THE NATIONAL COUNCIL FOR TECHNICAL AND VOCATIONAL EDUCATION AND TRAINING

OCCUPATIONAL STANDARDS

OCCUPATION: PETROCHEMICAL ENGINEERING TECHNICIAN

LEVEL: NTA LEVEL 4

FEBRUARY 2024

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ABBREVIATIONS

CBET	-	Competency Based Education and Training
DCS	-	Distributed Control System
NACTVET	-	National Council for Technical and Vocational Education and Training
NOS	-	National Occupational Standards
OS	-	Occupational Standards
TET	-	Technical Education and Training
TVET	-	Technical and Vocational Education and Training

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 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 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, related 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.
Occupational Competence:	The application and performance of knowledge and skills to perform consistently to that consistently meet the standards required by 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, with a high level of human development. This requires a skilled workforce that is aligned with the needs of the public and private sectors of the economy. The National Council for Technical and Vocational Education and Training (NACTVET) has begun the job of drafting Occupational Standards (OS) that will eventually be adopted as National Occupational Standards (NOS) for use in the delivery of TET that meets the needs of the labour market and the country's economic agenda.

Occupational Standards (OS) are performance criteria that are matched with labour market demands. Each of them describes the functions, performance standards, and understanding or knowledge underpinning a given occupation. They combine skills, knowledge, and attitudes to describe best practice. They are useful tools for establishing job roles, personnel recruitment, supervision, and appraisal, as well as TET Standards. They are also helpful for benchmarking and harmonizing job qualifications on a national and international level. Standards, in general, provide a solid framework for high-quality TET that is labour market-relevant, current, and consistent in application across all public and private institutions.

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

For the purpose of TET delivery, Tanzania has adopted the Competence Based Education and Training (CBET) approach. The CBET approach focuses on providing learners with the skills and knowledge required to meet the occupational standards. Occupational standards are thus

the starting point for developing competency-based training (CBET) programmes. Therefore, it is quite pertinent for TET institutions to use the relevant occupational standards as a benchmark for formulating their curricula.

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

The document explains how the occupational standards were developed, as well as the scope, the occupational profile in the form of DACUM charts, and the Occupational Standards.

2.0. OCCUPATIONAL STANDARD DEVELOPMENT PROCESS

The process of developing these Occupational Standards involved both local and international expertise. The process began with an examination of major documents that guide Tanzanian skills development including the *10-year National Skills Development Strategy (2016-2026).* NACTVET labour market reports were also used in the literature review to determine the skills demand in the Tanzanian labour market as a whole.

After the literature review, a team of experts in consultation with practitioners developed draft occupational standards. The draft document was used to develop an occupational profile for each occupation (DACUM Chart), which is attached as an **Appendix** to every Occupational Standard.

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

3.0. THE SCOPE AND OVERVIEW OF THE OCCUPATION STANDARDS FOR PETROCHEMICAL ENGINEERING TECHNICIAN

The standards cover a broad range of duties and tasks that can be performed by a petrochemical engineering Technician. However, the occupational standards are not meant to replace individual job descriptions. Instead, they are to be used for guidance in defining skill levels and knowledge for the technician in specific settings or positions. The petrochemical engineering Technician may perform tasks in a number of key areas of the occupational standards, but not

necessarily in all areas. For example, in large operations, other individuals may be employed or designated to perform specific tasks.

Petrochemical engineering technicians shall complete the start-up and shutdown of centrifugal pumps, reciprocating pumps, and heat exchangers and adjust relatively complex process parameters under the supervision of petrochemical engineers. Generally, the petrochemical engineering Technician performs the following duties and tasks:

a) Carry out material handling
b) Conduct material heat exchange
c) Conduct material heating
d) Material reaction
e) Perform material separation
f) Carry out maintenance of pump and pipeline
g) Conduct material compression
h) Perform material separation
i) Identify faults and fix the process equipment
g) Carry out maintenance of process equipment

