THE NATIONAL COUNCIL FOR TECHNICAL AND VOCATIONAL EDUCATION AND TRAINING

OCCUPATIONAL STANDARDS

OCCUPATION: WELDING ENGINEER

LEVEL: NTA LEVEL 7

FEBRUARY 2024

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ABBREVIATIONS

APW	All Position Welding
AW	Automatic Welding
CBET	Competency Based Education and Training
ERW	Electric Resistance Welding
FLOW	Flow Welding
FS	Furnace Soldering
GMAW	Gas Metal Arc Welding
NACTVET	National Council for Technical and Vocational Education and Training
NOS	National Occupational Standards
OPW	Overhead Position Welding
OS	Occupational Standards
QIM	Quality Inspection and Management
RW	Robot Welding
SAW	Submerged Arc Welding
SMAW	Shielded Metal Arc Welding
TIG	Tungsten-arc Inert-Gas Welding
TS	Torch Soldering
TET	Technical Education and Training
TVET	Technical and Vocational Education and Training
WPM	Welding Production Management
WPQ	Welding Procedure Qualification

WPS	Welding Procedure Specification
WT	Welding Technology

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 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.
Occupational Competence:	The application of knowledge and skills that consistently meet the standards required by 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 workplace, 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 WELDING ENGINEERS

The standards cover a broad range of duties and tasks that can be performed by a Welding 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 Welding 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 welding engineers shall have a good level of welding technology and skills, be able to manage welding production workshops and construction sites, prepare, guide, and implement welding technical documents, inspect, analyze, and control welding quality, predict welding production risks, solve general technical problems, analyze major technical problems and propose solutions, conduct welding production safety management, and provide professional training and guidance to welding

personnel. Generally, the Welding Engineer performs the following responsibilities:

a) Compile, revise, review, and continuously improve welding process technical documents and welding quality control documents

b) Guide, manage, and supervise the welding construction site

c) Develop welding production plan

d) Estimate the welding project cost

e) Conduct human resource management for welding production

f) Control the quality of welding projects

g) Generate relevant work management documents and technical analysis reports

h) Conduct safety management for welding production

i) Solve major technical problems in welding production

j) Design and improve welding fixtures

k) Maintain and manage welding equipment and supporting facilities

l) Assess and predict the risks of welded structures

m) Provide professional training, technical guidance, and technical supervision

n) Conduct welding technology and quality analysis

o) Perform difficult skill operations such as overhead welding, oblique welding, and obstacle welding using common welding methods

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 WELDING ENGINEER – NTA LEVEL 7

<table>
<tr><td>OCCUPATION</td><td>WELDING ENGINEER</td><td>OCCUPATION CODE</td><td></td></tr>
<tr><td>DUTY TITLE</td><td>PERFORM SHIELDED METAL ARC WELDING (SMAW) OPW</td><td>DUTY NO.</td><td>701</td></tr>
<tr><td>TASK TITLE</td><td>CONDUCT BUTT SMAW OPW OF LOW-CARBON STEEL OR LOW-ALLOY STEEL PLATE</td><td>TASK NO.</td><td>7011</td></tr>
<tr><td>PERFORMANCE CRITERIA</td><td colspan="3">The person performing this task must be able to complete the operation process of SMAW OPW of low carbon steel or low-alloy steel plate according to the specific welding technology.</td></tr>
<tr><td>RANGE STATEMENT</td><td colspan="3">The task can be performed in the welding workshop under the supervision of welding engineers or mechanical engineers.
The equipment and tools to be used include:
1. Power supply of SMAW;
2. Ground wire clamp;
3. Electrode holder;
4. Welding fixture;
5. Slag hammer;
6. Electric angle grinder;
7. File;
8. Electrode dry oven;
9. Electrode insulation barrel;
10. Welding mask;
11. Wire brush;
12. Hammer;
13. Chisel;
14. Weld gauge;
15. Personal protective equipment (safety helmet, safety shoes, protective clothing, welding gloves, etc.).
16. Safety gear</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. Read drawings or technical process documents;
2. Check and commission the equipment, fixtures, tools, and safety protective equipment used;</td><td colspan="2">Detailed knowledge about:
1.0 Methods
The person performing this task must be able to explain how to:
1.1 Maintain and manage the SMAW equipment;
1.2 Conduct butt SMAW OPW of low-carbon steel or low-alloy steel plate;
1.3 Conduct SMAW OPW;</td></tr>
</table>

3. Select welding parameters according to drawings or process requirements; 4. Select electrodes; 5. Prepare workpiece weld groove; 6. Remove the rust and stains around the weld seam and groove of the workpiece; 7. Assemble and position the assembled workpiece, reserve gaps and reverse deformation angles according to process requirements; 8. Fix the workpiece on the fixture according to the overhead welding position; 9. Determine the appropriate number of welding layers and passes; 10. Perform arc striking, welding, and arc stopping operations by layers and passes; 11. Clean the surface of the welded joint; 12. Check the appearance quality of welded joints; 13. Clean tools, equipment and workplace; 14. Store tools and equipment. 15. Observe health, occupational and environmental safety, rules and regulations 16. Observe health, occupational and environmental safety, rules and regulations	1.4 Prevent and control welding deformation; 1.5 Clean the surface of the welded joint; 1.6 Check the appearance quality of the welds. **2.0 Principle** The person performing this task must be able to explain the following principles: 2.1 Protection scope, use, and maintenance specifications of protective equipment in various environments; 2.2 Welding material selection standards; 2.3 Selection and preparation principles of grooves; 2.4 Principle of butt SMAW OPW of low carbon steel or low alloy steel plate by layers and passes. **3.0 Theories** The person performing this task must be able to explain the following: 3.1 Welding performance of metal materials; 3.2 Mechanical drawing and drawing reading; 3.3 Preparation method of process for butt SMAW OPW of low carbon steel or low alloy steel plate; 3.4 Classification, characteristics, and application of welding equipment; 3.5 Classification, causes, and preventive measures of welding defects; 3.6 Forming process for butt SMAW OPW of low carbon steel or low alloy steel plate. **4.0 Essential Skills** 4.1 Communication skills; 4.2 Management skills; 4.3 Equipment maintenance skills; 4.4 Report writing skills. **5.0 Math Skills** 5.1 Data analysis skills 5.2. Engineering mathematics skills
DESCRIPTION ON THE END PRODUCTS / SERVICE	Butt SMAW OPW of low-carbon steel or low-alloy steel plate is conducted according to technical standards and welding specifications, and welds meet quality requirements.
CIRCUMSTANTIAL KNOWLEDGE	**Detailed knowledge about:** 1. Safe operation and use of equipment and tools 2. Safe operation and use of testing tools 3. Occupational health and safety

OCCUPATION	WELDING ENGINEER	**OCCUPATION CODE**	
DUTY TITLE	PERFORM SHIELDED METAL ARC WELDING (SMAW) OPW	**DUTY NO.**	701
TASK TITLE	CONDUCT BUTT SMAW OPW OF STAINLESS STEEL PLATE	**TASK NO.**	7012
PERFORMANCE CRITERIA	The person performing this task must be able to complete the operation process of SMAW OPW of stainless still plate according to the specific welding technology.		
RANGE STATEMENT	The task can be performed in the welding workshop under the supervision of welding engineers or mechanical engineers. The equipment and tools to be used include: 1. Power supply of SMAW; 2. Ground wire clamp; 3. Electrode holder; 4. Welding fixture; 5. Slag hammer; 6. Electric angle grinder; 7. File; 8. Electrode dry oven; 9. Electrode insulation barrel; 10. Welding mask; 11. Wire brush; 12. Hammer; 13. Chisel; 14. Weld gauge; 15. Personal protective equipment (safety helmet, safety shoes, protective clothing, welding gloves, etc.). 16. Safety gear		

EVIDENCE REQUIREMENTS	
PRACTICAL PERFORMANCE	**UNDERPINNING KNOWLEDGE**
The person performing this task must be able to do the following: 1. Read drawings or technical process documents; 2. Check and commission the equipment, fixtures, tools, and safety protective equipment used; 3. Select welding parameters according to drawings or process requirements; 4. Select electrodes; 5. Prepare workpiece weld groove; 6. Remove the rust and stains around the weld seam and groove of the workpiece;	**Detailed knowledge about:** **1.0 Methods** The person performing this task must be able to explain how to: 1.1 Maintain and manage the SMAW equipment; 1.2 Prepare the process for butt SMAW OPW of stainless steel plate; 1.3 Conduct SMAW OPW; 1.4 Prevent and control welding deformation; 1.5 Clean the surface of the welded joint; 1.6 Check the appearance quality of the welds. **2.0 Principle**

