NATIONAL COUNCIL FOR TECHNICAL AND VOCATIONAL EDUCATION AND TRAINING

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PROPOSED OCCUPATIONAL STANDARDS

OCCUPATION: MECHATRONICS TECHNICIAN

LEVEL: NTA 4

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ABBREVIATIONS

CCD	Control Circuit Diagram
CAD	Computer-Aided Design
CBET	Competency Based Education and Training
DDM	Digital Multimeter
EF	Electromechanical Equipment
HC	Hydraulic Circuit
I/O	Input/Output
LED	Light Emitting Diode
MDI	Manual Data Input
MOPP	Maintenance Operation Processes and Procedures
NACTVET	National Council for Technical and Vocational Education and Training
NOS	National Occupational Standards
OS	Occupational Standards
PC	Personal Computer
PID	Proportional-Integral-Derivative
PLC	Programmable Logic Controller
PPE	Personal Protective Equipment
SFC	Sequential Function Diagram
TET	Technical Education and Training
TVET	Technical and Vocational Education and Training
UM	Micrometer

GLOSSARY OF TERMS

Circumstantial Knowledge:	Detailed knowledge, which allows the decision-making in regard to different circumstances and cross cutting issues.
Competence:	The ability to use knowledge, understanding, practical, and thinking skills to perform effectively to the workplace standards required in employment.
Competency:	A description of the ability one possesses when able to perform a given occupational task effectively and efficiently.
Competency-based Education:	An instructional programme that derives its content from validated tasks and bases assessment on the learner's performance.
Curriculum:	A description or composite of statements about "what is to be learned" by the trainee/student in a particular instructional programme; a product that states the "intended learning outcomes".
Educational/Training Programme:	The complete curriculum and instruction (what and how) that is designed to prepare a person for employment in a job or other particular performance situation.
Occupation:	A specific position requiring the performance of specific tasks – essentially the same tasks are performed by all employees having the same title. (Example: baker)
Occupational Area:	This is a broad grouping of related jobs. (Example: food service)
Occupational Competence:	The application of knowledge and skills that consistently meet the standards required by the work context.
Occupational Standards:	Specific requirements of competences people are expected to demonstrate in a particular occupational area, including knowledge and relevant attitudes. They also act as a performance tool of assessment of the prescribed outcomes.
Occupational/Job Analysis:	A process used to identify the tasks that are important to employees in any given occupation**.**
Performance Criteria:	Indicate expected end results or outcomes in the form of evaluative statements.
Skills:	The ability to perform occupational tasks with a high degree of proficiency within a given occupation. Skill is conceived of as a composite of three completely interdependent components: cognitive, affective, and psychomotor.

Standards:	A set of statements, which if proved true under working conditions, means that an individual is meeting an expected level and type of performance.
Task Analysis:	The process of analysing each task to determine the steps, circumstantial knowledge, attitudes, performance standards, tools and materials needed, as well as safety concerns required for the employees performing it.
Task:	A work activity that has a definite beginning and ending, is observable or measurable, and consists of two or more definite steps that leads to a product, service, or decision.
Underpinning Knowledge:	Crucial knowledge that an individual must acquire in order to demonstrate competences that are associated in performing a given task.
Verification Process:	The process of having experts review and confirm the importance of the task (competency) statements identified through occupational analysis. Other questions, such as the degree of task learning difficulty are also frequently asked. This process is also sometimes referred to as validation.

1.0. INTRODUCTION

Technical Education and Training (TET) is one of the most important education sub-sectors in Tanzania, responsible for developing a skilled workforce to support the country's industrialization economic agenda. Tanzania's *Development Vision 2025* intends to raise the country's economy to a middle-income status. This requires a skilled workforce that is aligned with the needs of the public and private sectors of the economy. The National Council for Technical Education has begun the job of drafting Occupational Standards that will eventually be adopted as National Occupational Standards for TET in order to ensure that it meets the needs of the labour market and the country's economic agenda.

National Occupational Standards (NOS) are performance criteria that are matched with labour market demands. Each National Occupation Standard describes functions, performance standards, and knowledge/understanding for one important function or task. They combine skills, knowledge, and attitudes to describe best practice. They are useful tools for establishing job roles, personnel recruiting, supervision, and appraisal, as well as TET standards. They're also helpful for benchmarking and harmonizing qualifications on a national and international level. Standards, in general, provide a solid framework for high-quality TET that is labour market-relevant, current, and consistent in delivery across all public and private institutions.

However, it must be noted that, Occupational Standards and Training standards/qualifications standards are different. Occupational standards are defined in terms of activities performed by a person in a selected occupation (e.g., an electrical engineer designs electrical wiring circuits, performs troubleshooting in electrical wiring, etc.) and they are usually defined by employers following procedures agreed upon by all stakeholders. Education and training standards are developed from the activities defined in occupational standards, and they include learning objectives to ensure that the necessary skills and knowledge are developed by a person to enable him or her to function at an agreed level in an occupation. Education and Training standards are used to define curricula in training institutions. It is however critical that there must be a direct link between the occupational standards and the training standards to respond to the demands of the labour market.

In TET delivery, Tanzania adopted the Competence Based Education and Training (CBET) approach. The CBET approach focuses on providing learners with the skills and knowledge required to meet the occupational standards. Occupational standards are thus the starting point for developing competency-based training (CBET) programmes. TET institutions will be required to benchmark their curricula with relevant occupational standards.

Occupational Standards are developed based on a given occupation's current and future demands. As a result, they serve as a means of bridging the gap between the worlds of employment and technical education and training (TET).

The Mechatronics Technician Occupation has its own set of occupational standards. The document explains how the occupational standards were developed, as well as the scope, the occupational profile in the form of DACUM charts, and the Occupational Standards.

