NATIONAL COUNCIL FOR TECHNICAL AND VOCATIONAL EDUCATION AND TRAINING

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PROPOSED OCCUPATIONAL STANDARDS

OCCUPATION: RAILWAY LOCOMOTIVE OPERATION AND MAINTENANCE ENGINEER

LEVEL: NTA 8

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ABBREVIATIONS

APU	Auxiliary Power Unit
BCU	Braking Control Unit
CIR -	Cab Integrated Radio
CTCS	Chinese Train Control System
CBET	Competency Based Education and Training
CCU	Central Control Unit
CI	Traction Inverter
EBV	Electronic Brake Valve
HVB	Main Circuit Breaker
LCDM	Liquid Crystal Display Module
LBJ	Train Protection Alarm Equipment (Lieche Baohu Jingbao)
LKJ	Train Operation Monitoring and Recording Device (Lieche Jiankong Jilu)
MOPP	Maintenance Operation Processes and Procedures
MVB	Multifunction Vehicle Bus
NACTVET	National Council for Technical and Vocational Education and Training
NOS	National Occupational Standards
OS	Occupational Standards
PLC	Programmable Logic Controller
PPE	Personal Protective Equipment
PWM	Pulse Width Modulation

TET	Technical Education and Training
TVET	Technical and Vocational Education and Training
VVVF	Variable Voltage Variable Frequency
WTB	Wire Train Bus

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 Railway Locomotive Operation and Maintenance Engineer 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 standard 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 Railway Locomotive Operation and Maintenance Engineers 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 RAILWAY LOCOMOTIVE OPERATION AND MAINTENANCE ENGINEERS

These standards cover a broad range of duties and tasks that can be performed by a Railway Locomotive Operation and Maintenance Engineer. 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 Railway Locomotive Operation and Maintenance Engineer 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 Railway Locomotive Operation and Maintenance Engineer operates, inspects, maintains, and repairs railway locomotives under the supervision of an engineer. The technician is able to handle unusual situations on the circuit that are encountered by railway locomotives during crew operations; while in the workshop, the technician completes inspections and maintenance, and is able to deal with faults in the locomotive's running gear, braking system, traction transmission system and running safety devices.

Generally, the Railway Locomotive Operation and Maintenance Engineer performs the following responsibilities:

a) Troubleshooting of locomotive running gears

b) Troubleshooting of locomotive braking systems

c) Troubleshooting of locomotive traction transmission systems

d) Troubleshooting of running safety devices

e) Handling of abnormal running

f) Development of railway locomotive overhaul process

g) Optimization of locomotive utilization

h) Drawing of organization and implementation of locomotive working diagrams

i) Organization and management of locomotive operation and maintenance and dispatching of work safety

j) Analysis of locomotive operation record data

k) Drawing of schematic diagrams of train operation

l) Provision of technical support and resolution of queries

m) Investigation and resolution of problems, such as operational failures

n) Preparation of reports and documents

o) Implementation of relevant studies

p) Supervision on subordinates

The Occupational Standards have been clustered into NTA qualification levels, i.e. NTA level 7 and 8.

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 RAILWAY LOCOMOTIVE OPERATION AND MAINTENANCE ENGINEER - NTA 8

OCCUPATION	RAILWAY LOCOMOTIVE OPERATION AND MAINTENANCE ENGINEER	**OCCUPATION CODE**	
DUTY TITLE	DEVELOPMENT OF OVERHAUL PROCESS	**DUTY NO.**	801
TASK TITLE	DEVELOPMENT OF OVERHAUL PROCESS FOR LOCOMOTIVE RUNNING GEARS	**TASK NO.**	8011
PERFORMANCE CRITERIA	The person performing this task must be able to develop the overhaul process for locomotive running gears in accordance with the overhaul process.		
RANGE STATEMENT	The task can be performed in the technical management office under the supervision of railway locomotive operation and maintenance engineers. The tools and equipment to be used include: 1. Office equipment such as computers; 2. Locomotive maintenance manual.		

EVIDENCE REQUIREMENT	
PRACTICAL PERFORMANCE	**UNDERPINNING KNOWLEDGE**
The person performing this task must be able to do the following: 1. Develop the overhaul process for air pipelines; 2. Develop the overhaul process for sand spreading devices; 3. Develop the overhaul process for rim lubrication devices; 4. Develop the overhaul process for rock sweepers; 5. Develop the overhaul process for axle box suspension devices; 6. Develop the overhaul process for motor suspension devices; 7. Develop the overhaul process for the brake unit; 8. Develop the overhaul process for axle drive devices; 9. Clean the workplace;	**Detailed knowledge about:** **1.0 Methods** The person performing this task must be able to explain how to: 1.1 Develop the overhaul process for locomotive running gears. **2.0 Principles** The person performing this task must be able to explain the following principles: 2.1 Safety and environmental protection; 2.2 Safety standards and technical standards of parts for locomotive overhaul. **3.0 Theories** The person performing this task must be able to explain the following: 3.1 The overhaul process for the parts of locomotive

10. Arrange and store the tools and equipment.	running gears; 3.2 Overhaul methods for the parts of locomotive running gears; 3.3 Technical requirements for the parts of locomotive running gears; 3.4 Tooling and equipment requirements for the parts of locomotive running gears; 3.5 Usage of overhaul tools and equipment. **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 development of the overhaul process for locomotive running gears is completed in accordance with technical requirements.
CIRCUMSTANTIAL KNOWLEDGE	**Detailed knowledge about:** 1. Safety operation of operating machines and tools; 2. Safety operation of the overhaul process; 3. Occupational health and safety; 4. Waste disposal methods.

