THE NATIONAL COUNCIL FOR TECHNICAL AND VOCATIONAL EDUCATION AND TRAINING

OCCUPATIONAL STANDARDS

OCCUPATION: WELDING TECHNICIAN

LEVEL: NTA LEVEL 6

FEBRUARY 2024

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ABBREVIATIONS

AC	Alternating Current
CBET	Competency Based Education and Training
DC	Direct Current
EWD	Electrode-to-wire Distance
EWPD	Electrode-to-welded Part Distance
ET	Eddy current Testing
MAG	Metal Active Gas Arc Welding
MIG	Metal Inert-gas Welding
MT	Magnetic Particle Testing
NACTVET	National Council for Technical and Vocational Education and Training
NDT	Non-destructive Testing
NOS	National Occupational Standards
OS	Occupational Standards
PT	Penetrant Testing
RT	Radiographic Testing
TET	Technical Education and Training
TIG	Tungsten Inert Gas Welding
TVET	Technical and Vocational Education and Training
UT	Ultrasonic Testing
VPPAW	Variable Polarity Plasma Welding
WFS	Wire Feed Rate

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 for personnel in a particular occupational area, including knowledge and relevant attitudes. They also act as performance tools 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 criteria, 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, consists of two or more definite steps, and leads to products, service, or decisions.
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 working conditions.

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 TECHNICIAN

The standards cover a broad range of duties and tasks that can be performed by a Welding 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 Welding Technician may perform tasks in a number of key areas of the Occupational Standards, but not necessarily in all areas. For example, in large operations, other individuals may be employed or designated to perform specific tasks.

The Welding Technician shall weld and inspect welded joints in various engineering structural parts in a safe environment under the supervision of engineers. In the workshop, technicians complete various welding and inspection tasks, ranging from simple manual shielded metal arc welding of flat butt joints to gas welding of all positions, developing welding procedures, and inspecting welding defects. Generally, the Welding Technician performs the following duties:

a) Implementation of welding safety operation

b) Formulation of simple welding process

c) Inspection and maintenance of welding equipment

d) Manual Shielded Metal Arc Welding (SMAW) of flat butt joint

e) Manual Shielded Metal Arc Welding (SMAW) of horizontal butt joint

f) Manual Shielded Metal Arc Welding (SMAW) of vertical butt joint

g) Gas Metal Arc Welding (GMAW) of flat butt joint with consumable electrode and gas shield

h) Gas Metal Arc Welding (GMAW) of horizontal butt joint with consumable electrode and gas shield

i) Gas Metal Arc Welding (GMAW) of vertical butt joint with consumable electrode and gas shield

j) Manual tungsten inert gas welding of flat butt joint

k) Horizontal and vertical manual tungsten inert gas welding

l) Gas welding of flat fillet joint

m) Gas welding of flat butt joint

n) All-position gas welding

o) Brazing of low carbon steel

p) Inspection of welding defects

The Occupational Standards have been clustered into NTA qualification levels, i.e. NTA 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 WELDING TECHNICIAN – NTA LEVEL 6

<table>
<tr><td>OCCUPATION</td><td>WELDING TECHNICIAN</td><td>OCCUPATION CODE</td><td></td></tr>
<tr><td>DUTY TITLE</td><td>DETECT WELDING DEFECTS</td><td>DUTY NO.</td><td>601</td></tr>
<tr><td>TASK TITLE</td><td>CARRY OUT ANALYSIS OF WELDING DEFECTS</td><td>TASK NO.</td><td>6011</td></tr>
<tr><td>PERFORMANCE CRITERIA</td><td colspan="3">The person performing this task must be able to classify welding defects and accurately identify the types of defects in the welded joints.</td></tr>
<tr><td>RANGE STATEMENT</td><td colspan="3">The task can be performed in the welding inspection workshop under the supervision of welding engineers or inspection engineers.
The tools and equipment to be used include:
1. Welded joints with defects;
2. Spotlights;
3. Film viewer;
4. Magnifier;
5. Slides;
6. Defect images.
7. Safety gear</td></tr>
<tr><td colspan="4">EVIDENCE REQUIREMENT</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. Select appropriate tools and equipment;
2. Observe and identify visual defects;
3. Use a film viewer to analyze internal defects;
4. Use defect images to identify various welding defects;
5. Use slides to learn how to differentiate between defect types;
6. Clean the tools, equipment and workplace;
7. Store tools and equipment.
8. Observe health, occupational and environmental safety, rules and regulations</td><td colspan="2">Detailed knowledge about:
1.0 Methods
The person performing this task must be able to explain how to:
1.1 Observe the health and safety prevention measures;
1.2 Classify welding detections;
1.3 Identify types of welding defects.

2.0 Methods
The person performing this task must be able to explain the following principles:
2.1 Properties and characteristics of various welding defects;
2.2 The impact of welding defects on joint performance;
2.3 Specific methods for destructive testing;
2.4 Types and principles of non-destructive testing.

3.0 Theories
The person performing this task must be able to explain the following:</td></tr>
</table>

	3.1 Causes and influencing factors of various welding defects; 3.2 Measures to prevent welding defects. **4.0 Essential skills** 4.1 Communication skills; 4.2 Customer service skills; 4.3 Teamwork skills; 4.4 Report writing skills; 4.5 Learning skills.
DESCRIPTION OF THE END PRODUCT / SERVICE:	Analysis of welding defects is performed as per approved standards and technical specifications
CIRCUMSTANTIAL KNOWLEDGE:	**Detailed knowledge about:** 1. Safety operation of testing instruments; 2. Occupational health and safety.

OCCUPATION	WELDING TECHNICIAN	**OCCUPATION CODE**	
DUTY TITLE	DETECT WELDING DEFECTS	**DUTY NO.**	601
TASK TITLE	CONDUCT CONVENTIONAL WELDING INSPECTION OPERATIONS	**TASK NO.**	6012
PERFORMANCE CRITERIA	The person performing this task must be able to detect and determine the level of welding defects using conventional methods in accordance with technical requirements.		
RANGE STATEMENT	The task can be performed in the welding inspection workshop under the supervision of welding engineers or inspection engineers. The tools and equipment to be used include: 1. Welded joints to be inspected; 2. Spotlights; 3. Machines for tensile, bend, impact, and hardness tests; 4. A Complete set of metallographic inspection equipment and consumables; 5. Visual detection equipment and instruments; 6. X-ray sets, film viewers, film systems, intensifying screens, image quality meters, and a complete set of auxiliary equipment; 7. Safety lamps, darkrooms and supporting equipment, darkroom processing reagents; 8. Ultrasonic detectors, test blocks, coupling agents; 9. Magnetic particle testing flaw detectors, magnetic particles or suspensions, standard test pieces and test blocks; 10. Dye penetrant testing materials, equipment, and test blocks; 11. Eddy current testing sensors, host machines, and comparative samples; 12. Pressure test media and supporting instruments; 13. Leakage test media and supporting instruments; 14. Personal protective equipment such as safety shoes, goggles, gloves, and work clothes. 15. Safety gear		

EVIDENCE REQUIREMENT	
PRACTICAL PERFORMANCE	**UNDERPINNING KNOWLEDGE**
The person performing this task must be able to do the following: 1. Observe the health and safety prevention measures; 2. Select appropriate test method 3. Select appropriate operation tools and equipment; 4. Inspect appearance defects; 5. Inspect surface and near-surface defects; 6. Inspect internal defects; 7. Inspect weld strength;	**Detailed knowledge about:** **1.0 Methods** The person performing this task must be able to explain how to: 1.1 Carry out destructive testing; 1.2 Inspect on the appearance; 1.3 Perform non-destructive testing; 1.4 Inspect the strength and sealing of joints; 1.5 Grade welding defects.

7. Inspect the sealing of welded joints; 8. Inspect joint structure; 9. Clean the tools, equipment and workplace; 10. Store tools and equipment. 11. Observe health, occupational and environmental safety, rules and regulations	**2.0 Methods** The person performing this task must be able to explain the following principles: 2.1 Principles of destructive testing for welded joints; 2.2 Principles of non-destructive testing methods for welded joints; 2.3 Principles of compressive strength and sealing testing of welded joints. **3.0 Theories** The person performing this task must be able to explain the following: 3.1 Precautions for possible defects in welded joints: 3.2 Inspection methods and operation requirements for detecting welding defects. **4.0 Essential skills** 4.1 Communication skills; 4.2 Customer service skills; 4.3 Teamwork skills; 4.4 Report writing skills. **5.0 Mathematical skills** 5.1 Geometry.
DESCRIPTION OF THE END PRODUCT / SERVICE:	Welding inspection using conventional testing methods is performed as per approved standards and technical specifications.
CIRCUMSTANTIAL KNOWLEDGE:	**Detailed knowledge about:** 1. Safety operation of testing instruments; 2. Occupational health and safety protection; 3. Environmental protection; 4. Radiation protection.

