

- Drawing and design skills
- Communication skills
- Problem solving skills
- Analytical skills
- Forging techniques
- Using measuring and inspection tools and equipment
- Troubleshooting machine faults
- Using manufacturer's manuals

Required Knowledge

The individual needs to demonstrate knowledge of:

- OSHA 2007
- WIBA 2007
- Marking out tools
- Measuring tools
- Power tools
- Machine maintenance
- Engineering drawing and design
- Inspection tools and equipment
- Forging methods

EVIDENCE GUIDE

This provides advice on assessment and must be read in conjunction with the performance criteria, required skills and knowledge and range.

1. Critical aspects of Competency	1.1 Produced detailed working drawing of the forging work component as per drawing standards.
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	1.2 Prepared forging operation plan as per working drawing 1.3 Prepared forging workpiece as per task requirement 1.4 Set up forging tools and equipment 1.5 Performed forging operations as per operation plan 1.6 Inspected forged components as per working drawing specification. 1.7 Maintained forging tools, machines and equipment as per manufacturer's manual 1.8 Performed housekeeping as per OSHA and occupational procedures.
2. Resource Implications	The following resources should be provided: 2.1 A workshop equipped with: 2.1.1 Heating equipment 2.1.2 Forging tools, equipment and accessories 2.1.3 Engineering materials 2.1.4 Measuring and inspection tools and equipment
3. Methods of Assessment	Competency in this unit may be assessed through: 3.1 Observation (Project work, Practical assessment) 3.2 Oral questioning 3.3 Written tests 3.4 Portfolio of evidence 3.5 Third party report
4. Context of Assessment	Competency in this unit may be assessed through: 4.1 On the job 4.2 Simulated work environment i.e., in a training institution
5. Guidance information for assessment	Holistic assessment with other units relevant to the industry sector, workplace and job role is recommended.

PERFORM FOUNDRY WORKS

UNIT CODE: 0715 551 22A

TVET CDACC UNIT CODE: ENG/OS/ME/CR/02/6/MA

UNIT DESCRIPTION

This unit covers the competencies required in performing foundry works. It involves preparing working drawing, preparing casting operation plan, produce moulding patterns, prepare moulding sand, make sand mould, melt casting materials, pour molten metal and inspect casting.

ELEMENT AND PERFORMANCE CRITERIA

ELEMENT	PERFORMANCE CRITERIA
These describe the key outcomes which make up workplace function	These are assessable statements which specify the required level of performance for each of the elements. <i>Bold and italicized terms are elaborated in the Range</i>
1. Prepare working drawing	1.1 Requirements of casting work are identified as per job specifications. 1.2 Free hand sketch of casting work is produced as per job specification. 1.3 Detailed drawing of cast work is produced as per drawing standards. 1.4 Detailed casting drawing is submitted for approval as per organization procedure.
2. Prepare casting operation plan	2.1 Working drawing is interpreted according to technical drawing standards. 2.2 Casting operations are identified as per working drawing. 2.3 Identified operations are sequenced as per job specifications. 2.4 <i>Tools and equipment</i> are identified based on operations

	2.5 Materials are identified as per working drawing specifications.
3. Produce moulding patterns	3.1 Safety is observed according to OSHA standards 3.2 Perform house keeping 3.3 Pattern making Material is selected as per the job specification. 3.4 Pattern making tools and equipment are selected as per the job requirement. 3.5 Pattern is selected as per job specification. 3.6 Pattern is constructed as per working drawing. 3.7 Pattern parts are assembled as per the specifications.
4. Prepare moulding sand	4.1 Moulding tools and equipment are selected as per job specification. 4.2 Moulding sand is selected as per job requirements. 4.3 Moulding sand is conditioned as per specifications. 4.4 Additives are incorporated as per specification. 4.5 Moulding sand is tested as per standards.
5. Make sand mould	5.1 Moulding process is selected as per job specification. 5.2 Pattern is placed on the flask as per the requirements. 5.3 Flask is filled with the moulding sand as per requirement. 5.4 Mould cores (cavities) are made as per job requirement. 5.5 Coal dust is spread in the inner lining of the moulding core. 5.6 Mould is assembled as per specification.

	5.7 Pouring channels and vents are prepared as per job requirement.
6. Melt casting materials	6.1 Materials to be melted are selected as per job specification. 6.2 Furnace is selected as per the material. 6.3 Furnace is set up as per the manual 6.4 Furnace is charged as per requirements 6.5 Preheating and fluxing is carried out as per requirements. 6.6 Temperature is increased gradually to the melting point. 6.7 Skimming is performed as per the guidelines 6.8 Temperature is controlled by use pyrometer as per the guidelines.
7. Carry Out Casting Process	7.1 Pouring temperature is observed as per requirement. 7.2 Molten metal is poured onto the prep-made sand mould as per requirement. 7.3 The cast is removed from the mould as per job specification.
8. Inspect casting	8.1 Inspection tools and equipment are assembled as per the work requirements. 8.2 Visual inspection carried out as per specifications. 8.3 Dimensions are confirmed as per the job specification. 8.4 Destructive and non-destruction tests are carried out as the manual. 8.5 Casting defects are rectified as per requirements. 8.6 Heat treatment is carried out as per the standard operating procedures. 8.7 Cast is finished as per the dimensions.

