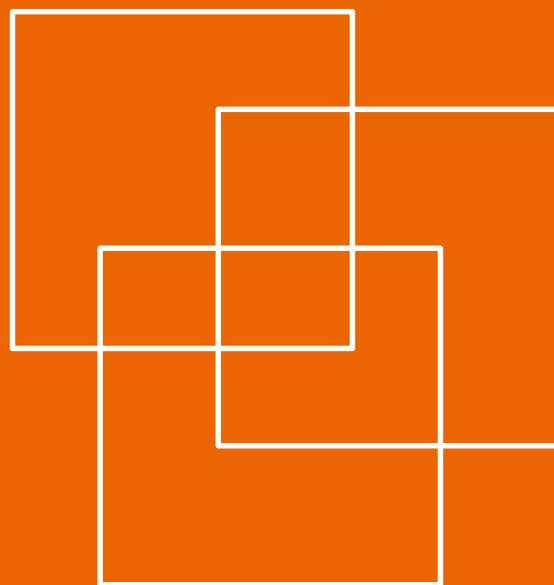


Regional Model Competency Standards: Welding services



Regional Model Competency Standards: Welding services

Regional Skills Programme
Regional Office for Asia and the Pacific

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Preface

Welders are vital in many industries, and in particular these that are expanding, such as construction, shipbuilding, infrastructure development and mining. An estimation model for the occupational demands in six ASEAN economies (Cambodia, Indonesia, Lao People's Democratic Republic, the Philippines, Thailand and Viet Nam) for 2025 indicates the likely need for particular types of workers, including construction workers. The demand for construction workers which can include welders will increase to 3.3 million in total. The majority of ASEAN Member States are also prioritizing transport, construction and infrastructure, which will require an increase in the supply of workers with engineering and construction skills such as welding, electrical wiring and bricklaying. (ILO and ADB, 2014: 62).

Economic growth in the industrial sector means the need to meet skills gaps in welding services has become critical. Welding can be a highly dangerous occupation, due to exposure to fumes and gases, and working conditions that may require working in hazardous places, such as heights or in confined spaces. It is critical that occupational safety and health measures are incorporated into all aspects of the work.

The need to improve the quality and effectiveness of training systems remains a major challenge for many countries in the Asia-Pacific region. The skills of workers are critical to enterprises' productivity and competitiveness, as well as the workers' own employability. Much effort has been made to improve the relevance of the training systems, to ensure that the skills that workers possess meet the needs of the workplace.

The establishment of the ASEAN Economic Community (AEC 2015), with the goal of creating economic integration, a single market production base and a freer flow of skilled labour in the region, has increased the importance to sending and receiving countries of being able to recognize the skills of migrant workers.

To help accelerate the improvement of training systems and the mutual recognition of skills, the ILO has developed, in consultation with employers, governments and workers, the Regional Model Competency Standards (RMCS). These have been developed in identified priority areas and are in a simplified format.

Competency standards are a set of benchmarks that define the skills, knowledge and attributes people need to perform a work role. They are developed in consultation with industry, in order to ensure they reflect the needs of the workplace. These standards are primarily used to develop and implement training, to assess the outcomes of training, and to assess the level of a person's existing skills and competencies.

The RMCS are intended to be a regional reference for developing competency standards for those countries that are in the process of creating standards, or reviewing existing national standards. The RMCS can provide the basis for developing national competency standards in countries so they can avoid developing standards from scratch. By providing a regional reference for competency standards, I also hope that the RMCS can assist ASEAN regional integration by facilitating the mutual recognition of the skills of workers across borders.



Tomoko Nishimoto
Assistant Director-General and Regional Director
for Asia and the Pacific

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The RMCS for Welding Work was developed by the Regional Skills Programme, starting in December 2012. Mr Arnould de Nadaillac, an international skills development Expert, developed the draft with a team, including a Thai international expert with 35 years of welding experience in Asia, who was also the former Chief Executive Officer of the Welding Institute of Thailand (IIW system).

The RMCS were developed after adapting and integrating contents from four national competency systems; including Australia, New Zealand, the Philippines and Thailand. A comparison and alignment was made with the International Welding Certification System.

Feedback and further inputs to the RMCS were provided during a consultation with the Training Centre for International Welding (TCIW), Thailand. Special thanks for comments and suggestions go to Mr. Winit Sueptaetrakun, Skill Development Technical Officer, Professional Level Office of Skill Standard and Testing Development, and Mr. Vacharapong Mukcherd, Skill Development Technical Officer, Professional Level Samut Prakarn Regional Institute for Skill Development, under the leadership of Mr. Nakorn Silpa-archa, Permanent Secretary, Ministry of Labour, Thailand (who was at that time Director-General of the Department of Skills Development).

Ms Carmela Torres, ILO Senior Specialist on Skills and Employability, provided overall technical supervision in the development of the RMCS. Ms Wendy Wyatt, ILO TVET Consultant, provided expert content and editing of the final draft. We extend our thanks to Ms Alin Sirisaksopit and Ms Suttida Chaikitsakol for their assistance with the revisions of the RMCS. In addition, Ms Wilawan Wiseschinda and Ms Ruttiya Bhula-or formatted and finalized this publication.

Glossary

Arc Welding

Arc welding uses a welding power supply to create an electric arc between an electrode and the base material to melt the metals at the welding point. Arc welding can use either direct (DC) or alternating (AC) current, and consumable or non-consumable electrodes. Arc welding processes may be manual, semi-automatic, or fully automated.

American Society of Mechanical Engineers (ASME)

The ASME is an engineering professional society, a standards organization, a research and development organisation, a lobbying organization and a provider of training and education. Founded as an engineering society focused on mechanical engineering in North America, ASME is today multidisciplinary and global.

American Welding Society (AWS)

The American Welding Society (AWS) publishes over 240 AWS-developed codes, recommended practices and guides, which are written in accordance with American National Standards Institute practices.

Asian Welding Federation (AWF)

The AWF is a non-profit making organization devoted to the improvement and promotion of welding technology through knowledge exchange to improve technological progress and growth of the welding communities in Asia. At 2014, member countries are China, Indonesia, Islamic Republic of Iran, India, Japan, Republic of Korea, Malaysia, Mongolia, Myanmar, the Philippines, Singapore, Thailand and Viet Nam.

Destructive Testing (DT)

Destructive testing involves conducting tests that are carried out to the specimen's failure, in order to understand a specimen's structural performance or material behaviour under different loads. These tests are generally much easier to carry out, yield more information, and are easier to interpret than non-destructive testing. It is most suitable for objects that will be mass-produced, as the cost of destroying a small number of specimens is negligible. Examples of destructive testing are:

- Nick break (hitting by hammer)
- Stress tests
- Fillet break-over
- Hydraulic pressing
- Bend tests
- Hardness tests

Flux-Cored Arc Welding (FCAW)

FCAW is a semi-automatic or automatic arc welding process, which is a variation of the GMAW technique. FCAW wire is actually a fine metal tube filled with powdered flux materials. An externally supplied shielding gas is sometimes used, but often the flux itself is relied upon to generate protection

from the atmosphere, producing both gaseous protection and liquid slag protecting the weld. The process is widely used in construction because of its high welding speed and portability.

Gas Metal Arc Welding (GMAW)

Also referred to by its subtypes metal inert gas (MIG) welding or metal active gas (MAG) welding. GMAW is a semi-automatic or automatic welding process with a continuously fed consumable wire acting as both electrode and filler metal, along with an inert or semi-inert shielding gas flowed around the wire to protect the weld site from contamination. GMAW is commonly used in industries such as the automobile industry for its quality, versatility and speed. Because of the need to maintain a stable shroud of shielding gas around the weld site, it can be problematic to use the GMAW process in areas of high air movement such as outdoors.

Gas Tungsten Arc Welding (GTAW)

Also known as tungsten inert gas (TIG) welding. GTAW is a manual arc welding process that uses a non-consumable electrode made of tungsten, an inert or semi-inert gas mixture, and a separate filler material. Especially useful for welding thin materials, this method is characterized by a stable arc and high quality welds, but it requires significant operator skill and can only be accomplished at relatively low speeds. GTAW produces very clean and high-quality welds, making it a good choice for applications in which aesthetics count or X-ray-quality welds are required. It also works well on thin materials, which makes it a good process for computer housings, electronic components, and tubing.

Manual Metal Arc Welding (MMAW)

See SMAW

Metal Active Gas Welding (MAG)

See GMAW

Metal Inert Gas Welding (MIG)

See GMAW

Non-Destructive Testing (NDT)

NDT is a wide group of analysis techniques used to evaluate the properties of a material, component or system without causing damage. Because NDT does not permanently alter the article being inspected, it is a valuable technique that can save both money and time. NDT techniques include:

- Visual inspection
- Liquid penetrant testing
- Magnetic particle testing
- Acoustic monitoring (using sound waves)
- X ray testing
- Ultrasonic testing
- Digital testing

Oxyacetylene Welding (OAW)

In oxy-fuel welding, a welding torch is used to weld metals. Welding metal results when two pieces are heated to a temperature that produces a shared pool of molten metal. The molten pool is generally supplied with additional metal called filler. Oxy-fuel welding is widely used for welding pipes and tubes, as well as repair work. OAW has an advantage of being portable and not needing electricity.

Shielded Metal Arc Welding (SMAW)

SMAW is also known as manual metal arc welding (MMAW) or stick welding. SMAW is a manual arc welding process that uses an electric current to strike an arc between the base material and a consumable electrode rod or stick. The electrode rod is made of a material that is compatible with the base material being welded and is covered with a flux that gives off vapours that serve as a shielding gas and provide a layer of slag, both of which protect the weld area from atmospheric contamination.

The process is versatile and relatively simple and is common in the maintenance and repair industry. It is used extensively in the construction of steel structures, in industrial fabrication and repair work.

Standards/Technical Standards

A standard is a document that provides requirements, specifications, guidelines or characteristics that can be used consistently to ensure that materials, products, processes and services are fit for their purpose. Standards are published in terms of codes, procedures and specifications.

Many nations or regions have standards bodies. Key bodies producing standards, and the acronym for their standards, are:

- American Welding Society (AWS) Standards
- American Society for Mechanical Engineering (ASME) Standards
- Australian/New Zealand (AS/NZS) Standards
- Canadian Standards Association (CSA) Standards
- British Standards (BS)
- International Organization for Standardization (ISO) Standards
- European Union (EN) standards
- German Standards (DIN and others)

As examples, some key welding standards are:

- *AWS D1.1/D1.1m 2010: Structural Welding Code Steel* – this code covers the welding requirements for any type of welded structure made from the commonly used carbon and low-alloy constructional steels;
- *AWS B2.1 Specification for Welding Procedure and Performance Qualification* – this code contains the requirements for fabricating and erecting welded steel structures;
- *AWS D1.3 Structural Welding Code-Sheet Steel* - this code covers the requirements associated with welding sheet steel having a minimum specified yield point no greater than 80 000 psi (550 MPa). The code requirements cover any welded joint made from the commonly used structural quality low-carbon hot rolled and cold rolled sheet and strip steel with or without zinc coating (galvanized); and
- *ASME Boiler and Pressure Vessel Code section IX: "Qualification Standard for welding and brazing procedures, welders, brazers and welding and brazing operators".*

Threshold Limit Value (TLV)

The threshold limit value (TLV) of a chemical substance is a level to which it is believed a worker can be exposed day after day for a working lifetime without adverse health effects.

Tungsten Inert Gas welding (TIG)

See Gas Tungsten Arc Welding (GTAW)

Welding Procedure Specification (WPS)

A WPS is a document that describes how welding is to be carried out in production. Its purpose is to aid the planning and quality control of the welding operation. They are recommended for all welding operations and most application codes and standards make them mandatory.

Glossary of training and assessment terms

Competency

The ability to perform particular tasks and duties to the standard of performance expected in the workplace, applying all relevant skills, knowledge and attitudes consistently over time in the required workplace situations.

Unit of competency

An agreed statement of the skills and knowledge required for effective performance of a particular job or job function.

Competency standards

Competency standards are made up of a number of units of competency each of which describes a key function or role in a particular job function or occupation.

Attainment of competency

Competencies may be gained in a number of ways including through:

- Formal or informal education and training
- Experiences in the workplace
- General life experience, and/or
- Any combination of the above.

Unit title

A short title that summarises the main job function covered by the unit; accompanied by an alphanumeric code that follows ILO guidelines.

Unit descriptor

A short statement giving a more detailed description of the job function covered by the unit.

Elements of competency

These are the major functions and tasks that make up the competency.

Performance criteria

The performance standard or tasks that are involved in each of the relevant job functions. Critical terms or phrases may be written in bold italics and then defined in Range statement, in the order of their appearance in the performance criteria.

Critical skills and essential knowledge

Brief statements that outline key skills and required knowledge for the job function covered by this unit. Knowledge identifies what a person needs to know to perform the work in an informed and effective manner. Skills describe how the knowledge is converted to a workplace outcome.

Evidence guide

The Evidence guide information to the assessor about how the competency may be demonstrated, such as conditions and context of assessment, suitable methods of assessment and resource implications.

Range statement

Brief statements that clarify the scope and range of performance, including clarification on contexts, operations and equipment referred to in the performance criteria. As applicable, the meanings of key terms used in the performance criteria are also explained in the Range statement.

Acronyms

General

5S	Sorting, Straightening, Shining, Standardizing, Sustaining
ASME	American Society of Mechanical Engineers
AWF	Asian Welding Federation
AWS	American Welding Society
ISO	International Organization for Standardization
MDAS	Multiplication, Division, Addition and Subtraction
OSH	Occupational Safety and Health
PPE	Personal Protective Equipment
WPS	Weld Procedures Specification

Welding technology

DT	Destructive Testing
FCAW	Flux Core Arc Welding
GMAW	Gas Metal Arc Welding
GTAW	Gas Tungsten Arc Welding
MAG	Metal Active Gas welding
MIG	Metal Inert Gas welding
MMAW	Manual Metal Arc Welding
NDT	Non Destructive Testing
OAW	Oxyacetylene Welding
SAW	Submerged Arc Welding
SMAW	Shielded Metal Arc Welding
TIG	Tungsten Inert Gas welding

Welding standards bodies

AS/NZS	Australian/New Zealand standards
AWS	American Welding Society
BS	British Standards
CSA	Canadian Standards Association Standards
ISO	International Organization for Standardization

Introduction

National competency standards play an important and increasing role in skills development and recognition in the Asia-Pacific region, as they do in many other parts of the world. They are a guide to the range of skills and knowledge required for a whole industry. Competency standards can be flexibly combined into jobs and occupations. They are the common basis for training programmes, skills assessment and certification in many countries.

Competency standards, when recognized nationally, or across a cluster of nations, can form a key component in assisting the mobility of skilled labour. As part of a quality assurance system, the assessment of a person's skills against accepted benchmarks means those skills can be applied in other similar work. Potential employers can feel confident in the level of competencies. Workers returning from employment in other countries can have the skills they gained working there formally recognized. The Regional Model Competency Standards (RMCS) are the reference standards at the regional level that can be used in various ways to underpin efficient and effective skill development. In addition, they are considered to be essential tools to protect migrant workers, their rights and to ensure their better reintegration.

