THE NATIONAL COUNCIL FOR TECHNICAL AND VOCATIONAL EDUCATION AND TRAINING

OCCUPATIONAL STANDARDS

OCCUPATION: WATER CONSERVANCY ENGINEERING TECHNICIAN

LEVEL: NTA LEVEL 5

FEBRUARY 2024

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ABBREVIATIONS

CBET	Competency Based Education and Training
CEC	Concrete Engineering Construction
CRW	Construction of Rebar Works
DRO	Drilling Rig Operation
EC	Earthwork Construction
HGO	Hydraulic Gate Operation
HM	Hydrogeological Monitoring
NACTVET	National Council for Technical and Vocational Education and Training
NOS	National Occupational Standards
OS	Occupational Standards
TET	Technical Education and Training
TVET	Technical and Vocational Education and Training
WCPM	Water Conservancy Project Monitoring
WCOCM	Water Conservancy Organization and Construction Management

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: catering service)
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 performance tools of assessment of the prescribed outcomes.
Performance criteria:	Indicate the expected end results or outcome in form of evaluative statements.
Skills:	The ability to perform occupational tasks with a high degree of proficiency within a given occupation. Skills are conceived of as a

	composite of three completely interdependent components: cognitive, affective, and psychomotor activities.
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 analyzing each task to determine the steps, circumstantial knowledge, attitudes, performance criteria, tools and materials needed, and safety concerns required of employees performing it.
Task:	A work activity that has a definite beginning and ending, is observable or measurable, consists of two or more definite steps, and leads to a product, service, or decision.
Underpinning knowledge:	The crucial knowledge that an individual must acquire in order to perform a given task.
Verification process:	The process of experts reviewing and confirming the statements of tasks (competency) through occupational analysis. Other questions such as the degree of task learning difficulty are also frequently asked. This process is sometimes referred to as validation.
Occupational competence:	The application of knowledge and skills to perform consistently to the standards required in the working context.

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, with a high level of human development. 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 and Vocational Education and Training (NACTVET) has begun the job of drafting Occupational Standards (OS) that will eventually be adopted as National Occupational Standards (NOS) for use in the delivery of TET that meets the needs of the labour market and the country's economic agenda.

Occupational Standards (OS) are performance criteria that are matched with labour market demands. Each of them describes the functions, performance standards, and understanding or knowledge underpinning a given occupation. They combine skills, knowledge, and attitudes to describe best practice. They are useful tools for establishing job roles, personnel recruitment, supervision, and appraisal, as well as TET Standards. They are also helpful for benchmarking and harmonizing job 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 application across all public and private institutions.

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

For the purpose of TET delivery, Tanzania has 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. Therefore, it is quite pertinent

for TET institutions to use the relevant occupational standards as a benchmark for formulating their curricula.

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.

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. PROCESS OF OCCUPATIONAL STANDARDS ESTABLISHMENT

The process of developing these Occupational Standards involved both local and international expertise. The process began with an examination of major documents that guide Tanzanian skills development including the *10-year National Skills Development Strategy (2016-2026).* NACTVET 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 team of experts in consultation with practitioners developed draft occupational standards. The draft document was used to develop an occupational profile for each occupation (DACUM Chart), which is attached as an **Appendix** to every Occupational Standard.

The occupational standards were validated during the stakeholders' forum held on 22nd and 23rd February 2024 at Morogoro. The information from the stakeholders' forum provides insight from the workplaces, professional bodies, regulatory bodies and sector ministries regarding trends and changes in the profession, including how well graduates are prepared for working in the occupation.

3.0. THE SCOPE AND OVERVIEW OF THE OCCUPATIONAL STANDARDS FOR WATER CONSERVANCY ENGINEERING TECHNICIANS

These standards cover a broad range of duties and tasks that can be performed by a Water Conservancy Engineering Technician. However, the occupational standards are not meant to replace individual job descriptions, they are to be used for guidance in defining skill levels and knowledge for the technician in specific settings or positions. The Water Conservancy Engineering 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 Water Conservancy Engineering Technician works under the supervision of the engineer, operating the drilling rig to complete drilling construction, and overseeing the construction site, including earthwork and reinforced concrete works. Additionally, they are required to perform water conservancy project monitoring and maintenance, hydraulic gate operation and maintenance, and

hydrogeological surveys. Generally, the Water Conservancy Engineering Technician performs the following duties:

a) Operate drilling rig;
b) Identify and select earthwork construction machinery (equipment);
c) Operate and maintain earthwork construction machinery (equipment);
d) Prepare earthwork construction scheme and provide onsite guidance;
e) Identify and select concrete construction materials and equipment;
f) Carry out concrete construction and finishing;
g) Formulate and check the concrete construction plan;
h) Perform steel bar processing, connection, and installation;
i) Prepare the steel bar construction scheme;
j) Monitor the water conservancy project and record the data;
k) Detect, inspect and maintain water conservancy project monitoring facilities;
l) Perform routine inspection and maintenance of hydraulic gate operation, abnormality identification and local maintenance, abnormality elimination, and equipment maintenance;
m) Observe and measure (test) precipitation, water level, and flow, and reorganize data;
n) Carry out hydrogeological survey, groundwater observation, water quality monitoring;
o) Install and maintain hydrogeological survey instruments and equipment, and perform hydrogeological information prediction;
p) Carry out water conservancy engineering construction management.

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

4.0. VALIDITY PERIOD

The Occupational Standards will be valid for 3-5 years due to the fast-changing nature of technology. The review will proceed in the same manner as the previous one, with new occupational standards being developed based on current labour market information.