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

4.0. VALIDITY PERIOD

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

5.0 OCCUPATIONAL STANDARDS

5.1 OCCUPATIONAL STANDARDS FOR PETROCHEMICAL ENGINEERING TECHNICIAN - NTA LEVEL 4

<table>
<tr><td>OCCUPATION</td><td>PETROCHEMICAL ENGINEERING TECHNICIAN</td><td>OCCUPATION CODE</td><td></td></tr>
<tr><td>DUTY TITLE</td><td>CARRY OUT MATERIAL HANDLING</td><td>DUTY NO.</td><td>401</td></tr>
<tr><td>TASK TITLE</td><td>START-UP CENTRIFUGAL PUMP</td><td>TASK NO.</td><td>4011</td></tr>
<tr><td>PERFORMANCE CRITERIA</td><td colspan="3">The person performing this task must be able to start up the centrifugal pump according to technical requirements and operation manual.</td></tr>
<tr><td>RANGE STATEMENT</td><td colspan="3">The task can be performed in the production equipment under the supervision of senior technicians and petrochemical engineering technician process engineers. The equipment and tools to be used include:
1. PPE, such as work clothes, safety shoes, helmet, gloves, safety glasses, earplugs, etc.
2. Walkie-talkie;
3. Wrench;
4. Stethoscope;
5. Portable vibration meter;
6. Portable thermo-detector;
7. Centrifugal pump;
8. Instrument system.</td></tr>
<tr><td colspan="4">EVIDENCE REQUIREMENTS</td></tr>
<tr><td colspan="2">PRACTICAL PERFORMANCE</td><td colspan="2">UNDERPINNING KNOWLEDGE</td></tr>
<tr><td colspan="2">The person performing this task must be able to do the following:
1. Wear labour protection appliance neatly while performing tasks;
2. Check the foundation and all fixing bolts for looseness, and ensure that the coupling protective cover is securely installed;
3. Check the lubricating oil level and quality;
4. Contact the instrument operator to confirm that the probe is not loose;
5. Confirm that the inlet valve is fully open, the outlet valve is closed, and the check valve is closed;
6. Start the motor and check</td><td colspan="2">Detailed knowledge about:

1.0. Methods
The person performing this task must be able to explain how to:
1.1 Check equipment, electrical, instrument and valves;
1.2 Conduct turning;
1.3 Conduct priming;
1.4 Start up centrifugal pump;
1.5 Adjust and confirm after start-up;
1.6 Read process flow diagrams.

2.0. Principles
The person performing this task must be able to explain the following principles:
2.1 Fluid density;
2.2 Fluid viscosity;
2.3 Fluid pressure;
2.4 Basic concepts of basic equations of hydrostatics;
2.5 Structure of centrifugal pumps;</td></tr>
</table>

the current; 7. Open the outlet electric valve and adjust the pump outlet pressure; 8. Check that the equipment is running without any abnormal noise or leakage; 9. Check the operating status of the pump and bearing temperature; 10. Check that the pump bearing vibration is normal and the motor bearing vibration is normal; 11. Read the process flow diagram; 12. Clean tools, equipment and workplaces; 13. Store tools and equipment. 14. Observe health, occupational and environmental safety rules and regulations.	2.6 Operating principles of centrifugal pumps; 2.7 Reasons for pump priming; 2.8 Reasons for turning; 2.9 Function of lubricating oil; 2.10 Reasons for closing the rear valve of the centrifugal pump during start-up; 2.11 Process flow of fluid transportation; 2.12 Classification and function of pipe fittings and valves. **3.0. Theories** The person performing this task must be able to explain the following: 2.1 Inspection steps before the start-up of centrifugal pump; 2.2 Start-up steps of centrifugal pump; 2.3 Adjustment steps after the start-up of centrifugal pump; **4.0. Essential Skills** 4.1 Communication skills; 4.2 Teamwork skills; 4.3 Safety protection skills; 4.4 Record filling skills. **5.0. Math Skills** 5.1 Basic numerical calculation and unit conversion.
DESCRIPTION ON THE END PRODUCTS / SERVICE	The centrifugal pump is started according to the technical requirements and operation manual.
CIRCUMSTANTIAL KNOWLEDGE	**Detailed knowledge about:** 1. Safety and health knowledge; 2. Knowledge of process flow and equipment structure diagram reading; 3. Knowledge of electrical instrument; 4. Knowledge of environmental protection.

OCCUPATION	PETROCHEMICAL ENGINEERING TECHNICIAN	**OCCUPATION CODE**	
DUTY TITLE	CARRY OUT MATERIAL HANDLING	**DUTY NO.**	401
TASK TITLE	SHUT DOWN THE CENTRIFUGAL PUMP	**TASK NO.**	4012
PERFORMANCE CRITERIA	The person performing this task must be able to shut down the centrifugal pump according to technical requirements and operation manual.		
RANGE STATEMENT	The task can be performed in the production equipment under the supervision of senior technicians and petrochemical engineering technician process engineers. The equipment and tools to be used include: 1. PPE, such as work clothes, safety shoes, helmet, gloves, safety glasses, earplugs, etc. 2. Walkie-talkie; 3. Wrench; 4. Stethoscope; 5. Portable vibration meter; 6. Portable thermo-detector; 7. Centrifugal pump; 8. Instrument system.		

