title 9: Maintain conveyor systems

Title 10: Perform heat treatment processes on engineering metals

Title 11: Perform non-destructive tests on metal parts and components

Title 12: Test the physical properties of engineering metals

Title 13:

Unit standards and specific outcomes in National Certificate in Mechanical Engineering (Fitting) NQF Level 3

Title 1: Grind tools and drill bits

Specific outcome 1.1: Plan and prepare for tool grinding

Specific outcome 1.2: Prepare site and equipment

Specific outcome 1.3: Inspect and assess tool condition

Specific outcome 1.4: Grind tool

Specific outcome 1.5: Check tool for compliance with manufacturer specifications

Specific outcome 1.6: Care for and store tool grinding tools and equipment

Specific outcome 1.7: Record information on work done

Specific outcome 1.8: Discuss and explain incidents and problems related to tool grinding

Specific outcome 1.9: Work safely with due care for self, fellow workers, machines, equipment, materials and the environment

Title 2: Maintain bearings in machines and equipment

Specific outcome 2.1: Plan and prepare for bearing replacement

Specific outcome 2.2: Prepare site and equipment for bearing replacement
Specific outcome 2.3: Check bearings in situ
Specific outcome 2.4: Remove and inspect bearings
Specific outcome 2.5: Install bearings to machines and equipment

Title 3: Maintain pumps

Specific outcome 3.1: Plan and prepare for pump maintenance
Specific outcome 3.2: Prepare site and equipment
Specific outcome 3.3: Inspect and assess pump condition
Specific outcome 3.4: Maintain pump
Specific outcome 3.5: Check pump for compliance with operational requirements
Specific outcome 3.6: Care for and store system maintenance tools and equipment

Title 4: Maintain heat exchangers and pressure vessels

Specific outcome 4.1: Plan and prepare for heat exchanger and pressure vessel maintenance / pressure testing
Specific outcome 4.2: Prepare site and equipment
Specific outcome 4.3: Inspect and assess heat exchanger / pressure vessel condition
Specific outcome 4.4: Maintain heat exchanger and pressure vessels
Specific outcome 4.5: Conduct pressure test
Specific outcome 4.6: Check heat exchanger for compliance with operational requirements

Title 5: Maintain direct drives

Specific outcome 5.1: Plan and prepare for direct drive maintenance
Specific outcome 5.2: Prepare site and equipment for direct drive maintenance
Specific outcome 5.3: Maintain direct drive
Specific outcome 5.4: Align direct drives
Specific outcome 5.5: Apply quality checks on completed work
Specific outcome 5.6: Conduct post-maintenance activities

Title 6: Maintain dynamic seals in machines and / or equipment

Specific outcome 6.1: Plan and prepare for seal replacement
Specific outcome 6.2: Prepare site and equipment for seal replacement
Specific outcome 6.3: Maintain dynamic seals
Specific outcome 6.4: Check equipment for compliance with operational requirements

Title 7: Maintain brakes and clutches

Specific outcome 7.1: Plan and prepare for brake and clutch maintenance

Specific outcome 7.2: Prepare site and equipment for brake and clutch maintenance

Specific outcome 7.3: Check brakes and clutches in situ

Specific outcome 7.4: Install brakes and clutches to machines and equipment

Title 8: Maintain lubricating systems

Specific outcome 8.1: Plan and prepare for repairs to lubricating system

Specific outcome 8.2: Prepare site and equipment

Specific outcome 8.3: Inspect and assess lubricating system functioning

Specific outcome 8.4: Rectify lubrication system faults

Title 9: Maintain conveyor systems

Specific outcome 9.1: Plan and prepare for conveyor system maintenance

Specific outcome 9.2: Prepare site and equipment

Specific outcome 9.3: Inspect and assess conveyor system

Specific outcome 9.4: Maintain conveyor system

Title 10: Perform heat treatment processes on engineering metals

Specific outcome 10.1: Discuss and explain the heat treatment of metals

Specific outcome 10.2: Determine heat treatment requirements

Specific outcome 10.3: Prepare materials and equipment for heat treatment process

Specific outcome 10.4 Complete heat treatment of metals

Title 11: Perform non-destructive tests on metal parts and components

Specific outcome 11.1: Receive samples and check against documentation

Specific outcome 11.2: Carry out testing using ultrasonic methods

Specific outcome 11.3: Test parts for surface defects using magnetic particle inspection

Specific outcome 11.4 Recognise and report problems, changes and/or malfunctions while working

Title 12: Test the physical properties of engineering metals

Specific outcome 12.1: Receive samples and check against documentation

Specific outcome 12.2: Prepare for tests

Specific outcome 12.3: Complete tests and interpret and record results

Specific outcome 12.4: Store samples

Specific outcome 12.5: Care for test equipment

Title 13: Produce detailed engineering drawings

Specific outcome 13.1: Determine drawing requirements

Specific outcome 13.2: Perform calculations to produce drawing

Specific outcome 13.3: Produce drawings

NATIONAL CERTIFICATE IN MECHANICAL ENGINEERING (FITTING) NQF LEVEL 4

UNIT STANDARDS ON NQF LEVEL 4

CORE

Title 1: Maintain gearboxes
Title 2: Maintain compressors
Title 3: Maintain fluid power / pneumatic systems
Title 4: Diagnose and repair faults on equipment and machinery during production/operation
Title 5: Align machines and equipment using laser technology

ELECTIVE

Title 6: Maintain safety valves
Title 7: Stopple operational pipelines
Title 8: Refurbish machines
Title 9: Commission assembly / machine
Title 10: Produce complex engineering drawings

UNIT STANDARDS AND SPECIFIC OUTCOMES IN NATIONAL CERTIFICATE IN MECHANICAL ENGINEERING (FITTING) NQF LEVEL 4

Title 1: Maintain gearboxes

Specific outcome 1.1: Plan and prepare for gearbox maintenance
Specific outcome 1.2: Prepare site and equipment
Specific outcome 1.3: Inspect and assess gearbox maintenance requirements
Specific outcome 1.4: Maintain gearbox
Specific outcome 1.5: Check gearbox for compliance with operational requirements
Specific outcome 1.6: Care for and store system maintenance tools and equipment
Specific outcome 1.7: Record information on work done
Specific outcome 1.8: Discuss and explain incidents and problems related to gearbox maintenance
Specific outcome 1.9: Work safely with due care for self, fellow workers, machines, equipment, materials and the environment

Title 2: Maintain compressors

Specific outcome 2.1: Plan and prepare for compressor maintenance

Specific outcome 2.2: Prepare site and equipment
Specific outcome 2.3: Inspect and assess compressor maintenance requirements
Specific outcome 2.4: Maintain compressor

Title 3: Maintain fluid power / pneumatic systems

Specific outcome 3.1: Plan and prepare for fluid power / pneumatic system maintenance
Specific outcome 3.2: Prepare site and equipment for maintenance activity
Specific outcome 3.3: Maintain fluid power / pneumatic system
Specific outcome 3.4: Apply quality checks on completed work
Specific outcome 3.5: Conduct post-repair activities

Title 4: Diagnose and repair faults on equipment and machinery during production/operation

Specific outcome 4.1: Monitor the performance of equipment and machinery during operation
Specific outcome 4.2: Perform minor repairs on line
Specific outcome 4.3: Determine major equipment and machinery component repairs
Specific outcome 4.4: Work safely with due care for self, fellow workers, machines, equipment, materials and the environment

Title 5: Align machines and equipment using laser technology

Specific outcome 5.1: Plan and prepare for machine and equipment alignment
Specific outcome 5.2: Prepare site and equipment for machine and equipment alignment
Specific outcome 5.3: Align machines and equipment
Specific outcome 5.4: Apply quality checks on completed work
Specific outcome 5.5: Conduct post-alignment activities
Specific outcome 5.6: Care for and store alignment tools and equipment
Specific outcome 5.7: Discuss and explain incidents and problems related to machine and equipment alignment

Title 6: Maintain safety valves

Specific outcome 6.1: Plan and prepare for safety valve maintenance
Specific outcome 6.2: Prepare site and equipment
Specific outcome 6.3: Inspect and assess safety valve maintenance requirements
Specific outcome 6.4: Maintain safety valve

Title 7: Stopple operational pipelines

Specific outcome 7.1: Plan and prepare for work activity

Specific outcome 7.2: Prepare site and equipment for drilling into and plugging the operational pipe line

Specific outcome 7.3: Drill into the operational pipeline, tap the fitting and install the pipeline plug

Specific outcome 7.4: Check stoppling process for conformance to specifications

Specific outcome 7.5: Identify non-conforming components, changes and / or malfunctions and take appropriate corrective action

Title 8: Refurbish machines

Specific outcome 8.1: Plan and prepare for refurbishment

Specific outcome 8.2: Prepare site and equipment

Specific outcome 8.3: Carry out fault diagnosis on machines

Specific outcome 8.4: Refurbish machines

Specific outcome 8.5: Recognise and report problems or changes while working

Specific outcome 8.6: Record information on work done

Specific outcome 8.7: Discuss and explain incidents and problems related to refurbishment activity

Title 9: Commission assembly / machine

Specific outcome 9.1: Plan and prepare for commissioning

Specific outcome 9.2: Commission machine / assembly

Specific outcome 9.3: Identify non-conformances, diagnose faults and take corrective action

Specific outcome 9.4: Complete commissioning activity

Title 10: Produce complex engineering drawings

Specific outcome 10.1: Determine drawing requirements

Specific outcome 10.2: Perform calculations to produce drawing

Specific outcome 10.3: Produce drawings

Specific outcome 10.4 Record information on work done

SOUTH AFRICAN QUALIFICATIONS AUTHORITY

National Certificate in Mechanical Engineering (Fitting and Machining) NQF Level 2

Field: Manufacturing, Engineering and Technology - NSB 06

Sub-field: Manufacturing & Assembly

Level: 2

Credit: 185

Issue date:

Review date:

Rationale for the qualification:

The field of engineering machining is characterized by work-to-order, low volume manufacture of components using different machining methods for use in a variety of industries including the automotive, metal, appliance manufacturing, plastic, tyre and rubber industries. People working in the engineering machining field require specialized technical skills and knowledge, as well as highly developed hand skills in order to adapt to and meet the requirements of the constantly changing products that must be manufactured.

The field of engineering fitting is characterized by the provision of engineering maintenance, repair and installation services and support in a variety of industries. The equipment requiring such service and support ranges from sophisticated equipment to antiquated single station machines. People working in the mechanical engineering field require specialized technical skills and knowledge, as well as highly developed hand skills in order to meet the mechanical engineering requirements of diverse industries.

This is the first qualification in a series for learners who want to follow a career in the field of engineering fitting and machining. This qualification focuses on developing skills and knowledge necessary to begin such a career.

It also provides learners who have gained relevant experience in the workplace with an opportunity to obtain credits through an RPL process.

The qualification also forms the basis for further learning in field of engineering fitting and machining where the learner will be able to specialize.

Purpose:

The purpose of the qualification is to provide learners, education and training providers and employers with the standards and the range of learning required to work effectively in various industries making use of engineering fitting and machining skills and to meet the challenges of such an environment.

The primary skills that are recognised in this qualification are the ability to machine simple components using a variety of machining methods and the ability to apply basic mechanical assembly, maintenance and repair fundamentals to recognise and respond to equipment component defects. These capabilities require an understanding of basic machining theory, machinery functioning and maintenance, engineering materials and tools and concepts of measurement, and basic engineering drawings. Hand skills play a large role in this qualification.

Qualified learners will also understand:

- the basics of how a business functions
- their role in the business, i.e. in engineering and related activities
- how they are affected by legislation, regulations, agreements and policies related to their particular work environment.

With this understanding learners will be able to participate in workplace activities.

Access to the Qualification:

Open access.

This qualification series recognises skills, knowledge and values relevant to a workplace. It is designed for learners who:

- Have attended courses and then apply the knowledge gained to activities in the workplace

- Are already workers and have acquired the skills and knowledge without attending formal courses
- Are part of a learnership programme which integrates structured learning and work experience.

Learning assumed to be in place:

This qualification assumes learners have a General Education and Training Certificate at NQF level 1, or alternatively, an ABET level 4 qualification.

If the learner does not already have such a qualification, learning in preparation for this qualification would also have to include:

- Literacy and numeracy
- Basic concepts of science and technology

Exit Level Outcomes and Assessment Criteria:

Exit level outcome 1

Demonstrate an understanding of a variety of machining methods and an ability to produce simple components that meet quality and output requirements, working safely and in an environmentally aware manner.

Associated Assessment Criteria

- Output and quality requirements are met
- Safe working practices are adhered to
- Can respond to questions and discuss issues related to the theoretical principles of machining, the various machining methods and the functioning of machinery.

Exit level outcome 2:

Demonstrate an understanding of the mechanical equipment maintenance process and an ability to recognise and respond to equipment component maintenance requirements that will result in increased levels of safety, health, quality or efficiency.

Associated Assessment Criteria

- Appropriate checks are performed on components
- Components are maintained to specifications.
- Non-conformances and actions taken are reported accurately and clearly
- Can respond to questions and discuss issues related to the basic component maintenance process relevant to the outcomes

Exit level outcome 3:

Understand and use appropriate hand and power tools, machinery and equipment to:

- make simple adjustments to equipment and process
- maintain mechanical components

Associated Assessment Criteria

- Mechanical components are maintained to specification
- Adjustments made are appropriate
- Downtime is minimised
- No material or product is damaged or its quality compromised
- Quality, safety and environmental procedures are followed

Exit level outcome 4

Identify engineering materials used in the machining process and describe their characteristics and applications.

Associated Assessment Criteria

- Engineering materials are identified and their physical properties described
- Can respond to questions and discuss issues related to the common applications and methods of processing and manufacturing using engineering materials

Exit level outcome 5

Demonstrate an ability to read, interpret and produce basic engineering drawings.

Associated Assessment Criteria

- Components to be machined are identified and requirements interpreted from engineering drawing
- Engineering drawing produced meets job requirements
- Can respond to questions and discuss issues related to engineering drawing concepts and material lists

Exit level outcome 6

Demonstrate a familiarity with routine maintenance procedures and operations for machinery

Associated Assessment Criteria

- Process agents are applied consistently and systematically
- Pre-operational checks are performed and identified problems reported to appropriate personnel
- Can respond to questions and discuss issues related to routine maintenance on machinery

Exit level outcome 7

Recognise and respond to routine problems related to the machining process.

Associated Assessment Criteria

- Various options are considered before a solution is chosen
- Lessons learnt in previous performances are used
- Responses are appropriate to the nature of the problem
- Problems are accurately reported to relevant personnel in a timely manner
- Can respond to questions and discuss issues related to routine problems encountered while working

Exit level outcome 8

Communicate with peers and members of supervisory/management levels by demonstrating the ability to summarise information and express opinions on given information in spoken or written form

Associated Assessment Criteria

- Communication is effective, regular and ongoing
- Information is clear and accurate and conveyed in a timely manner
- Relationships with peers and supervisory/management levels are established and functioning

Exit level outcome 9

Demonstrate an understanding of options for further learning in this or a related field of learning and preparation requirements for such learning

Associated Assessment Criteria

- Options are explained
- Preparation requirements are explained.
- Learning plan is developed

International comparability

As a starting point, the series of qualifications in the field of mechanical engineering covering machining, fitting, fitting and machining, and tooling manufacture specialisations, of which this qualification forms a part, was compared to other, similar outcomes-based qualifications, certifications or skills standards in New Zealand and Australia. It was found to be difficult to compare the New Zealand and Australian narrow focus qualifications with these broad-based qualifications that also include fundamentals and generic core standards. It was further difficult to undertake such comparisons given that the New Zealand and Australian qualifications, although they are in the same field of mechanical engineering and cover the same areas of specialisation (thus containing a large degree of similar content) are conceptualized as three year qualifications without exit level outcomes at the intermediate levels (NQF levels 2 and 3). This notwithstanding, the technical content of this series of

qualifications for mechanical engineering (with the various specialisations) of which the highest qualification is at level 4 does correspond with the equivalent level of qualification in mechanical engineering (with the various specialisations) in Australia and New Zealand.

Integrated Assessment:

Integrated assessment at the level of the qualification provides an opportunity for learners to show they are able to integrate concepts, actions and ideas achieved across a range of unit standards and contexts. Integrated assessment must evaluate the quality of observable performance as well as the thinking behind the performance.

Some assessment aspects will demand practical demonstration while others may not. In some case inference will be necessary to determine competence depending on the nature and context within which performance takes place.

Since this is a foundational qualification, it is necessary to ensure that the fundamental part of the qualification is also targeted to ensure that while the competence may have been achieved in a particular context, learners are able to apply it in a range of other contexts and for further learning. The assessment should also ensure that all the critical cross-field outcomes have been achieved.

Recognition of prior learning:

This qualification may be obtained through RPL. The learner should be thoroughly briefed of the mechanism to be used and support and guidance should be provided. Care should be taken that the mechanism used provides the learner with an opportunity to demonstrate competence and is not too onerous as to prevent learners from taking up the RPL option towards gaining a qualification.

Articulation possibilities:

The qualification has been designed and structured so that qualifying learners can move from one context to another. Employers or institutions should be able to evaluate the outcomes of this qualification against the needs of their context and structure top-up learning appropriately. Equally, holders of other qualifications may be evaluated against this qualification for the purpose of RPL.

