NATIONAL COUNCIL FOR TECHNICAL EDUCATION

November 2022

Proposed Occupational Standards for Railway Engineering Technician

Occupation: Railway Engineering Technician

Level: NTA-6

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Foreword

The National Council for Technical Education (NACTE) is a corporate body established by the National Council for Technical Education Act, Cap.129. The Act provides a legal framework for the Council to coordinate the provision of technical education and training in Tanzania. The mandate of NACTE is three-fold, namely: Regulatory, Quality Assurance and Policy Advisory.

In discharging its mandate, the Council has been charged with the responsibilities, among others, to:

(a) assist technical institutions in the transmission of knowledge, principles and training in the field of technical education and training for the benefit of the people of Tanzania;

(b) assist technical institutions in the overall development of the quality of education they provide and to promote and to maintain approved academic standards;

(c) establish and make awards in technical education which are consistent in standard and comparable to related awards in Tanzania and internationally;

(d) ensure that the quality of education required for the awards is met and maintained throughout the duration of the delivery of the course.

In the course of execution of these responsibilities, the Council has been instituting various measures aiming at advancing the quality of training provided in technical institutions in respect of the changing demands of the labour market, both local and international.

To achieve the above obligation, NACTE, under the Ministry of Education, Science and Technology implemented the East Africa Skills for Transformation and Regional Integration Project (EASTRIP), a project aiming at promoting regional integration through supporting the regional corridors and sector markets, developing common standards and qualifications, and promoting mobility of students, faculty, and

graduates. The project supports the Government of Tanzania to address shortage of skills in five sectors namely:

(a) Energy;
(b) Construction;
(c) Information and Communication Technology (ICT);
(d) Transportation;
(e) Agri-business.

To address the skills, miss-match and shortage in the five (5) sectors in the country, the project funded, among others, a component of Development of Occupational Standards for Technical and Vocational Education and Training (TVET). In this regard, NACTE invited qualified and highly experienced experts from China and Tanzania to carry out the development of Occupational Standards. The exercise was carried out from May to November 2022.

Since Occupational Standards are statements of work performance reflecting the ability to successfully complete the functions required in an occupation, as well as the application of knowledge, skills, attitudes and understanding in an occupation, it is the Council's expectations that the developed standards will form a robust base for decision making and provide explicit guidance to policy makers, curriculum developers, educators, employers and other stakeholders in matters related to manpower planning as well as execution of Technical and Vocational Education and Training undertakings.

Prof. J. W. Kondoro — Dar es Salaam

Chairman — **October 2022**

Acknowledgement

The National Council for Technical Education (NACTE) is charged with the mandate to be the Quality Assurance organ of the Government in matters related to Technical and Vocational Education and Training (TVET) and production of qualified manpower for both local and international labour markets. In order to realize this obligation, NACTE endeavours to institute policies, guidelines and standards and to set the quality benchmarks for training institutions.

However, this is only possible if there is a strong base, linking the training institutions on one hand and the demands of the industry/labour market for relevant manpower on the other hand. Therefore, the Council undertook a step to develop Occupational Standards in sectors considered to be the engine to steer the country's desire to achieve an industrial economy. This exercise would not be a success without the input and support from our stakeholders. I am indebted to acknowledge some of them here.

I wish to acknowledge and appreciate the support from the Ministry of Education, Science and Technology through the East Africa Skills for Transformation and Regional Integration Project (EASTRIP) for the financial support which facilitated the preparation of this document. I also wish to appreciate Ms. Leah Lukindo and Eng. Dr. Simon Baregu for the tireless efforts and commitment in facilitating and guiding the standards development process, Ms. Eileen Tzamburakis and Ms. Chausiku Yakweli Ibrahim for compiling and type setting the final document; and the NACTE Secretariat for coordinating the whole exercise.

At the same time, the Council hoped to further enhance the internationalization level of Occupational Standards and promote the modernization and internationalization of industries, so as to promote Tanzania's integration with the international market and expand its development potential. Therefore, the Council invited the China-Africa Vocational Education Alliance and the China-Africa (Chongqing) Vocational Education Alliance to cooperate with Chinese vocational colleges, together with

experts from the Tanzanian industry and universities, to jointly develop, revise, and review documents of Occupational Standards, for providing assistance for the development of vocational education and related industries in Tanzania based on the experts' rich experience in occupational education, and relying on China's advanced and complete industrial chain and position in the international market.

Therefore, I would like to extend my sincere gratitude to this team of wonderful experts for their hard work, dedication and their wisdom and experience in the preparation of this document. I would like to recognise the inputs of the following institutions and experts:

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Last but not least, I would like to acknowledge the enormous inputs from all stakeholders who were consulted during the validation process to provide their expert views and opinions on the validity of the contents and preparation of this document for customers' consumption.