EVIDENCE REQUIREMENTS

PRACTICAL PERFORMANCE	**UNDERPINNING KNOWLEDGE**
The person performing this task must be able to do the following: 1. Wear labour protection appliance neatly while performing tasks; 2. Contact the electrical to confirm that the electric valve operates flexibly; 3. Contact the instrument operator to confirm that all probes are not loose; 4. Close the outlet electric valve to zero percent opening; 5. Turn off the motor and observe the current returning to zero; 6. Confirm that the check valve is fully closed; 7. Confirm that the system pipeline network pressure is normal; 8. Check that there is no leakage in the packing seal and that the drain pipe is not	**Detailed knowledge about:** **1.0. Methods** The person performing this task must be able to explain how to: 1.1 Check equipment, electrical, instrument and valves; 1.2 Shut down the pump; 1.3 Check equipment, electrical, instrument and valves after pump shutdown; 1.4 Check the system pressure after pump shutdown. **2.0. Principles** The person performing this task must be able to explain the following principles: 2.1 Definition and calculation of flow; 2.2 Definition and calculation of flow rate; 2.3 Types of fluid flow; 2.4 Reasons for closing the pump first and then the valve during the shutdown of centrifugal pump; 2.5 Types of seals. **3.0. Theories** The person performing this task must be able to explain the following: 3.1 Inspection steps before the shutdown of centrifugal pump;

blocked; 9. Check the outlet pipeline pressure gauge to return to zero; 10. Clean tools, equipment and workplaces; 11. Store tools and equipment. 12. Observe health, occupational and environmental safety rules and regulations.	3.2 Shutdown steps of centrifugal pump. **4.0. Essential Skills** 4.1 Communication skills; 4.2 Teamwork skills; 4.3 Safety protection skills; 4.4 Record filling skills. **5.0. Math Skills** 5.1 Basic numerical calculation and unit conversion.
DESCRIPTION ON THE END PRODUCTS / SERVICE	The centrifugal pump is shut down according to technical requirements and operation manual.
CIRCUMSTANTIAL KNOWLEDGE	**Detailed knowledge about:** 1. Safety and health knowledge; 2. Knowledge of process flow and equipment structure diagram reading; 3. Knowledge of electrical instruments; 4. Knowledge of environmental protection.

OCCUPATION	PETROCHEMICAL ENGINEERING TECHNICIAN	**OCCUPATION CODE**	
DUTY TITLE	CARRY OUT MATERIAL HANDLING	**DUTY NO.**	401
TASK TITLE	ADJUST AND OPERATE THE CENTRIFUGAL PUMP FLOW	**TASK NO.**	4013
PERFORMANCE CRITERIA	The person performing this task must be able to adjust and operate the centrifugal pump flow according to technical requirements and process parameters.		
RANGE STATEMENT	The task can be performed in the production equipment under the supervision of senior technicians and petrochemical engineering technician process engineers. The equipment and tools to be used include: 1. PPE, such as work clothes, safety shoes, helmet, gloves, safety glasses, earplugs, etc. 2. Walkie-talkie; 3. Wrench; 4. Stethoscope; 5. Portable vibration meter; 6. Portable thermo-detector; 7. Centrifugal pump; 8. DCS operation system; 9. Instrument system.		

EVIDENCE REQUIREMENTS

PRACTICAL PERFORMANCE	**UNDERPINNING KNOWLEDGE**
The person performing this task must be able to do the following: 1. Wear labour protection appliance neatly while performing tasks; 2. Monitor flow, pressure, and liquid level; 3. Identify abnormal process parameters; 4. Adjust flow and pressure; 5. Record data; 6. Clean tools, equipment and workplaces; 7. Store tools and equipment. 8. Observe health, occupational and environmental safety rules and regulations.	**Detailed knowledge about:** **1.0. Methods** The person performing this task must be able to explain how to: 1.1 Adjust and control flow; 1.2 Adjust and control liquid level; 1.3 Adjust and control pressure. **2.0. Principles** The person performing this task must be able to explain the following principles: 2.1 Basic equations of hydrostatics; 2.2 Application of Bernoulli equation; 2.3 Definition and calculation of straight pipe resistance; 2.4 Definition and calculation of local resistance; 2.5 Characteristic parameters of centrifugal pumps; 2.6 Characteristic curve of centrifugal pumps; 2.7 Operating points of centrifugal pumps; 2.8 Reasons for abnormal pressure in centrifugal pumps; 2.9 Reasons for abnormal flow of centrifugal pumps. **3.0. Theories**