5.0. OCCUPATIONAL STANDARDS

5.1 OCCUPATIONAL STANDARDS FOR WATER CONSERVANCY ENGINEERING TECHNICIANS - NTA LEVEL 5

OCCUPATION	WATER CONSERVANCY ENGINEERING TECHNICIAN	**OCCUPATION CODE**	
DUTY TITLE	EXCAVATE WATER INTAKE WELLS	**DUTY NO.**	501
TASK TITLE	USE AND MAINTAIN COMMON DRILLING RIGS	**TASK NO.**	5011
PERFORMANCE CRITERIA	The person performing this task must be able to use and maintain common drilling rigs according to technical requirements.		
RANGE STATEMENT	The task may be executed on the drilling site under the supervision of a Senior Technician or Geological Engineer. The tools and equipment to be used include: 1. Hydrogeological drilling rig; 2. Drill tools. 3. Safety gear		

EVIDENCE REQUIREMENT	
PRACTICAL PERFORMANCE	**UNDERPINNING KNOWLEDGE**
The person performing this task must be able to do the following: 1. Comply with safety, quality and environmental protection measures when performing this task; 2. Comply with drilling construction procedures when performing this task; 3. Install drilling rig; 4. Check installation of drilling rig; 5. Check connecting bolts of drilling rig; 6. Check transmission parts of drilling rig; 7. Check lubrication of drilling rig;	**Detailed knowledge about:** **1.0 Methods** The person performing this task must be able to explain how to: 1.1 Check drilling rig; 1.2 Use drilling rig; 1.3 Maintain drilling rig. **2.0 Principle** The person performing this task must be able to explain the following principles: 2.1 Safety, quality and environmental protection standards; 2.2 Drilling construction procedures.

8. Check oil leakage of drilling rig; 9. Operate clutch normally; 10. Operate clutch by inching; 11. Operate drilling rig with variable speed; 12. Operate drilling rig separately; 13. Lift drilling tool; 14. Lower drilling tool; 15. Brake drilling rig; 16. Operate drilling rig with micro-motion; 17. Adjust clearance of lifting mechanism; 18. Maintain drilling rig.	**3.0 Theories** The person performing this task must be able to explain: 3.1 Main structure of drilling rig; 3.2 Working principle of drilling rig; 3.3 Using methods of drilling rig. **4.0 Essential skills** 4.1 Communication skills; 4.2 Management skills; 4.3 Data storage skills; 4.4 Customer service skills; 4.5 Teamwork skills; 4.6 Report writing skills; 4.7 Computer operation skills.
DESCRIPTION OF THE END PRODUCT / SERVICE	Common drilling rigs are used and maintained according to requirements and regulations.
CIRCUMSTANTIAL KNOWLEDGE	**Detailed knowledge about:** 1. Work safety and management; 2. Engineering quality control; 3. Occupational health and safety; 4. Mechanical basics; 5. Electrical engineering basics; 6. Electrical welding.

OCCUPATION	WATER CONSERVANCY ENGINEERING TECHNICIAN	**OCCUPATION CODE**	
DUTY TITLE	EXCAVATE WATER INTAKE WELL	**DUTY NO.**	501
TASK TITLE	TROUBLESHOOT GENERAL MECHANICAL PROBLEMS	**TASK NO.**	5012
PERFORMANCE CRITERIA	The person performing this task must be able to troubleshoot general mechanical problems according to technical requirements.		
RANGE STATEMENT	The task may be executed on the drilling site under the supervision of a Senior Technician or Geological Engineer. The tools and equipment to be used include: 1. Hydrogeological drilling rig; 2. Mud pump; 3. Drilling tower; 4. Air compressor; 5. Shaft-forming pipes. 6. Safety gear		

EVIDENCE REQUIREMENT	
PRACTICAL PERFORMANCE	**UNDERPINNING KNOWLEDGE**
The person performing this task must be able to do the following: 1. Comply with safety, quality and environmental protection measures when performing this task; 2. Choose correct tools, equipment and safety protection articles for tasks; 3. Troubleshoot main faults of drilling rig; 4. Troubleshoot main faults of reciprocating pump; 5. Troubleshoot main faults of diesel engine;	**Detailed knowledge about:** **1.0 Methods** The person performing this task must be able to explain how to: 1.1 Troubleshoot main faults of drilling rig; 1.2 Troubleshoot main faults of reciprocating pump; 1.3 Troubleshoot main faults of diesel engine; 1.4 Troubleshoot main faults of motor. **2.0 Principle** The person performing this task must be able to explain the following principles:

6. Troubleshoot main faults of motor.	2.1 Troubleshooting of general mechanical problems. **3.0 Theories** The person performing this task must be able to explain: 3.1 Main faults of drilling rig; 3.2 Main faults of reciprocating pump; 3.3 Main faults of diesel engine; 3.4 Main faults of motor. **4.0. Essential skills** 4.1 Communication skills; 4.2 Management skills; 4.3 Data storage skills; 4.4 Customer service skills; 4.5 Teamwork skills; 4.6 Drilling rig operation skills; 4.7 Tool and equipment use and maintenance skills.
DESCRIPTION OF THE END PRODUCT / SERVICE	The general mechanical problems are troubleshot according to requirements of the regulations and mechanical troubleshooting guidelines.
CIRCUMSTANTIAL KNOWLEDGE	**Detailed knowledge about:** 1. Work safety and management; 2. Engineering quality control; 3. Occupational health and safety; 4. Mechanical basics; 5. Electrical engineering basics; 6. Electrical welding.