OCCUPATION	RAILWAY LOCOMOTIVE OPERATION AND MAINTENANCE ENGINEER	**OCCUPATION CODE**	
DUTY TITLE	DEVELOPMENT OF OVERHAUL PROCESS	**DUTY NO.**	801
TASK TITLE	DEVELOPMENT OF OVERHAUL PROCESS FOR THE LOCOMOTIVE BRAKING SYSTEM	**TASK NO.**	8012
PERFORMANCE CRITERIA	The person performing this task must be able to develop the overhaul process for the locomotive braking system in accordance with the technical conditions of the workshop, the locomotive braking system maintenance manual, and lean production requirements.		
RANGE STATEMENT	The task can be performed in the locomotive production workshop / office under the supervision of railway locomotive operation and maintenance engineers. The tools and equipment to be used include: 1. Office equipment such as computers; 2. Locomotive maintenance manual.		

EVIDENCE REQUIREMENT	
PRACTICAL PERFORMANCE	**UNDERPINNING KNOWLEDGE**
The person performing this task must be able to do the following: 1. Develop the overhaul process for the JZ-7 brake; 2. Develop the overhaul process for the DK-1 brake; 3. Develop the overhaul process for the CCB II brake; 4. Develop the overhaul process for the Faiveley brake; 5. Develop the overhaul process for the accessories of braking devices; 6. Develop the overhaul process for air compressors and air source purification units; 7. Develop the overhaul process for basic braking devices; 8. Comply with industry standards; 9. Clean the workplace; 10. Arrange and store the tools and equipment.	**Detailed knowledge about:** **1.0 Methods** The person performing this task must be able to explain how to: 1.1 Overhaul locomotive brakes; 1.2 Overhaul the accessories of braking devices; 1.3 Overhaul air compressors and air source purification units; 1.4 Overhaul basic braking devices; 1.5 Handle common faults in locomotive braking systems; 1.6 Comply with the requirements for developing overhaul processes. **2.0 Principles** The person performing this task must be able to explain the following principles: 2.1 Principles of locomotive braking system overhaul; 2.2 Technical requirements for overhauling locomotive braking systems.

	3.0 Theories The person performing this task must be able to explain the following: 3.1 Overhaul process for locomotive braking systems; 3.2 Daily maintenance schemes for locomotive braking systems; 3.3 Common troubleshooting procedures for locomotive braking systems; 3.4 Operating procedures of special equipment for overhaul. **4.0 Essential Skills** 4.1 Communication skills; 4.2 Computer skills; 4.3 Practical writing skills.
DESCRIPTION OF THE END PRODUCT / SERVICE	The overhaul process for the locomotive braking system is developed in accordance with the locomotive maintenance manual.
CIRCUMSTANTIAL KNOWLEDGE	**Detailed knowledge about:** 1. Security regulations of workshop sites; 2. Occupational health and safety; 3. Waste disposal methods.

OCCUPATION	RAILWAY LOCOMOTIVE OPERATION AND MAINTENANCE ENGINEER	**OCCUPATION CODE**	
DUTY TITLE	DEVELOPMENT OF OVERHAUL PROCESS	**DUTY NO.**	801
TASK TITLE	DEVELOPMENT OF OVERHAUL PROCESS FOR LOCOMOTIVE MOTORS AND ELECTRIC APPARATUS	**TASK NO.**	8013
PERFORMANCE CRITERIA	The person performing this task must be able to develop the overhaul process for locomotive motors and electric apparatus in accordance with the technical conditions of the workshop, the locomotive braking system maintenance manual, and lean production requirements.		
RANGE STATEMENT	The task can be performed in the machinery production workshop office. The tools and equipment to be used include: 1. Office equipment such as computers; 2. Locomotive maintenance manual.		

EVIDENCE REQUIREMENT	
PRACTICAL PERFORMANCE	**UNDERPINNING KNOWLEDGE**
The person performing this task must be able to do the following: 1. Develop the overhaul process for main generators; 2. Develop the overhaul process for traction motors; 3. Develop the overhaul process for auxiliary motors; 4. Develop the overhaul process for main transformers; 5. Develop the overhaul process for high-voltage apparatus on the roof of the locomotive; 6. Develop the overhaul process for low-voltage apparatus on the roof of the locomotive; 7. Comply with industry standards.	**Detailed knowledge about:** **1.0 Methods** The person performing this task must be able to explain how to: 1.1 Overhaul main generators; 1.2 Overhaul traction motors; 1.3 Overhaul auxiliary motors; 1.4 Overhaul main transformers; 1.5 Overhaul the high-voltage apparatus on the roof of the locomotive; 1.6 Overhaul the low-voltage apparatus of the locomotive; 1.7 Handle common faults in locomotive motors and electric apparatus; 1.8 Comply with the requirements for developing overhaul processes. **2.0 Principles** The person performing this task must be able to explain the following principles: 2.1 Overhaul principles and fundamentals of locomotive motors and electric apparatus.