7. Assemble and position the assembled workpiece, reserve gaps and reverse deformation angles according to process requirements; 8. Fix the workpiece on the fixture according to the overhead welding position; 9. Determine the appropriate number of welding layers and passes; 11. Perform arc striking, welding, and arc stopping operations by layers and passes; 12. Clean the surface of the welded joint; 13. Check the appearance quality of welded joints; 14. Clean tools, equipment and workplace; 15. Store tools and equipment. 16. Observe health, occupational and environmental safety, rules and regulations 17. Observe health, occupational and environmental safety, rules and regulations	The person performing this task must be able to explain the following principles: 2.1 Protection scope, use, and maintenance specifications of protective equipment in various environments; 2.2 Welding material selection standards; 2.3 Selection and preparation principles of grooves; 2.4 Principle of butt SMAW OPW of stainless steel plate by layers and passes. **3.0 Theories** The person performing this task must be able to explain the following: 3.1 Welding performance of metal materials; 3.2 Mechanical drawing and drawing reading; 3.3 Preparation method of process for butt SMAW OPW of stainless steel plate; 3.4 Classification, characteristics, and application of welding equipment; 3.5 Classification, causes, and preventive measures of welding defects; 3.6 Forming process for butt SMAW OPW of stainless steel plate. **4.0 Essential Skills** 4.1 Communication skills; 4.2 Management skills; 4.3 Equipment maintenance skills; 4.4 Report writing skills. **5.0 Math Skills** 5.1 Data analysis skills; 5.2 Engineering mathematics skills.
DESCRIPTION ON THE END PRODUCTS / SERVICE	Butt SMAW OPW of stainless steel plate is conducted according to technical standards and Welding Specifications, and welds meet quality requirements.
CIRCUMSTANTIAL KNOWLEDGE	**Detailed knowledge about:** 1. Safe operation and use of equipment and tools; 2. Safe operation and use of testing tools; 3. Occupational health and safety.

OCCUPATION	WELDING ENGINEER	**OCCUPATION CODE**	
DUTY TITLE	PERFORM GMAW OPW	**DUTY NO.**	702
TASK TITLE	CONDUCT BUTT GMAW OPW OF LOW CARBON STEEL PLATE	**TASK NO.**	7021
PERFORMANCE CRITERIA	The person performing this task must be able to complete the operation process of butt GMAW OPW of low carbon steel plate according to the specific welding technology.		
RANGE STATEMENT	The task can be performed in the welding workshop under the supervision of welding engineers or mechanical engineers. The equipment and tools to be used include: 1. Power supply of GMAW; 2. Carbon dioxide or mixed gas cylinders; 3. Carbon dioxide relief valve; 4. Ground wire clamp; 5. Wire feeder of GMAW; 6. Welding torch; 7. Welding fixture; 8. Slag hammer; 9. Electric angle grinder; 10. File; 11. Pliers; 12. Welding mask; 13. Wire brush; 14. Hammer; 15. Weld gauge; 16. Personal protective equipment (safety helmet, safety shoes, protective clothing, welding gloves, etc.). 17. Safety gear		

EVIDENCE REQUIREMENTS	
PRACTICAL PERFORMANCE	**UNDERPINNING KNOWLEDGE**
The person performing this task must be able to do the following: 1. Read drawings or technical process documents; 2. Check and commission the equipment, fixtures, tools, and safety protective equipment used; 3. Select welding parameters according to drawings or process requirements; 4. Select welding wire and shielding gas; 5. Prepare workpiece weld groove; 6. Remove the rust and stains around the weld seam and groove of the workpiece;	**Detailed knowledge about:** **1.0 Methods** The person performing this task must be able to explain how to: 1.1. Maintain and manage the GMAW equipment; 1.2 Prepare the process for the Butt GMAW OPW of low carbon steel plate; 1.3 Conduct the GMAW OPW; 1.4 Prevent and control welding deformation; 1.5 Clean the surface of the welded joint; 1.6 Check the appearance quality of the welds.

7. Assemble and position the assembled workpiece, reserve gaps and reverse deformation angles according to process requirements; 8. Fix the workpiece on the fixture according to the overhead welding position; 9. Determine the appropriate number of welding layers and passes; 10. Perform arc striking, welding, and arc stopping operations by layers and passes; 11. Clean the surface of the welded joint; 12. Check the appearance quality of welded joints; 13. Clean tools, equipment and workplace; 14. Store tools and equipment. 15. Observe health, occupational and environmental safety, rules and regulations 16. Observe health, occupational and environmental safety, rules and regulations	**2.0 Principle** The person performing this task must be able to explain the following principles: 2.1 Protection scope, use, and maintenance specifications of protective equipment in various environments; 2.2 Welding material selection standards; 2.3 Selection and preparation principles of grooves; 2.4 Principle of butt GMAW OPW of low carbon steel plate by layers and passes. **3.0 Theories** The person performing this task must be able to explain the following: 3.1 Welding performance of metal materials; 3.2 Mechanical drawing and drawing reading; 3.3 Preparation method for the process of the Butt GMAW OPW of low carbon steel plate; 3.4 Classification, characteristics, and application of welding equipment; 3.5 Classification, causes, and preventive measures of welding defects; 3.6 Forming process of butt GMAW OPW weld of low carbon steel plate. **4.0 Essential Skills** 4.1 Communication skills; 4.2 Management skills; 4.3 Equipment maintenance skills; 4.4 Report writing skills. **5.0 Math Skills** 5.1 Data analysis skills; 5.2 Engineering mathematics skills.
DESCRIPTION ON THE END PRODUCTS / SERVICE	Butt GMAW OPW of low carbon steel plate is conducted according to technical standards and Welding Procedure Specification, and welds meet quality requirements.
CIRCUMSTANTIAL KNOWLEDGE	**Detailed knowledge about:** 1. Safe operation and use of equipment and tools; 2. Safe operation and use of testing tools; 3. Occupational health and safety.

OCCUPATION	WELDING ENGINEER	**OCCUPATION CODE**	
DUTY TITLE	PERFORM GMAW OPW	**DUTY NO.**	702
TASK TITLE	CONDUCT BUTT GMAW OPW OF STAINLESS STEEL PLATE	**TASK NO.**	7022
PERFORMANCE CRITERIA	The person performing this task must be able to complete the operation process of butt GMAW OPW of stainless steel plate according to the specific welding technology.		
RANGE STATEMENT	The task can be performed in the welding workshop under the supervision of welding engineers or mechanical engineers. The equipment and tools to be used include: 1. Power supply of GMAW; 2. Carbon dioxide or mixed gas cylinders; 3. Carbon dioxide relief valve; 4. Ground wire clamp; 5. Wire feeder of GMAW; 6. Welding torch; 7. Welding fixture; 8. Slag hammer; 9. Electric angle grinder; 10. File; 11. Pliers; 12. Welding mask; 13. Wire brush; 14. Hammer; 15. Weld gauge; 16. Personal protective equipment (safety helmet, safety shoes, protective clothing, welding gloves, etc.). 17. Safety gear		

EVIDENCE REQUIREMENTS

PRACTICAL PERFORMANCE	**UNDERPINNING KNOWLEDGE**
The person performing this task must be able to do the following: 1. Read drawings or technical process documents; 2. Check and commission the equipment, fixtures, tools, and safety protective equipment used; 3. Select welding parameters according to drawings or process requirements; 4. Select welding wire and shielding gas; 5. Prepare workpiece weld groove; 6. Remove the rust and stains around the weld seam and groove of the workpiece;	**Detailed knowledge about:** **1.0 Methods** The person performing this task must be able to explain how to: 1.1 Maintain and manage the GMAW equipment; 1.2 Prepare the process for the Butt GMAW OPW of stainless steel plate; 1.3 Conduct the GMAW OPW; 1.4 Prevent and control welding deformation; 1.5 Clean the surface of the welded joint; 1.6 Check the appearance quality of the welds.