2.0. OCCUPATIONAL STANDARD DEVELOPMENT PROCESS

The Occupational standards development process began with an examination of major documents that guide Tanzanian skill development. The *10-year National Skills Development Strategy (2016-2026)* was one of the documents reviewed, and it outlined six (6) economic sectors that should be prioritized when developing skills development programmes.

These sectors include: Transport and Logistics, Tourism and Hospitality, Agribusiness, Construction, Energy and ICT. NACTE labour market reports were also used in the literature review to determine the skills demand in the Tanzanian labour market as a whole.

After the literature review, a workshop comprised of expert workers and educators with substantial knowledge and experience in the occupation conducted an occupational analysis utilizing the DACUM approach to produce the occupational profile. The analysis resulted in DACUM Charts, which are attached as **Appendix 1** to this document.

The occupational standards were then developed. Experts in Occupational Analysis and the Development of Occupational Standards facilitated the workshop. Interviews, online surveys, and a stakeholder forum were used to validate the Occupational Standards. Engineers, supervisory technicians on the job, and experienced Mechatronics Technicians were key informants in the survey to discover occupational trends. This information was used to gain insight from the workplaces regarding trends and changes in the profession, including how well graduates are prepared for working in the occupation. A total of ... online surveys were completed by experts from the labour market across the country. Apart from the surveys aiding in defining the scope for the occupational analysis, they also served to engage a wide cross-section of experts in the occupation. Apart from this, the stakeholders' forum was attended by ... participants from different parts of the country representing various companies.

3.0. THE SCOPE AND OVERVIEW OF THE OCCUPATION STANDARDS FOR MECHATRONICS TECHNICIANS

These standards cover a broad range of duties and tasks that can be performed by a Mechatronics Technician. However, the occupational standards are not meant to replace individual job descriptions. Instead, they are to be used for guidance in defining skill levels and knowledge for the

technician in specific settings or positions. The Mechatronics Technician may perform tasks in a number of key areas of the occupational standards, but not necessarily in all areas. For example, in large operations, other individuals may be employed or designated to perform specific tasks.

The Mechatronics Technicians work under the supervision of engineers. They can install simple circuits, prepare the preliminary work of mechanical parts processing, process simple mechanical parts, operate and maintain electromechanical equipment, install electromechanical equipment, debug electromechanical equipment, operate and maintain numerical control equipment, install and debug automatic production lines, analyse and correct faults with electromechanical equipment, and engage in electromechanical equipment sales activities.
Generally, the Mechatronics Technician performs the following responsibilities:

a) Simple part machining
b) Machining preparation of mechanical parts
c) Simple machining of mechanical parts
d) Operation and maintenance of electromechanical equipment
e) Electromechanical equipment installation
f) Electromechanical equipment debugging
g) Operation and maintenance of NC machining equipment
h) Installation and debugging of automatic production line
i) Electromechanical equipment operation and maintenance
j) Sales of electromechanical equipment

The Occupational Standards have been clustered into NTA qualification levels, i.e. NTA level 4, 5 and 6.

4.0. VALIDITY PERIOD

Due to the rapid development of technology, the validity period of occupational standards is 3-5 years. The review will proceed in the same manner as the one before it, with new occupational standards being developed based on current trends of the labour market.

5.0. OCCUPATIONAL STANDARDS

5.1 OCCUPATIONAL STANDARDS FOR MECHATRONICS TECHNICIAN – NTA 4

OCCUPATION	MECHATRONICS TECHNICIAN	**OCCUPATION CODE**	400
DUTY TITLE	INSTALLATION OF SIMPLE CIRCUIT	**DUTY NO.**	401
TASK TITLE	READING OF CIRCUIT SCHEMATIC DIAGRAMS	**TASK NO.**	4011
PERFORMANCE CRITERIA	The person performing this task must be able to read the symbols of electronic components in circuit schematic diagram, unit circuit structure and working principle, and the relationship between unit circuits according to the electronic component user manual.		
RANGE STATEMENT	The task can be performed in an equipment manufacturing enterprise under the supervision of mechatronics engineers. The tools and equipment to be used include: 1. Tools and equipment: Set square, drawing pencils (H, HB, B, 2B), eraser; 2. Materials: Circuit schematic diagram, electronic component user manual.		

EVIDENCE REQUIREMENT	
PRACTICAL PERFORMANCE	**UNDERPINNING KNOWLEDGE**
The person performing this task must be able to do the following: 1. Select tools and equipment for the task; 2. Review the layout of circuit diagrams; 3. Read the title bar of circuit schematic diagram to understand the basic overview of electrical and electronic components; 4. Read the circuit schematic diagram, find out the input and output of the schematic diagram, and determine the flow and direction of the circuit signal; 5. Guess the purpose and usage of components according to their shape and symbol; 6. Identify the parameters of each component in the circuit diagram, clarify the specific functions of each component, and record the relevant parameters of each component; 7. Analyze the components on the circuit diagram, imagine the physical structure and shape and working principle of the components; 8. Analyze the circuit diagram and understand the connection relationship	**Detailed knowledge about: CIRCUMSTANTIAL KNOWLEDGE** **1.0 Methods** The person performing this task must be able to explain how to: 1.1 Read the title bar and schedule of circuit drawings; 1.2 Identify the structure and purpose of each component; 1.3 Understand the parameters of commonly-used electrical and electronic components; 1.4 Analyze the connection relationship of each component. **2.0 Principles** The person performing this task must be able to explain the following principles: 2.1 Structural principle of electronic circuit diagram; 2.2 Normative principle of symbols; 2.3 Principle of circuit diagram form; 2.4 Principle of representation methods of components. **3.0 Theories** The person performing this task must be able to explain the following:

between components; 9. List the bill of materials of components according to the circuit diagram; 10. Divide functional units according to the core components in the circuit; 11. Analyse and summarize the working principle of the whole circuit diagram based on the previous analysis and prepare the report.	3.1 Basic theory of electrician; 3.2 Ohm's law; 3.3 Watt's Law; 3.4 Faraday's Law; 3.5 Kirchhoff's Law; 3.6 Principle of electrical control. **4.0 Essential Skills** 4.1 Skills of finding information; 4.2 Report writing skills; 4.3 Communication skills; 4.4 Teamwork skills; 4.5 Spatial imagination ability; 4.6 Time management ability. **5.0 Math Skills** 5.1 Parameter calculation of components; 5.2 Materials science; 5.3 Computer skills.
DESCRIPTION OF THE END PRODUCT / SERVICE	The electronic components are identified according to the circuit schematic drawings, and the electrical components are identified according to the electrical schematic diagrams.
CIRCUMSTANTIAL KNOWLEDGE	Detailed knowledge about: 1. Electrician drawings reading; 2. Safe use of working tools; 3. Safe use of measuring tools.

OCCUPATION	MECHATRONICS TECHNICIAN	**OCCUPATION CODE**	400
DUTY TITLE	INSTALLATION OF SIMPLE CIRCUIT	**DUTY NO.**	401
TASK TITLE	INVENTORY AND INSPECTION OF COMPONENTS	**TASK NO.**	4012
PERFORMANCE CRITERIA	The person performing this task must be able to identify and inspect electronic components in accordance with the electronic component user manual and the component list.		
RANGE STATEMENT	The task can be performed in an equipment manufacturing enterprise under the supervision of mechatronics engineers. The tools and equipment to be used include: 1. Tools and equipment: Set square, drawing pencils (H, HB, B, 2B), eraser, multimeter; 2. Materials: Circuit schematic diagram, electronic component user manual, wires, electronic components and electrical components.		

EVIDENCE REQUIREMENT

PRACTICAL PERFORMANCE	**UNDERPINNING KNOWLEDGE**
The person performing this task must be able to do the following: 1. Prepare the work area; 2. Select appropriate tools and equipment for the task; 3. Check the multimeter and other testing tools; 4. Review electronic circuit diagram or electrical schematic diagram and list the bill of materials of components; 5. Identify the physical components and count the electronic or electrical components against the bill of materials of components; 6. Measure the relevant parameters of each component through appearance identification or using a multimeter; 7. Record the inspection result of each component; 8. Clean the tools and work areas; 9. Arrange and store the tools and equipment; 10. Write component inventory and inspection report, and be able to list the components.	**CIRCUMSTANTIAL KNOWLEDGE** **1.0 Methods** The person performing this task must be able to explain how to: 1.1 Check the components against the bill of materials; 1.2 Identify physical components; 1.3 Use a multimeter to detect the parameters of electronic or electrical components; 1.4 Methods of parameter identification of commonly-used electronic components. **2.0 Principles** The person performing this task must be able to explain the following principles: 2.1 Basic principles of electrical and electronic technology; 2.2 Principles of the classification of the appearance and structure of commonly-used electronic or electrical components; 2.3 Principle of the use of multimeters. **3.0 Theories** The person performing this task must be able to explain the following: 3.1 Writing format of component inventory list and inspection report; 3.2 Working principle of commonly-used electronic or electrical components; 3.3 Usage of multimeters.

	4.0 Essential Skills 4.1 Skills of finding information; 4.2 Use of multimeters; 4.3 Communication skills; 4.4 Teamwork skills; 4.5 Spatial imagination ability; 4.6 Time management ability. **5.0 Math Skills** 5.1 Parameter calculation of components; 5.2 Materials science; 5.3 Computer skills.
DESCRIPTION OF THE END PRODUCT / SERVICE	The inventory and inspection of electronic or electrical components are completed in accordance with the circuit schematic drawing and the requirements of the bill of materials (electronic or electrical components).
CIRCUMSTANTIAL KNOWLEDGE	Detailed knowledge about: 1. Electrician drawings reading; 2. Safe use of working tools.

OCCUPATION	MECHATRONICS TECHNICIAN	**OCCUPATION CODE**	400
DUTY TITLE	INSTALLATION OF SIMPLE CIRCUIT	**DUTY NO.**	401
TASK TITLE	INSTALLATION OF THE CIRCUIT ACCORDING TO THE DRAWING	**TASK NO.**	4013
PERFORMANCE CRITERIA	The person performing this task must be able to complete the installation and wiring of electronic or electrical components according to the design requirements of the circuit schematic diagram, and realize the overall function of circuit design.		
RANGE STATEMENT	The task can be performed in an equipment manufacturing enterprise under the supervision of mechatronics engineers. 1. Tools and equipment: Set square, drawing pencils (H, HB, B, 2B), erasers, mounting workbench, multimeter, electrical toolbox, soldering iron, wiring tools (screwdriver, wire stripper, electrician knife, needle-nose pliers, etc.) 2. Materials: Circuit schematic diagram, electronic component user manual, wires, electronic components, electrical components, insulation tape, socket, switch and other electrical and electronic accessories.		