	3.0 Theories The person performing this task must be able to explain the following: 3.1 Overhaul process for locomotive motors and electric apparatus; 3.2 Daily maintenance schemes for locomotive motors and electric apparatus; 3.3 Common troubleshooting methods for locomotive motors and electric apparatus; 3.4 Operating methods of special equipment for overhaul. **4.0 Essential Skills** 4.1 Communication skills; 4.2 Computer skills; 4.3 Practical writing skills.
DESCRIPTION OF THE END PRODUCT / SERVICE	The overhaul process for locomotive motors and electric apparatus is developed in accordance with the locomotive maintenance manual.
CIRCUMSTANTIAL KNOWLEDGE	**Detailed knowledge about:** 1. Security regulations of workshop sites; 2. Occupational health and safety; 3. Waste disposal methods.

OCCUPATION	RAILWAY LOCOMOTIVE OPERATION AND MAINTENANCE ENGINEER	**OCCUPATION CODE**	
DUTY TITLE	DEVELOPMENT OF OVERHAUL PROCESS FOR DIESEL ENGINES	**DUTY NO.**	801
TASK TITLE	DEVELOPMENT OF OVERHAUL PROCESS FOR LOCOMOTIVE RUNNING GEARS	**TASK NO.**	8014
PERFORMANCE CRITERIA	The person performing this task must be able to develop the overhaul process for diesel engines in accordance with the overhaul process.		
RANGE STATEMENT	The task can be performed in the overhaul workshop under the supervision of senior technicians or railway locomotive operation and maintenance engineers. The tools and equipment to be used include: 1. Personal protective equipment, such as safety shoes, goggles, gloves; 2. Computers.		

EVIDENCE REQUIREMENT

PRACTICAL PERFORMANCE	**UNDERPINNING KNOWLEDGE**
The person performing this task must be able to do the following: 1. Analyze the composition and structure of the diesel engine; 2. Develop the overhaul process for power packs; 3. Develop the overhaul process for superchargers and intercoolers; 4. Develop the overhaul process for front-end boxes; 5. Develop the overhaul process for crankshafts; 6. Develop the oil sump overhaul process; 7. Develop the overhaul process for engine bodies; 8. Develop the overhaul process for water and oil pumps; 9. Develop the overhaul process for piston connecting rods; 10. Develop the overhaul process for flywheel group components; 11. Clean the workplace; 12. Arrange and store the tools and	**Detailed knowledge about:** **1.0 Methods** The person performing this task must be able to explain how to: 1.1 Develop the overhaul process for diesel engines. **2.0 Principles** The person performing this task must be able to explain the following principles: 2.1 Procedures and standards for locomotive safety and overhaul; 2.2 Safety and environmental protection. **3.0 Theories** The person performing this task must be able to explain the following: 3.1 Overhaul process for diesel engine parts; 3.2 Usage of appropriate tools and equipment. **4.0 Essential Skills** 4.1 Communication skills; 4.2 Customer service skills;

equipment.	4.3 Teamwork skills; 4.4 Report writing skills.
DESCRIPTION OF THE END PRODUCT / SERVICE	The development of the overhaul process for locomotive running gears is completed in accordance with technical requirements.
CIRCUMSTANTIAL KNOWLEDGE	**Detailed knowledge about:** 1. Safety operation of operating machines and tools; 2. Safety operation of the overhaul process; 3. Occupational health and safety; 4. Maintenance operation processes and procedures (MOPP); 5. Waste disposal methods.

OCCUPATION	RAILWAY LOCOMOTIVE OPERATION AND MAINTENANCE ENGINEER	**OCCUPATION CODE**	
DUTY TITLE	OPTIMIZATION OF LOCOMOTIVE OPERATION	**DUTY NO.**	802
TASK TITLE	TRAIN TRACTION CALCULATION	**TASK NO.**	8021
PERFORMANCE CRITERIA	The person performing this task must be able to determine the traction mass and calculate the running hour and speed and the consumption of energy and fuel in accordance with railway conditions and locomotive tractive force.		
RANGE STATEMENT	The task can be performed in the maintenance operations office under the supervision of railway locomotive operation and maintenance engineers. The tools and equipment to be used include: 1. Computers; 2. Traction computing softwares.		

EVIDENCE REQUIREMENT	
PRACTICAL PERFORMANCE	**UNDERPINNING KNOWLEDGE**
The person performing this task must be able to do the following: 1. Comply with the safety and health prevention measures; 2. Select appropriate computing equipment and software; 3. Select appropriate computational parameters; 4. Select the appropriate formula; 5. Complete manual calculation for the train operation process; 6. Complete target calculation with traction calculation software; 7. Record the calculation process and data; 8. Explain the calculation process and results.	**Detailed knowledge about:** **1.0 Methods** The person performing this task must be able to explain how to: 1.1 Determine the traction mass; 1.2 Calculate the number of running hours; 1.3 Calculate the running speed; 1.4 Calculate energy and fuel consumption. **2.0 Principles** The person performing this task must be able to explain the following principles: 2.1 Principles of traction calculation. **3.0 Theories** The person performing this task must be able to explain the following: 3.1 Standards of locomotive traction characteristic curves; 3.2 Train resistance standards; 3.3 Braking force standards for train operation; 3.4 Train movement equations.

	4.0 Essential Skills 4.1 Communication skills; 4.2 Computer skills; 4.3 Customer service skills; 4.4 Teamwork skills; 4.5 Report writing skills.
DESCRIPTION OF THE END PRODUCT / SERVICE	Traction calculation is carried out in accordance with relevant specifications.
CIRCUMSTANTIAL KNOWLEDGE	**Detailed knowledge about:** 1. Computer information security protection; 2. Occupational health and safety.

