# NATIONAL OCCUPATIONAL STANDARDS

# FOR

# WELDING AND FABRICATION TECHNICIAN

# LEVEL 6



TVET CDACC

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NAIROBI

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## FOREWORD

The provision of quality education and training is fundamental to the Government's overall strategy for social economic development. Quality education and training will contribute to achievement of Kenya's development blue print and sustainable development goals.

Reforms in the education sector are necessary for the achievement of Kenya Vision 2030 and meeting the provisions of the Constitution of Kenya 2010. The education sector had to be aligned to the Constitution and this resulted in the formulation of the Policy Framework for Reforming Education and Training (Sessional Paper No. 4 of 2016). A key feature of this policy is the radical change in the design and delivery of the TVET training. This policy document requires that training in TVET be competency based, Curriculum development be industry led, certification be based on demonstration of competence and mode of delivery allows for multiple entry and exit in TVET programmes.

These reforms demand that industry takes a leading role in Curriculum development to ensure the Curriculum addresses its competence needs. It is against this background that these Occupational Standards were developed for the purpose of developing a competency-based Curriculum for Welding and Fabrication Level 6. These Occupational Standards will also be the basis for assessment of an individual for competence certification.



It is my conviction that these Occupational Standards will play a great role towards development of competent human resource for the Engineering sector's growth and sustainable development.

**PRINCIPAL SECRETARY, VOCATIONAL AND TECHNICAL TRAINING**
**MINISTRY OF EDUCATION**

## PREFACE

Kenya Vision 2030 aims to transform the country into a newly industrializing, "middle-income country providing a high-quality life to all its citizens by the year 2030". Kenya intends to create a globally competitive and adaptive human resource base to meet the requirements of a rapidly industrializing economy through life-long education and training. TVET has a responsibility of facilitating the process of inculcating knowledge, skills and attitudes necessary for catapulting the nation to a globally competitive country, hence the paradigm shift to embrace Competency Based Education and Training (CBET).

The Technical and Vocational Education and Training Act No. 29 of 2013 and the Sessional Paper No. 4 of 2016 on Reforming Education and Training in Kenya, emphasized the need to reform Curriculum development, assessment and certification. This called for shift to CBET to address the mismatch between skills acquired through training and skills needed by industry as well as increase the global competitiveness of Kenyan labour force.

The TVET Curriculum Development, Assessment and Certification Council (TVET CDACC), in conjunction with Mechanical Engineering Sector Skills Advisory Committee (SSAC), have developed these Occupational Standards for a Welding and Fabrication Technician. These Occupational Standards will be the basis for development of competency-based Curriculum for Welding and Fabrication Level 6. These Standards will also be the basis for assessment of an individual for competence certification.



The Occupational Standards are designed and organized with clear performance criteria for each element of a unit of competency. These standards also outline the required knowledge and skills as well as evidence guide.

I am grateful to the Council Members, Council Secretariat, Mechanical Engineering SSAC, expert workers and all those who participated in the development of these Occupational Standards.

**CHAIRPERSON, TVET CDACC**

## ACKNOWLEDGEMENT

These Occupational Standards were developed through combined effort of various stakeholders from private and public organizations. I am sincerely thankful to the management of these organizations for allowing their staff to participate in this course. I wish to acknowledge the invaluable contribution of industry players who provided inputs towards the development of these Standards.

I thank TVET Curriculum Development, Assessment and Certification Council (TVET CDACC) for providing guidance on the development of these Standards. My gratitude goes to the Mechanical Engineering Sector Skills Advisory Committee (SSAC) members for their contribution to the development of these Standards. I thank all the individuals and organizations who participated in the validation of these Standards.

I acknowledge all institutions which in one way or another contributed to the development of these Standards.



**CHAIRPERSON**
**MECHANICAL ENGINEERING SECTOR SKILLS ADVISORY COMMITTEE**

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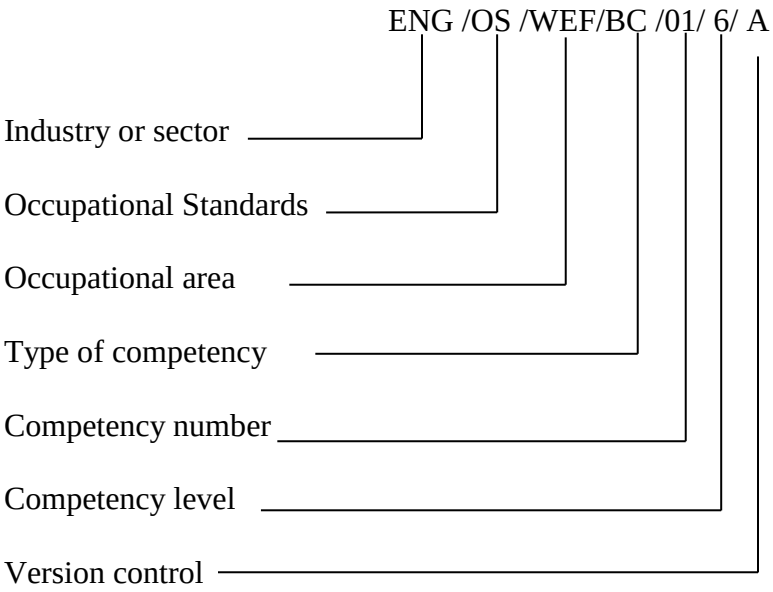
## ABBREVIATIONS AND ACRONYMNS

| | |
|---|---|
| BC | Basic Competency |
| CBET | Competency Based Education and Training |
| CC | Common Competency |
| CDACC | Curriculum Development Assessment and Certification Council |
| CR | Core Competency |
| MoE | Ministry of Education |
| NGO | Non-Governmental Organization |
| OS | Occupational Standards |
| OSHA | Occupation Safety and Health Act |
| PPE | Personal Protective Equipment |
| SSAC | Sector Skills Advisory Committee |
| CDACC | Curriculum Development Assessment and Certification Council |
| TVET | Technical and Vocational Education and Training |
| WEF | Welding and Fabrication |