	The person performing this task must be able to explain the following: 3.1 Method of operation and adjustment of DCS central control system. **4.0. Essential Skills** 4.1 Communication skills; 4.2 Teamwork skills; 4.3 Safety protection skills; 4.4 Record filling skills. **5.0. Math Skills** 5.1 Basic numerical calculation and unit conversion.
DESCRIPTION ON THE END PRODUCTS / SERVICE	The centrifugal pump flow is adjusted and operated according to the technical requirements and process parameters.
CIRCUMSTANTIAL KNOWLEDGE	**Detailed knowledge about:** 1. Safety and health knowledge; 2. Knowledge of process flow and equipment structure diagram reading; 3. Knowledge of electrical instrument; 4. Knowledge of environmental protection.

OCCUPATION	PETROCHEMICAL ENGINEERING TECHNICIAN	**OCCUPATION CODE**	
DUTY TITLE	CARRY OUT MATERIAL HANDLING	**DUTY NO.**	401
TASK TITLE	START UP THE ELECTRIC RECIPROCATING PUMPS	**TASK NO.**	4014
PERFORMANCE CRITERIA	The person performing this task must be able to start the electric reciprocating pump according to the technical requirements and operation manual.		
RANGE STATEMENT	The task can be performed in the production equipment under the supervision of senior technicians and petrochemical engineering technician process engineers. The equipment and tools to be used include: 1. PPE, such as work clothes, safety shoes, helmets, gloves, safety glasses, earplugs, etc. 2. Walkie-talkie; 3. Wrench; 4. Stethoscope; 5. Portable vibration meter; 6. Portable thermo-detector; 7. Reciprocating pump; 8. Instrument system.		

EVIDENCE REQUIREMENTS

PRACTICAL PERFORMANCE	**UNDERPINNING KNOWLEDGE**
The person performing this task must be able to do the following: 1. Wear labour protection appliance neatly while performing tasks; 2. Check whether the pump components are complete; 3. Check the oil ejector and oiling condition; 4. Clean the lubricating oil hole; 5. Remove condensate from cylinder; 6. Open the exhaust valve of the oil cylinder and introduce steam to warm the cylinder; 7. Confirm that the outlet valves and inlet valves are open; 8. Observe the temperature rise of the pump body after introducing liquid; 9. Open the hand valve in front of the pressure gauge	**Detailed knowledge about:** **1.0. Methods** The person performing this task must be able to explain how to: 1.1 Check components, oil ejectors, and lubricating oil for oiling; 1.2 Clean lubricating oil holes; 1.3 Remove the condensed water from the cylinder and warm the cylinder; 1.3 Start up reciprocating pump; 1.4 Adjust and confirm after start-up; 1.5 Read process flow diagrams. **2.0. Principle** The person performing this task must be able to explain the following principles: 2.1 Fluid density; 2.2 Fluid viscosity; 2.3 Fluid pressure; 2.4 Basic concepts of basic equations of hydrostatics; 2.5 Structure of reciprocating pumps; 2.6 Operating principles of reciprocating pumps; 2.7 Reasons for turning; 2.8 Reasons for removing water and warming cylinder; 2.9 Reasons for opening the outlet valve of the reciprocating pump during start-up;

and safety valve; 10. Open the inlet steam valve wide, start the pump, and observe the operation; 11. Observe flow rate, pressure, and leakage; 12. Clean tools, equipment and workplaces; 13. Store tools and equipment. 14. Observe health, occupational and environmental safety rules and regulations.	2.10 Requirements for temperature control of reciprocating pump equipment; 2.11 Factors affecting the suction height of reciprocating pumps. **3.0. Theories** The person performing this task must be able to explain the following: 3.1 Inspection steps before the start-up of reciprocating pump; 3.2 Start-up steps of reciprocating pump; 3.3 Adjustment steps after the start-up of reciprocating pump. **4.0. Essential Skills** 4.1 Communication skills; 4.2 Teamwork skills; 4.3 Safety protection skills; 4.4 Record filling skills. **5.0. Math Skills** 5.1 Basic numerical calculation and unit conversion.
DESCRIPTION ON THE END PRODUCTS / SERVICE	The reciprocating pump is started according to technical requirements and operation manual.
CIRCUMSTANTIAL KNOWLEDGE	**Detailed knowledge about:** 1. Safety and health knowledge; 2. Knowledge of process flow and equipment structure diagram reading; 3. Knowledge of electrical instrument; 4. Knowledge of environmental protection.