OCCUPATION	RAILWAY LOCOMOTIVE OPERATION AND MAINTENANCE ENGINEER	**OCCUPATION CODE**	
DUTY TITLE	OPTIMIZATION OF LOCOMOTIVE OPERATION	**DUTY NO.**	802
TASK TITLE	ANALYSIS OF LOCOMOTIVE OPERATION RECORD DATA	**TASK NO.**	8022
PERFORMANCE CRITERIA	The person performing this task must be able to complete the analysis of locomotive operation record data in accordance with relevant regulations.		
RANGE STATEMENT	The task can be performed in the locomotive operations office under the supervision of railway locomotive operation and maintenance engineers. The tools and equipment to be used include: 1. Computers; 2. Locomotive operation record data analysis software.		

EVIDENCE REQUIREMENT	
PRACTICAL PERFORMANCE	**UNDERPINNING KNOWLEDGE**
The person performing this task must be able to do the following: 1. Comply with the safety and health prevention measures; 2. Use locomotive operation record data analysis software; 3. Identify points of violations during the operation of the locomotive crew; 4. Judge the operation of the locomotive crew; 5. Analyze data to summarize operational experience.	**Detailed knowledge about:** **1.0 Methods** The person performing this task must be able to explain how to: 1.1 Use locomotive operation data analysis and recording software; 1.2 Use the software to identify points of violations. **2.0 Principles** The person performing this task must be able to explain the following principles: 2.1 Causes of the occurrence of points of violations in data analysis. **3.0 Theories** The person performing this task must be able to explain the following: 3.1 Principles for determining points of violations in data analysis. **4.0 Essential Skills** 4.1 Communication skills; 4.2 Computer skills; 4.3 Customer service skills;

	4.4 Teamwork skills; 4.5 Report writing skills.
DESCRIPTION OF THE END PRODUCT / SERVICE	The analysis of locomotive operation record data is completed in accordance with relevant regulations.
CIRCUMSTANTIAL KNOWLEDGE	**Detailed knowledge about:** 1. Computer information security protection; 2. Occupational health and safety.

OCCUPATION	RAILWAY LOCOMOTIVE OPERATION AND MAINTENANCE ENGINEER	**OCCUPATION CODE**	
DUTY TITLE	OPTIMIZATION OF LOCOMOTIVE OPERATION	**DUTY NO.**	802
TASK TITLE	DRAWING OF SCHEMATIC DIAGRAMS OF TRAIN OPERATION	**TASK NO.**	8023
PERFORMANCE CRITERIA	The person performing this task must be able to prepare schematic diagrams of train operation in accordance with the *Regulation for the Management of Railway Locomotive Utilization* and the *Regulations for Railway Technical Management*.		
RANGE STATEMENT	The task can be performed in the locomotive operations office under the supervision of railway locomotive operation and maintenance engineers. The tools and equipment to be used include: 1. Computers; 2. Preparation software for schematic diagrams of train operation.		

EVIDENCE REQUIREMENT	
PRACTICAL PERFORMANCE	**UNDERPINNING KNOWLEDGE**
The person performing this task must be able to do the following: 1. Comply with the safety and health prevention measures; 2. Use a computer to prepare the schematic diagram of train operation; 3. Draw the train speed curve; 4. Draw the running-hour curve; 5. Indicate railway longitudinal sections and signal machine locations; 6. Draw the schematic plan of the station; 7. Identify the location of the pick-up and return handles; 8. Indicate where the power brake is to be used and returned; 9. Label the amount of air brake depressurization and the location and rate of relief; 10. Indicate the speed limit of the zone and that of the turnouts at each station within the zone; 11. Label the location of the phasing area	**Detailed knowledge about:** **1.0 Methods** The person performing this task must be able to explain how to: 1.1 Manage the base data of railways; 1.2 Manage the plotting data of schematic diagrams of train operation; 1.3 Synthesize longitudinal section curves of railways; 1.4 Complete the calculation of the train operation curve. **2.0 Principles** The person performing this task must be able to explain the following principles: 2.1 Drawing principles of schematic diagrams of train operation. **3.0 Theories** The person performing this task must be able to explain the following: 3.1 Meaning of icons and curves in schematic

of the contact network; 12. List the precautions for each zone.	diagrams of train operation; 3.2 Principles of determining the icons and curves in schematic diagrams of train operation. **4.0 Essential Skills** 4.1 Communication skills; 4.2 Computer skills; 4.3 Customer service skills; 4.4 Teamwork skills; 4.5 Report writing skills.
DESCRIPTION OF THE END PRODUCT / SERVICE	The preparation of schematic diagrams of train operation is completed.
CIRCUMSTANTIAL KNOWLEDGE	**Detailed knowledge about:** 1. Computer information security protection; 2. Occupational health and safety; 3. Methods of preparing train working diagrams.

OCCUPATION	RAILWAY LOCOMOTIVE OPERATION AND MAINTENANCE ENGINEER	**OCCUPATION CODE**	
DUTY TITLE	OPTIMIZATION OF LOCOMOTIVE OPERATION	**DUTY NO.**	802
TASK TITLE	OPTIMIZATION OF LOCOMOTIVE ROUTING LAYOUT	**TASK NO.**	8024
PERFORMANCE CRITERIA	The person performing this task must be able to optimize the locomotive routing layout through rational planning and making full use of the advantageous performance of modern locomotives and transportation equipment.		
RANGE STATEMENT	The task can be performed in the locomotive operations office under the supervision of railway locomotive operation and maintenance engineers. The tools and equipment to be used include: 1. Computers; 2. Preparation software for locomotive working diagrams.		