Dr. A. B. Rutayuga — Dar es Salaam

Executive Secretary — October **2022**

Abbreviations

CBET	Competence-based Education and Training
NACTE	National Council for Technical Education
NOS	National Occupational Standards
OS	Occupational Standards
PPE	Personal Protective Equipment
TET	Technical Education and Training
TVET	Technical and Occupational Education and Training

Glossary

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 during the occupation.
Competency:	A description of the ability one possesses when able to perform a given occupational task effectively and efficiently.
Competence based education:	An instructional program 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 program; a product that states the "intended learning outcomes".
Education/training program:	The complete courses 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: pastry chef)
Occupational analysis:	A process used to identify the tasks that are important to employees in any given occupation.
Occupational area:	This is a broad grouping of related jobs. Example: food service.
Occupational standards:	Specific requirements of competence for people are expected to demonstrate in a particular occupational area, including knowledge and relevant attitudes. They also act as performance tools for the assessment of the prescribed outcomes.

Performance criteria:	It indicates the expected end results or outcome 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:	It is a set of statements, which if proven 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, related knowledge, attitudes, performance criteria, tools and materials needed, and safety concerns required of employees performing it.
Tasks:	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:	This is crucial knowledge that an individual must acquire in order to demonstrate competences that are associated with 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.
Occupational competence:	The application of knowledge and skills to perform consistently to the standards required in the work 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. 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 labor market and the country's economic agenda.

National Occupational Standards (NOS) are performance criteria that are matched with labor market demands. Each National Occupational Standard describes the functions, performance criteria, and knowledge/understanding of one important function or task, as well as the best practices combining skills, knowledge, and attitude. 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. The occupational standards, in general, provide a solid framework for high-quality TET that is labor market-relevant, current and consistent in delivery across all public and private institutions.

However, it must be noted that, the occupational standards and Training standards/qualifications standards are different. The occupational standards are defined in terms of activities performed by a person in a selected occupation (e.g., a railway engineering technician adjusts the rail gap and eliminates the track expansion and excel-out fault of the railway line, 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 courses 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 demands of the labor 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. The occupational standards are thus the starting point for developing Competence-based Education and Training (CBET) programs. TET institutions will be required to benchmark their courses with relevant occupational standards.

The 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 engineering technician has its own set of occupational standards. The document explains how the occupational standards were developed, as well as the scope, the occupational profile in the form of DACUM charts, and the occupational standards.

2.0. Occupational Standard Development Process

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

These sectors include: transport and logistics, tourism and hospitality, agribusiness, construction, energy and ICT. The labor market reports of the National Council for Technical Education, Tanzania were also used in the literature review to determine the skills demand in the Tanzanian labor market as a whole.

After the literature review, a workshop comprised of expert practitioners and educators with substantial knowledge and experience in the occupation conducted an occupational analysis utilizing the curriculum development methods to produce the

occupational profile. The analysis results in DACUM Charts, which are attached as **Schedule 1** to this document.

Thus the occupational standards are developed. Experts in Occupational Analysis and the Development of Occupational Standards have facilitated the workshop. Interviews, online surveys, and a stakeholder forum have been used to verify and validate the occupational standards. Engineers, supervisory technicians on the job, and experienced railway engineering technicians are key informants in the survey to discover occupational trends. This information has been 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. Apart from the survey aiding in defining the scope of the occupational analysis, they serve to engage a wide cross-section of experts in the occupation.

3.0. Scope and Overview of the Occupational Standards for Railway Engineering Technicians

These standards cover a broad range of duties and tasks that can be performed by a railway 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 technicians in specific settings or positions. Railway engineering technicians can perform tasks in many key areas of occupational standards, but not necessarily in all areas. For example, other individuals can be hired or assigned to perform specific tasks in an overhaul of a railway line.

The railway engineering technicians are engaged in the construction, inspection, maintenance, overhaul, and patrol of railway lines, bridges and culverts, tunnels and other buildings to ensure the safe and smooth operation of railway infrastructures and support the daily safe, fast and comfortable operation of the railway. They perform all responsibilities related to the construction, inspection, maintenance and patrol of lines, bridges and culverts and tunnel buildings in railway infrastructure.