OCCUPATION	WELDING TECHNICIAN	**OCCUPATION CODE**	
DUTY TITLE	CONDUCT MANUAL SHIELDED METAL ARC WELDING (SMAW)	**DUTY NO.**	602
TASK TITLE	PERFORM VERTICAL BUTT WELDING OF LOW CARBON OR LOW ALLOY STEEL PLATES USING SHIELDED METAL ARC WELDING	**TASK NO.**	6021
PERFORMANCE CRITERIA	The person performing this task must be able to use shielded metal arc welding to accomplish butt joint welding for low carbon steel or low alloy steel plates.		
RANGE STATEMENT	The task can be performed in a factory or welding site under the supervision of welding engineers. The tools and equipment to be used include: 1. Personal protective equipment such as flame-retardant work clothes, insulated safety shoes, splash-proof goggles, safety helmets, welding leather gloves, and head-mounted welding masks; 2. Welding documents such as welding construction drawings and welding process manuals; 3. DC arc welding power supplies such as welding cables, 300A welding tongs, and ground clamps; 4. Groove cleaning tools such as electric or pneumatic angle grinders and electric or pneumatic straight grinders; 5. Auxiliary tools such as slag hammers, chisels, and pliers; 6. Welding rod drying equipment such as welding rod drying ovens and welding rod insulation barrels; 7. Welding seam testing tools such as welding seam testing rulers, steel straightedges, scribers, and marker pens; 8. Welding materials, such as welding rods that meet the requirements of the welding process manual. 9. Safety gear		

EVIDENCE REQUIREMENT	
PRACTICAL PERFORMANCE	**UNDERPINNING KNOWLEDGE**
The person performing this task must be able to do the following: 1. Read welding construction drawings and welding process manuals; 2. Start up and adjust DC arc welding power supplies; 3. Dry and insulate welding rods; 4. Perform pre-weld cleaning on grooves; 5. Assemble and position welding plate joints; 6. Perform bottom layer single-sided welding and double-sided forming, filling/covering layer welding;	**Detailed knowledge about:** **1.0 Methods** The person performing this task must be able to explain how to: 1.1 Adjust the process parameters of DC arc welding power supplies; 1.2 Perform groove cleaning and assembly; 1.3 Carry out butt welding of low carbon steel or low alloy steel plates; 1.4 Conduct welding seam appearance quality inspection.

7. Clean up the weld layer/pass; 8. Inspect the appearance quality of the weld seam; 9. Fill out the weld seam inspection certificate; 10. Clean up the work site. 11. 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 Principles for selecting welding process parameters for vertical butt welding of low carbon or low alloy steel plates using shielded metal arc welding; 2.2 Key points for assembly operation and positioned welding requirements of groove for butt-welding low carbon or low alloy steel plates; 2.3 Key points for welding operations of vertical butt welding of low carbon or low alloy steel plates using shielded metal arc welding; 2.4 Control board butt welding deformation process measures standards; 2.5 Weld seam appearance quality inspection standards. **3.0 Theories** The person performing this task must be able to explain the following: 3.1 Specific content of welding patterns and symbols; 3.2 Weldability standards for low carbon steel and low alloy steel; 3.3 Underpinning knowledge of welding power supply; 3.4 Metallurgical characteristics of welding; 3.5 Circumstantial knowledge of welding rod; 3.6 Key points regarding welding stress and deformation; 3.7 Classification of welding defects. **4.0 Essential skills** 4.1 Occupational health and safety; 4.2 Teamwork skills; 4.3 Report writing skills; 4.4 Learning skills.
DESCRIPTION OF THE END PRODUCT / SERVICE:	The vertical butt welding of low carbon or low alloy steel plates using shielded metal arc welding is completed in accordance with technical requirements or relevant quality standards provided in construction drawings.
CIRCUMSTANTIAL KNOWLEDGE:	**Detailed knowledge about:** 1. Occupational health and safety.

OCCUPATION	WELDING TECHNICIAN	**OCCUPATION CODE**	
DUTY TITLE	CONDUCT MANUAL SHIELDED METAL ARC WELDING (SMAW)	**DUTY NO.**	602
TASK TITLE	PERFORM HORIZONTALLY FIXED WELDING FOR BUTT-WELDING OF LOW CARBON OR LOW ALLOY STEEL PIPES	**TASK NO.**	6022
PERFORMANCE CRITERIA	The person performing this task must be able to use shielded metal arc welding to accomplish horizontally fixed welding for butt-welding low carbon or low alloy steel pipes.		
RANGE STATEMENT	The task can be performed in a factory or welding site under the supervision of welding engineers. The tools and equipment to be used include: 1. Personal protective equipment such as flame-retardant work clothes, insulated safety shoes, splash-proof goggles, safety helmets, welding leather gloves, and head-mounted welding masks; 2. Welding documents such as welding construction drawings and welding process manuals; 3. DC arc welding power supplies such as welding cables, 300A welding tongs, and ground clamps; 4. Groove cleaning tools such as electric or pneumatic angle grinders and electric or pneumatic straight grinders; 5. Auxiliary tools such as slag hammers, chisels, and pliers; 6. Welding rod drying equipment such as welding rod drying ovens and welding rod insulation barrels; 7. Welding seam testing tools such as welding seam testing rulers, steel straightedges, scribers, and marker pens; 8. Welding materials, such as welding rods that meet the requirements of the welding process manual. 9. Safety gear		

EVIDENCE REQUIREMENT	
PRACTICAL PERFORMANCE	**UNDERPINNING KNOWLEDGE**
The person performing this task must be able to do the following: 1. Read welding construction drawings and welding process manuals; 2. Start up and adjust DC arc welding power supplies; 3. Dry and insulate welding rods; 4. Clear the groove before welding preparation; 5. Assemble and position the pipe joints for welding;	**Detailed knowledge about:** **1.0 Methods** The person performing this task must be able to explain how to: 1.1 Adjust the process parameters of DC arc welding power supplies; 1.2 Clean groove, assemble, and position the pipe joints for welding; 1.3 Carry out horizontally fixed welding for butt-welding low carbon or low alloy steel pipes; 1.4 Conduct welding seam appearance quality inspection.

6. Perform bottom layer, filling/capping layer welding operations. 7. Clean up the weld layer/pass; 8. Inspect the appearance quality of the weld seam; 9. Fill out the weld seam inspection certificate; 10. Clean up the work site. 11. 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 Principles for selecting welding process parameters of horizontally fixed welding for butt-welding low carbon or low alloy steel pipes; 2.2 Key points for assembly operation and positioned welding requirements of horizontally fixed groove for butt-welding low carbon or low alloy steel pipes; 2.3 Key points for welding operations of horizontally fixed welding for butt-welding low carbon or low alloy steel pipes; 2.4 Control valve butt welding deformation process measures standards; 2.5 Weld seam appearance quality inspection standards. **3.0 Theories** The person performing this task must be able to explain the following: 3.1 Specific content of welding patterns and symbols; 3.2 Weldability of low carbon steel and low alloy steel; 3.3 Underpinning knowledge of welding power supply; 3.4 Metallurgical characteristics of welding; 3.5 Circumstantial knowledge of welding rod; 3.6 Key points regarding welding stress and deformation; 3.7 Classification of welding defects. **4.0 Essential skills** 4.1 Teamwork skills; 4.2 Report writing skills; 4.3 Learning skills.
DESCRIPTION OF THE END PRODUCT / SERVICE:	Horizontally fixed welding for butt-welding of low carbon or low alloy steel pipes is performed in accordance with technical requirements or relevant quality standards provided in construction drawings.
CIRCUMSTANTIAL KNOWLEDGE:	**Detailed knowledge about:** 1. Occupational health and safety; 2. Safety operations of electric or pneumatic tools.

OCCUPATION	WELDING TECHNICIAN	**OCCUPATION CODE**	
DUTIES	CONDUCT MANUAL SHIELDED METAL ARC WELDING (SMAW)	**DUTY NO.**	602
TASK TITLE	PERFORM SADDLE-TYPE FULL-PENETRATION BEVEL JOINT FOR PIPE-TO-PLATE CONNECTION WELDING USING SHIELDED METAL ARC WELDING WITH WELDING ELECTRODES	**TASK NO.**	6023
PERFORMANCE CRITERIA	The person performing this task must be able to use shielded metal arc welding to perform the welding of saddle-type full-penetration bevel joint for pipe-to-plate connection.		
RANGE STATEMENT	The task can be performed in a factory or welding site under the supervision of welding engineers. The tools and equipment to be used include: 1. Personal protective equipment such as flame-retardant work clothes, insulated safety shoes, splash-proof goggles, safety helmets, welding leather gloves, and head-mounted welding masks; 2. Welding documents such as welding construction drawings and welding process manuals; 3. DC arc welding power supplies such as welding cables, 300A welding tongs, and ground clamps; 4. Groove cleaning tools such as electric or pneumatic angle grinders and electric or pneumatic straight grinders, pitsaw files; 5. Auxiliary tools include slag hammers and chisels; 6. Welding rod drying equipment such as welding rod drying ovens and welding rod insulation barrels; 7. Welding seam testing tools such as welding seam testing rulers, steel straightedges, scribers, and marker pens, welding seam sample rulers; 8. Welding materials, such as welding rods that meet the requirements of the welding process manual. 9. Safety gear		

EVIDENCE REQUIREMENT	
PRACTICAL PERFORMANCE	**UNDERPINNING KNOWLEDGE**
The person performing this task must be able to do the following: 1. Read welding construction drawings and welding process manuals; 2. Start up and adjust DC arc welding power supplies; 3. Dry and insulate welding rods; 4. Clear the groove before welding preparation;	**Detailed knowledge about:** **1.0 Methods** The person performing this task must be able to explain how to: 1.1 Adjust the process parameters of DC arc welding power supplies; 1.2 Clean groove, assemble, and position the pipe-to-plate joints for welding; 1.3 Weld the saddle-type full-penetration bevel joint for pipe-to-plate connection;