## KEY TO UNIT CODE



## OVERVIEW

Welding and Fabrication Level 6 qualification consists of competencies that a person must achieve to enable him/her to carry out various welding processes including gas welding, manual metal arc welding, Tungsten Inert Gas (TIG) welding and Metal Active Gas (MAG) welding. In addition, it also involves competencies for performing welding quality control, designing products and structures and fabricating products and structures.

The units of competency comprising this qualification include the following basic, common and core competencies:

**Basic Units of Competency**

| Unit Code | Unit Title |
|---|---|
| ENG/OS/WEF/BC/01/6/A | Demonstrate communication skills |
| ENG/OS/WEF/BC/02/6/A | Demonstrate digital literacy |
| ENG/OS/WEF/BC/03/6/A | Demonstrate entrepreneurial skills |
| ENG/OS/WEF/BC/04/6/A | Demonstrate employability skills |
| ENG/OS/WEF/BC/05/6/A | Demonstrate environmental literacy |
| ENG/OS/WEF/BC/06/6/A | Demonstrate occupational safety and health practices |



**Common Units of Competency**

| Unit Code | Unit Title |
|---|---|
| ENG/OS/WEF/CC/01/6/A | Prepare and interpret technical drawings |
| ENG/OS/WEF/CC/02/6/A | Apply engineering mathematics |
| ENG/OS/WEF/CC/03/6/A | Apply mechanical science principles |
| ENG/OS/WEF/CC/04/6/A | Apply fluid mechanics principles |
| ENG/OS/WEF/CC/05/6/A | Apply thermodynamics principles |
| ENG/OS/WEF/CC/06/6/A | Apply material science and perform metallurgical |

| | |
|---|---|
| | processes |

**Core Units of Competency**

| Unit Code | Unit Title |
|---|---|
| ENG/OS/WEF/CR/01/6/A | Perform soldering and gas welding |
| ENG/OS/WEF/CR/02/6/A | Perform manual metal arc welding |
| ENG/OS/WEF/CR/03/6/A | Perform Tungsten Inert Gas (TIG) welding |
| ENG/OS/WEF/CR/04/6/A | Perform Metal Active Gas(MAG) welding |
| ENG/OS/WEF/CR/05/6/A | Perform spot and seam resistance welding |
| ENG/OS/WEF/CR/06/6/A | Perform underwater arc welding |
| ENG/OS/WEF/CR/07/6/A | Perform submerged arc welding |
| ENG/OS/WEF/CR/08/6/A | Perform plasma and laser beam welding |
| ENG/OS/WEF/CR/9/6/A | Perform welding inspection and quality control |
| ENG/OS/WEF/CR/10/6/A | Design products and structures |
| ENG/OS/WEF/CR/11/6/A | Fabricate products and structures |

The units of competency perform spot and seam resistance welding, perform underwater arc welding, perform submerged arc welding and perform plasma and laser beam welding are optional.

# BASIC UNITS OF COMPETENCY

## DEMONSTRATE COMMUNICATION SKILLS

**UNIT CODE:** ENG/OS/WEF/CC/01/6/A

**UNIT DESCRIPTION**

This unit covers the competencies required to demonstrate communication skills. It involves meeting communication needs of clients and colleagues, developing communication strategies, establishing and maintaining communication pathways, conducting interviews, facilitating group discussion and representing the organization.

**ELEMENTS AND PERFORMANCE CRITERIA**

| **ELEMENT**<br>These describe the key outcomes which make up workplace function | **PERFORMANCE CRITERIA**<br>These are assessable statements which specify the required level of performance for each of the elements.<br>***Bold and italicized terms are elaborated in the Range*** |
|---|---|
| 1. Meet communication needs of clients and colleagues | 1.1 Specific communication needs of clients and colleagues are identified and met based on workplace requirements<br>1.2 Different communication approaches are identified and applied according to clients' needs<br>1.3 Conflict is identified and addressed as per the standards of the organization |
| 2. Develop communication strategies | 2.1 Strategies for effective internal and external dissemination of information are developed as per organization's requirements<br>2.2 Special communication needs are considered in developing strategies according workplace procedures<br>2.3 ***Communication strategies*** are analyzed, evaluated and revised based the workplace needs |
| 3. Establish and maintain communication pathways | 3.1 Pathways of communication are established as per organization policy<br>3.2 Pathways are maintained and reviewed according to organization procedures |
| 4. Promote use of communication strategies | 4.1 Information is provided to all areas of the organization as per strategy requirements<br>4.2 Effective communication techniques are articulated and modeled according work requirements<br>4.3 Personnel are given guidance about adapting communication strategies as per organization procedures |