Moderation Options:

- Anyone assessing a learner against this qualification must be registered as an assessor with the MERS ETQA or any other relevant ETQA

- Any institution or learning provider offering learning towards the achievement of this qualification should be accredited as a provider with the MERS ETQA or any other relevant ETQA
- Moderation of assessment should be overseen by the MERS ETQA or any other relevant ETQA according to the moderation guidelines provided for in this qualification as well as the agreed ETQA procedures

Criteria for registration of assessors

The following criteria should be applied by the relevant ETQA:

1. Appropriate qualification in the field of mechanical engineering (fitting and machining) – with a minimum of 3 years' experience working in the field. The subject matter experience of the assessor can be established by recognition of prior learning.
2. Appropriate experience and understanding of assessment theory, processes and practices
3. Good interpersonal skills and the ability to balance the conflicting requirements of:

- Maintaining national standards
- The interests of the learner
- The need for transformation and redressing the legacies of the past
- The cultural background and language of the learner

4. Registration as an assessor with the MERS ETQA or any other relevant ETQA
5. Any other criteria required by the MERS ETQA or any other relevant ETQA

National Certificate in Mechanical Engineering (Fitting and Machining) NQF Level 2

Fundamental			
NLRD	**Title**	**Level**	**Credits**
	Communication		
8962	Maintain and adapt oral communication	2	5
8963	Access and use information from texts	2	5
8964	Write for a defined context	2	5
	Communicate at work	2	5
	Mathematics		
8982	Demonstrate an understanding of rational and irrational numbers and number systems within the context of relevant calculations	2	3
8983	Use mathematics to investigate and monitor the financial aspects of personal and community life	2	2
9009	Apply basic knowledge of statistics and probability in order to investigate life and work related problems	2	3
9008	Measure, estimate and calculate physical quantities and explore, describe and represent geometrical relationships in two dimensions in different life or workplace contexts	2	3
9007	Work with a range of patterns and basic functions to solve related problems	2	5
Core			
NLRD	**Title**	**Level**	**Credits**
	Materials		
	Identify engineering materials, their characteristics and applications, and common metal tests and treatments used in engineering	2	4
	Tools, equipment and machines		

	Select, use and care for engineering measuring equipment	2	4
	Select, use and care for engineering power tools	2	6
	Select, use and care for engineering hand tools	2	8
	Perform basic welding / joining of metals	2	8
	Mark off basic engineering shapes	2	2
	Perform routine maintenance	2	8
	Sling loads	2	4
	Drawings and design		
	Read, interpret and produce basic engineering drawings	2	6
	Machining		
	Operate and monitor a drilling machine to produce simple components	2	6
	Operate and monitor a surface grinding machine to produce simple components	2	8
	Operate and monitor a milling machine to produce simple components	2	12
	Operate and monitor a lathe to produce simple components	2	12
	Maintain and repair		
	Maintain static seals in machines and / or equipment	2	4
	Maintain indirect drives	2	6
	Maintain pipe systems	2	20
	Safety, Health & Environment		
	Keep the work area safe and productive	2	8
	Business Relations		
	Explain the individual's role within business	2	4
	People Interacting, leading and developing		

	Develop a learning plan and a portfolio for assessment	2	6
	Understand and deal with HIV/AIDs	2	3

Elective			
NLRD	**Safety, Health & Environment**		
	Perform basic first aid	2	4
	Perform basic fire fighting	2	2
	Information technology		
7547	Operate a personal computer system	2	6
7548	Use a personal computer operating system	2	3
	Suggested additional learning		
9268	Manage basic personal finance	2	6
	Minimum elective credits required		**10**

SOUTH AFRICAN QUALIFICATIONS AUTHORITY

National Certificate in Mechanical Engineering (Fitting and Machining) NQF Level 3

Field: Manufacturing, Engineering and Technology - NSB 06

Sub-field: Manufacturing & Assembly

Level: 3

Credit: 174

Issue date:

Review date:

Rationale for the qualification:

The field of engineering machining is characterized by work-to-order, low volume manufacture of components using different machining methods for use in a variety of industries including the automotive, metal, appliance manufacturing, plastic, tyre and rubber industries. People working in the engineering machining field require specialized technical skills and knowledge, as well as highly developed hand skills in order to adapt to and meet the requirements of the constantly changing products that must be manufactured.

The field of engineering fitting is characterized by the provision of engineering maintenance, repair and installation services and support in a variety of industries. The equipment requiring such service and support ranges from sophisticated equipment to antiquated single station machines. People working in the mechanical engineering field require specialized technical skills and knowledge, as well as highly developed hand skills in order to meet the mechanical engineering requirements of diverse industries.

This is the second qualification in a series for learners who want to follow a career in the field of engineering fitting and machining.

It also provides learners who have gained relevant experience in the workplace with an opportunity to obtain credits through an RPL process.

The qualification also forms the basis for further learning in the field of engineering fitting and machining where the learner will be able to specialize.

Purpose:

The purpose of the qualification is to provide learners, education and training providers and employers with the standards and the range of learning required to work effectively in various industries making use of fitting and engineering machining skills and meet the challenges of such an environment.

The primary skills that are recognised in this qualification are the ability to produce components of some complexity using a variety of machining methods and the ability to fault find, dismantle, maintain, repair and install complex mechanical assemblies and diagnose and repair equipment and machinery during production/operation. These capabilities require an understanding of advanced machining and mechanical theory, detailed engineering drawings and a variety of tests and treatments used on engineering metals. Hand skills play a large role in this qualification.

Qualifying learners will also be able to relate what they are doing to scientific and technological principles and concepts. They will also be able to maintain and support the various policies and procedures related to the safety, health, environment and quality systems that govern their workplace.

Access to the Qualification:

Open access.

This qualification series recognises skills, knowledge and values relevant to a workplace. It is designed for learners who:

- Have attended courses and then apply the knowledge gained to activities in the workplace
- Are already workers and have acquired the skills and knowledge without attending formal courses

- Are part of a learnership programme which integrates structured learning and work experience.

Learning assumed to be in place:

This qualification assumes learners have a national certificate in mechanical engineering (fitting and machining) level 2.

If the learner does not already have such a qualification, learning in preparation for this qualification would also have to include:

- Language and maths beyond basic literacy and numeracy
- Basic concepts of science and technology related to machining methods, engineering materials and tools used in the machining process
- An ability to produce simple components using a variety of machining methods
- An ability to apply basic mechanical assembly, maintenance and repair fundamentals to recognise and respond to equipment component defects.
- Concepts of organising factors in labour, business and the economy
- Role and purpose of procedures related to workplace relationships, roles and responsibilities

Exit Level Outcomes and Assessment Criteria:

Exit level outcome 1

Demonstrate an ability to produce components of some complexity using a variety of machining methods and operations, meeting output requirements and working safely with due care for fellow workers and the environment

Associated Assessment Criteria

- Output and quality requirements are met
- Machining time limits are adhered to
- Safe working practices are adhered to
- Can respond to questions and discuss issues related to the theoretical principles of machining and the various machining methods and their respective operations at this level

Exit level outcome 2

Demonstrate an ability to select and apply appropriate inspection methods to determine component compliance with specifications

Associated Assessment Criteria

- Appropriate inspection methods are chosen and applied
- Can respond to questions and discuss issues related to various inspection methods and procedures and the principles underpinning such methods

Exit level outcome 3:

Demonstrate an understanding of and an ability to fault find, dismantle, maintain, assemble and install a variety of mechanical assemblies and make close tolerance adjustments to equipment and process, meeting output requirements and working safely with due care for fellow workers and the environment

Associated Assessment Criteria

- Condition of equipment and machinery is monitored
- Faults in equipment and machinery are diagnosed.
- Equipment and machinery are maintained to required standards and overhauled at required intervals
- Dismantling sequence of assemblies meets specifications
- Assemblies and installations meet specifications
- Safe working practices are adhered to

Exit level outcome 4

Demonstrate an understanding of lubrication systems and an ability to maintain such systems

Associated Assessment Criteria

- Lubrication systems are maintained to specifications
- Can respond to questions and discuss issues related to the lubrication systems of equipment and machinery within the plant

Exit level outcome 5

Demonstrate an ability to read and interpret detailed engineering drawings.

Associated Assessment Criteria

- Components and assemblies to be machined identified and requirements interpreted from engineering drawing
- Machined components and assemblies meet drawing specifications

Exit level outcome 6

Select appropriate procedures to solve familiar problems within an engineering machining and fitting environment and operate within clearly defined contexts, with some scope for personal decision-making and responsibility

Associated Assessment Criteria

- Appropriate procedures are selected to solve problems in an efficient and effective manner
- Unfamiliar problems are accurately reported to appropriate personnel
- Can respond to questions and discuss issues related to familiar problems in the machining of components and assemblies

Exit level outcome 7

Communicate with peers, customers and members of supervisory/management levels by demonstrating the ability to gather and summarise information from a range of sources and produce coherent presentations in a prescribed format

Associated Assessment Criteria

- Information is gathered from a range of sources and accurately summarised into a prescribed format.
- Information is clear and accurate and presented in a timely manner in the required format to appropriate parties.
- Relationships with peers and supervisory./management levels are established and functioning

Exit level outcome 8

Demonstrate an understanding of options for further learning in this or a related field of learning and preparation requirements for such learning

Associated Assessment Criteria

- Options are explained
- Preparation requirements are explained.
- Learning plan is developed

International comparability

This qualification was compared to other, similar outcomes- based qualifications, certifications or skills standards in New Zealand, Australia and the United Kingdom.

Integrated Assessment:

Integrated assessment at the level of the qualification provides an opportunity for learners to show they are able to integrate concepts, actions and ideas achieved across a range of unit standards and contexts. Integrated assessment must evaluate the quality of observable performance as well as the thinking behind the performance.

Some assessment aspects will demand practical demonstration while others may not. In some case inference will be necessary to determine competence depending on the nature and context within which performance takes place.

It will be necessary to necessary to ensure that the fundamental part of the qualification is also targeted to ensure that while the competence may have been achieved in a particular context, learners are able to apply it in a range of other contexts and for further learning. The assessment should also ensure that all the critical cross-field outcomes have been achieved.

Recognition of prior learning:

This qualification may be obtained through a process of RPL. The learner should be thoroughly briefed prior to the assessment and support provided to assist in the process of developing a portfolio. While this is primarily a workplace-based qualification, evidence from other areas of endeavour may be introduced if pertinent to any of the exit-level outcomes.

Articulation possibilities:

The qualification has been designed and structured so that qualifying learners can move from one context to another. Employers or institutions should be able to evaluate the outcomes of this qualification against the needs of their context and structure top-up learning appropriately. Equally, holders of other qualifications may be evaluated against this qualification for the purpose of RPL.

Moderation Options:

- Anyone assessing a learner against this qualification must be registered as an assessor with the MERS ETQA or any other relevant ETQA
- Any institution or learning provider offering learning towards the achievement of this qualification should be accredited as a provider with the MERS ETQA or any other relevant ETQA
- Moderation of assessment should be overseen by the MERS ETQA or any other relevant ETQA according to the moderation guidelines provided for in this qualification as well as the agreed ETQA procedures

Criteria for registration of assessors

The following criteria should be applied by the relevant ETQA:

1. Appropriate qualification in the field of mechanical engineering (fitting and machining) – with a minimum of 3 years' experience working in the field. The subject matter experience of the assessor can be established by recognition of prior learning.
2. Appropriate experience and understanding of assessment theory, processes and practices
3. Good interpersonal skills and the ability to balance the conflicting requirements of:

- Maintaining national standards
- The interests of the learner
- The need for transformation and redressing the legacies of the past
- The cultural background and language of the learner

4. Registration as an assessor with the MERS ETQA or any other relevant ETQA
5. Any other criteria required by the MERS ETQA or any other relevant ETQA

Fundamental			
NLRD	**Title**	**Level**	**Credits**
	Communication		
8968	Accommodate audience and context needs in oral communication	3	5
8969	Interpret and use information from texts	3	5
8970	Write texts for a range of communicative contexts	3	5
9529	Compile feasibility and commissioning reports	3	3
9528	Communicate with clients	3	3
	Mathematics		
9010	Demonstrate an understanding of the use of different number bases and measurement units and an awareness of error in the context of relevant calculations	3	2
9014	Use mathematics to investigate and monitor the financial aspects of personal and business issues	3	5
9012	Investigate life-related problems using data and probabilities	3	5
9013	Measure, estimate and calculate physical quantities and explore, describe and represent, interpret and justify geometrical relationships in two and three dimensional space relevant to the life or workplace of the community	3	4
Core			
NLRD	**Title**	**Level**	**Credits**
	Machining		
	Produce components by performing engineering milling operations	3	20
	Produce components by performing engineering turning operations	3	20

	Produce components by performing engineering grinding operations	3	12
	Grind tools and drill bits	3	4
	Maintain and repair		
	Maintain bearings in machines and equipment	3	8
	Maintain pumps	3	24
	Maintain heat exchangers and pressure vessels	3	8
	Maintain direct drives	3	6
	Maintain dynamic seals in machines and equipment	3	3
	Maintain brakes and clutches	3	6
	Maintain lubricating systems	3	4
	Business Relations		
9526	Manage basic business finance	3	6
9530	Manage work time effectively	3	3

SOUTH AFRICAN QUALIFICATIONS AUTHORITY

National Certificate in Mechanical Engineering (Fitting and Machining) NQF Level 4

Field: Manufacturing, Engineering and Technology - NSB 06

Sub-field: Manufacturing & Assembly

Level: 4

Credit: 179

Issue date:

Review date:

Rationale for the qualification:

The field of engineering machining is characterized by work-to-order, low volume manufacture of components using different machining methods for use in a variety of industries including the automotive, metal, appliance manufacturing, plastic, tyre and rubber industries. People working in the engineering machining field require specialized technical skills and knowledge, as well as highly developed hand skills in order to adapt to and meet the requirements of the constantly changing products that must be manufactured.

The field of engineering fitting is characterized by the provision of engineering maintenance, repair and installation services and support in a variety of industries. The equipment requiring such service and support ranges from sophisticated equipment to antiquated single station machines. People working in the mechanical engineering field require specialized technical skills and knowledge, as well as highly developed hand skills in order to meet the mechanical engineering requirements of diverse industries.

This is a third qualification in a series for learners who want to follow a career in the field of engineering fitting and machining.

It also provides learners who have gained relevant experience in the workplace with an opportunity to obtain credits through an RPL process.

The qualification also forms the basis for further learning in the field of engineering fitting and machining where the learner will be able to specialize.

Purpose:

The purpose of the qualification is to provide learners, education and training providers and employers with the standards and the range of learning required to work effectively in various industries making use of fitting and engineering machining skills and meet the challenges of such an environment.

The primary skills that are recognised in this qualification are the ability to produce complex components using a variety of machining methods and the ability to maintain and overhaul complex equipment and machinery, and assemble and install complex components using technology aids. These capabilities require an understanding of advanced machining and mechanical theory and complex engineering drawings. Hand skills play a large role in this qualification.

The learner must furthermore choose from a number of elective unit standards for various machining methods and for computer numerical controlled (CNC) programming, setting and operation. Although the CNC unit standards are elective at present, it is recommended that learners choose these standards.

Qualified learners will also understand:

- How to plan, schedule and evaluate own work
- How to interact with team leaders and develop the capacity of team members to maintain and support quality, safety and health systems

With this understanding learners will be able to participate in workplace activities.

Qualifying learners will also be able to relate what they see and experience to scientific and technological principles and concepts.

Access to the Qualification:

Open access.

This qualification series recognises skills, knowledge and values relevant to a workplace. It is designed for learners who:

- Have attended courses and then apply the knowledge gained to activities in the workplace
- Are already workers and have acquired the skills and knowledge without attending formal courses
- Are part of a learnership programme which integrates structured learning and work experience.

Learning assumed to be in place:

This qualification assumes learners have a national certificate in engineering machining (fitting and machining specialisation) level 3.

If the learner does not already have such a qualification, learning in preparation for this qualification would also have to include:

- Language and maths related to organising and controlling their environment
- Maths and applicable scientific and technological concepts related to machining of components and the dismantling, maintenance, repair and installation of assemblies
- An ability to produce components of some complexity using a variety of machining methods
- Maths and applicable scientific and technological concepts related to the dismantling, maintenance, repair and installation of assemblies
- The ability to dismantle, maintain, repair and install a variety of assemblies
- Concepts of contributing factors in labour, business and the economy
- Role and purpose of systems which support workplace relationships, procedures, roles and responsibilities

Exit Level Outcomes and Assessment Criteria:

Exit level outcome 1

Demonstrate an ability to produce complex components using a variety of machining methods and operations, meeting output requirements and working safely with due care for fellow workers and the environment

Associated Assessment Criteria

- Output and quality requirements met
- Machining time limits are adhered to
- Safe working practices are adhered to
- Can respond to questions and discuss issues related to the theoretical principles of machining and the various machining methods and their respective operations at this level

Exit level outcome 2

Demonstrate an understanding of quality specifications and an ability to interpret these and evaluate components machined to determine compliance

Associated Assessment Criteria

- Quality specifications interpreted and applied to machined component and compliance determined and reported
- Can respond to questions and discuss issues related to quality specifications and the principles underpinning such specifications

Exit level outcome 3

Demonstrate an understanding of and an ability to fault find, dismantle, maintain, repair and install complex mechanical assemblies, meeting output requirements and working safely with due care for fellow workers and the environment

Associated Assessment Criteria

- Condition of equipment and machinery is monitored and faults diagnosed
- Assemblies are maintained and refurbished to required standards
- Output requirements are met
- Safe working practices are adhered to
- Can respond to questions and discuss issues related to assembly, maintenance and refurbishment of complex assemblies

Exit level outcome 4

Demonstrate an understanding of production/operation maintenance requirements and an ability to diagnose and repair faults on machinery and equipment during production/operation

Associated Assessment Criteria

- Recurrent equipment and machinery faults and their root causes identified
- Minor repairs on line are performed
- Documentation on major repair requirements completed
- Equipment and machinery components requiring major repair dismantled and dispatched to workshop
- Major repair requirements reported
- Production time schedule maintained
- Potential production and maintenance problems are explained and discussed

Specific outcome 12.4: Apply quality checks on machined component

Specific outcome 12.5: Recognise and report problems, changes and/or malfunctions while operating

Title 13: Maintain static seals in machines and / or equipment

Specific outcome 13.1: Plan and prepare for seal replacement

Specific outcome 13.2: Prepare site and equipment for seal replacement

Specific outcome 13.3: Maintain static seals

Specific outcome 13.4: Check equipment for compliance with operational requirements

Specific outcome 13.5: Record information on work done

Specific outcome 13.6: Discuss and explain incidents and problems related to replacing static seals

Specific outcome 13.7: Work safely with due care for self, fellow workers, machines, equipment, materials and the environment

Title 14: Maintain indirect drives

Specific outcome 14.1: Plan and prepare for indirect drive maintenance

Specific outcome 14.2: Prepare site and equipment for indirect drive maintenance

Specific outcome 14.3: Maintain indirect drive

Specific outcome 14.4: Align indirect drives

Specific outcome 14.5: Apply quality checks on completed work

Specific outcome 14.6: Conduct post-maintenance activities

Title 15: Maintain pipe systems

Specific outcome 15.1: Plan and prepare for pipe system maintenance

Specific outcome 15.2: Prepare site and equipment for pipe system maintenance

Specific outcome 15.3: Maintain pipe system

Specific outcome 15.4 Apply quality checks on completed work

Specific outcome 15.5 Conduct post-repair activities

Exit level outcome 5

Demonstrate an understanding of fluid power/pneumatic systems and an ability to maintain such systems

Associated Assessment Criteria

- Fluid power/pneumatic systems are maintained to specifications
- Can respond to questions and discuss issues related to the fluid power/pneumatic systems of equipment and machinery within the plant

Exit level outcome 6

Demonstrate an ability to read and interpret complex engineering drawings

Associated Assessment Criteria

- Components and assemblies to be machined identified and requirements interpreted from engineering drawing
- Machined components and assemblies meet drawing specifications

Exit level outcome 7

Maintain and support procedures to solve a variety of problems, both familiar and unfamiliar, within an engineering machining context and operate within familiar and new situations, taking responsibility and making decisions

Associated Assessment Criteria

- Solutions to machining problems are based on a clear analysis of information gathered through diagnostic procedures.
- Procedures are modified to respond to unfamiliar problems where appropriate
- Can respond to questions and discuss issues related to familiar and unfamiliar problems arising in the machining of complex components
- All actions related to problem solving are accurately recorded for future reference

Exit level outcome 8

Communicate and present information clearly and reliably and demonstrate the ability to analyse information to identify problems and determine trends

Associated Assessment Criteria

- Conditions, evidence and incidences are reported accurately in a timely manner and discussed with peers and management
- Data gathered through diagnostic procedures is examined systematically and analysis is repeated until problem is solved.
- Records are available for scrutiny and future reference

Exit level outcome 9

Demonstrate an understanding of options for further learning in this or a related field of learning and preparation requirements for such learning

Associated Assessment Criteria

- Options are explained
- Preparation requirements are explained.
- Learning plan is developed

International comparability

This qualification was compared to other, similar outcomes- based qualifications, certifications or skills standards in New Zealand, Australia and the United Kingdom.