Generally, railway engineering technicians are familiar with and master national and industrial technical standards and specifications, read and analyze engineering drawings to fully understand the lines, bridge and tunnel structures in railway infrastructure, carry out equipment construction, check and determine, and repair any defects and inconsistencies. They create and maintain safe, fast and comfortable railway operation conditions by patrolling lines, bridges and tunnels, repairing and replacing faulty equipment, and upgrading and transforming infrastructure. These occupational standards highlight the core knowledge, skills, competence and personal attributes that railway engineering technicians must possess to successfully complete the responsibilities assigned to them, including:

a. Construction and maintenance of railway line facilities
b. Construction and maintenance of railway bridge and culvert facilities
c. Construction and maintenance of railway tunnel facilities
d. Railway line patrol
e. Patrol of railway bridges and culverts
f. Railway tunnel patrol
g. Subordinates supervision
h. Resources management
i. Works in accordance with the safety and health regulations of the Occupational Safety and Health Standards (OSHA).

The occupational standards are grouped to suit the NTA qualification levels, i.e. NTA levels 4, 5 and 6.

4.0. Validity Period

In consideration of the rapid development of technology, the validity period of occupational standards is determined to be 3-5 years. The review will proceed in the same manner as the previous one, with new occupational standards being developed based on current labor market Information.

5.0. Occupational Standards

5.1. Occupational Standards for Railway Engineering Technician - NTA 6

OCCUPATION	RAILWAY ENGINEERING TECHNICIAN	**OCCUPATION CODE**	
DUTY TITLE	RAILWAY LINE OPERATION	**DUTY NO.**	601
TASK TITLE	RAIL OPERATION	**TASK NO.**	6011
PERFORMANCE CRITERIA	The person performing this task must be able to carry out rail maintenance based on occupational standards and technical requirements.		
RANGE STATEMENT	This task can be performed on the railway site under the supervision of railway engineers. The following tools and equipment are required: 1. Light vehicles and trolleys; 2. Gauging rule, chord wire and steel ruler; 3. Common tools for tamping, track lining and track diversion; 4. Common tools for bolt oiling and gasket removal; 5. Labor protection appliances.		
EVIDENCE REQUIREMENTS			
PRACTICAL PERFORMANCE	**BASIC KNOWLEDGE**		
The person performing this task must be able to: 1. Observe health and safety precautions when performing tasks; 2. Select proper tools and equipment for the task; 3. Adjust the rail gap in sections; 4. Replace the rail; 5. Straighten the rail; 6. Maintain the turnout; 7. Align the curve; 8. Repair the joint; 9. Clean tools, equipment and workplaces; 10. Safely store tools and equipment.	**Detailed knowledge about:** **1.0. Methods** The person performing the task must be able to explain: 1.1. Measure and calculate the rail gap and its misalignment, and formulate and implement the rail gap adjustment scheme; 1.2. Organize the replacement of turnout switch rails, stock rails, frogs and guard rails, organize the replacement of rails in sections and arrange shortened rails; 1.3. Straighten the rail with rail straightener; 1.4. Conduct turnout lifting and lining in groups, and adjust the turnout connection curve; 1.5. Calculate and adjust the curve superelevation, calculate the curve lining amount and adjust it; 1.6. Analyze causes for joint defects and comprehensively control the defects.		

	2.0. Principles The person must be able to explain the principles of each rail operation. **3.0. Theory** The person performing the task must be able to explain the following: 3.1. Rail operation methods and procedures; 3.2. Possible problems and causes for rail operation. **4.0. Essential skills** 4.1. Communication skills; 4.2. Teamwork skills; 4.3. Report writing skills.
DESCRIPTION OF THE END PRODUCTS/SERVICE	Complete routine inspection and maintenance of railway rails based on occupational standards and technical requirements.
CIRCUMSTANTIAL KNOWLEDGE	**Detailed knowledge about:** 1. Safe operation of tools; 2. Safe operation of measuring instruments; 3. Occupational health and safety; 4. Waste disposal method.

OCCUPATION	RAILWAY ENGINEERING TECHNICIAN	**OCCUPATION CODE**	
DUTY TITLE	RAILWAY LINE OPERATION	**DUTY NO.**	601
TASK TITLE	CROSSING OPERATION	**TASK NO.**	6012
PERFORMANCE CRITERIA	The person performing this task must be able to lay and renovate railway crossings based on occupational standards and technical requirements.		
RANGE STATEMENT	This task can be performed on the railway site under the supervision of railway engineers. The following tools and equipment are required: 1. Light vehicles and trolleys; 2. Gauging rule, chord wire and steel ruler; 3. Common tools for tamping, track lining and track diversion; 4. Common tools for bolt oiling and gasket removal; 5. Labor protection appliances.		