OCCUPATION	PETROCHEMICAL ENGINEERING TECHNICIAN	**OCCUPATION CODE**	
DUTY TITLE	CARRY OUT MATERIAL HANDLING	**DUTY NO.**	401
TASK TITLE	SHUT DOWN THE RECIPROCATING PUMPS	**TASK NO.**	4015
PERFORMANCE CRITERIA	The person performing this task must be able to shut down the electric reciprocating pump according to technical requirements and operation manual.		
RANGE STATEMENT	The task can be performed in the production equipment under the supervision of senior technicians and petrochemical engineering technician process engineers. The equipment and tools to be used include: 1. PPE, such as work clothes, safety shoes, helmet, gloves, safety glasses, earplugs, etc. 2. Walkie-talkie; 3. Wrench; 4. Stethoscope; 5. Portable vibration meter; 6. Portable thermo-detector; 7. Reciprocating pump; 8. Instrument system.		

EVIDENCE REQUIREMENTS

PRACTICAL PERFORMANCE	**UNDERPINNING KNOWLEDGE**
The person performing this task must be able to do the following: 1. Wear labour protection appliance neatly while performing tasks; 2. Close steam inlet; 3. Close steam outlet; 4. Close the inlet valve and outlet valve of pump; 5. Close the pressure gauge valve and safety valve; 6. Release the pressure inside the oil cylinder; 7. Open the cylinder drain valve and drain the water in the cylinder; 8. Do a good job in antifreeze and clean tools, equipment and workplaces; 9. Store tools and equipment. 10. Observe health, occupational and environmental safety rules and regulations.	**Detailed knowledge about:** **1.0. Methods** The person performing this task must be able to explain how to: 1.1 Check equipment, electrical, instrument and valves; 1.2 Shut down the pump; 1.3 Check equipment, electrical, instrument and valves after pump shutdown; 1.4 Check the system pressure after pump shutdown. **2.0. Principles** The person performing this task must be able to explain the following principles: 2.1 Definition and calculation of flow; 2.2 Definition and calculation of flow rate; 2.3 Types of fluid flow; 2.4 Reasons for closing the steam inlet first and then the steam outlet during the shutdown of reciprocating pump; 2.5 Reasons for draining water in the cylinder. **3.0. Theories** The person performing this task must be able to explain the following: 3.1 Inspection steps before the shutdown of

	reciprocating pump; 3.2 Shutdown steps of reciprocating pump. **4.0. Essential Skills** 4.1 Communication skills; 4.2 Teamwork skills; 4.3 Safety protection skills; 4.4 Record filling skills **5.0. Math Skills** 5.1 Basic numerical calculation and unit conversion.
DESCRIPTION ON THE END PRODUCTS / SERVICE	The reciprocating pump is shut down according to technical requirements and operation manual.
CIRCUMSTANTIAL KNOWLEDGE	**Detailed knowledge about:** 1. Safety and health knowledge; 2. Knowledge of process flow and equipment structure diagram reading; 3. Knowledge of electrical instrument; 4. Knowledge of environmental protection.

OCCUPATION	PETROCHEMICAL ENGINEERING TECHNICIAN	**OCCUPATION CODE**	
DUTY TITLE	CARRY OUT MATERIAL HANDLING	**DUTY NO.**	401
TASK TITLE	ADJUST AND OPERATE THE ELECTRIC RECIPROCATING PUMP FLOW	**TASK NO.**	4016
PERFORMANCE CRITERIA	The person performing this task must be able to adjust and operate the electric reciprocating pump flow according to technical requirements and process parameters.		
RANGE STATEMENT	The task can be performed in the production equipment under the supervision of senior technicians and petrochemical engineering technician process engineers. The equipment and tools to be used include: 1. PPE, such as work clothes, safety shoes, helmet, gloves, safety glasses, earplugs, etc. 2. Walkie-talkie; 3. Wrench; 4. Stethoscope; 5. Portable vibration meter; 6. Portable thermo detector; 7. Reciprocating pump; 8. DCS operation system; 9. Instrument system.		

EVIDENCE REQUIREMENTS	
PRACTICAL PERFORMANCE	**UNDERPINNING KNOWLEDGE**
The person performing this task must be able to do the following: 1. Wear labour protection appliance neatly while performing tasks; 2. Monitor flow, pressure, and liquid level; 3. Check for leakage, packing and wear; 4. Identify abnormal process parameters; 5. Adjust flow and pressure; 6. Record data; 7. Check the system pressure after pump shutdown; 8. Clean tools, equipment and workplaces; 9. Store tools and equipment. 10. Observe health, occupational and environmental safety rules and regulations.	**Detailed knowledge about:** **1.0. Methods** The person performing this task must be able to explain how to: 1.1 Adjust and control flow; 1.2 Adjust and control liquid level; 1.3 Adjust and control pressure. **2.0. Principles** The person performing this task must be able to explain the following principles: 2.1 Basic equations of hydrostatics; 2.2 Application of Bernoulli equation; 2.3 Definition and calculation of straight pipe resistance; 2.4 Definition and calculation of local resistance; 2.5 Characteristic parameters of reciprocating pumps; 2.6 Characteristic curve of reciprocating pumps; 2.7 Operating points of reciprocating pumps; 2.8 Reasons for abnormal pressure in reciprocating pumps; 2.9 Reasons for abnormal flow of reciprocating pumps.