EVIDENCE REQUIREMENT

PRACTICAL PERFORMANCE	**UNDERPINNING KNOWLEDGE**
The person performing this task must be able to do the following: 1. Prepare the work area; 2. Select appropriate tools and equipment for the task; 3. Check the installation workbench; 4. Check multimeter and wiring tools; 5. Check the electronic components against the bill of materials of components; 6. Lay out the position of each component in accordance with the requirements of the drawings; 7. Complete the standard installation of each device; 8. Complete the wiring between components according to electrical standards; 9. Check and test whether the installation meets the drawing requirements; 10. Complete the whole circuit test and calibration; 11. Clean the tools and work areas; 12. Arrange and store the tools and equipment.	**CIRCUMSTANTIAL KNOWLEDGE** **1.0 Methods** The person performing this task must be able to explain how to: 1.1 Match the current intensity of the wire with the rating of the socket; 1.2 Use testing tools; 1.3 Lay out the position of components according to the drawing requirements, and carry out wiring and cabling; 1.4 Test and verify the installed circuit as a whole. **2.0 Principles** The person performing this task must be able to explain the following principles: 2.1 Electrical wiring standard operating principles; 2.2 Safety operation principles; 2.3 Principles of circuit planning; 2.4 Principles of environmental protection and material selection; 2.5 Physical cabling principles. **3.0 Theories** The person performing this task must be able to explain the following: 3.1 Composition of the circuit: Power supply, wire,

	switch, load, etc.; 3.2 Voltage, current and resistance; 3.3 Ohm's law; 3.4 Parallel circuit and series circuit; 3.5 Electrical safety knowledge; 3.6 Common electrical components. **4.0 Essential Skills** 4.1 Testing tool skills; 4.2 Skills of installing components; 4.3 Communication skills; 4.4 Teamwork skills; 4.5 Spatial imagination ability; 4.6 Time management ability. **5.0 Math Skills** 5.1 Parameter calculation of components; 5.2 Materials science; 5.3 Computer skills.
DESCRIPTION OF THE END PRODUCT / SERVICE	The hardware circuit wiring is completed, with the circuit running normally, in accordance with the design requirements of circuit schematic diagram.
CIRCUMSTANTIAL KNOWLEDGE	Detailed knowledge about: 1. Electrician drawings reading; 2. Safe use of working tools.

OCCUPATION	MECHATRONICS TECHNICIAN	**OCCUPATION CODE**	400
DUTY TITLE	MACHINING PREPARATION OF MECHANICAL PARTS	**DUTY NO.**	402
TASK TITLE	READING OF MECHANICAL PART DRAWINGS AND ASSEMBLY DRAWINGS	**TASK NO.**	4021
PERFORMANCE CRITERIA	The person performing this task must be able to use the knowledge and skills to read the basic mechanical part and assembly drawings in accordance with the current regulations and standards of mechanical drawings.		
RANGE STATEMENT	The task can be performed in an equipment manufacturing enterprise under the close supervision of mechatronics technical engineers. **The tools and equipment to be used include:** Mechanical part drawing or assembly drawing; Mechanical part design manual.		

EVIDENCE REQUIREMENT

PRACTICAL PERFORMANCE	**UNDERPINNING KNOWLEDGE**
The person performing this task must be able to do the following: 1. Read the title bar of part drawing to understand the basic situation of mechanical parts; 2. Read the part drawing, guess the purpose and connection relationship of each part structure according to its structure and shape; 3. Read the sizes on the part drawing, and make clear the structure, size and positional relationship of each part; 4. Read the technical requirements on the part drawing and clarify the quality requirements of each part; 5. Read the title bar and detail bar on the assembly drawing to understand the basic overview of the machine (component); 6. Analyse each view on the assembly drawing, and clarify the intention and key points expressed by each view; 7. Analyse the parts on the assembly drawing and imagine the structure and shape of the parts; 8. Analyse the dimensions and technical requirements of each part marked on the assembly drawing; 9. Analyse and summarize the dimensions and technical requirements of the whole assembly	**Detailed knowledge about:** **1.0 Methods** The person performing this task must be able to explain how to: 1.1 Read the title bar and schedule of mechanical drawings; 1.2 Guess the part structure and the purpose and connection relationship of each part structure; 1.3 Read the dimensions on mechanical drawings; 1.4 Read the technical requirements on mechanical drawings. **2.0 Principle** The person performing this task must be able to explain the following principles: 2.1 Steps and principles of reading mechanical part drawings; 2.2 Assembly relationship and working principle of each part; 2.3 Application principle of the analysis assembly drawing. **3.0 Theories** The person performing this task must be able to explain the following: 3.1 Methods of using mechanical drawing specifications; 3.2 Projection law of three-views; 3.3 Specified drawing of standard parts.

drawing on the basis of the previous analysis, and fully understand the machine (components).	**4.0 Essential Skills** 4.1 Skills of finding information; 4.2 Disassembly and assembly skills; 4.3 Communication skills; 4.4 Teamwork skills; 4.5 Spatial imagination ability. **5.0. Math Skills** 5.1 Calculation of structural shapes and sizes; 5.2 Calculation of positioning dimensions.
DESCRIPTION OF THE END PRODUCT / SERVICE	Parts are identified according to mechanical part drawings, and machines or components are identified according to mechanical assembly drawings.
CIRCUMSTANTIAL KNOWLEDGE	**Detailed knowledge about:** 1. Mechanical drawing standards and rules; 2. Proper use of reference books.

OCCUPATION	MECHATRONICS TECHNICIAN	**OCCUPATION CODE**	400
DUTY TITLE	MACHINING PREPARATION OF MECHANICAL PARTS	**DUTY NO.**	402
TASK TITLE	DRAWING OF SIMPLE MECHANICAL PART DRAWINGS AND ASSEMBLY DRAWINGS	**TASK NO.**	4022
PERFORMANCE CRITERIA	The person performing this task must be able to apply the knowledge and skills to correctly draw simple mechanical part drawings and assembly drawings in accordance with the current regulations and standards in the electromechanical field.		
RANGE STATEMENT	The task can be performed in an equipment manufacturing enterprise under the close supervision of mechatronics technical engineers. The tools and equipment to be used include: 1. **Tools and equipment:** Computer, AutoCAD software, printer, mechanical drawing board, T-square, set square, French curve, drawing pencils (H, HB, B, 2B), eraser, compass, measuring equipment and instruments (vernier caliper, outer micrometer, inner dial indicator, universal angle ruler, depth micrometer, height vernier, surface roughness sample block, V-block, gauge block). 2. **Materials:** Drawing scroll.		