Labour mobility and the need for recognition

The labour market in Asia is characterised by a high level of worker migration, within the region and to external countries. In 2013, Asia accounted for 31 per cent of the global international migrant stock (UN, 2013).¹ Many developing countries have come to rely heavily on remittances sent from individuals working abroad to their families at home. Remittances in the 2010s are now nearly three times the size of official development assistance and larger than private debt and portfolio equity flows to developing countries. The importance of remittances as a source of foreign currency earnings is increasing, particularly in South Asia (World Bank, 2013).²

Many migrants do have skills that were acquired in their home country but not all of their skills are necessarily formally certified. This reduces their prospect for employment and better working conditions that correspond with their skills. Upon their return, there is little opportunity to have their newly acquired skills and work experience formally acknowledged. These are missed opportunities in capitalizing on the wealth of new learning and skills the workers bring back. This scenario impacts negatively on the individual worker's future employment prospects both within the region and outside. It also impedes their country's capacity to build a skilled and qualified workforce.

Training systems and the need for improvement

Training systems in the Asia-Pacific region are often criticized on the basis that there is a mismatch between the skills offered and the needs of workers and employers. This means that some people are learning skills that are not needed by industry and training organizations are wasting their limited resources providing training that is not used. This is a serious problem for any country, as it holds back development and growth in productivity and employment.

¹ United Nations, Department of Economic and Social Affairs: *Trends in international migrant stock: The 2013 Revision*. <http://esa.un.org/unmigration/TIMSA2013/migrantstocks2013.htm> [accessed 7 Oct. 2014].

² World Bank: *Migration and Development Brief 22*. Migration and Remittances Team, Development Prospects Group. April 2014 <http://www.worldbank.org/prospects/migrationandremittances> [accessed 7 Oct. 2014].

The RMCS were developed in a simplified format so that they could be used in discussions between stakeholders to reduce this mismatch. The competencies are designed so that they can be modified to meet the specific requirements of an employer, job or workplace. Some competency elements will need to be added or deleted depending on the local requirements. This review process must take place to ensure the relevancy of any learning, training or assessment strategy based on the standards.

Welding occupation

Welding is the principal industrial process used for joining metals. In typical industrialised countries 0.2 to 2 per cent of the total workforce is engaged in welding. Welders are used in many industries and majority of them are employed in the ship building, transport equipment, manufacturing, building construction, petrochemical, mining and metallurgical industries. Welding is in demand in the growing Asian economy and mostly found in these industries. Thus, the growth rate as well as the demand for skilled workers in these industries have escalated. As a result of the 2015 ASEAN integration, majority of the ASEAN Member States are also prioritizing transport, construction and infrastructure which calls for expanding the supply of workerse in engineering and construction skills such as welding, electrical wiring and bricklaying (ILO and ADB, 2014: 62).

Welders may work outdoors, often in inclement weather, or indoors, sometimes in a confined area. They may work on a scaffold, high off the ground, and they occasionally must lift heavy objects and work in awkward positions. These activities place welders at risk of occupational hazards associated with working at heights or in confined spaces, and manual lifting. Welders also exposed to welding fumes and gases, which may be hazardous to their health. Welding fume exposure in the workplace is a serious occupational hazard. In workplaces where welding is undertaken, occupational safety and health measures must be in place and enforced. Furthermore, the training and the skills assessment of welders must integrate and highlight the importance of occupational safety and health in the workplace.

Purpose of the RMCS

These competency standards were developed as a basis for identifying skills needed in the workplace, so that training and assessment resources can be developed and individuals tested against the standards. Training resources might include a curriculum, test projects, learner guides, texts, references, teaching strategies, group activities and an assessment system that can be used to determine competence in each unit of competency.

The standards can also be used in many other ways as a reference material, for example, for recruitment and development of job descriptions. The complete sets of competency standards included in these RMCS, however, do not represent a common job description or expectation of the work performance of every welders. Each job of a welder should be negotiated as part of their employment contract and different levels and complexities of tasks and responsibilities should be reflected in working conditions including wages.

Different countries will have different customs and any training provided should reflect these different customs and expectations. Similarly, there will be different legislation and government regulations that apply in different countries and regions and these also must be taken into account in designing training programmes. It is, therefore, important that the effort in developing and updating national competency standards form not only a part of skills development initiatives for a welder but also a part of the broader effort in promoting their decent work.

Content

The RMCS are grouped functionally and not along the line of jobs or occupations. This enables the users of the RMCS to tailor make their own ‘competency standards for welders by selecting and

grouping the units of competencies from the RMCS to better fit their national and local understanding and situations.

These standards reflect the level of workers with no technical vocational education background, as this population represents the largest portion of workers in ASEAN. For workers with higher level of experience and qualification, the competencies to be added will include supervisory skills, special welding materials, difficult welding positions, specific theoretical knowledge (e.g. metallurgy) and inspection and testing skills (Destructive, Non Destructive Testing).

The units contained in these standards relate to the most common materials used in building and boat construction: carbon steel, alloy steel. Welding for products found in other industry areas and materials such as stainless steel or aluminum, in general, require a higher level of welding skill. Welding technologies used in specific manufacturing processes like in automotive (spot welding for thin plates), railway industry (resistance butt welding) are not included in these standards.

In order to align as much as possible existing systems and support an easy transfer to various countries, the existing competency standards of targeted countries in Asia-Pacific and especially from the Philippines, Australia, New Zealand, and Thailand. A comparison was also made to the International Welding Certification System (International Institute of Welding or IIW).

As a whole, the competencies within these countries are very similar, with a number from 10-20 units or standards of general (not specialized by sector) welding competencies at the corresponding levels of role responsibility. These standards cover the knowledge and skills found in the International Welding Certification except knowledge of the international welding standards for aluminum and stainless steel welding.

Templates for the RMCS

The template used follows the model of unit description applied in various countries in Asia and the Pacific as well as the other RMCS developed by the ILO. Each unit of competency describes the skills a worker applies when performing the identified task or role, as well as the underpinning skills, knowledge and attitudes the worker needs to perform the task effectively.

Individual units define the competency outcomes necessary for a particular area of work. It is the combination of a number of units that describes a whole job role. The combination of units also captures the need to manage different tasks simultaneously and to adapt to different workplace environments and situations.

These RMCS have been divided into six functional areas, which are comprised of 32 units of competency. These are summarised in the table following.

Functional area	Code	Unit title
A Core units	WS-A1	Practice housekeeping procedures
	WS-A2	Practice occupational safety and health procedures
	WS-A3	Apply safety and health practice
	WS-A4	Read and understand drawing and sketches
	WS-A5	Read and understand WPS
	WS-A6	Perform basic industry calculation
	WS-A7	Contribute to quality system
	WS-A8	Use hand tools
	WS-A9	Prepare weld materials
	WS-A10	Set-up welding equipment
	WS-A11	Fit up weld materials
	WS-A12	Repair weld
B Performing fillet and groove welding on carbon steel plate	WS-B1	Weld carbon steel plates using FCAW
	WS-B2	Weld carbon steel plates using GMAW
	WS-B3	Weld carbon steel plates using GTAW
	WS-B4	Weld plates using SAW
	WS-B5	Weld carbon steel plates using SMAW
C Performing groove welding on carbon steel pipe	WS-C1	Weld carbon steel pipes using FCAW
	WS-C2	Weld carbon steel pipes using GMAW
	WS-C3	Weld carbon steel pipes using GTAW
	WS-C4	Weld carbon steel pipes using SAW
D Performing fillet & groove welding on carbon steel plate & tubes/pipes	WS-D1	Perform gas welding in carbon steel plates and tubes
	WS-D2	Weld carbon steel plates and pipes using SMAW
E Performing fillet and groove welding on alloy steel plate	WS-E1	Weld alloy steel plates using FCAW
	WS-E2	Perform gas welding in alloy steel plates and tubes
	WS-E3	Weld alloy steel plates using GMAW
	WS-E4	Weld alloy steel plates using GTAW
	WS-E5	Weld alloy steel plates using SMAW
F Performing fillet and groove welding on alloy steel pipe	WS-F1	Weld alloy steel pipes using FCAW
	WS-F2	Weld alloy steel pipes using GMAW
	WS-F3	Weld alloy steel pipes using GTAW
	WS-F4	Weld alloy steel pipes using SMAW

Functional area A – Core skills

WS-A1 Practice housekeeping procedures

Unit details

Functional area A	Core competencies
Unit title	Practice housekeeping procedures
Unit code	WS-A1

Description

This unit covers the knowledge, skills and attitudes required to apply the basic housekeeping procedures.

Elements of competency	Performance criteria
1. Sort and remove unnecessary items	<p>1.1 Reusable, recyclable materials are sorted in accordance with company/office procedures.</p> <p>1.2 Unnecessary items are removed and disposed of in accordance with company or office procedures.</p>
2. Arrange items	<p>2.1 Items are arranged in accordance with company/office housekeeping procedures.</p> <p>2.2 Work area is arranged according to job requirements.</p> <p>2.3 Activities are prioritized based on instructions.</p> <p>2.4 Items are provided with clear and visible identification marks based on procedure.</p> <p>2.5 Safety equipment and evacuation passages are kept clear and accessible based on instructions.</p>
3. Maintain work area, tools and equipment	<p>3.1 Cleanliness and orderliness of work area is maintained in accordance with company/office procedures</p> <p>3.2 Tools and equipment are cleaned in accordance with manufacturer's instructions/manual</p> <p>3.3 Minor repairs are performed on tools and equipment in accordance with manufacturer's instruction/manual</p> <p>3.4 Defective tools and equipment are reported to immediate supervisor.</p>
4. Follow standardized work process and procedures	<p>4.1 Materials for common use are maintained in designated area based on procedures.</p> <p>4.2 Work is performed according to standard work procedures. Abnormal incidents are reported to immediate supervisor.</p>
5. Perform work spontaneously	<p>5.1 Work is performed as per instruction.</p> <p>5.2 Company and office decorum are followed and complied with.</p> <p>5.3 Work is performed in accordance with occupational safety and Health (OSH) requirements.</p>

Evidence guide

To demonstrate competency in this unit the candidate must meet performance criteria and skills and knowledge requirements. The candidate must be able to:

- demonstrate the basic procedures of 5S.

Critical skills and essential knowledge

- Accident/Hazard reporting procedures
- Basic communication skills
- Environmental requirements relative to work safety
- General OSH principles and legislation
- Interpersonal skills
- Principles of 5S
- Reading skills required to interpret instructions
- Reporting/recording accidents and potential hazards
- Safety signs and symbols
- Work process and procedures

Critical skills

The ability to:

- Identify communication requirements
- Identify concerns related to contract and or job description
- Negotiate scope of work and working conditions
- Relate to people from diverse backgrounds and people with diverse abilities
- Request advice, to give/receive feedback and to work with others
- Select and use methods appropriate to communication tasks
- Understand and process basic workplace documentation

Essential knowledge

- Advantages and disadvantages of different modes of communication (e.g. written and non-verbal)
- Communication methods relevant to the workplace and the work role
- Effective communication while working with others
- Legal rights related to contract, job description, working conditions, roles and responsibilities
- Work-related documentation requirements

Range statement

Unnecessary items may include:

- Non-recyclable materials
- Pictures, posters and other materials not related to work activity
- Unserviceable tools and equipment
- Waste materials

Identification marks:

- Colour coding
- Labels
- Tags

Minor repairs may include:

- Application of lubricants
- Replacement of parts
- Sharpening of tools
- Tightening of nuts, bolts and screws

Decorum:

- Behaviour
- Company/office rules and regulations
- Company/office uniform

The following resources must be provided:

- Facilities, materials tools and equipment necessary for the activity

Competency is to be assessed through a combination of:

- Demonstration with questioning
- Interview
- Third party report

Competency is to be assessed while a task is being undertaken in the workplace or in a simulated workplace setting.

WS-A2 Practice occupational safety and health procedures

Unit details

Functional area A	Core competencies
Unit title	Practice occupational safety and health procedures
Unit code	WS-A2

Description

This unit covers the outcomes required to comply with regulatory and organizational requirements for occupational safety and health.

Elements of competency	Performance criteria
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1. Identify hazards and risks	<p>1.1 Safety regulations and workplace safety and hazard control practices and procedures are clarified and explained based on organization procedures.</p> <p>1.2 Hazards/risks in the workplace and their corresponding indicators are identified to minimize or eliminate risk to co-workers, workplace and environment in accordance with organization procedures.</p> <p>1.3 Contingency measures during workplace accidents, fire and other emergencies are recognized and established in accordance with organization procedures.</p>
2. Evaluate hazards and risks	<p>2.1 Terms of maximum tolerable limits which when exceeded will result in harm or damage are identified based on threshold limit values (TLV).</p> <p>2.2 Effects of the hazards are determined.</p> <p>2.3 OSH issues and/or concerns and identified safety hazards are reported to designated personnel in accordance with workplace requirements and relevant workplace OSH legislation.</p> <p>2.4 Safety equipment and evacuation passages are kept clear and accessible based on instructions.</p>
3. Control hazards and risks	<p>3.1 Occupational Safety and Health (OSH) procedures for controlling hazards/risks in workplace are consistently followed.</p> <p>3.2 Procedures for dealing with workplace accidents, fire and emergencies are followed in accordance with organization OSH policies.</p> <p>3.3 Personal protective equipment (PPE) is correctly used in accordance with organization OSH procedures and practices.</p> <p>3.4 Appropriate assistance is provided in the event of a workplace emergency in accordance with established organization protocol.</p>
4. Maintain OSH awareness	<p>4.1 Emergency-related drills and trainings are participated in as per established organization guidelines and procedures.</p> <p>4.2 OSH personal records are completed and updated in accordance with workplace requirements.</p>

Evidence guide

To demonstrate competency in this unit the candidate must meet performance criteria and skills and knowledge requirements. The candidate must be able to:

- complete and update OSH personal records in accordance with workplace requirements;
- explain clearly established workplace safety and hazard control practices and procedures;
- follow Occupational Safety and Health (OSH) procedures for controlling hazards/risks in workplace;
- identify hazards/risks in the workplace and its corresponding indicators in accordance with company procedures;
- identify terms of maximum tolerable limits based on threshold limit value;
- recognize contingency measures during workplace accidents, fire and other emergencies; and
- use Personal Protective Equipment (PPE) in accordance with company OSH procedures and practices.

Critical skills and essential knowledge

- Communication skills
- Hazards/risks identification and control
- Hazards/risks identification and control skills
- Health consciousness
- Interpersonal skills
- OSH indicators
- OSH procedures and practices and regulations
- Organization safety and health protocol
- Personal hygiene practices
- PPE types and uses
- Practice of personal hygiene
- Safety consciousness
- Threshold Limit Value (TLV)

Range statement

Safety regulations:

- Building code
- Clean Air Act
- Local Occupational Safety and Health Standards
- National Electrical and Fire Safety Codes
- Regulations on safety legal requirements
- Waste management statutes and rules

Hazards/Risks:

- Biological hazards- bacteria, viruses, plants, parasites, mites, molds, fungi, insects
- Chemical hazards – dusts, fibers, mists, fumes, smoke, gasses, vapors
- Ergonomics
- Physical hazards – impact, illumination, pressure, noise, vibration, temperature, radiation
- Physiological factors – monotony, personal relationship, work out cycle
- Psychological factors – over exertion/ excessive force, awkward/static positions, fatigue, direct pressure, varying metabolic cycles

Contingency measures:

- (Calling designed) emergency personnel
- Decontamination

- Evacuation
- Isolation

Personal Protective Equipment (PPE):

- Anti-static suits
- Apron/gown/coverall/jump suit
- Ear muffs
- Face mask/shield
- Gloves
- Goggles
- Hair net/cap/bonnet
- Mask

Emergency-related drills and training:

- Basic life support
- Decontamination of chemical and toxic
- Disaster preparedness/management
- Earthquake drill
- Fire drill
- First aid
- Spillage control

OSH personal records:

- Accident reports
- Incident reports
- Medical/Health records
- OSH-related training completed

The following resources must be provided:

- Health records
- OSH personal records
- PPE
- Workplace or assessment location

Competency may be assessed through a combination of:

- Case Study/Situation
- Interview
- Portfolio assessment

Competency is to be assessed while a task is being undertaken in the workplace or in a simulated workplace setting.