	8.8 Inspection report is compiled as per organization requirement.
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RANGE

This section provides a work environment and conditions to which the performance criteria apply. It allows for a different work environment and situations that will affect performance.

Variable	Range May include but not limited to:
1. Foundry tools and equipment	• Hand tools • Moulding boxes • Mechanical tools
2. Pattern making materials	• Wood • Plastic • Metals • Wax
3. Types of patterns	• Two piece pattern • Multi-piece pattern • Match plate pattern • Gated pattern • Skeleton pattern • Cope and drag pattern • Loose piece pattern
4. Types of moulding sand	• Green sand mould • Dry-sand mould • Skin dried sand mould • Shell moulds • Loam sand mould
5. Moulding processes	• Bench moulding

	• Floor moulding • Pit moulding • Plate moulding • Flask less moulding • Vacuum moulding • Machine moulding
6. Types of furnaces	• Cupola furnace • Induction furnace • Crucible furnace • Blast furnace • Electric furnace
7. Pyrometers may	• Optical pyrometer • Radiation/infrared pyrometer
8. Inspections tools	• Tools for visual inspection • Tools for destructive and non-destructive test.
9. Casting defects	• Porosity defects • Shrinkage defect • Warping • Sinks • Slags inclusions • Dross • Hot tears • Cold shut
10. Finishing process in casting	• Trimming • Machining • Grinding • Fettling • Shot blast • Heat treatment

REQUIRED SKILLS AND KNOWLEDGE

This section describes the skills and knowledge required for this unit of competency.

Required Skills

The individual needs to demonstrate the following skills:

- Engineering Materials
- Problem solving skills
- Communication skills
- Casting techniques
- Mould making skills
- Pattern making skills
- Digital literacy skills

Required Knowledge

The individual needs to demonstrate knowledge of:

- Casting methods
- Workplace housekeeping procedures
- Occupational Safety and Health Act of Kenya laws 2007 with focus on personal safety, equipment safety and workplace
- Applicable machine operation standards
- Material selection criteria
- Documentation and production processes
- Machine settings
- Engineering Science and Mathematics principles
- Principles of management Applicable machine operation standards

EVIDENCE GUIDE

This provides advice on assessment and must be read in conjunction with the performance criteria, required skills and knowledge and range.

1. Critical aspects of Competency	Assessment requires evidence that the candidate: 1.1 Produced detailed drawing of cast work is as per drawing standards. 1.2 Identified tools and equipment based on operations 1.3 Produced moulding patterns as per job description and working drawing. 1.4 Prepared moulding sand as per requirements. 1.5 Made sand mould as per job specification. 1.6 Melted metal in the furnace as per manufacturer's manual. 1.7 Poured molten metal to the mould cavity as per the procedures. 1.8 Inspected casted parts as per the job requirements 1.9 Performed housekeeping as per the organization's policy.
2. Resource Implications	2.1 Workplace: Real or simulated work area 2.2 Appropriate Tools & equipment 2.3 Materials relevant to the activity
3. Methods of Assessment	3.1 Written 3.2 Oral questioning/interview 3.3 Observation 3.4 Third party report 3.5 Project
4. Context of Assessment	Competency may be assessed: 4.1 On-job 4.2 Simulated workplace environment

5. Guidance information for assessment	Holistic assessment with other units relevant to the industry sector, workplace and job role is recommended.
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OPERATE CNC MILLING MACHINE

UNIT CODE: 0715 551 23A

TVET CDACC UNIT CODE: ENG/OS/ME/CR/03/6/MA

UNIT DESCRIPTION

This unit covers the competencies required in operating a CNC Milling machine. It involves preparing working drawing, milling operation plan, performing CNC Milling programming, setting up CNC Milling machine, performing CNC Milling operations, carrying out CNC milling operations and maintaining CNC milling machine and tools

ELEMENT AND PERFORMANCE CRITERIA

ELEMENT	PERFORMANCE CRITERIA
These describe the key outcomes which make up workplace function	These are assessable statements which specify the required level of performance for each of the elements. <i>Bold and italicized terms are elaborated in the Range</i>
1. Prepare working drawing	1.1 Required mechanical components of the milling work are identified as per job specification. 1.2 Freehand sketch of the mechanical component is produced as per job specification 1.3 Detailed working drawing of the mechanical component is produced as per drawing standards 1.4 Mechanical component detailed working drawing is submitted for approval as per organization procedure.