7. Assemble and position the assembled workpiece, reserve gaps and reverse deformation angles according to process requirements; 8. Fix the workpiece on the fixture according to the overhead welding position; 9. Determine the appropriate number of welding layers and passes; 10. Perform arc striking, welding, and arc stopping operations by layers and passes; 11. Clean the surface of the welded joint; 12. Check the appearance quality of welded joints; 13. Clean tools, equipment and workplace; 14. Store tools and equipment. 15. Observe health, occupational and environmental safety, rules and regulations 16. Observe health, occupational and environmental safety, rules and regulations	**2.0 Principle** The person performing this task must be able to explain the following principles: 2.1 Protection scope, use, and maintenance specifications of protective equipment in various environments; 2.2 Welding material selection standards; 2.3 Selection and preparation principles of grooves; 2.4. Principle of butt GMAW OPW of stainless steel plate by layers and passes. **3.0 Theories** The person performing this task must be able to explain the following: 3.1 Welding performance of metal materials; 3.2 Mechanical drawing and drawing reading; 3.3 Preparation method for the process of the Butt GMAW OPW of stainless steel plate; 3.4 Classification, characteristics, and application of welding equipment; 3.5 Classification, causes, and preventive measures of welding defects; 3.6 Forming process of butt GMAW OPW weld of stainless steel plate. **4.0 Essential Skills** 4.1 Communication skills; 4.. Management skills; 4.3 Equipment maintenance skills; 4.4 Report writing skills. **5.0 Math Skills** 5.1 Data analysis skills; 5.2 Engineering mathematics skills.
DESCRIPTION ON THE END PRODUCTS / SERVICE	Butt GMAW OPW of stainless steel conducted according to technical standards and Welding Procedure Specification, and welds meet quality requirements.
CIRCUMSTANTIAL KNOWLEDGE	**Detailed knowledge about:** 1. Safe operation and use of equipment and tools; 2. Safe operation and use of testing tools; 3. Occupational health and safety.

OCCUPATION	WELDING ENGINEER	**OCCUPATION CODE**	
DUTY TITLE	PERFORM TIG OPW	**DUTY NO.**	703
TASK TITLE	CONDUCT BUTT TIG OPW OF LOW ALLOY PLATES	**TASK NO.**	7031
PERFORMANCE CRITERIA	The person performing this task must be able to complete the operation process of butt TIG OPW of low alloy plates according to the specific welding technology.		
RANGE STATEMENT	The task can be performed in the welding workshop under the supervision of welding engineers or mechanical engineers. The equipment and tools to be used include: 1. Power supply of TIG; 2. Ground wire clamp; 3. Welding torch; 4. Argon cylinder; 5. Argon relief valve; 6. Welding fixture; 7. Electric angle grinder; 8. File; 9. Welding mask; 10. Wire brush; 11. Chisel; 12. Hammer; 13. Pliers; 14. Tungsten grinder; 15. Weld gauge; 16. Personal protective equipment (safety helmet, safety shoes, protective clothing, welding gloves, etc.). 17. Safety gear		

EVIDENCE REQUIREMENTS	
PRACTICAL PERFORMANCE	**UNDERPINNING KNOWLEDGE**
The person performing this task must be able to do the following: 1. Read drawings or technical process documents; 2. Check and commission the equipment, fixtures, tools, and safety protective equipment used; 3. Select welding parameters according to drawings or process requirements; 4. Select nozzle, wire and tungsten electrode; 5. Prepare workpiece weld groove; 6. Remove the rust and stains around the weld seam and groove of the workpiece;	**Detailed knowledge about:** **1.0 Methods** The person performing this task must be able to explain how to: 1.1 Maintain and manage TIG equipment; 1.2 Prepare the process for butt TIG OPW of low alloy plate; 1.3 Conduct TIG OPW; 1.4 Prevent and control welding deformation; 1.5 Clean the surface of the welded joint; 1.6 Check the appearance quality of the welds. **2.0 Principle**

7. Assemble and position the assembled workpiece, reserve gaps and reverse deformation angles according to process requirements; 8. Fix the workpiece on the fixture according to the overhead welding position; 9. Determine the appropriate number of welding layers and passes; 10. Perform arc striking, welding, and arc stopping operations by layers and passes; 11. Clean the surface of the welded joint; 12. Check the appearance quality of welded joints; 13. Clean tools, equipment and workplace; 14. Store tools and equipment. 15. Observe health, occupational and environmental safety, rules and regulations 16. Observe health, occupational and environmental safety, rules and regulations	The person performing this task must be able to explain the following principles: 2.1 Protection scope, use, and maintenance specifications of protective equipment in various environments; 2.2 Welding material selection standards; 2.3 Selection and preparation principles of grooves; 2.4 Principle of butt TIG OPW of low alloy steel plate by layers and passes. **3.0 Theories** The person performing this task must be able to explain the following: 3.1 Welding performance of metal materials; 3.2 Mechanical drawing and drawing reading; 3.3 Preparation method for the process of butt TIG OPW of low alloy plate; 3.4 Classification, characteristics, and application of welding equipment; 3.5 Classification, causes, and preventive measures of welding defects; 3.6 Forming process for butt TIG OPW of low carbon steel. **4.0 Essential Skills** 4.1 Communication skills; 4.2 Management skills; 4.3 Equipment maintenance skills; 4.4 Report writing skills. **5.0 Math Skills** 5.1 Data analysis skills; 5.2 Engineering mathematics skills.
DESCRIPTION ON THE END PRODUCTS / SERVICE	Butt TIG OPW of low carbon steel plate is conducted according to technical standards and Welding Procedure Specification, and welds meet quality requirements.
CIRCUMSTANTIAL KNOWLEDGE	**Detailed knowledge about:** 1. Safe operation and use of equipment and tools 2. Safe operation and use of testing tools 3. Occupational health and safety

OCCUPATION	WELDING ENGINEER	**OCCUPATION CODE**	
DUTY TITLE	PERFORM TIG OPW	**DUTY NO.**	703
TASK TITLE	CONDUCT BUTT HORIZONTAL FIXED TIG OF LOW ALLOY STEEL PIPE	**TASK NO.**	7032
PERFORMANCE CRITERIA	The person performing this task must be able to complete the operation process of butt horizontal fixed TIG of low alloy steel pipe according to the specific welding technology.		
RANGE STATEMENT	The task can be performed in the welding workshop under the supervision of welding engineers or mechanical engineers. The equipment and tools to be used include: 1. Power supply of tungsten-arc inert-gas welding; 2. Ground wire clamp; 3. Welding torch; 4. Argon cylinder; 5. Argon relief valve; 6. Welding fixture; 7. Pipe clamp; 8. Electric angle grinder; 9. File; 10. Welding mask; 11. Wire brush; 11. Chisel; 13. Hammer; 14. Pliers; 15. Tungsten grinder; 16. Weld gauge; 17. Personal protective equipment (safety helmet, safety shoes, protective clothing, welding gloves, etc.). 18. Safety gear		

EVIDENCE REQUIREMENTS	
PRACTICAL PERFORMANCE	**UNDERPINNING KNOWLEDGE**
The person performing this task must be able to do the following: 1. Read drawings or technical process documents; 2. Check and commission the equipment, fixtures, tools, and safety protective equipment used; 3. Select welding parameters according to drawings or process requirements; 4. Select nozzle, wire and tungsten electrode; 5. Prepare workpiece weld groove;	**Detailed knowledge about:** **1.0 Methods** The person performing this task must be able to explain how to: 1.1 Maintain and manage TIG equipment; 1.2 Prepare the process for butt horizontal fixed TIG of low alloy steel pipe; 1.3 Conduct TIG OPW; 1.4 Prevent and control welding deformation; 1.5 Clean the surface of the welded joint; 1.6 Check the appearance quality of the welds.