	3.0. Theories The person performing this task must be able to explain the following: 3.1 Operation and adjustment of DCS central control system. **4.0. Essential Skills** 4.1 Communication skills; 4.2 Teamwork skills; 4.3 Safety protection skills; 4.4 Record filling skills. **5.0. Math Skills** 5.1 Basic numerical calculation and unit conversion.
DESCRIPTION ON THE END PRODUCTS / SERVICE	The electric reciprocating pump flow is adjusted and operated according to operating procedures and process parameters.
CIRCUMSTANTIAL KNOWLEDGE	**Detailed knowledge about:** 1. Safety and health knowledge; 2. Knowledge of process flow and equipment structure diagram reading; 3. Knowledge of electrical instruments; 4. Knowledge of environmental protection.

OCCUPATION	PETROCHEMICAL ENGINEERING TECHNICIAN	**OCCUPATION CODE**	
DUTY TITLE	CONDUCT MATERIAL HEAT EXCHANGE	**DUTY NO.**	402
TASK TITLE	CHECK AND START UP THE TUBULAR HEAT EXCHANGER	**TASK NO.**	4021
PERFORMANCE CRITERIA	The person performing this task must be able to check and start up the tubular heat exchanger according to technical requirements and operation manual.		
RANGE STATEMENT	The task can be performed in the production equipment under the supervision of senior technicians and petrochemical engineering technician process engineers. The equipment and tools to be used include: 1. PPE, such as work clothes, safety shoes, helmet, gloves, safety glasses, earplugs, etc. 2. Walkie-talkie; 3. Wrench; 4. Four-in-one gas detector; 5. Portable vibration meter; 6. Portable thermo detector; 7. Tubular heat exchanger; 8. Instrument system.		

EVIDENCE REQUIREMENTS	
PRACTICAL PERFORMANCE	**UNDERPINNING KNOWLEDGE**
The person performing this task must be able to do the following: 1. Wear labour protection appliance neatly while performing tasks; 2. Choose a suitable heating agent or coolant; 3. Check whether the instruments, valves, etc. on the device are complete and functional; 4. Determine basic data such as fluid flow, inlet and outlet temperatures, and operating pressure; 5. Remove the blind plate of the heat exchanger; 6. Change oxygen content of the heat exchanger; 7. Test the air tightness of the heat exchanger; 8. Use tubular heat exchanger, cold medium first and then hot medium;	**Detailed knowledge about:** **1.0. Methods** The person performing this task must be able to explain how to: 1.1 Check equipment, electrical, instrument and valves; 1.2 Remove the blind plate of the heat exchanger; 1.3 Change oxygen content of the heat exchanger; 1.4 Test the air tightness of the heat exchanger; 1.5 Start up; 1.6 Adjust and confirm after start-up. **2.0. Principles** The person performing this task must be able to explain the following principles: 2.1 Basic structure of tubular heat exchanger; 2.2 Dosage of coolant; 2.3 Fourier's law; 2.4 Newton's law of cooling; 2.5 Heat transfer area of tubular heat exchanger; 2.6 Heat transfer temperature difference of tubular heat exchanger; 2.7 Heat load of tubular heat exchanger; 2.8 Heat transfer coefficient of tubular heat exchanger; 2.9 Types and standards of tubular heat exchanger;

9. Check the temperature and pressure changes at the inlet and outlet of the cold and hot fluids after start-up; 10. Check and confirm that the heat exchanger in use has no leakage; 11. Clean tools, equipment and workplaces; 12. Store tools and equipment. 13. Observe health, occupational and environmental safety rules and regulations.	2.10 Basic heat transfer equations for tubular heat exchanger; 2.11 Start-up of tubular heat exchanger. **3.0. Theories** The person performing this task must be able to explain the following: 3.1 Inspection steps before the start-up of tubular heat exchanger; 3.2 Process flow of tubular heat exchanger; 3.3 Performance parameters of tubular heat exchanger. **4.0. Essential Skills** 4.1 Communication skills; 4.2 Teamwork skills; 4.3 Safety protection skills; 4.4 Record filling skills. **5.0. Math Skills** 5.1 Basic numerical calculation and unit conversion.
DESCRIPTION ON THE END PRODUCTS / SERVICE	The tubular heat exchanger is checked and started according to technical requirements and operation manual.
CIRCUMSTANTIAL KNOWLEDGE	**Detailed knowledge about:** 1. Occupational health and safety; 2. Knowledge of process flow and equipment structure diagram reading; 3. Knowledge of electrical instrument; 4. Knowledge of environmental protection.