Integrated Assessment:

Integrated assessment at the level of the qualification provides an opportunity for learners to show they are able to integrate concepts, actions and ideas achieved across a range of unit standards and contexts. Integrated assessment must evaluate the quality of observable performance as well as the thinking behind the performance.

Some assessment aspects will demand practical demonstration while others may not. In some case inference will be necessary to determine competence depending on the nature and context within which performance takes place.

It will be necessary to necessary to ensure that the fundamental part of the qualification is also targeted to ensure that while the competence may have been achieved in a particular context, learners are able to apply it in a range of other contexts and for further learning. The assessment should also ensure that all the critical cross-field outcomes have been achieved.

Recognition of prior learning:

This qualification may be obtained through a process of RPL. The learner should be thoroughly briefed prior to the assessment and support provided to assist in the process of developing a portfolio. While this is primarily a workplace-based qualification, evidence from other areas of endeavour may be introduced if pertinent to any of the exit-level outcomes.

Articulation possibilities:

The qualification has been designed and structured so that qualifying learners can move from one context to another. Employers or institutions should be able to evaluate the outcomes of this qualification against the needs of their context and structure top-up learning appropriately.

Equally, holders of other qualifications may be evaluated against this qualification for the purpose of RPL.

Moderation Options:

- Anyone assessing a learner against this qualification must be registered as an assessor with the MERS ETQA or any other relevant ETQA
- Any institution or learning provider offering learning towards the achievement of this qualification should be accredited as a provider with the MERS ETQA or any other relevant ETQA
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Criteria for registration of assessors

The following criteria should be applied by the relevant ETQA:

1. Appropriate qualification in the field of mechanical engineering (fitting and machining) – with a minimum of 3 years' experience working in the field. The subject matter experience of the assessor can be established by recognition of prior learning.
2. Appropriate experience and understanding of assessment theory, processes and practices
3. Good interpersonal skills and the ability to balance the conflicting requirements of:

- Maintaining national standards
- The interests of the learner
- The need for transformation and redressing the legacies of the past
- The cultural background and language of the learner

4. Registration as an assessor with the MERS ETQA or any other relevant ETQA
5. Any other criteria required by the MERS ETQA or any other relevant ETQA

Fundamental			
NLRD	**Title**	**Level**	**Credits**
	Communication		
8968	Engage in sustained oral communication and evaluate spoken texts	4	5
8969	Read, analyse and respond to a variety of texts	4	5
8970	Write for a wide range of contexts	4	5
9529	Write a technical report **	4	4
9528	Communicate in an assertive manner with clients and fellow workers **	4	4
	Mathematics		
9014	Use mathematics to investigate and monitor the financial aspects of personal, business and national issues	4	4
9015	Apply knowledge of statistics and probability to critically interrogate and effectively communicate findings on life related problems	4	6
9016	Measure, estimate and calculate physical quantities and explore, critique and prove geometrical relationships in two and three dimensional space in the life and workplace of the adult with increasing responsibilities	4	6
	Life Skills		
	Develop a personal financial plan *	4	2
Core			
NLRD	**Title**	**Level**	**Credits**
	Machining		
	Produce complex components using milling machines	4	20
	Produce complex components using lathes	4	20
	Maintain and repair		

	Maintain gearboxes	4	10
	Maintain compressors	4	16
	Maintain a fluid power/pneumatic system	4	12
	Diagnose and repair faults on equipment and machinery during production/operation	4	24
	Align machines and equipment using laser technology	4	6
	Elective		
NLRD	**Titles**		**Credits**
	Machining		
	Write simple computer numerical controlled (CNC) programmes and set and operate a CNC machine	4	24
	Grind tools and cutters used in engineering machining operations	4	8
	Produce complex components by performing internal and external grinding operations	4	12
	Produce components by performing horizontal boring operations	4	12
	Produce components by performing vertical boring operations	4	8
	Set automatic production lathes	4	10
	Write programmes for CNC machining centres using proprietary software	4	30
	Produce components using wire cutting operations	4	10
	Maintain and repair		
	Maintain safety valves	4	4
	Stopple engineering pipelines	4	16
	Refurbish machines	4	24
	Commission assembly/machine	4	8
	Drawings and design		
	Produce complex engineering drawings	4	6

People interacting, leading and developing			
Develop the skills of a work group*	5	10	
Business Relations			
Contribute to the implementation and maintenance of business processes *	4	10	

NATIONAL CERTIFICATE IN MECHANICAL ENGINEERING (FITTING AND MACHINING) NQF LEVEL 2
UNIT STANDARDS ON NQF LEVEL 2

CORE

Title 1: Identify engineering metals, their characteristics and applications and common metal tests and treatments used in engineering

Title 2: Select, use and care for engineering measuring equipment

Title 3: Select, use and care for engineering power tools

Title 4: Select, use and care for engineering hand tools

Title 5: Perform basic welding / joining of metals

Title 6: Mark off basic engineering shapes

Title 7: Perform routine maintenance

Title 8: Read, interpret and produce engineering drawings

Title 9: Operate and monitor a drilling machine to produce simple components

Title 10: Operate and monitor a surface grinding machine to produce simple components

Title 11: Operate and monitor a milling machine to produce simple components

Title 12: Operate and monitor a lathe to produce simple components

Title 13: Maintain static seals in machines and / or equipment

Title 14: Maintain indirect drives

Title 15: Maintain pipe systems

UNIT STANDARDS AND SPECIFIC OUTCOMES IN
NATIONAL CERTIFICATE IN MECHANICAL ENGINEERING (FITTING AND MACHINING) NQF LEVEL 2

Title 1: Identify engineering materials, their characteristics and applications and common metal tests and treatments used in engineering

Specific outcome 1.1: Identify materials used in common engineering applications

Specific outcome 1.2: Discuss the physical properties of engineering materials used in common engineering applications

Specific outcome 1.3: Explain the common applications and methods of processing and manufacturing using engineering materials

Specific outcome 1.4: Demonstrate an understanding of the common metal tests used in engineering

Specific outcome 1.5: Demonstrate an understanding of heat treatment processes

Specific outcome 1.6: Explain the effects external factors have on engineering materials

Title 2: Select, use and care for engineering measuring equipment

Specific outcome 2.1: Explain and discuss basic units of measure and symbols

Specific outcome 2.2: Select and use engineering measuring equipment

Specific outcome 2.3: Care for and maintain measuring equipment

Specific outcome 2.4: Recognise and report problems, changes and/or malfunctions while working

Specific outcome 2.5: Work safely with due care for self, fellow workers, equipment, materials and the environment

Title 3: Select, use and care for engineering power tools

Specific outcome 3.1: Select and use engineering power tools

Specific outcome 3.2: Care for and maintain engineering power tools

Specific outcome 3.3: Check on power supply connections to equipment

Specific outcome 3.4: Recognise and report problems, changes and/or malfunctions while working

Title 4: Select, use and care for engineering hand tools

Specific outcome 4.1: Select and use engineering hand tools

Specific outcome 4.2: Care for and maintain hand tools

Specific outcome 4.3: Recognise and report problems, changes and/or malfunctions while working

Specific outcome 4.4: Work safely with due care for self, fellow workers, equipment, materials and the environment

Title 5: Perform basic welding / joining of metals

Specific outcome 5.1: Prepare for work activity

Specific outcome 5.2: Weld/join metals

Specific outcome 5.3: Apply quality checks on completed weld/joint

Specific outcome 5.4: Perform finishing activities

Specific outcome 5.5: Report out of compliance or unsafe conditions while working

Specific outcome 5.6: Work safely with due care for self, fellow workers, equipment, materials and the environment

Title 6: Mark off basic engineering shapes

Specific outcome 6.1: Plan and prepare materials for marking off

Specific outcome 6.2: Mark off materials

Specific outcome 6.3: Apply quality checks on completed work

Specific outcome 6.4: Care for and store marking off equipment

Title 7: Perform routine maintenance

Specific outcome 7.1: Plan and prepare for routine maintenance

Specific outcome 7.2: Monitor the condition of machinery and equipment

Specific outcome 7.3: Perform routine maintenance

Specific outcome 7.4 Apply quality checks on completed work

Title 8: Read, interpret and produce basic engineering drawings

Specific outcome 8.1: Discuss and explain basic engineering drawing concepts and material lists

Specific outcome 8.2: Interpret basic engineering drawings

Specific outcome 8.3: Produce drawing

Title 9: Operate and monitor a drilling machine to produce simple components

Specific outcome 9.1: Prepare for work activity

Specific outcome 9.2: Set drilling machine

Specific outcome 9.3: Perform drilling operations

Specific outcome 9.4: Apply quality checks on machined component

Title 10: Operate and monitor a surface grinding machine to produce simple components

Specific outcome 10.1: Prepare for work activity

Specific outcome 10.2: Set grinding machine

Specific outcome 10.3: Set grinding machine

Specific outcome 10.4: Apply quality checks on machined component

Title 11: Operate and monitor a milling machine to produce simple components

Specific outcome 11.1: Prepare for work activity

Specific outcome 11.2: Set milling machine

Specific outcome 11.3: Perform milling operations

Specific outcome 11.4: Apply quality checks on machined component

Title 12: Operate and monitor a lathe to produce simple components

Specific outcome 12.1: Prepare for work activity

Specific outcome 12.2: Set lathe

Specific outcome 12.3: Perform turning operations

Specific outcome 12.4: Apply quality checks on machined component

Specific outcome 12.5: Recognise and report problems, changes and/or malfunctions while operating

Title 13: Maintain static seals in machines and / or equipment

Specific outcome 13.1: Plan and prepare for seal replacement

Specific outcome 13.2: Prepare site and equipment for seal replacement

Specific outcome 13.3: Maintain static seals

Specific outcome 13.4: Check equipment for compliance with operational requirements

Specific outcome 13.5: Record information on work done

Specific outcome 13.6: Discuss and explain incidents and problems related to replacing static seals

Specific outcome 13.7: Work safely with due care for self, fellow workers, machines, equipment, materials and the environment

Title 14: Maintain indirect drives

Specific outcome 14.1: Plan and prepare for indirect drive maintenance

Specific outcome 14.2: Prepare site and equipment for indirect drive maintenance

Specific outcome 14.3: Maintain indirect drive

Specific outcome 14.4: Align indirect drives

Specific outcome 14.5: Apply quality checks on completed work

Specific outcome 14.6: Conduct post-maintenance activities

Title 15: Maintain pipe systems

Specific outcome 15.1: Plan and prepare for pipe system maintenance

Specific outcome 15.2: Prepare site and equipment for pipe system maintenance

Specific outcome 15.3: Maintain pipe system

Specific outcome 15.4 Apply quality checks on completed work

Specific outcome 15.5 Conduct post-repair activities

NATIONAL CERTIFICATE IN MECHANICAL ENGINEERING (FITTING AND MACHINING) NQF LEVEL 3

UNIT STANDARDS ON NQF LEVEL 3

CORE

Title 1: Produce components by performing engineering milling operations
Title 2: Produce components by performing engineering turning operations
Title 3: Produce components by performing engineering grinding operations
Title 4: Grind tools and drill bits
Title 5: Maintain bearings in machines and equipment
Title 6: Maintain pumps
Title 7: Maintain heat exchangers and pressure vessels
Title 8: Maintain direct drives
Title 9: Maintain dynamic seals in machines and / or equipment
Title 10: Maintain brakes and clutches
Title 11: Maintain lubricating systems

ELECTIVE

Title 12: Maintain conveyor systems
Title 13: Perform heat treatment processes on engineering metals
Title 14: Perform non-destructive tests on metal parts and components
Title 15: Test the physical properties of engineering metals
Title 16: Produce detailed engineering drawings

UNIT STANDARDS AND SPECIFIC OUTCOMES IN NATIONAL CERTIFICATE IN MECHANICAL ENGINEERING (FITTING AND MACHINING) NQF LEVEL 3

Title 1: Produce components by performing engineering milling operations

Specific outcome 1.1: Prepare for work activity
Specific outcome 1.2: Set milling machine
Specific outcome 1.3: Perform milling operations
Specific outcome 1.4: Apply quality checks on machined component
Specific outcome 1.5: Recognise and report problems, changes and/or malfunctions while operating
Specific outcome 1.6: Record information on work done
Specific outcome 1.7 Work safely with due care for self, fellow workers, machines, equipment, materials and the environment

Title 2: Produce components by performing engineering turning operations

Specific outcome 2.1: Prepare for work activity

Specific outcome 2.2: Set lathe

Specific outcome 2.3: Perform turning operations

Specific outcome 2.4: Apply quality checks on machined component

Title 3: Produce components by performing engineering grinding operations

Specific outcome 3.1: Prepare for work activity

Specific outcome 3.2: Set grinding machine

Specific outcome 3.3: Perform grinding operations

Specific outcome 3.4: Apply quality checks on machined component

Title 4: Grind tools and drill bits

Specific outcome 4.1: Plan and prepare for tool grinding

Specific outcome 4.2: Prepare site and equipment

Specific outcome 4.3: Inspect and assess tool condition

Specific outcome 4.4: Grind tool

Title 5: Maintain bearings in machines and equipment

Specific outcome 5.1: Plan and prepare for bearing replacement

Specific outcome 5.2: Prepare site and equipment for bearing replacement

Specific outcome 5.3: Check bearings in situ

Specific outcome 5.4: Remove and inspect bearings

Specific outcome 5.5: Install bearings to machines and equipment

Specific outcome 5.6: Check installation for compliance with operational requirements

Title 6: Maintain pumps

Specific outcome 6.1: Plan and prepare for pump maintenance

Specific outcome 6.2: Prepare site and equipment

Specific outcome 6.3: Inspect and assess pump condition

Specific outcome 6.4: Maintain pump

Specific outcome 6.5: Check pump for compliance with operational requirements

Specific outcome 6.6: Care for and store system maintenance tools and equipment

Title 7: Maintain heat exchangers and pressure vessels

Specific outcome 7.1: Plan and prepare for heat exchanger and pressure vessel maintenance / pressure

testing

Specific outcome 7.2: Prepare site and equipment

Specific outcome 7.3: Inspect and assess heat exchanger / pressure vessel condition

Specific outcome 7.4: Maintain heat exchanger and pressure vessels

Specific outcome 7.5: Conduct pressure test

Specific outcome 7.6: Check heat exchanger for compliance with operational requirements

Title 8: Maintain direct drives

Specific outcome 8.1: Plan and prepare for direct drive maintenance

Specific outcome 8.2: Prepare site and equipment for direct drive maintenance

Specific outcome 8.3: Maintain direct drive

Specific outcome 8.4: Align direct drives

Specific outcome 8.5: Apply quality checks on completed work

Specific outcome 8.6: Conduct post-maintenance activities

Title 9: Maintain dynamic seals in machines and / or equipment

Specific outcome 9.1: Plan and prepare for seal replacement

Specific outcome 9.2: Prepare site and equipment for seal replacement

Specific outcome 9.3: Maintain dynamic seals

Specific outcome 9.4: Check equipment for compliance with operational requirements

Title 10: Maintain brakes and clutches

Specific outcome 10.1: Plan and prepare for brake and clutch maintenance

Specific outcome 10.2: Prepare site and equipment for brake and clutch maintenance

Specific outcome 10.3: Check brakes and clutches in situ

Specific outcome 10.4 Install brakes and clutches to machines and equipment

Title 11: Maintain lubricating systems

Specific outcome 11.1: Plan and prepare for repairs to lubricating system

Specific outcome 11.2: Prepare site and equipment

Specific outcome 11.3: Inspect and assess lubricating system functioning

Specific outcome 11.4 Rectify lubrication system faults

Title 12: Maintain conveyor systems

Specific outcome 12.1: Plan and prepare for conveyor system maintenance

Specific outcome 12.2: Prepare site and equipment

Specific outcome 12.3: Inspect and assess conveyor system

Specific outcome 12.4: Maintain conveyor system

Title 13: Perform heat treatment processes on engineering metals

Specific outcome 13.1: Discuss and explain the heat treatment of metals

Specific outcome 13.2: Determine heat treatment requirements

Specific outcome 13.3: Prepare materials and equipment for heat treatment process

Specific outcome 13.4: Complete heat treatment of metals

Title 14: Perform non-destructive tests on metal parts and components

Specific outcome 14.1: Receive samples and check against documentation

Specific outcome 14.2: Carry out testing using ultrasonic methods

Specific outcome 14.3: Test parts for surface defects using magnetic particle inspection

Specific outcome 14.4: Recognise and report problems, changes and/or malfunctions while working

Title 15: Test the physical properties of engineering metals

Specific outcome 15.1: Receive samples and check against documentation

Specific outcome 15.2: Prepare for tests

Specific outcome 15.3: Complete tests and interpret and record results

Specific outcome 15.4: Store samples

Specific outcome 15.5: Care for test equipment

Title 16: Produce detailed engineering drawings

Specific outcome 16.1: Determine drawing requirements

Specific outcome 16.2: Perform calculations to produce drawing

Specific outcome 16.3: Produce drawings

NATIONAL CERTIFICATE IN MECHANICAL ENGINEERING (FITTING AND MACHINING) NQF LEVEL 4

UNIT STANDARDS ON NQF LEVEL 4

CORE

Title 1: Produce complex components using milling machines

Title 2: Produce complex components using lathes

Title 3: Maintain gearboxes

Title 4: Maintain compressors

Title 5: Maintain fluid power / pneumatic systems

Title 6: Diagnose and repair faults on equipment and machinery during production/operation

Title 7: Align machines and equipment using laser technology

ELECTIVE

Title 8: Write simple computer numerical controlled (CNC) programmes and set and operate a CNC machine

Title 9: Grind tools and cutters used in engineering machining operations

Title 10: Produce complex components by performing internal and external grinding operations