6. Remove the rust and stains around the weld seam and groove of the workpiece; 7. Assemble and position the assembled workpiece, reserve gaps and reverse deformation angles according to process requirements; 8. Fix the workpiece on the fixture according to the butt horizontal fixed position; 9. Determine the appropriate number of welding layers and passes; 10. Perform arc striking, welding, and arc stopping operations by layers and passes; 11. Clean the surface of the welded joint; 12. Check the appearance quality of welded joints; 13. Clean tools, equipment and workplace; 14. Store tools and equipment. 15. Observe health, occupational and environmental safety, rules and regulations 16. Observe health, occupational and environmental safety, rules and regulations	**2.0 Principle** The person performing this task must be able to explain the following principles: 2.1 Protection scope, use, and maintenance specifications of protective equipment in various environments; 2.2 Welding material selection standards; 2.3 Selection and preparation principles of grooves; 2.4 Principle of butt horizontal fixed TIG of low alloy steel pipe by layers and passes. **3.0 Theories** The person performing this task must be able to explain the following: 3.1 Welding performance of metal materials; 3.2 Mechanical drawing and drawing reading; 3.3 Preparation method for the process of butt horizontal fixed TIG of low alloy steel pipe; 3.4 Classification, characteristics, and application of welding equipment; 3.5 Classification, causes, and preventive measures of welding defects; 3.6 Forming process for butt horizontal fixed TIG of low alloy steel pipe. **4.0 Essential Skills** 4.1 Communication skills; 4.2 Management skills; 4.3 Equipment maintenance skills; 4.4 Report writing skills. **5.0 Math Skills** 5.1 Data analysis skills; 5.2 Engineering mathematics skills.
DESCRIPTION ON THE END PRODUCTS / SERVICE	Butt horizontal fixed TIG of low alloy steel pipe is conducted according to technical standards and Welding Procedure Specification, and welds meet quality requirements.
CIRCUMSTANTIAL KNOWLEDGE	**Detailed knowledge about:** 1. Safe operation and use of equipment and tools; 2. Safe operation and use of testing tools; 3. Occupational health and safety.

OCCUPATION	WELDING ENGINEER	**OCCUPATION CODE**	
DUTY TITLE	CARRY OUT FLOW WELDING OF NON-FERROUS METALS	**DUTY NO.**	704
TASK TITLE	CONDUCT TS OF ALUMINUM AND ALUMINUM ALLOY PIPES	**TASK NO.**	7041
PERFORMANCE CRITERIA	The person performing this task must be able to complete the operation process of TS of aluminum and aluminum alloy pipes according to the specific welding technology.		
RANGE STATEMENT	The task can be performed in the welding workshop under the supervision of welding engineers or mechanical engineers. The equipment and tools to be used include: 1. Oxygen; 2. Propane or acetylene; 3. Oxygen relief valve; 4. Propane (acetylene) relief valve; 5. Welding torch; 6. Welding fixture; 7. Cleaning agents for aluminum and aluminum alloy; 8. Electric angle grinder; 9. Pliers; 10. File; 11. Welding goggles; 12. Stainless steel wire brush; 13. Hammer; 14. Chisel; 15. Weld gauge; 16. Personal protective equipment (safety helmet, safety shoes, protective clothing, welding gloves, etc.); 17. Filler materials (aluminum or other) 18. Safety gear		

EVIDENCE REQUIREMENTS	
PRACTICAL PERFORMANCE	**UNDERPINNING KNOWLEDGE**
The person performing this task must be able to do the following: 1. Read drawings or technical process documents; 2. Check and commission the equipment, fixtures, tools, and safety protective equipment used; 3. Select welding parameters according to drawings or process requirements; 4. Select filler materials and combustion gases; 5. Prepare workpiece weld groove;	**Detailed knowledge about:** **1.0 Methods** The person performing this task must be able to explain how to: 1.1 Maintain and manage TS equipment; 1.2 Prepare the process for TS of aluminum and aluminum alloy pipes; 1.3 Perform TS operation; 1.4 Prevent and control welding deformation; 1.5 Clean the surface of the welded joint; 1.6 Check the appearance quality of the welds.

6. Remove the rust and stains around the weld seam and groove of the workpiece; 7. Assemble and position the assembled workpiece, reserve gaps according to process requirements; 8. Fix the workpiece on the fixture; 9. Select the appropriate flame and temperature for TS according to the process; 10. Clean the surface of the welded joint; 11. Check the appearance quality of welded joints; 12. Clean tools, equipment and workplace; 13. Store tools and equipment. 14. Observe health, occupational and environmental safety, rules and regulations 15. Observe health, occupational and environmental safety, rules and regulations	**2.0 Principle** The person performing this task must be able to explain the following principles: 2.1 Protection scope, use, and maintenance specifications of protective equipment in various environments; 2.2 Welding material selection standards; 2.3 Selection and preparation principles of grooves; 2.4 Principles for the placement of TS metals and fluxes for aluminum and aluminum alloy pipes. **3.0 Theories** The person performing this task must be able to explain the following: 3.1 Welding performance of metal materials; 3.2 Mechanical drawing and drawing reading; 3.3 Preparation method for the process of TS of aluminum and aluminum alloy pipes; 3.4 Classification, characteristics, and application of welding equipment; 3.5 Classification, causes, and preventive measures of welding defects; 3.6 Forming process of TS weld of aluminum and aluminum alloy pipes. **4.0 Essential Skills** 4.1 Communication skills; 4.2 Management skills; 4.3 Equipment maintenance skills; 4.4 Report writing skills. **5.0 Math Skills** 5.1 Data analysis skills; 5.2 Engineering mathematics skills.
DESCRIPTION ON THE END PRODUCTS / SERVICE	TS of aluminum and aluminum alloy pipes is conducted according to technical standards and Welding Procedure Specification, and welds meet quality requirements.
CIRCUMSTANTIAL KNOWLEDGE	**Detailed knowledge about:** 1. Safe operation and use of equipment and tools; 2. Safe operation and use of testing tools; 3. Occupational health and safety.

OCCUPATION	WELDING ENGINEER	**OCCUPATION CODE**	
DUTY TITLE	CARRY OUT FLOW WELDING OF NON-FERROUS METALS	**DUTY NO.**	704
TASK TITLE	CONDUCT BUTT OR LAP FS OF COPPER AND COPPER ALLOY PLATE	**TASK NO.**	7042
PERFORMANCE CRITERIA	The person performing this task must be able to complete the operation process of butt or lap FS of copper and copper alloy plate according to the specific welding technology.		
RANGE STATEMENT	The task can be performed in the welding workshop under the supervision of welding engineers or mechanical engineers. The equipment and tools to be used include: 1. Brazing furnace; 2. Electric control cabinet; 3. Electric angle grinder; 4. Positioning fixture; 5. File; 6. Wire brush; 7. Wood hammer or rubber hammer; 8. Chisel; 9. Pliers; 10. Weld gauge; 11. Personal protective equipment (safety helmet, safety shoes, protective clothing, welding gloves, etc.). 12. Safety gear		

EVIDENCE REQUIREMENTS

PRACTICAL PERFORMANCE	**UNDERPINNING KNOWLEDGE**
The person performing this task must be able to do the following: 1. Read drawings or technical process documents; 2. Check and commission the equipment, fixtures, tools, and safety protective equipment used; 3. Select welding parameters according to drawings or process requirements; 4. Select FS materials; 5. Clean the surface of the workpiece; 6. Adjust the butt or lap gap of the workpiece according to the process requirements and fix it with fixture; 7. Place the fixed workpiece and FS material into the FS furnace; 8. Operate the FS furnace according to the process flow;	**Detailed knowledge about:** **1.0 Methods** The person performing this task must be able to explain how to: 1.1 Maintain and manage FS equipment; 1.2 Prepare the process for butt or lap FS of copper and copper alloy plate; 1.3 Perform FS operation; 1.4 Prevent and control welding deformation; 1.5 Clean the surface of the welded joint; 1.6 Check the appearance quality of the welds. **2.0 Principle** The person performing this task must be able to explain the following principles: 2.1 Protection scope, use, and maintenance specifications of protective equipment in various environments;

9. Remove the workpiece for surface cleaning; 10. Check the appearance quality of welded joints; 11. Clean tools, equipment and workplace; 12. Store tools and equipment. 13. Observe health, occupational and environmental safety, rules and regulations 14. Observe health, occupational and environmental safety, rules and regulations	2.2 Welding material selection standards 2.3 Selection and preparation principles of grooves; 2.4 Principles for placing metals and fluxes for butt or lap FS of copper and copper alloy plates. **3.0 Theories** The person performing this task must be able to explain the following: 3.1 Welding performance of metal materials; 3.2 Mechanical drawing and drawing reading; 3.3 Preparation method for the process of butt or lap FS of copper and copper alloy plate; 3.4 Classification, characteristics, and application of welding equipment; 3.5 Classification, causes, and preventive measures of welding defects; 3.6 Forming process of butt or lap FS weld of copper and copper alloy plate. **4.0 Essential Skills** 4.1 Communication skills; 4.2 Management skills; 4.3 Equipment maintenance skills; 4.4 Report writing skills. **5.0 Math Skills** 5.1 Data analysis skills; 5.2 Engineering mathematics skills.
DESCRIPTION ON THE END PRODUCTS / SERVICE	Butt or lap FS of copper and copper alloy plate is conducted according to technical standards and Welding Procedure Specification, and welds meet quality requirements.
CIRCUMSTANTIAL KNOWLEDGE	**Detailed knowledge about:** 1. Safe operation and use of equipment and tools; 2. Safe operation and use of testing tools; 3. Occupational health and safety.