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|---|---|
| 5. Conduct interview | 5.1 A range of appropriate communication strategies are employed in ***interview situations*** based on the workplace requirements<br>5.2 Records of interviews are made and maintained in accordance with organizational procedures<br>5.3 Effective questioning, listening and nonverbal communication techniques are used as per needs |
| 6. Facilitate group discussion | 6.1 Mechanisms to enhance ***effective group interaction*** are identified and implemented according to workplace requirements<br>6.2 Strategies to encourage group participation are identified and used as per organizations' procedures<br>6.3 Meetings objectives and agenda are set and followed based on workplace requirements<br>6.4 Relevant information is provided and feedback obtained according to set protocols<br>6.5 Evaluation of group communication strategies is undertaken in accordance with workplace guidelines<br>6.6 Specific communication needs of individuals are identified and addressed as per individual needs |
| 7. Represent the organization | 5.1 7Relevant presentation are researched and presented based on internal or external communication forums requirements<br>5.2 Presentation is delivered in a clear and sequential manner as per the predetermined time<br>5.3 Presentation is made as per appropriate media<br>5.4 Difference views are respected based on workplace procedures<br>5.5 Written communication is done as per organizational standards<br>5.6 Inquiries are responded according to organizational standard |



**RANGE**

This section provides work environment and conditions to which the performance criteria apply. It allows for different work environment and situations that will affect performance.

| **Variable** | **Range** |
|---|---|
| ***1.*** Communication strategies may | • Language switch<br>• Comprehension check |

| | |
|---|---|
| include but not limited to: | • Repetition<br>• Asking confirmation<br>• Paraphrase<br>• Clarification request<br>• Translation<br>• Restructuring<br>• Approximation<br>• Generalization |
| 2. Effective group interaction may include but not limited to: | • Identifying and evaluating what is occurring within an interaction in a nonjudgmental way<br>• Using active listening<br>• Making decision about appropriate words, behavior<br>• Putting together response which is culturally appropriate<br>• Expressing an individual perspective<br>• Expressing own philosophy, ideology and background and exploring impact with relevance to communication |
| 3. Situations may include but not limited to: | • Establishing rapport<br>• Eliciting facts and information<br>• Facilitating resolution of issues<br>• Developing action plans<br>• Diffusing potentially difficult situations |



**REQUIRED SKILLS AND KNOWLEDGE**

This section describes the skills and knowledge required for this unit of competency.

**Required Skills**

The individual needs to demonstrate the following skills:

- Communication
- Active listening
- Interpretation
- Negotiation
- Writing

**Required Knowledge**

The individual needs to demonstrate knowledge of:

- Communication process
- Dynamics of groups
- Styles of group leadership
- Key elements of communications strategy

**EVIDENCE GUIDE**

This provides advice on assessment and must be read in conjunction with the performance criteria, required skills and knowledge and range.

| | |
|---|---|
| 1. Critical aspects of Competency | Assessment requires evidence that the candidate:<br>1.1 Developed communication strategies to meet the organization requirements and applied in the workplace<br>1.2 Established and maintained communication pathways for effective communication in the workplace<br>1.3 Used communication strategies involving exchanges of complex oral information |
| 2. Resource Implications | The following resources should be provided:<br>2.1 Access to relevant workplace or appropriately simulated environment where assessment can take place<br>2.2 Materials relevant to the proposed activity or tasks |
| 3. Methods of Assessment | Competency in this unit may be assessed through:<br>3.1 Direct observation<br>3.2 Oral questioning<br>3.3 Written texts |
| 4. Context of Assessment | Competency may be assessed:<br>4.1 On-the-job<br>4.2 Off-the –job<br>4.3 During Industrial attachment |
| 5. Guidance information for assessment | Holistic assessment with other units relevant to the industry sector, workplace and job role is recommended. |

## DEMONSTRATE DIGITAL LITERACY

**UNIT CODE:** ENG/OS/WEF/CC/02/6/A

### UNIT DESCRIPTION

This unit describes competencies required to demonstrate digital literacy. It involves, identifying computer software and hardware, applying security measures to data, hardware, and software in automated environment, applying computer software in solving task, applying internet and email in communication at workplace, applying desktop publishing in official assignments and preparing presentation packages.

### ELEMENTS AND PERFORMANCE CRITERIA

| **ELEMENT**<br><br>These describe the key outcomes which make up workplace function | **PERFORMANCE CRITERIA**<br><br>These are assessable statements which specify the required level of performance for each of the elements.<br><br>***Bold and italicized terms are elaborated in the Range*** |
|---|---|
| 1. Identify appropriate computer software and hardware | 1.1 Concepts of ICT are determined in accordance with computer equipment<br>1.2 Classifications of computers are determined in accordance with manufacturers specification<br>1.3 Appropriate computer software is identified according to manufacturer's specification<br>1.4 Appropriate computer hardware is identified according to manufacturer's specification<br>1.5 Functions and commands of operating system are determined in accordance with manufacturer's specification |
| 2. Apply security measures to data, hardware, software in automated environment | 2.1 ***Data security and privacy are classified*** in accordance with the prevailing technology<br>2.2 ***Security threats*** reidentified ***and control measures*** are applied in accordance with laws governing protection of ICT<br>2.3 Computer threats and crimes are detected in accordance to Information Management security guidelines<br>2.4 Protection against computer crimes is undertaken in accordance with laws governing protection of ICT |