WS-A3 Apply safety and health practice

Unit details

Functional area A	Core competencies
Unit title	Apply safety and health practice
Unit code	WS-A3

Description

This unit covers the competencies required to apply safety practices in the welding area.

Elements of competency	Performance criteria
------------------------	----------------------

1. Identify hazardous area	1.1 Hazards are identified correctly in accordance with OSH principles. 1.2 Safety signs and symbols are identified and adhered to. 1.3 Dangerous situations in relation to electricity (DC, AC), humidity, are identified.
2. Use protective clothing and devices	2.1 Appropriate protective clothing and devices correctly selected and used in accordance with OSH requirements or industry/company policy.
3. Perform safe handling of tools, power source, accessory, equipment and materials	3.1 Safety procedures for pre-use check and operation of tools and equipment followed in accordance with industry/ company policies. 3.2 Tools, equipment and materials handled safely in accordance with OSH requirements and industry/ company policies.
4. Perform first aid	4.1 First aid treatment of injuries is carried out according to recommended procedures.
5. Use fire extinguisher	5.1 Fire extinguisher selected and operated correctly according to the type of fire .

Evidence guide

To demonstrate competency in this unit the candidate must meet performance criteria and skills and knowledge requirements. The candidate must be able to:

- handle tools, power source, accessory, equipment and materials properly
- identify hazardous area
- perform first aid
- use fire extinguisher
- use protective clothing and devices

Critical skills and essential knowledge

- Communicating with superiors and co-workers
- Fire extinguishers
- First aid
- Handling tools and materials
- Hazards in the workplace (confined space, presence of flammable and/or explosive materials or containers, defective equipment, hot metal hard and /or hot particles)
- Housekeeping
- Operating machine tools

- Power source and accessory
- Safety precautionary measures
- Shop and site safety signs, symbols and alarms
- Understanding instruction

Range statement

Hazards (general and welding specific):

- Burns and fires, fire prevention, fire fighting
- Electric shock
- Noise hazards
- UV- and heat radiation
- Welding fumes

Protective clothing and devices:

- Cap
- Overalls
- Safety glasses/goggles
- Safety shoes

Injuries:

- Burns/scalds
- Concussion shock
- Cuts and abrasions
- Foreign bodies in the eye
- Fractures
- Poisoning

Type of fires:

- Combustible metals (magnesium, sodium, etc.)
- Common combustibles (wood, cloth, paper, rubber and plastic)
- Energized electrical equipment (wiring, fuse boxes, circuit breakers, appliances, etc.)
- Flammable liquids (gasoline, oil, solvents, paints, etc.)

The following resources must be provided:

- Materials relevant to the proposed activity
- Tools, equipment and facilities appropriate to processes or activity

Competency may be assessed through a combination of:

- Demonstration
- Practical exercises
- Written or oral short answer questions

Competency is to be assessed in the workplace or in simulated workplace environment.

WS-A4 Read and understand drawing and sketches

Unit details

Functional area A	Core competencies
Unit title	Read and understand drawing and sketches
Unit code	WS-A4

Description

This unit covers the competencies required to read and understand drawings and sketches.

Elements of competency	Performance criteria
1. Identify standard alphabet of lines	1.1 Alphabet of lines are identified. 1.2 Uses of the alphabet of lines are explained.
2. Identify orthographic/isometric views	2.1 Orthographic and isometric drawing are identified. 2.2 Orthographic and isometric views are explained.
3. Understand meaning of standard drawing symbols, dimensional tolerances and notations	3.1 Drawing symbols are understood according to drawing standards. 3.2 Dimensional tolerances , notations are understood according to specifications. 3.3 Types of welds and joints (characteristics, size, surface finish) are understood.

Evidence guide

To demonstrate competency in this unit the candidate must meet performance criteria and skills and knowledge requirements. The candidate must be able to:

- understand technical drawings and sketches.

Critical skills and essential knowledge

- Alphabet of lines
- Basic calculations
- Communication skills (reading and comprehension)
- Drawing symbols
- Projections
- Tolerances

Range statement

Drawing technique includes:

- Exploded view
- Hidden view technique
- Perspective

Tolerances:

- Angular tolerance
- General tolerance
- Geometric tolerance

Types of welds and joints**Projections:**

- First angle projections
- Third angle projections

The following resources must be provided:

- Components
- Measuring tools
- Working drawing or plans or sketches or Welding Procedure Specification (WPS) required by client

Competency may be assessed through a combination of:

- Demonstration
- Direct observation
- Portfolio
- Project/work sample
- Written or oral short answer questions

Competency may be assessed in the workplace or in simulated workplace environment.

WS-A5 Read and understand Welding Procedures Specifications

Unit details

Functional area A	Core competencies
Unit title	Read and understand Welding Procedures Specifications
Unit code	WS-A5

Description

This unit covers the competencies required to read and understand Welding Procedures Specifications (WPS).

Elements of competency	Performance criteria
1. Identify common content of WPS	1.1 Demonstrated ability to understand terminologies used in WPS . 1.2 Understanding of common acronyms used in WPS (codes).
2. Interpret and explain WPS	2.1 Ability to interpret and explain a range of WPS. 2.2 Ability to follow a demonstrated simple welding procedure to prepare a sample WPS.

Evidence guide

To demonstrate competency in this unit the candidate must meet performance criteria and skills and knowledge requirements. The candidate must be able to:

- understand a range of WPS documents.

Critical skills and essential knowledge

- Common content of WPS
- Groupings of materials
- Purpose of Welding Procedures Specifications
- Written communication skills (reading and comprehension)

Range statement

Range of **WPS** to include different:

- Materials
- Types of welds
- Welding methods
- Welding positions

Terminologies used in WPS may include:

- Clamp type
- Consumables
- Current
- Diameter
- Electrical characteristics - amps, volts, current
- Flow
- Gas
- Material
- Nozzle diameter
- Pass location diagram
- Polarity

- Pre-heat
- Purge gas
- Rate
- Shielding gas
- Speed
- Speed heat input
- Thickness
- Weld positions
- Weld preparation diagram

Acronyms used in WPS include:

- ASME
- AWS
- FCAW
- GMAW
- GTAW
- GTAW
- ISO
- MAG
- MIG
- MMAW
- OAWSAW
- SMAW
- TIG

The following resources must be provided:

- Welding Procedure Specification (WPS) required by clients

Competency may be assessed through a combination of:

- Demonstration
- Direct observation
- Portfolio
- Project/work sample
- Written or oral short answer questions

Competency may be assessed in the workplace, a simulated workplace environment or off the job environment.

WS-A6 Contribute to quality system

Unit details

Functional area A	Core competencies
Unit title	Contribute to quality system
Unit code	WS-A6

Description

This unit covers the competencies required to perform basic calculations using the four fundamental operations.

Elements of competency	Performance criteria
1. Perform four fundamental operations	1.1 Simple calculations involving whole numbers, mixed numbers, fraction and decimal are performed using four fundamental operations.
2. Perform conversion of units	2.1 Units are converted to the required figure using the given formulae. 2.2 English measurements are converted to metric measurements according to procedure.
3. Perform calculations on algebraic expressions	3.1 Simple calculations are performed on algebraic expressions using four fundamental operations. 3.2 Simple transposition of formulae is carried out to isolate the variable required, involving the four fundamental operations .
4. Compute simple percentage and ratio	4.1 Percentages are computed using appropriate formula. 4.2 Ratio and proportion are computed using appropriate formula.

Evidence guide

To demonstrate competency in this unit the candidate must meet performance criteria and skills and knowledge requirements. The candidate must be able to:

- involve fractions and decimals;
- involve fractions and mixed numbers;
- involve ratio and proportion;
- on algebraic expressions;
- perform calculations; and
- use four fundamental operations.

Critical skills and essential knowledge

- English and metric system of measurements
- Equation formulation
- Four fundamental operations
- Method of transposing formulae

Range statement

Units:

- Decimal
- Fractions

- Mixed numbers

Four fundamental operations:

- Addition
- Division
- Multiplication
- Subtraction

The following resources must be provided:

- Components.
- Materials relevant to the proposed activity
- Measuring tools
- Tools and facilities appropriate to processes or activity
- Working drawing or plans or sketches or Welding Procedure Specification (WPS) required by client

Competency may be assessed through a combination of:

- Practical exercises
- Written or oral short answer questions

Competency may be assessed in the workplace or in simulated workplace environment.

WS-A7 Perform industry calculation

Unit details

Functional area A	Core competencies
Unit title	Perform industry calculation
Unit code	WS-A7

Description

This unit covers the competencies required to perform basic calculations using the four fundamental operations.

Elements of competency	Performance criteria
1. Inspect welding work done	<p>1.1 Appropriate inspections are conducted to ensure company quality systems or procedures or work instruction is maintained/ followed.</p> <p>1.2 Faults/defects are identified and rectified according to acceptance criteria.</p>
2. Apply quality standards to welding work	<p>2.1 Inspections are conducted throughout the manufacturing processes to ensure quality standards are maintained.</p> <p>2.2 Appropriate quality standards are applied throughout the welding work.</p> <p>2.3 All activities are coordinated throughout the workplace to ensure efficient quality work outcomes.</p> <p>2.4 Records of work quality are maintained according to the company requirements or work instruction.</p>
3. Protect company property and customer interests	<p>3.1 Possible damage to company property is avoided by adherence to company quality procedures.</p> <p>3.2 Quality of work is followed to ensure customer requirements and company standards are met.</p>

Evidence guide

To demonstrate competency in this unit the candidate must meet performance criteria and skills and knowledge requirements. The candidate must be able to:

- apply quality standards to work;
- inspect work done against specification;
- procedure or work instruction or WPS; and
- protect company property and customer interests.

Critical skills and essential knowledge

- Communicating with superiors and co-workers
- Communication/feedback methods-written and verbal
- Company systems, processes and work quality requirements
- Handling materials, tools and equipment
- Problem solving skills
- Quality objective
- Safety precautionary measures

- Welder identification system
- Work inspection techniques

Range statement

Quality system and procedures:

Quality system and procedures may be contained in:

- Company/industry rules
- Equipment maintenance schedules
- Inspection and testing plan (ITP)
- Product specifications
- Safe work procedures
- Technical procedures adopted or specifically prepared standards
- Work instructions
- WPS

Company property includes:

- Base materials
- Facilities
- Hand and power tools
- OS&H
- Production and/or fabrication equipment
- Welding consumables

The following resources must be provided:

- Materials relevant to the proposed activity
- Tools, equipment and facilities appropriate to processes or activity

Competency may be assessed through a combination of:

- Demonstration
- Practical exercises
- Written or oral short answer questions

Competency may be assessed in the workplace or in simulated workplace environment.

WS-A8 Use hand tools

Unit details

Functional area A **Core competencies**

Unit title **Use hand tools**

Unit code **WS-A8**

Description

This unit covers the competencies required to use hand tools.

Elements of competency Performance criteria

- | | |
|------------------------|---|
| 1. Select hand tools | 1.1 Hand tools selected are appropriate to the requirements of the task. |
| | 1.2 Unsafe or defective tools are identified and marked for repair according to procedure. |
| 2. Use hand tools | 2.1 Hand tools are used to produce the desired outcomes to job specifications. |
| | 2.2 Task performed in accordance with company or industry safety procedure. |
| 3. Maintain hand tools | 3.1 Routine maintenance of hand tools is undertaken according to standard operating procedures, principles and techniques. |
| | 3.2 Hand tools are stored in designated location in accordance with manufacturer's instruction/standard operating procedure. |

Evidence guide

To demonstrate competency in this unit the candidate must meet performance criteria and skills and knowledge requirements. The candidate must be able to:

- perform routine maintenance and storage of hand tools; and
- select and use hand tools appropriate to the job.

Critical skills and essential knowledge

- Communicating with superiors and co-workers
- Hand tool defects
- Handling tools and materials
- Procedure, principles and techniques in maintenance of hand tools
- Types and uses of hand tools
- Understanding instructions

Range statement

Hand tools include but are not limited to:

- Chisels
- Clamps
- Files
- Gouges
- Grinding wheel
- Hammers (ball peen, chipping)
- Scrapers

- Steel brush
- Wrenches

Tasks may include:

- Adjusting
- Assembling
- Dismantling
- Finishing of item or components
- Repairing

Routine maintenance may include:

- Cleaning
- Hand sharpening
- Lubricating
- Simple tool repair
- Tightening

The following resources must be provided:

- Materials relevant to the proposed activity
- Tools, equipment and facilities appropriate to the process or activity.

Competency may be assessed through a combination of:

- Demonstration
- Practical exercises
- Written or oral short answer questions

Competency may be assessed in the workplace or in simulated workplace environment.

WS-A9 Prepare weld materials

Unit details

Functional area A	Core competencies
Unit title	Prepare weld materials
Unit code	WS-A9

Description

This unit covers the skills, knowledge and attitudes in joint preparation for welding.

Elements of competency	Performance criteria
1. Inspect welding work done	1.1 Cutting equipment should be operational and should conform to acceptable OS&H standards. 1.2 Essential parameters and results of thermal cutting should be set up. 1.3 Major components of cutting equipment and their function use. 1.4 Set up cutting equipment is appropriate for operation work instruction intended.
2. Cut and prepare edge of materials	2.1 Materials are cut based on specified dimension/specifications. 2.2 Task is performed in accordance with company or industry requirements and safety procedure.
3. Clean surfaces and edges	3.1 Surfaces are cleaned to required specifications . 3.2 Suitable cutting surface. 3.3 Task performed in accordance with company or industry requirements and safety procedure .
4. Prepare welding consumables	4.1 Dry, store and handle welding consumables . 4.2 Identify the designation of welding consumables as used on WPSs. 4.3 Welding consumables are prepared in accordance with manufacturer's instructions.
5. Prepare welding safety and protective equipment	5.1 PPE should conform to acceptable OS&H requirement and standards.

Evidence guide

To demonstrate competency in this unit the candidate must meet performance criteria and skills and knowledge requirements. The candidate must be able to:

- perform edge preparation in accordance with WPS and safety procedures; and
- use edge preparation equipment and tools in accordance with the requirements or manufacturer's instructions.