OCCUPATION	WELDING ENGINEER	**OCCUPATION CODE**	
DUTY TITLE	CARRY OUT FLOW WELDING OF NON-FERROUS METALS	**DUTY NO.**	704
TASK TITLE	CONDUCT TS OF COPPER AND COPPER ALLOY PIPES	**TASK NO.**	7043
PERFORMANCE CRITERIA	The person performing this task must be able to complete the operation process of TS of copper and copper alloy pipes according to the specific welding technology.		
RANGE STATEMENT	The task can be performed in the welding workshop under the supervision of welding engineers or mechanical engineers. The equipment and tools to be used include: 1. Oxygen; 2. Propane (acetylene); 3. Oxygen relief valve; 4. Propane (acetylene) relief valve; 5. Welding torch; 6. Welding fixture; 7. Copper pipe bender; 8. Copper pipe expander; 9. Copper pipe cutter; 10. Pipe nozzle cleaner; 11. Sandpaper; 12. Electric angle grinder; 13. Pliers; 14. Welding goggles; 15. Wire brush; 16. Wood hammer or rubber hammer; 17. Weld gauge; 18. Personal protective equipment (safety helmet, safety shoes, protective clothing, welding gloves, etc.). 19. Safety gear		

EVIDENCE REQUIREMENTS	
PRACTICAL PERFORMANCE	**UNDERPINNING KNOWLEDGE**
The person performing this task must be able to do the following: 1. Read drawings or technical process documents; 2. Check and commission the equipment, fixtures, tools, and safety protective equipment used; 3. Select welding parameters according to drawings or process requirements; 4. Select FLOW materials and combustion gases;	**Detailed knowledge about:** **1.0 Methods** The person performing this task must be able to explain how to: 1.1. Maintain and manage TS equipment; 1.2 Prepare the process for TS of copper and copper alloy pipes; 1.3 Perform TS operation; 1.4 Prevent and control welding deformation; 1.5 Clean the surface of the welded joint;

5. Prepare workpiece weld groove; 6. Remove the rust and stains around the weld seam and groove of the workpiece; 7. Assemble and position the assembled workpiece, reserve gaps according to process requirements; 8. Fix the workpiece on the fixture; 9. Select the appropriate flame and temperature for TS according to the process; 10. Clean the surface of the welded joint; 11. Check the appearance quality of welded joints; 12. Clean tools, equipment and workplace; 13. Store tools and equipment. 14. Observe health, occupational and environmental safety, rules and regulations	1.6 Check the appearance quality of the welds; **2.0 Principle** The person performing this task must be able to explain the following principles: 2.1 Protection scope, use, and maintenance specifications of protective equipment in various environments; 2.2 Welding material selection standards; 2.3 Selection and preparation principles of grooves; 2.4 Principles for the placement of TS metals and fluxes for copper and copper alloy pipes; **3.0 Theories** The person performing this task must be able to explain the following: 3.1 Welding performance of metal materials; 3.2 Mechanical drawing and drawing reading; 3.3 Preparation method for the process of TS of copper and copper alloy pipes; 3.4 Classification, characteristics, and application of welding equipment; 3.5 Classification, causes, and preventive measures of welding defects; 3.6 Forming process of TS weld of copper and copper alloy pipes; **4.0 Essential Skills** 4.1 Communication skills; 4.2 Management skills; 4.3 Equipment maintenance skills; 4.4 Report writing skills. **5.0 Math Skills** 5.1 Data analysis skills; 5.2 Engineering mathematics skills.
DESCRIPTION ON THE END PRODUCTS / SERVICE	TS of copper and copper alloy pipes is conducted according to technical standards and Welding Procedure Specification, and welds meet quality requirements.
CIRCUMSTANTIAL KNOWLEDGE	**Detailed knowledge about:** 1. Safe operation and use of equipment and tools; 2. Safe operation and use of testing tools; 3. Occupational health and safety.

OCCUPATION	WELDING ENGINEER	OCCUPATION CODE	
DUTY TITLE	PERFORM AUTOMATIC WELDING	**DUTY NO.**	**705**
TASK TITLE	PERFORM AUTOMATIC SAW	**TASK NO.**	**7051**
PERFORMANCE CRITERIA	The person performing this task must be able to complete the operation process of automatic SAW according to the specific welding technology.		
RANGE STATEMENT	The task can be performed in the welding workshop under the supervision of welding engineers or mechanical engineers. The equipment and tools to be used include: 1. Power supply of automatic SAW; 2. Carbon arc gouging or plasma gouging equipment; 3. Ground wire clamp; 4. Welding fixture console; 5. Slag removal tools; 6. Electric angle grinder; 7. File; 8. Welding mask; 9. Wire brush; 10. Hammer; 11. Chisel; 12. Pliers; 13. Weld gauge; 14. Personal protective equipment (safety helmet, safety shoes, protective clothing, welding gloves, etc.); 15. Wire electrodes; 16. Flux granules; 17. Flux feeding equipment. 18. Safety gear		

EVIDENCE REQUIREMENTS	
PRACTICAL PERFORMANCE	**UNDERPINNING KNOWLEDGE**
The person performing this task must be able to do the following: 1. Read drawings or technical process documents; 2. Check and commission the equipment, fixtures, tools, and safety protective equipment used; 3. Set welding parameters, layers and passes according to drawings or process requirements; 4. Select welding wire and flux; 5. Prepare the workpiece weld groove, run-on tab, and run-off tab;	**Detailed knowledge about:** **1.0 Methods** The person performing this task must be able to explain how to: 1.1 Maintain and manage automatic SAW equipment; 1.2 Prepare the process for automatic SAW; 1.3 Operate the automatic SAW equipment; 1.4 Prevent and control welding deformation; 1.5 Clean the surface of the welded joint; 1.6 Check the appearance quality of the welds. **2.0 Principle**

6. Remove the rust and stains around the weld seam and groove of the workpiece; 7. Assemble and position the assembled workpiece, reserve gaps and reverse deformation angles according to process requirements; 8. Install run-on tab and run-off tab at both ends of the welds; 9. Fix the workpiece on the fixture console according to the down hand position; 10. Start the equipment to complete the welding operation by layers and passes; 11. Remove the flux and slag from each weld; 12. Clean the surface of the welded joint; 13. Check the appearance quality of welded joints; 14. Clean tools, equipment and workplace; 15. Store tools and equipment. 16. Observe health, occupational and environmental safety, rules and regulations	The person performing this task must be able to explain the following principles: 2.1 Protection scope, use, and maintenance specifications of protective equipment in various environments; 2.2 Welding material selection standards; 2.3 Selection and preparation principles of grooves; 2.4 Principle of automatic SAW by layers and passes. **3.0 Theories** The person performing this task must be able to explain the following: 3.1 Welding performance of metal materials; 3.2 Mechanical drawing and drawing reading; 3.3 Preparation method for the process of automatic SAW; 3.4 Classification, characteristics, and application of welding equipment; 3.5 Classification, causes, and preventive measures of welding defects; 3.6 Forming process for automatic SAW. **4.0 Essential Skills** 4.1 Communication skills; 4.2 Management skills; 4.3 Equipment maintenance skills; 4.4 Report writing skills. **5.0 Math Skills** 5.1 Data analysis skills; 5.2 Engineering mathematics skills.
DESCRIPTION ON THE END PRODUCTS / SERVICE	Automatic SAW is performed according to technical standards and Welding Procedure Specification, and welds meet quality requirements
CIRCUMSTANTIAL KNOWLEDGE	**Detailed knowledge about:** 1. Safe operation and use of equipment and tools; 2. Safe operation and use of testing tools; 3. Occupational health and safety.