OCCUPATION	WATER CONSERVANCY ENGINEERING TECHNICIAN	**OCCUPATION CODE**	
DUTY TITLE	OPERATE COMMON TYPES OF DRILLING RIGS	**DUTY NO.**	501
TASK TITLE	REPAIR DRILLING TOOL FAULTS	**TASK NO.**	5013
PERFORMANCE CRITERIA	The person performing this task must be able to repair drill tool faults in accordance with technical requirements.		
RANGE STATEMENT	The task may be executed on the drilling site under the supervision of a Chief Engineer or Leader in charge. The tools and equipment to be used include: 1. Hydrogeological drilling rig; 2. Mud pump; 3. Drilling tower; 4. Air compressor; 5. Borehole inclinometer; 6. Shaft-forming pipes. 7. Safety gear		

EVIDENCE REQUIREMENT	
PRACTICAL PERFORMANCE	**UNDERPINNING KNOWLEDGE**
The person performing this task must be able to do the following: 1. Comply with safety, quality and environmental protection measures when performing this task; 2. Choose correct tools, equipment and safety protection articles for tasks; 3. Judge faults of drilling tools; 4. Repair faults of drilling tool.	**Detailed knowledge about:** **1.0 Methods** The person performing this task must be able to explain how to: 1.1 Judge faults of drilling rig; 1.2 Repair faults of drilling tool. **2.0 Principle** The person performing this task must be able to explain the following principles:

	2.1 Drilling construction procedures; 2.2 Safety, quality and environmental protection standards; **3.0 Theories** The person performing this task must be able to explain: 3.1 Abnormal phenomena; 3.2 Causes of abnormal phenomena; 3.3 Handling method of drilling tools. **4.0. Essential skills** 4.1 Communication skills; 4.2 Management skills; 4.3 Data storage skills; 4.4 Customer service skills; 4.5 Teamwork skills; 4.6 Report writing skills.
DESCRIPTION OF THE END PRODUCT / SERVICE	The drilling tool faults are repaired according to technical requirements**.**
CIRCUMSTANTIAL KNOWLEDGE	**Detailed knowledge about:** 1. Work safety and management; 2. Engineering quality control; 3. Occupational health and safety; 4. Mechanical basics; 5. Electrical engineering basics; 6. Electrical welding.

OCCUPATION	WATER CONSERVANCY ENGINEERING TECHNICIAN	**OCCUPATION CODE**	
DUTY TITLE	EXCAVATE WATER INTAKE WELL	**DUTY NO.**	501
TASK TITLE	DEAL WITH GENERAL DOWN-HOLE TROUBLES	**TASK NO.**	5014
PERFORMANCE CRITERIA	The person performing this task must be able to deal with general down-hole troubles according to technical requirements.		
RANGE STATEMENT	The task may be executed on the drilling site under the supervision of a Chief Engineer or Leader in charge. The tools and equipment to be used include: 1. Die tap and die collar; 2. Catch sleeve; 3. Fishing spear; 4. Cutting knife; 5. Mill; 6. Grappling basket; 7. Lifter. 8. Safety gear		

EVIDENCE REQUIREMENT	
PRACTICAL PERFORMANCE	**UNDERPINNING KNOWLEDGE**
The person performing this task must be able to do the following: 1. Comply with safety, quality and environmental protection measures when performing this task; 2. Choose correct tools, equipment and safety protection articles for tasks; 3. Check drilling equipment for obvious faults; 4. Check the hole for factors affecting the drilling rig;	**Detailed knowledge about:** **1.0 Methods** The person performing this task must be able to explain how to: 1.1 Deal with general down-hole troubles. **2.0 Principle** The person performing this task must be able to explain the following principles:

5. Identify accurate location of accident and current situation of the hole; 6. Propose feasible solutions; 7. Deal with general down-hole troubles.	2.1 Handling of down-hole troubles; 2.2 Safety, quality and environmental protection standards. **3.0 Theories** The person performing this task must be able to explain: 3.1 Orders of dealing with general down-hole troubles; 3.2 Methods of dealing with general down-hole troubles; 3.3 Essentials of dealing with general down-hole troubles; 3.4 Project quality indexes and work safety measures. **4.0 Essential skills** 4.1 Communication skills; 4.2 Customer service skills; 4.3 Teamwork skills; 4.4 Report writing skills.
DESCRIPTION OF THE END PRODUCT / SERVICE	The general down-hole troubles are dealt with according to technical requirements
CIRCUMSTANTIAL KNOWLEDGE	**Detailed knowledge about:** 1. Work safety and management; 2. Engineering quality control; 3. Occupational health and safety; 4. Mechanical basics; 5. Electrical engineering basics; 6. Electrical welding.

OCCUPATION	WATER CONSERVANCY ENGINEERING TECHNICIAN	**OCCUPATION CODE**	
DUTY TITLE	CARRY OUT WATER CONSERVANCY PROJECT CONSTRUCTION	**DUTY NO.**	502
TASK TITILE	OPERATE AND MAINTAIN THE EARTHWORK EXCAVATION EQUIPMENT	**TASK NO.**	5021
PERFORMANCE CRITERIA	The person performing this task must be able to operate and maintain the earthwork excavation equipment according to safety technical requirements and excavation operation instructions.		
RANGE STATEMENT	The task may be executed on the water conservancy construction site under the supervision of a Senior Technician or Water Conservancy Engineer. The tools and equipment to be used include: 1. Bulldozer; 2. Excavator. 3. Safety gear		