Critical skills and essential knowledge

- Cutting techniques

- Ferrous materials: low carbon steel, structural steel, high strength steel, grey cast iron
- Gouging techniques
- Grinding techniques
- Measuring and communication skills
- Observance of safety procedures
- Operation of cutting equipment such as mechanical, gas and plasma
- Operation of grinding equipment
- Safety procedures for cutting and grinding
- Selection of appropriate method of edge preparation
- Selection or use of appropriate cutting equipment, accessories and supplies
- Set up of cutting equipment such as mechanical, gas and plasma
- Understanding of plans and drawings

Range statement

Cut **material** using:

- Disc cutter
- Gas for cutting ex. acetylene, oxygen, air and nitrogen
- Grinding wheel
- Oxy-acetylene gas cutting equipment (manual and /or automatic)
- Plasma cutting equipment (manual and/or automatic)
- Shearing machine

Surfaces and edges are cleaned by:

- Chemical washing (degreaser)
- Filing
- Grinding or sandblasting

Specifications based on:

- Client specification
- Reference Industry standards
- Welding codes

Safety procedures:

- Checking electrical equipment and devices
- Checking oxy-acetylene hose for gas leaks
- Gas container handling and installation
- Securing oxy-acetylene tanks before, during and after use
- Switch off equipment after use
- Wearing of required PPE

Base materials and **welding consumables:**

- Alloy steel
- Carbon steel
- Cutting accessories
- Cutting gases
- Gouging power source, accessories and electrodes
- Grinding/cutting discs
- Mild steel
- Run on/run off, backing plates/ring
- Use and handling of fillers consumable

The following resources must be provided:

- Cutting equipment and facilities
- Grinding equipment and facilities

- Measuring tools
- PPE
- Relevant documentation such as WPS and working drawing
- Stand-by fire-fighting equipment
- Supplies and materials

Competency may be assessed through a combination of:

- Inspection of prepared edges
- Observation/evaluation
- Oral questioning

Competency is to be assessed while a task is being undertaken in the workplace or in a simulated workplace setting.

WS-A10 Set-up welding equipment

Unit details

Functional area A	Core competencies
Unit title	Set up welding equipment
Unit code	WS-A10

Description

This unit covers the skills, knowledge and attitudes in preparing equipment for welding.

Elements of competency	Performance criteria
1. Inspect welding work done	<ul style="list-style-type: none">1.1 Welding equipment is fit to the purpose.1.2 Welding power source is set up in accordance with job requirements, welding procedures and specifications, technical drawings and manufacturer's instructions.1.3 Welding power source should be connected to an independent power supply and wired up or set to the polarity indicated in the welding procedures /specifications or as recommended by the manufacturer.1.4 Current, voltage, gas pressures/flows and wire feed settings are fine-tuned or adjusted consistent with job requirements to produce acceptable weld.1.5 Task is completed without causing damage to the tools, equipment and materials and injury to self and others.
2. Apply quality standards to welding work	<ul style="list-style-type: none">2.1 Welding machine accessories and consumables are identified from job requirements, welding procedures and specifications.2.2 Welding power source accessories and consumables are set up in accordance with job requirements, welding procedures and specifications and/or manufacturer's instructions.2.3 Spools firmly locked to holder, rollers adjusted to correct tension.2.4 Flux recovery equipment installed where needed.2.5 Flux oven /heaters installed where needed.
3. Set up welding positioners, jigs and fixtures	<ul style="list-style-type: none">3.1 Braces, stiffeners, rails and other jigs are provided and in conformity with job requirements.3.2 Work items/materials are protected from strong winds, drafts and rainfall.
4. Set up pre-heating tools/ equipment as required	<ul style="list-style-type: none">4.1 Pre-heating equipment appropriate to the job requirement and specifications.4.2 Equipment operated in conformance with the manufacturer's instructions.

Evidence guide

To demonstrate competency in this unit the candidate must meet performance criteria and skills and knowledge requirements. The candidate must be able to:

- accessible and convenient location;
- pre-heating equipment within allotted time and in accordance with OS&H rules; and
- set up and installed welding power source, accessories, welding positioners, jigs and fixtures.

Critical skills and essential knowledge

- Basic electricity
- Communication skills
- Fine tuning of welding power source and accessories for optimum operation
- Minor repairs/maintenance of welding power source and accessories
- Operating capacity of welding machine and accessories
- Power requirement and capacity of welding power source and its accessories
- Recognizing operational abnormalities and faults in welding power source and accessories
- Setting and operating welding power source and accessories
- Shop safety, housekeeping and 5S procedures
- Types and uses of welding equipment and accessories
- Use of PPE

Range statement**Welding power source**

Types, kind and uses of:

- Alternating current (AC)
- Constant current
- Constant voltage
- Direct current (DC)

Polarity

Application and uses:

- Alternating current
- Direct current – electrode positive (reverse polarity)
- Direct current – electrode negative (straight polarity)

Accessories contact tips:

- Flux recovery equipment
- Nozzle
- Tractor rollers and rails
- Wire feeders and wire cutter

The following resources must be provided:

- Appropriately ventilated work area/shop with welding facilities, power source and accessories
- PPE

Competency may be assessed through a combination of:

- Observation/evaluation
- Oral questioning

Competency is to be assessed while a task is being undertaken in the workplace or in a simulated workplace setting.

WS-A11 Fit up weld materials

Unit details

Functional area A	Core competencies
Unit title	Fit up weld materials
Unit code	WS-A11

Description

This unit covers the competencies required to joint fit up base materials for welding.

Elements of competency	Performance criteria
------------------------	----------------------

1. Perform tack welding	1.1 Tack welding performed in accordance with the requirements of WPS and client's specifications. 1.2 Tack welding is performed in a manner that is visually and dimensionally acceptable . 1.3 Backing plate, stiffener, running plate, end of plate is installed as required. 1.4 Joints are free from rust, paints, grease and other foreign materials prior to fit up or tack weld.
2. Check gap and alignment to welding work	2.1 Root gap is performed in accordance with the requirements of WPS. 2.2 Alignment is within the range of acceptability of code and standard. 2.3 Fitted materials are visually free from distortion on.
3. Set up welding positioner	3.1 Weld part is positioned and secured according to the requirements.

Evidence guide

To demonstrate competency in this unit the candidate must meet performance criteria and skills and knowledge requirements. The candidate must be able to:

- check gap, alignment and dimensional;
- perform tack welding; and
- set up welding positioners.

Critical skills and essential knowledge

- Applying weld techniques
- Communication skills
- Drawing and plan interpretation
- Fit up
- Fit up tolerances
- Handling welding materials and consumables
- How to read and follow the WPS
- Identification of weld defects
- Measurements
- Measuring skills
- Observance of safety procedures

- Pre-heating technique
- Rectifying weld defects
- Setting up of jigs, fixtures, clamps
- Welding codes (symbols)
- Welding materials and consumables

Range statement

Tack welding

Dimension of tacking length and size:

- Tack interval point and area

Visually and dimensionally acceptable tack welds:

- Contribute to quality system Fully fused to the base metal
- Evenly distributed.
- Free from defects and discontinuities

Backing materials:

- Steel, Copper, Ceramic, Gas

Root gap:

- Electrode/Filler size
- Welding process application
- WPS requirements

Alignment:

- Codes and specifications
- Client requirements
- Welding sequences (backstepping)

The following resources must be provided:

- Appropriately ventilated work area/shop with welding facilities, machines and accessories
- Drawing and plans
- PPE

Competency may be assessed through a combination of:

- Observation/evaluation
- Oral questioning

Competency is to be assessed while a task is being undertaken in the workplace or in a simulated workplace setting.

WS-A12 Repair weld

Unit details

Functional area A **Core competencies**

Unit title **Repair weld**

Unit code **WS-A12**

Descriptor

This unit covers the competencies required to repair weld.

Elements of competency	Performance criteria
------------------------	----------------------

- | | |
|--------------------------------|--|
| 1. Mark/locate weld defects | 1.1 Weld defects are located and marked according to recommended practice. |
| 2. Prepare tools and equipment | 2.1 Tools and equipment are prepared based on repair procedure approved by the client.
2.2 Task is performed in accordance with repair procedure and safety procedure. |
| 3. Remove defects | 3.1 Weld defects are removed/excavated in accordance with approved industry procedures or client requirements.
3.2 Removal of non-defective welds is minimized and cleaned.
3.3 Welding inspector is informed to verify the extent of defect removal.
3.4 Task is performed in accordance with company or industry requirement and safety procedure. |
| 4. Perform re-welding | 4.1 Re-welding is performed in accordance with approved repair procedure.
4.2 Task is performed in accordance with company or industry requirement and safety procedure.
4.3 Re-welding is performed with no new weld defects or damages occurred.
4.4 Weld is visually checked after re-welding for acceptability. |

Evidence guide

To demonstrate competency in this unit the candidate must meet performance criteria and skills and knowledge requirements. The candidate must be able to:

- repair weld defects within the approved weld repair procedures.

Critical skills and essential knowledge

- Applying correct weld techniques
- Causes and identification of weld defects
- Communication skills
- Handling materials and consumables
- Handling welding tools and equipment
- Identifying weld defects
- Materials and consumables
- Measuring skills

- Operating weld defect removal tools and equipment
- Rectifying weld defects
- Repair techniques
- Selection and use of PPE
- Use of weld repair procedures
- Welding codes (symbols)
- Welding equipment and tools

Range statement

Weld defects:

- Burn through
- Concavity/convexity
- Cracks
- Crater cracks
- Degree of reinforcement
- Excess/incomplete penetration
- Lack of fusion (tie-in)
- Misalignment
- Overlap
- Pinholes/blowholes
- Porosity
- Solid inclusion
- Under fill
- Undercut

Tools and equipment:

- Barriers
- Chipping hammer
- Extension cord and lightings
- Files
- Gouging power source and accessories
- Portable grinding wheel
- Portable oven
- Welding power source and accessories

Defects removed by:

- Arc air carbon gouging
- Cutting (mechanical, gas)
- Grinding
- Selection of the repair method based on type of failures, possible fabrication of new or replacement parts, weld type and location, distortion control

The following resources must be provided:

- PPE
- Relevant documentation such as WPS and approved repair procedure
- Supplies and materials
- Weld defect removal and repair facilities and equipment

Competency may be assessed through a combination of:

- Observation and interview
- Performance record

Competency is to be assessed while a task is being undertaken in the workplace or in a simulated.

Functional area B: Perform fillet and groove welding on carbon steel plate

WS-B1 Weld carbon steel plates using FCAW

Unit details

Functional area B	Functional area B
Unit title	Weld carbon steel plates using FCAW
Unit code	WS-B1

Descriptor

This unit covers the skills, knowledge and attitudes in welding carbon steel plates using FCAW process.

Elements of competency	Performance criteria
1. Prepare power source, accessories and position	1.1 Welding power source is adjusted to fit to the purpose. 1.2 Accessories are prepared and welding position is correct following approved WPS .
2. Perform root pass	2.1 Root pass is performed in accordance with approved WPS. 2.2 Task is performed in accordance with approved WPS and safety procedure. 2.3 Root pass is cleaned and free from defect. 2.4 Weld is visually checked for discontinuities and acceptable in accordance with applicable codes or standards. It is repaired as required.
3. Weld filling passes	3. Filling passes are performed in accordance with approved WPS and use a run or multi run technique. 3.1 Run or multi run is cleaned and free from defect.
4. Perform capping	4.1 Capping is performed in accordance with approved WPS and run or multi run technique. 4.2 Weld is visually checked for discontinuities and acceptable in accordance with applicable codes or standards. 4.3 Defects are repaired as required.

Evidence guide

To demonstrate competency in this unit the candidate must meet performance criteria and skills and knowledge requirements. The candidate must be able to:

- weld carbon steel plates using FCAW process in 2G and 3G positions to acceptable standard following the approved WPS.

Critical skills and essential knowledge

- Applying weld techniques using FCAW techniques

- Basic mathematics (Multiplication Division Addition Subtraction: MDAS)
- Communication skills
- Consumables: flux-cored electrode (self-shielded/gas shielded), shielding gases
- Drawing/Plan/WPS
- FCAW parameter adjustment
- FCAW welding accessories
- Handling welding consumables
- Handling welding tools and equipment
- Measuring skills
- Rectifying weld defects
- Welding codes (symbols)
- Welding power source, and tools

Range statement

WPS requirements:

- Backing material (weld metal, backing plate and ceramics)
- Cleaning method
- Joint preparation and fit up
- Parameter setting (polarity, amperage or wire feed speed, voltage, gas pressure or flow rate)
- Run and multi run techniques
- Temperature condition if necessary
- Thickness: 1.6mm – unlimited (plate)
- Travel speed
- Type and size of electrode wire
- Type of material: Carbon steel
- Welding positions: 1F- 4F, 1G - 3G
- Welding power source and accessories: rectifier transformer type, wire feeder

Defects:

- Arc strike
- Burn through
- Concavity/convexity
- Cracks
- Crater cracks
- Face/root reinforcement
- Lack of fusion/penetration
- Misalignment
- Overlap
- Pinholes/blowholes
- Porosity
- Solid inclusion
- Spatters
- Under fill
- Undercut

The following resources must be provided:

- Appropriately ventilated work area/shop with welding facilities and equipment
- FCAW facilities and equipment
- PPE
- Relevant documentation such as WPS and working drawing
- Stand by fire fighting equipment
- Supplies and materials

Competency may be assessed through a combination of:

- Demonstration and interview
- Observation and interview
- Portfolio (work records, certificates, awards, endorsements, etc.)
- Written test

Competency is to be assessed while a task is being undertaken in the workplace or in a simulated workplace setting.

WS-B2 Weld carbon steel plates using GMAW

Unit details

Functional area B

Functional area B

Unit title

Weld carbon steel plates using GMAW

Unit code

WS-B2

Descriptor

This unit covers the skills, knowledge and attitudes in welding carbon steel plates using GMAW.

Elements of competency

Performance criteria

- | | |
|---|---|
| 1. Prepare power source, accessories and position | 1.1 Welding power source is adjusted to fit to the purpose.
1.2 Accessories are prepared and welding position is correct following approved WPS . |
| 2. Perform root pass | 2.1 Root pass is performed in accordance with approved WPS.
2.2 Task is performed in accordance with approved WPS and safety procedure.
2.3 Root pass is cleaned and free from defect.
2.4 Weld is visually checked for discontinuities and acceptable in accordance with applicable codes or standards. It is repaired as required. |
| 3. Weld filling passes | 3.1 Filling passes are performed in accordance with approved WPS and use a run or multi run technique.
3.2 Run or multi run is cleaned and free from defect. |
| 4. Perform capping | 4.1 Capping is performed in accordance with approved WPS and run or multi run technique.
4.2 Weld is visually checked for discontinuities and acceptable in accordance with applicable codes or standards.
4.3 Defects are repaired as required. |

Evidence guide

To demonstrate competency in this unit the candidate must meet performance criteria and skills and knowledge requirements. The candidate must be able to:

- weld carbon steel plates using GMAW process in 2G and 3G positions to acceptable standard following the approved WPS

Critical skills and essential knowledge

- Acceptance of weld defects
- Applying weld techniques
- Basic mathematics (Multiplication Division Addition Subtraction: MDAS)
- Communication skills
- Consumables: electrode wire, shielding gases or mixed gases
- Drawing/Plan/WPS
- Environmental effect

- GMAW equipment malfunctions
- Handling welding materials and consumables
- Handling welding tools and equipment
- Measuring skills
- Modes of metal transfer
- Rectifying weld defects
- Welding codes (symbols)
- Welding equipment and tools: GMAW welding accessories

Range statement

WPS requirements:

- Backing material (weld metal, backing plate or ceramics)
- Cleaning method
- Joint preparation and fit up
- Mode of metal transfer: short-circuiting, globular, spray, pulsating
- Nozzle size
- Run and multi run techniques
- Temperature conditions if necessary
- Type and size of electrode wire
- Type of material: carbon steel
- Wall thickness: 1.6mm – unlimited (plate)
- Welding accessories: rectifier transformer type, wire feeder
- Welding parameter (polarity, amperage, voltage, wire feed speed and travel speed)
- Welding positions: 1F- 4F, 1G - 3G

Defects:

- Arc strike
- Burn through
- Concavity/convexity
- Cracks
- Crater cracks
- Face/root reinforcement
- Lack of fusion/penetration
- Misalignment
- Overlap
- Pinholes/blowholes
- Porosity
- Spatters
- Undercut
- Underfill

The following resources must be provided:

- Appropriately ventilated work area/shop with welding facilities and equipment
- GMAW facilities and equipment
- PPE
- Relevant documentation such as WPS and working drawing
- Stand by fire-fighting equipment
- Supplies and materials

Competency may be assessed through a combination of:

- Demonstration and interview
- Observation and interview
- Portfolio (work records, certificates, awards, endorsements, etc.)
- Written test

Competency is to be assessed while a task is being undertaken in the workplace or in a simulated workplace setting.