5. Assemble and position the pipe joints for welding; 6. Perform bottom layer, filling/capping layer welding operations. 7. Clean up the weld layer/pass; 8. Inspect the appearance quality of the weld seam; 9. Fill out the weld seam inspection certificate; 10. Clean up the work site. 11. Observe health, occupational and environmental safety, rules and regulations	1.4 Conduct welding seam appearance quality inspection. **2.0 Principle** The person performing this task must be able to explain the following principles: 2.1 Principles for selecting welding process parameters for saddle-type full-penetration bevel joint welding; 2.2 Key points for assembly and positioning welding requirements of saddle-type full-penetration bevel joint; 2.3 Key points for welding operations of saddle-type full-penetration bevel joint; 2.4 Control valve butt welding deformation process measures; 2.5 Weld seam appearance quality inspection standards. **3.0 Theories** The person performing this task must be able to explain the following: 3.1 Specific content of welding patterns and symbols; 3.2 Weldability of low carbon steel and low alloy steel; 3.3 Underpinning knowledge of welding power supply; 3.4 Metallurgical characteristics of welding; 3.5 Circumstantial knowledge of welding rod; 3.6 Key points regarding welding stress and deformation; 3.7 Classification of welding defects. **4.0 Essential skills** 4.1 Teamwork skills; 4.2 Report writing skills; 4.3 Learning skills.
DESCRIPTION OF THE END PRODUCT / SERVICE:	The welding of saddle-type full-penetration bevel joint for pipe-to-plate connection using shielded metal arc welding is performed in accordance with the construction drawing specifications or relevant quality standards;
CIRCUMSTANTIAL KNOWLEDGE:	**Detailed knowledge about:** 1. Occupational health and safety; 2. Safety operations of electric or pneumatic tools.

<table>
<tr><td>OCCUPATION</td><td>WELDING TECHNICIAN</td><td>OCCUPATION CODE</td><td></td></tr>
<tr><td>DUTY TITLE</td><td>PERFORM GAS METAL ARC WELDING (GMAW) OF VERTICAL BUTT JOINT WITH CONSUMABLE ELECTRODE AND GAS SHIELD</td><td>DUTY NO.</td><td>603</td></tr>
<tr><td>TASK TITLE</td><td>CARRY OUT GAS METAL ARC WELDING FOR VERTICAL BUTT WELDING OF LOW CARBON STEEL OR LOW ALLOY STEEL PLATES</td><td>TASK NO.</td><td>6031</td></tr>
<tr><td>PERFORMANCE CRITERIA</td><td colspan="3">The person performing this task must be able to use gas metal arc welding equipment to perform butt joint welding according to approved standards and welding process specification.</td></tr>
<tr><td>RANGE STATEMENT</td><td colspan="3">The task can be performed in a factory or welding site under the supervision of welding engineers.
The tools and equipment to be used include:
1. Personal protective equipment such as flame-retardant work clothes, insulated safety shoes, splash-proof goggles, safety helmets, welding leather gloves, and head-mounted welding masks;
2. Welding documents such as welding construction drawings and welding process manuals;
3. Gas shielded welding power supply, such as welding guns, relief valves, ground clamps;
4. Groove cleaning tools such as electric or pneumatic angle grinders and electric or pneumatic straight grinders, pitsaw files;
5. Auxiliary tools include slag hammers and chisels;
6. Welding seam testing tools such as welding seam testing rulers, steel straightedges, scribers, and marker pens, welding seam sample rulers;
7. Welding materials, such as welding wire and welding shielding gas specified in the welding process specification
8. Safety gear.</td></tr>
<tr><td colspan="4">EVIDENCE REQUIREMENT</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 welding construction drawings and welding process manuals;
2. Install and commission gas metal arc welding power supply;
3. Clear the groove before welding preparation;
4. Assemble and position welding of butt joint of low carbon steel or low alloy steel plates;</td><td colspan="2">Detailed knowledge about:
1.0 Methods
The person performing this task must be able to explain how to:
1.1 Adjust process parameters of gas metal arc welding;
1.2 Clean, assemble, and position welding of butt joint bevel of low carbon steel or low alloy steel plates;
1.3 Carry out vertical butt joint welding for low carbon or low alloy steel plates;
1.4 Conduct welding seam appearance quality inspection.</td></tr>
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5. Perform bottom layer, filling/capping layer welding operations. 6. Clean up the weld layer/pass; 7. Detect the appearance quality of welds; 8. Fill out the weld seam inspection certificate; 9. Clean up the work site. 10. Observe health, occupational and environmental safety, rules and regulations	**2.0 Principles** The person performing this task must be able to explain the following principles: 2.1 Principles for selecting welding process parameters for butt welding (vertical welding) of low carbon steel or low alloy steel plates; 2.2 Key points for assembly operation and positioned welding requirements of vertical butt joint for welding low carbon or low alloy steel plates; 2.3 Key points for welding operations of vertical butt joint welding for low carbon or low alloy steel plates; 2.4 Principle of control valve butt welding deformation; 2.5 Weld seam appearance quality inspection standards. **3.0 Theories** The person performing this task must be able to explain the following: 3.1 Specific content of welding patterns and symbols; 3.2 Weldability of low carbon steel and low alloy steel; 3.3 Underpinning knowledge of welding power supply; 3.4 Metallurgical characteristics of welding; 3.5 Key points regarding welding stress and deformation; 3.6 Classification of welding defects. **4.0 Essential skills** 4.1 Teamwork skills; 4.2 Report writing skills; 4.3 Learning skills.
DESCRIPTION OF THE END PRODUCT / SERVICE:	Gas metal arc welding of butt joint for low carbon steel or low alloy steel plates is performed in accordance with technical requirements or relevant quality standards provided in construction drawings.
CIRCUMSTANTIAL KNOWLEDGE:	**Detailed knowledge about:** 1. Occupational health and safety; 2. Safety operation of gas metal arc welding power supply; 3. Safety operations of electric or pneumatic tools.

OCCUPATION	WELDING TECHNICIAN	**OCCUPATION CODE**	
DUTY TITLE	PERFORM GAS METAL ARC WELDING (GMAW) OF VERTICAL BUTT JOINT WITH CONSUMABLE ELECTRODE AND GAS SHIELD	**DUTY NO.**	603
TASK TITLE	CARRY OUT HORIZONTALLY FIXED GAS METAL ARC WELDING FOR BUTT-WELDING LOW CARBON OR LOW ALLOY STEEL PIPES	**TASK NO.**	6032
PERFORMANCE CRITERIA	The person performing this task must be able to use gas metal arc welding equipment to perform horizontally fixed welding for butt-welding of low carbon or low alloy steel pipes.		
RANGE STATEMENT	The task can be performed in a factory or welding site under the supervision of welding engineers. The tools and equipment to be used include: 1. Personal protective equipment such as flame-retardant work clothes, insulated safety shoes, splash-proof goggles, safety helmets, welding leather gloves, and head-mounted welding masks; 2. Welding documents such as welding construction drawings and welding process manuals; 3. Gas shielded welding power supply, such as welding guns, relief valves, ground clamps; 4. Groove cleaning tools such as electric or pneumatic angle grinders and electric or pneumatic straight grinders, pitsaw files; 5. Auxiliary tools include slag hammers and chisels; 6. Welding seam testing tools such as welding seam testing rulers, steel straightedges, scribers, and marker pens, welding seam sample rulers; 7. Welding materials, such as welding wire and welding shielding gas specified in the welding process specification. 8. Safety gear		

EVIDENCE REQUIREMENT	
PRACTICAL PERFORMANCE	**UNDERPINNING KNOWLEDGE**
The person performing this task must be able to do the following: 1. Read welding construction drawings and welding process manuals; 2. Install and commission gas metal arc welding power supply; 3. Clear the groove before welding preparation; 4. Assemble and position welding of horizontally fixed joint for butt-welding low carbon steel or low alloy steel pipes;	**Detailed knowledge about:** **1.0 Methods** The person performing this task must be able to explain how to: 1.1 Adjust process parameters of gas metal arc welding; 1.2 Clean, assemble, and position welding of horizontally fixed groove for butt-welding low carbon or low alloy steel pipes; 1.3 Weld the horizontally fixed joint for low carbon steel or low alloy steel pipe butt joint; 1.4 Conduct welding seam appearance quality inspection.

5. Perform bottom layer, filling/capping layer welding operations. 6. Weld layer/pass; 7. Detect the appearance quality of welds; 8. Fill out the weld seam inspection certificate; 9. Clean up the work site. 10. Observe health, occupational and environmental safety, rules and regulations	**2.0 Principles** The person performing this task must be able to explain the following principles: 2.1 Principles for selecting welding process parameters for horizontally fixed welding for butt-welding low carbon or low alloy steel pipes; 2.2 Key points for assembly operation and positioned welding requirements for horizontally fixed joint for butt-welding low carbon steel or low alloy steel pipes; 2.3 Key points for welding operations of horizontally fixed joint welding for butt-welding low carbon or low alloy steel pipes; 2.4 Control valve butt welding deformation process measures; 2.5 Weld seam appearance quality inspection standards. **3.0 Theories** The person performing this task must be able to explain the following: 3.1 Specific content of welding patterns and symbols; 3.2 Weldability of low carbon steel and low alloy steel; 3.3 Underpinning knowledge of welding power supply; 3.4 Metallurgical characteristics of welding; 3.5 Circumstantial knowledge of welding wire and welding shielding gas; 3.6 Key points regarding welding stress and deformation; 3.7 Classification requirements of welding defects. **4.0 Essential Skills** 4.1 Teamwork skills; 4.2 Report writing skills; 4.3 Learning skills.
DESCRIPTION OF THE END PRODUCT / SERVICE:	The welding of horizontally fixed butt joint for low carbon steel or low alloy steel pipes using gas metal arc welding is performed in accordance with the technical requirements or relevant quality standards.
CIRCUMSTANTIAL KNOWLEDGE:	**Detailed knowledge about:** 1. Occupational health and safety; 2. Safety operation of gas metal arc welding power supply; 3. Safety operations of electric or pneumatic tools.