| | |
|---|---|
| 3. Apply computer software in solving tasks | 3.1 ***Word processing concepts*** are applied in resolving workplace tasks, report writing and documentation as per the job requirements<br>3.2 ***Word processing utilities*** are applied in accordance with workplace procedures<br>3.3 Worksheet layout is prepared in accordance with work procedures<br>3.4 Worksheet is built and data manipulated in the worksheet in accordance with workplace procedures<br>3.5 Continuous data manipulated on worksheet is undertaken in accordance with work requirements<br>3.6 Database design and manipulation is undertaken in accordance with office procedures<br>3.7 Data sorting, indexing, storage, retrieval and security is provided in accordance with workplace procedures |
| 4. Apply internet and email in communication at workplace | 4.1 Electronic mail addresses are opened and applied in workplace communication in accordance with office policy<br>4.2 Office internet functions are defined and executed in accordance with office procedures<br>4.3 ***Network configuration*** is determined in accordance with office operations procedures<br>4.4 Official World Wide Web is installed and managed according to workplace procedures |
| 5. Apply Desktop publishing in official assignments | 5.1 Desktop publishing functions and tools are identified in accordance with manufactures specifications<br>5.2 Desktop publishing tools are developed in accordance with work requirements<br>5.3 Desktop publishing tools are applied in accordance with workplace requirements<br>5.4 Typeset work is enhanced in accordance with workplace standards |
| 6. Prepare presentation packages | 6.1 Types of presentation packages are identified in accordance with office requirements<br>6.2 Slides are created and formulated in accordance with workplace procedures<br>6.3 Slides are edited and run-in accordance with work procedures<br>6.4 Slides and handouts are printed according to work |

| | |
|---|---|
| | requirements |

**RANGE**

This section provides work environments and conditions to which the performance criteria apply. It allows for different work environments and situations that will affect performance.

| Variable | Range |
|---|---|
| 1. Appropriate computer hardware may include but not limited to: | Collection of physical parts of a computer system such as:<br>• Computer case, monitor, keyboard, and mouse<br>• All the parts inside the computer case, such as the hard disk drive, motherboard and video card |
| 2. Data security and privacy may include but not limited to: | • Confidentiality of data<br>• Cloud computing<br>• Integrity -but-curious data surfing |
| 3. Security and control measures may include but not limited to: | • Counter measures against cyber terrorism<br>• Risk reduction<br>• Cyber threat issues<br>• Risk management<br>• Pass-wording |
| 4. Security threats may include but not limited to: | • Cyber terrorism<br>• Hacking |



**REQUIRED SKILLS AND KNOWLEDGE**

This section describes the skills and knowledge required for this unit of competency.

**Required Skills**

The individual needs to demonstrate the following skills:

- Analytical skills
- Interpretation
- Typing
- Communication

- Computing (applying fundamental operations such as addition, subtraction, division and multiplication)
- Using calculator
- Basic ICT skills

**Required Knowledge**

The individual needs to demonstrate knowledge of:

- Software concept
- Functions of computer software and hardware
- Data security and privacy
- Computer security threats and control measures
- Technology underlying cyber-attacks and networks
- Cyber terrorism
- Computer crimes
- Detection and protection of computer crimes
- Laws governing protection of ICT
- Word processing;
    - ✓ Functions and concepts of word processing.
    - ✓ Documents and tables creation and manipulations
    - ✓ Mail merging
    - ✓ Word processing utilities
- Spread sheets;
    - ✓ Meaning, formulae, function and charts, uses and layout
    - ✓ Data formulation, manipulation and application to cells
    - ✓
- Database;
    - ✓ Database design, data manipulation, sorting, indexing, storage retrieval and security
- Desktop publishing;
    - ✓ Designing and developing desktop publishing tools
    - ✓ Manipulation of desktop publishing tools
    - ✓ Enhancement of typeset work and printing documents
- Presentation Packages;
    - ✓ Types of presentation Packages
    - ✓ Creating, formulating, running, editing, printing and presenting slides and handouts
- Networking and Internet;

- ✓ Computer networking and internet.
- ✓ Electronic mail and world wide web

- Emerging trends and issues in ICT;
  - ✓ Identify and integrate emerging trends and issues in ICT
  - ✓ Challenges posed by emerging trends and issues

**EVIDENCE GUIDE**

This provides advice on assessment and must be read in conjunction with the performance criteria, required skills and knowledge and range.

| | |
|---|---|
| 1. Critical Aspects of Competency | Assessment requires evidence that the candidate:<br>1.1 Identified and controlled security threats<br>1.2 Detected and protected computer crimes<br>1.3 Applied word processing in office tasks<br>1.4 Designed, prepared work sheet and applied data to the cells in accordance to workplace procedures<br>1.5 Opened electronic mail for office communication as per workplace procedure<br>1.6 Installed internet and World Wide Web for office tasks in accordance with office procedures<br>1.7 Integrated emerging issues in computer ICT applications<br>1.8 Applied laws governing protection of ICT |
| 2. Resource Implications | The following resources should be provided:<br>2.1 Access to relevant workplace where assessment can take place<br>2.2 Appropriately simulated environment where assessment can take place |
| 3. Methods of Assessment | Competency may be assessed through:<br>3.1 Observation<br>3.2 Oral questioning<br>3.3 Written test<br>3.4 Portfolio of Evidence<br>3.5 Interview<br>3.6 Third party report |
| 4. Context of Assessment | Competency may be assessed:<br>4.1 On-the-job<br>4.2 Off-the –job |

| | |
|---|---|
| | 4.3 During Industrial attachment |
| 5. Guidance information for assessment | Holistic assessment with other units relevant to the industry sector, workplace and job role is recommended. |