OCCUPATION	WELDING ENGINEER	**OCCUPATION CODE**	
DUTY TITLE	PERFORM AUTOMATIC WELDING	**DUTY NO.**	705
TASK TITLE	PERFORM AUTOMATIC ERW	**TASK NO.**	7052
PERFORMANCE CRITERIA	The person performing this task must be able to complete the operation process of automatic ERW according to the specific welding technology.		
RANGE STATEMENT	The task can be performed in the welding workshop under the supervision of welding engineers or mechanical engineers. The equipment and tools to be used include: 1. Power supply of automatic ERW; 2. Ground wire clamp; 3. Welding fixture console; 4. Control system; 5. Slag hammer; 6. Electric angle grinder; 7. File; 8. Welding mask; 9. Wire brush; 10. Hammer; 11. Chisel; 12. Pliers; 13. Weld gauge; 14. Personal protective equipment (safety helmet, safety shoes, protective clothing, welding gloves, etc.). 15. Safety gear		

EVIDENCE REQUIREMENTS	
PRACTICAL PERFORMANCE	**UNDERPINNING KNOWLEDGE**
The person performing this task must be able to do the following: 1. Read drawings or technical process documents; 2. Check and commission the equipment, fixtures, tools, and safety protective equipment used; 3. Remove the rust and stains around the weld seam and groove of the workpiece; 4. Clean assembly and fix workpieces; 5. Operate automatic ERW equipment and peripheral equipment for automatic ERW; 6. Call, save, copy and delete automatic ERW procedures; 7. Identify the welding process status of automatic ERW; 8. Clean the surface of the welded joint	**Detailed knowledge about:** **1.0 Methods** The person performing this task must be able to explain how to: 1.1 Maintain and manage the automatic ERW equipment; 1.2 Prepare the process for automatic ERW; 1.3 Operate the automatic ERW equipment; 1.4 Prevent and control welding deformation; 1.5 Clean the surface of the welded joint; 1.6 Check the appearance quality of the welds. **2.0 Principle** The person performing this task must be able to explain the following principles:

9. Check the appearance quality of welded joints; 10. Clean tools, equipment and workplace; 11. Store tools and equipment. 12. Observe health, occupational and environmental safety, rules and regulations	2.1 Protection scope, use, and maintenance specifications of protective equipment in various environments; 2.2 Welding material selection standards; 2.3 Selection and preparation principles of grooves; 2.4 Principle of automatic ERW. **3.0 Theories** The person performing this task must be able to explain the following: 3.1 Welding performance of metal materials; 3.2 Mechanical drawing and drawing reading; 3.3 Preparation method for the process of automatic ERW; 3.4 Classification, characteristics, and application of welding equipment; 3.5 Classification, causes, and preventive measures of welding defects; 3.6 Forming process for automatic ERW. **4.0 Essential Skills** 4.1 Communication skills; 4.2 Management skills; 4.3 Equipment maintenance skills; 4.4 Report writing skills. **5.0 Math Skills** 5.1 Data analysis skills; 5.2 Engineering mathematics skills.
DESCRIPTION ON THE END PRODUCTS / SERVICE	Automatic ERW is performed according to technical standards and Welding Procedure Specification, and welds meet quality requirements.
CIRCUMSTANTIAL KNOWLEDGE	**Detailed knowledge about:** 1. Safe operation and use of equipment and tools; 2. Safe operation and use of testing tools; 3. Occupational health and safety.

OCCUPATION	WELDING ENGINEER	**OCCUPATION CODE**	
DUTY TITLE	CARRY OUT OPERATION AND MAINTENANCE OF WELDING ROBOTS	**DUTY NO.**	706
TASK TITLE	CARRY OUT MAINTENANCE OF WELDING ROBOTS	**TASK NO.**	7061
PERFORMANCE CRITERIA	The person performing this task must be able to diagnose welding robot faults and carry out maintenance operations.		
RANGE STATEMENT	The task can be performed in the welding workshop under the supervision of welding engineers or mechanical engineers. The equipment and tools to be used include: 1. Welding robot; 2. Controller; 3. Teach pendant; 4. Cusp; 5. Vacuum cleaner; 6. Pliers; 7. Wrench; 8. Gun calibrator; 9. Gun cleaner; 10. Personal protective equipment (safety helmet, safety shoes, protective clothing, welding gloves, etc.). 11. Safety gear		

EVIDENCE REQUIREMENTS

PRACTICAL PERFORMANCE	**UNDERPINNING KNOWLEDGE**
The person performing this task must be able to do the following: 1. Select appropriate tools, equipment, and protective equipment; 2. Evaluate welding robots and peripheral equipment; 3. Analyze the faults of welding robot and peripheral equipment; 4. Handle the faults of welding robot and peripheral equipment; 5. Clean tools, equipment and workplace; 6. Store tools and equipment. 7. 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 for faults in welding robot and peripheral equipment; 1.2 Maintain and manage the welding robot and peripheral equipment; 1.3 Operate the welding robot and peripheral equipment. **2.0 Principle** The person performing this task must be able to explain the following principles: 2.1 Protection scope, use, and maintenance specifications of protective equipment in various environments; 2.2 Principle of fault analysis of welding robot;

	2.3 Acceptance standards for welding robot and peripheral equipment. **3.0 Theories** The person performing this task must be able to explain the following: 3.1 Classification, characteristics and applications of welding robot and peripheral equipment; 3.2 Reasons and solutions for the occurrence of robot fault information numbers or codes. **4.0 Essential Skills** 4.1 Communication skills; 4.2 Management skills; 4.3 Equipment maintenance skills; 4.4 Report writing skills. **5.0 Math Skills** 5.1 Data analysis skills; 5.2 Engineering mathematics skills.
DESCRIPTION ON THE END PRODUCTS / SERVICE	Fault inspection, troubleshooting, and maintenance management on the welding robot and peripheral equipment is performed according to technical standards and equipment maintenance procedures
CIRCUMSTANTIAL KNOWLEDGE	**Detailed knowledge about:** 1. Safe operation and use of equipment and tools; 2. Safe operation and use of testing tools; 3. Occupational health and safety.

OCCUPATION	WELDING ENGINEER	**OCCUPATION CODE**	
DUTY TITLE	CARRY OUT OPERATION AND MAINTENANCE OF WELDING ROBOTS	**DUTY NO.**	706
TASK TITLE	CONDUCT RW TEACHING PROGRAMMING	**TASK NO.**	7062
PERFORMANCE CRITERIA	The person performing this task must be able to complete the operation process of RW teaching programming according to the specific welding technology.		
RANGE STATEMENT	The task can be performed in the welding workshop under the supervision of welding engineers or mechanical engineers. The equipment and tools to be used include: 1. Arc welding robot; 2. Controller; 3. Teaching box; 4. Power supply of arc welding; 5. shielding gas; 6. Gas relief valve; 7. Slag hammer; 8. Electric angle grinder; 9. Welding mask; 10. Wire brush; 11. Hammer; 12. Chisel; 13. Pliers; 14. Weld gauge; 15. Personal protective equipment (safety helmet, safety shoes, protective clothing, welding gloves, etc.). 16. Safety gear		