Title 11: Produce components by performing horizontal boring operations

Title 12: Produce components by performing vertical boring operations

Title 13: Set automatic production lathes

Title 14: Produce components using wire cutting operations

Title 15: Maintain safety valves

Title 16: Stopple operational pipelines

Title 17: Refurbish machines

Title 18: Commission assembly / machine

Title 19: Produce complex engineering drawings

UNIT STANDARDS ON NQF LEVEL 5

ELECTIVE

Title 20: Write computer numerical controlled (CNC) programmes for CNC machining centres using proprietary software

UNIT STANDARDS AND SPECIFIC OUTCOMES IN NATIONAL CERTIFICATE IN MECHANICAL ENGINEERING (FITTING AND MACHINING) NQF LEVEL 4

Title 1: Produce complex components using milling machines

Specific outcome 1.1: Prepare for work activity

Specific outcome 1.2: Set milling machine

Specific outcome 1.3: Perform milling operations

Specific outcome 1.4: Apply quality checks on machined component

Specific outcome 1.5: Recognise and report problems, changes and/or malfunctions while operating

Specific outcome 1.6: Record information on work done

Specific outcome 1.7: Work safely with due care for self, fellow workers, machines, equipment, materials and the environment

Title 2: Produce complex components using lathes

Specific outcome 2.1: Prepare for work activity

Specific outcome 2.2: Set lathe

Specific outcome 2.3: Perform turning operations

Specific outcome 2.4: Apply quality checks on machined component

Title 3: Maintain gearboxes

Specific outcome 3.1: Plan and prepare for gearbox maintenance

Specific outcome 3.2: Prepare site and equipment

Specific outcome 3.3: Inspect and assess gearbox maintenance requirements

Specific outcome 3.4: Maintain gearbox

Specific outcome 3.5: Check gearbox for compliance with operational requirements

Specific outcome 3.6: Care for and store system maintenance tools and equipment

Specific outcome 3.7: Record information on work done

Specific outcome 3.8: Discuss and explain incidents and problems related to gearbox maintenance

Title 4: Maintain compressors

Specific outcome 4.1: Plan and prepare for compressor maintenance

Specific outcome 4.2: Prepare site and equipment

Specific outcome 4.3: Inspect and assess compressor maintenance requirements

Specific outcome 4.4: Maintain compressor

Title 5: Maintain fluid power / pneumatic systems

Specific outcome 5.1: Plan and prepare for fluid power / pneumatic system maintenance

Specific outcome 5.2: Prepare site and equipment for maintenance activity

Specific outcome 5.3: Maintain fluid power / pneumatic system

Specific outcome 5.4: Apply quality checks on completed work

Specific outcome 5.5: Conduct post-repair activities

Title 6: Diagnose and repair faults on equipment and machinery during production/operation

Specific outcome 6.1: Monitor the performance of equipment and machinery during operation

Specific outcome 6.2: Perform minor repairs on line

Specific outcome 6.3: Determine major equipment and machinery component repairs

Specific outcome 6.4: Work safely with due care for self, fellow workers, machines, equipment, materials and the environment

Title 7: Align machines and equipment using laser technology

Specific outcome 7.1: Plan and prepare for machine and equipment alignment

Specific outcome 7.2: Prepare site and equipment for machine and equipment alignment

Specific outcome 7.3: Align machines and equipment

Specific outcome 7.4: Apply quality checks on completed work

Specific outcome 7.5: Conduct post-alignment activities

Specific outcome 7.6: Care for and store alignment tools and equipment

Specific outcome 7.7: Discuss and explain incidents and problems related to machine and equipment alignment

Title 8: Write simple computer numerical controlled (CNC) programmes and set and operate a CNC machine

Specific outcome 8.1: Prepare and write programme

Specific outcome 8.2: Prepare to set machine

Specific outcome 8.3: Set machine to perform the specified work

Specific outcome 8.4: Produce sample component

Specific outcome 8.5: Operate CNC machine

Title 9: Grind tools and cutters used in engineering machining operations

Specific outcome 9.1: Prepare for work activity

Specific outcome 9.2: Set grinding machine

Specific outcome 9.3: Perform tool and cutter grinding operations

Specific outcome 9.4: Apply quality checks on machined tool/cutter

Title 10: Produce complex components by performing internal and external grinding operations

Specific outcome 10.1: Prepare for work activity

Specific outcome 10.2: Set grinding machine

Specific outcome 10.3: Perform universal grinding operations

Specific outcome 10.4 Apply quality checks on machined component

Title 11: Produce components by performing horizontal boring operations

Specific outcome 11.1: Prepare for work activity

Specific outcome 11.2: Set horizontal boring machine

Specific outcome 11.3: Perform horizontal boring operations

Specific outcome 11.4 Clean machine

Title 12: Produce components by performing vertical boring operations

Specific outcome 12.1: Prepare for work activity

Specific outcome 12.2: Set vertical boring machine

Specific outcome 12.3: Perform vertical boring operations

Specific outcome 12.4: Apply quality checks on machined component

Title 13: Set automatic production lathes

Specific outcome 13.1: Prepare for machine set up

Specific outcome 13.2: Set machine

Specific outcome 13.3: Produce sample component

Specific outcome 13.4: Monitor machine setting

Title 14: Produce components using wire cutting operations

Specific outcome 14.1: Prepare for work activity

Specific outcome 14.2: Set up wire cutting machine for operation

Specific outcome 14.3: Perform wire cutting operations

Specific outcome 14.4: Apply quality checks on component

Title 15: Maintain safety valves

Specific outcome 15.1: Plan and prepare for safety valve maintenance

Specific outcome 15.2: Prepare site and equipment

Specific outcome 15.3: Inspect and assess safety valve maintenance requirements

Specific outcome 15.4: Maintain safety valve

Title 16: Stopple operational pipelines

Specific outcome 16.1: Plan and prepare for work activity

Specific outcome 16.2: Prepare site and equipment for drilling into and plugging the operational pipe line

Specific outcome 16.3: Drill into the operational pipeline, tap the fitting and install the pipeline plug

Specific outcome 16.4: Check stoppling process for conformance to specifications

Specific outcome 16.5: Identify non-conforming components, changes and / or malfunctions and take appropriate corrective action

Title 17: Refurbish machines

Specific outcome 17.1: Plan and prepare for refurbishment

Specific outcome 17.2: Prepare site and equipment

Specific outcome 17.3: Carry out fault diagnosis on machines

Specific outcome 17.4: Refurbish machines

Specific outcome 17.5: Recognise and report problems or changes while working

Specific outcome 17.6: Record information on work done

Specific outcome 17.7: Discuss and explain incidents and problems related to refurbishment activity

Title 18: Commission assembly / machine

Specific outcome 18.1: Plan and prepare for commissioning

Specific outcome 18.2: Commission machine / assembly

Specific outcome 18.3: Identify non-conformances, diagnose faults and take corrective action

Specific outcome 18.4: Complete commissioning activity

Title 19: Produce complex engineering drawings

Specific outcome 19.1: Determine drawing requirements

Specific outcome 19.2: Perform calculations to produce drawing

Specific outcome 19.3: Produce drawings

Specific outcome 19.4: Record information on work done

Title 20: Write computer numerical controlled (CNC) programmes for CNC machining centres using proprietary software

Specific outcome 20.1: Prepare to write programme

Specific outcome 20.2: Write programme

Specific outcome 20.3: Verify programme

Specific outcome 20.4: Recognise and report problems and changes while programming

SOUTH AFRICAN QUALIFICATIONS AUTHORITY

National Certificate in Mechanical Engineering (Fitting) NQF Level 3

Field: Manufacturing, Engineering and Technology- NSB 06

Sub-field: Manufacturing & Assembly

Level: 3

Credit: 133

Issue date:

Review date:

Rationale for the qualification:

The field of mechanical engineering (fitting) is characterized by the provision of engineering maintenance, repair and installation services and support in a variety of industries. The equipment requiring such service and support ranges from sophisticated equipment to antiquated single station machines. People working in the mechanical engineering field require specialized technical skills and knowledge, as well as highly developed hand skills in order to meet the mechanical engineering requirements of diverse industries.

This is the second qualification in a series for learners who want to follow a career in the field of mechanical engineering (fitting).

It also provides learners who have gained relevant experience in the workplace with an opportunity to obtain credits through an RPL process.

The qualification also forms the basis for further learning in field of mechanical engineering where learners will engage in more complex maintenance and repair activities.

Purpose:

The purpose of the qualification is to provide learners, education and training providers and employers with the standards and the range of learning required to work effectively in various industries making use of mechanical engineering skills and meet the challenges of such an environment.

The primary skills that are recognised in this qualification are the ability to fault find, dismantle, maintain, repair and install a variety of assemblies. These capabilities require an understanding of advanced mechanical theory and detailed engineering drawings as well as a familiarity with the equipment and processes within the environment in which the learner is working. Hand skills play a large role in this qualification.

Qualifying learners will also be able to relate what they are doing to scientific and technological principles and concepts. They will also be able to maintain and support the various policies and procedures related to the safety, health, environment and quality systems that govern their workplace.

What learners achieve in this qualification will also serve as a basis for further learning where they will engage in more complex maintenance and repair activities.

Access to the Qualification:

Open access.

This qualification series recognises skills, knowledge and values relevant to a workplace. It is designed for learners who:

- Have attended courses and then apply the knowledge gained to activities in the workplace
- Are already workers and have acquired the skills and knowledge without attending formal courses
- Are part of a learnership programme which integrates structured learning and work experience.

Learning assumed to be in place:

This qualification assumes learners have a national certificate in mechanical engineering (fitting) level 2.

If the learner does not already have such a qualification, learning in preparation for this qualification would also have to include:

- Language and maths beyond basic literacy and numeracy
- Basic concepts of science and technology related to mechanical engineering, engineering materials and tools used in the maintenance process
- An ability to apply basic mechanical assembly, maintenance and repair fundamentals to recognise and respond to equipment component defects.
- Concepts of organising factors in labour, business and the economy
- Role and purpose of procedures related to workplace relationships, roles and responsibilities

Exit Level Outcomes and Assessment Criteria:

Exit level outcome 1:

Demonstrate an understanding of and an ability to fault find, dismantle, maintain, assemble and install a variety of mechanical assemblies and make close tolerance adjustments to equipment and process, meeting output requirements and working safely with due care for fellow workers and the environment

Associated Assessment Criteria

- Condition of equipment and machinery is monitored
- Faults in equipment and machinery are diagnosed.
- Equipment and machinery are maintained to required standards and overhauled at required intervals
- Dismantling sequence of assemblies meets specifications
- Assemblies and installations meet specifications
- Safe working practices are adhered to

Exit level outcome 2

Demonstrate an understanding of lubrication systems and an ability to maintain such systems

Associated Assessment Criteria

- Lubrication systems are maintained to specifications
- Can respond to questions and discuss issues related to the lubrication systems of equipment and machinery within the plant

Exit level outcome 3

Select appropriate procedures to solve familiar problems within a mechanical engineering environment and operate within clearly defined contexts, with some scope for personal decision-making and responsibility

Associated Assessment Criteria

- Appropriate procedures are selected to solve problems in an efficient and effective manner
- Unfamiliar problems are accurately reported to appropriate personnel
- Can respond to questions and discuss issues related to familiar problems in mechanical engineering (fitting)

Exit level outcome 4

Communicate with peers, production personnel and members of supervisory/management levels by demonstrating the ability to gather and summarise information from a range of sources and produce coherent presentations in a prescribed format

Associated Assessment Criteria

- Information is gathered from a range of sources and accurately summarised into a prescribed format.
- Information is clear and accurate and presented in a timely manner in the required format to appropriate parties.
- Relationships with peers, production personnel and supervisory/management levels are established and functioning

Exit level outcome 5

Demonstrate an understanding of options for further learning in this or a related field of learning and preparation requirements for such learning

Associated Assessment Criteria

- Options are explained
- Preparation requirements are explained.
- Learning plan is developed

International comparability

This qualification was compared to other, similar outcomes- based qualifications, certifications or skills standards in New Zealand, Australia and the United Kingdom.

Integrated Assessment:

Integrated assessment at the level of the qualification provides an opportunity for learners to show they are able to integrate concepts, actions and ideas achieved across a range of unit standards and contexts. Integrated assessment must evaluate the quality of observable performance as well as the thinking behind the performance.

Some assessment aspects will demand practical demonstration while others may not. In some case inference will be necessary to determine competence depending on the nature and context within which performance takes place.

It will be necessary to necessary to ensure that the fundamental part of the qualification is also targeted to ensure that while the competence may have been achieved in a particular context, learners are able to apply it in a range of other contexts and for further learning. The assessment should also ensure that all the critical cross-field outcomes have been achieved.

Recognition of prior learning:

This qualification may be obtained through a process of RPL. The learner should be thoroughly briefed prior to the assessment and support provided to assist in the process of developing a portfolio. While this is primarily a workplace-based qualification, evidence from other areas of endeavour may be introduced if pertinent to any of the exit-level outcomes.

Articulation possibilities:

The qualification has been designed and structured so that qualifying learners can move from one context to another. Employers or institutions should be able to evaluate the outcomes of this qualification against the needs of their context and structure top-up learning appropriately.
Equally, holders of other qualifications may be evaluated against this qualification for the purpose of RPL.

Moderation Options:

- Anyone assessing a learner against this qualification must be registered as an assessor with the MERS ETQA or any other relevant ETQA
- Any institution or learning provider offering learning towards the achievement of this qualification should be accredited as a provider with the MERS ETQA or any other relevant ETQA
- Moderation of assessment should be overseen by the MERS ETQA or any other relevant ETQA according to the moderation guidelines provided for in this qualification as well as the agreed ETQA procedures

Criteria for registration of assessors

The following criteria should be applied by the relevant ETQA:

1. Appropriate qualification in the field of mechanical engineering (fitting) – with a minimum of 3 years' experience working in the field. The subject matter experience of the assessor can be established by recognition of prior learning.

2. Appropriate experience and understanding of assessment theory, processes and practices
3. Good interpersonal skills and the ability to balance the conflicting requirements of:

- Maintaining national standards
- The interests of the learner
- The need for transformation and redressing the legacies of the past
- The cultural background and language of the learner

4. Registration as an assessor with the MERS ETQA or any other relevant ETQA
5. Any other criteria required by the MERS ETQA or any other relevant ETQA

National Certificate in Mechanical Engineering (Fitting) NQF Level 3

Fundamental			
NLRD	**Title**	**Level**	**Credits**
	Communication		
8968	Accommodate audience and context needs in oral communication	3	5
8969	Interpret and use information from texts	3	5
8970	Write texts for a range of communicative contexts	3	5
9529	Compile feasibility and commissioning reports	3	3
9528	Communicate with clients	3	3
	Mathematics		
9010	Demonstrate an understanding of the use of different number bases and measurement units and an awareness of error in the context of relevant calculations	3	2
9014	Use mathematics to investigate and monitor the financial aspects of personal and business issues	3	5
9012	Investigate life-related problems using data and probabilities	3	5
9013	Measure, estimate and calculate physical quantities and explore, describe and represent, interpret and justify geometrical relationships in two and three dimensional space relevant to the life or workplace of the community	3	4
	Working with information		
9357	Develop and use keyboard skills to enter text	1	3
7572	Demonstrate a knowledge of and produce computer spreadsheets using basic functions	2	3
Core			
NLRD	**Title**	**Level**	**Credits**
	Tools, equipment and machines		
	Grind tools and drill bits	3	4

	Maintain and repair		
	Maintain bearings in machines and equipment	3	8
	Maintain pumps	3	24
	Maintain heat exchangers and pressure vessels	3	8
	Maintain direct drives	3	6
	Maintain dynamic seals in machines and equipment	3	3
	Maintain brakes and clutches	3	6
	Maintain lubricating systems	3	4
	Safety, Health & Environment		
	Apply safety, health and environmental protection procedures	3	6
	Business Relations		
9526	Manage basic business finance	3	6
9530	Manage work time effectively	3	3
	Elective		
NLRD	**Titles**		**Credits**
	Maintain and repair		
	Maintain conveyor systems	3	6
	Materials		
	Perform heat treatment processes on engineering metals	3	8
	Perform non-destructive tests on metal parts and components	3	4
	Test the physical properties of engineering metals	3	6
	Drawings and design		
	Produce detailed engineering drawings	3	6
	Suggested additional learning		

8038	Operate lift trucks	3	6
8039	Operate cranes	3	10
	Minimum elective credits required		**12**

SOUTH AFRICAN QUALIFICATIONS AUTHORITY

National Certificate in Mechanical Engineering (Fitting) NQF Level 4

Field: Manufacturing, Engineering and Technology - NSB 06

Sub-field: Manufacturing & Assembly

Level: 4

Credit: 135

Issue date:

Review date:

Rationale for the qualification:

The field of mechanical engineering (fitting) is characterized by the provision of engineering maintenance, repair and installation services and support in a variety of industries. The production equipment requiring such service and support ranges from sophisticated equipment to antiquated single station machines. People working in the mechanical engineering field require specialized technical skills and knowledge, as well as highly developed hand skills in order to meet the mechanical engineering requirements of such diverse industries.

This is the third qualification in a series for learners who want to follow a career in the field of mechanical engineering (fitting).

It also provides learners who have gained relevant experience in the workplace with an opportunity to obtain credits through an RPL process.

The qualification also forms the basis for further learning in field of mechanical engineering within the higher education and training band.

Purpose:

The purpose of the qualification is to provide learners, education and training providers and employers with the standards and the range of learning required to work effectively in various industries making use of mechanical engineering skills and meet the challenges of such an environment.

The primary skills that are recognised in this qualification are the ability to fault find, dismantle, maintain, repair and install complex mechanical assemblies and diagnose and repair equipment and machinery during production/operation. These capabilities require an understanding of advanced mechanical theory and complex engineering drawings. Hand skills play a large role in this qualification.

Qualified learners will also understand:

- How to plan, schedule and evaluate own work
- How to interact with team leaders and develop the capacity of team members to maintain and support quality, safety and health systems.

With this understanding learners will be able to participate in workplace activities.

Access to the Qualification:

Open access.

This qualification series recognises skills, knowledge and values relevant to a workplace. It is designed for learners who:

- Have attended courses and then apply the knowledge gained to activities in the workplace
- Are already workers and have acquired the skills and knowledge without attending formal courses
- Are part of a learnership programme which integrates structured learning and work experience.

Learning assumed to be in place:

This qualification assumes learners have a national certificate in mechanical engineering level 3.