OCCUPATION	WELDING TECHNICIAN	**OCCUPATION CODE**	
DUTY TITLE	CONDUCT HORIZONTAL AND VERTICAL MANUAL TUNGSTEN INERT GAS WELDING	**DUTY NO.**	604
TASK TITLE	PERFORM MANUAL TUNGSTEN INERT GAS WELDING OF LOW CARBON STEEL OR LOW ALLOY STEEL PIPES WITH HORIZONTAL ROTATION FOR BUTT JOINT	**TASK NO.**	6041
PERFORMANCE CRITERIA	The person performing this task must be able to perform manual tungsten inert gas welding of low carbon steel or low alloy steel pipes with horizontal rotation for butt joint, according to approved standards and technical specifications for welding of steel plates.		
RANGE STATEMENT	The task can be performed in the welding workshop under the supervision of senior technicians or welding engineers. The tools and equipment to be used include: 1. Devices: Welding power supply, TIG welding gun, ground clamp, water cooler, rotary table; 2. Tools: Angle grinder, straight grinder, pitsaw file, hammer, ø2.4 tungsten electrode, weld inspection gauge, wire brush; 3. Welding materials: Welding wire (ø2.0, ø2.4, ø3.0); 4. Labor protection articles: Labor protection clothing and safety shoes, masks, welding gloves, KN95 masks, protective goggles, and earplugs. 5. Safety gear		

EVIDENCE REQUIREMENT	
PRACTICAL PERFORMANCE	**UNDERPINNING KNOWLEDGE**
The person performing this task must be able to do the following: 1. Obtain the task sheet for pipeline horizontal rotary welding; 2. Analyze the requirements of the task sheet; 3. Collect the required welding materials; 4. Confirm that the welding materials have the necessary quality inspection certificates; 5. Check the welding equipment; 6. Check pipe specifications and models; 7. Collect the necessary tools for cleaning the welds; 8. Clean the pipes with the cleaning tools;	Detailed knowledge about: **1.0 Methods** The person performing this task must be able to explain how to: 1.1 Collect the welding materials; 1.2 Turn on the welding power supply; 1.3 Adjust the process parameters of DC arc welding power supplies; 1.4 Conduct pipe butt welding with horizontal rotary motion; 1.5 Conduct welding seam appearance quality inspection; 1.6 Turn off welding power supply; 1.7 Inspect the safety of welding site. **2.0 Principles** The person performing this task must be able to explain the following principles:

9. Use a weld inspection gauge for self-check after welding; 10. Contact the specialized inspection personnel to check the quality of the welds; 11. Contact the scheduling personnel to complete the transfer of the product pipes; 12. Archive the task sheet; 13. Clean the tools, equipment and the workplace; 14. Store tools and equipment; 15. Conduct pipe joint welding. 16. Observe health, occupational and environmental safety, rules and regulations	2.1 Principles for selecting welding process parameters of pipe butt welding with horizontal rotary motion; 2.2 Key points for full penetration welding of horizontal rotary pipe joint; 2.3 Key points of operation for pipe butt welding deformation process measures. **3.0 Theories** The person performing this task must be able to explain the following: 3.1 Precautions for the representation of weld symbols; 3.2 Selection requirements for welding materials; 3.3 Weldability standards for low carbon steel or low alloy steel pipes; 3.4 Classification and qualitative methods of welding defects. **4.0 Essential skills** 4.1 Teamwork skills; 4.2 Report writing skills; 4.3 Learning skills.
DESCRIPTION OF THE END PRODUCT / SERVICE:	The manual tungsten inert gas welding of low carbon steel or low alloy steel pipes with horizontal rotation for butt joint is performed in accordance with the technical requirements or relevant quality standards
CIRCUMSTANTIAL KNOWLEDGE:	**Detailed knowledge about:** 1. Foundations of occupational health and safety; 2. Safety operation of welding equipment; 3. Safety operations of electric or pneumatic tools.

OCCUPATION	WELDING TECHNICIAN	**OCCUPATION CODE**	
DUTY TITLE	CONDUCT HORIZONTAL AND VERTICAL MANUAL TUNGSTEN INERT GAS WELDING	**DUTY NO.**	604
TASK TITLE	PERFORM VERTICAL FIXED MANUAL TUNGSTEN INERT GAS WELDING OF LOW ALLOY STEEL PIPES FOR BUTT JOINT	**TASK NO.**	6042
PERFORMANCE CRITERIA	The person performing this task must be able to perform vertical fixed manual tungsten inert gas welding of low carbon steel or low alloy steel pipes butt joint, in accordance with approved standards and technical specifications for the butt joint welding of steel plates.		
RANGE STATEMENT	The task can be performed in the welding workshop under the supervision of senior technicians or welding engineers. The tools and equipment to be used include: 1. Devices: Welding power supply, TIG welding gun, ground clamp, water cooler; 2. Tools: Angle grinder, straight grinder, pitsaw file, hammer, ø2.4 tungsten electrode, weld inspection gauge, wire brush; 3. Welding materials: Welding wire (ø2.0, ø2.4, ø3.0); 4. Labor protection articles: Labor protection clothing and safety shoes, masks, welding gloves, KN95 masks, protective goggles, and earplugs. 5. Safety gear		

EVIDENCE REQUIREMENT	
PRACTICAL PERFORMANCE	**UNDERPINNING KNOWLEDGE**
The person performing this task must be able to do the following: 1. Obtain a task sheet for vertical fixed welding of steel pipes; 2. Analyze the requirements of the task sheet; 3. Collect the required welding materials; 4. Confirm that the welding materials have the necessary quality inspection certificates; 5. Check the TIG welding equipment; 6. Check pipe specifications and models; 7. Collect the necessary tools for cleaning the welds; 8. Prepare and use tools for pipe cleaning prior to welding;	**Detailed knowledge about:** **1.0 Methods** The person performing this task must be able to explain how to: 1.1 Collect the welding materials; 1.2 Turn on the welding power supply; 1.3 Adjust the process parameters of DC arc welding power supplies; 1.4 Conduct vertical fixed welding of steel pipes; 1.5 Conduct welding seam appearance quality inspection; 1.6 Turn off welding power supply; 1.7 Inspect the safety of welding site. **2.0 Principles** The person performing this task must be able to explain the following principles: 2.1 Principles for selecting welding process parameters of pipe butt welding with vertical fixed position;

9. Use a weld inspection gauge for self-check after welding; 10. Contact the specialized inspection personnel to check the quality of the welds; 11. Contact the scheduling personnel to complete the transfer of the product pipes; 12. Archive the task sheet; 13. Clean the tools, equipment and the workplace; 14. Store the tools and equipment. 15. Observe health, occupational and environmental safety, rules and regulations	2.2 Key points for full penetration welding of vertically fixed pipe joints; 2.3 Deformation process measures for welding pipe joints; 2.4 Execution of welding procedure sheets. **3.0 Theories** The person performing this task must be able to explain the following: 3.1 Precautions for the representation of weld symbols; 3.2 Operational points for welding low carbon steel or low alloy steel pipes; 3.3 Classification and qualitative methods of welding defects. **4.0 Essential skills** 4.1 Teamwork skills; 4.2 Report writing skills; 4.3 Learning skills.
DESCRIPTION OF THE END PRODUCT / SERVICE:	Vertical fixed manual tungsten inert gas welding of low alloy steel pipes is performed in accordance with technical requirements in construction drawings or relevant quality standards.
CIRCUMSTANTIAL KNOWLEDGE:	**Detailed knowledge about:** 1. Foundations of occupational health and safety; 2. Safety operation of welding equipment; 3. Safety operations of electric or pneumatic tools.