EVIDENCE REQUIREMENTS	
PRACTICAL PERFORMANCE	**BASIC KNOWLEDGE**
The person performing this task must be able to: 1. Observe health and safety precautions when performing tasks; 2. Select proper tools and equipment for the task; 3. Lay the crossing; 4. Renovate the crossing; 5. Clean tools, equipment and workplaces; 6. Safely store tools and equipment.	**Detailed knowledge about:** **1.0. Methods** The person performing the task must be able to explain: 1.1. Technical requirements for crossing laying; 1.2. Standards for crossing maintenance. **2.0. Principles** The person must be able to explain the principles of crossing operation. **3.0. Theory** The person performing the task must be able to explain the following: 3.1. Contents and operation of crossing laying; 3.2. Contents and operation of crossing renovation. **4.0. Essential skills** 4.1. Communication skills; 4.2. Teamwork skills; 4.3. Report writing skills.

DESCRIPTION OF THE END PRODUCTS/SERVICE	Maintain railway line facilities based on occupational standards and technical requirements.
CIRCUMSTANTIAL KNOWLEDGE	**Detailed knowledge about:** 1. Safe operation of tools; 2. Safe operation of measuring instruments; 3. Occupational health and safety; 4. Waste disposal method.

OCCUPATION	RAILWAY ENGINEERING TECHNICIAN	**OCCUPATION CODE**	
DUTY TITLE	RAILWAY LINE OPERATION	**DUTY NO.**	601
TASK TITLE	INSPECTION AND FAULT HANDLING	**TASK NO.**	6013
PERFORMANCE CRITERIA	The person performing this task must be able to carry out railway line inspection and fault handling based on occupational standards and technical requirements.		
RANGE STATEMENT	This task can be performed on the railway site under the supervision of railway engineers. The following tools and equipment are required: 1. Light vehicles and trolleys; 2. Gauging rule, chord wire and steel ruler; 3. Common tools for tamping, track lining and track diversion; 4. Common tools for bolt oiling and gasket removal; 5. Labor protection appliances.		

EVIDENCE REQUIREMENTS	
PRACTICAL PERFORMANCE	**BASIC KNOWLEDGE**
The person performing this task must be able to: 1. Observe health and safety precautions when performing tasks; 2. Select proper tools and equipment for the task; 3. Inspect the equipment; 4. Handle faults; 5. Clean tools, equipment and workplaces; 6. Safely store tools and equipment.	**Detailed knowledge about:** **1.0. Methods** The person performing the task must be able to explain: 1.1. Inspect the line equipment and turnout equipment, observe the displacement of the jointless track, and use the dynamic and static data to control the defects ; 1.2. Deal with the broken track and expanded track of the line, and organize emergency repair of the line in the accident or disaster section. **2.0. Principles** The person must be able to explain the principles of inspection and fault handling. **3.0. Theory** The person performing the task must be able to explain the following: 3.1. Contents and operation of equipment inspection; 3.2. Contents and operation of fault handling.

	4.0. Essential skills 4.1. Communication skills; 4.2. Teamwork skills; 4.3. Report writing skills.
DESCRIPTION OF THE END PRODUCTS/SERVICE	Effectively complete routine inspection and fault handling of railway lines based on occupational standards and technical requirements.
CIRCUMSTANTIAL KNOWLEDGE	**Detailed knowledge about:** 1. Safe operation of tools; 2. Safe operation of measuring instruments; 3. Occupational health and safety; 4. Waste disposal method.

OCCUPATION	RAILWAY ENGINEERING TECHNICIAN	**OCCUPATION CODE**	
DUTY TITLE	RAILWAY LINE OPERATION	**DUTY NO.**	601
TASK TITLE	PRODUCTION MANAGEMENT	**TASK NO.**	6014
PERFORMANCE CRITERIA	The person performing this task must be able to improve the railway line construction management and production process based on occupational standards and technical requirements.		
RANGE STATEMENT	This task can be performed on the railway site under the supervision of railway engineers. The following tools and equipment are required: 1. Data related to construction and maintenance; 2. Tools and equipment related to construction and maintenance; 2. Labor protection appliances.		

EVIDENCE REQUIREMENTS	
PRACTICAL PERFORMANCE	**BASIC KNOWLEDGE**
The person performing this task must be able to: 1. Observe health and safety precautions when performing tasks; 2. Select proper tools and equipment for the task; 3. Prepare the construction organization design scheme of Level III and below and organize the construction; 4. Organize the laying or removal of temporary lines; 5. Improve line maintenance and construction process; 5. Clean tools, equipment and workplaces; 6. Safely store tools and equipment.	**Detailed knowledge about:** **1.0. Methods** The person performing the task must be able to explain: 1.1. Prepare the construction organization design scheme of Level III and below; 1.2. Lay or remove temporary lines. **2.0. Principles** The person must be able to explain the principles of the construction organization design scheme. **3.0. Theory** The person performing the task must be able to explain the following: 3.1. Labor and material quota standards; 3.2. Line maintenance and construction process. **4.0. Essential skills** 4.1. Communication skills; 4.2. Teamwork skills; 4.3. Report writing skills.