WS-B3 Weld carbon steel plates using GTAW

Unit details

Functional area B

Functional area B

Unit title

Weld carbon steel plates using GTAW

Unit code

WS-B3

Descriptor

This unit covers the skills, knowledge and attitudes in welding carbon steel plates using GTAW process.

Elements of competency

Performance criteria

- | | |
|---|---|
| 1. Prepare power source, accessories and position | 1.1 Welding power source is adjusted to fit to the purpose.
1.2 Accessories are prepared and welding position is correct following approved WPS . |
| 2. Perform root pass | 2.1 Root pass is performed in accordance with approved WPS.
2.2 Task is performed in accordance with approved WPS and safety procedure.
2.3 Root pass is cleaned and free from defect.
2.4 Weld is visually checked for discontinuities and acceptable in accordance with applicable codes or standards. It is repaired as required. |
| 3. Weld filling passes | 4. Filling passes are performed in accordance with approved WPS and use a run or multi run technique.
4.1 Run or multi run is cleaned and free from defect. |
| 5. Perform capping | 5.1 Capping is performed in accordance with approved WPS and run or multi run technique.
5.2 Weld is visually checked for discontinuities and acceptable in accordance with applicable codes or standards.
5.3 Defects are repaired as required. |

Evidence guide

To demonstrate competency in this unit the candidate must meet performance criteria and skills and knowledge requirements. The candidate must be able to:

- weld carbon steel plates using GTAW process in 2G and 3G positions to acceptable standard following the approved WPS.

Critical skills and essential knowledge

- Applying weld techniques for GTAW
- Basic mathematics (Multiplication Division Addition Subtraction: MDAS)
- Cleaning method
- Communication skills
- Consumables: flux-cored electrode (self-shielded/gas shielded), shielding gases
- Drawing/plan/WPS
- GTAW welding accessories

- Handling welding materials, consumables and gas flow rate
- Handling welding tools and equipment
- Measuring skills
- Rectifying weld defects
- Welding codes (symbols)
- Welding power source, and tools

Range statement

WPS requirements:

- Cleaning method
- Consumables: filler rod (diameter), tungsten rod (type and size), shielding gas (argon and other available inert gas)
- Joint preparation
- Parameter setting (polarity, amperage, voltage)
- Shielding gas flow rate
- Temperature conditions if necessary
- Travel speed
- Type of material: carbon steel
- Wall thickness: 1.6 mm and above
- Welding accessories
- Welding positions: 1F-4F, 1G-4G

Defects:

- Burn through
- Concavity/convexity
- Cracks
- Crater cracks
- Face/root reinforcement
- Lack of fusion/penetration
- Misalignment
- Overlap
- Pinholes/blowholes
- Porosity
- Tungsten inclusion
- Under fill
- Undercut

The following resources must be provided:

- Appropriately ventilated work area/shop with welding facilities and equipment
- Fumes extractor
- GTAW facilities and equipment
- PPE
- Relevant documentation such as WPS and working drawing
- Stand by firefighting equipment
- Supplies and materials

Competency may be assessed through a combination of:

- Demonstration and interview
- Observation and interview
- Portfolio (work records, certificates, awards, endorsements, etc.)
- Written test

Competency is to be assessed while a task is being undertaken in the workplace or in a simulated workplace setting.

WS-B4 Weld plates using SAW

Unit details

Functional area B	Functional area B
Unit title	Weld plates using SAW
Unit code	WS-B24

Descriptor

This unit covers the skills, knowledge and attitudes required in setting up and operating automatic/mechanic welding equipment used in welding carbon steel plates.

Elements of competency Performance criteria

- | | |
|---|---|
| 1. Prepare power source, accessories and position | 1.1 Welding power source is adjusted to fit to the purpose.
1.2 Accessories are prepared and welding position is correct following approved WPS . |
| 2. Perform root pass | 2.1 Root pass is performed in accordance with approved WPS.
2.2 Task is performed in accordance with approved WPS and safety procedure.
2.3 Root pass is cleaned and free from defect.
2.4 Weld is visually checked for discontinuities and acceptable in accordance with applicable codes or standards. It is repaired as required. |
| 3. Weld filling passes | 3.1 Filling passes are performed in accordance with approved WPS and use a run or multi run technique.
3.2 Run or multi run is cleaned and free from defect. |
| 4. Perform capping | 4.1 Capping is performed in accordance with approved WPS and run or multi run technique.
4.2 Weld is visually checked for discontinuities and acceptable in accordance with applicable codes or standards.
4.3 Defects are repaired as required. |

Evidence guide

To demonstrate competency in this unit the candidate must meet performance criteria and skills and knowledge requirements. The candidate must be able to:

- set up and operated automatic welding equipment used in welding carbon steel plates in 1F, 2F and 1G positions to acceptable standard following the approved WPS.

Critical skills and essential knowledge

- Basic mathematics (Multiplication Division Addition Subtraction: MDAS)
- Communication skills
- Drawing/plan/WPS
- Flux recovery techniques
- Handling welding materials and consumables
- Handling welding tools and equipment
- Identification of weld defects

- Materials and consumables (electrodes wire, base metal, flux)
- Measuring skills
- Rectifying weld defects
- SAW equipment and tools (wire feeder, flux hopper, flux recovery, motor and rail, and control panel)
- Setting electrode wire feeder
- Setting up and operating SAW equipment and accessories
- Setting weld plates and arc length
- Setting welding parameters (current, voltage and travel speed)
- Welding codes and symbols

Range statement

WPS requirements:

- Cleaning method
- Joint preparation
- Material thickness: 12.7mm (1/2") and above
- Parameter setting (polarity, amperage, voltage)
- Preheating requirement (optional)
- Temperature conditions if necessary
- Travel speed
- Type and size of electrode wire
- Type of material: carbon steel, backing materials (weld metal, plate or ceramics), types of fluxes
- Welding equipment: gen-set, rectifier, wire feeder, flux hopper, run-on/run-off plates, flux recovery
- Welding positions: 1F and 2F, 1G

Defects:

- Burn-through
- Concavity/convexity
- Cracks
- Crater cracks
- Face/root reinforcement
- Lack of fusion/penetration
- Misalignment
- Overlap
- Pinholes/blowholes
- Porosity
- Slag and solid inclusion
- Spatters
- Under fill
- Undercut

The following resources must be provided:

- Materials and consumables
- PPE
- Relevant documentation such as WPS and working drawing
- SAW facilities and equipment
- Stand-by fire-fighting equipment

Competency may be assessed through a combination of:

- Demonstration and interview
- Observation and interview
- Portfolio (work records, certificates, awards, endorsements, etc.)

- Written test

Competency is to be assessed while a task is being undertaken in the workplace or in a simulated workplace setting.

WS-B5 Weld carbon steel plates using SMAW

Unit details

Functional area B

Functional area B

Unit title

Weld carbon steel plates using SMAW

Unit code

WS-B5

Descriptor

This unit covers the skills, knowledge and attitudes required in setting up and operating automatic/mechanic welding equipment used in welding carbon steel plates using SMAW process.

Elements of competency

Performance criteria

- | | |
|---|---|
| 1. Prepare power source, accessories and position | 1.1 Welding power source is adjusted to fit to the purpose.
1.2 Accessories are prepared and welding position is correct following approved WPS . |
| 2. Perform root pass | 2.1 Root pass is performed in accordance with approved WPS.
2.2 Task is performed in accordance with approved WPS and safety procedure.
2.3 Root pass is cleaned and free from defect.
2.4 Weld is visually checked for discontinuities and acceptable in accordance with applicable codes or standards. It is repaired as required. |
| 3. Weld filling passes | 3.1 Filling passes are performed in accordance with approved WPS and use a run or multi run technique.
3.2 Run or multi run is cleaned and free from defect. |
| 4. Perform capping | 4.1 Capping is performed in accordance with approved WPS and run or multi run technique.
4.2 Weld is visually checked for discontinuities and acceptable in accordance with applicable codes or standards.
4.3 Defects are repaired as required. |

Evidence guide

To demonstrate competency in this unit the candidate must meet performance criteria and skills and knowledge requirements. The candidate must be able to:

- weld carbon steel plates in 2G and 3G positions to acceptable standard following the approved WPS.

Critical skills and essential knowledge

- Applying weld techniques
- Basic mathematics (multiplication, division, addition and subtraction)
- Communication skills
- Drawing/plan/WPS
- Electrode heating and warming (low hydrogen type)
- Handling welding materials and consumables
- Handling welding tools and equipment

- Identification of weld defects
- Materials and consumables (electrodes type, base metal)
- Measuring skills
- Parameter setting
- Rectifying weld defects
- Welding codes (symbol)
- Welding equipment and tools

Range statement

WPS requirements:

- Cleaning method
- Joint preparation
- Material thickness: 1.6mm – unlimited (plate)
- Parameter setting (polarity, amperage, voltage)
- Preheating/post weld heating treatment (PWHT)
- Temperature conditions if necessary
- Travel speed
- Type and size of electrode
- Type of material: carbon steel
- Welding positions: 1F, 2F, 3F, 4F, 1G, 2G, 3G

Defects:

- Arc strike
- Burn through
- Concavity/convexity
- Cracks
- Crater cracks
- Face/root reinforcement
- Lack of fusion/penetration
- Misalignment
- Overlap
- Pinholes/blowholes
- Porosity
- Slag inclusion
- Spatters
- Under fill
- Undercut

The following resources must be provided:

- Appropriately ventilated work area/shop with welding facilities and equipment
- PPE
- Relevant documentation such as WPS and working drawing
- Supplies and materials

Competency may be assessed through a combination of:

- Demonstration and interview
- Observation and interview
- Portfolio (work records, certificates, awards, endorsements, etc)
- Written test

Competency is to be assessed while a task is being undertaken in the workplace or in a simulated workplace setting.

Functional area C: Performing groove welding on carbon steel pipe

WS-C1 Weld carbon steel pipes using FCAW

Unit details

Functional area C

Functional area C

Unit title

Weld carbon steel pipes using FCAW

Unit code

WS-C1

Descriptor

This unit covers the skills, knowledge and attitudes in welding carbon steel pipes using FCAW processes.

Elements of competency

Performance criteria

- | | |
|---|---|
| 1. Prepare power source, accessories and position | 1.1 Welding power source is adjusted to fit to the purpose.
1.2 Accessories are prepared and welding position is correct following approved WPS . |
| 2. Perform root pass | 2.1 Root pass is performed in accordance with approved WPS.
2.2 Task is performed in accordance with approved WPS and safety procedure.
2.3 Root pass is cleaned and free from defect.
2.4 Weld is visually checked for discontinuities and acceptable in accordance with applicable codes or standards. It is repaired as required. |
| 3. Weld filling passes | 3.1 Filling passes are performed in accordance with approved WPS and use a run or multi run technique.
3.2 Run or multi run is cleaned and free from defect. |
| 4. Perform capping | 4.1 Capping is performed in accordance with approved WPS and run or multi run technique.
4.2 Weld is visually checked for discontinuities and acceptable in accordance with applicable codes or standards.
4.3 Defects are repaired as required. |

Evidence guide

To demonstrate competency in this unit the candidate must meet performance criteria and skills and knowledge requirements. The candidate must be able to:

- weld carbon steel pipes using FCAW in 2G, 5G and/or 6G positions to acceptable standard following the approved WPS.

Critical skills and essential knowledge

- Applying weld techniques using FCAW techniques
- Basic mathematics (Multiplication Division Addition Subtraction: MDAS)

- Communication skills
- Drawing/plan/WPS
- FCAW welding accessories
- Handling welding materials, consumables and gas flow rate
- Handling welding tools and equipment
- Materials and consumables: base metal, flux-cored electrode (self-shielded/gas shielded), shielding gases
- Measuring skills
- Rectifying weld defects
- Weld defects and FCAW equipment malfunctions
- Welding codes (symbols)
- Welding equipment and tools

Range statement

WPS requirements:

- Backing material (weld metal, backing plate and ceramics)
- Cleaning method
- Joint preparation
- Parameter setting (wire feed speed, voltage, voltage, gas flow rate)
- Temperature conditions if necessary
- Thickness: 1.6mm and above
- Travel speed
- Type and size of flux core electrode
- Type of material: carbon steel, diameter 25.4mm (1inch) and above
- Welding accessories: rectifier transformer type, wire feeder
- Welding positions: 2G and 5G and/or 6G

Defects:

- Arc strike
- Burn through
- Concavity/convexity
- Cracks
- Crater cracks
- Face/root reinforcement
- Flux and solid material inclusion
- Lack of fusion/penetration
- Misalignment
- Overlap
- Pinholes/blowholes
- Porosity
- Spatters
- Under fill
- Undercut

The following resources must be provided:

- Appropriately ventilated work area/shop with welding facilities and equipment
- FCAW facilities and equipment
- PPE
- Relevant documentation such as WPS and working drawing
- Stand by firefighting equipment
- Supplies and materials

Competency may be assessed through a combination of:

- Demonstration and interview
- Observation and interview
- Portfolio (work records, certificates, awards, endorsements, etc.)
- Written test

Competency is to be assessed while a task is being undertaken in the workplace or in a simulated workplace setting.

WS-C2 Weld carbon steel pipes using GMAW

Unit details

Functional area C	Functional area C
Unit title	Weld carbon steel pipes using GMAW
Unit code	WS-C2

Descriptor

This unit covers the skills, knowledge and attitudes in welding carbon steel pipes using GMAW processes.

Elements of competency	Performance criteria
1. Prepare power source, accessories and position	1.1 Welding power source is adjusted to fit to the purpose. 1.2 Accessories are prepared and welding position is correct following approved WPS .
2. Perform root pass	2.1 Root pass is performed in accordance with approved WPS. 2.2 Task is performed in accordance with approved WPS and safety procedure. 2.3 Root pass is cleaned and free from defect. 2.4 Weld is visually checked for discontinuities and acceptable in accordance with applicable codes or standards. It is repaired as required.
3. Weld filling passes	3.1 Filling passes are performed in accordance with approved WPS and use a run or multi run technique. 3.2 Run or multi run is cleaned and free from defect.
4. Perform capping	4.1 Capping is performed in accordance with approved WPS and run or multi run technique. 4.2 Weld is visually checked for discontinuities and acceptable in accordance with applicable codes or standards. 4.3 Defects are repaired as required.

Evidence guide

To demonstrate competency in this unit the candidate must meet performance criteria and skills and knowledge requirements. The candidate must be able to:

- weld carbon steel pipes using GMAW process in 2G and 5G and/or 6G positions to acceptable standards following the approved WPS.