EVIDENCE REQUIREMENT

PRACTICAL PERFORMANCE	**UNDERPINNING KNOWLEDGE**
The person performing this task must be able to do the following: 1. Select the required machinery according to the engineering needs; 2. Operate the selected machinery according to engineering needs; 3. Identify the excavation sequence layout plan; 4. Determine the location and size of earthwork excavation; 5. Set warning signs before mechanical excavation;	**Detailed knowledge about:** **1.0 Methods** The person performing this task must be able to explain how to: 1.1 Normally operate bulldozers to clear obstacles in the construction area; 1.2 Normally operate excavator to excavate earthwork. **2.0 Principle** The person performing this task must be able to explain the following principles: 2.1 Quality requirements for mechanical excavation of earthwork;

6. Check the solidity of the mechanical excavation components; 7. Clear the obstacles in the construction area; 8. Forbid people to stand within the rotation radius of the excavator; 9. Excavate the earthwork in the correct order of excavation and ensure safety; 10. Clean up the surface of the machine; 11. Sort excavation machines in an orderly manner. 12. Observe health, occupational and environmental safety rules and regulations.	2.2 Basic requirements for the safe operation of mechanical construction sites. **3.0 Theories** The person performing this task must be able to explain: 3.1 Operational requirements for bulldozers to clear obstacles; 3.2 Sequence and operational requirements for excavator to excavate earthwork. **4.0 Essential skills** 4.1 Communication skills; 4.2 Operation skills; 4.3 Teamwork skills.
DESCRIPTION OF THE END PRODUCT / SERVICE	The earthwork excavation equipment is operated and maintained according to safety technical requirements and operation instructions of the earthwork excavation equipment.
CIRCUMSTANTIAL KNOWLEDGE	**Detailed knowledge about:** 1. Operational specifications of construction machines; 2. Safety measures setting for earthwork excavation; 3. Environmental and occupational health. 4. Safety operation of operating tools

OCCUPATION	WATER CONSERVANCY ENGINEERING TECHNICIAN	**OCCUPATION CODE**	
DUTY TITLE	CARRY OUT WATER CONSERVANCY PROJECT CONSTRUCTION	**DUTY NO.**	502
TASK TITLE	OPERATE AND MAINTAIN EARTHWORK TRANSPORTATION EQUIPMENT	**TASK NO.**	5022
PERFORMANCE CRITERIA	The person performing this task must be able to operate and maintain the earthwork transportation equipment according to safety technical requirements and the operation instructions of the earthwork transportation equipment		
RANGE STATEMENT	The task may be executed on the water conservancy construction site under the supervision of a Senior Technician or Water Conservancy Engineer. The tools and equipment to be used include: 1. Dump truck; 2. Excavator; 3. Loader. 4. Safety gear		

EVIDENCE REQUIREMENT	
PRACTICAL PERFORMANCE	**UNDERPINNING KNOWLEDGE**
The person performing this task must be able to do the following: 1. Choose the required machines according to the engineering needs; 2. Properly operate the selected machines according to the engineering needs; 3. Identify the roadmap of earthwork transportation and the layout of the material yard;	**Detailed knowledge about:** **1.0 Methods** The person performing this task must be able to explain how to: 1.1 Normally operate the loading equipment workflow; 1.2 Normally operate the transportation equipment workflow. **2.0 Principle** The person performing this task must be able to explain the following principles:

4. Determine the quantity of earthwork transportation and transportation distance; 5. Choose suitable transportation equipment and inspect it before earthwork transportation; 6. Inspect the safety of earthwork loading equipment and alert area; 7. Carry out earthwork transportation according to the correct process and ensure safety; 8. Clean up the surface of transportation machines; 9. Sort the transportation machines in an orderly manner. 10. Observe health, occupational and environmental safety rules and regulations.	2.1 Basic requirements for the reasonable configuration of earthwork transportation equipment; 2.2 Basic requirements for the safe operation of transportation sites. **3.0 Theories** The person performing this task must be able to explain: 3.1 Basic operational procedures and construction specifications for earthwork transportation; 3.2 Sequence and operational requirements for earthwork transportation equipment. **4.0 Essential skills** 4.1 Communication skills; 4.2 Operation skills; 4.3 Teamwork skills.
DESCRIPTION OF THE END PRODUCT / SERVICE	The earthwork transportation equipment is operated and maintained according to the safety technical requirements and operation instructions for earthwork transportation equipment.
CIRCUMSTANTIAL KNOWLEDGE	**Detailed knowledge about:** 1. Operational specifications of transportation machines; 2. Safety measures setting for earthwork transportation; 3. Environmental and occupational health.

OCCUPATION	WATER CONSERVANCY ENGINEERING TECHNICIAN	**OCCUPATION CODE**	
DUTY TITLE	CARRY OUT WATER CONSERVANCY PROJECT CONSTRUCTION	**DUTY NO.**	502
TASK TITLE	OPERATE AND MAINTAIN EARTHWORK ROLLING EQUIPMENT	**TASK NO.**	5023
PERFORMANCE CRITERIA	The person performing this task must be able to operate and maintain the earthwork rolling equipment according to safety technical requirements and operation instructions of the earthwork rolling equipment.		
RANGE STATEMENT	The task may be executed on the water conservancy construction site under the supervision of a Senior Technician or Water Conservancy Engineer. The tools and equipment to be used include: 1. Smooth-wheel roller; 2. Ribbed roller or sheep-foot roller; 3. Vibratory roller; 4. Pneumatic tired roller; 5. Rammer. 6. Safety gear		