DESCRIPTION OF THE END PRODUCTS/SERVICE	Effectively improve the railway line construction management and production process based on occupational standards and technical requirements.
CIRCUMSTANTIAL KNOWLEDGE	**Detailed knowledge about:** 1. Safe operation of tools; 2. Labor and material quota standards; 3. Construction organization design of railway engineering; 4. Line maintenance and construction process; 5. Occupational health and safety.

OCCUPATION	RAILWAY ENGINEERING TECHNICIAN	**OCCUPATION CODE**	
DUTY TITLE	RAILWAY BRIDGE AND TUNNEL OPERATION	**DUTY NO.**	602
TASK TITLE	LEVEL THE BRIDGE DECK AND REPLACE THE WHOLE BRIDGE DECK	**TASK NO.**	6021
PERFORMANCE CRITERIA	The person performing this task must be able to level the railway bridge deck and replace the whole bridge deck based on occupational standards and technical requirements.		
RANGE STATEMENT	This task can be performed on the railway site under the supervision of railway engineers. The following tools and equipment are required: 1. Leveling rod; 2. Total station; 3. Tools for replacing bridge deck; 4. Ruler and bridge sleeper making tools; 5. Labor protection appliances.		

EVIDENCE REQUIREMENTS	
PRACTICAL PERFORMANCE	**BASIC KNOWLEDGE**
The person performing this task must be able to: 1. Observe health and safety precautions when performing tasks; 2. Select proper tools and equipment for the task; 3. Level the bridge deck; 4. Replace the whole bridge deck; 5. Clean tools, equipment and workplaces; 6. Safely store tools and equipment.	**Detailed knowledge about:** 1.1. **Methods** The person performing the task must be able to explain: 1.1. Level the bridge deck and calculate the bridge sleeper height; 1.2. Configure bridge sleepers and guard timbers, fabricate and replace bridge sleepers and guard timbers, and calculate the quantity of bridge sleepers and guard timbers. **2.0. Principles** The person performing this task must be able to explain the principles of the following: 2.1. Knowledge of bridge deck leveling survey 2.2. Knowledge of line curve and slope; 2.3. Knowledge of leveling; 2.4. Method for calculating bridge sleeper height;

	2.5. Use method of machines and tools for replacing bridge deck; 2.6. Knowledge about timber properties; 2.7. Protection knowledge of bridge deck replacement and relevant regulations on train release conditions; 2.8. Specifications and standards of bridge sleepers and guard timbers; 2.9. Camber setting of bridge deck; 2.10. Relevant provisions on geometric dimension of track; 2.11. Method for replacing bridge sleepers. **3.0. Theory** The person performing the task must be able to explain the following: 3.1. Contents and operation of equipment inspection; 3.2. Contents and operation of fault handling. **4.0. Essential skills** 4.1. Communication skills; 4.2. Teamwork skills; 4.3. Report writing skills.
DESCRIPTION OF THE END PRODUCTS/SERVICE	Effectively level the railway bridge deck and replace the whole bridge deck based on occupational standards and technical requirements.
CIRCUMSTANTIAL KNOWLEDGE	**Detailed knowledge about:** 1. Safe operation of tools; 2. Safe operation of measuring instruments; 3. Occupational health and safety; 4. Waste disposal method.

OCCUPATION	RAILWAY ENGINEERING TECHNICIAN	**OCCUPATION CODE**	
DUTY TITLE	RAILWAY BRIDGE AND TUNNEL OPERATION	**DUTY NO.**	602
TASK TITLE	APPLY STEEL BEAM COATING	**TASK NO.**	6022
PERFORMANCE CRITERIA	The person performing this task must be able to carry out the coating of railway steel beams based on occupational rules and technical requirements.		
RANGE STATEMENT	This task can be performed on the railway site under the supervision of railway engineers. The following tools and equipment are required: 1. Air supply equipment: air compressor, air storage barrel and air supply pipeline; 2. Sand preparation equipment: sand sieving machine, sand transport trolley and sand storage bin; 3. Sand blasting machines and tools: high-pressure rubber pipe, oil-water separator, air storage barrel, sand holding equipment, sand blasting nozzle and connector, sand blasting suits and other labor protection appliances as well as air supply pipe; 4. Painting tools; 5. Dry film thickness gauge, wet film thickness gauge, derusting hammer, derusting scraper knife and wire brush; 6. Monkey wrench and iron wire.		