OCCUPATION	PETROCHEMICAL ENGINEERING TECHNICIAN	**OCCUPATION CODE**	
DUTY TITLE	CONDUCT MATERIAL HEAT EXCHANGE	**DUTY NO.**	402
TASK TITLE	SHUT DOWN THE TUBULAR HEAT EXCHANGER	**TASK NO.**	4022
PERFORMANCE CRITERIA	The person performing this task must be able to shut down the tubular heat exchanger according to technical requirements and operation manual.		
RANGE STATEMENT	The task can be performed in the production equipment under the supervision of senior technicians and petrochemical engineering technician process engineers. The equipment and tools to be used include: 1. PPE, such as work clothes, safety shoes, helmet, gloves, safety glasses, earplugs, etc. 2. Walkie-talkie; 3. Wrench; 4. Four-in-one gas detector; 5. Portable vibration meter; 6. Portable thermo detector; 7. Tubular heat exchanger; 8. Instrument system.		

EVIDENCE REQUIREMENTS

PRACTICAL PERFORMANCE	UNDERPINNING KNOWLEDGE
The person performing this task must be able to do the following: 1. Wear labour protection appliance neatly while performing tasks; 2. Check the changes in cold and hot fluids to ensure no leakage; 4. Check whether the tubular heat exchanger and the joint between the pipe and the pipe sheet are damaged; 5. Stop the tubular heat exchanger, hot fluid first and then cold fluid; 6. Drain the liquid in the shell side and tube side; 7. Replace tubular heat exchanger; 8. Deliver and overhaul tubular heat exchanger; 9. Clean tools, equipment and workplaces; 10. Store tools and equipment. 11. Observe health, occupational	**Detailed knowledge about:** **1.0. Methods** The person performing this task must be able to explain how to: 1.1 Check equipment, electrical, instrument and valves; 1.2 Shut down; 1.3 Check equipment, electrical, instrument and valves after pump shutdown; 1.4 Replace tubular heat exchanger; 1.5 Deliver and overhaul tubular heat exchanger. **2.0. Principles** The person performing this task must be able to explain the following principles: 2.1 Convective heat transfer of tubular heat exchanger; 2.2 Fluid property; 2.3 Fluid motion state; 2.4 Reasons for stopping the hot fluid first and then the cold fluid during the shutdown of tubular heat exchanger; 2.5 Reasons for high point vent and low point drain on tube side and shell side after shutdown; 2.6 Shutdown of tubular heat exchanger.

and environmental safety rules and regulations.	**3.0. Theories** The person performing this task must be able to explain the following: 3.1 Inspection steps before the shutdown of tubular heat exchanger; 3.2 Shutdown steps of tubular heat exchanger. **4.0. Essential Skills** 4.1 Communication skills; 4.2 Teamwork skills; 4.3 Safety protection skills; 4.4 Record filling skills. **5.0. Math Skills** 5.1 Basic numerical calculation and unit conversion.
DESCRIPTION ON THE END PRODUCTS / SERVICE	The tubular heat exchanger is shut down according to technical requirements and operation manual.
CIRCUMSTANTIAL KNOWLEDGE	**Detailed knowledge about:** 1. Occupational health and safety; 2. Knowledge of process flow and equipment structure diagram reading; 3. Knowledge of electrical instrument; 4. Knowledge of environmental protection.

OCCUPATION	PETROCHEMICAL ENGINEERING TECHNICIAN	**OCCUPATION CODE**	
DUTY TITLE	CONDUCT MATERIAL HEAT EXCHANGE	**DUTY NO.**	402
TASK TITLE	OPERATE THE HEAT EXCHANGER	**TASK NO.**	4023
PERFORMANCE CRITERIA	The person performing this task must be able to operate the heat exchanger according to technical requirements and process parameters.		
RANGE STATEMENT	The task can be performed in the production equipment under the supervision of senior technicians and petrochemical engineering technician process engineers. The equipment and tools to be used include: 1. PPE, such as work clothes, safety shoes, helmet, gloves, safety glasses, earplugs, etc. 2. Walkie-talkie; 3. Wrench; 4. Four-in-one gas detector; 5. Portable vibration meter; 6. Portable thermo detector; 7. Tubular heat exchanger; 8. DCS operation system; 9. Instrument system.		