EVIDENCE REQUIREMENT	
PRACTICAL PERFORMANCE	**UNDERPINNING KNOWLEDGE**
The person performing this task must be able to do the following: 1. Choose the required machines according to the engineering needs; 2. Operate properly the machines according to the engineering needs; 3. Select properly the compaction parameters according to the engineering profile;	**Detailed knowledge about:** **1.0 Methods** The person performing this task must be able to explain how to:

4. Select correctly the running mode of rolling machines according to the engineering profile; 5. Carry out safety inspection on machines and equipment; 6. Carry out routine maintenance of machines and equipment. 7. Observe health, occupational and environmental safety rules and regulations.	1.1 Standardize the selection process of rolling machinery (equipment); 1.2 Standardize the operational process of rolling machinery (equipment); 1.3 Standardize the operational process of rolling machinery (equipment) running mode; 1.4 standardize the operational process of rolling machinery (equipment) safety inspection; 1.5 Standardize the operational process of rolling machinery (equipment) routine maintenance. **2.0 Principle** The person performing this task must be able to explain the following principles: 2.1 Basic requirements for the reasonable configuration of earthwork rolling machinery (equipment); 2.2 Basic requirements for the safety operation of rolling machinery (equipment) on the site. **3.0 Theories** The person performing this task must be able to explain: 3.1 Basic operational procedures and construction specifications for earthwork rolling; 3.2 Sequence and operating requirements of earthwork rolling machinery (equipment). **4.0 Essential skills** 4.1 Communication skills; 4.2 Operation skills; 4.3 Teamwork skills.
DESCRIPTION OF THE END PRODUCT / SERVICE	The earthwork rolling equipment is operated and maintained. According to safety technical requirements and the operation instructions of earthwork rolling equipment.

CIRCUMSTANTIAL KNOWLEDGE	**Detailed knowledge about:** 1. Operations specifications of mechanical equipment; 2. Safety measures setting for earthwork rolling; 3. Environmental and occupational health; and 4. Safety operation of operation tools.

OCCUPATION	WATER CONSERVANCY ENGINEERING TECHNICIAN	**OCCUPATION CODE**	
DUTY TITLE	CARRY OUT WATER CONSERVANCY PROJECT CONSTRUCTION	**DUTY NO.**	502
TASK TITLE	MANUFACTURE AND MIX READY-MIXED CONCRETES	**TASK NO.**	5024
PERFORMANCE CRITERIA	The person performing this task must be able to manufacture and mix ready mixed concrete according to technical manufacturing and concrete mixing requirements		
RANGE STATEMENT	The task may be executed on the water conservancy construction site under the supervision of a Senior Technician or Water Conservancy Engineer. The tools and equipment to be used include: 1. Concrete manufacturing facilities 2. Concrete mixer; 3. Slump tester. 4. Safety gear		

EVIDENCE REQUIREMENT	
PRACTICAL PERFORMANCE	**UNDERPINNING KNOWLEDGE**
The person performing this task must be able to do the following: 1. Control the processes of measurement and mixing of concrete constituent materials, concrete quality inspection, transportation, etc; 2. Inspect whether the main production equipment for concrete conforms to the current national standards, and inspect whether concrete mixing equipment, placing equipment, machines and tools are in good condition; 3. Inspect whether the raw materials used in production, concrete design intensity level, concrete production mix ratio,	**Detailed knowledge about:** **1.0 Methods** The person performing this task must be able to explain how to: 1.1 Know the preparations before concrete production; 1.2 Know the quality identification of concrete during production and its recording; 1.3 know the preparation of concrete for transportation work after production. **2.0 Principle** The person performing this task must be able to explain the following principles:

engineering name and parts are compatible; 4. Adjust the concrete production according to the records of weather, production and inspection; 5. Inspect whether the collapse and cohesiveness meet the mix ratio or the requirements specified in the contract. All parties participating in the witness shall sign and file the opening identification record; 6. Record and print the mix ratio for concrete production, and conduct random inspection, verification and production records by the project manager and supervising engineer; 7. Adopt statistical methods of quality management to conduct regular statistical analysis and guide subsequent production; 8. Keep mixing equipment, metering equipment and its auxiliary equipment in a clean and normal operating condition. 9. Observe health, occupational and environmental safety rules and regulations.	2.1 Quality requirements for the production of concrete; 2.2 Safety requirements for production of machinery. **3.0 Theories** The person performing this task must be able to explain: 3.1 Using methods and operating procedures of production machinery; 3.2 Equipment requirements for different properties of concrete; 3.3 Concrete mix ratio calculations and their precautions; 3.4 Quality control during concrete pouring; 3.5 Collection and organization of concrete instructional materials. **4.0 Essential skills** 4.1 Communication skills; 4.2 Management skills; 4.3 Teamwork skills; 4.4 Calculation skills.
DESCRIPTION OF THE END PRODUCT / SERVICE	The ready mixed concretes are manufactured and mixed according to technical manufacturing and concrete mixing requirements.
CIRCUMSTANTIAL KNOWLEDGE	**Detailed knowledge about:** 1. Representing methods of concrete intensity grades; 2. Identification of the cohesiveness and water retention of concrete mixes;