EVIDENCE REQUIREMENT	
PRACTICAL PERFORMANCE	**UNDERPINNING KNOWLEDGE**
The person performing this task must be able to do the following: 1. Comply with the safety and health prevention measures; 2. Obtain the data required to optimize the locomotive routing layout; 3. Optimize the locomotive routing layout by computers; 4. Verify the results of the optimized locomotive routing layout.	**Detailed knowledge about:** **1.0 Methods** The person performing this task must be able to explain how to: 1.1 Determine the locations of the locomotive depot and the turnaround depot; 1.2 Determine the length of locomotive routing. **2.0 Principles** The person performing this task must be able to explain the following principles: 2.1 Principles of optimizing the locomotive routing layout; 2.2 Methods of improving transportation efficiency; 2.3 Methods of optimizing the layout of transportation equipment. **3.0 Theories** The person performing this task must be able to explain the following: 3.1 Types of locomotive routing; 3.2 Locomotive operation systems;

	3.3 Locomotive crew systems; 3.4 Methods of locomotive utilization. **4.0 Essential Skills** 4.1 Communication skills; 4.2 Computer skills; 4.3 Customer service skills; 4.4 Teamwork skills; 4.5 Report writing skills.
DESCRIPTION OF THE END PRODUCT / SERVICE	The preparation of schematic diagrams of train operation is completed.
CIRCUMSTANTIAL KNOWLEDGE	**Detailed knowledge about:** 1. Computer information security protection; 2. Occupational health and safety; 3. Methods of optimizing the locomotive routing layout.

OCCUPATION	RAILWAY LOCOMOTIVE OPERATION AND MAINTENANCE ENGINEER	**OCCUPATION CODE**	
DUTY TITLE	DRAWING OF LOCOMOTIVE WORKING DIAGRAMS	**DUTY NO.**	803
TASK TITLE	ANALYSIS OF THE EFFICIENCY OF LOCOMOTIVE UTILIZATION	**TASK NO.**	8031
PERFORMANCE CRITERIA	The person performing this task must be able to calculate the number of locomotives and train pairs, the coefficient of locomotive utilization, the average kilometers per day of locomotives, the average gross traction weight, the technical speed, and other indicators of locomotive utilization in accordance with the locomotive working diagram.		
RANGE STATEMENT	The task can be performed in the locomotive utilization analysis room under the supervision of railway locomotive operation and maintenance engineers. The tools and equipment to be used include: 1. Computers; 2. Application of commonly-used software; 3. Peripheral equipment of computers.		

EVIDENCE REQUIREMENT

PRACTICAL PERFORMANCE	**UNDERPINNING KNOWLEDGE**
The person performing this task must be able to do the following: 1. Observe the preventive measures for health and safety; 2. Use commonly-used software; 3. Calculate the number of locomotives; 4. Calculate the average kilometers per day of locomotives; 5. Calculate the average gross traction weight; 6. Calculate the assisted running rate of locomotives; 7. Comply with computer information security regulations; 8. Clean the workplace; 9. Organize the archived material.	**Detailed knowledge about:** **1.0 Methods** The person performing this task must be able to explain how to: 1.1 Calculate the locomotive utilization quantity indicator; 1.2 Calculate the locomotive utilization quality indicator; 1.3 Calculate energy and fuel consumption. **2.0 Principles** The person performing this task must be able to explain the following principles: 2.1 Locomotive utilization indicators. **3.0 Theories** The person performing this task must be able to explain the following: 3.1 Day (shift) plan of the locomotive working diagram;

	3.2 Locomotive utilization quality indicators; 3.3 Locomotive utilization quantity indicators. **4.0 Essential Skills** 4.1 Communication skills; 4.2 Computer skills; 4.3 Data analysis skills; 4.4 Teamwork skills; 4.5 Report writing skills.
DESCRIPTION OF THE END PRODUCT / SERVICE	The indicators of locomotive utilization are analyzed, and the efficiency of locomotive utilization is improved in accordance with the locomotive working diagram.
CIRCUMSTANTIAL KNOWLEDGE	**Detailed knowledge about:** 1. Office software operation; 2. Computer information security protection; 3. Occupational health and safety.

OCCUPATION	RAILWAY LOCOMOTIVE OPERATION AND MAINTENANCE ENGINEER	**OCCUPATION CODE**	
DUTY TITLE	DRAWING OF LOCOMOTIVE WORKING DIAGRAMS	**DUTY NO.**	803
TASK TITLE	DRAWING OF LOCOMOTIVE WORKING DIAGRAMS	**TASK NO.**	8032
PERFORMANCE CRITERIA	The person performing this task must be able to draw locomotive working diagrams in accordance with such technical standards as railway station conditions, prepared passing capacity of locomotive depots, locomotive routing and modes of travel.		
RANGE STATEMENT	The task can be performed in the locomotive utilization room under the supervision of railway locomotive operation and maintenance engineers. The tools and equipment to be used include: 1. Computers; 2. Graphics softwares.		