EVIDENCE REQUIREMENTS	
PRACTICAL PERFORMANCE	**BASIC KNOWLEDGE**
The person performing this task must be able to: 1. Observe health and safety precautions when performing tasks; 2. Select proper tools and equipment for the task; 3. Conduct derusting for the whole steel beam; 4. Allocate coating according to the environment; 5. Conduct coating for the whole steel beam; 6. Clean tools, equipment and workplaces;	**Detailed knowledge about:** **1.0. Methods** The person performing the task must be able to explain: 1.1. Conduct derusting for the whole steel beam; 1.2. Conduct coating for the whole steel beam; 1.3 Measure the film thickness. **2.0. Principles** The person performing this task must be able to explain the principles of the following: 2.1. Use and maintenance methods of detecting instrument;

7. Safely store tools and equipment.	2.2. Performance and use method of coating materials; 2.3. Performance, use and maintenance methods of coating machines and tools; 2.4. Steel beam coating process and acceptance criteria. **3.0. Theory** The person performing the task must be able to explain the following: 3.1. Contents and operation of equipment inspection; 3.2. Contents and operation of fault handling. **4.0. Essential skills** 4.1. Communication skills; 4.2. Teamwork skills; 4.3. Report writing skills.
DESCRIPTION OF THE END PRODUCTS/SERVICE	Effectively conduct coating of railway steel beams based on occupational standards and technical requirements.
CIRCUMSTANTIAL KNOWLEDGE	**Detailed knowledge about:** 1. Use and maintenance methods of detecting instrument; 2. Performance and use method of coating materials; 3. Performance, use and maintenance methods of coating machines and tools; 4. Steel beam coating process and acceptance criteria.

OCCUPATION	RAILWAY ENGINEERING TECHNICIAN	**OCCUPATION CODE**	
DUTY TITLE	RAILWAY BRIDGE AND TUNNEL OPERATION	**DUTY NO.**	602
TASK TITLE	LIFT AND LOWER THE BEAM AND REPLACE THE SUPPORT	**TASK NO.**	6023
PERFORMANCE CRITERIA	The person performing this task must be able to lift and lower the beam and replace the support based on occupational standards and technical requirements.		
RANGE STATEMENT	This task can be performed on the railway site under the supervision of railway engineers. The following tools and equipment are required: 1. Chisel, hammer and screw key; 2. Cement, sand and formwork; 3. Wire brush and brush; 4. Jack.		

EVIDENCE REQUIREMENTS	
PRACTICAL PERFORMANCE	**BASIC KNOWLEDGE**
The person performing this task must be able to: 1. Observe health and safety precautions when performing tasks; 2. Select proper tools and equipment for the task; 3. Lift and lower the beam with jacking device; 4. Remove and install the support; 5. Clean tools, equipment and workplaces; 6. Safely store tools and equipment.	**Detailed knowledge about:** **1.0. Methods** The person performing the task must be able to explain: 1.1. Lift and lower the beam; 1.2. Remove the support; 1.3. Replace the support. **2.0. Principles** The person performing this task must be able to explain the principles of the following: 2.1. Performance, use and maintenance methods of jacking devices and tools; 2.2. Methods and requirements for lifting and lowering the beam; 2.3. Relevant knowledge of support structure; 2.4. Support installation methods and standards; 2.5. Protection knowledge of support replacement. **3.0. Theory** The person performing the task must be able to explain the following:

	3.1. Contents and operation of equipment inspection; 3.2. Contents and operation of fault handling. **4.0. Essential skills** 4.1. Communication skills; 4.2. Teamwork skills; 4.3. Report writing skills.
DESCRIPTION OF THE END PRODUCTS/SERVICE	Effectively lift and lower the beam and replace the support based on occupational standards and technical requirements.
CIRCUMSTANTIAL KNOWLEDGE	**Detailed knowledge about:** 1. Performance, use and maintenance methods of jacking devices and tools; 2. Methods and requirements for lifting and lowering the beam; 3. Relevant knowledge of support structure; 4. Support installation methods and standards; 5. Protection knowledge of support replacement.

OCCUPATION	RAILWAY ENGINEERING TECHNICIAN	**OCCUPATION CODE**	
DUTY TITLE	RAILWAY BRIDGE AND TUNNEL OPERATION	**DUTY NO.**	602
TASK TITLE	CARRY OUT BOX CULVERT OR CYLINDRICAL CULVERT JACKING	**TASK NO.**	6024
PERFORMANCE CRITERIA	The person performing this task must be able to carry out box culvert or cylindrical culvert jacking based on occupational standards and technical requirements.		
RANGE STATEMENT	This task can be performed on the railway site under the supervision of railway engineers. The following tools and equipment are required: 1. Reinforcement equipment; 2. Back; 3. Jack and other jacking equipment; 4. Box culvert or cylindrical culvert; 5. Total station and level; 6. Crane and hoist.		