If the learner does not already have such a qualification, learning in preparation for this qualification would also have to include:

- Language and maths related to organising and controlling their environment

- Maths and applicable scientific and technological concepts related to the dismantling, maintenance, repair and installation of assemblies
- The ability to dismantle, maintain, repair and install a variety of assemblies
- Concepts of contributing factors in labour, business and the economy
- Role and purpose of systems which support workplace relationships, procedures, roles and responsibilities

Exit Level Outcomes and Assessment Criteria:

Exit level outcome 1

Demonstrate an understanding of and an ability to fault find, dismantle, maintain, repair and install complex mechanical assemblies, meeting output requirements and working safely with due care for fellow workers and the environment

Associated Assessment Criteria

- Condition of equipment and machinery is monitored and faults diagnosed
- Assemblies are maintained and refurbished to required standards
- Output requirements are met
- Safe working practices are adhered to
- Can respond to questions and discuss issues related to assembly, maintenance and refurbishment of complex assemblies

Exit level outcome 2

Demonstrate an understanding of production/operation maintenance requirements and an ability to diagnose and repair faults on machinery and equipment during production/operation

Associated Assessment Criteria

- Recurrent equipment and machinery faults and their root causes identified
- Minor repairs on line are performed
- Documentation on major repair requirements completed
- Equipment and machinery components requiring major repair dismantled and dispatched to workshop
- Major repair requirements reported
- Production time schedule maintained
- Potential production and maintenance problems are explained and discussed

Exit level outcome 3

Demonstrate an understanding of fluid power/pneumatic systems and an ability to maintain such systems

Associated Assessment Criteria

- Fluid power/pneumatic systems are maintained to specifications
- Can respond to questions and discuss issues related to the fluid power/pneumatic systems of equipment and machinery within the plant

Exit level outcome 4

Maintain and support procedures to solve a variety of problems, both familiar and unfamiliar, within an engineering maintenance and repair context and operate within familiar and new situations, taking responsibility and making decisions

Associated Assessment Criteria

- Solutions to problems are based on a clear analysis of information gathered through diagnostic procedures.
- Procedures are modified to respond to unfamiliar problems where appropriate
- Can respond to questions and discuss issues related to familiar and unfamiliar problems arising in the mechanical maintenance environment
- All actions related to problem solving are accurately recorded for future reference

Exit level outcome 5

Communicate and present information clearly and reliably and demonstrate the ability to analyse information to identify problems and determine trends

Associated Assessment Criteria

- Conditions, evidence and incidences are reported accurately in a timely manner and discussed with peers and management
- Data gathered through diagnostic procedures is examined systematically and analysis is repeated until problem is solved.
- Records are available for scrutiny and future reference

Exit level outcome 6

Demonstrate an understanding of options for further learning in this or a related field of learning and preparation requirements for such learning

Associated Assessment Criteria

- Options are explained
- Preparation requirements are explained.
- Learning plan is developed

International comparability

This qualification was compared to other, similar outcomes- based qualifications, certifications or skills standards in New Zealand, Australia and the United Kingdom.

Integrated Assessment:

Integrated assessment at the level of the qualification provides an opportunity for learners to show they are able to integrate concepts, actions and ideas achieved across a range of unit standards and contexts. Integrated assessment must evaluate the quality of observable performance as well as the thinking behind the performance.

Some assessment aspects will demand practical demonstration while others may not. In some case inference will be necessary to determine competence depending on the nature and context within which performance takes place.

It will be necessary to necessary to ensure that the fundamental part of the qualification is also targeted to ensure that while the competence may have been achieved in a particular context, learners are able to apply it in a range of other contexts and for further learning. The assessment should also ensure that all the critical cross-field outcomes have been achieved.

Recognition of prior learning:

This qualification may be obtained through a process of RPL. The learner should be thoroughly briefed prior to the assessment and support provided to assist in the process of developing a portfolio. While this is primarily a workplace-based qualification, evidence from other areas of endeavour may be introduced if pertinent to any of the exit-level outcomes.

Articulation possibilities:

The qualification has been designed and structured so that qualifying learners can move from one context to another. Employers or institutions should be able to evaluate the outcomes of this qualification against the needs of their context and structure top-up learning appropriately.
Equally, holders of other qualifications may be evaluated against this qualification for the purpose of RPL.

Moderation Options:

- Anyone assessing a learner against this qualification must be registered as an assessor with the MERS ETQA or any other relevant ETQA

- Any institution or learning provider offering learning towards the achievement of this qualification should be accredited as a provider with the MERS ETQA or any other relevant ETQA
- Moderation of assessment should be overseen by the MERS ETQA or any other relevant ETQA according to the moderation guidelines provided for in this qualification as well as the agreed ETQA procedures

Criteria for registration of assessors

The following criteria should be applied by the relevant ETQA:

1. Appropriate qualification in the field of mechanical engineering (fitting) – with a minimum of 3 years' experience working in the field. The subject matter experience of the assessor can be established by recognition of prior learning.
2. Appropriate experience and understanding of assessment theory, processes and practices
3. Good interpersonal skills and the ability to balance the conflicting requirements of:

- Maintaining national standards
- The interests of the learner
- The need for transformation and redressing the legacies of the past
- The cultural background and language of the learner

4. Registration as an assessor with the MERS ETQA or any other relevant ETQA
5. Any other criteria required by the MERS ETQA or any other relevant ETQA

Fundamental			
NLRD	**Title**	**Level**	**Credits**
	Communication		
8968	Engage in sustained oral communication and evaluate spoken texts	4	5
8969	Read, analyse and respond to a variety of texts	4	5
8970	Write for a wide range of contexts	4	5
9529	Write a technical report	4	4
9528	Communicate in an assertive manner with clients and fellow workers	4	4
	Mathematics		
9014	Use mathematics to investigate and monitor the financial aspects of personal, business and national issues	4	4
9015	Apply knowledge of statistics and probability to critically interrogate and effectively communicate findings on life related problems	4	6
9016	Measure, estimate and calculate physical quantities and explore, critique and prove geometrical relationships in two and three dimensional space in the life and workplace of the adult with increasing responsibilities	4	6
	Life Skills		
	Develop a personal financial plan	4	2
Core			
NLRD	**Title**	**Level**	**Credits**
	Maintain and repair		
	Maintain gearboxes	4	10
	Maintain compressors	4	16
	Maintain a fluid power / pneumatic system	4	12
	Diagnose and repair faults on equipment and machinery during production/operation	4	24
	Align machines and equipment using laser technology	4	6
	Safety, Health & Environment		

	Monitor the application of safety, health and environmental protection procedures	4	4
	Business Relations		
	Contribute to the implementation and maintenance of business processes	4	10
	Elective		
NLRD	**Titles**		**Credits**
	Maintain and repair		
	Maintain safety valves	4	4
	Stopple operational pipelines	4	16
	Refurbish machines	4	24
	Commission assembly/machine	4	8
	Drawings and design		
	Produce complex engineering drawings	4	6
	Minimum elective credits required		**12**

SOUTH AFRICAN QUALIFICATIONS AUTHORITY

National Certificate in Mechanical Engineering (Machining) NQF Level 2

Field: Manufacturing, Engineering and Technology- NSB 06

Sub-field: Manufacturing & Assembly

Level: 2

Credit: 151

Issue date:

Review date:

Rationale for the qualification:

The field of engineering machining is characterized by work-to-order, low volume manufacture of components using different machining methods for use in a variety of industries including the automotive, metal, appliance manufacturing, plastic, tyre and rubber industries. People working in the engineering machining field require specialized technical skills and knowledge, as well as highly developed hand skills in order to adapt to and meet the requirements of the constantly changing products that must be manufactured.

This is the first qualification in a series for learners who want to follow a career in the field of engineering machining. This qualification focuses on developing skills and knowledge necessary to begin such a career.

It also provides learners who have gained relevant experience in the workplace with an opportunity to obtain credits through an RPL process.

The qualification also forms the basis for further learning in field of engineering and machining where the learner will be able to specialize in engineering machining or tooling manufacture.

Purpose:

The purpose of the qualification is to provide learners, education and training providers and employers with the standards and the range of learning required to work effectively in various industries making use of engineering fitting and machining skills and to meet the challenges of such an environment.

The primary skills that are recognised in this qualification are the ability to machine simple components using a variety of machining methods and the ability to apply basic mechanical assembly, maintenance and repair fundamentals to recognise and respond to equipment component defects. These capabilities require an understanding of basic machining theory, machinery functioning and maintenance, engineering materials and tools and concepts of measurement, and basic engineering drawings. Hand skills play a large role in this qualification.

Qualified learners will also understand:

- the basics of how a business functions
- their role in the business, i.e. in engineering and related activities
- how they are affected by legislation, regulations, agreements and policies related to their particular work environment.

With this understanding learners will be able to participate in workplace activities.

Access to the Qualification:

Open access.

This qualification series recognises skills, knowledge and values relevant to a workplace. It is designed for learners who:

- Have attended courses and then apply the knowledge gained to activities in the workplace
- Are already workers and have acquired the skills and knowledge without attending formal courses
- Are part of a learnership programme which integrates structured learning and work experience.

Learning assumed to be in place:

This qualification assumes learners have a General Education and Training Certificate at NQF level 1, or alternatively, an ABET level 4 qualification.

If the learner does not already have such a qualification, learning in preparation for this qualification would also have to include:

- Literacy and numeracy
- Basic concepts of science and technology

Exit Level Outcomes and Assessment Criteria:

Exit level outcome 1

Demonstrate an understanding of a variety of machining methods and an ability to produce simple components that meet quality and output requirements, working safely and in an environmentally aware manner.

Associated Assessment Criteria

- Output and quality requirements are met
- Safe working practices are adhered to
- Can respond to questions and discuss issues related to the theoretical principles of machining, the various machining methods and the functioning of machinery.

Exit level outcome 2

Identify engineering materials used in the machining process and describe their characteristics and applications.

Associated Assessment Criteria

- Engineering materials are identified and their physical properties described
- Can respond to questions and discuss issues related to the common applications and methods of processing and manufacturing using engineering materials

Exit level outcome 3

Demonstrate an ability to read, interpret and produce basic engineering drawings.

Associated Assessment Criteria

- Components to be machined are identified and requirements interpreted from engineering drawing
- Engineering drawing produced meets job requirements
- Can respond to questions and discuss issues related to engineering drawing concepts and material lists

Exit level outcome 4

Demonstrate a familiarity with routine maintenance procedures and operations for machinery

Associated Assessment Criteria

- Process agents are applied consistently and systematically
- Pre-operational checks are performed and identified problems reported to appropriate personnel
- Can respond to questions and discuss issues related to routine maintenance on machinery

Exit level outcome 5

Recognise and respond to routine problems related to the machining process.

Associated Assessment Criteria

- Various options are considered before a solution is chosen
- Lessons learnt in previous performances are used
- Responses are appropriate to the nature of the problem
- Problems are accurately reported to relevant personnel in a timely manner
- Can respond to questions and discuss issues related to routine problems encountered while working

Exit level outcome 6

Communicate with peers and members of supervisory/management levels by demonstrating the ability to summarise information and express opinions on given information in spoken or written form

Associated Assessment Criteria

- Communication is effective, regular and ongoing
- Information is clear and accurate and conveyed in a timely manner
- Relationships with peers and supervisory/management levels are established and functioning

Exit level outcome 7

Demonstrate an understanding of options for further learning in this or a related field of learning and preparation requirements for such learning

Associated Assessment Criteria

- Options are explained
- Preparation requirements are explained.
- Learning plan is developed

International comparability

As a starting point, the series of qualifications in the field of mechanical engineering covering machining, fitting, fitting and machining, and tooling manufacture specialisations, of which this qualification forms a part, was compared to other, similar outcomes-based qualifications, certifications or skills standards in New Zealand and Australia. It was found to be difficult to compare the New Zealand and Australian narrow focus qualifications with these broad-based qualifications that also include fundamentals and generic core standards. It was further difficult to undertake such comparisons given that the New Zealand and Australian qualifications, although they are in the same field of mechanical engineering and cover the same areas of specialisation (thus containing a large degree of similar content) are conceptualized as three year qualifications without exit level outcomes at the intermediate levels (NQF levels 2 and 3). This notwithstanding, the technical content of this series of qualifications for mechanical engineering (with the various specialisations) of which the highest qualification is at level 4 does correspond with the equivalent level of qualification in mechanical engineering (with the various specialisations) in Australia and New Zealand.

Integrated Assessment:

Integrated assessment at the level of the qualification provides an opportunity for learners to show they are able to integrate concepts, actions and ideas achieved across a range of unit standards and contexts. Integrated assessment must evaluate the quality of observable performance as well as the thinking behind the performance.

Some assessment aspects will demand practical demonstration while others may not. In some case inference will be necessary to determine competence depending on the nature and context within which performance takes place.

Since this is a foundational qualification, it is necessary to ensure that the fundamental part of the qualification is also targeted to ensure that while the competence may have been achieved in a particular context, learners are able to apply it in a range of other contexts and for further learning. The assessment should also ensure that all the critical cross-field outcomes have been achieved.

Recognition of prior learning:

This qualification may be obtained through RPL. The learner should be thoroughly briefed of the mechanism to be used and support and guidance should be provided. Care should be taken that the mechanism used provides the learner with an opportunity to demonstrate competence and is

not too onerous as to prevent learners from taking up the RPL option towards gaining a qualification.

Articulation possibilities:

The qualification has been designed and structured so that qualifying learners can move from one context to another. Employers or institutions should be able to evaluate the outcomes of this qualification against the needs of their context and structure top-up learning appropriately. Equally, holders of other qualifications may be evaluated against this qualification for the purpose of RPL.

Moderation Options:

- Anyone assessing a learner against this qualification must be registered as an assessor with the MERS ETQA or any other relevant ETQA
- Any institution or learning provider offering learning towards the achievement of this qualification should be accredited as a provider with the MERS ETQA or any other relevant ETQA
- Moderation of assessment should be overseen by the MERS ETQA or any other relevant ETQA according to the moderation guidelines provided for in this qualification as well as the agreed ETQA procedures

Criteria for registration of assessors

The following criteria should be applied by the relevant ETQA:

1. Appropriate qualification in the field of mechanical engineering (machining) – with a minimum of 3 years' experience working in the field. The subject matter experience of the assessor can be established by recognition of prior learning.
2. Appropriate experience and understanding of assessment theory, processes and practices
3. Good interpersonal skills and the ability to balance the conflicting requirements of:

- Maintaining national standards
- The interests of the learner
- The need for transformation and redressing the legacies of the past
- The cultural background and language of the learner

4. Registration as an assessor with the MERS ETQA or any other relevant ETQA
5. Any other criteria required by the MERS ETQA or any other relevant ETQA

National Certificate in Mechanical Engineering (Machining) NQF Level 2

Fundamental			
NLRD	**Title**	**Level**	**Credits**
	Communication		
8962	Maintain and adapt oral communication	2	5
8963	Access and use information from texts	2	5
8964	Write for a defined context	2	5
	Communicate at work	2	5
	Mathematics		
8982	Demonstrate an understanding of rational and irrational numbers and number systems within the context of relevant calculations	2	3
8983	Use mathematics to investigate and monitor the financial aspects of personal and community life	2	2
9009	Apply basic knowledge of statistics and probability in order to investigate life and work related problems	2	3
9008	Measure, estimate and calculate physical quantities and explore, describe and represent geometrical relationships in two dimensions in different life or workplace contexts	2	3
9007	Work with a range of patterns and basic functions to solve related problems	2	5
Core			
NLRD	**Title**	**Level**	**Credits**
	Materials		
	Identify engineering materials, their characteristics and applications, and common metal tests and treatments used in engineering	2	4
	Tools, equipment and machines		

	Select, use and care for engineering measuring equipment	2	4
	Select, use and care for engineering power tools	2	6
	Select, use and care for engineering hand tools	2	8
	Perform basic welding / joining of metals	2	8
	Mark off basic engineering shapes	2	2
	Perform routine maintenance	2	8
	Drawings and design		
	Read, interpret and produce basic engineering drawings	2	6
	Machining		
	Operate and monitor a drilling machine to produce simple components	2	6
	Operate and monitor a surface grinding machine to produce simple components	2	8
	Operate and monitor a milling machine to produce simple components	2	12
	Operate and monitor a lathe to produce simple components	2	12
	Safety, Health & Environment		
	Keep the work area safe and productive	2	8
	Business Relations		
	Explain the individual's role within business	2	4
	People interacting, leading and developing		
	Develop a learning plan and a portfolio for assessment	2	6
	Understand and deal with HIV / Aids	2	3

Elective			
NLRD	**Tooling manufacture**		
	Manufacture basic tooling (requirement for learners wanting to embark on a career path in tooling manufacture)	2	24
	Safety, Health & Environment		
	Perform basic first aid	2	4
	Perform basic fire fighting	2	2
	Information technology		
7547	Operate a personal computer system	2	6
7548	Use a personal computer operating system	2	3
	Suggested additional learning		
9268	Manage basic personal finance	2	6
	Minimum elective credits required		**10**

SOUTH AFRICAN QUALIFICATIONS AUTHORITY

National Certificate in Mechanical Engineering (Machining) NQF Level 3

Field: Manufacturing, Engineering and Technology - NSB 06

Sub-field: Manufacturing & Assembly

Level: 3

Credit: 126

Issue date:

Review date:

Rationale for the qualification:

The field of engineering machining is characterized by work-to-order, low volume manufacture of components using different machining methods for use in a variety of industries including the automotive, metal, appliance manufacturing, plastic, tyre and rubber industries. People working in the engineering machining field require specialized technical skills and knowledge, as well as highly developed hand skills in order to adapt to and meet the requirements of the constantly changing products that must be manufactured.

This is a second qualification in a series for learners who want to follow a career in the field of engineering machining, specialising in engineering machining skills.

It also provides learners who have gained relevant experience in the workplace with an opportunity to obtain credits through an RPL process.

The qualification also forms the basis for further learning in field of engineering and machining where the learner will be able to further specialize at NQF level 4.

Purpose:

The purpose of the qualification is to provide learners, education and training providers and employers with the standards and the range of learning required to work effectively in various industries making use of engineering machining skills to meet the challenges of such an environment.

The primary skill that is recognised in this qualification is the ability to produce components of some complexity using a variety of machining methods. This capability requires an understanding of advanced machining theory, detailed engineering drawings and a variety of tests and treatments used on engineering metals. Hand skills play a large role in this qualification.

Qualifying learners will also be able to relate what they are doing to scientific and technological principles and concepts. They will also be able to maintain and support the various policies and procedures related to the safety, health, environment and quality systems that govern their workplace.

Access to the Qualification:

Open access.

This qualification series recognises skills, knowledge and values relevant to a workplace. It is designed for learners who:

- Have attended courses and then apply the knowledge gained to activities in the workplace
- Are already workers and have acquired the skills and knowledge without attending formal courses
- Are part of a learnership programme which integrates structured learning and work experience.

Learning assumed to be in place:

T This qualification assumes learners have a national certificate in engineering machining level 2.