EVIDENCE REQUIREMENT	
PRACTICAL PERFORMANCE	**UNDERPINNING KNOWLEDGE**
The person performing this task must be able to do the following: 1. Use traction calculation software; 2. Search for railway conditions; 3. Collect locomotive tractive force; 4. Observe safety regulations; 5. Clean the workplace; 6. Arrange and store the tools and equipment.	**Detailed knowledge about:** **1.0 Methods** The person performing this task must be able to explain how to: 1.1 Determine the traction mass; 1.2 Calculate the number of running hours; 1.3 Calculate the running speed; 1.4 Calculate energy and fuel consumption. **2.0 Principles** The person performing this task must be able to explain the following principles: 2.1 Principles of traction calculation. **3.0 Theories** The person performing this task must be able to explain the following: 3.1 Locomotive traction characteristic curves; 3.2 Train resistance; 3.3 Braking force of train operation; 3.4 Train movement equations.

	4.0 Essential Skills 4.1 Communication skills; 4.2 Computer skills; 4.3 Customer service skills; 4.4 Teamwork skills; 4.5 Report writing skills.
DESCRIPTION OF THE END PRODUCT / SERVICE	Traction calculation is carried out in accordance with relevant specifications.
CIRCUMSTANTIAL KNOWLEDGE	**Detailed knowledge about:** 1. Computer information security protection; 2. Occupational health and safety.

OCCUPATION	RAILWAY LOCOMOTIVE OPERATION AND MAINTENANCE ENGINEER	**OCCUPATION CODE**	
DUTY TITLE	DRAWING OF LOCOMOTIVE WORKING DIAGRAMS	**DUTY NO.**	803
TASK TITLE	ORGANIZATION AND IMPLEMENTATION OF LOCOMOTIVE WORKING DIAGRAMS	**TASK NO.**	8033
PERFORMANCE CRITERIA	The person performing this task must be able to organize and implement the day (shift) plan of the locomotive working diagram and locomotive utilization emergency command in accordance with the locomotive working diagram.		
RANGE STATEMENT	The task can be performed in the locomotive depot operation room under the supervision of railway locomotive operation and maintenance engineers. The tools and equipment to be used include: 1. Phone number of dispatch command; 2. Computers; 3. Fax machines; 4. Printers; 5. Record telephones.		

EVIDENCE REQUIREMENT	
PRACTICAL PERFORMANCE	**UNDERPINNING KNOWLEDGE**
The person performing this task must be able to do the following: 1. Observe the preventive measures for health and safety; 2. Choose suitable tools; 3. Prepare day-shift locomotive utilization plans; 4. Organize locomotive maintenance plans; 5. Communicate running tips and give dispatch orders; 6. Handle the joining and unjoining of spare locomotives; 7. Organize rescue train departures; 8. Clean the tools, equipment and workplaces; 9. Organize and archive relevant materials.	**Detailed knowledge about:** **1.0 Methods** The person performing this task must be able to explain how to: 1.1 Prepare day-shift locomotive utilization plans; 1.2 Organize locomotive maintenance plans; 1.3 Communicate running tips; 1.4 Give dispatch orders. **2.0 Principles** The person performing this task must be able to explain the following principles: 2.1 Principles for the issuance of various orders. **3.0 Theories** The person performing this task must be able to explain the following: 3.1 Rest time standards for the crew;

	3.2 The importance of emergency command of train operation; 3.3 Regulation sources for each order. **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	Orders are given in accordance with relevant rules and regulations.
CIRCUMSTANTIAL KNOWLEDGE	**Detailed knowledge about:** 1. Occupational health and safety; 2. Computer information security protection.

OCCUPATION	RAILWAY LOCOMOTIVE OPERATION AND MAINTENANCE ENGINEER	**OCCUPATION CODE**	
DUTY TITLE	ORGANIZATION AND MANAGEMENT OF LOCOMOTIVE OPERATION AND MAINTENANCE AND DISPATCHING OF WORK SAFETY	**DUTY NO.**	804
TASK TITLE	MANAGEMENT OF LOCOMOTIVE TECHNICAL DOCUMENTS	**TASK NO.**	8041
PERFORMANCE CRITERIA	The person performing this task must be able to manage locomotive technical documents in accordance with the instructions of the supervisor.		
RANGE STATEMENT	The task can be performed in the office and in the field under the supervision of railway locomotive operation and maintenance engineers. The tools and equipment to be used include: 1. Computers; 2. Record telephones; 3. Fax machines; 4. Printers; 5. Breathalyzers.		

EVIDENCE REQUIREMENT

PRACTICAL PERFORMANCE	**UNDERPINNING KNOWLEDGE**
The person performing this task must be able to do the following: 1. Check and submit train working diagrams and locomotive working diagrams; 2. Complete the locomotive utilization plan; 3. Prepare and manage the image and text technical documents of locomotive operation and maintenance, dispatching operation, etc.; 4. Receive, verify, and communicate dispatch orders; 5. Manage the regulations, orders, documents, telegrams, etc. related to train running, operation and maintenance; 6. Set up relevant ledgers.	**Detailed knowledge about:** **1.0 Methods** The person performing this task must be able to explain how to: 1.1 Manage locomotive technical documents. **2.0 Principles** The person performing this task must be able to explain the following principles: 2.1 Basic principles and main ways of managing locomotive technical documents. **3.0 Theories** The person performing this task must be able to explain the following: 3.1 Locomotive technical standards and data identification and management methods. **4.0 Essential Skills**

	4.1 Communication skills; 4.2 Computer skills; 4.3 Teamwork skills; 4.4 Document writing skills.
DESCRIPTION OF THE END PRODUCT / SERVICE	Locomotive technical documents are managed in accordance with the instructions of the superior.
CIRCUMSTANTIAL KNOWLEDGE	**Detailed knowledge about:** 1. Safety operation of equipment and tools; 2. Safety operation of measuring instruments; 3. Occupational health and safety.