EVIDENCE REQUIREMENTS	
PRACTICAL PERFORMANCE	**BASIC KNOWLEDGE**
The person performing this task must be able to: 1. Observe health and safety precautions when performing tasks; 2. Select proper tools and equipment for the task; 3. Carry out construction setting-out; 4. Jack the box culvert and cylindrical culvert; 5. Clean tools, equipment and workplaces; 6. Safely store tools and equipment.	**Detailed knowledge about:** 1.1. **Methods** The person performing the task must be able to explain: 1.1. Carry out construction setting-out; 1.2. Jack the box culvert; 1.3. Jack the cylindrical culvert. **2.0. Principles** The person performing this task must be able to explain the principles of the following: 2.1. Knowledge of construction survey and setting-out; 2.2. Relevant knowledge of engineering drawing reading; 2.3. Performance, use and maintenance methods of production and jacking machines and tools; 2.4. Line reinforcement methods and requirements;

	2.5. Protection knowledge of jacking operation and relevant regulations on train release conditions; 2.6. Knowledge of fabrication and jacking survey as well as use methods of level and theodolite; 2.7. Common jacking process and method; 2.8. Fabrication methods and technical standards of box culverts and cylindrical culverts. **3.0. Theory** The person performing the task must be able to explain the following: 3.1. Contents and operation of equipment inspection; 3.2. Contents and operation of fault handling. **4.0. Essential skills** 4.1. Communication skills; 4.2. Teamwork skills; 4.3. Report writing skills.
DESCRIPTION OF THE END PRODUCTS/SERVICE	Effectively carry out box culvert or cylindrical culvert jacking based on occupational standards and technical requirements.
CIRCUMSTANTIAL KNOWLEDGE	**Detailed knowledge about:** 1. Knowledge of construction survey and setting-out; 2. Relevant knowledge of engineering drawing reading; 3. Performance, use and maintenance methods of production and jacking machines and tools; 4. Line reinforcement methods and requirements; 5. Protection knowledge of jacking operation and relevant regulations on train release conditions; 6. Knowledge of fabrication and jacking survey as well as use methods of level and theodolite; 7. Common jacking process and method; 8. Fabrication methods and technical standards of box culverts and cylindrical culverts.

OCCUPATION	RAILWAY ENGINEERING TECHNICIAN	**OCCUPATION CODE**	
DUTY TITLE	RAILWAY BRIDGE AND TUNNEL OPERATION	**DUTY NO.**	602
TASK TITLE	QUALITY ASSESSMENT AND ACCEPTANCE CHECK OF BRIDGE AND TUNNEL EQUIPMENT	**TASK NO.**	6025
PERFORMANCE CRITERIA	The person performing this task must be able to conduct quality assessment and acceptance check of bridge and tunnel equipment based on occupational standards and technical requirements.		
RANGE STATEMENT	This task can be performed on the railway site under the supervision of railway engineers. The following tools and equipment are required: 1. Total station and level; 2. Ruler and marking pen; 3. Strain gauge; 4. Concrete strength tester and protective layer thickness tester.		

EVIDENCE REQUIREMENTS	
PRACTICAL PERFORMANCE	**BASIC KNOWLEDGE**
The person performing this task must be able to: 1. Observe health and safety precautions when performing tasks; 2. Select proper tools and equipment for the task; 3. Evaluate the status of bridges and tunnels, and assess the maintenance quality; 4. Conduct equipment acceptance for bridge and tunnel overhaul and maintenance; 5. Clean tools, equipment and workplaces; 6. Safely store tools and equipment.	**Detailed knowledge about:;** 1.2. **Methods** The person performing the task must be able to explain: 1.1. Quality assessment; 1.2. Acceptance check of bridge and tunnel equipment. **2.0. Principles** The person performing this task must be able to explain the principles of the following: 2.1. Maintenance quality assessment criteria; 2.2. Condition assessment criteria; 2.3. Acceptance criteria for major maintenance of bridges and tunnels; 2.4. Knowledge related to quality management. **3.0. Theory** The person performing the task must be able to explain the following:

	3.1. Contents and operation of equipment inspection; 3.2. Contents and operation of fault handling. **4.0. Essential skills** 4.1. Communication skills; 4.2. Teamwork skills; 4.3. Report writing skills.
DESCRIPTION OF THE END PRODUCTS/SERVICE	Effectively complete the quality assessment and acceptance check of bridge and tunnel equipment based on occupational standards and technical requirements.
CIRCUMSTANTIAL KNOWLEDGE	**Detailed knowledge about:** 1. Maintenance quality assessment criteria; 2. Condition assessment criteria; 3. Acceptance criteria for major maintenance of bridges and tunnels; 4. Knowledge related to quality management.