If the learner does not already have such a qualification, learning in preparation for this qualification would also have to include:

- Language and maths beyond basic literacy and numeracy
- Basic concepts of science and technology related to machining methods, engineering materials and tools used in the machining process
- An ability to produce simple components using a variety of machining methods

- Concepts of organising factors in labour, business and the economy
- Role and purpose of procedures related to workplace relationships, roles and responsibilities

Exit Level Outcomes and Assessment Criteria:

Exit level outcome 1

Demonstrate an ability to produce components of some complexity using a variety of machining methods and operations, meeting output requirements and working safely with due care for fellow workers and the environment

Associated Assessment Criteria

- Output and quality requirements are met
- Safe working practices are adhered to
- Can respond to questions and discuss issues related to the theoretical principles of machining and the various machining methods and their respective operations at this level

Exit level outcome 2

Demonstrate an ability to select and apply appropriate inspection methods to determine component compliance with specifications

Associated Assessment Criteria

- Appropriate inspection methods are chosen and applied
- Can respond to questions and discuss issues related to various inspection methods and procedures and the principles underpinning such methods

Exit level outcome 3

Demonstrate an ability to read and interpret detailed engineering drawings.

Associated Assessment Criteria

- Components and assemblies to be machined are identified and requirements interpreted from engineering drawing
- Machined components and assemblies meet drawing specifications

Exit level outcome 4

Select appropriate procedures to solve familiar problems within an engineering machining environment and operate within clearly defined contexts, with some scope for personal decision-making and responsibility

Associated Assessment Criteria

- Appropriate procedures are selected to solve problems in an efficient and effective manner
- Unfamiliar problems are accurately reported to appropriate personnel

- Can respond to questions and discuss issues related to familiar problems in the machining of components and assemblies

Exit level outcome 5

Communicate with peers, customers and members of supervisory/management levels by demonstrating the ability to gather and summarise information from a range of sources and produce coherent presentations in a prescribed format

Associated Assessment Criteria

- Information is gathered from a range of sources and accurately summarised into a prescribed format.
- Information is clear and accurate and presented in a timely manner in the required format to appropriate parties.
- Relationships with peers and supervisory./management levels are established and functioning

Exit level outcome 6

Demonstrate an understanding of options for further learning in this or a related field of learning and preparation requirements for such learning

Associated Assessment Criteria

- Options are explained
- Preparation requirements are explained.
- Learning plan is developed

International comparability

As a starting point, the series of qualifications in the field of mechanical engineering covering machining, fitting, fitting and machining, and tooling manufacture specialisations, of which this qualification forms a part, was compared to other, similar outcomes-based qualifications, certifications or skills standards in New Zealand and Australia. It was found to be difficult to compare the New Zealand and Australian narrow focus qualifications with these broad-based qualifications that also include fundamentals and generic core standards. It was further difficult to undertake such comparisons given that the New Zealand and Australian qualifications, although they are in the same field of mechanical engineering and cover the same areas of specialisation (thus containing a large degree of similar content) are conceptualized as three year qualifications without exit level outcomes at the intermediate levels (NQF levels 2 and 3). This notwithstanding, the technical content of this series of qualifications for mechanical engineering (with the various specialisations) of which the highest qualification is at level 4 does correspond with the equivalent level of qualification in mechanical engineering (with the various specialisations) in Australia and New Zealand.

Integrated Assessment:

Integrated assessment at the level of the qualification provides an opportunity for learners to show they are able to integrate concepts, actions and ideas achieved across a range of unit standards and contexts. Integrated assessment must evaluate the quality of observable performance as well as the thinking behind the performance.

Some assessment aspects will demand practical demonstration while others may not. In some case inference will be necessary to determine competence depending on the nature and context within which performance takes place.

It will be necessary to necessary to ensure that the fundamental part of the qualification is also targeted to ensure that while the competence may have been achieved in a particular context, learners are able to apply it in a range of other contexts and for further learning. The assessment should also ensure that all the critical cross-field outcomes have been achieved.

Recognition of prior learning:

This qualification may be obtained through a process of RPL. The learner should be thoroughly briefed prior to the assessment and support provided to assist in the process of developing a portfolio. While this is primarily a workplace-based qualification, evidence from other areas of endeavour may be introduced if pertinent to any of the exit-level outcomes.

Articulation possibilities:

The qualification has been designed and structured so that qualifying learners can move from one context to another. Employers or institutions should be able to evaluate the outcomes of this qualification against the needs of their context and structure top-up learning appropriately. Equally, holders of other qualifications may be evaluated against this qualification for the purpose of RPL.

Moderation Options:

- Anyone assessing a learner against this qualification must be registered as an assessor with the MERS ETQA or any other relevant ETQA
- Any institution or learning provider offering learning towards the achievement of this qualification should be accredited as a provider with the MERS ETQA or any other relevant ETQA

- Moderation of assessment should be overseen by the MERS ETQA or any other relevant ETQA according to the moderation guidelines provided for in this qualification as well as the agreed ETQA procedures

Criteria for registration of assessors

The following criteria should be applied by the relevant ETQA:

1. Appropriate qualification in the field of mechanical engineering (machining) – with a minimum of 3 years' experience working in the field. The subject matter experience of the assessor can be established by recognition of prior learning.
2. Appropriate experience and understanding of assessment theory, processes and practices
3. Good interpersonal skills and the ability to balance the conflicting requirements of:

- Maintaining national standards
- The interests of the learner
- The need for transformation and redressing the legacies of the past
- The cultural background and language of the learner

4. Registration as an assessor with the MERS ETQA or any other relevant ETQA
5. Any other criteria required by the MERS ETQA or any other relevant ETQA

Fundamental			
NLRD	**Title**	**Level**	**Credits**
	Communication		
8968	Accommodate audience and context needs in oral communication	3	5
8969	Interpret and use information from texts	3	5
8970	Write texts for a range of communicative contexts	3	5
9529	Compile feasibility and commissioning reports	3	3
9528	Communicate with clients	3	3
	Mathematics		
9010	Demonstrate an understanding of the use of different number bases and measurement units and an awareness of error in the context of relevant calculations	3	2
9014	Use mathematics to investigate and monitor the financial aspects of personal and business issues	3	5
9012	Investigate life-related problems using data and probabilities	3	5
9013	Measure, estimate and calculate physical quantities and explore, describe and represent, interpret and justify geometrical relationships in two and three dimensional space relevant to the life or workplace of the community	3	4
Core			
NLRD	**Title**	**Level**	**Credits**
	Machining		
	Produce components by performing engineering milling operations	3	20
	Produce components by performing engineering turning operations	3	20
	Produce components by performing engineering grinding operations	3	12
	Business Relations		
9526	Manage basic business finance	3	6
9530	Manage work time effectively	3	3

	People interacting, leading and developing		
	Develop learning strategies and techniques	3	3
	Elective		
NLRD	**Titles**		**Credits**
	Materials		
	Perform heat treatment processes on engineering metals	3	8
	Perform non-destructive tests on metal parts and components	3	4
	Test the physical properties of engineering metals	3	6
	Drawings and design		
	Produce detailed engineering drawings	3	6
	Suggested additional learning		
8038	Operate lift trucks	3	6
8039	Operate cranes	3	10
	Minimum elective credits required		**25**

SOUTH AFRICAN QUALIFICATIONS AUTHORITY

National Certificate in Mechanical Engineering (Machining) NQF Level 4

Field: Manufacturing, Engineering and Technology- NSB 06

Sub-field: Manufacturing & Assembly

Level: 4

Credit: 129

Issue date:

Review date:

Rationale for the qualification:

The field of engineering machining is characterized by work-to-order, low volume manufacture of components using different machining methods for use in a variety of industries including the automotive, metal, appliance manufacturing, plastic, tyre and rubber industries. People working in the engineering machining field require specialized technical skills and knowledge, as well as highly developed hand skills in order to adapt to and meet the requirements of the constantly changing products that must be manufactured.

This is a third qualification in a series for learners who want to follow a career in the field of engineering machining, specialising in engineering machining skills.

It also provides learners who have gained relevant experience in the workplace to gain credits through an RPL process.

The qualification also forms the basis for further learning in field of engineering within the higher education and training band.

Purpose:

The purpose of the qualification is to provide learners, education and training providers and employers with the standards and the range of learning required to work effectively in various industries making use of engineering machining skills and meet the challenges of such an environment.

The primary skill that is recognised in this qualification is the ability to produce complex components to precision specifications using a variety of machining methods. This capability requires an understanding of advanced machining theory and complex engineering drawings. The learner must furthermore choose from a number of elective unit standards for various machining methods and for computer numerical controlled (CNC) programming, setting and operation. Although the CNC unit standards are elective at present, it is recommended that learners choose these standards. Hand skills play a large role in this qualification.

Qualified learners will also understand:

- How to plan, schedule and evaluate own work
- How to interact with team leaders and develop the capacity of team members to maintain and support quality, safety and health systems.

With this understanding learners will be able to participate in workplace activities.

Qualifying learners will also be able to relate what they see and experience to scientific and technological principles and concepts.

Access to the Qualification:

Open access.

This qualification series recognises skills, knowledge and values relevant to a workplace. It is designed for learners who:

- Have attended courses and then apply the knowledge gained to activities in the workplace
- Are already workers and have acquired the skills and knowledge without attending formal courses
- Are part of a learnership programme which integrates structured learning and work experience.

Learning assumed to be in place:

This qualification assumes learners have a national certificate in engineering machining (machining specialisation) level 3.

If the learner does not already have such a qualification, learning in preparation for this qualification would also have to include:

- Language and maths related to organising and controlling their environment
- Maths and applicable scientific and technological concepts related to machining of components
- An ability to produce components of some complexity using a variety of machining methods
- Concepts of contributing factors in labour, business and the economy
- Role and purpose of systems which support workplace relationships, procedures, roles and responsibilities

Exit Level Outcomes and Assessment Criteria:

Exit level outcome 1

Demonstrate an ability to produce complex components using a variety of machining methods and operations, meeting output requirements and working safely with due care for fellow workers and the environment

Associated Assessment Criteria

- Output and quality requirements are met
- Machining time limits are adhered to
- Safe working practices are adhered to
- Can respond to questions and discuss issues related to the theoretical principles of machining and the various machining methods and their respective operations at this level

Exit level outcome 2

Demonstrate an understanding of quality specifications and an ability to interpret these and evaluate components machined to determine compliance

Associated Assessment Criteria

- Quality specifications interpreted and applied to machined component and compliance determined and reported
- Can respond to questions and discuss issues related to quality specifications and the principles underpinning such specifications

Exit level outcome 3

Demonstrate an ability to read and interpret complex engineering drawings.

Associated Assessment Criteria

- Components and assemblies to be machined identified and requirements interpreted from engineering drawing
- Machined components and assemblies meet drawing specifications

Exit level outcome 4

Maintain and support procedures to solve a variety of problems, both familiar and unfamiliar, within an engineering machining context and operate within familiar and new situations, taking responsibility and making decisions

Associated Assessment Criteria

- Solutions to machining problems are based on a clear analysis of information gathered through diagnostic procedures.
- Procedures are modified to respond to unfamiliar problems where appropriate.
- Can respond to questions and discuss issues related to familiar and unfamiliar problems arising in the machining of complex components
- All actions related to problem solving are accurately recorded for future reference

Exit level outcome 5

Communicate and present information clearly and reliably and demonstrate the ability to analyse information to identify problems and determine trends

Associated Assessment Criteria

- Conditions, evidence and incidences are reported accurately in a timely manner and discussed with peers and management
- Data gathered through diagnostic procedures is examined systematically and analysis is repeated until problem is solved.
- Records are available for scrutiny and future reference

Exit level outcome 6

Demonstrate an understanding of options for further learning in this or a related field of learning and preparation requirements for such learning

Associated Assessment Criteria

- Options are explained
- Preparation requirements are explained.
- Learning plan is developed

International comparability

This qualification was compared to other, similar outcomes- based qualifications, certifications or skills standards in New Zealand, Australia and the United Kingdom.

Integrated Assessment:

Integrated assessment at the level of the qualification provides an opportunity for learners to show they are able to integrate concepts, actions and ideas achieved across a range of unit standards and contexts. Integrated assessment must evaluate the quality of observable performance as well as the thinking behind the performance.

Some assessment aspects will demand practical demonstration while others may not. In some case inference will be necessary to determine competence depending on the nature and context within which performance takes place.

It will be necessary to necessary to ensure that the fundamental part of the qualification is also targeted to ensure that while the competence may have been achieved in a particular context, learners are able to apply it in a range of other contexts and for further learning. The assessment should also ensure that all the critical cross-field outcomes have been achieved.

Recognition of prior learning:

This qualification may be obtained through a process of RPL. The learner should be thoroughly briefed prior to the assessment and support provided to assist in the process of developing a portfolio. While this is primarily a workplace-based qualification, evidence from other areas of endeavour may be introduced if pertinent to any of the exit-level outcomes.

Articulation possibilities:

The qualification has been designed and structured so that qualifying learners can move from one context to another. Employers or institutions should be able to evaluate the outcomes of this qualification against the needs of their context and structure top-up learning appropriately.
Equally, holders of other qualifications may be evaluated against this qualification for the purpose of RPL.

Moderation Options:

- Anyone assessing a learner against this qualification must be registered as an assessor with the MERS ETQA or any other relevant ETQA
- Any institution or learning provider offering learning towards the achievement of this qualification should be accredited as a provider with the MERS ETQA or any other relevant ETQA
- Moderation of assessment should be overseen by the MERS ETQA or any other relevant ETQA according to the moderation guidelines provided for in this qualification as well as the agreed ETQA procedures

Criteria for registration of assessors

The following criteria should be applied by the relevant ETQA:

1. Appropriate qualification in the field of mechanical engineering (machining) – with a minimum of 3 years' experience working in the field. The subject matter experience of the assessor can be established by recognition of prior learning.
2. Appropriate experience and understanding of assessment theory, processes and practices
3. Good interpersonal skills and the ability to balance the conflicting requirements of:

- Maintaining national standards
- The interests of the learner
- The need for transformation and redressing the legacies of the past
- The cultural background and language of the learner

4. Registration as an assessor with the MERS ETQA or any other relevant ETQA
5. Any other criteria required by the MERS ETQA or any other relevant ETQA

National Certificate in Mechanical Engineering (Machining) NQF Level 4

Fundamental			
NLRD	**Title**	**Level**	**Credits**
	Communication		
8968	Engage in sustained oral communication and evaluate spoken texts	4	5
8969	Read, analyse and respond to a variety of texts	4	5
8970	Write for a wide range of contexts	4	5
9529	Write a technical report	4	4
9528	Communicate in an assertive manner with clients and fellow workers	4	4
	Mathematics		
9014	Use mathematics to investigate and monitor the financial aspects of personal, business and national issues	4	4
9015	Apply knowledge of statistics and probability to critically interrogate and effectively communicate findings on life related problems	4	6
9016	Measure, estimate and calculate physical quantities and explore, critique and prove geometrical relationships in two and three dimensional space in the life and workplace of the adult with increasing responsibilities	4	6
Core			
NLRD	**Title**	**Level**	**Credits**
	Machining		
	Produce complex components using milling machines	4	20
	Produce complex components using lathes	4	20
	People interacting, leading and developing		
	Develop the skills of a workgroup	5	10
	Business Relations		
	Contribute to the implementation and maintenance of business processes	4	10

Elective			
NLRD	**Titles**	**Level**	**Credits**
	Machining		
	Write simple computer numerical controlled (CNC) programmes and set and operate a CNC machine	4	24
	Grind tools and cutters used in engineering machining operations	4	8
	Produce complex components by performing internal and external grinding operations	4	12
	Produce components by performing horizontal boring operations	4	12
	Produce components by performing vertical boring operations	4	8
	Set automatic production lathes	4	10
	Write programmes for CNC machining centres using proprietary software	5	30
	Drawings and design		
	Produce complex engineering drawings	4	6
	Life Skills		
	Develop a personal financial plan	4	2

SOUTH AFRICAN QUALIFICATIONS AUTHORITY

National Certificate in Mechanical Engineering (Tooling Manufacture) NQF Level 3

Field: Manufacturing, Engineering and Technology - NSB 06

Sub-field: Manufacturing & Assembly

Level: 3

Credit: 169

Issue date:

Review date:

Rationale for the qualification:

The field of engineering machining is characterized by work-to-order, low volume manufacture of components using different machining methods for use in a variety of industries including the automotive, metal, appliance manufacturing, plastic, tyre and rubber industries. People working in the engineering machining field require specialized technical skills and knowledge, as well as highly developed hand skills in order to adapt to and meet the requirements of the constantly changing products that must be manufactured.

This is a second qualification in a series for learners who want to follow a career in the field of engineering machining, specialising in tooling manufacture. This qualification applies to the manufacture of tools, jigs, dies and fixtures and plastic injection moulds. The learner must demonstrate competence in either of the two skills areas to receive credits for this qualification.

It also provides learners who have gained relevant experience in the workplace to gain credits through an RPL process.

The qualification also forms the basis for further learning in field of engineering and machining where the learner will be able to further specialize at NQF level 4.

Purpose:

The purpose of the qualification is to provide learners, education and training providers and employers with the standards and the range of learning required to work effectively in various industries making use of tooling manufacturing skills and meet the challenges of such an environment.

The underpinning skill that is recognised in this qualification is the ability to produce components of some complexity using a variety of machining methods. The primary skill that is recognised in this qualification is the ability to use this underpinning skill to manufacture and repair production tooling. These capabilities require an understanding of advanced machining theory, detailed engineering drawings and a variety of tests and treatments used on engineering metals. Hand skills play a large role in this qualification.

Qualifying learners will also be able to relate what they are doing to scientific and technological principles and concepts. They will also be able to maintain and support the various policies and procedures related to the safety, health, environment and quality systems that govern their workplace.

Access to the Qualification:

Open access.

This qualification series recognises skills, knowledge and values relevant to a workplace. It is designed for learners who:

- Have attended courses and then apply the knowledge gained to activities in the workplace
- Are already workers and have acquired the skills and knowledge without attending formal courses
- Are part of a learnership programme which integrates structured learning and work experience.

Learning assumed to be in place:

T This qualification assumes learners have a national certificate in engineering machining level 2.