	3. Occupational health, safety and construction environment protection.

OCCUPATION	WATER CONSERVANCY ENGINEERING TECHNICIAN	**OCCUPATION CODE**	
DUTY TITLE	CARRY OUT WATER CONSERVANCY PROJECT CONSTRUCTION	**DUTY NO.**	502
TASK TITLE	READ, DETAIL AND TRIM CONCRETE FORMWORK DRAWINGS	**TASK NO.**	5025
PERFORMANCE CRITERIA	The person performing this task must be able to read, detail and trim concrete formwork drawings according to specifications for construction of concrete formwork installation and removal.		
RANGE STATEMENT	The task may be executed on the water conservancy construction site under the supervision of a Senior Technician or Water Conservancy Engineer. The tools and equipment to be used include: 1. Tower Crane; 2. Hammer; 3. Wrench. 4. Safety gear		

EVIDENCE REQUIREMENT

PRACTICAL PERFORMANCE	**UNDERPINNING KNOWLEDGE**
The person performing this task must be able to do the following: 1. Read the engineering plan and section drawing and carry out the formwork detailing; 2. Install the formwork according to the engineering drawings, ensure tight joints, smooth surface and brush isolating agent; 3. Ensure adequate load-bearing capacity, stiffness and stability of the formwork and its supports to withstand the weight, lateral pressure and construction load of the poured concrete; 4. Carry out formwork acceptance prior to concrete placement, observe and maintain the formwork and its supports during	**Detailed knowledge about:** **1.0 Methods** The person performing this task must be able to explain how to: 1.1 Determine the accuracy of reading engineering drawings; 1.2 Determine the sequence of formwork detailing and installation; 1.3 Determine the quality of formwork construction; 1.4 Formulate formwork removal and trimming plan. **2.0 Principle** The person performing this task must be able to explain the following principles:

formwork installation and concrete placement; 5. Install and trim the complex formwork; 6. Remove the formwork in the order of principle: first remove after support, and first support after removal. 7. Observe health, occupational and environmental safety rules and regulations.	2.1 Specifications for the construction of concrete formwork installation; 2.2 Specifications for the construction of concrete formwork removal; **3.0 Theories** The person performing this task must be able to explain: 3.1 Steps of engineering drawing; 3.2 Technical points of structural construction drawings; 3.3 Identification of construction site hazards; 3.4 Steps and precautions for formwork removal and trimming. **4.0 Essential skills** 4.1 Communication skills; 4.2 Management skills; 4.3 Teamwork skills.
DESCRIPTION OF THE END PRODUCT / SERVICE	The concrete formwork drawings are read, detailed and trimmed according to specifications for construction of concrete formwork installation and removal
CIRCUMSTANTIAL KNOWLEDGE	**Detailed knowledge about:** 1. Formwork installation; 2. Formwork trimming; 3. Formwork removal.

OCCUPATION	WATER CONSERVANCY ENGINEERING TECHNICIAN	**OCCUPATION CODE**	
DUTY TITLE	CARRY OUT WATER CONSERVANCY PROJECT CONSTRUCTION	**DUTY NO.**	502
TASK TITLE	CHECK AND APPROVE THE QUALITY OF READY-MIXED CONCRETE	**TASK NO.**	5026
PERFORMANCE CRITERIA	The person performing this task must be able to check and approve the quality of ready-mixed concrete according to the standard comprehensive strength tests.		
RANGE STATEMENT	The task may be executed on the water conservancy construction site under the supervision of a Senior Technician or Water Conservancy Engineer. The tools and equipment to be used include: 1. Slump tester; 2. Concrete extensibility tester; 3. Pressure tester. 4. Safety gear		

EVIDENCE REQUIREMENT	
PRACTICAL PERFORMANCE	**UNDERPINNING KNOWLEDGE**
The person performing this task must be able to do the following: 1. Verify the accompanying Delivery Note for each mixer truck; 2. Test the collapse (or expansion) of the concrete; 3. Choose and determine the maintenance methods for special concrete and special component concrete; 4. Maintain special concrete and special component concrete according to the special programme; 5. Identify the causes of concrete defects; 6. Repair all types of concrete defects as required by the work procedures.	**Detailed knowledge about:** **1.0 Methods** The person performing this task must be able to explain how to: 1.1 Test the collapse and expansion of the concrete; 1.2 Maintain the concrete; 1.3 Judge the quality of concrete. **2.0 Principle** The person performing this task must be able to explain the following principles:

7. Observe health, occupational and environmental safety rules and regulations.	2.1 Quality control principle of concrete acceptance; 2.2 Rigorous principle of concrete testing. **3.0 Methods** The person performing this task must be able to explain: 3.1 Concrete slump and expansion test methods; 3.2 Intensity grade codes and mix ratios of ready-mixed concrete; 3.3 Factors affecting the various methods of concrete maintenance; 3.4 Judgment methods for the quality of concrete maintenance. **4.0 Essential skills** 4.1 Communication skills; 4.2 Management skills; 4.3 Teamwork skills. **5.0 Mathematical skills** 5.1 Sampling method.
DESCRIPTION OF THE END PRODUCT / SERVICE	The quality of ready-mixed concrete is checked and approved in accordance with standard concrete comprehensive strength tests and other technical requirements.
CIRCUMSTANTIAL KNOWLEDGE	**Detailed knowledge about:** 1. Mechanical properties of materials; 2. Statistical analysis of experimental data.

OCCUPATION	WATER CONSERVANCY ENGINEERING TECHNICIAN	**OCCUPATION CODE**	
DUTY TITLE	CARRY OUT WATER CONSERVANCY PROJECT CONSTRUCTION	**DUTY NO.**	502
TASK TITLE	READ AND INTERPRET THE GENERAL COMPONENT REINFORCEMENT DRAWINGS	**TASK NO.**	5027
PERFORMANCE CRITERIA	The person performing this task must be able to read and interpret the general component drawings according to the standard technical requirements.		
RANGE STATEMENT	The task may be executed on the water conservancy construction site under the supervision of a Water Conservancy Engineer or Civil Engineer. The tools and equipment to be used include: 1. Measuring and marking tools: tape measure, angle ruler, pencil, ruler, chalk, etc. 2. Safety protection equipment: safety belt, helmet, gloves, ear plugs, safety shoes, etc.		