## DEMONSTRATE ENTREPRENEURIAL SKILLS

**UNIT CODE :** ENG/OS/WEF/CC/03/6/A

**UNIT DESCRIPTION**

This unit covers the competencies required to demonstrate understanding of entrepreneurship. It involves demonstrating understanding of an entrepreneur, entrepreneurship, and self-employment, identifying entrepreneurship opportunities, creating entrepreneurial awareness, applying entrepreneurial motivation, developing business innovative strategies and developing business plan.

**ELEMENTS AND PERFORMANCE CRITERIA**

| ELEMENT | PERFORMANCE CRITERIA |
|---|---|
| 1. Demonstrate understanding of an Entrepreneur | 1. 1 Entrepreneurs and Business persons are distinguished as per principles of entrepreneurship<br>1. 2 ***Types of entrepreneurs*** are identified as per principles of entrepreneurship<br>1. 3 Ways of becoming an Entrepreneur are identified as per principles of Entrepreneurship<br>1. 4 ***Characteristics of Entrepreneurs*** are identified as per principles of Entrepreneurship<br>1. 5 Factors affecting Entrepreneurship development are explored as per principles of Entrepreneurship |
| 2. Demonstrate understanding of Entrepreneurship and self-employment | 2. 1 Entrepreneurship and self-employment are distinguished as per principles of entrepreneurship<br>2. 2 Importance of self-employment is analysed based on business procedures and strategies<br>2. 3 ***Requirements for entry into self-employment*** are identified according to business procedures and strategies<br>2. 4 Role of an Entrepreneur in business is determined according to business procedures |

| | |
|---|---|
| | and strategies<br>2. 5 Contributions of Entrepreneurs to National development are identified as per business procedures and strategies<br>2. 6 Entrepreneurship culture in Kenya is explored as per business procedures and strategies<br>2. 7 Born or made Entrepreneurs are distinguished as per entrepreneurial traits |
| 3. Identify Entrepreneurship opportunities | 3.1 Sources of business ideas are identified as per business procedures and strategies<br>3.2 Business ideas and opportunities are generated as per business procedures and strategies<br>3.3 Business life cycle is analysed as per business procedures and strategies<br>3.4 Legal aspects of business are identified as per procedures and strategies<br>3.5 Product demand is assessed as per market strategies<br>3.6 Types of ***business environment*** are identified and evaluated as per business procedures<br>3.7 Factors to consider when evaluating business environment are explored based on business procedure and strategies<br>3.8 Technology in business is incorporated as per best practice |
| 4. Create entrepreneurial awareness | 4.1 ***Forms of businesses*** are explored as per business procedures and strategies<br>4.2 Sources of business finance are identified as per business procedures and strategies<br>4.3 Factors in selecting source of business finance are identified as per business procedures and strategies<br>4.4 ***Governing policies*** on Small Scale Enterprises (SSEs) are determined as per business procedures and strategies<br>4.5 Problems of starting and operating SSEs are explored as per business procedures and strategies |

| | |
|---|---|
| 5. Apply entrepreneurial motivation | 5.1 ***Internal and external motivation*** factors are determined in accordance with motivational theories<br>5.2 Self-assessment is carried out as per entrepreneurial orientation<br>5.3 Effective communications are carried out in accordance with communication principles<br>5.4 Entrepreneurial motivation is applied as per motivational theories |
| 6. Develop innovative business strategies | 6.1 Business innovation strategies are determined in accordance with the organization strategies<br>6.2 Creativity in business development is demonstrated in accordance with business strategies<br>6.3 ***Innovative business strategies*** are developed as per business principles<br>6.4 Linkages with other entrepreneurs are created as per best practice<br>6.5 ICT is incorporated in business growth and development as per best practice |
| 7. Develop Business Plan | 7.1 Identified Business is described as per business procedures and strategies<br>7.2 Marketing plan is developed as per business plan format<br>7.3 Organizational/Management plan is prepared in accordance with business plan format<br>7.4 Production/operation plan in accordance with business plan format<br>7.5 Financial plan is prepared in accordance with the business plan format<br>7.6 Executive summary is prepared in accordance with business plan format<br>7.7 Business plan is presented as per best practice |



**RANGE**

This section provides work environment and conditions to which the performance criteria apply. It allows for different work environment and situations that will affect performance.