If the learner does not already have such a qualification, learning in preparation for this qualification would also have to include:

- Language and maths beyond basic literacy and numeracy
- Basic concepts of science and technology related to machining methods, engineering materials and tools used in the machining process
- An ability to produce simple components using a variety of machining methods
- An ability to manufacture basic tooling
- Concepts of organising factors in labour, business and the economy
- Role and purpose of procedures related to workplace relationships, roles and responsibilities

Exit Level Outcomes and Assessment Criteria:

Exit level outcome 1

Demonstrate an ability to produce components of some complexity using a variety of machining methods and operations, meeting output requirements and working safely with due care for fellow workers and the environment

Associated Assessment Criteria

- Output and quality requirements are met
- Safe working practices are adhered to
- Can respond to questions and discuss issues related to the theoretical principles of machining and the various machining methods and their respective operations at this level

Exit level outcome 2

Demonstrate an understanding of and an ability to manufacture and maintain production tooling

Associated Assessment Criteria

- Output and quality requirements are met
- Time frames for manufacturing tooling are adhered to
- Production tooling is maintained and repaired to job specifications
- Safe working practices are adhered to

Can respond to questions and discuss issues related to the theoretical principles underpinning tooling manufacture

Exit level outcome 3

Demonstrate an ability to select and apply appropriate inspection methods to determine component compliance with specifications

Associated Assessment Criteria

- Appropriate inspection methods are chosen and applied

- Can respond to questions and discuss issues related to various inspection methods and procedures and the principles underpinning such methods

Exit level outcome 4

Demonstrate an ability to read and interpret detailed engineering drawings.

Associated Assessment Criteria

- Tooling to be manufactured is identified and requirements interpreted from engineering drawing
- Manufactured tooling meets drawing specifications

Exit level outcome 5

Select appropriate procedures to solve familiar problems within an engineering machining environment and operate within clearly defined contexts, with some scope for personal decision-making and responsibility

Associated Assessment Criteria

- Appropriate procedures are selected to solve problems in an efficient and effective manner
- Unfamiliar problems are accurately reported to appropriate personnel
- Can respond to questions and discuss issues related to familiar problems in the machining of components and assemblies

Exit level outcome 6

Communicate with peers, customers and members of supervisory/management levels by demonstrating the ability to gather and summarise information from a range of sources and produce coherent presentations in a prescribed format

Associated Assessment Criteria

- Information is gathered from a range of sources and accurately summarised into a prescribed format.
- Information is clear and accurate and presented in a timely manner in the required format to appropriate parties.
- Relationships with peers and supervisory./management levels are established and functioning

Exit level outcome 7

Demonstrate an understanding of options for further learning in this or a related field of learning and preparation requirements for such learning

Associated Assessment Criteria

- Options are explained
- Preparation requirements are explained.
- Learning plan is developed

International comparability

As a starting point, the series of qualifications in the field of mechanical engineering covering machining, fitting, fitting and machining, and tooling manufacture specialisations, of which this qualification forms a part, was compared to other, similar outcomes-based qualifications, certifications or skills standards in New Zealand and Australia. It was found to be difficult to compare the New Zealand and Australian narrow focus qualifications with these broad-based qualifications that also include fundamentals and generic core standards. It was further difficult to undertake such comparisons given that the New Zealand and Australian qualifications, although they are in the same field of mechanical engineering and cover the same areas of specialisation (thus containing a large degree of similar content) are conceptualized as three year qualifications without exit level outcomes at the intermediate levels (NQF levels 2 and 3). This notwithstanding, the technical content of this series of qualifications for mechanical engineering (with the various specialisations) of which the highest qualification is at level 4 does correspond with the equivalent level of qualification in mechanical engineering (with the various specialisations) in Australia and New Zealand.

Integrated Assessment:

Integrated assessment at the level of the qualification provides an opportunity for learners to show they are able to integrate concepts, actions and ideas achieved across a range of unit standards and contexts. Integrated assessment must evaluate the quality of observable performance as well as the thinking behind the performance.

Some assessment aspects will demand practical demonstration while others may not. In some case inference will be necessary to determine competence depending on the nature and context within which performance takes place.

It will be necessary to necessary to ensure that the fundamental part of the qualification is also targeted to ensure that while the competence may have been achieved in a particular context, learners are able to apply it in a range of other contexts and for further learning. The assessment should also ensure that all the critical cross-field outcomes have been achieved.

Recognition of prior learning:

This qualification may be obtained through RPL. The learner should be thoroughly briefed on the mechanism to be used and support and guidance should be provided. Care should be taken that the mechanism used provides the learner with an opportunity to demonstrate competence and is not too onerous as to prevent learners from taking up the RPL option towards gaining a qualification.

Articulation possibilities:

The qualification has been designed and structured so that qualifying learners can move from one context to another. Employers or institutions should be able to evaluate the outcomes of this qualification against the needs of their context and structure top-up learning appropriately. Equally, holders of other qualifications may be evaluated against this qualification for the purpose of RPL.

Moderation Options:

- Anyone assessing a learner against this qualification must be registered as an assessor with the MERS ETQA or any other relevant ETQA
- Any institution or learning provider offering learning towards the achievement of this qualification should be accredited as a provider with the MERS ETQA or any other relevant ETQA
- Moderation of assessment should be overseen by the MERS ETQA or any other relevant ETQA according to the moderation guidelines provided for in this qualification as well as the agreed ETQA procedures

Criteria for registration of assessors

The following criteria should be applied by the relevant ETQA:

1. Appropriate qualification in the field of mechanical engineering (tooling manufacture) – with a minimum of 3 years' experience working in the field. The subject matter experience of the assessor can be established by recognition of prior learning.
2. Appropriate experience and understanding of assessment theory, processes and practices
3. Good interpersonal skills and the ability to balance the conflicting requirements of:

- Maintaining national standards
- The interests of the learner
- The need for transformation and redressing the legacies of the past
- The cultural background and language of the learner

4. Registration as an assessor with the MERS ETQA or any other relevant ETQA
5. Any other criteria required by the MERS ETQA or any other relevant ETQA

National Certificate in Mechanical Engineering (Tooling Manufacture) NQF Level 3

Fundamental			
NLRD	**Title**	**Level**	**Credits**
	Communication		
8968	Accommodate audience and context needs in oral communication	3	5
8969	Interpret and use information from texts	3	5
8970	Write texts for a range of communicative contexts	3	5
9529	Compile feasibility and commissioning reports	3	3
9528	Communicate with clients	3	3
	Mathematics		
9010	Demonstrate an understanding of the use of different number bases and measurement units and an awareness of error in the context of relevant calculations	3	2
9014	Use mathematics to investigate and monitor the financial aspects of personal and business issues	3	5
9012	Investigate life-related problems using data and probabilities	3	5
9013	Measure, estimate and calculate physical quantities and explore, describe and represent, interpret and justify geometrical relationships in two and three dimensional space relevant to the life or workplace of the community	3	4

Core			
NLRD	**Title**	**Level**	**Credits**
	Machining		
	Produce components by performing engineering milling operations	3	20
	Produce components by performing engineering turning operations	3	20
	Produce components by performing engineering grinding operations	3	12
	Tooling manufacture		
	Manufacture production tooling to drawing or sample part	3	36
	Maintain and repair production tooling	3	20
	Business Relations		
9526	Manage basic business finance	3	6
9530	Manage work time effectively	3	3
	People interacting, leading and developing		
	Develop learning strategies and techniques	3	3
Elective			
NLRD	**Titles**		**Credits**
	Tooling manufacture		
	Produce components by spark eroding machining operations	3	8
	Materials		
	Perform heat treatment processes on engineering metals	3	8
	Perform non-destructive tests on metal parts and components	3	4
	Test the physical properties of engineering metals	3	6
	Drawings and design		

	Produce detailed engineering drawings	3	6
	Suggested additional learning		
8038	Operate lift trucks	3	6
8039	Operate cranes	3	10
	Minimum elective credits required		**12**

SOUTH AFRICAN QUALIFICATIONS AUTHORITY

National Certificate in Mechanical Engineering (Tooling Manufacture) NQF Level 4

Field: Manufacturing, Engineering and Technology- NSB 06

Sub-field: Manufacturing & Assembly

Level: 4

Credit: 183

Issue date:

Review date:

Rationale for the qualification:

The field of engineering machining is characterized by work-to-order, low volume manufacture of components using different machining methods for use in a variety of industries including the automotive, metal, appliance manufacturing, plastic, tyre and rubber industries. People working in the engineering machining field require specialized technical skills and knowledge, as well as highly developed hand skills in order to adapt to and meet the requirements of the constantly changing products that must be manufactured.

This is a third qualification in a series for learners who want to follow a career in the field of engineering machining, specialising in tooling manufacture. This qualification applies to the manufacture of tools, jigs, dies and fixtures and plastic injection moulds. The learner must demonstrate competence in either of the two skills areas to receive credits for this qualification.

It also provides learners who have gained relevant experience in the workplace to gain credits through an RPL process.

The qualification also forms the basis for further learning in field of engineering within the higher education and training band.

Purpose:

The purpose of the qualification is to provide learners, education and training providers and employers with the standards and the range of learning required to work effectively in various industries making use of tooling manufacturing skills and meet the challenges of such an environment.

The underpinning skill that is recognised in this qualification is the ability to produce components using a variety of machining methods. The primary skill that is recognised in this qualification is the ability to use this underpinning skill to manufacture complex tooling and to diagnose and repair faults on tooling during the production run. These capabilities require an understanding of advanced machining theory and complex engineering drawings. Hand skills play a large role in this qualification.

The learner may also choose from a number of elective unit standards for various machining methods and for computer numerical controlled (CNC) programming, setting and operation. Although the CNC unit standards are elective at present, it is recommended that learners choose these standards.

Qualified learners will also understand:

- How to plan, schedule and evaluate own work
- How to interact with team leaders and develop the capacity of team members to maintain and support quality, safety and health systems.

With this understanding learners will be able to participate in workplace activities.

Qualifying learners will also be able to relate what they see and experience to scientific and technological principles and concepts.

Access to the Qualification:

Open access.

This qualification series recognises skills, knowledge and values relevant to a workplace. It is designed for learners who:

- Have attended courses and then apply the knowledge gained to activities in the workplace

- Are already workers and have acquired the skills and knowledge without attending formal courses
- Are part of a learnership programme which integrates structured learning and work experience.

Learning assumed to be in place:

This qualification assumes learners have a national certificate in engineering machining (machining specialisation) level 3.

If the learner does not already have such a qualification, learning in preparation for this qualification would also have to include:

- Language and maths related to organising and controlling their environment
- Maths and applicable scientific and technological concepts related to the manufacturing of production tooling and the machining of components
- An ability to produce components of some complexity using a variety of machining methods
- An ability to manufacture and maintain production tooling
- Concepts of contributing factors in labour, business and the economy
- Role and purpose of systems which support workplace relationships, procedures, roles and responsibilities

Exit Level Outcomes and Assessment Criteria:

Exit level outcome 1

Demonstrate an understanding of and an ability to manufacture complex tooling

Associated Assessment Criteria

- Output and quality requirements met
- Time frames for manufacturing tooling are adhered to
- Safe working practices are adhered to

Exit level outcome 2

Demonstrate an understanding of and an ability to diagnose and repair faults on tooling during the production run

Associated Assessment Criteria

- Recurrent tooling faults and their root causes identified
- Minor repairs on line performed
- Tooling requiring major repair dismantled and dispatched to workshop
- Potential production and maintenance problems are identified

Exit level outcome 3

Demonstrate an understanding of quality specifications and an ability to interpret these and evaluate tooling manufactured to determine compliance

Associated Assessment Criteria

- Quality specifications interpreted and applied to manufactured tooling and compliance determined and reported
- Can respond to questions and discuss issues related to quality specifications and the principles underpinning such specifications

Exit level outcome 4

Demonstrate an ability to read and interpret complex engineering drawings.

Associated Assessment Criteria

- Tooling to be manufactured is identified and requirements interpreted from engineering drawing
- Manufactured tooling meets drawing specifications

Exit level outcome 5

Maintain and support procedures to solve a variety of problems, both familiar and unfamiliar, within an engineering machining context and operate within familiar and new situations, taking responsibility and making decisions

Associated Assessment Criteria

- Solutions to machining problems are based on a clear analysis of information gathered through diagnostic procedures.
- Procedures are modified to respond to unfamiliar problems where appropriate
- Can respond to questions and discuss issues related to familiar and unfamiliar problems arising in the machining of complex components
- All actions related to problem solving are accurately recorded for future reference

Exit level outcome 6

Communicate and present information clearly and reliably and demonstrate the ability to analyse information to identify problems and determine trends

Associated Assessment Criteria

- Conditions, evidence and incidences are reported accurately in a timely manner and discussed with peers and management
- Data gathered through diagnostic procedures is examined systematically and analysis is repeated until problem is solved.

- Records are available for scrutiny and future reference

Exit level outcome 7

Demonstrate an understanding of options for further learning in this or a related field of learning and preparation requirements for such learning

Associated Assessment Criteria

- Options are explained
- Preparation requirements are explained.
- Learning plan is developed

International comparability

As a starting point, the series of qualifications in the field of mechanical engineering covering machining, fitting, fitting and machining, and tooling manufacture specialisations, of which this qualification forms a part, was compared to other, similar outcomes-based qualifications, certifications or skills standards in New Zealand and Australia. It was found to be difficult to compare the New Zealand and Australian narrow focus qualifications with these broad-based qualifications that also include fundamentals and generic core standards. It was further difficult to undertake such comparisons given that the New Zealand and Australian qualifications, although they are in the same field of mechanical engineering and cover the same areas of specialisation (thus containing a large degree of similar content) are conceptualized as three year qualifications without exit level outcomes at the intermediate levels (NQF levels 2 and 3). This notwithstanding, the technical content of this series of qualifications for mechanical engineering (with the various specialisations) of which the highest qualification is at level 4 does correspond with the equivalent level of qualification in mechanical engineering (with the various specialisations) in Australia and New Zealand.

Integrated Assessment:

Integrated assessment at the level of the qualification provides an opportunity for learners to show they are able to integrate concepts, actions and ideas achieved across a range of unit standards and contexts. Integrated assessment must evaluate the quality of observable performance as well as the thinking behind the performance.

Some assessment aspects will demand practical demonstration while others may not. In some case inference will be necessary to determine competence depending on the nature and context within which performance takes place.

National Certificate in Mechanical Engineering (Tooling Manufacture) NQF Level 4

Fundamental			
NLRD	**Title**	**Level**	**Credits**
	Communication		
8968	Engage in sustained oral communication and evaluate spoken texts	4	5
8969	Read, analyse and respond to a variety of texts	4	5
8970	Write for a wide range of contexts	4	5
9529	Write a technical report	4	4
9528	Communicate in an assertive manner with clients and fellow workers	4	4
	Mathematics		
9014	Use mathematics to investigate and monitor the financial aspects of personal, business and national issues	4	4
9015	Apply knowledge of statistics and probability to critically interrogate and effectively communicate findings on life related problems	4	6
9016	Measure, estimate and calculate physical quantities and explore, critique and prove geometrical relationships in two and three dimensional space in the life and workplace of the adult with increasing responsibilities	4	6
Core			
NLRD	**Title**	**Level**	**Credits**
	Machining		
	Produce complex components using milling machines	4	20
	Produce complex components using lathes	4	20
	Tooling Manufacture		
	Manufacture complex tooling		48
	Diagnose and repair faults on tooling during the production run		24
	People interacting, leading and developing		

	Develop the skills of a workgroup	5	10
	Business Relations		
	Contribute to the implementation and maintenance of business processes	4	10
	Elective		
NLRD	**Titles**	**Level**	**Credits**
	Tooling Manufacture		
	Produce components using wire cutting operations	4	10
	Machining		
	Write simple computer numerical controlled (CNC) programmes and set and operate a CNC machine	4	24
	Grind tools and cutters used in engineering machining operations	4	8
	Produce complex components by performing internal and external grinding operations	4	12
	Produce components by performing horizontal boring operations	4	12
	Produce components by performing vertical boring operations	4	8
	Set automatic production lathes	4	10
	Write computer numerical controlled (CNC) programmes for CNC machining centres using proprietary software	4	30
	Drawings and design		
	Produce complex engineering drawings	4	6

	People interacting, leading and developing		
	Life Skills		
	Develop a personal financial plan	4	2

- Maintaining national standards
- The interests of the learner
- The need for transformation and redressing the legacies of the past
- The cultural background and language of the learner

4. Registration as an assessor with the MERS ETQA or any other relevant ETQA
5. Any other criteria required by the MERS ETQA or any other relevant ETQA

It will be necessary to necessary to ensure that the fundamental part of the qualification is also targeted to ensure that while the competence may have been achieved in a particular context, learners are able to apply it in a range of other contexts and for further learning. The assessment should also ensure that all the critical cross-field outcomes have been achieved.

Recognition of prior learning:

This qualification may be obtained through RPL. The learner should be thoroughly briefed of the mechanism to be used and support and guidance should be provided. Care should be taken that the mechanism used provides the learner with an opportunity to demonstrate competence and is not too onerous as to prevent learners from taking up the RPL option towards gaining a qualification.

Articulation possibilities:

The qualification has been designed and structured so that qualifying learners can move from one context to another. Employers or institutions should be able to evaluate the outcomes of this qualification against the needs of their context and structure top-up learning appropriately.
Equally, holders of other qualifications may be evaluated against this qualification for the purpose of RPL.