OCCUPATION	WELDING TECHNICIAN	**OCCUPATION CODE**	
DUTY TITLE	CONDUCT HORIZONTAL AND VERTICAL MANUAL TUNGSTEN INERT GAS WELDING	**DUTY NO.**	604
TASK TITLE	CARRY OUT MANUAL TUNGSTEN INERT GAS WELDING OF BUTT JOINT FOR LOW CARBON STEEL OR LOW ALLOY STEEL PLATES	**TASK NO.**	6043
PERFORMANCE CRITERIA	The person performing this task must be able to perform butt joint welding of low carbon steel or low alloy steel plates using TIG method, in accordance with approved standards and technical specifications for the butt joint welding of steel plates.		
RANGE STATEMENT	The task can be performed in the welding workshop under the supervision of senior technicians or welding engineers. The tools and equipment to be used include: 1. Devices: Welding power supply, TIG welding gun, ground clamp, water cooler; 2. Tools: Angle grinder, straight grinder, pitsaw file, hammer, ø2.4 tungsten electrode, weld inspection gauge, wire brush; 3. Welding materials: Welding wire (ø2.0, ø2.4, ø3.0); 4. Labor protection articles: Labor protection clothing and safety shoes, masks, welding gloves, KN95 masks, protective goggles, and earplugs. 5. Safety gear		

EVIDENCE REQUIREMENT	
PRACTICAL PERFORMANCE	**UNDERPINNING KNOWLEDGE**
The person performing this task must be able to do the following: 1. Obtain a task sheet for vertical fixed welding of steel plates; 2. Analyze the requirements of the task sheet; 3. Collect the required welding materials; 4. Confirm that the welding materials have the necessary quality inspection certificates; 5. Check the TIG welding equipment; 6. Check panel specifications and models; 7. Collect the necessary tools for cleaning the welds; 8. Clean the surface of plate grooves;	**Detailed knowledge about:** **1.0 Methods** The person performing this task must be able to explain how to: 1.1 Collect the welding materials; 1.2 Turn on the welding power supply; 1.3 Adjust the process parameters of DC arc welding power supplies; 1.4 Conduct vertical fixed welding of steel plates; 1.5 Conduct welding seam appearance quality inspection; 1.6 Turn off welding power supply; 1.7 Inspect the safety of welding site. **2.0 Principles** The person performing this task must be able to explain the following principles: 2.1 Principles for selecting welding process parameters of vertical fixed welding of steel plates;

9. Use a weld inspection gauge for self-check after welding; 10. Contact the specialized inspection personnel to check the quality of the welds; 11. Contact the scheduling personnel to complete the transfer of the product pipes; 12. Archive the task sheet; 13. Clean the tools, equipment and the workplace; 14. Store the tools and equipment. 15. Observe health, occupational and environmental safety, rules and regulations	2.2 Key points for full penetration welding in vertical fixed welding of steel plates; 2.3 Deformation process measures for welding board joints; 2.4 Execution of welding procedure sheets. **3.0 Theories** The person performing this task must be able to explain the following: 3.1 Precautions for the representation of weld symbols; 3.2 Weldability of low carbon steel and low alloy steel; 3.3 Underpinning knowledge of welding power supply; 3.4 Metallurgical characteristics of welding; 3.5 Circumstantial knowledge of welding wire; 3.6 Key points regarding welding stress and deformation; 3.7 Classification methods of welding defects. **4.0 Essential skills** 4.1 Teamwork skills; 4.2 Report writing skills; 4.3 Learning skills.
DESCRIPTION OF THE END PRODUCT / SERVICE:	Low alloy steel plate butt welding by manual tungsten inert gas (TIG) vertical welding is performed in accordance with approved standards or technical specifications provided in construction drawings.
CIRCUMSTANTIAL KNOWLEDGE:	**Detailed knowledge about:** 1. Foundations of occupational health and safety; 2. Safety operation of welding equipment; 3. Safety operations of electric or pneumatic tools.

OCCUPATION	WELDING TECHNICIAN	**OCCUPATION CODE**	
DUTY TITLE	CONDUCT HORIZONTAL AND VERTICAL MANUAL TUNGSTEN INERT GAS WELDING	**DUTY NO.**	604
TASK TITLE	EXECUTE MANUAL TUNGSTEN INERT GAS WELDING FOR STAINLESS STEEL PLATE BUTT WELDING	**TASK NO.**	6044
PERFORMANCE CRITERIA	The person performing this task must be able to perform vertical fixed welding of stainless-steel plates using TIG method in compliance with the approved standards for welded joints.		
RANGE STATEMENT	The task can be performed in the welding workshop under the supervision of senior technicians or welding engineers. The tools and equipment to be used include: 1. Devices: Welding power supply, TIG welding gun, ground clamp, water cooler; 2. Tools: Angle grinder, straight grinder, pitsaw file, hammer, ø2.4 tungsten electrode, weld inspection gauge, wire brush; 3. Welding materials: Welding wire (ø2.0, ø2.4, ø3.0); 4. Labor protection articles: Labor protection clothing and safety shoes, masks, welding gloves, KN95 masks, protective goggles, and earplugs. 5. Safety gear		

EVIDENCE REQUIREMENT	
PRACTICAL PERFORMANCE	**UNDERPINNING KNOWLEDGE**
The person performing this task must be able to do the following: 1. Obtain a task sheet for vertical fixed welding of stainless-steel plates; 2. Analyze the requirements of the task sheet; 3. Collect the required welding materials; 4. Confirm that the welding materials have the necessary quality inspection certificates; 5. Check the welding equipment; 6. Inspect specifications and models of stainless-steel plates; 7. Collect the necessary tools for cleaning the welds; 8. Clean the grooves on stainless steel plates; 9. Use a weld inspection gauge for self-check after welding;	**Detailed knowledge about:** **1.0 Methods** The person performing this task must be able to explain how to: 1.1 Collect the welding materials; 1.2 Turn on the welding power supply; 1.3 Adjust the process parameters of DC arc welding power supplies; 1.4 Conduct vertical fixed welding of stainless-steel plates; 1.5 Conduct welding seam appearance quality inspection; 1.6 Turn off welding power supply; 1.7 Inspect the safety of welding site. **2.0 Principles** The person performing this task must be able to explain the following principles: 2.1 Principles for selecting welding process parameters of vertical fixed welding of stainless-steel plates;

10. Contact the specialized inspection personnel to check the quality of the welds; 11. Contact the scheduling personnel to complete the transfer of the product pipes; 12. Archive the task sheet; 13. Clean the tools, equipment and the workplace; 14. Store the tools and equipment. 15. Observe health, occupational and environmental safety, rules and regulations	2.2 Key points for full penetration welding in vertical fixed welding of stainless-steel plates; 2.3 Deformation process measures for welding stainless steel plates; 2.4 Execution of welding procedure sheets. **3.0 Theories** The person performing this task must be able to explain the following: 3.1 Precautions for the representation of weld symbols; 3.2 Welding characteristics of stainless steel plates; 3.3 Classification and qualitative methods of welding defects. **4.0 Essential skills** 4.1 Teamwork skills; 4.2 Report writing skills; 4.3 Learning skills.
DESCRIPTION OF THE END PRODUCT / SERVICE:	Manual tungsten inert gas (TIG) welding for stainless steel plate butt welding is performed in accordance with technical requirements or relevant quality standards provided in construction drawings.
CIRCUMSTANTIAL KNOWLEDGE:	**Detailed knowledge about:** 1. Foundations of occupational health and safety; 2. Safety operation of welding equipment; 3. Safety operations of electric or pneumatic tools.

OCCUPATION	WELDING TECHNICIAN	**OCCUPATION CODE**	
DUTY TITLE	PERFORM GAS WELDING IN ALL POSITIONS	**DUTY NO.**	605
TASK TITLE	CARRY OUT VERTICAL FIXED GAS WELDING FOR LOW ALLOY STEEL PIPES	**TASK NO.**	6051
PERFORMANCE CRITERIA	The person performing this task must be able to perform vertical fixed gas welding for low alloy steel pipes by using oxy-acetylene gas welding method according to approved standards for welded joints.		
RANGE STATEMENT	The task can be performed in the welding workshop under the supervision of senior technicians or welding engineers. The tools and equipment to be used include: 1. Devices: Oxygen cylinders, acetylene cylinders, welding torches, oxygen hoses, acetylene hoses; 2. Tools: Angle grinders, straight grinders, pitsaw files, hammers, weld inspection gauges, wire brushes, nozzle cleaners; 3. Welding materials: Welding wire (ø2.0, ø2.4, ø3.0); 4. Personal protection articles: Labor protection clothing and safety shoes, masks, welding gloves, KN95 masks, protective goggles, and earplugs. 5. Safety gear		

EVIDENCE REQUIREMENT	
PRACTICAL PERFORMANCE	**UNDERPINNING KNOWLEDGE**
The person performing this task must be able to do the following: 1. Obtain a task sheet for vertical fixed gas welding of low alloy steel pipes; 2. Analyze the requirements of the task sheet; 3. Collect the required welding materials; 4. Confirm that the welding materials have the necessary quality inspection certificates; 5. Check the welding equipment; 6. Inspect specifications and models of low alloy steel pipes; 7. Perform the welding operation; 8. Collect the necessary tools for cleaning the welds; 9. Clean the grooves of low alloy steel pipes; 10. Use a weld inspection gauge for self-check after welding;	**Detailed knowledge about:** **1.0 Methods** The person performing this task must be able to explain how to: 1.1 Analyze welding requirements in task sheets; 1.2 Adjust gas welding process parameters; 1.3 Install safely gas welding equipment; 1.4 Conduct vertical fixed gas welding for low alloy steel pipes; 1.5 Conduct welding seam appearance quality inspection; 1.6 Inspect the safety of welding site. **2.0 Principles** The person performing this task must be able to explain the following principles: 2.1 Principles for selecting welding process parameters for vertical fixed welding for butt-welding low alloy steel pipes; 2.2 Key points for full penetration welding of vertically fixed low alloy steel pipes;

11. Contact the specialized inspection personnel to check the quality of the welds; 12. Contact the scheduling personnel to complete the transfer of the product pipes; 13. Archive the task sheet; 14. Clean the tools, equipment and the workplace; 15. Store the tools and equipment. 16. Observe health, occupational and environmental safety, rules and regulations	2.3 Deformation process measures for welding low alloy steel pipes; 2.4 Key points for execution of welding procedure sheets. **3.0 Theories** The person performing this task must be able to explain the following: 3.1 Precautions for the representation of weld symbols; 3.2 Weldability characteristics of low carbon steel and low alloy steel; 3.3 Metallurgical characteristics of welding; 3.4 Circumstantial knowledge of welding wire; 3.5 Key points regarding welding stress and deformation; 3.6 Classification methods of welding defects. **4.0 Essential Skills** 4.1 Teamwork skills; 4.2 Report writing skills; 4.3 Learning skills.
DESCRIPTION OF THE END PRODUCT / SERVICE:	Vertical fixed gas welding for low alloy steel pipes is completed in accordance with technical requirements or relevant quality standards provided in construction drawings.
CIRCUMSTANTIAL KNOWLEDGE:	**Detailed knowledge about:** 1. Foundations of occupational health and safety; 2. Safety operation of gas welding; 3. Safety operation of gas welding equipment; 4. Safety operations of electric or pneumatic tools.