EVIDENCE REQUIREMENT	
PRACTICAL PERFORMANCE	**UNDERPINNING KNOWLEDGE**
The person performing this task must be able to do the following: 1. Prepare the work area; 2. Select appropriate tools and equipment for the task; 3. Use reasonable tools to complete the drawing work in accordance with the requirements, improve the quality and increase the clarity of drawing lines, and facilitate the copying of drawings; 4. Write on drawings in a standardized and neat way, and the draw lines that meet the four standards: neatness, evenness, blackness and glossiness; 5. Use two-dimensional mapping software to make engineering drawings; 6. Use a printer or plotter to output drawings; 7. Make 3D part drawing, namely isometric drawing; 8. Complete drawing file management such as drawing folding and drawing binding as required;	**Detailed knowledge about:** **1.0 Methods** The person performing this task must be able to explain how to: 1.1 Use drawing instruments, tools and measuring instruments; 1.2 Draw all kinds of line types of engineering drawings; 1.3 Use computers and two-dimensional mapping software. **2.0 Principles** The person performing this task must be able to explain the following principles: 2.1 Principles and requirements of civilized on-site production; 2.2 Knowledge and principles of safety operation and labor protection; 2.3 Principles of national basic standards for drawing. **3.0 Theories** The person performing this task must be able to

	explain the following: 3.1 Basic knowledge of the projection methods; 3.2 Knowledge of the use and maintenance of plotters and tools; 3.3 Basic knowledge of computer drawing; 3.4 Basic knowledge of professional drawings. **4.0 Essential Skills** 4.1 Use of plotter tools; 4.2 Use of measuring tools; 4.3 Communication skills; 4.4 Being trustworthy; 4.5 Dedication; 4.6 Time management skills; 4.7 Computer skills; 4.8 Ability to organize drawings and files. **5.0 Math Skills** 5.1 Simple numerical calculation; 5.2 Calculation of positioning dimensions.
DESCRIPTION OF THE END PRODUCT / SERVICE	Part drawings and assembly drawings are drawn according to machining preparation requirements.
CIRCUMSTANTIAL KNOWLEDGE	**Detailed knowledge about:** 1. Drawing standards and rules; 2. Safe use of working tools and equipment; 3. Safe use of measuring tools; 4. Safety, health and environment; 5. Waste disposal methods.

OCCUPATION	MECHATRONICS TECHNICIAN	**OCCUPATION CODE**	400
DUTY TITLE	MACHINING PREPARATION OF SIMPLE MECHANICAL PARTS	**DUTY NO.**	402
TASK TITLE	INVENTORY AND INSPECTION OF TOOLS	**TASK NO.**	4023
PERFORMANCE CRITERIA	The person performing this task must be able to use knowledge and skills to inventory and inspect necessary tools in accordance with current regulations and standards in the field of electromechanical engineering.		
RANGE STATEMENT	The task can be performed in an equipment manufacturing enterprise under the close supervision of mechatronics technical engineers. The tools and equipment to be used include: 1. **Tools and equipment:** Personal Protective Equipment (PPE); 2. **Materials:** Dust-free cloth.		

EVIDENCE REQUIREMENT

PRACTICAL PERFORMANCE	**UNDERPINNING KNOWLEDGE**
The person performing this task must be able to do the following: 1. Prepare the work area; 2. Select appropriate tools and equipment for the task; 3. Check percussion tools such as copper rods and steel hammers; 4. Check adjustable wrench, hexagon wrench and special tools for tool change; 5. Check file tools; 6. Check turning tools and milling cutters; 7. Check the vice; 8. Check measuring tools; 9. Wipe the oil stains and blots on the tool surface with a dust-free cloth.	**Detailed knowledge about:** **1.0 Methods** The person performing this task must be able to explain how to: 1.1 Check mechanical tools and ensure that there are no missing or lost ones; 1.2 Check the integrity of each tool in case of damage, corrosion, fracture, etc.; 1.3 Clean each tool to ensure that there is no accumulated dust, dirt or grease; 1.4 Apply proper amount of engine oil or lubricating oil on tools without motors to prevent corrosion; 1.5 Assemble the tools that need to be reassembled, such as wrenches, pliers, screwdrivers, back to their original state; 1.6 Mark the tools that are easy to wear or confuse, for easy identification; 1.7 Store all the tools in the specified location in turn for the next use. **2.0 Principle** The person performing this task must be able to explain the following principles: 2.1 Usage and safety operation procedures; 2.2 Accuracy and stability of mechanical tools; 2.3 Mechanical cleaning standard; 2.4 Composition of mechanical components. **3.0 Theories** The person performing this task must be able to explain

	the following: 3.1 Understanding of the usage and safety operation procedures of the mechanical tools before using them; 3.2 Regular maintenance of mechanical tools to guarantee their accuracy and stability; 3.3 Cleaning and finishing: regular cleaning of mechanical tools to ensure that their surfaces are clean, dust-free and oil-free; 3.4 Thorough inventory: an inventory shall be made before each use of mechanical tools to ensure their completeness and quantity, and check for loose, damaged or missing parts; 3.5 Rigor and care: each component shall be carefully inspected during inspection, especially in some vulnerable and damaged places, and patience is required to prevent negligence; 3.6 Timely repair: if the mechanical tools are found to be faulty or incomplete, corresponding measures should be taken to repair or replace them immediately; 3.7 Prevention of misoperation: when using mechanical tools, misoperation should be prevented and the safety of the worker and others should be ensured. **4.0 Essential Skills** 4.1 Use of measuring tools; 4.2 Communication skills; 4.3 Teamwork spirit; 4.4 Being trustworthy; 4.5 Dedication; 4.6 Time management; 4.7 Computer skills; 4.8 Report writing skills. **5.0 Math Skills** 5.1 Dimensional operation.
DESCRIPTION OF THE END PRODUCT / SERVICE	The necessary tools are checked and maintained after use in accordance with the drawings and process requirements.
CIRCUMSTANTIAL KNOWLEDGE	**Detailed knowledge about:** 1. Safe use of working tools and equipment; 2. Safe use of measuring tools; 3. Safety, health and environment; 4. Waste disposal methods.