EVIDENCE REQUIREMENTS	
PRACTICAL PERFORMANCE	**UNDERPINNING KNOWLEDGE**
The person performing this task must be able to do the following: 1. Read drawings or technical process documents; 2. Check and commission the equipment, fixtures, tools, and safety protective equipment used; 3. Select welding wire and shielding gas; 4. Prepare workpiece weld groove; 5. Remove the rust and stains around the weld seam and groove of the workpiece; 6. Assemble and position the assembled workpiece, reserve gaps and reverse	**Detailed knowledge about:** **1.0 Methods** The person performing this task must be able to explain how to: 1.1. Maintain and manage the welding robot; 1.2 Prepare the RW process; 1.3 Operate the welding robot and peripheral equipment; 1.4 Prevent and control welding deformation; 1.5 Check the appearance quality of the welds. **2.0 Principle**

deformation angles according to process requirements; 7. Fix the assembled workpiece on the console; 8. Hold the teach pendant; 9. Manipulate the movement of each axis of the robot with the teach pendant; 10. Select a coordinate system; 11. Move the end effector of the robot to the designated position and maintain the correct posture; 12. Select a teaching mode for teaching programming of plane straight line and arc trajectory; 13. Clean tools, equipment and workplace; 14. Store tools and equipment. 15. Observe health, occupational and environmental safety, rules and regulations	The person performing this task must be able to explain the following principles: 2.1 Protection scope, use, and maintenance specifications of protective equipment in various environments; 2.2 Welding material selection standards; 2.3 Selection and preparation principles of grooves; 2.4 Principles for using teach pendant of welding robot; 2.5 Action principle of welding robot; 2.6 Principles for setting technical parameters of welding robot. **3.0 Theories** The person performing this task must be able to explain the following: 3.1 Welding performance of metal materials; 3.2 Mechanical drawing and drawing reading; 3.3 Preparation method of RW process; 3.4 Classification, characteristics and applications of welding robot and peripheral equipment; 3.5 Teaching programming method for welding robot; 3.6 Classification, causes, and preventive measures of welding defects; 3.7 Forming process of RW weld. **4.0 Essential Skills** 4.1 Communication skills; 4.2 Management skills; 4.3 Equipment maintenance skills; 4.4 Report writing skills. **5.0 Math Skills** 5.1 Data analysis skills; 5.2 Engineering mathematics skills.
DESCRIPTION ON THE END PRODUCTS / SERVICE	Teaching programming and welding operations for welding robot is conducted according to technical standards and Welding Procedure Specifications, and welds meet quality requirements.
CIRCUMSTANTIAL KNOWLEDGE	**Detailed knowledge about:** 1. Safe operation and use of equipment and tools;

	2. Safe operation and use of testing tools; 3. Occupational health and safety.		
OCCUPATION	WELDING ENGINEER	**OCCUPATION CODE**	
DUTY TITLE	CARRY OUT WELDING TECHNOLOGY MANAGEMENT	**DUTY NO.**	707
TASK TITLE	PREPARE WELDING PROCESS CARD	**TASK NO.**	7071
PERFORMANCE CRITERIA	The person performing this task must be able to prepare welding process cards according to technical document requirements and safety regulations to guide welding workers in welding operation		
RANGE STATEMENT	The task can be performed in the welding workshop under the supervision of welding engineers or mechanical engineers. The equipment and tools to be used include: 1. Computers and auxiliary equipment; 2. Drawing software; 3. Related reference books; 4. Printer. 5. Safety gear		

EVIDENCE REQUIREMENTS	
PRACTICAL PERFORMANCE	**UNDERPINNING KNOWLEDGE**
The person performing this task must be able to do the following: 1. Read welding technology documents; 2. Analyze welding structure; 3. Determine detailed requirements for welded joints; 4. Analyze the process route; 5. Select welding equipment; 6. Analyze operating conditions and environment; 7. Prepare welding process card. 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 Draw welding structure diagram; 1.2 Analyze the welding process route; 1.3 Prepare welding process documents. **2.0 Principle** The person performing this task must be able to explain the following principles: 2.1 Protection scope, use, and maintenance specifications of protective equipment in various environments; 2.2 Standards and specifications for the preparation of welding process documents. **3.0 Theories** The person performing this task must be able to explain the following: 3.1 Welding performance and application of metal materials; 3.2 Mechanical drawing and drawing reading; 3.3 Welding structure process and production;

	3.4 Causes and preventive measures for welding defects; 3.5 Prevention and control of welding deformation; 3.6 Welding quality inspection and analysis. **4.0 Essential Skills** 4.1 Communication skills; 4.2 Management skills; 4.3 Drawing skills; 4.4 Quality analysis skills; 4.5 Computer application skills; 4.6 Technical report writing skills. **5.0 Math Skills** 5.1 Data analysis skills; 5.2 Engineering mathematics skills.
DESCRIPTION ON THE END PRODUCTS / SERVICE	Welding process card that meets quality requirements is prepared based on technical standards and drawing requirements
CIRCUMSTANTIAL KNOWLEDGE	**Detailed knowledge about:** 1. Computer operation; 2. Use of drawing software; 3. Occupational health and safety.

OCCUPATION	WELDING ENGINEER	**OCCUPATION CODE**	
DUTY TITLE	CARRY OUT WELDING TECHNOLOGY MANAGEMENT	**DUTY NO.**	707
TASK TITLE	CARRY OUT WELDING FIXTURE DESIGN AND MODIFICATION	**TASK NO.**	7072
PERFORMANCE CRITERIA	The person performing this task must be able to design and modify welding fixture according to technical requirements and safety regulations		
RANGE STATEMENT	The task can be performed in the welding office and workshop under the supervision of welding engineers or mechanical engineers. The equipment and tools to be used include: 1. Computers and auxiliary equipment; 2 Drawing software; 3. Related reference books; 4. Printer. 5. Safety gear		

EVIDENCE REQUIREMENTS	
PRACTICAL PERFORMANCE	**UNDERPINNING KNOWLEDGE**
The person performing this task must be able to do the following: 1. Analyze the welding structure using fixture; 2. Refer to drawings and technical documents for welding structure; 3. Refer to the assembly process specification for welding structures; 4. Design and draw fixture drawings; 5. Develop fixture manufacturing process; 6. Guide fixture manufacturing; 7. Testing the reliability, usability, and safety of fixture 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. Design and modify welding fixtures; 1.2 Prepare the welding fixture manufacturing process; 1.3 Test the usability of welding fixtures. **2.0 Principle** The person performing this task must be able to explain the following principles: 2.1 Mechanical Engineering principles; 2.2 Welding fixture design principles; 2.3 Design and fabrication assembly standards for fixtures; 2.4 Precision requirements for fixtures. **3.0 Theories** The person performing this task must be able to explain the following: 3.1 Mechanical drawing; 3.2 Welding structure analysis; 3.3 Operating characteristics of common welding methods; 3.4 Performance analysis of welding fixture materials;

	3.5 Analysis of structural defects of welding fixture; 3.6 Controllability of welding fixtures on welding structure deformation. **4.0 Essential Skills** 4.1 Communication skills; 4.2 Management skills; 4.3 Drawing skills; 4.4 Structure design capability; 4.5 Quality analysis skills; 4.6 Computer application skills; 4.7 Technical report writing skills. **5.0 Math Skills** 5.1 Data analysis skills; 5.2 Engineering mathematics skills.
DESCRIPTION ON THE END PRODUCTS / SERVICE	Welding fixture that meets safety and quality requirements is designed and modified based on technical standards and drawing requirements
CIRCUMSTANTIAL KNOWLEDGE	**Detailed knowledge about:** 1. Computer operation; 2. Use of drawing software; 3. Occupational health and safety.

OCCUPATION	WELDING ENGINEER	**OCCUPATION CODE**	
DUTY TITLE	CARRY OUT WELDING TECHNOLOGY MANAGEMENT	**DUTY NO.**	707
TASK TITLE	CARRY OUT QUALITY ANALYSIS OF WELDING STRUCTURES	**TASK NO.**	7073
PERFORMANCE CRITERIA	The person performing this task must be able to analyze the quality of welding according to the quality requirements of the welding structure		
RANGE STATEMENT	The task can be performed in the welding office and workshop under the supervision of welding engineers or mechanical engineers. The equipment and tools to be used include: 1. Computers and auxiliary equipment; 2. Drawing software; 3. Related reference books; 4. Printer. 5. Safety gear		

EVIDENCE REQUIREMENTS	
PRACTICAL PERFORMANCE	**UNDERPINNING KNOWLEDGE**
The person performing this task must be able to do the following: 1. Check the quality of welding structure; 2. Analyze the quality of welding structure; 3. Write a welding quality analysis report; 4. Develop welding process improvement measures. 5. 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 the welding quality; 1.2 Analyze the quality of welding structure; 1.3 Improve the welding structure process; 1.4 Evaluate the welding procedures; 1.5 Prepare quality report. **2.0 Principle** The person performing this task must be able to explain the following principles: 2.1 Welding structure and quality acceptance standards; 2.2 Welding quality management specification. **3.0 Theories** The person performing this task must be able to explain the following: 3.1 Classification of welding defects; 3.2 Causes and preventive measures of welding defects; 3.3 Welding quality inspection and analysis; 3.4 Welding structure manufacturing; 3.5 Welding procedure qualification.