OCCUPATION	RAILWAY LOCOMOTIVE OPERATION AND MAINTENANCE ENGINEER	**OCCUPATION CODE**	
DUTY TITLE	ORGANIZATION AND MANAGEMENT OF LOCOMOTIVE OPERATION AND MAINTENANCE AND DISPATCHING OF WORK SAFETY	**DUTY NO.**	804
TASK TITLE	MANAGEMENT OF O&M WORKSHOP FACILITIES	**TASK NO.**	8042
PERFORMANCE CRITERIA	The person performing this task must be able to manage O&M workshop facilities in accordance with technical requirements.		
RANGE STATEMENT	The task can be performed in the utilization workshop under the supervision of associate directors of professional management or engineers. The tools and equipment to be used include: 1. Computers; 2. Record telephones; 3. Fax machines; 4. Printers; 5. Breathalyzers.		

EVIDENCE REQUIREMENT	
PRACTICAL PERFORMANCE	**UNDERPINNING KNOWLEDGE**
The person performing this task must be able to do the following: 1. Choose appropriate inspection tools, equipment and safety protection equipment; 2. Choose suitable tools; 3. Manage the tools and equipment; 4. Supervise the storage of tools, materials, equipment and spare parts; 5. Supervise the maintenance of O&M workshop tools and equipment.	**Detailed knowledge about:** **1.0 Methods** The person performing this task must be able to explain how to: 1.1 Manage O&M workshop facilities. **2.0 Principles** The person performing this task must be able to explain the following principles: 2.1 Principles of managing O&M workshop facilities. **3.0 Theories** The person performing this task must be able to explain the following: 3.1 Methods of managing the O&M workshop; 3.2 Methods of using tools and equipment. **4.0 Essential Skills**

	4.1 Communication skills; 4.2 Teamwork skills; 4.3 Report writing skills.
DESCRIPTION OF THE END PRODUCT / SERVICE	The management of O&M workshop facilities is accomplished in accordance with technical requirements.
CIRCUMSTANTIAL KNOWLEDGE	**Detailed knowledge about:** 1. Safety operation of equipment and tools; 2. Safety operation of measuring instruments; 3. Occupational health and safety.

OCCUPATION	RAILWAY LOCOMOTIVE OPERATION AND MAINTENANCE ENGINEER	**OCCUPATION CODE**	
DUTY TITLE	ORGANIZATION AND MANAGEMENT OF LOCOMOTIVE OPERATION AND MAINTENANCE AND DISPATCHING OF WORK SAFETY	**DUTY NO.**	804
TASK TITLE	MANAGEMENT OF O&M WORKSHOP EMPLOYEES	**TASK NO.**	8043
PERFORMANCE CRITERIA	The person performing this task must be able to manage O&M workshop employees as required.		
RANGE STATEMENT	The task can be performed in the office or on site under the supervision of associate directors of professional management or engineers. The tools and equipment to be used include: 1. Computers; 2. Record telephones; 3. Fax machines; 4. Printers; 5. Breathalyzers.		

EVIDENCE REQUIREMENT

PRACTICAL PERFORMANCE	UNDERPINNING KNOWLEDGE
The person performing this task must be able to do the following: 1. Comply with the basic requirements of safety management in the O&M workshop; 2. Choose appropriate tools, equipment and safety protection equipment; 3. Establish the management system for inspection and evaluation; 4. Organize and implement technical safety education; 5. Organize the education and examination on rules and regulations; 6. Assign duties and responsibilities to O&M workshop employees; 7. Formulate training plans for locomotive utilization and safety	**Detailed knowledge about:** **1.0 Methods** The person performing this task must be able to explain how to: 1.1 Implement basic requirements for safety management; 1.2 Complete inspection and evaluation management; 1.3 Complete education and examinations on rules and regulations; 1.4 Develop training plans. **2.0 Principles** The person performing this task must be able to explain the following principles: 2.1 Basic requirements for managing O&M workshop employees; 2.2 Requirements for the assignment of duties and responsibilities of O&M workshop employees.

management, and organize and implement relevant training.	**3.0 Theories** The person performing this task must be able to explain the following: 3.1 Basic requirements for running safety management; 3.2 Technical safety education standards; 3.3 Management standards of the locomotive dispatching office; 3.4 Running safety management duties; 3.5 Methods of managing running safety equipment. **4.0 Essential Skills** 4.1 Communication skills; 4.2 Team management skills; 4.3 Problem solving skills.
DESCRIPTION OF THE END PRODUCT / SERVICE	O&M workshop employees are managed in accordance with relevant rules and regulations.
CIRCUMSTANTIAL KNOWLEDGE	**Detailed knowledge about:** 1. Scope of duties; 2. Occupational health and safety; 3. Safety operation of O&M equipment.

OCCUPATION	RAILWAY LOCOMOTIVE OPERATION AND MAINTENANCE ENGINEER	**OCCUPATION CODE**	
DUTY TITLE	ORGANIZATION AND MANAGEMENT OF LOCOMOTIVE OPERATION AND MAINTENANCE AND DISPATCHING OF WORK SAFETY	**DUTY NO.**	804
TASK TITLE	MANAGEMENT OF THE FULL LIFE CYCLE OF LOCOMOTIVES	**TASK NO.**	8044
PERFORMANCE CRITERIA	The person performing this task must be able to manage the full life cycle of locomotives as required.		
RANGE STATEMENT	The task can be performed in the workshop under the supervision of specialized managers and technicians. The tools and equipment to be used include: 1. Computers; 2. Record telephones; 3. Fax machines; 4. Printers; 5. Breathalyzers.		