OCCUPATION	MECHATRONICS TECHNICIAN	**OCCUPATION CODE**	400
DUTY TITLE	MACHINING OF SIMPLE MECHANICAL PARTS	**DUTY NO.**	402
TASK TITLE	SAFETY INSPECTION OF PROCESSING EQUIPMENT	**TASK NO.**	4024
PERFORMANCE CRITERIA	The person performing this task must be able to conduct safety inspections of processing equipment in accordance with current regulations and standards in the field of electromechanical engineering.		
RANGE STATEMENT	The task can be performed in an equipment manufacturing enterprise under the close supervision of mechatronics technical engineers. The tools and equipment to be used include: **1. Tools and equipment:** Personal protective equipment (PPE), jack, fitter's workbench, bench vice, grinder, file, junior hacksaw, screw tap, threading die, bench drilling machine, vertical drilling machine, radial drilling machine; **2. Materials:** Part drawings, part blanks.		

EVIDENCE REQUIREMENT

PRACTICAL PERFORMANCE	**UNDERPINNING KNOWLEDGE**
The person performing this task must be able to do the following: 1. Tie the cuffs and skirts of the work clothes; female workers shall wear helmet; 2. Check whether the tools used are complete, intact and reliable, and strictly abide by the safety operation procedures of commonly-used tools; 3. Place cutting tools and measuring tools; 4. Do not use files, scrapers, etc. without handles; ensure that in case of a problem found with the handle, it should be immediately reported to the instructor and replaced immediately; 5. Clamp the saw blade correctly when using a hand saw, and do not install it too loose or too tight; 6. Do not wear gloves when using a hammer, and there must be no oil stain on the handle; check whether the handle is loose and wipe off the oil stain; do not wear gloves when holding the hammer; 7. Wear protective glasses when cutting; 8. Ensure that the workpiece surface should be higher than the jaw surface when filing; Do not blow the file with	**Detailed knowledge about:** **1.0 Methods** The person performing this task must be able to explain how to: 1.1 Master the safety operation procedures for commonly-used tools; 1.2 Master the safety operation requirements of the commonly-used equipment. **2.0 Principles** The person performing this task must be able to explain the following principles: 2.1 On-site work safety requirements; 2.2 Knowledge of safety operation and labor protection; 2.3 Environmental protection. **3.0 Theories** The person performing this task must be able to explain the following: 3.1 Common sense of electricity use; 3.2 Basic requirements for routine operation of fitters; 3.3 Knowledge of use and maintenance of tools, fixtures and measuring tools. **4.0 Essential Skills**

your mouth, wipe the surface of the file and workpiece by hand, so as to avoid the file blowing into your eyes and the file slipping; 9. Check the jack to ensure that it must be flat at the bottom, with the tightness of the top and silk mouth appropriate; 10. Abide by safety specifications strictly and use drilling machines skillfully; 11. Skillfully use electric drills according to safety rules.	4.1 Communication skills; 4.2 Teamwork spirit; 4.3 Being trustworthy; 4.4 Dedication; 4.5 Safety consciousness; 4.6 Report writing skills. **5.0 Math Skills** 5.1 Dimensional operation.
DESCRIPTION OF THE END PRODUCT / SERVICE	Safety inspection on equipment and tools to be used is carried out in accordance with drawing and process requirements.
CIRCUMSTANTIAL KNOWLEDGE	**Detailed knowledge about:** 1. Drawing standards and rules; 2. Safe use of working tools and equipment; 3. Safe use of measuring tools; 4. Safety, health and environment; 5. Waste disposal methods.

OCCUPATION	MECHATRONICS TECHNICIAN	**OCCUPATION CODE**	400
DUTY TITLE	MACHINING OF SIMPLE MECHANICAL PARTS	**DUTY NO.**	403
TASK TITLE	STEREOSCOPIC SCRIBING	**TASK NO.**	4031
PERFORMANCE CRITERIA	The person performing this task must be able to use knowledge and skills to stereo-line the blank or workpiece in accordance with current regulations and standards in the field of electromechanical engineering.		
RANGE STATEMENT	The task can be performed in an equipment manufacturing enterprise under the close supervision of mechatronics technical engineers. To successfully perform the task, the equipment and tools to be used include: 1. **Tools and equipment:** Personal protective equipment (PPE), height gauge, scribing platform, square box, scribing needle, scribing plate, scribing gauge, scribing card, sample punch, v-shaped iron, jack, measuring equipment and instruments (vernier caliper, outer diameter micrometer, inner dial indicator, universal angle ruler, depth micrometer, height vernier, surface roughness sample block, v-shaped block, gauge block), toolbox; 2. **Materials:** Part drawings, part blanks.		