	4.0 Essential Skills 4.1 Communication skills; 4.2 Management skills; 4.3 Drawing skills; 4.4 Structure design capability; 4.5 Quality analysis skills; 4.6 Computer application skills; 4.7 Technical report writing skills. **5.0 Math Skills** 5.1 Data analysis skills; 5.2 Engineering mathematics skills.
DESCRIPTION ON THE END PRODUCTS / SERVICE	Welding structure quality analysis is performed according to technical standards and production management rules, and safety and technical management is effectively undertaken.
CIRCUMSTANTIAL KNOWLEDGE	**Detailed knowledge about:** 1. Computer operation; 2. Use of drawing software; 3. Occupational health and safety; 4. Safe use of testing equipment.

APPENDIX: DACUM CHART FOR WELDING ENGINEER - NTA LEVEL 7

DUTIES	TASKS	ENABLERS
1.0 Perform Shielded Metal Arc Welding (SMAW) OPW	1.1 Conduct Butt SMAW OPW of low-carbon steel or low-alloy steel plate. 1.2 Conduct butt SMAW OPW of stainless steel plate.	**General skills and knowledge** · Cooperate with others using communication skills and report to the superiors · Skills and knowledge in workshop safety rules · Reading of welding equipment instruction manual · Use of welding equipment · Reading of technical documents and drawings · Welding principle and defect control · Knowledge of metal materials · Knowledge of welding process · Knowledge and practice of blanking and cutting · Knowledge and practice of SMAW · Welding quality inspection · Welding structure manufacturing · Occupational health and safety **Tools and equipment** · Personal protective equipment (safety helmet, safety shoes, protective clothing, welding gloves, etc.) · SMAW equipment · Complete set of tools for SMAW · Special measuring tools · Fire safety equipment · Fire alarm **Materials** · Low carbon or low alloy steel plate · Low carbon steel wire · Stainless steel plate · Stainless steel electrode

		Requirements for employees · Teamwork spirit · Honesty · Time management · Keeping promises
2.0 Perform GMAW OPW	2.1 Conduct Butt GMAW OPW of low carbon steel plate. 2.2 Conduct butt GMAW OPW of stainless steel plate.	**General skills and knowledge** · Cooperate with others using communication skills and report to the superiors · Skills and knowledge in workshop safety rules · Reading of welding equipment instruction manual · Use of welding equipment · Reading of technical documents and drawings · Welding principle and defect control · Knowledge of metal materials · Knowledge of welding process · Knowledge and practice of blanking and cutting · Knowledge and practice of GMAW · Welding quality inspection · Welding structure manufacturing · Occupational health and safety **Tools and equipment** · Personal protective equipment (safety helmet, safety shoes, protective clothing, welding gloves, etc.) · GMAW equipment · Complete set of tools for GMAW · Special measuring tools · Fire safety equipment · Fire alarm **Materials** · Low carbon steel plate · Low carbon steel wire

		· Carbon dioxide · Stainless steel plate · Stainless steel wire · Mixed gas (typically 80% argon and 20% carbon dioxide) **Requirements for employees** · Teamwork spirit · Honesty · Time management · Keeping promises
3.0 Perform TIG OPW	3.1 Conduct butt TIG OPW of low alloy plates. 3.2 Conduct butt horizontal fixed TIG of low alloy steel pipe.	**General skills and knowledge** · Cooperate with others using communication skills and report to the superiors · Skills and knowledge in workshop safety rules · Reading of welding equipment instruction manual · Use of welding equipment · Reading of technical documents and drawings · Welding principle and defect control · Knowledge of metal materials · Knowledge of welding process · Knowledge and practice of blanking and cutting · Knowledge and practice of TIG and other non-GMAW · Welding quality inspection · Welding structure manufacturing · Occupational health and safety **Tools and equipment** · Personal protective equipment (safety helmet, safety shoes, protective clothing, welding gloves, etc.) · TIG equipment · Complete set of tools for TIG · Special measuring tools · Fire safety equipment

		· Fire alarm **Materials** · Low alloy steel plate · Low alloy steel wire · Argon · Low alloy steel pipe · Low alloy steel wire · Argon **Requirements for employees** · Teamwork spirit · Honesty · Time management · ● Keeping promises
4.0 Carry out FLOW of non-ferrous metals	4.1 Conduct TS of aluminum and aluminum alloy pipes. 4.2 Conduct butt or lap FS of copper and copper alloy plate. 4.3 Conduct TS of copper and copper alloy pipes.	**General skills and knowledge** · Cooperate with others using communication skills and report to the superiors · Skills and knowledge in workshop safety rules · Reading of welding equipment instruction manual · Use of welding equipment · Reading of technical documents and drawings · FLOW principle and defect control · Knowledge of metal materials · Knowledge of welding process · Knowledge and practice of blanking and cutting · Knowledge and practice of common FLOW methods such as TS and FS · Welding quality inspection · Welding structure manufacturing · Occupational health and safety **Tools and equipment** · Personal protective equipment (safety helmet, safety shoes, protective clothing, welding gloves, etc.)

		· TS and FS equipment · Complete set of tools for TS and FS operations · Special measuring tools · Fire safety equipment · Fire alarm **Materials** · Aluminum and aluminum alloy pipes · Aluminum and aluminum alloy metals · Fluxes · Oxygen - acetylene or oxygen - propane · Copper and copper alloy plate · Copper and copper alloy metals · Fluxes · Stop-off agent · Copper and copper alloy pipes · Copper and copper alloy metals · Oxygen - acetylene or oxygen - propane **Requirements for employees** · Teamwork spirit · Honesty · Time management · ● Keeping promises
5.0 Perform Automatic welding	5.1 Perform Automatic SAW. 5.2 Perform Automatic ERW.	**General skills and knowledge** · Cooperate with others using communication skills and report to the superiors · Skills and knowledge in workshop safety rules · Reading of welding equipment instruction manual · Use of welding equipment · Reading of technical documents and drawings · Welding principle and defect control · ERW principle and defect control · Knowledge of metal

		materials · Knowledge of welding process · Knowledge and practice of blanking and cutting · Knowledge and practice of common automatic welding methods such as automatic SAW and automatic ERW · Welding quality inspection · Welding structure manufacturing · Occupational health and safety **Tools and equipment** · Personal protective equipment (safety helmet, safety shoes, protective clothing, welding gloves, etc.) · Automatic SAW and automatic ERW equipment · Complete set of tools for automatic SAW and automatic ERW · Special measuring tools · Fire safety equipment · Fire alarm **Materials** · Low carbon steel plate · Low carbon steel wire · Appropriate flux · Low carbon steel plate **Requirements for employees** · Teamwork spirit · Honesty · Time management · Keeping promises
6.0 Carry out operation and maintenance of welding robots	6.1 Carry out maintenance of welding robots. 6.2 Conduct RW teaching programming.	**General skills and knowledge** · Cooperate with others using communication skills and report to the superiors · Skills and knowledge in workshop safety rules · Reading of welding equipment instruction manual

		· Use of welding equipment · Reading of technical documents and drawings · Welding principle and defect control · Knowledge of metal materials · Knowledge of welding process · Knowledge and practice of blanking and cutting · Knowledge and practice of RW · Welding quality inspection · Welding structure manufacturing · Occupational health and safety **Tools and equipment** · Personal protective equipment (safety helmet, safety shoes, protective clothing, welding gloves, etc.) · Welding robots and peripheral equipment · Complete set of tools for welding robot operation · Special measuring tools · Fire safety equipment · Fire alarm **Materials** · Low alloy steel plate · Low alloy steel wire · Mixed gas (typically 80% argon and 20% carbon dioxide) **Requirements for employees** · Teamwork spirit · Honesty · Time management · Keeping promises
7.0 Carry out welding technology management	7.1 Prepare welding process card. 7.2 Carry out welding fixture design and modification.	**General skills and knowledge** · Cooperate with others using communication skills and

	7.3 Carry out quality analysis of welding structures.	report to the superiors · Skills and knowledge in workshop safety rules · Reading of technical documents and drawings · Welding principle and defect control · Knowledge of metal materials · Preparation of welding process · Knowledge of blanking and cutting · Knowledge of welding method · Welding quality inspection · Welding structure manufacturing · Welding fixture design and modification · Knowledge of welding procedure qualification · Occupational health and safety **Tools and equipment** · Computer · Printer · Drawing software **Materials** · Print cartridge · Printing paper **Requirements for employees** · Teamwork spirit · Honesty · Time management · Keeping promises