OCCUPATION	WELDING TECHNICIAN	**OCCUPATION CODE**	
DUTY TITLE	PERFORM GAS WELDING IN ALL POSITIONS	**DUTY NO.**	605
TASK TITLE	CARRY OUT HORIZONTALLY FIXED GAS WELDING FOR LOW ALLOY STEEL PIPES	**TASK NO.**	6052
PERFORMANCE CRITERIA	The person performing this task must be able to perform horizontally fixed gas welding for low alloy steel pipes by using oxy acetylene gas welding method according to quality inspection standards for welded joints.		
RANGE STATEMENT	The task can be performed in the welding workshop under the supervision of senior technicians or welding engineers. The tools and equipment to be used include: 1. Devices: Oxygen cylinders, acetylene cylinders, welding torches, oxygen hoses, acetylene hoses, rotary table; 2. Tools: Angle grinders, straight grinders, pitsaw files, hammers, weld inspection gauges, wire brushes, nozzle cleaners; 3. Welding materials: Welding wire (ø2.0, ø2.4, ø3.0); 4. Labor protection articles: Labor protection clothing and safety shoes, masks, welding gloves, KN95 masks, protective goggles, and earplugs. 5. Safety gear		

EVIDENCE REQUIREMENT	
PRACTICAL PERFORMANCE	**UNDERPINNING KNOWLEDGE**
The person performing this task must be able to do the following: 1. Obtain a task sheet for horizontally fixed gas welding of low alloy steel pipes; 2. Analyze the requirements of the task sheet; 3. Collect the required welding materials; 4. Confirm that the welding materials have the necessary quality inspection certificates; 5. Check the welding equipment; 6. Inspect specifications and models of low alloy steel pipes; 7. Perform welding process 8. Collect the necessary tools for cleaning the welds; 9. Clean the grooves of low alloy steel pipes; 10. Use a weld inspection gauge for self-check after welding;	**Detailed knowledge about:** **1.0 Methods** The person performing this task must be able to explain how to: 1.1 Analyze welding requirements in task sheets; 1.2 Adjust gas welding process parameters; 1.3 Install safely gas welding equipment; 1.4 Conduct horizontally fixed gas welding for low alloy steel pipes; 1.5 Conduct welding seam appearance quality inspection; 1.6 Inspect the safety of welding site. **2.0 Principles** The person performing this task must be able to explain the following principles: 2.1 Principles for selecting welding process parameters for horizontally fixed welding for butt-welding low alloy steel pipes; 2.2 Key points for full penetration welding of horizontally fixed low alloy steel pipes; 2.3 Deformation process measures for welding low alloy steel pipes;

11. Contact the specialized inspection personnel to check the quality of the welds; 12. Contact the scheduling personnel to complete the transfer of the product pipes; 13. Archive the task sheet; 14. Clean the tools, equipment and the workplace; 15. Store the tools and equipment. 16. Observe health, occupational and environmental safety, rules and regulations	2.4 Key points for execution of welding procedure sheets. **3.0 Theories** The person performing this task must be able to explain the following: 3.1 Precautions for the representation of weld symbols; 3.2 Weldability characteristics of low carbon steel and low alloy steel; 3.3 Metallurgical characteristics of welding; 3.4 Circumstantial knowledge of welding wire; 3.5 Key points regarding welding stress and deformation; 3.6 Classification methods of welding defects. **4.0 Essential Skills** 4.1 Teamwork skills; 4.2 Report writing skills; 4.3 Learning skills.
DESCRIPTION OF THE END PRODUCT / SERVICE:	Horizontally fixed gas welding for low alloy steel pipes is performed in accordance with technical requirements or relevant quality standards provided in construction drawings.
CIRCUMSTANTIAL KNOWLEDGE:	**Detailed knowledge about:** 1. Foundations of occupational health and safety; 2. Safety operation of gas welding; 3. Safety operation of gas welding equipment; 4. Safety operations of electric or pneumatic tools.

OCCUPATION	WELDING TECHNICIAN	**OCCUPATION CODE**	
DUTY TITLE	PERFORM GAS WELDING IN ALL POSITIONS	**DUTY NO.**	605
TASK TITLE	CONDUCT 45° FIXED JOINT GAS WELDING FOR LOW ALLOY STEEL PIPES	**TASK NO.**	6053
PERFORMANCE CRITERIA	The person performing this task must be able to complete 45° fixed joint gas welding for low alloy steel pipes by using oxy-acetylene gas welding method according to approved standards for welded joints.		
RANGE STATEMENT	The task can be performed in the welding workshop under the supervision of senior technicians or welding engineers. The tools and equipment to be used include: 1. Devices: Oxygen cylinders, acetylene cylinders, welding torches, oxygen hoses, acetylene hoses; 2. Tools: Angle grinders, straight grinders, pitsaw files, hammers, weld inspection gauges, wire brushes, nozzle cleaners; 3. Welding materials: Welding wire (ø2.0, ø2.4, ø3.0); 4. Labor protection articles: Labor protection clothing and safety shoes, masks, welding gloves, KN95 masks, protective goggles, and earplugs. 5. Safety gear		

EVIDENCE REQUIREMENT

PRACTICAL PERFORMANCE	**UNDERPINNING KNOWLEDGE**
The person performing this task must be able to do the following: 1. Analyze the requirements of the task sheet; 2. Collect the required welding materials; 3. Confirm that the welding materials have the necessary quality inspection certificates; 4. Check the welding equipment; 5. Inspect specifications and models of low alloy steel pipes; 6. Perform welding process 7. Collect the necessary tools for cleaning the welds; 8. Clean the grooves of low alloy steel pipes; 9. Use a weld inspection gauge for self-check after welding; 10. Contact the specialized inspection personnel to check the quality of the welds;	**Detailed knowledge about:** **1.0 Methods** The person performing this task must be able to explain how to: 1.1 Analyze welding requirements in task sheets; 1.2 Adjust gas welding process parameters; 1.3 Install safely gas welding equipment; 1.4 Conduct vertical fixed gas welding for low alloy steel pipes; 1.5 Conduct welding seam appearance quality inspection; 1.6 Inspect the safety of welding site. **2.0 Principles** The person performing this task must be able to explain the following principles: 2.1 Principles for selecting welding process parameters of 45° fixed welding for butt-welding low carbon or low alloy steel pipes; 2.2 Key points for full penetration welding of 45° fixed low alloy steel pipes; 2.3 Deformation process measures for welding low alloy steel pipes;

11. Contact the scheduling personnel to complete the transfer of the product pipes; 12. Archive the task sheet; 13. Clean the tools, equipment and the workplace; 14. Store tools and equipment. 15. Observe health, occupational and environmental safety, rules and regulations	2.4 Key points for execution of welding procedure sheets. **3.0 Theories** The person performing this task must be able to explain the following: 3.1 Precautions for the representation of weld symbols; 3.2 Weldability characteristics of low carbon steel and low alloy steel; 3.3 Metallurgical characteristics of welding; 3.4 Circumstantial knowledge of welding wire; 3.5 Key points regarding welding stress and deformation; 3.6 Classification methods of welding defects. **4.0 Essential skills** 4.1 Teamwork skills; 4.2 Report writing skills; 4.3 Learning skills.
DESCRIPTION OF THE END PRODUCT / SERVICE:	45° fixed oint gas welding for low alloy steel pipe butt welding is completed in accordance with technical requirements or relevant quality standards provided in construction drawings.
CIRCUMSTANTIAL KNOWLEDGE:	**Detailed knowledge about:** 1. Foundations of occupational health and safety; 2. Safety operation of gas welding; 3. Safety operation of gas welding equipment; 4. Safety operations of electric or pneumatic tools.