Critical skills and essential knowledge

- Applying weld techniques for GTAW
- Basic mathematics (Multiplication Division Addition Subtraction: MDAS)
- Communication skills
- Drawing/plan/WPS
- Handling welding materials and consumables and gas flow rate
- Handling welding tools and equipment

- Materials and consumables: filler rod, tungsten rod, shielding gas, base metal
- Measuring skills
- Rectifying weld defects
- Weld defects
- Welding codes (symbols)
- Welding equipment and tools

Range statement

WPS requirements:

- Cleaning method
- Consumables: filler rod (diameter), tungsten rod (type and design), shielding gas (argon and other available inert gas)
- Current setting (polarity, amperage, voltage)
- Joint preparation
- Shielding gas flow rate
- Temperature conditions if necessary
- Travel speed
- Type of material: carbon or mild steel, diameter 25.4 mm (1 inch) and above
- Wall thickness: 1.6mm and above
- Welding accessories
- Welding positions: 2G and 5G and/or 6G

Defects:

- Burn through
- Concavity/convexity
- Cracks
- Crater cracks
- Face/root reinforcement
- Lack of fusion/penetration pinholes/blowholes
- Misalignment
- Overlap
- Porosity
- Tungsten inclusion
- Under fill
- Undercut

The following resources must be provided:

- Appropriately ventilated work area/shop with welding facilities and equipment
- Fumes extractor
- GTAW facilities and equipment
- PPE
- Relevant documentation such as WPS and working drawing
- Stand by firefighting equipment
- Supplies and materials

Competency may be assessed through a combination of:

- Demonstration and interview
- Observation and interview
- Portfolio (work records, certificates, awards, endorsements, etc.)
- Written test

Competency is to be assessed while a task is being undertaken in the workplace or in a simulated workplace setting.

WS-C3 Weld carbon steel pipes using GTAW

Unit details

Functional area C

Functional area C

Unit title

Weld carbon steel pipes using GTAW

Unit code

WS-C3

Descriptor

This unit covers the skills, knowledge and attitudes in welding carbon steel plates using GTAW processes.

Elements of competency

Performance criteria

- | | |
|---|---|
| 1. Prepare power source, accessories and position | 1.1 Welding power source is adjusted to fit to the purpose.
1.2 Accessories are prepared and welding position is correct following approved WPS . |
| 2. Perform root pass | 2.1 Root pass is performed in accordance with approved WPS.
2.2 Task is performed in accordance with approved WPS and safety procedure.
2.3 Root pass is cleaned and free from defect.
2.4 Weld is visually checked for discontinuities and acceptable in accordance with applicable codes or standards. It is repaired as required. |
| 3. Weld filling passes | 3.1 Filling passes are performed in accordance with approved WPS and use a run or multi run technique.
3.2 Run or multi run is cleaned and free from defect. |
| 4. Perform capping | 4.1 Capping is performed in accordance with approved WPS and run or multi run technique.
4.2 Weld is visually checked for discontinuities and acceptable in accordance with applicable codes or standards.
4.3 Defects are repaired as required. |

Evidence guide

To demonstrate competency in this unit the candidate must meet performance criteria and skills and knowledge requirements. The candidate must be able to:

- weld carbon steel plates using GTAW process in 2G and 3G positions to acceptable standard following the approved WPS.

Critical skills and essential knowledge

- Applying weld techniques for GTAW
- Basic mathematics (Multiplication Division Addition Subtraction: MDAS)
- Cleaning method
- Communication skills
- Consumables: flux-cored electrode (self-shielded/gas shielded), shielding gases
- Drawing/plan/WPS
- GTAW welding accessories

- Handling welding materials, consumables and gas flow rate
- Handling welding tools and equipment
- Measuring skills
- Rectifying weld defects
- Welding codes (symbols)
- Welding power source, and tools

Range statement

WPS requirements:

- Cleaning method
- Consumables: filler rod (diameter), tungsten rod (type and size), shielding gas (argon and other available inert gas)
- Joint preparation
- Parameter setting (polarity, amperage, voltage)
- Shielding gas flow rate
- Temperature conditions if necessary
- Travel speed
- Type of material: carbon steel
- Wall thickness: 1.6 mm and above
- Welding accessories
- Welding positions: 1F-4F, 1G-4G

Defects:

- Burn Through
- Concavity/convexity
- Cracks
- Crater cracks
- Face/root reinforcement
- Lack of fusion/penetration
- Misalignment
- Overlap
- Pinholes/blowholes
- Porosity
- Tungsten inclusion
- Under fill
- Undercut

The following resources must be provided:

- Appropriately ventilated work area/shop with welding facilities and equipment
- Fumes extractor
- GTAW facilities and equipment
- PPE
- Relevant documentation such as WPS and working drawing
- Stand by firefighting equipment
- Supplies and materials

Competency may be assessed through a combination of:

- Demonstration and interview
- Observation and interview
- Portfolio (work records, certificates, awards, endorsements, etc.)
- Written test

Competency to be assessed while a task is being undertaken in the workplace or in a simulated workplace setting.

WS-C4 Weld carbon steel pipes using SAW

Unit details

Functional area C

Functional area C

Unit title

Weld carbon steel pipes using SAW

Unit code

WS-C4

Descriptor

This unit covers the skills, knowledge and attitudes required in setting up and operating automatic/mechanic welding equipment used in welding carbon steel pipes

Elements of competency

Performance criteria

- | | |
|---|---|
| 1. Prepare power source, accessories and position | 1.1 Welding power source is adjusted to fit to the purpose.
1.2 Accessories are prepared and welding position is correct following approved WPS . |
| 2. Perform root pass | 2.1 Root pass is performed in accordance with approved WPS.
2.2 Task is performed in accordance with approved WPS and safety procedure.
2.3 Root pass is cleaned and free from defect.
2.4 Weld is visually checked for discontinuities and acceptable in accordance with applicable codes or standards. It is repaired as required. |
| 3. Weld filling passes | 3.1 Filling passes are performed in accordance with approved WPS and use a run or multi run technique.
3.2 Run or multi run is cleaned and free from defect. |
| 4. Perform capping | 4.1 Capping is performed in accordance with approved WPS and run or multi run technique.
4.2 Weld is visually checked for discontinuities and acceptable in accordance with applicable codes or standards.
4.3 Defects are repaired as required. |

Evidence guide

To demonstrate competency in this unit the candidate must meet performance criteria and skills and knowledge requirements. The candidate must be able to:

- set up and operate automatic/mechanical welding equipment used in welding carbon steel pipes in 1G position to acceptable standard following the approved WPS.

Critical skills and essential knowledge

- Communication skills
- Drawing/plan/WPS
- Flux recovery techniques
- Handling welding materials and consumables
- Handling welding tools and equipment
- Materials and consumables (electrodes wire, base metal, flux)
- Measuring skills

- Rectifying weld defects
- SAW equipment and tools (wire feeder, Flux hopper, flux recovery, motor and rail, and control panel)
- Setting electrode wire feeder
- Setting up and operating SAW equipment and accessories
- Setting weld plates and arc length
- Setting welding parameters (current, voltage and travel speed)

Range statement

WPS requirements:

- Welding positions: 1G rotated
- Type of material: carbon steel, backing materials (weld metal, ring and ceramics), types of fluxes
- Type and size of electrode wire
- Travel speed
- Parameter setting (polarity, amperage, voltage)
- Preheating requirement (optional)
- Backing material (weld metal, backing plate and ceramics)
- Welding accessories: gen-set, rectifier, wire feeder, flux hopper, flux recovery
- Joint preparation
- Cleaning method
- Temperature condition if necessary
- Wall thickness: 12mm (1/2") and above

Defects:

- Burn through
- Concavity/convexity
- Cracks
- Crater cracks
- Face/root reinforcement
- Lack of fusion/penetration
- Misalignment
- Overlap
- Pinholes/blowholes
- Porosity
- Slag inclusion
- Spatters
- Under fill
- Undercut

The following resources must be provided:

- Appropriately ventilated work area/shop with welding facilities and equipment
- PPE
- Relevant documentation such as WPS and working drawing
- SAW facilities and equipment
- Stand by fire fighting equipment
- Supplies and materials

Competency may be assessed through a combination of:

- Demonstration and interview
- Observation and interview
- Portfolio (work records, certificates, awards, endorsements, etc.)
- Written test

Competency is to be assessed while a task is being undertaken in the workplace or in a simulated workplace setting.

Functional area D: Performing fillet and groove welding on carbon steel plate and tubes or pipes

WS-D1 Perform gas welding in carbon steel plates and tubes

Unit details

Functional area D	Functional area D
Unit title	Perform gas welding in carbon steel plates and tubes
Unit code	WS-D1

Descriptor

This unit covers the skills, knowledge and attitudes in gas welding carbon steel plates and tubes.

Elements of competency Performance criteria

1. Prepare power source, accessories and position	1.1 Select the proper burner, the desired burning gas and the required pressures/flows. 1.2 Adjust type of flame to be used for welding. 1.3 Gas welding equipment and accessories are prepared and welding position is correct following approved WPS .
2. Perform surface preparation	2.1 Surface preparation is performed in accordance with acceptable cleaning procedure and standards.
3. Perform gas welding	3.1 Weld pass is performed in accordance with WPS. 3.2 Weld is visually checked for discontinuities and acceptable in accordance with applicable codes or standards are repaired as required.
4. Clean weld pass	4.1 Weld pass is cleaned and free from defects and discontinuities. 4.2 Task is performed in accordance with company or industry requirements and safety procedure.

Evidence guide

To demonstrate competency in this unit the candidate must meet performance criteria and skills and knowledge requirements. The candidate must be able to:

- perform gas welding of carbon steel plates and tubes to acceptable standard following the approved WPS.

Critical skills and essential knowledge

- Applying weld techniques (forward and backward)
- Basic mathematics (Multiplication Division Addition Subtraction: MDAS)
- Communication skills
- Drawing/plan/WPS
- Gas welding equipment and tools
- Handling gas welding materials and consumables
- Handling welding tools, gas and equipment

- Identification of weld defects
- Materials and consumables: filler rod, oxy- acetylene, base metal, etc.)
- Measuring skills
- Rectifying weld defects
- Types of flame
- Welding codes (symbols)

Range statement

Material thickness:

- 1.6mm - 3mm.

Gas welding equipment and accessories:

- Filler rod/consumable insert
- Gas welding accessories (hoses, regulators/flow meters, lighter and cylinder gas **tanks**, flash back arrestor)
- Heating torches
- Portable grinder
- PPE (goggles, lenses, mask, apron, gloves, etc)
- Steel brush
- Welding tips as required size
- Wrenches and chipping hammer.

Tanks or cylinders:

- Oxygen/acetylene.

WPS:

- Cleaning method
- Material type: carbon steel, filler rod
- Materials thickness
- Type of flame
- Type of joint
- Welding position: flat, horizontal, vertical and overhead.

Standards:

- Client standards and applicable codes.

Cleaning procedure:

- Chemical (solvent, thinners, acids, etc.)
- Manual (hand filing, sanding, chipping, etc.)
- Mechanical (grinding, brushing, etc.).

Defects:

- Burn through
- Concavity/convexity
- Cracks
- Crater cracks
- Face and root reinforcement
- Lack of fusion/penetration
- Misalignment
- Overlap
- Pinholes/blowholes
- Porosity
- Under fill
- Undercut.

The following resources must be provided:

- Appropriately ventilated work area/shop with welding facilities and equipment
- Fume extractor if applicable
- Gas welding facilities and equipment
- PPE
- Relevant documentation such as WPS and working drawing
- Stand by fire-fighting equipment
- Supplies and materials.

Competency may be assessed through a combination of:

- Demonstration and interview
- Observation and interview
- Portfolio (work records, certificates, awards, endorsements, etc.)
- Written test.

Competency is to be assessed while a task is being undertaken in the workplace or in a simulated workplace setting.

WS-D2 Weld carbon steel plates and pipes using SMAW

Unit details

Functional area D	Functional area D
Unit title	Weld carbon steel plates and pipes using SMAW
Unit code	WS-D2

Descriptor

This unit covers the skills, knowledge and attitudes in welding carbon steel plates and pipes using SMAW process.

Elements of competency Performance criteria

1. Prepare power source, accessories and position	1.1 Select the proper burner, the desired burning gas and the required pressures/flows. 1.2 Adjust type of flame to be used for welding. 1.3 Gas welding equipment and accessories are prepared and welding position is correct following approved WPS .
2. Perform surface preparation	2.1 Surface preparation is performed in accordance with acceptable cleaning procedure and standards .
3. Perform gas welding	3.1 Weld pass is performed in accordance with WPS. 3.2 Weld is visually checked for discontinuities and acceptable in accordance with applicable codes or standards are repaired as required.
4. Clean weld pass	4.1 Weld pass is cleaned and free from defects and discontinuities. 4.2 Task is performed in accordance with company or industry requirements and safety procedure.

Evidence guide

To demonstrate competency in this unit the candidate must meet performance criteria and skills and knowledge requirements. The candidate must be able to:

- perform gas welding of carbon steel plates and tubes to acceptable standard following the approved WPS.

Critical skills and essential knowledge

- Applying weld techniques (forward and backward)
- Basic mathematics (Multiplication Division Addition Subtraction: MDAS)
- Communication skills
- Drawing/plan/WPS
- Gas welding equipment and tools
- Handling gas welding materials and consumables
- Handling welding tools, gas and equipment
- Identification of weld defects
- Materials and consumables: filler rod, oxy- acetylene, base metal, etc.)
- Measuring skills
- Rectifying weld defects

- Types of flame
- Welding codes (symbols)

Range statement

Material thickness:

- 1.6mm – 3mm.

Gas welding equipment and accessories:

- Filler rod/consumable insert
- Gas welding accessories (hoses, regulators/flow meters, lighter and cylinder gas **tanks**, flash back arrestor)
- Heating torches
- Portable grinder
- PPE (goggles, lenses, mask, apron, gloves, etc)
- Steel brush
- Welding tips as required size
- Wrenches and chipping hammer

Tanks or cylinders:

- Oxygen/acetylene

WPS:

- Cleaning method
- Material type: carbon steel, filler rod
- Materials thickness
- Type of flame
- Type of joint
- Welding position: flat, horizontal, vertical and overhead

Standards:

- Client standards and applicable codes

Cleaning procedure:

- Chemical (solvent, thinners, acids, etc.)
- Manual (hand filing, sanding, chipping, etc.)
- Mechanical (grinding, brushing, etc.)

Defects:

- Burn through
- Concavity/convexity
- Cracks
- Crater cracks
- Face and root reinforcement
- Lack of fusion/penetration
- Misalignment
- Overlap
- Pinholes/blowholes
- Porosity
- Under fill
- Undercut

The following resources must be provided:

- Appropriately ventilated work area/shop with welding facilities and equipment
- Fume extractor if applicable
- Gas welding facilities and equipment
- PPE

- Relevant documentation such as WPS and working drawing
- Stand by fire-fighting equipment
- Supplies and material.

Competency may be assessed through a combination of:

- Demonstration and interview
- Observation and interview
- Portfolio (work records, certificates, awards, endorsements, etc.)
- Written test

Competency is to be assessed while a task is being undertaken in the workplace or in a simulated workplace setting.

Functional area E: Performing fillet and groove welding on alloy steel plate

WS-E1 Weld alloy steel plates using FCAW

Unit details

Functional area E	Functional area E
Unit title	Weld alloy steel plates using FCAW
Unit code	WS-E1

Descriptor

This unit covers the skills, knowledge and attitudes in welding alloy steel plates using FCAW process.