OCCUPATION	RAILWAY ENGINEERING TECHNICIAN	**OCCUPATION CODE**	
DUTY TITLE	RAILWAY BRIDGE AND TUNNEL OPERATION	**DUTY NO.**	602
TASK TITLE	TECHNICAL MANAGEMENT	**TASK NO.**	6026
PERFORMANCE CRITERIA	The person performing this task must be able to manage the production process of railway bridges and tunnels and improve the production process based on occupational standards and technical requirements.		
RANGE STATEMENT	This task can be performed on the railway site under the supervision of railway engineers. The following tools and equipment are required: 1. Data related to construction and maintenance; 2. Tools and equipment related to construction and maintenance; 2. Labor protection appliances.		

EVIDENCE REQUIREMENTS	
PRACTICAL PERFORMANCE	**BASIC KNOWLEDGE**
The person performing this task must be able to: 1. Observe health and safety precautions when performing tasks; 2. Select proper tools and equipment for the task; 3. Calculate workload according to construction drawings; 4. Prepare daily and monthly production plans; 5. Improve bridge and tunnel maintenance construction process; 6. Write a technical summary; 7. Clean tools, equipment and workplaces; 8. Safely store tools and equipment.	**Detailed knowledge about:** **1.0. Methods** The person performing the task must be able to explain: 1.1. Prepare daily and monthly production plans; 1.2. Bridge and tunnel maintenance and construction technology. **2.0. Principles** The person must be able to explain the principle of preparing daily and monthly production plans. **3.0. Theory** The person performing the task must be able to explain the following: 3.1. Labor and material quota standards; 3.2. Bridge and tunnel maintenance and construction technology. **4.0. Essential skills** 4.1. Communication skills;

	4.2. Teamwork skills; 4.3. Report writing skills.
DESCRIPTION OF THE END PRODUCTS/SERVICE	Effectively complete production process management and production technology improvement of railway bridges and tunnels based on occupational standards and technical requirements.
CIRCUMSTANTIAL KNOWLEDGE	**Detailed knowledge about:** 1. Safe operation of tools; 2. Labor and material quota standards; 3. Calculate workload according to construction drawings; 4. Methods and requirements for preparing daily and monthly production plans; 5. Bridge and tunnel maintenance and construction technology; 6. Content and writing method of technical summary; 7. Occupational health and safety.

Table 1: DACUM Chart for Railway Engineering Technician - NTA 6

DUTIES	TASKS	ENABLERS
1.0. Railway line operation	1.1. Rail operation 1.2. Crossing operation 1.3. Inspection and fault handling 1.4. Production management	**Common skills and knowledge** • Abide by rules and regulations and work safely • Employ communication skills to work with others and report to superiors • Use the manufacturer's manual • Skills and knowledge in inspection, maintenance and patrol of railway line facilities • Interpretation of engineering and technical drawings • Railway engineering surveying • Civil engineering material science • Knowledge of basic engineering structures • Construction organization design of railway engineering **Tools and equipment**

DUTIES	TASKS	ENABLERS
		• Safety helmet, goggles, gloves, safety clothing, leg guards, safety shoes and other labor protection appliances • Common operation protection tools • Common inspection tools and equipment for railway line facilities • Common maintenance tools and equipment for railway line facilities **Materials** Track equipment and engineering materials in accordance with technical standards and specifications **Worker behaviors** Teamwork spirit, integrity, time management and keeping promises
2.0. Railway bridge and tunnel operation	2.1. Level the bridge deck and replace the whole bridge deck 2.2. Apply steel beam coating	**Common skills and knowledge** • Abide by rules and regulations and work safely

DUTIES	TASKS	ENABLERS
	2.3. Lift and lower the beam and replace the support 2.4. Carry out box culvert or cylindrical culvert jacking 2.5. Quality assessment and acceptance of bridge and tunnel equipment 2.6. Technical management	• Employ communication skills to work with others and report to superiors • Use the manufacturer's manual • Skills and knowledge in inspection, maintenance and patrol of railway bridge and tunnel facilities • Interpretation of engineering drawings • Railway engineering surveying • Civil engineering material science • Knowledge of basic engineering structures • Knowledge of engineering construction and acceptance • Knowledge of structural mechanics • Construction organization design of railway engineering **Tools and equipment**

DUTIES	TASKS	ENABLERS
		• Safety helmet, goggles, gloves, safety clothing, leg guards, safety shoes and other labor protection appliances • Common operation protection tools • Common inspection tools and equipment for railway bridge and tunnel facilities • Common maintenance tools and equipment for railway bridge and tunnel facilities **Materials** Bridge and tunnel components and engineering materials in accordance with technical standards and specifications **Worker behaviors** Teamwork spirit, integrity, time management and keeping promises