EVIDENCE REQUIREMENT

PRACTICAL PERFORMANCE	**UNDERPINNING KNOWLEDGE**
The person performing this task must be able to do the following: 1. Interpret the locomotive overhaul system; 2. Interpret the regulations for the management of locomotive retirement; 3. Set up relevant ledgers; 4. Complete the application and approval of relevant procedures; 5. Maintain relevant technical files.	**Detailed knowledge about:** **1.0 Methods** The person performing this task must be able to explain how to: 1.1 Manage the full life cycle of locomotives. **2.0 Principles** The person performing this task must be able to explain the following principles: 2.1 Methods of managing the full life cycle of locomotives. **3.0 Theories** The person performing this task must be able to explain the following: 3.1 The locomotive overhaul system; 3.2 Regulations for the management of locomotive retirement.

	4.0 Essential Skills 4.1 Communication skills; 4.2 Customer service skills; 4.3 Computer application skills; 4.4 Teamwork skills; 4.5 Report writing skills.
DESCRIPTION OF THE END PRODUCT / SERVICE	The full cycle life of the locomotive is managed in accordance with technical requirements.
CIRCUMSTANTIAL KNOWLEDGE	**Detailed knowledge about:** 1. Scope of duties; 2. Occupational health and safety; 3. Safety operation of O&M operating machines and tools.

TABLE 1: DACUM CHARTS FOR RAILWAY LOCOMOTIVE OPERATION AND MAINTENANCE ENGINEER - NTA 8

DUTIES	TASKS	ENABLERS
1.0 Development of overhaul process	1.1 Development of overhaul process for locomotive running gears.	**General skills and knowledge** · Cooperation with others using communication skills and submission of reports to the superiors · Use of locomotive maintenance manuals · Overhaul process requirements for locomotive running gears, braking systems, motors and electric apparatus and diesel engines · Overhaul process for locomotive components **Tools and equipment** · Protective equipment such as insulating shoes, work clothes, goggles and gloves · Flashlights, inspection hammers, wrenches, steel rulers, vernier calipers and other commonly-used tools · Detection equipment, overhead cranes, lathes and other commonly-used overhaul equipment **Materials** · Lubricating grease and gear oil **Requirements for employees** · Teamwork spirit, integrity, time management and commitment
	1.2 Development of overhaul process for the locomotive braking system.	
	1.3 Development of overhaul process for locomotive motors and electric apparatus.	
	1.4 Development of overhaul process for diesel engines.	
2.0 Optimization of locomotive operation	2.1 Train traction calculation.	**General skills and knowledge** · Cooperation with others using communication skills and submission of reports to the
	2.2 Analysis of locomotive operation record data.	
	2.3 Drawing of schematic	

DUTIES	TASKS	ENABLERS
	diagrams of train operation.	superiors · Use of locomotive maintenance manuals · Methods and principles of train traction calculation · Methods of using traction calculation software · Methods of using locomotive operation record data analysis software · Drawing of schematic diagrams of train operation · Drawing of locomotive working diagrams **Tools and equipment** · Computers · Traction calculation software · Locomotive operation data analysis and recording software · Preparation software for schematic diagrams of train operation · Preparation software for locomotive working diagrams **Materials** · No requirement **Requirements for employees** · Teamwork spirit, integrity, time management and commitment
	2.4 Optimization of locomotive routing layout.	
3.0 Drawing of locomotive working diagrams	3.1 Analysis of the efficiency of locomotive utilization.	**General skills and knowledge** · Cooperation with others using communication skills and submission of reports to the superiors · Use of locomotive maintenance manuals · Compliance with monitoring and
	3.2 Drawing of locomotive working diagrams.	
	3.3 Organization and implementation of locomotive working diagrams.	

DUTIES	TASKS	ENABLERS
		security precautions · Regulations relating to railway technical management · Railway locomotive emergency command handling · Railway locomotive utilization, maintenance and overhaul dynamics · Calculation of quantitative and qualitative indicators of locomotive utilization **Tools and equipment** · Computers · Commonly-used software · Peripheral equipment of computers **Materials** · No requirement **Requirements for employees** · Teamwork spirit, integrity, time management and commitment
4.0 Organization and management of locomotive operation and maintenance and dispatching of work safety	4.1 Management of locomotive technical documents. 4.2 Management of O&M workshop facilities. 4.3 Management of O&M workshop employees. 4.4 Management of the full life cycle of locomotives.	**General skills and knowledge** · Cooperation with others using communication skills and submission of reports to the superiors · Use of locomotive maintenance manuals · Basic principles and management methods for locomotive-related technical documents · Regulations for the management of O&M workshop facilities · Regulations for the management of O&M workshop employees · Basic requirements for running safety management · Management standards of

DUTIES	TASKS	ENABLERS
		locomotive dispatching · Methods of managing the full life cycle of locomotives · Regulations for the management of locomotive retirement · Locomotive overhaul system **Tools and equipment** · Computers · Commonly-used software · Peripheral equipment of computers **Materials** · No requirement **Requirements for employees** · Teamwork spirit, integrity, time management and commitment