EVIDENCE REQUIREMENT	
PRACTICAL PERFORMANCE	**UNDERPINNING KNOWLEDGE**
The person performing this task must be able to do the following: 1. Recognize the structural construction drawings of frames, shear walls, mixed structures, etc; 2. Recognize the prefabricated component reinforcement drawings; 3. Recognize the construction scheme of reinforcement works; 4. Lay out the reinforcement for simple support beam, slab,	**Detailed knowledge about:** **1.0 Methods** The person performing this task must be able to explain how to: 1.1 Recognize various structural construction drawings and prefabricated component reinforcement drawings, and lay out reinforcement for simple components. **2.0 Principle** The person performing this task must be able to explain the following principles:

structural column and other simple components. 5. Observe health, occupational and environmental safety rules and regulations.	2.1 Symbolic representation and construction methods of structural construction drawings; 2.2 Mechanical properties of different types of structures; 2.3 Properties and usage of various construction components. **3.0 Theories** The person performing this task must be able to explain: 3.1 Structural mechanics; 3.2 Structural design of reinforced concrete; 3.3 Theoretical knowledge related to construction techniques. **4.0 Essential skills** 4.1 Communication skills; 4.2 Management skills; 4.3 Teamwork skills.
DESCRIPTION OF THE END PRODUCT / SERVICE	The general component reinforcement drawings are read and interpreted according to technical requirements.
CIRCUMSTANTIAL KNOWLEDGE	**Detailed knowledge about:** 1. Basic knowledge of structural construction drawing recognition; 2. General construction knowledge of prefabricated components; 3. Relationship of reinforcement position between connection nodes of components; 4. Structural knowledge of beams, slabs, columns, walls and general stairs.

OCCUPATION	WATER CONSERVANCY ENGINEERING TECHNICIAN	**OCCUPATION CODE**	
DUTY TITLE	CARRY OUT WATER CONSERVANCY PROJECT CONSTRUCTION	**DUTY NO.**	502
TASK TITLE	CONNECT THE THREAD, SOCKET EXTRUSION JOINT	**TASK NO.**	5028
PERFORMANCE CRITERIA	The person performing this task must be able to connect the thread, socket and the extrusion joint according to technical requirements.		
RANGE STATEMENT	The task may be executed on the water conservancy construction site under the supervision of a Water Conservancy Engineer or Civil Engineer. The tools and equipment to be used include: 1. Processing equipment such as reinforcement shear, steel bar bender, CNC processing equipment, etc.; 2. Measuring tools such as reinforcement locator, calliper, straightedge and gauge, etc.; 3. Connecting equipment such as threading machine, socket extruder, etc.; 4. Hand-held tools such as hand-held electric drill, electric wrench, electric welding machine, etc.; 5. Connecting components such as rebar coupler, reinforcement welding material, reinforcement lap joint, etc.; 6. Personal protective equipment such as safety helmet, gloves, protective goggles, etc.		

EVIDENCE REQUIREMENT	
PRACTICAL PERFORMANCE	**UNDERPINNING KNOWLEDGE**
The person performing this task must be able to do the following: 1. Carry out connections of tapered thread, straight thread and socket extrusion joints; 2. Carry out the reinforcement connection and assembly of	**Detailed knowledge about:** **1.0 Methods** The person performing this task must be able to explain how to:

conventional prefabricated components. 3. Observe health, occupational and environmental safety rules and regulations.	1.1 Carry out thread processing and joint connection using tools such as torsion shears and chucking machines; 1.2 Carry out socket extrusion joint connections using tools such as hydraulic presses and extrusion machines; 1.3 Carry out reinforcement connection and assembly using bolts, rebar sockets, connection plates and other tools. **2.0 Principles** The person performing this task must be able to explain the following principles: 2.1 Principle of threaded connections; 2.2 Principle of socket extrusion joint connection; 2.3 Principle of reinforcement connection and assembly. **3.0 Theories** The person performing this task must be able to explain: 3.1 Design and calculation principles of threaded connections and socket extrusion joint connections; 3.2 Structural design and assembly principles of reinforcement connection and assembly. **4.0 Essential skills** 4.1 Communication skills; 4.2 Management skills; 4.3 Teamwork skills; 4.4 Safety consciousness.
DESCRIPTION OF THE END PRODUCT / SERVICE	The thread socket and the extrusion joints are connected in accordance with standard technical requirements.
CIRCUMSTANTIAL KNOWLEDGE	**Detailed knowledge about:**

	1. General knowledge of relevant structural reinforcement and structural requirements; 2. Knowledge of reinforcement mechanical connection; 3. Knowledge of reinforcement mechanical joint sampling retest.