Elements of competency	Performance criteria
1. Prepare power source, accessories and position	1.1 Welding power source is adjusted to fit to the purpose. 1.2 Gas welding equipment and accessories are prepared and welding position is correct following approved WPS .
2. Perform root pass	2.1 Root pass is performed in accordance with approved WPS. 2.2 Task is performed in accordance with approved WPS and safety procedure. 2.3 Root pass is cleaned and free from defect. 2.4 Weld is visually checked for discontinuities and acceptable in accordance with applicable codes or standards. It is repaired as required.
3. Weld filling passes	3.1 Filling passes are performed in accordance with approved WPS and use a run or multi run technique. 3.2 Run or multi run is cleaned and free from defect.
4. Perform capping	4.1 Capping is performed in accordance with approved WPS and run or multi run technique. 4.2 Weld is visually checked for discontinuities and acceptable in accordance with applicable codes or standards. 4.3 Defects are repaired as required.

Evidence guide

To demonstrate competency in this unit the candidate must meet performance criteria and skills and knowledge requirements. The candidate must be able to:

- weld alloy steel plates using FCAW process in 2G and 3G positions to acceptable standard following the approved WPS.

Critical skills and essential knowledge

- Applying weld techniques using FCAW techniques
- Basic mathematics (Multiplication Division Addition Subtraction: MDAS)

- Communication skills
- Drawing/plan/WPS
- FCAW welding accessories
- Handling welding materials and consumables and shielding gas flow rate materials and consumables
- Handling welding tools and equipment
- Materials and consumables: base metal, flux-cored electrode (self-shielded/gas shielded), shielding gases
- Measuring skills
- Rectifying weld defects
- Weld defects and FCAW equipment malfunctions
- Welding codes (symbols)
- Welding Equipment and tools

Range statement

Gas welding equipment and accessories:

- Filler rod/consumable insert
- Gas welding accessories (hoses, regulators/flow meters, lighter and cylinder gas tanks, flash back arrestor)
- Heating torches
- Portable grinder
- PPE (goggles, lenses, mask, apron, gloves, etc)
- Steel brush
- Welding tips as required size
- Wrenches and chipping hammer

WPS requirements:

- Cleaning method
- Consumables: flux cored electrode (self-shielded and gas shielded), shielding gas (argon and other available inert gas)
- Joint preparation
- Parameter setting (Wire feed speed, voltage)
- Shielding gas flow rate
- Temperature conditions if necessary
- Thickness: 1.6mm – unlimited (plate)
- Travel speed
- Type of material: alloy steel
- Welding positions: 1F- 4F, 1G – 3G

Defects:

- Arc strike
- Burn through
- Concavity/convexity
- Cracks
- Crater cracks
- Elongated inclusion
- Face/root reinforcement
- Lack of fusion/penetration
- Misalignment
- Overlap
- Pinholes/blowholes
- Porosity
- Solid inclusion

- Under fill
- Undercut

The following resources must be provided:

- Appropriately ventilated work area/shop with welding facilities and equipment
- FCAW facilities and equipment
- Fume extractor if applicable
- PPE
- Relevant documentation such as WPS and working drawing
- Stand by fire-fighting equipment
- Supplies and materials

Competency may be assessed through a combination of:

- Demonstration and interview
- Observation and interview
- Portfolio (work records, certificates, awards, endorsements, etc.)
- Written test

Competency is to be assessed while a task is being undertaken in the workplace or in a simulated workplace setting.

WS-E2 Perform gas welding in alloy steel plates and tubes

Unit details

Functional area E

Functional area E

Unit title

Perform gas welding in alloy steel plates and tubes

Unit code

WS-E2

Descriptor

This unit covers the skills, knowledge and attitudes in gas welding alloy steel and pure copper plates and tubes.

Elements of competency

Performance criteria

- | | |
|--|--|
| 1. Prepare welding equipment, accessories and position | 1.1 Select the proper burner, the desired burning gas and the required pressures/flows.
1.2 Adjust type of flame to be used for welding.
1.3 Gas welding equipment and accessories are prepared and welding position is correct following approved WPS . |
| 2. Perform surface preparation | 2.1 Surface preparation is performed in accordance with acceptable cleaning procedure and standards. |
| 3. Perform gas welding | 3.1 Weld pass is performed in accordance with WPS.
3.2 Weld is visually checked for discontinuities and acceptable in accordance with applicable codes or standards are repaired as required. |
| 4. Clean weld pass | 4.1 Weld pass is cleaned and free from defects and discontinuities.
4.2 Task is performed in accordance with company or industry requirements and safety procedure. |

Evidence guide

To demonstrate competency in this unit the candidate must meet performance criteria and skills and knowledge requirements. The candidate must be able to:

- perform gas welding/brazing of alloy and copper plates and tubes to acceptable standard following the approved WPS.

Critical skills and essential knowledge

- Applying weld techniques (forward and backward)
- Basic mathematics (Multiplication Division Addition Subtraction: MDAS)
- Communication skills
- Drawing/plan/WPS
- Handling gas welding materials and consumables
- Handling welding tools and equipment
- Materials and consumables: filler, rod, oxy- acetylene, base metal, etc.)
- Measuring skills
- Rectifying weld defects
- Weld defects

- Welding codes (symbols)
- Welding equipment and tools

Range statement

Material thickness:

- 1.6mm - 3 mm

Gas welding equipment and accessories:

- Filler wire/consumable insert
- Gas welding equipment (hoses, regulators/flow meters, lighter and cylinder gas tanks, flash back arrestor)
- Heating torches
- Portable grinder
- PPE (goggles, lenses, mask, apron, gloves, etc)
- Steel brush
- Welding tips as required size
- Wrenches and chipping hammer

Tanks or cylinders:

- Oxygen/acetylene.

WPS:

- Flow rate as recommended
- Material type: pure copper, copper nickel, stainless steel, silver-based material
- Type and size of consumables: pure copper filler wire (diameter 0.8 – 2.4mm), copper nickel filler wire (diameter 0.8 – 2.4mm), stainless filler wire (diameter 0.8 – 2.4 mm), silver-based filler wire (0.8 – 2.4mm), brazing fluxes
- Type of gas: oxygen/acetylene
- Type of insert: metallic
- Type of pre-heating: blow torch
- Welding position: flat, horizontal, vertical and overhead

Standards:

- Client standards and applicable codes

Cleaning procedure:

- Chemical (solvent, thinners, acids, etc.)
- Manual (hand filing, sanding, chipping, etc.)
- Mechanical (grinding, brushing, etc.)

Defects:

- Burn through
- Concavity/convexity
- Cracks
- Crater cracks
- Face/root reinforcement
- Lack of fusion/penetration
- Misalignment
- Overlap
- Pinholes/blowholes
- Porosity
- Under fill
- Undercut

The following resources must be provided:

- Appropriately ventilated work area/shop with welding facilities and equipment

- Fume extractor if applicable
- Gas welding facilities and equipment
- PPE
- Relevant documentation such as WPS and working drawing
- Stand by fire-fighting equipment
- Supplies and materials

Competency may be assessed through a combination of:

- Demonstration and interview
- Observation and interview
- Portfolio (work records, certificates, awards, endorsements, etc.)
- Written test

Competency is to be assessed while a task is being undertaken in the workplace or in a simulated workplace setting.

WS-E3 Weld alloy steel plates using GMAW

Unit details

Functional area E

Functional area E

Unit title

Weld alloy steel plates using GMAW

Unit code

WS-E3

Descriptor

This unit covers the skills, knowledge and attitudes in welding alloy steel plates using GMAW process.

Elements of competency

Performance criteria

- | | |
|---|---|
| 1. Prepare power source, accessories and position | 1.1 Welding power source is adjusted to fit to the purpose.
1.2 Accessories are prepared and welding position is correct following approved WPS. |
| 2. Perform root pass | 2.1 Root pass is performed in accordance with approved WPS .
2.2 Task is performed in accordance with approved WPS and safety procedure.
2.3 Root pass is cleaned and free from defect.
2.4 Weld is visually checked for discontinuities and acceptable in accordance with applicable codes or standards. It is repaired as required. |
| 3. Weld filling passes | 3.1 Filling passes are performed in accordance with approved WPS and use a run or multi run technique.
3.2 Run or multi run is cleaned and free from defect. |
| 4. Perform capping | 4.1 Capping is performed in accordance with approved WPS and run or multi run technique.
4.2 Weld is visually checked for discontinuities and acceptable in accordance with applicable codes or standards.
4.3 Defects are repaired as required. |

Evidence guide

To demonstrate competency in this unit the candidate must meet performance criteria and skills and knowledge requirements. The candidate must be able to:

- weld alloy steel plates using GMAW process in 2G and 3G positions to acceptable standard following the approved WPS.

Critical skills and essential knowledge

- Applying weld techniques
- Basic mathematics (Multiplication Division Addition Subtraction: MDAS)
- Communication skills
- Drawing/plan/WPS
- Handling welding materials and consumables
- Handling welding tools and equipment
- Materials and consumables: filler wire for alloy-steel materials, shielding gases

- Measuring skills
- Modes of metal transfer
- Rectifying weld defects
- Weld defects and GMAW equipment malfunctions
- Welding codes (symbols)
- Welding equipment and tools: GMAW mode of metal transfer, GMAW welding accessories

Range statement

WPS requirements:

- Cleaning method
- Consumables: Solid wire (diameter), shielding gas (CO₂ or other available mixed gas)
- Current setting (polarity, wire feed speed, voltage)
- Joint preparation
- Material thickness: 1.6mm – unlimited (plate)
- Shielding gas flow rate
- Travel speed
- Type of material: alloy steel
- Type of metal transfer
- Welding accessories
- Welding positions: 1F- 4F, 1G - 3G

Defects:

- Arc strike
- Burn through
- Concavity/convexity
- Cracks
- Crater cracks
- Degree of reinforcement
- Distortion
- Elongated intrusion
- Lack of fusion
- Misalignment
- Overlap
- Pinholes/blowholes
- Porosity
- Under Fill
- Undercut

The following resources must be provided:

- Appropriately ventilated work area/shop with welding facilities and equipment
- Fumes extractor
- GMAW facilities and equipment
- PPE
- Relevant documentation such as WPS and working drawing
- Stand by firefighting equipment
- Supplies and materials

Competency may be assessed through a combination of:

- Demonstration and interview
- Observation and interview
- Portfolio (work records, certificates, awards, endorsements, etc.)
- Written test

Competency is to be assessed while a task is being undertaken in the workplace or in a simulated workplace setting.

WS-E4 Weld alloy steel plates using GTAW

Unit details

Functional area E

Functional area E

Unit title

Weld alloy steel plates using GTAW

Unit code

WS-E4

Descriptor

This unit covers the skills, knowledge and attitudes required in welding alloy steel plates using GTAW process.

Elements of competency

Performance criteria

- | | |
|---|---|
| 1. Prepare power source, accessories and position | 1.1 Welding power source is adjusted to fit to the purpose.
1.2 Accessories are prepared and welding position is correct following approved WPS . |
| 2. Perform root pass | 2.1 Root pass is performed in accordance with approved WPS.
2.2 Task is performed in accordance with approved WPS and safety procedure.
2.3 Root pass is cleaned and free from defect.
2.4 Weld is visually checked for discontinuities and acceptable in accordance with applicable codes or standards. It is repaired as required. |
| 3. Weld filling passes | 3.1 Filling passes are performed in accordance with approved WPS and use a run or multi run technique.
3.2 Run or multi run is cleaned and free from defect. |
| 4. Perform capping | 4.1 Capping is performed in accordance with approved WPS and run or multi run technique.
4.2 Weld is visually checked for discontinuities and acceptable in accordance with applicable codes or standards.
4.3 Defects are repaired as required. |

Evidence guide

To demonstrate competency in this unit the candidate must meet performance criteria and skills and knowledge requirements. The candidate must be able to:

- weld alloy steel plates using GTAW in 2G and 3G and 4G positions to acceptable standards following approved WPS.

Critical skills and essential knowledge

- Applying weld techniques for GTAW
- Basic mathematics (Multiplication Division Addition Subtraction: MDAS)
- Communication skills
- Drawing/plan/WPS interpretation
- Handling welding materials, consumables and gas flow rate
- Handling welding tools and equipment
- Interpretation of weld defects

- Materials and consumables: filler rod, tungsten rod, shielding gas, base metal
- Measuring skills
- Rectifying weld defects
- Welding codes (symbols)
- Welding equipment and tools

Range statement

WPS requirements:

- Cleaning method
- Consumables: filler rod (diameter), tungsten rod (type and design), shielding gas (argon and other available inert gas, purging gas as required)
- Current setting (polarity, amperage, voltage)
- Joint preparation
- Shielding gas flow rate
- Temperature conditions if necessary
- Travel speed
- Type of material: alloy steel plate
- Wall thickness: 1.6mm and above
- Welding accessories
- Welding positions: 1F-4F, 1G-4G

Defects:

- Arc Strike
- Burn through
- Concavity/convexity
- Cracks
- Crater cracks
- Face/root reinforcement
- Lack of fusion/penetration
- Misalignment
- Overlap
- Pinholes/blowholes
- Porosity
- Tungsten inclusion
- Under fill
- Undercut

The following resources must be provided:

- Appropriately ventilated work area/shop with welding facilities and equipment
- Fumes extractor
- GTAW facilities and equipment
- PPE
- Relevant documentation such as WPS and working drawing
- Stand by firefighting equipment
- Supplies and materials

Competency may be assessed through a combination of:

- Demonstration and interview
- Observation and interview
- Portfolio (work records, certificates, awards, endorsements, etc.)
- Written test

Competency is to be assessed while a task is being undertaken in the workplace or in a simulated workplace setting.

WS-E5 Weld alloy steel plates using SMAW

Unit details

Functional area E

Functional area E

Unit title

Weld carbon steel plates using SMAW

Unit code

WS-E5

Descriptor

This unit covers the skills, knowledge and attitudes in welding alloy steel plates using SMAW process.

Elements of competency

Performance criteria

- | | |
|---|---|
| 1. Prepare power source, accessories and position | 1.1 Welding power source is adjusted to fit to the purpose.
1.2 Accessories are prepared and welding position is correct following approved WPS . |
| 2. Perform root pass | 2.1 Root pass is performed in accordance with approved WPS.
2.2 Task is performed in accordance with approved WPS and safety procedure.
2.3 Root pass is cleaned and free from defect.
2.4 Weld is visually checked for discontinuities and acceptable in accordance with applicable codes or standards. It is repaired as required. |
| 3. Weld filling passes | 3.1 Filling passes are performed in accordance with approved WPS and use a run or multi run technique.
3.2 Run or multi run is cleaned and free from defect. |
| 4. Perform capping | 4.1 Capping is performed in accordance with approved WPS and run or multi run technique.
4.2 Weld is visually checked for discontinuities and acceptable in accordance with applicable codes or standards.
4.3 Defects are repaired as required. |

Evidence guide

To demonstrate competency in this unit the candidate must meet performance criteria and skills and knowledge requirements. The candidate must be able to:

- understand method in welding alloy steel plates using SMAW process.