| **Variable** | **Range** |
|---|---|
| 1. Types of entrepreneurs may include but not limited to: | • Innovators<br>• Imitators<br>• Craft<br>• Opportunistic<br>• Speculators |
| 2. Characteristics of Entrepreneurs may include but not limited to: | • Creative<br>• Innovative<br>• Planner<br>• Risk taker<br>• Networker<br>• Confident<br>• Flexible<br>• Persistent<br>• Patient<br>• Independent<br>• Future oriented<br>• Goal oriented |
| 3. Requirements for entry into self-employment may include but not limited to | • Technical skills<br>• Management skills<br>• Entrepreneurial skills<br>• Resources<br>• Infrastructure |
| 4. Internal and external motivation may include but not limited to: | • Interest<br>• Passion<br>• Freedom<br>• Prestige<br>• Rewards<br>• Punishment<br>• Enabling environment |

| | |
|---|---|
| | • Government policies |
| 5. Business environment may include but not limited to: | • External<br>• Internal<br>• Intermediate |
| 6. Forms of businesses may include but not limited to: | • Sole proprietorship<br>• Partnership<br>• Limited companies<br>• Cooperatives |
| 7. Governing policies may include but not limited to: | • Increasing scope for finance<br>• Promoting cooperation between entrepreneurs and private sector<br>• Reducing regulatory burden on entrepreneurs<br>• Developing IT tools for entrepreneurs |
| 8. Innovative business strategies may include but not limited to: | • New products<br>• New methods of production<br>• New markets<br>• New sources of supplies<br>• Change in industrialization |



**REQUIRED SKILLS AND KNOWLEDGE**

This section describes the skills and knowledge required for this unit of competency.

**Required Skills**

The individual needs to demonstrate the following skills:

- Analytical
- Management
- Problem-solving
- Root-cause analysis
- Communication

**Required Knowledge**

The individual needs to demonstrate knowledge of:

- Decision making
- Business communication

- Change management
- Competition
- Risk
- Net working
- Time management
- Leadership
- Factors affecting entrepreneurship development
- Principles of Entrepreneurship
- Features and benefits of common operational practices, e. g., continuous improvement (kaizen), waste elimination,
- Conflict resolution
- Health, safety and environment (HSE) principles and requirements
- Customer care strategies
- Basic financial management
- Business strategic planning
- Impact of change on individuals, groups and industries
- Government and regulatory processes
- Local and international market trends
- Product promotion strategies
- Market and feasibility studies
- Government and regulatory processes
- Local and international business environment
- Relevant developments in other industries
- Regional/ County business expansion strategies



**EVIDENCE GUIDE**

This provides advice on assessment and must be read in conjunction with the performance criteria, required skills and knowledge and range.

| | |
|---|---|
| 1. Critical Aspects of Competency | 1. 1 Assessment requires evidence that the candidate:<br>1. 2 Distinguished entrepreneurs and businesspersons correctly<br>1. 3 Identified ways of becoming an entrepreneur appropriately<br>1. 4 Explored factors affecting entrepreneurship development appropriately<br>1. 5 Analysed importance of self-employment |

| | |
|---|---|
| | accurately<br>1. 6 Identified requirements for entry into self-employment correctly<br>1. 7 Identified sources of business ideas correctly<br>1. 8 Generated Business ideas and opportunities correctly<br>1. 9 Analysed business life cycle accurately<br>1. 10 Identified legal aspects of business correctly<br>1. 11 Assessed product demand accurately<br>1. 12 Determined Internal and external motivation factors appropriately<br>1. 13 Carried out communications effectively<br>1. 14 Identified sources of business finance correctly<br>1. 15 Determined Governing policy on small scale enterprise appropriately<br>1. 16 Explored problems of starting and operating SSEs effectively<br>1. 17 Developed Marketing, Organizational/Management, Production/Operation and Financial plans correctly<br>1. 18 Prepared executive summary correctly<br>1. 19 Determined business innovative strategies appropriately<br>1. 20 Presented business plan effectively |
| 2. Resource Implications | The following resources should be provided:<br>2.1 Access to relevant workplace where assessment can take place<br>2.2 Appropriately simulated environment where assessment can take place |
| 3. Methods of Assessment | 3.1 Written tests<br>3.2 Oral questions<br>3.3 Third party report<br>3.4 Interviews<br>3.5 Portfolio of Evidence |
| 4. Context of Assessment | Competency may be assessed<br>4.1 On-the-job<br>4.2 Off-the –job |

| | |
|---|---|
| | 4.3 During Industrial attachment |
| 5. Guidance information for assessment | Holistic assessment with other units relevant to the industry sector, workplace and job role is recommended. |

## DEMONSTRATE EMPLOYABILITY SKILLS

**UNIT CODE:** ENG/OS/WEF/CC/04/6/A

**UNIT DESCRIPTON**

This unit covers competencies required to demonstrate employability skills. It involves conducting self-management, demonstrating interpersonal communication, critical safe work habits, leading a workplace team, planning and organizing work, maintaining professional growth and development, demonstrating workplace learning, problem solving skills and managing ethical performance.

**ELEMENTS AND PERFORMANCE CRITERIA**

| **ELEMENT**<br><br>These describe the key outcomes which make up workplace function. | **PERFORMANCE CRITERIA**<br><br>These are assessable statements which specify the required level of performance for each of the elements.<br><br>***Bold and italicized terms are elaborated in the Range*** |
|---|---|
| 1. Conduct self-management | 1.1 Personal vision, mission and goals are formulated based on potential and in relation to organization objectives<br>1.2 Emotional intelligence is demonstrated as per workplace requirements.<br>1.3 Individual performance is evaluated and monitored according to the agreed targets.<br>1.4 Assertiveness is developed and maintained based on the requirements of the job.<br>1.5 Accountability and responsibility for own actions are demonstrated based on workplace instructions.<br>1.6 Self-esteem and a positive self-image are developed and maintained based on values.<br>1.7 Time management, attendance and punctuality are observed as per the organization policy.<br>1.8 Goals are managed as per the organization's objective<br>1.9 Self-strengths and weaknesses are identified based on personal objectives |
| 2. Demonstrate | 2.1 Writing skills are demonstrated as per communication |