EVIDENCE REQUIREMENTS	
PRACTICAL PERFORMANCE	**UNDERPINNING KNOWLEDGE**
The person performing this task must be able to do the following: 1. Wear labour protection appliance neatly while performing tasks; 2. Monitor flow, pressure, and inlet/outlet temperature; 3. Identify abnormal process parameters; 4. Adjust flow, pressure, and temperature; 5. Record data; 6. Clean tools, equipment and workplaces; 7. Store tools and equipment. 8. Observe health, occupational and environmental safety rules and regulations.	**Detailed knowledge about:** **1.0. Methods** The person performing this task must be able to explain how to: 1.1 Adjust and control flow; 1.2 Adjust and control pressure; 1.3 Adjust and control inlet/outlet temperature. **2.0. Principles** The person performing this task must be able to explain the following principles: 2.1 Definition and calculation of heat transmission resistance; 2.2 Fourier's law; 2.3 Newton's law of cooling; 2.4 Common types of heat exchangers in industrial production. **3.0. Theories** The person performing this task must be able to explain the following: 3.1 Method of operation and adjustment of DCS central control system. 3.2 Reasons for abnormal flow in tubular heat

	exchanger; 3.3 Reasons for abnormal pressure in tubular heat exchanger; 3.4 Reasons for abnormal temperature of tubular heat exchanger. **4.0. Essential Skills** 4.1 Communication skills; 4.2 Teamwork skills; 4.3 Safety protection skills; 4.4 Record filling skills.
DESCRIPTION ON THE END PRODUCTS / SERVICE	The tubular heat exchanger is adjusted according to operating procedures and the process parameters of central control as specified in the instruction
CIRCUMSTANTIAL KNOWLEDGE	**Detailed knowledge about:** 1. Occupational health and safety; 2. Knowledge of process flow and equipment structure diagram reading; 3. Knowledge of electrical instrument; 4. Knowledge of environmental protection.

APPENDIX: DACUM CHARTS FOR PETROCHEMICAL ENGINEERING TECHNICIAN - NTA LEVEL 4

DUTIES	TASKS	ENABLERS
1.0 Carry out material handling	1.1 Start up centrifugal pump 1.2 Shut down centrifugal pump 1.3 Adjust and operate the centrifugal pump according to the process parameters of central control as specified in the instruction 1.4 Start up the electric reciprocating pumps 1.5 Shut down the reciprocating pump 1.6 Adjust and operate the reciprocating pump flow	**General skills and knowledge** • Cooperate with others using communication skills and report to the superiors • Use and operating procedures • Skills and knowledge in chemical production safety and equipment operation • Read process flow diagrams • Interpretation of structure diagram of centrifugal pump equipment • Interpretation of structure diagram of reciprocating pump equipment • Basic numerical calculation and unit conversion **Tools and equipment** • PPE, such as work clothes, safety shoes, helmet, gloves, safety glasses, earplugs, etc. • Walkie-talkie • Wrench • Stethoscope • Portable vibration meter • Portable thermo detector • Centrifugal pump • Reciprocating pump • DCS operation system • Instrument system **Materials** Air valve, bearing, seal, lubricating grease, Teflon tape, gasket, lubricating oil, grease **Requirements for employees** Environmental awareness, safety operation awareness, teamwork spirit, integrity, time management, and keeping promises
2.0 Conduct material heat exchange	2.1 Check and start up the tubular heat exchanger 2.2 Shut down the tubular heat exchanger 2.3 Operate the heat exchanger	**General skills and knowledge** • Cooperate with others using communication skills and report to the superiors • Use and operating procedures • Skills and knowledge in chemical production safety and equipment operation

DUTIES	TASKS	ENABLERS
		• Read process flow diagrams • Interpretation of structure diagram of tubular heat exchanger • Basic numerical calculation and unit conversion **Tools and equipment** • PPE, such as work clothes, safety shoes, helmet, gloves, safety glasses, earplugs, etc. • Walkie-talkie • Wrench • Four-in-one gas detector • Portable vibration meter • Portable thermo detector • Tubular heat exchanger • DCS operation system • Instrument system **Materials** Air valve, bearing, seal, Teflon tape, gasket **Requirements for employees** Environmental awareness, safety operation awareness, teamwork spirit, integrity, time management, and keeping promises