OCCUPATION	WELDING TECHNICIAN	**OCCUPATION CODE**	
DUTY TITLE	PERFORM BRAZING OF LOW CARBON STEEL	**DUTY NO.**	606
TASK TITLE	CARRY OUT FLAME BRAZING OF LOW CARBON STEEL PLATES	**TASK NO.**	6061
PERFORMANCE CRITERIA	The person performing this task must be able to perform brazing of low carbon steel plates in accordance with technical requirements and quality standards.		
RANGE STATEMENT	The task can be performed in the welding workshop under the supervision of senior welding technicians or welding engineers. The tools and equipment to be used include: 1. Combustible gases, combustion-supporting gases; 2. Welding torch; 3. Filler metals, fluxes, anti-flow agents; 4. Assembly workbenches, workpiece fixing fixtures, welding workbenches; 5. Weldment cooling liquid; 6. Joint cleaning testing reagents and solutions; 7. Steel wire brushes, grinders for surface cleaning of workpieces and joints; 8. Magnifiers and other appearance inspection tools; 9. Personal protective equipment such as safety shoes, goggles, gloves, and work clothes. 10. Safety gear		

EVIDENCE REQUIREMENT	
PRACTICAL PERFORMANCE	**UNDERPINNING KNOWLEDGE**
The person performing this task must be able to do the following: 1. Observe the health and safety prevention measures; 2. Select appropriate tools, equipment, filler metals, fluxes, anti-flow agents; 3. Inspect the safety of equipment, tools, and fixtures used; 4. 4. Conduct surface cleaning, assembly, and fixing of workpieces for brazing; 5. Adjust flame type; 6. Conduct heating, apply filler metals, fluxes, liquid filler metals for filling, and conduct cooling operations; 7. Clean welded joints;	**Detailed knowledge about:** **1.0 Methods** The person performing this task must be able to explain how to: 1.1 Select welding equipment, tools, and materials; 1.2 Complete welding operation; 1.3 Clean workpieces after welding; 1.4 Carry out self-check of appearance quality of joints. **2.0 Principles** The person performing this task must be able to explain the following principles: 2.1 Selection principles for brazing clearance; 2.2 Principles for selecting combustible gases, assisting gases, welding torches, filler metals, fluxes, anti-flow agents, and other materials. **3.0 Theories**

8. Carry out self-check of appearance quality of joints; 9. Clean the tools, equipment and workplace; 10. Arrange and store the tools and equipment. 11. Observe health, occupational and environmental safety, rules and regulations	The person performing this task must be able to explain the following: 3.1 Safety inspection methods for flame brazing equipment, tools, and fixtures for low carbon steel plate joining and overlapping; 3.2 Process essentials for flame brazing of low carbon steel plates joining and overlapping; 3.3 Operation methods for flame brazing of low carbon steel plates joining and overlapping; 3.4 Methods for cleaning the joints of flame brazing of low carbon steel plates joining and overlapping. **4.0 Essential skills** 4.1 Communication skills; 4.2 Customer service skills; 4.3 Teamwork skills; 4.4 Interpretation skills for process documents; 4.5 Entrepreneurial skills; 4.6 Learning skills.
DESCRIPTION OF THE END PRODUCT / SERVICE:	Flame brazing of low carbon steel plates is performed in accordance with technical standards and customer requirements.
CIRCUMSTANTIAL KNOWLEDGE:	**Detailed knowledge about:** 1. Occupational health and safety protection; 2. Environmental protection; 3. Radiation protection.

OCCUPATION	WELDING TECHNICIAN	**OCCUPATION CODE**	
DUTY TITLE	PERFORM BRAZING OF LOW CARBON STEEL	**DUTY NO.**	606
TASK TITLE	CONDUCT BRAZING OF LOW CARBON STEEL PLATES IN A FURNACE	**TASK NO.**	6062
PERFORMANCE CRITERIA	The person performing this task must be able to perform brazing of low carbon steel plates in a furnace in accordance with technical requirements and approved standards.		
RANGE STATEMENT	The task can be performed in the welding workshop under the supervision of senior welding technicians or welding engineers. The tools and equipment to be used include: 1. Brazing furnace; 2. Protective gases; 3. Filler metals, fluxes, anti-flow agents; 4. Workpiece clamps, assembly workbenches, workpiece fixing fixtures, welding workbenches; 5. Weldment cooling liquid; ; 6. Joint cleaning testing reagents and solutions; 7. Steel wire brushes, grinders for surface cleaning of workpieces and joints; 8. Magnifiers and other appearance inspection tools; 9. Personal protective equipment such as safety shoes, goggles, gloves, and work clothes. 10. Safety gear		

EVIDENCE REQUIREMENT	
PRACTICAL PERFORMANCE	**UNDERPINNING KNOWLEDGE**
The person performing this task must be able to do the following: 1. Observe the health and safety prevention measures; 2. Select appropriate tools, equipment, fixtures, filler metals, fluxes, anti-flow agents, and protective gases; 3. Inspect the safety of equipment, tools, and fixtures used; 4. Conduct surface cleaning, assembly, and fixing of workpieces for brazing; 5. Pre-set and add filler metals and fluxes; 6. Conduct operations such as workpiece loading, heating, cooling, and unloading;	**Detailed knowledge about:** **1.0 Methods** The person performing this task must be able to explain how to: 1.1 Select welding equipment, tools, fixtures, and protective gases; 1.2 Execute welding operations in accordance with process documents; 1.3 Clean and maintain workpieces after welding; 1.4 Implement self-check of appearance quality of joints. **2.0 Principles** The person performing this task must be able to explain the following principles: 2.1 Selection principles for brazing clearance; 2.2 Principles for selecting filler metals, fluxes, anti-flow agents, protective gases, etc.

7. Clean welded joints; 8. Carry out self-check of appearance quality of joints; 9. Clean the tools, equipment and workplace; 10. Arrange and store the tools and equipment. 11. Observe health, occupational and environmental safety, rules and regulations	**3.0 Theories** The person performing this task must be able to explain the following: 3.1 Methods for safety inspection of equipment, tools and clamps; 3.2 Process essentials for low carbon steel plates joining/overlapping in a furnace; 3.3 Operating methods for brazing of low carbon steel plates joining and overlapping in a furnace; 3.4 Methods for cleaning the brazing joints of low carbon steel plates joining/overlapping in a furnace; 3.5 Circumstantial knowledge related to self-check of surface defects and appearance quality of welded joints. **4.0 Essential skills** 4.1 Communication skills; 4.2 Customer service skills; 4.3 Teamwork skills; 4.4 Interpretation skills for process documents; 4.5 Entrepreneurial skills; 4.6 Learning skills.
DESCRIPTION OF THE END PRODUCT / SERVICE:	Brazing of low carbon steel plates in a furnace is performed in accordance with technical standards and customer requirements.
CIRCUMSTANTIAL KNOWLEDGE:	**Detailed knowledge about:** 1. Occupational health and safety protection; 2. Environmental protection; 3. Radiation protection.

OCCUPATION	WELDING TECHNICIAN	**OCCUPATION CODE**	
DUTY TITLE	PERFORM BRAZING OF LOW CARBON STEEL	**DUTY NO.**	606
TASK TITLE	PERFORM INDUCTION BRAZING OF LOW CARBON STEEL PLATES	**TASK NO.**	6063
PERFORMANCE CRITERIA	The person performing this task must be able to carry out induction brazing of low carbon steel plates in accordance with technical requirements and quality standards.		
RANGE STATEMENT	The task can be performed in the welding workshop under the supervision of senior welding technicians or welding engineers. The tools and equipment to be used include: 1. Induction brazing power supply, induction coils, and supporting equipment; 2. Protective gases; 3. Filler metals, fluxes, anti-flow agents; 4. Workpiece clamps, assembly workbenches, workpiece fixing fixtures, welding workbenches; 5. Weldment cooling liquid; 6. Joint cleaning testing reagents and solutions; 7. Steel wire brushes, grinders for surface cleaning of workpieces and joints; 8. Magnifiers and other appearance inspection tools; 9. Personal protective equipment such as safety shoes, goggles, gloves, and work clothes. 10. Safety gear		

EVIDENCE REQUIREMENT	
PRACTICAL PERFORMANCE	**UNDERPINNING KNOWLEDGE**
The person performing this task must be able to do the following: 1. Observe the health and safety prevention measures; 2. Select appropriate tools, equipment, fixtures, filler metals, fluxes, anti-flow agents, and protective gases; 3. Inspect the safety of equipment, tools, and fixtures used; 4. 4. Conduct surface cleaning, assembly, and fixing of workpieces for brazing; 5. Pre-set and add filler metals and fluxes; 6. Perform operations such as induction heating, insulation, cooling, etc.;	**Detailed knowledge about:** **1.0 Methods** The person performing this task must be able to explain how to: 1.1 Select welding equipment, tools, fixtures, and protective gases; 1.2 Execute welding operations in accordance with process documents; 1.3 Clean and maintain workpieces after welding; 1.4 Carry out self-check of appearance quality of joints. **2.0 Principles** The person performing this task must be able to explain the following principles: 2.1 Selection principles for workpiece assembly and brazing clearance;

7. Clean welded joints; 8. Carry out self-check of appearance quality of joints; 9. Clean the tools, equipment and workplace; 10. Arrange and store the tools and equipment. 11. Observe health, occupational and environmental safety, rules and regulations	2.2 Principles for selecting induction current frequency, filler metals, fluxes, anti-flow agents, protective gases, etc. **3.0 Theories** The person performing this task must be able to explain the following: 3.1 Methods for safety inspection of equipment, tools and clamps; 3.2 Process essentials for induction brazing of low carbon steel plates; 3.3 Operating methods for induction brazing of low carbon steel plates; 3.4 Cleaning method for induction brazing joints of low carbon steel plates; 3.5 Circumstantial knowledge related to self-check of surface defects and appearance quality of welded joints. **4.0 Essential skills** 4.1 Communication skills; 4.2 Customer service skills; 4.3 Teamwork skills; 4.4 Interpretation skills for process documents; 4.5 Entrepreneurial skills; 4.6 Learning skills.
DESCRIPTION OF THE END PRODUCT / SERVICE:	Induction brazing of low carbon steel plates is performed in accordance with technical standards and customer requirements.
CIRCUMSTANTIAL KNOWLEDGE:	**Detailed knowledge about:** 1. Occupational health and safety protection; 2. Environmental protection; 3. Radiation protection; 4. Circumstantial knowledge related to electromagnetic induction.