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|---|---|
| interpersonal communication | policy<br>2.2 Negotiation and persuasion skills are demonstrated as per communication policy<br>2.3 Internal and external stakeholders' needs are identified and interpreted as per the communication policy<br>2.4 Communication networks are established based on workplace policy<br>2.5 Information is shared as per communication policy |
| 3. Demonstrate critical safe work habits | 3.1 Stress is managed in accordance with workplace policy.<br>3.2 Punctuality and time consciousness is demonstrated in line with workplace policy.<br>3.3 Personal objectives are integrated with organization goals based on organization's strategic plan.<br>3.4 ***Resources*** are utilized in accordance with workplace policy.<br>3.5 Work priorities are set in accordance to workplace goals and objectives.<br>3.6 Leisure time is recognized and utilized in line with personal objectives.<br>3.7 ***Drugs and substances of abuse*** are identified and avoided based on workplace policy.<br>3.8 HIV and AIDS prevention awareness is demonstrated in line with workplace policy.<br>3.9 Safety consciousness is demonstrated in the workplace based on organization safety policy.<br>3.10 ***Emerging issues*** are identified and dealt with in accordance with organization policy. |
| 4. Lead a workplace team | 4.1 Performance targets for the ***team*** are set based on organization's objectives<br>4.2 Duties are assigned in accordance with the organization policy.<br>4.3 ***Forms of communication*** in a team are established according to organization's policy.<br>4.4 Team performance is evaluated based on set targets as per workplace policy.<br>4.5 Conflicts are resolved between team members in line with organization policy.<br>4.6 Gender related issues are identified and mainstreamed in |

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| | accordance workplace policy.<br>4.7 Human rights and fundamental freedoms are identified and respected as Constitution of Kenya 2010.<br>4.8 Healthy relationships are developed and maintained in line with workplace. |
| 5. Plan and organize work | 5.1 Work plans are prepared based on activities and budget.<br>5.2 Assigned tasks are interpreted and expectations identified as per the workplace instructions.<br>5.3 Task occupational safety and health requirements are identified and observed regulations.<br>5.4 Work resources are identified, mobilized, allocated and utilized based on organization work plans.<br>5.5 Work activities are monitored and evaluated in line with work plans and workplace policy.<br>5.6 Work plans are reviewed based on target and available resources. |
| 6. Maintain professional growth and development | 6.1 Personal training needs are identified and assessed in line with the requirements of the job.<br>6.2 ***Training and career opportunities*** are identified and utilized based on job requirements.<br>6.3 Resources for training are mobilized and allocated based organizations and individual skills needs.<br>6.4 Licensees and certifications relevant to job and career are obtained and renewed as per policy.<br>6.5 Work priorities and personal commitments are balanced and managed based on requirements of the job and personal objectives.<br>6.6 Recognitions are sought as proof of career advancement in line with professional requirements. |
| 7. Demonstrate workplace learning | 7.1 Learning opportunities are sought and managed based on job requirement and organization policy.<br>7.2 Improvement in performance is demonstrated based on courses attended.<br>7.3 Application of learning is demonstrated in both technical and non-technical aspects based on requirements of the job<br>7.4 Time and effort is invested in learning new skills based on job requirements |

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| | 7.5 Initiative is taken to create more effective and efficient processes and procedures in line with workplace policy.<br>7.6 New systems are developed and maintained in accordance with the requirements of the job.<br>7.7 Awareness of personal role in workplace ***innovation*** is demonstrated based on requirements of the job. |
| 8. Demonstrate problem solving skills | 8.1 Creative, innovative and practical solutions are developed based on the problem<br>8.2 Independence and initiative in identifying and solving problems is demonstrated based on requirements of the job.<br>8.3 Team problems are solved as per the workplace guidelines<br>8.4 Problem solving strategies are applied as per the workplace guidelines<br>8.5 Problems are analyzed and assumptions tested as per the context of data and circumstances |
| 9. Manage ethical performance | 9.1 Policies and guidelines are observed as per the workplace requirements<br>9.2 Self-worth and professionalism is exercised in line with personal goals and organizational policies<br>9.3 Code of conduct is observed as per the workplace requirements<br>9.4 Integrity is demonstrated as per legal requirement |



**RANGE**

This section provides work environment and conditions to which the performance criteria apply. It allows for different work environment and situations that will affect performance.

| **Variable** | **Range** |
|---|---|
| 1. Drug and substance abuse may include but not limited to: | Commonly abused<br>• Alcohol<br>• Tobacco<br>• Miraa<br>• Over-the-counter drugs<br>• Cocaine |

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| | • Bhang<br>• Glue |
| 2. Feedback may include but not limited to: | • Verbal<br>• Written<br>• Informal<br>• Formal |
| 3. Relationships may include but not limited to: | • Man/Woman<br>• Trainer/trainee<br>• Employee/employer<br>• Client/service provider<br>• Husband/wife<br>• Boy/girl<br>• Parent/child<br>• Sibling relationships |
| 4. Forms of communication may include but not limited to: | • Written<br>• Visual<br>• Verbal<br>• Non verbal<br>• Formal and informal |
| 5. Team may include but not limited to: | • Small work group<br>• Staff in a section/department<br>• Inter-agency group |
| 6. Personal growth may include but not limited to: | • Growth in the job<br>• Career mobility<br>• Gains and exposure the job gives<br>• Net workings<br>• Benefits that accrue to the individual as a result of noteworthy performance |
| 7. Personal objectives may include but not limited to: | • Long term<br>• Short term<br>• Broad<br>• Specific |
| 8. Trainings and career opportunities may includes but not limited to | • Participation in training programs<br>• Serving as Resource Persons in conferences and workshops |