OCCUPATION	WATER CONSERVANCY ENGINEERING TECHNICIAN	OCCUPATION CODE	
DUTY TITLE	CARRY OUT WATER CONSERVANCY PROJECT CONSTRUCTION	**DUTY NO.**	502
TASK TITLE	TIE, INSTALL AND FIX REINFORCEMENT MESH AND FRAMEWORK	**TASK NO.**	5029
PERFORMANCE CRITERIA	The person performing this task must be able to tie, install and fix reinforcement mesh and framework according to technical requirements.		
RANGE STATEMENT	The task may be executed on the water conservancy construction site under the supervision of a Water Conservancy Engineer or Civil Engineer. The tools and equipment to be used include: 1. Steel bar processing machine, used for cutting, bending, and cold machining of steel bars; 2. Electric welding machine, used for welding steel bars; 3. Measuring tools, such as tape and protractor, used for measuring and marking steel bars; 4. Hand tools, such as hammers, pliers and wrenches, used for holding and fixing steel bars during processing and splicing; 5. Protective equipment, such as gloves, goggles and masks, used for protecting the safety and health of workers; 6. Vehicle-mounted lifting equipment, used for transporting and handling large steel bars.		

EVIDENCE REQUIREMENT	
PRACTICAL PERFORMANCE	**UNDERPINNING KNOWLEDGE**
The person performing this task must be able to do the following: 1. Tie, install and fix the reinforcement mesh and framework;	**Detailed knowledge about:** **1.0 Methods** The person performing this task must be able to explain how to:

2. Set up reinforcement limiters as required by the construction instructions; 3. Conduct self-inspection; 4. Inspect the quality of tying, positioning and fixing of reinforcement mesh and framework; 5. Adjust the reinforcement position; 6. Repair the displacement and deformation of reinforcement during construction. 7. Observe health, occupational and environmental safety rules and regulations.	1.1 Tie, install and fix the reinforcement mesh and framework; 1.2 Set up reinforcement limiters as required by the construction instructions; 1.3 Inspect the quality of tying, positioning and fixing of reinforcement mesh and framework; 1.4 Adjust the reinforcement position; 1.5 Repair the displacement and deformation of reinforcement during construction. **2.0 Principle** The person performing this task must be able to explain the following principles: 2.1 Principle of reinforcement tying; 2.2 Principle of reinforcement anchorage; 2.3 Principle of reinforcement node construction; 2.4 Theory of reinforcement connection and installation quality. **3.0 Theories** The person performing this task must be able to explain:

	3.1 Requirements for anchorage and joint location of reinforcement; 3.2 Knowledge of conventional reinforcement node construction; 3.3 Knowledge of reinforcement connection and installation quality; 3.4 Requirements for the setting of pads, plastic cards, support bars, etc.; 3.5 Tying technics and requirements for prefabricated reinforcement framework. **4.0 Essential skills** 4.1 Communication skills; 4.2 Management skills; 4.3 Teamwork skills; 4.4 Safety consciousness.
DESCRIPTION OF THE END PRODUCT / SERVICE	The reinforcement mesh and framework are tied, installed and fixed according to technical requirements.
CIRCUMSTANTIAL KNOWLEDGE	**Detailed knowledge about:** 1. Principle of reinforcement tying; 2. Principle of reinforcement anchorage; 3. Principle of reinforcement node construction; 4. Theory of reinforcement connection and installation quality.

APPENDIX: DACUM CHARTS FOR WATER CONSERVANCY ENGINEERING TECHNICIAN - NTA LEVEL 5

DUTIES	TASKS	ENABLERS
1.0 Excavate water intake wells	1.1 Use and maintain common drilling rigs. 1.2 Troubleshoot general mechanical problems. 1.3 Repair drilling tool faults. 1.4 Deal with general down-hole troubles.	**Generic skills and knowledge** • Application of communication skills to work with others and report to superiors • Use of drilling rig • Maintenance of drilling rig • Troubleshooting of general mechanical problems • Repair of drilling tool • Handling of general down-hole trouble • Knowledge of safety, quality and environmental protection • Interpretation of construction drawings • Occupational safety and health. **Tools and equipment** • Safety helmet, safety belt, work clothes, work shoes, gloves and other personal protective equipment • Fire safety equipment • Work safety signs • Lightning rod, drilling tower shed rope, hoist protection device, faucet guide rope, lifter protective screen and other safety protection facilities **Materials** • Water and mud

DUTIES	TASKS	ENABLERS
		Worker behaviours • Teamwork spirit • Integrity • Safety consciousness • Quality consciousness
2.0 Carry out water conservancy project construction	2.1 Operate and maintain the earthwork excavation equipment. 2.2 Operate and maintain earthwork transportation equipment. 2.3 Operate and maintain earthwork rolling equipment. 2.4 Manufacture and mix ready-mixed concrete. 2.5 Read, detail and trim concrete formwork drawings. 2.6 Check and approve the quality of ready-mixed concrete. 2.7 Read and interpret the general component reinforcement drawings. 2.8 Connect the thread, socket extrusion joint. 2.9 Tie, install and fix reinforcement mesh and framework.	**General skills and knowledge:** • Calculative and statistical skills • Mechanical operation skills • Reinforcement, Concrete Materials Science • Interpretation of complex drawings • Construction surveying and setting-out • Completion of construction records **Tools and equipment** • Bulldozer • Excavator • Loader • Dump truck • Smooth-wheel roller • Ribbed roller or sheep-foot roller • Vibratory roller • Pneumatic tired roller • Rammer • Concrete pump • Concrete mixing station • Concrete spreader • Cutting machine • Torque wrench • Level gauge

DUTIES	TASKS	ENABLERS
		• Reinforcement cutting machine • Reinforcement bender • Thread processing equipment • Socket extrusion machine • Reinforcement tying tool • Fixing tool • Personal safety equipment **Materials** • Wood • Formwork • Cement • Grit • Gravel • Steel bar • Concrete • Steel bar mesh **Worker behaviours** • Have good communication ability • Have strong teamwork spirit and communication skills • Have a good consciousness of safety and construction quality