APPENDIX: DACUM CHART FOR WELDING TECHNICIAN - NTA LEVEL 6

DUTIES	TASKS	ENABLERS
1.0 Detect welding defects	1.1 Carry out analysis of welding defects.	**General skills and knowledge** • Cooperation with others using communication skills and report to the superiors • Health and safety prevention knowledge • Interpretation of welding inspection-related standards • Identification of welding defects • Cleaning of tools, equipment and workplace • Proper storage of tools and equipment **Tools and equipment** • Machines for tensile, bend, impact, and hardness tests • Polishing machines • Metallographic microscopes • Visual inspection equipment and instruments such as welding inspection rulers, magnifiers, endoscopes • X-ray sets, film viewers, safety lamps, darkrooms and supporting equipment, darkroom processing reagents • Ultrasonic detectors, test blocks • magnetic particle testing flaw detectors, magnetic particles or suspensions, standard test pieces and test blocks • Penetrant detection equipment and test blocks • Eddy current testing sensors, host machines, and comparative samples • Pressure test media and supporting instruments • Leakage testing medium, supporting instruments • Slides • Intensifying screens • Image quality meters and full set of auxiliary equipment • Safety shoes, goggles, gloves, and work clothes
	1.2 Conduct conventional welding inspection operations.	

DUTIES	TASKS	ENABLERS
		Materials • Welded joints to be inspected • Defect images • Sandpapers • Grinding pastes • Polishing clothes • Corrosion reagents • Film systems • Coupling agents • Penetrant testing agents **Requirements for employees** • Teamwork spirit • Integrity • Pursuit of excellence • Attention to detail • Time management • Emphasis on commitment
2.0 Conduct manual Shielded Metal Arc Welding (SMAW) of vertical butt joint	2.1 Perform vertical butt welding of low carbon or low-alloy steel plates using shielded metal arc welding. 2.2 Perform horizontally fixed welding for butt-welding of low carbon or low alloy steel pipes. 2.3 Perform saddle-type full-penetration bevel joint for pipe-to-plate connection welding using shielded metal arc welding with welding electrodes.	**General skills and knowledge** • Cooperate with others using communication skills and report to the superiors • Identification and interpretation of technical drawings and welding process guides • Skills and knowledge in welding power connection and adjustment • Skill and knowledge in operating pneumatic/electric angle grinders, pneumatic/electric straight grinders, assembly clamps, and fixtures • Skills and knowledge in operating weld appearance testing tools • Welding process, metal materials, electrical basics, mechanical drawing **Tools and equipment** • Personal protective equipment such as flame-retardant work clothes, insulated safety shoes, splash-proof goggles, safety helmets, welding leather gloves, and head-mounted welding masks • Welding documents such as welding construction drawings and welding process manuals

DUTIES	TASKS	ENABLERS
		• DC arc welding power supplies such as welding cables, welding tongs, and ground clamps • Groove cleaning tools, such as electric/pneumatic angle grinders, pneumatic/electric straight grinders, pliers • Auxiliary tools include slag hammers and chisels • Welding rod drying equipment such as welding rod drying ovens and welding rod insulation barrels • Welding seam testing tools such as welding seam testing rulers, steel straightedges, scribers, and marker pens **Materials** • Welding rods that meet the requirements of welding process guides • Welded sample **Requirements for employees** • Teamwork spirit • Integrity • Quality consciousness • Time management
3.0 Perform Gas Metal Arc Welding (GMAW) of vertical butt joint with consumable electrode and gas shield	3.1 Carry out Gas metal arc welding for vertical butt welding of low carbon steel or low alloy steel plates. 3.2 Carry out horizontally fixed gas metal arc welding for butt-welding low carbon or low alloy steel pipes.	**General skills and knowledge** • Cooperation with others using communication skills and report to the superiors • Identification and interpretation of technical drawings and welding process guides • Skills and knowledge in welding power connection and adjustment • Skills and knowledge in the safe use of welding protective gas, gas cylinders, and pressure gauges • Skill and knowledge in operating pneumatic/electric angle grinders, pneumatic/electric angle grinder and straight grinders, assembly clamps, and fixtures • Skills and knowledge in operating weld appearance testing tools

DUTIES	TASKS	ENABLERS
		• Welding process, metal materials, electrical basics, mechanical drawing **Tools and equipment** • Personal protective equipment such as flame-retardant work clothes, insulated safety shoes, splash-proof goggles, safety helmets, welding leather gloves, and head-mounted welding masks • Welding documents such as welding construction drawings and welding process manuals • Gas shielded welding power supply, such as welding cables, welding guns, ground clamps • Groove cleaning tools, such as electric/pneumatic angle grinders, pneumatic/electric angle grinders, pliers • Auxiliary tools include slag hammers and chisels • Welding seam testing tools such as welding seam testing rulers, steel straightedges, scribers, and marker pens **Materials** • Welding wire that meets the requirements of welding process guides; welding protective gas; • Welded sample **Requirements for employees** • Teamwork spirit • Integrity • Quality consciousness • Time management
4.0 Conduct horizontal and vertical manual tungsten inert gas welding	4.1 Perform manual tungsten inert gas welding of low carbon steel or low alloy steel pipes with horizontal rotation for butt joint. 4.2 Perform vertical fixed manual tungsten inert gas welding of low alloy steel pipes for butt joint.	**General skills and knowledge** • Use of communication skills to work with others • Use of welding quality system • manual tungsten inert gas welding skills for plate and pipe butt joints • Safe handling of argon cylinders • Safety operation of welding • Interpretation of welding symbols

DUTIES	TASKS	ENABLERS
	4.3 Carry out manual tungsten inert gas welding of butt joint for low carbon steel or low alloy steel plates.	• Metal material properties • Qualitative determination of welding defects **Tools and equipment** • Labour protection clothing and safety shoes, masks, welding gloves, masks, protective goggles, and earplugs • Weld inspection gauges, steel straightedges • Angle grinder, straight grinder, pitsaw file, hammer, tungsten electrode, weld inspection gauge, wire brush, nozzle cleaner • Welding power supply, TIG welding gun, ground clamp, water cooler, rotary table, argon gas regulator **Materials** • Welding wire • Argon **Requirements for employees** • Teamwork spirit • Integrity • Time management • Emphasis on commitment
	4.4 Execute manual tungsten inert gas welding for stainless steel plate butt welding.	
5.0 Perform Gas welding in all positions	5.1 Carry out vertical fixed gas welding for low alloy steel pipes.	**General skills and knowledge** • Use of communication skills to work with others • Use of welding quality system • Safe handling of gas cylinders • Manual gas welding skills for plate and pipe butt joints • Safety operation of welding • Interpretation of welding symbols • Metal material properties • Qualitative determination of welding defects **Tools and equipment** • Labor protection clothing and safety shoes, masks, welding gloves, KN95 masks, protective goggles, and earplugs • Weld inspection gauges, oxygen cylinders, acetylene cylinders,
	5.2 Carry out horizontally fixed gas welding for low alloy steel pipes.	
	5.3 Conduct 45° fixed joint gas welding for low alloy steel pipes.	

DUTIES	TASKS	ENABLERS
		welding guns, oxygen hoses, acetylene hoses, rotary tables, oxygen pressure regulator, acetylene pressure regulator • Angle grinder, straight grinder, pitsaw file, hammer, tungsten electrode, weld inspection gauge, wire brush, nozzle cleaner **Materials** • Welding wire • Flux • Oxygen • Acetylene **Requirements for employees** • Teamwork spirit • Integrity • Time management • Emphasis on commitment
6.0 Perform brazing of low carbon steel	6.1 Carry out flame brazing of low carbon steel plates 6.2 Conduct brazing of low carbon steel plates in a furnace. 6.3 Perform induction brazing of low carbon steel plates.	**General skills and knowledge** • Cooperate with others using communication skills and report to the superiors • Health and safety prevention knowledge • Interpretation of brazing process documents • Quality inspection of welded joint • Cleaning of tools, equipment and workplace • Proper storage of tools and equipment **Tools and equipment** • Torch • Assembly workbenches • Metallographic microscopes • Workpiece fixing fixtures • Welding workbenches • Brazing furnace • Workpiece clamps • Induction brazing power supply • Induction coils • Supporting equipment for induction brazing **Materials**

DUTIES	TASKS	ENABLERS
		• Combustible gases • Combustion-supporting gases • Protective gases • Filler metals • Brazing flux • Anti-flow agents • Weldment cooling liquid • Joint cleaning testing reagents and solutions • Wire brushes • Grinders • Magnifiers • Safety shoes • Goggles • Gloves • Work clothes **Requirements for employees** • Teamwork spirit • Integrity • Pursuit of excellence • Attention to detail • Time management • Emphasis on commitment