EVIDENCE REQUIREMENT

PRACTICAL PERFORMANCE	**UNDERPINNING KNOWLEDGE**
The person performing this task must be able to do the following: 1. Prepare the work area; 2. Select appropriate tools and equipment for the task; 3. Review the layout of part drawings; 4. See the drawing clearly, find out the marking position according to the process requirements, and select the marking benchmark; 5. Place workpieces and select marking tools correctly; 6. Clean up the scale, flash burr and silt on the blank; 7. Check the blank machining allowance; 8. Draw lines; 9. Check whether the marking of the marking part is complete; 10. Conduct dotting punch with samples to show clear boundaries on the drawn lines.	**Detailed knowledge about:** **1.0 Methods** The person performing this task must be able to explain how to: 1.1 Determine the shape and size of finished products processed by parts; 1.2 Determine the contour line or reference point of the part to be processed. **2.0 Principles** The person performing this task must be able to explain the following principles: 2.1 Requirements of civilized on-site production; 2.2 Knowledge of safety operation and labor protection; 2.3 Knowledge of environmental protection. **3.0 Theories** The person performing this task must be able to explain the following: 3.1 Knowledge of drawing reading; 3.2 Tolerance and fit; 3.3 Knowledge of use and maintenance of tools, fixtures and measuring tools. **4.0 Essential Skills**

	4.1 Communication skills; 4.2 Teamwork spirit; 4.3 Honesty and trustworthiness; 4.4 Dedication; 4.5 Time management ability; 4.6 Computer skills; 4.7 Report writing skills.
DESCRIPTION OF THE END PRODUCT / SERVICE	The contour line of the part to be processed or the point and line as a reference is drawn on the blank or workpiece with a scribing tool, in accordance with the drawings and process requirements.
CIRCUMSTANTIAL KNOWLEDGE	**Detailed knowledge about:** 1. Drawing standards and rules; 2. Safe use of working tools and equipment; 3. Safe use of measuring tools; 4. Safety, health and environment; 5. Waste disposal methods.

OCCUPATION	MECHATRONICS TECHNICIAN	**OCCUPATION CODE**	400
DUTY TITLE	MACHINING OF SIMPLE MECHANICAL PARTS	**DUTY NO.**	403
TASK TITLE	MACHINING OPERATION OF SIMPLE MECHANICAL PARTS	**TASK NO.**	4032
PERFORMANCE CRITERIA	The person performing this task must be able to apply knowledge and skills to process simple mechanical parts in equipment manufacturing enterprises in accordance with the current regulations and standards in the electromechanical field.		
RANGE STATEMENT	The task can be performed in an equipment manufacturing enterprise under the close supervision of mechatronics technical engineers. To successfully perform the task, the equipment and tools to be used include: 1. **Tools and equipment:** Personal protective equipment (PPE), fitter workbench, bench vice, grinder, file, junior hacksaw, screw tap, threading die, bench drilling machine, vertical drilling machine, radial drilling machine, measuring equipment and instruments (vernier caliper, outer micrometer, inner dial indicator, universal angle ruler, depth micrometer, height vernier, surface roughness sample block, V-block, gauge block), toolbox; 2. **Materials:** Part drawings, part blanks.		

EVIDENCE REQUIREMENT

PRACTICAL PERFORMANCE	**UNDERPINNING KNOWLEDGE**
The person performing this task must be able to do the following: 1. Check the workplace and tools; 2. Select machining tools and equipment for the task; 3. Review the contents of part drawings; 4. Use a file, with standard action when filing; 5. Use a junior hacksaw, with standard action when sawing; 6. Use a screw tap and a threading die, with appropriate size; 7. Use a vice to clamp firmly; 8. Use a grinder to grind the surface of parts, with the electrical safety ensured; 9. Use a drilling machine to drill holes; 10. Record the dimension values obtained from all machining; 11. Determine the processing effect; 12. Clean the tools and work areas;	**Detailed knowledge about:** **1.0 Methods** The person performing this task must be able to explain how to: 1.1 Utilize the calculation methods of machining allowance of parts; 1.2 Select processing modes of parts to be processed; 1.3 Determine the finished dimensions of parts. **2.0 Principles** The person performing this task must be able to explain the following principles: 2.1 Requirements of civilized on-site production; 2.2 Safety operation and labour protection; 2.3 Environmental protection. **3.0 Theories** The person performing this task must be able to explain the following: 3.1 Knowledge of drawing reading; 3.2 Tolerance and fit; 3.3 Knowledge of use and maintenance of tools, fixtures and measuring tools;

13. Store tools and safety devices; 14. Prepare the report.	3.4 Knowledge of equipment maintenance. **4.0 Essential Skills** 4.1 Communication skills; 4.2 Teamwork spirit; 4.3 Honesty and trustworthiness; 4.4 Dedication; 4.5 Time management; 4.6 Computer skills; 4.7 Report writing skills. **5.0 Math Skills** 5.1 Dimensional operation.
DESCRIPTION OF THE END PRODUCT / SERVICE	Excess metal materials on the blank or workpiece are removed with processing tools and equipment in accordance with the drawing and process requirement, so that the parts meet the requirements.
CIRCUMSTANTIAL KNOWLEDGE	**Detailed knowledge about:** 15. Drawing standards and rules; 16. Safe use of working tools and equipment; 17. Safe use of measuring tools; 18. Safety, health and environment; 19. Waste disposal methods.

OCCUPATION	MECHATRONICS TECHNICIAN	**OCCUPATION CODE**	400
DUTY TITLE	MACHINING OF SIMPLE MECHANICAL PARTS	**DUTY NO.**	403
TASK TITLE	ACCURACY INSPECTION OF MACHINING SIMPLE MECHANICAL PARTS	**TASK NO.**	4033
PERFORMANCE CRITERIA	The person performing this task must be able to apply the knowledge and skills to inspect the finished products and determine whether the parts are qualified in accordance with the current regulations and standards in the electromechanical field.		
RANGE STATEMENT	The task can be performed in an equipment manufacturing enterprise under the close supervision of mechatronics technical engineers. The tools and equipment to be used include: **1. Tools and equipment:** Personal protective equipment (PPE), measuring equipment (vernier caliper, outer micrometer, inner dial indicator, universal angle ruler, depth micrometer, height vernier caliper, surface roughness sample block, threaded plug gauge), toolbox; 2. **Materials:** Part drawings, part blanks.		