	1.5 Safety is observed as per OSHA standards 1.6 Perform housekeeping operations
2. Prepare CNC Milling operation plan	2.1 CNC Milling machine operations are identified as per working drawing 2.2 Tools are identified as per milling machine operations to be carried out. 2.3 Materials are identified as per working drawing specification. 2.4 Identified milling machine operations are sequenced as per the task requirement
3. Set up CNC Milling machine	1.1 Work piece is mounted on the chuck as per the operation plan. 1.2 CNC Milling Machine parameters are set as per manufacturers manual 1.3 Clamping devices are set and tightened according to standard operating procedures.
4. Perform CNC Milling programming	4.1 Preparatory commands are identified as per operation manual 4.2 Coordinate system is set as per machine specifications 4.3 CNC milling machine programs are written according to manufacturer's manual.
5. Carry out CNC Milling operations	5.1 Program software is loaded into the CNC milling machine as per the software manual 5.2 Program is simulated on the CNC Milling machine as per software manual 5.3 Workpiece is machined as per operation plan.

	5.4 Corrective measures are performed, if necessary, as per work requirement. 5.5 Finished product is removed from the CNC milling machine as per operation plan. 5.6 CNC Milling machine is shut down as per manufacturers manual.
6. Inspect finished work	6.1 Inspection tools and methods selected as per operation plan 6.2 Dimensions of finished work are inspected as per drawing specification. 6.3 Adjustments are made based on inspections results
7. Maintain CNC milling machine and tools	1.1 CNC Milling Machines are inspected as operation manual 1.2 Trouble shooting is carried out on CNC Milling machines and tools as per maintenance manual 1.3 Machines and tools are cleaned as per operation manual 1.4 CNC milling machine parts are lubricated in accordance with service manual. 1.5 Tools and equipment are stored as per organization policy 1.6 Regular back-ups and virus checks are performed as per software manual

RANGE

This section provides a work environment and conditions to which the performance criteria apply. It allows for a different work environment and situations that will affect performance.

Variable	Range
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1. CNC Milling machine operations	CNC Milling machine operations include but not limited to: • Flat Milling • Pocket Milling • Slot Milling • Drilling • Boring • Threading • Smoothing • Deburring • Engraving • 5- axis machining
2. CNC Milling Machine parameters	CNC Milling Machine parameters include but not limited to: • Spindle speed • Feed rate • Cutting speed • Depth of cut • Width of depth • Width of cut • Feed per tooth
3. CNC Milling machine clamping devices	CNC Milling machine clamping devices include but not limited to: • Toggle clamp • Screw clamps • Step blocks • Vacuum tables • Vacuum cups • Vices • Soft jaws

REQUIRED SKILLS AND KNOWLEDGE

This section describes the skills and knowledge required for this unit of competency.

Required Skills

The individual needs to demonstrate the following skills:

- Problem solving
- Tooling and set up
- Machine operation skills
- Technical drawing
- Measurement and inspection
- Trouble shooting
- Communication skills
- CNC programming

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Required Knowledge

The individual needs to demonstrate knowledge of:

- Knowledge of materials
- Finishing techniques
- CNC Milling machine cutters and equipment
- Heat treatment
- Safety
- Basic Engineering Principles
- Interpreting technical drawing
- Basic Mathematics
- Measurements

- CNC Milling machine defects and correction
- CNC Milling machine components
- CNC Milling machine types
- CNC Milling machine Cutting fluids

EVIDENCE GUIDE

This provides advice on assessment and must be read in conjunction with the performance criteria, required skills and knowledge and range.

1. Critical aspects of Competency	Assessment requires evidence that the candidate: 1.1 Produced detailed working drawing of the mechanical component as per drawing standards. 1.2 Prepared CNC Milling operation plan as per working drawing specification. 1.3 Set up CNC Milling machine as per working drawing specification. 1.4 Carried out CNC Milling operations as per operation plan. 1.5 Inspected finished work as per working drawing specification. 1.6 Maintained CNC milling machine and tools as per manufacturers manual. 1.7 Perform housekeeping as per OSHA.
2. Resource Implications	2.1 CNC Milling machine 2.2 Cutting tools 2.3 Work holding devices 2.4 Coolant system 2.5 CAD software 2.6 Safety equipment 2.7 Materials
3. Methods of Assessment	3.1 Written

	3.2 Oral questioning/interview 3.3 Observation (project) 3.4 Third party report
4. Context of Assessment	Competency may be assessed: 4.1 On-job 4.2 Simulated workplace environment
5. Guidance information for assessment	Holistic assessment with other units relevant to the industry sector, workplace and job role is recommended.