Moderation Options:

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Criteria for registration of assessors

The following criteria should be applied by the relevant ETQA:

1. Appropriate qualification in the field of mechanical engineering (tooling manufacture) – with a minimum of 3 years' experience working in the field. The subject matter experience of the assessor can be established by recognition of prior learning.
2. Appropriate experience and understanding of assessment theory, processes and practices
3. Good interpersonal skills and the ability to balance the conflicting requirements of:

NATIONAL CERTIFICATE IN MECHANICAL ENGINEERING (MACHINING) – NQF LEVEL 2

UNIT STANDARDS ON NQF LEVEL 2

CORE

Title 1: Identify engineering metals, their characteristics and applications and common metal tests and treatments used in engineering

Title 2: Select, use and care for engineering measuring equipment

Title 3: Select, use and care for engineering power tools

Title 4: Select, use and care for engineering hand tools

Title 5: Mark off basic engineering shapes

Title 6: Perform basic welding / joining of metals

Title 7: Perform routine maintenance

Title 8: Read, interpret and produce engineering drawings

Title 9: Operate and monitor a drilling machine to produce simple components

Title 10: Operate and monitor a surface grinding machine to produce simple components

Title 11: Operate and monitor a milling machine to produce simple components

Title 12: Operate and monitor a milling machine to produce simple components

ELECTIVE

Title 13: Manufacture basic tooling

UNIT STANDARDS AND SPECIFIC OUTCOMES IN NATIONAL CERTIFICATE IN MECHANICAL ENGINEERING (MACHINING) NQF LEVEL 2

Title 1: Identify engineering materials, their characteristics and applications and common metal tests and treatments used in engineering

Specific outcome 1.1: Identify materials used in common engineering applications

Specific outcome 1.2: Discuss the physical properties of engineering materials used in common engineering applications

Specific outcome 1.3: Explain the common applications and methods of processing and manufacturing using engineering materials

Specific outcome 1.4: Demonstrate an understanding of the common metal tests used in engineering

Specific outcome 1.5: Demonstrate an understanding of heat treatment processes

Specific outcome 1.6: Explain the effects external factors have on engineering materials

Title 2: Select, use and care for engineering measuring equipment

Specific outcome 2.1: Explain and discuss basic units of measure and symbols

Specific outcome 2.2: Select and use engineering measuring equipment

Specific outcome 2.3: Care for and maintain measuring equipment

Specific outcome 2.4: Recognise and report problems, changes and/or malfunctions while working

Specific outcome 2.5: Work safely with due care for self, fellow workers, equipment, materials and the environment

Title 3: Select, use and care for engineering power tools

Specific outcome 3.1: Select and use engineering power tools

Specific outcome 3.2: Care for and maintain engineering power tools

Specific outcome 3.3: Check on power supply connections to equipment

Specific outcome 3.4: Recognise and report problems, changes and/or malfunctions while working

Title 4: Select, use and care for engineering hand tools

Specific outcome 4.1: Select and use engineering hand tools

Specific outcome 4.2: Care for and maintain hand tools

Specific outcome 4.3: Recognise and report problems, changes and/or malfunctions while working

Specific outcome 4.4: Work safely with due care for self, fellow workers, equipment, materials and the environment

Title 5: Perform basic welding / joining of metals

Specific outcome 5.1: Prepare for work activity

Specific outcome 5.2: Weld/join metals

Specific outcome 5.3: Apply quality checks on completed weld/joint

Specific outcome 5.4: Perform finishing activities

Specific outcome 5.5: Report out of compliance or unsafe conditions while working

Specific outcome 5.6: Work safely with due care for self, fellow workers, equipment, materials and the environment

Title 6: Mark off basic engineering shapes

Specific outcome 6.1: Plan and prepare materials for marking off

Specific outcome 6.2: Mark off materials

Specific outcome 6.3: Apply quality checks on completed work

Specific outcome 6.4: Care for and store marking off equipment

Title 7: Perform routine maintenance

Specific outcome 7.1: Plan and prepare for routine maintenance

Specific outcome 7.2: Monitor the condition of machinery and equipment

Specific outcome 7.3: Perform routine maintenance

Specific outcome 7.4 Apply quality checks on completed work

Title 8: Read, interpret and produce basic engineering drawings

Specific outcome 8.1: Discuss and explain basic engineering drawing concepts and material lists

Specific outcome 8.2: Interpret basic engineering drawings

Specific outcome 8.3: Produce drawing

Title 9: Operate and monitor a drilling machine to produce simple components

Specific outcome 9.1: Prepare for work activity

Specific outcome 9.2: Set drilling machine

Specific outcome 9.3: Perform drilling operations

Specific outcome 9.4: Apply quality checks on machined component

Title 10: Operate and monitor a surface grinding machine to produce simple components

Specific outcome 9.1: Prepare for work activity

Specific outcome 10.2: Set grinding machine

Specific outcome 10.3: Set grinding machine

Specific outcome 10.4: Apply quality checks on machined component

Title 11: Operate and monitor a milling machine to produce simple components

Specific outcome 11.1: Prepare for work activity

Specific outcome 11.2: Set milling machine

Specific outcome 11.3: Perform milling operations

Specific outcome 11.4: Apply quality checks on machined component

Title 12: Operate and monitor a lathe to produce simple components

Specific outcome 12.1: Prepare for work activity

Specific outcome 12.2: Set lathe

Specific outcome 12.3: Perform turning operations

Specific outcome 12.4: Apply quality checks on machined component

Specific outcome 12.5: Recognise and report problems, changes and/or malfunctions while operating

Title 13: Manufacture basic tooling

Specific outcome 13.1:	Plan and prepare for tooling manufacturing process
Specific outcome 13.2:	Manufacture basic tooling
Specific outcome 13.3:	Assemble tooling
Specific outcome 13.4:	Perform sample part try-out
Specific outcome 13.5:	Recognise and report problems, changes and/or malfunctions while working
Specific outcome 13.6:	Record information on work done
Specific outcome 13.7:	Work safely with due care for self, fellow workers, machines, equipment, materials and the environment

NATIONAL CERTIFICATE IN MECHANICAL ENGINEERING (MACHINING) NQF LEVEL 3

UNIT STANDARDS ON NQF LEVEL 3

CORE

Title 1: Produce components by performing engineering milling components

Title 2: Produce components by performing engineering turning operations

Title 3: Produce components by performing engineering grinding operations

ELECTIVE

Title 4: Perform heat treatment processes on engineering metals

Title 5: Test the physical properties of engineering metals

Title 6: Perform non-destructive tests on metal components

Title 7: Produce detailed engineering drawings

UNIT STANDARDS AND SPECIFIC OUTCOMES IN NATIONAL CERTIFICATE IN MECHANICAL ENGINEERING (MACHINING) NQF LEVEL 3

Title 1: Produce components by performing engineering milling operations

Specific outcome 1.1: Prepare for work activity

Specific outcome 1.2: Set milling machine

Specific outcome 1.3: Perform milling operations

Specific outcome 1.4: Apply quality checks on machined component

Specific outcome 1.5: Recognise and report problems, changes and/or malfunctions while operating

Specific outcome 1.6: Record information on work done

Specific outcome 1.7 Work safely with due care for self, fellow workers, machines, equipment, materials and the environment

Title 2: Produce components by performing engineering turning operations

Specific outcome 2.1: Prepare for work activity

Specific outcome 2.2: Set lathe

Specific outcome 2.3: Perform turning operations

Specific outcome 2.4: Apply quality checks on machined component

Title 3: Produce components by performing engineering grinding operations

Specific outcome 3.1: Prepare for work activity

Specific outcome 3.2: Set grinding machine

Specific outcome 3.3: Perform grinding operations

Specific outcome 3.4: Apply quality checks on machined component

Title 4: Perform heat treatment processes on engineering metals

Specific outcome 4.1: Discuss and explain the heat treatment of metals

Specific outcome 4.2: Determine heat treatment requirements

Specific outcome 4.3: Prepare materials and equipment for heat treatment process

Specific outcome 4.4: Complete heat treatment of metals

Title 5: Perform non-destructive tests on metal parts and components

Specific outcome 5.1: Receive samples and check against documentation

Specific outcome 5.2: Carry out testing using ultrasonic methods

Specific outcome 5.3: Test parts for surface defects using magnetic particle inspection

Specific outcome 5.4: Recognise and report problems, changes and/or malfunctions while working

Title 6: Test the physical properties of engineering metals

Specific outcome 6.1: Receive samples and check against documentation

Specific outcome 6.2: Prepare for tests

Specific outcome 6.3: Complete tests and interpret and record results

Specific outcome 6.4: Store samples

Specific outcome 6.5: Care for test equipment

Title 7: Produce detailed engineering drawings

Specific outcome 7.1: Determine drawing requirements

Specific outcome 7.2: Perform calculations to produce drawing

Specific outcome 7.3: Produce drawings

NATIONAL CERTIFICATE IN MECHANICAL ENGINEERING (MACHINING) NQF LEVEL 4

UNIT STANDARDS ON NQF LEVEL 4

CORE

Title 1: Produce complex components using milling machines

Title 2: Produce complex components using lathes

ELECTIVE

Title 3: Write simple computer numerical controlled (CNC) programmes and set and operate a CNC machine

Title 4: Grind tools and cutters used in engineering machining operations

Title 5: Produce complex components by performing internal and external grinding operations

Title 6: Produce components by performing horizontal boring operations

Title 7: Produce components by performing vertical boring operations

Title 8: Set automatic production lathes

Title 9: Produce complex engineering drawings

UNIT STANDARDS ON NQF LEVEL 5

ELECTIVE

Title 10: Write computer numerical controlled (CNC) programmes for CNC machining centers using proprietary software

UNIT STANDARDS AND SPECIFIC OUTCOMES IN NATIONAL CERTIFICATE IN MECHANICAL ENGINEERING (MACHINING) NQF LEVEL 4

Title 1: Produce complex components using milling machines

Specific outcome 1.1: Prepare for work activity

Specific outcome 1.2: Set milling machine

Specific outcome 1.3: Perform milling operations

Specific outcome 1.4: Apply quality checks on machined component

Specific outcome 1.5: Recognise and report problems, changes and/or malfunctions while operating

Specific outcome 1.6: Record information on work done

Specific outcome 1.7: Work safely with due care for self, fellow workers, machines, equipment, materials and the environment

Title 2: Produce complex components using lathes

Specific outcome 2.1: Prepare for work activity

Specific outcome 2.2: Set lathe

Specific outcome 2.3: Perform turning operations

Specific outcome 2.4: Apply quality checks on machined component

Title 3: Write simple computer numerical controlled (CNC) programmes and set and operate a CNC machine

Specific outcome 3.1: Prepare and write programme

Specific outcome 3.2: Prepare to set machine

Specific outcome 3.3: Set machine to perform the specified work

Specific outcome 3.4: Produce sample component

Specific outcome 3.5: Operate CNC machine

Title 4: Grind tools and cutters used in engineering machining operations

Specific outcome 4.1: Prepare for work activity

Specific outcome 4.2: Set grinding machine

Specific outcome 4.3: Perform tool and cutter grinding operations

Specific outcome 4.4: Apply quality checks on machined tool/cutter

Title 5: Produce complex components by performing internal and external grinding operations

Specific outcome 5.1: Prepare for work activity

Specific outcome 5.2: Set grinding machine

Specific outcome 5.3: Perform universal grinding operations

Specific outcome 5.4 Apply quality checks on machined component

Title 6: Produce components by performing horizontal boring operations

Specific outcome 6.1: Prepare for work activity

Specific outcome 6.2: Set horizontal boring machine

Specific outcome 6.3: Perform horizontal boring operations

Specific outcome 6.4 Clean machine

Title 7: Produce components by performing vertical boring operations

Specific outcome 7.1: Prepare for work activity

Specific outcome 7.2: Set vertical boring machine

Specific outcome 7.3: Perform vertical boring operations

Specific outcome 7.4: Apply quality checks on machined component

Title 8: Set automatic production lathes

Specific outcome 8.1: Prepare for machine set up

Specific outcome 8.2: Set machine

Specific outcome 8.3: Produce sample component

Specific outcome 8.4: Monitor machine setting

Title 9: Produce complex engineering drawings

Specific outcome 9.1: Determine drawing requirements

Specific outcome 9.2: Perform calculations to produce drawing

Specific outcome 9.3: Produce drawings

Specific outcome 9.4: Record information on work done

Title 10: Write computer numerical controlled (CNC) programmes for CNC machining centres using proprietary software

Specific outcome 10.1: Prepare to write programme

Specific outcome 10.2: Write programme

Specific outcome 10.3: Verify programme

Specific outcome 10.4: Recognise and report problems and changes while programming

UNIT STANDARDS AND SPECIFIC OUTCOMES IN NATIONAL CERTIFICATE IN MECHANICAL ENGINEERING (TOOLING MANUFACTURE) NQF LEVEL 3

Title 1: Produce components by performing engineering milling operations

Specific outcome 1.1: Prepare for work activity

Specific outcome 1.2: Set milling machine

Specific outcome 1.3: Perform milling operations

Specific outcome 1.4: Apply quality checks on machined component

Specific outcome 1.5: Recognise and report problems, changes and/or malfunctions while operating

Specific outcome 1.6: Record information on work done

Specific outcome 1.7 Work safely with due care for self, fellow workers, machines, equipment, materials and the environment

Title 2: Produce components by performing engineering turning operations

Specific outcome 2.1: Prepare for work activity

Specific outcome 2.2: Set lathe

Specific outcome 2.3: Perform turning operations

Specific outcome 2.4: Apply quality checks on machined component

Title 3: Produce components by performing engineering grinding operations

Specific outcome 3.1: Prepare for work activity

Specific outcome 3.2: Set grinding machine

Specific outcome 3.3: Perform grinding operations

Specific outcome 3.4: Apply quality checks on machined component

Title 4: Manufacture production tooling to drawing or sample part

Specific outcome 4.1: Plan and prepare for tooling manufacturing process

Specific outcome 4.2: Manufacture production tooling

Specific outcome 4.3: Assemble tooling

Specific outcome 4.4: Perform sample part try-out

Specific outcome 4.5: Recognise and report problems, changes and/or malfunctions while working

Title 5: Maintain and repair production tooling

Specific outcome 5.1: Identify and analyse defects in tooling

Specific outcome 5.2: Dismantle and assess tooling components

Specific outcome 5.3: Manufacture and/or repair tooling components

Specific outcome 5.4: Assemble tooling components

Specific outcome 5.5: Reset tools into press and perform sample part try-out

Title 6: Produce components by spark eroding machining operations

Specific outcome 6.1: Manufacture electrode

Specific outcome 6.2: Prepare for spark eroding machining process

Specific outcome 6.3: Prepare spark eroding machine for operation

Specific outcome 6.4: Perform spark eroding operations

Specific outcome 6.5: Apply quality checks on component

Specific outcome 6.6: Recognise and report problems, changes and/or malfunctions while operating

Specific outcome 6.7 Record information on work done

Title 13: Perform heat treatment processes on engineering metals

Specific outcome 13.1: Discuss and explain the heat treatment of metals

Specific outcome 13.2: Determine heat treatment requirements

Specific outcome 13.3: Prepare materials and equipment for heat treatment process

Specific outcome 13.4: Complete heat treatment of metals

Title 14: Perform non-destructive tests on metal parts and components

Specific outcome 14.1: Receive samples and check against documentation

Specific outcome 14.2: Carry out testing using ultrasonic methods

Specific outcome 14.3: Test parts for surface defects using magnetic particle inspection

Specific outcome 14.4: Recognise and report problems, changes and/or malfunctions while working

Title 15: Test the physical properties of engineering metals

Specific outcome 15.1: Receive samples and check against documentation

Specific outcome 15.2: Prepare for tests

Specific outcome 15.3: Complete tests and interpret and record results

Specific outcome 15.4: Store samples

Specific outcome 15.5: Care for test equipment

Title 16: Produce detailed engineering drawings

Specific outcome 16.1: Determine drawing requirements

Specific outcome 16.2: Perform calculations to produce drawing

Specific outcome 16.3: Produce drawings

NATIONAL CERTIFICATE IN MECHANICAL ENGINEERING (TOOLING MANUFACTURE) NQF LEVEL 4

UNIT STANDARDS ON NQF LEVEL 4

CORE

Title 1: Produce complex components using milling machines

Title 2: Produce complex components using lathes

Title 3: Manufacture complex tooling

Title 4: Diagnose and repair faults on tooling during the production run

ELECTIVE

Title 5: Produce components using wire cutting operations

Title 6: Write simple computer numerical controlled (CNC) programmes and set and operate a CNC machine

Title 7: Grind tools and cutters used in engineering machining operations

Title 8: Produce complex components by performing internal and external grinding operations

Title 9: Produce components by performing horizontal boring operations

Title 10: Produce components by performing vertical boring operations

Title 11: Set automatic production lathes

UNIT STANDARDS ON NQF LEVEL 5

ELECTIVE

Title 12: Write computer numerical controlled (CNC) programmes for CNC machining centres using proprietary software

UNIT STANDARDS AND SPECIFIC OUTCOMES IN NATIONAL CERTIFICATE IN MECHANICAL ENGINEERING (TOOLING MANUFACTURE) NQF LEVEL 4

Title 1: Produce complex components using milling machines

Specific outcome 1.1: Prepare for work activity

Specific outcome 1.2: Set milling machine

Specific outcome 1.3: Perform milling operations

Specific outcome 1.4: Apply quality checks on machined component

Specific outcome 1.5: Recognise and report problems, changes and/or malfunctions while operating

Specific outcome 1.6: Record information on work done

Specific outcome 1.7: Work safely with due care for self, fellow workers, machines, equipment, materials

and the environment

Title 2: Produce complex components using lathes

Specific outcome 2.1: Prepare for work activity

Specific outcome 2.2: Set lathe

Specific outcome 2.3: Perform turning operations

Specific outcome 2.4: Apply quality checks on machined component

Title 3: Manufacture complex tooling

Specific outcome 3.1: Plan and prepare for tooling manufacturing process

Specific outcome 3.2: Manufacture complex tooling

Specific outcome 3.3: Assemble tooling

Specific outcome 3.4: Perform sample part try-out

Specific outcome 3.5: Recognise and report problems, changes and/or malfunctions while working

Title 4: Diagnose and repair faults on tooling during the production run

Specific outcome 4.1: Monitor the performance of tooling on the production run

Specific outcome 4.2: Perform minor repairs on line

Specific outcome 4.3: Record required major tooling repairs

Specific outcome 4.4: Identify potential production and maintenance problems

Title 5: Produce components using wire cutting operations

Specific outcome 5.1: Prepare for work activity

Specific outcome 5.2: Set up wire cutting machine for operation

Specific outcome 5.3: Perform wire cutting operations

Specific outcome 5.4: Apply quality checks on component

Title 6: Write simple computer numerical controlled (CNC) programmes and set and operate a CNC machine

Specific outcome 6.1: Prepare and write programme

Specific outcome 6.2: Prepare to set machine

Specific outcome 6.3: Set machine to perform the specified work

Specific outcome 6.4: Produce sample component

Specific outcome 6.5: Operate CNC machine

Title 7: Grind tools and cutters used in engineering machining operations

Specific outcome 7.1: Prepare for work activity

Specific outcome 7.2: Set grinding machine

Specific outcome 7.3: Perform tool and cutter grinding operations

Specific outcome 7.4: Apply quality checks on machined tool/cutter

Title 8: Produce complex components by performing internal and external grinding operations

Specific outcome 8.1: Prepare for work activity

Specific outcome 8.2: Set grinding machine

Specific outcome 8.3: Perform universal grinding operations

Specific outcome 8.4 Apply quality checks on machined component

Title 9: Produce components by performing horizontal boring operations

Specific outcome 9.1: Prepare for work activity

Specific outcome 9.2: Set horizontal boring machine

Specific outcome 9.3: Perform horizontal boring operations

Specific outcome 9.4 Clean machine

Title 10: Produce components by performing vertical boring operations

Specific outcome 10.1: Prepare for work activity

Specific outcome 10.2: Set vertical boring machine

Specific outcome 10.3: Perform vertical boring operations

Specific outcome 10.4: Apply quality checks on machined component

Title 11: Set automatic production lathes

Specific outcome 11.1: Prepare for machine set up

Specific outcome 11.2: Set machine

Specific outcome 11.3: Produce sample component

Specific outcome 11.4: Monitor machine setting

Title 12: Write computer numerical controlled (CNC) programmes for CNC machining centres using proprietary software

Specific outcome 12.1: Prepare to write programme

Specific outcome 12.2: Write programme

Specific outcome 12.3: Verify programme

Specific outcome 12.4: Recognise and report problems and changes while programming