EVIDENCE REQUIREMENT

PRACTICAL PERFORMANCE	**UNDERPINNING KNOWLEDGE**
The person performing this task must be able to do the following: 1. Memorize the test items and determination standards; 2. Calibrate testing tools; 3. Conduct visual inspection of the shape of parts; 4. Conduct tactile detection of the surface of parts; 5. Check the length, inner and outer diameters and depth of parts with vernier calipers; 6. Check the shape, inner diameter and depth of parts with micrometers; 7. Detect thread shapes with thread plug gauges; 8. Measure the angle of parts with universal angle rulers; 9. Measure the tolerance of height, shape and position of parts with height vernier calipers; 10. Check the dimensional error, shape error and position error of parts with dial indicators; 11. Detect the surface finish of parts	**Detailed knowledge about:** **1.0 Methods** The person performing this task must be able to explain how to: 1.1 Use tools and inspection methods to conduct appearance and shape inspection of parts; 1.2 Use part size testing tools and measurement methods; 1.3 Apply criteria for judging the conformity of parts. **2.0 Principles** The person performing this task must be able to explain the following principles: 2.1 Requirements of civilized on-site production; 2.2 Knowledge of safety operation and labor protection; 2.3 Knowledge of environmental protection. **3.0 Theories** The person performing this task must be able to explain the following: 3.1 Detecting range of measuring tools; 3.2 Use of measuring tools; 3.3 Tools maintenance knowledge. **4.0 Essential Skills**

with surface roughness sample blocks; 12. Clean the tools and work areas; 13. Arrange and store the tools and equipment; 14. Prepare the accuracy inspection report.	4.1 Use of measuring tools; 4.2 Determination of inspection standard; 4.3 Communication skills; 4.4 Teamwork spirit; 4.5 Honesty and trustworthiness; 4.6 Dedication; 4.7 Time management; 4.8 Materials science; 4.9 Computer skills; 4.10 Report writing skills. **5.0 Math Skills** 5.1 Calculation of dimensional deviation of parts.
DESCRIPTION OF THE END PRODUCT / SERVICE	Finished parts are inspected in accordance with the drawings and process requirements, whether the shape and size of the parts meet the requirements are determined, the non-conforming products are picked out, and an accuracy inspection report is issued.
CIRCUMSTANTIAL KNOWLEDGE	**Detailed knowledge about:** 1. Calibration of measuring equipment; 2. Safe use of working tools and equipment; 3. Safe use of measuring tools; 4. Safety, health and environment; 5. Waste disposal methods.

TABLE 1: DACUM CHARTS FOR MECHATRONICS TECHNICIAN - NTA 4

DUTIES	TASKS	ENABLERS
1.0 Installation of simple circuit	1.1 Reading of circuit schematic diagrams. 1.2 Inventory and inspection of components. 1.3 Installation of the circuit according to the drawing.	**General skills and knowledge** · Cooperation with others using communication skills and submission of reports to the superiors · Safety, health and environmental knowledge · Interpretation of technical drawings and documents · Fundamentals of Electrical and Electronic Technology · Commonly-used electronic components · Use of multimeters · Electrician foundation **Tools and equipment** · Personal protective equipment (PPE), such as safety boots, goggles, gloves, helmet, safety belt · General electrical tools: voltage tester, ladder, soldering iron, vacuum cleaner, etc. · Installation tools: screwdriver, electric drill, electrician knife, electrician tongs, wrench, etc. · Measuring tools: multimeter **Materials** · Electrical component, connector, mounting guide rail, wire, soldering tin wire, duct, pipe bender, cable connector, cable strap, etc. **Requirements for employees** · Teamwork spirit · Honesty and trustworthiness · Time management · Dedication
2.0 Machining preparation of mechanical parts	2.1 Reading of mechanical part drawings and assembly drawings. 2.2 Drawing of simple mechanical part drawings	**General skills and knowledge** · Cooperation with others using communication skills and submission of reports to the superiors

DUTIES	TASKS	ENABLERS
	and assembly drawings. 2.3 Inventory and inspection of tools. 2.4 Safety inspection of processing equipment.	· Basic knowledge and skills of mechanical drawing · Mechanical drawing reading **Tools and equipment** · Measuring tools and drawing tools Mechanical design reference book · Fitter tools **Materials** · Drawings **Requirements for employees** · Teamwork spirit · Honesty and trustworthiness · Time management · Emphasis on commitment
3.0 Machining of simple mechanical parts	3.1 Stereoscopic scribing. 3.2 Machining operation of simple mechanical parts. 3.3 Accuracy inspection of machining simple mechanical parts.	**General skills and knowledge** · Interpretation of part drawings · Selection of part blanks · Use of machining tools · Use of measuring tools · Fundamentals of engineering materials · Communication and coordination skills **Tools and equipment** · Personal protective equipment (PPE) · Measuring equipment and instruments (vernier caliper, outer diameter micrometer, inner diameter dial indicator, universal angle ruler, depth micrometer, height vernier caliper, surface roughness sample block, thread plug gauge) · Fitter workbench, bench vice, grinder, file, junior hacksaw, screw tap, threading die, bench drilling machine, vertical drilling machine, radial drilling machine · Toolbox **Materials**

DUTIES	TASKS	ENABLERS
		· Part drawings, part blanks. **Requirements for employees** · Communication skills · Teamwork spirit · Honesty and trustworthiness · Dedication