Critical skills and essential knowledge

- Applying weld techniques
- Basic mathematics (multiplication, division, addition and subtraction)
- Communication skills
- Drawing/plan/WPS
- Electrode heating and warming (low hydrogen type)
- Handling welding materials and consumables
- Handling welding tools and equipment

- Identification of weld defects
- Materials and consumables (electrodes, base metal)
- Measuring skills
- Rectifying weld defects
- Welding codes
- Welding equipment and tools

Range statement

WPS requirements:

- Cleaning method
- Current setting (polarity, amperage, voltage)
- Joint preparation
- Material thickness: 1.6mm – unlimited (plate)
- Temperature conditions if necessary
- Travel speed
- Type and size of electrode
- Type of material: alloy steel
- Welding positions: all positions

Defects:

- Arc Strike
- Burn through
- Concavity/convexity
- Cracks
- Crater cracks
- Face/root reinforcement
- Lack of fusion/penetration
- Misalignment
- Overlap
- Pinholes/blowholes
- Porosity
- Slag inclusion
- Spatters
- Under fill
- Undercut

The following resources must be provided:

- Appropriately ventilated work area/shop with welding facilities and equipment
- PPE
- Relevant documentation such as WPS and working drawing
- Supplies and materials

Competency may be assessed through a combination of:

- Demonstration and interview
- Observation and interview
- Portfolio (work records, certificates, awards, endorsements, etc.)
- Written test

Competency is to be assessed while a task is being undertaken in the workplace or in a simulated workplace setting.

Functional area F: Performaing filet and groove welding on alloy steel pipe

WS-F1 Weld alloy steel pipes using FCAW

Unit details

Functional area F

Functional area F

Unit title

Weld alloy steel pipes using FCAW

Unit code

WS-F1

Descriptor

This unit covers the skills, knowledge and attitudes in welding alloy steel pipes using FCAW process.

Elements of competency

Performance criteria

- | | |
|---|---|
| 1. Prepare power source, accessories and position | 1.1 Welding power source is adjusted to fit to the purpose.
1.2 Accessories are prepared and welding position is correct following approved WPS. |
| 2. Perform root pass | 2.1 Root pass is performed in accordance with approved WPS .
2.2 Task is performed in accordance with approved WPS and safety procedure.
2.3 Root pass is cleaned and free from defect.
2.4 Weld is visually checked for discontinuities and acceptable in accordance with applicable codes or standards. It is repaired as required. |
| 3. Weld filling passes | 3.1 Filling passes are performed in accordance with approved WPS and use a run or multi run technique.
3.2 Run or multi run is cleaned and free from defect. |
| 4. Perform capping | 4.1 Capping is performed in accordance with approved WPS and run or multi run technique.
4.2 Weld is visually checked for discontinuities and acceptable in accordance with applicable codes or standards.
4.3 Defects are repaired ad required. |

Evidence guide

To demonstrate competency in this unit the candidate must meet performance criteria and skills and knowledge requirements. The candidate must be able to:

- weld alloy steel pipes using FCAW in 2G, 5G and/or 6G positions to acceptable standard following the approved WPS.

Critical skills and essential knowledge

- Ability to perform root pass with FCAW or GTAW or SMAW process (if required)
- Applying weld techniques using FCAW

- Basic mathematics (Multiplication Division Addition Subtraction: MDAS)
- Communication skills
- Drawing/plan/WPS
- Handling welding materials and consumables and checking purity of shielding gas
- Handling welding tools and equipment
- Materials and consumables: alloy steel, flux-cored electrode, shielding gases
- Measuring skills
- Rectifying weld defects
- Weld defects and FCAW equipment malfunctions
- Welding codes (symbols)
- Welding equipment and tools: FCAW welding accessories and equipment

Range statement

WPS requirements:

- Backing material (weld metal, backing plate and ceramics)
- Cleaning method
- Joint preparation
- Parameter setting (polarity, wire feed speed, voltage)
- Temperature conditions if necessary
- Thickness: 1.6mm and above
- Travel speed
- Type and size of flux core electrode (self-shielded and gas shielded)
- Type of material: alloy steel pipes, diameter 25.4mm (1inch) and above
- Welding accessories: rectifier transformer Type, wire feeder
- Welding positions: 2G and 5G and/or 6G

Defects:

- Arc Strike
- Burn through
- Concavity/convexity
- Cracks
- Crater cracks
- Face/root reinforcement
- Lack of fusion/penetration
- Misalignment
- Overlap
- Pinholes/blowholes
- Porosity
- Solid inclusion
- Spatters
- Under fill
- Undercut

The following resources must be provided:

- Appropriately ventilated work area/shop with welding facilities and equipment
- FCAW facilities and equipment
- Fumes extractor, if applicable
- PPE
- Relevant documentation such as WPS and working drawing
- Stand by firefighting equipment
- Supplies and materials

Competency may be assessed through a combination of:

- Demonstration and interview

- Observation and interview
- Portfolio (work records, certificates, awards, endorsements, etc.)
- Written test

Competency is to be assessed while a task is being undertaken in the workplace or in a simulated workplace setting.

WS-F2 Weld alloy steel pipes using GMAW

Unit details

Functional area F

Functional area F

Unit title

Weld alloy steel pipes using GMAW

Unit code

WS-F2

Descriptor

This unit covers the skills, knowledge and attitudes in welding alloy steel pipes using GMAW process.

Elements of competency

Performance criteria

- | | |
|---|---|
| 1. Prepare power source, accessories and position | 1.1 Welding power source is adjusted to fit to the purpose.
1.2 Accessories are prepared and welding position is correct following approved WPS . |
| 2. Perform root pass | 2.1 Root pass is performed in accordance with approved WPS.
2.2 Task is performed in accordance with approved WPS and safety procedure.
2.3 Root pass is cleaned and free from defect.
2.4 Weld is visually checked for discontinuities and acceptable in accordance with applicable codes or standards. It is repaired as required. |
| 3. Weld filling passes | 3.1 Filling passes are performed in accordance with approved WPS and use a run or multi run technique.
3.2 Run or multi run is cleaned and free from defect. |
| 4. Perform capping | 4.1 Capping is performed in accordance with approved WPS and run or multi run technique.
4.2 Weld is visually checked for discontinuities and acceptable in accordance with applicable codes or standards.
4.3 Defects are repaired as required. |

Evidence guide

To demonstrate competency in this unit the candidate must meet performance criteria and skills and knowledge requirements. The candidate must be able to:

- weld alloy steel pipes using GMAW process in 2G and 5G and/or 6G positions to acceptable standards following the approved WPS.

Critical skills and essential knowledge

- Ability to perform root pass with GMAW or GTAW or SMAW process (if required)
- Applying weld techniques for GMAW
- Basic mathematics (Multiplication Division Addition Subtraction: MDAS)
- Communication skills
- Drawing/plan/WPS interpretation
- Handling welding materials and consumables and checking purity of shielding gas or inert

- gas
- Handling welding tools and equipment
- Interpretation of weld defects and GMAW equipment malfunctions
- Materials and consumables: electrode wire, shielding gases (mixed gases)
- Measuring skills
- Rectifying weld defects
- Welding codes (symbols)
- Welding equipment and tools: GMAW mode of metal transfer, GMAW welding accessories

Range statement

WPS requirements:

- Backing material (weld metal, backing ring or ceramics)
- Cleaning method
- Joint preparation
- Mode of metal transfer: short-circuiting, globular, spray, pulsating,
- Parameter setting (polarity, wire feed speed, voltage)
- Temperature conditions if necessary
- Travel speed
- Type and size of solid wire
- Type of material: carbon or mild steel, diameter 25.4 mm (1 inch) and above
- Wall thickness: 1.6mm and above
- Welding accessories: rectifier transformer type, wire feeder
- Welding positions: 2G and 5G and/or 6G

Defects:

- Arc strike
- Burn through
- Concavity/convexity
- Cracks
- Crater cracks
- Face/root reinforcement
- Lack of fusion/penetration
- Misalignment
- Overlap
- Pinholes/blowholes
- Porosity
- Solid inclusion
- Spatters
- Under fill
- Undercut

The following resources must be provided:

- Appropriately ventilated work area/shop with welding facilities and equipment
- Fumes extractor
- GMAW facilities and equipment
- PPE
- Relevant documentation such as WPS and working drawing
- Stand by firefighting equipment
- Supplies and materials

Competency may be assessed through a combination of:

- Demonstration and interview

- Observation and interview
- Portfolio (work records, certificates, awards, endorsements, etc.)
- Written test

Competency is to be assessed while a task is being undertaken in the workplace or in a simulated workplace setting.

WS-F3 Weld alloy steel pipes using GTAW

Unit details

Functional area F

Functional area F

Unit title

Weld alloy steel pipes using GTAW

Unit code

WS-F3

Descriptor

This unit covers the skills, knowledge and attitudes required in welding alloy steel pipes using GTAW process.

Elements of competency

Performance criteria

- | | |
|---|---|
| 1. Prepare power source, accessories and position | 1.1 Welding power source is adjusted to fit to the purpose.
1.2 Accessories are prepared and welding position is correct following approved WPS . |
| 2. Perform root pass | 2.1 Root pass is performed in accordance with approved WPS.
2.2 Task is performed in accordance with approved WPS and safety procedure.
2.3 Root pass is cleaned and free from defect.
2.4 Weld is visually checked for discontinuities and acceptable in accordance with applicable codes or standards. It is repaired as required. |
| 3. Weld filling passes | 3.1 Filling passes are performed in accordance with approved WPS and use a run or multi run technique.
3.2 Run or multi run is cleaned and free from defect. |
| 4. Perform capping | 4.1 Capping is performed in accordance with approved WPS and run or multi run technique.
4.2 Weld is visually checked for discontinuities and acceptable in accordance with applicable codes or standards.
4.3 Defects are repaired as required. |

Evidence guide

To demonstrate competency in this unit the candidate must meet performance criteria and skills and knowledge requirements. The candidate must be able to:

- weld alloy steel pipes using GTAW in 2G and 5G and/or 6G positions to acceptable standards following approved WPS.

Critical skills and essential knowledge

- Applying weld techniques for GTAW
- Basic mathematics (Multiplication Division Addition Subtraction: MDAS)
- Communication skills
- Drawing/plan/WPS
- Handling welding materials and consumables and gas flow rate
- Handling welding tools and equipment

- Identification of weld defects
- Materials and consumables: filler rod, tungsten rod, shielding gas, base metal
- Measuring skills
- Rectifying weld defects
- Welding codes (symbols)
- Welding equipment and tools

Range statement

WPS requirements:

- Burn through
- Cleaning method
- Concavity/convexity
- Consumables: filler rod (diameter), tungsten rod (type and design), shielding gas (argon and other available inert gas)
- Cracks
- Crater cracks
- Defects
- Face/root reinforcement
- Joint preparation
- Lack of fusion/penetration
- Misalignment
- Overlap
- Parameter setting (polarity, amperage, voltage)
- Pinholes/blowholes
- Porosity
- Shielding gas flow rate
- Temperature conditions if necessary
- Travel speed
- Tungsten inclusion
- Type of material: alloy steel or stainless steel
- Under fill
- Undercut
- Wall thickness: 1.6mm and above
- Welding accessories
- Welding positions: 2G and 5G and/or 6G

Defects:

- Arc strike
- Burn through
- Concavity/convexity
- Cracks
- Crater cracks
- Face/root reinforcement
- Lack of fusion/penetration
- Misalignment
- Overlap
- Pinholes/blowholes
- Porosity
- Solid inclusion
- Spatters
- Under fill
- Undercut

The following resources must be provided:

- Appropriately ventilated work area/shop with welding facilities and equipment
- Fumes extractor
- GTAW facilities and equipment
- PPE
- Relevant documentation such as WPS and working drawing
- Stand by firefighting equipment
- Supplies and materials

Competency may be assessed through a combination of:

- Demonstration and interview
- Observation and interview
- Portfolio (work records, certificates, awards, endorsements, etc.)
- Written test

Competency is to be assessed while a task is being undertaken in the workplace or in a simulated workplace setting.

WS-F4 Weld alloy steel pipes using SMAW

Unit details

Functional area F	Functional area F
Unit title	Weld alloy steel pipes using SMAW
Unit code	WS-F4

Descriptor

This unit covers the skills, knowledge and attitudes in welding alloy steel pipes using SMAW process.

Elements of competency	Performance criteria
1. Prepare power source, accessories and position	1.1 Welding power source is adjusted to fit to the purpose. 1.2 Accessories are prepared and welding position is correct following approved WPS .
2. Perform root pass	2.1 Root pass is performed in accordance with approved WPS. 2.2 Task is performed in accordance with approved WPS and safety procedure. 2.3 Root pass is cleaned and free from defect. 2.4 Weld is visually checked for discontinuities and acceptable in accordance with applicable codes or standards. It is repaired as required.
3. Weld filling passes	3.1 Filling passes are performed in accordance with approved WPS and use a run or multi run technique. 3.2 Run or multi run is cleaned and free from defect.
4. Perform capping	4.1 Capping is performed in accordance with approved WPS and run or multi run technique. 4.2 Weld is visually checked for discontinuities and acceptable in accordance with applicable codes or standards. 4.3 Defects are repaired as required.

Evidence guide

To demonstrate competency in this unit the candidate must meet performance criteria and skills and knowledge requirements. The candidate must be able to:

- weld alloy steel pipes in all positions and to acceptable standard following the approved WPS.

Critical skills and essential knowledge

- Applying weld techniques
- Basic Mathematics (Multiplication, Division, Addition and Subtraction)
- Communication skills
- Drawing/plan/WPS
- Electrode heating and warming (Low hydrogen type)

- Handling welding materials and consumables
- Handling welding tools and equipment
- Identification of weld defects
- Materials and consumables (electrodes, base metal)
- Measuring skills
- Rectifying weld defects
- Welding codes
- Welding Equipment and Tools

Range statement

WPS requirements:

- Cleaning method
- Joint preparation
- Material thickness: 1.6mm and above
- Parameter setting (polarity, amperage, voltage)
- Pipe diameter: 25.4 mm (1inch) - unlimited
- Temperature conditions if necessary
- Travel speed
- Type and size of electrode
- Type of material: alloy steel
- Welding positions: 2G, 5G and/or 6G

Defects:

- Arc strike
- Burn through
- Concavity/convexity
- Cracks
- Crater cracks
- Face/root reinforcement
- Lack of fusion/penetration
- Misalignment
- Overlap
- Pinholes/blowholes
- Porosity
- Slag inclusion
- Spatters
- Under fill
- Undercut

The following resources must be provided:

- Appropriately ventilated work area/shop with welding facilities and equipment
- PPE
- Relevant documentation such as WPS and working drawing
- Supplies and materials

Competency may be assessed through a combination of:

- Demonstration and interview
- Observation and interview
- Portfolio (work records, certificates, awards, endorsements, etc.)
- Written test

Competency is to be assessed while a task is being undertaken in the workplace or in a simulated workplace setting.

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- International Labour Organization (ILO) and Asian Development Bank (ADB). 2014. *ASEAN community 2015: Managing integration for better jobs and shared prosperity* (Bangkok: ILO and ADB). Available at: <http://www.adb.org/sites/default/files/publication/42818/asean-community-2015-managing-integration.pdf> [2 Feb. 2015].
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Regional Model Competency Standards: Welding services

The need to improve the quality and effectiveness of skills training systems remains a major challenge for many countries in the Asia-Pacific region.

National competency standards play an important role in skills development and recognition in the Asia-Pacific region, as they do in many other parts of the world. They are a guide to the range of skills and knowledge required for a whole industry. Competency standards can be flexibly combined into jobs and occupations. They are a common basis for training programmes, skills assessment and certification in many countries. The ILO has developed, in consultation with employers, governments and workers, Regional Model Competency Standard (RMCS) in identified priority areas in a simplified format. The RMCS will benefit those countries that are in the process of developing standards or reviewing existing national standards in the light of similar standards available in the region.

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