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| 9. Resource may include may but not limited to: | • Human<br>• Financial<br>• Technology |
| 10. Innovation may include but not limited to: | • New ideas<br>• Original ideas<br>• Different ideas<br>• Methods/procedures<br>• Processes<br>• New tools |
| 11. Emerging issues may include but not limited to: | • Terrorism<br>• Social media<br>• National cohesion<br>• Open offices |
| 12. Range of media for learning may include but not limited to: | • Mentoring<br>• peer support and networking<br>• IT and courses |



**REQUIRED SKILLS AND KNOWLEDGE**

This section describes the skills and knowledge required for this unit of competency.

**Required Skills**

The individual needs to demonstrate the following skills:

- Interpersonal
- Communication
- Critical thinking
- Organizational
- Negotiation
- Monitoring
- Evaluation
- Record keeping
- Problem solving
- Decision Making
- Resource utilization
- Resource mobilization

**Required Knowledge**

The individual needs to demonstrate knowledge of:

- Work values and ethics
- Company policies
- Company operations, procedures and standards
- Occupational Health and safety procedures
- Fundamental rights at work
- Workplace communication
- Concept of time
- Time management
- Decision making
- Types of resources
- Work planning
- Organizing work
- Monitoring and evaluation
- Record keeping
- Gender mainstreaming
- HIV and AIDS
- Drug and substance abuse
- Professional growth and development
- Technology in the workplace
- Innovation
- Emerging issues



**EVIDENCE GUIDE**

This provides advice on assessment and must be read in conjunction with the performance criteria, required skills and knowledge and range.

| | |
|---|---|
| 1. Critical aspects of Competency | Assessment requires evidence that the candidate:<br>1.1 Conducted self-management<br>1.2 Demonstrated interpersonal communication<br>1.3 Demonstrated critical safe work habits<br>1.4 Demonstrated the ability to lead a workplace team<br>1.5 Planned and organized work<br>1.6 Maintained professional growth and development<br>1.7 Demonstrated workplace learning<br>1.8 Demonstrated problem solving skills |

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| | 1.9 Demonstrated the ability to manage performance ethically |
| 2. Resource Implications | The following resources should be provided:<br>2.1 Access to relevant workplace where assessment can take place<br>2.2 Appropriately simulated environment where assessment can take place |
| 3. Methods of Assessment | Competency in this unit may be assessed through:<br>3.1 Observation<br>3.2 Oral questioning<br>3.3 Written test<br>3.4 Portfolio of Evidence<br>3.5 Interview<br>3.6 Third party report |
| 4. Context of Assessment | Competency may be assessed:<br>4.1 On-the-job<br>4.2 Off-the –job<br>4.3 During Industrial attachment |
| 5. Guidance information for assessment | Holistic assessment with other units relevant to the industry sector, workplace and job role is recommended. |

## DEMONSTRATE ENVIRONMENTAL LITERACY

**UNIT CODE:** ENG/OS/WEF/CC/05/6/A

**UNIT DESCRIPTION**

This unit specifies the competencies required to demonstrate environmental literacy. It involves, controlling environmental hazard and environmental pollution, demonstrating sustainable resource use, evaluating current practices in relation to resource usage, identifying environmental legislations/conventions for environmental concerns, implementing specific environmental programs, monitoring activities on environmental protection/Programs , analyzing resource use and developing resource conservation plans

**ELEMENTS AND PERFORMANCE CRITERIA**

| **ELEMENT**<br><br>These describe the key outcomes which make up workplace function. | **PERFORMANCE CRITERIA**<br><br>These are assessable statements which specify the required level of performance for each of the elements.<br><br>***Bold and italicized terms are elaborated in the Range*** |
|---|---|
| 1. Control environmental hazard | 1. 1 Storage methods for environmentally hazardous materials are strictly followed according to environmental regulations and OSHS.<br>1. 2 Disposal methods of hazardous wastes are followed according to environmental regulations and OSHS.<br>1. 3 ***PPE*** is used according to OSHS. |
| 2. Control environmental Pollution | 2.1 Environmental pollution ***control measures*** are implemented in accordance with international protocols.<br>2.2 Procedures for solid waste management are observed according Environmental Management and Coordination Act 1999<br>2.3 Methods for minimizing noise pollution is complied with based on Noise and Excessive Vibration *Pollution and* Control *Regulations*, 2009 |
| 3. Demonstrate sustainable resource use | 3.1 Methods for minimizing wastage are complied with based on organizational waste management guide |

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| | 3.2 Waste management procedures are employed following principles of 3Rs (Reduce, Reuse, Recycle)<br>3.3 Methods for economizing and reducing resource consumption are practiced as per the Constitution of Kenya 2010 Article 69 . |
| 4. Evaluate current practices in relation to resource usage | 4.1 Information on resource efficiency systems and procedures are collected and provided as per work groups/sector<br>4.2 Current resource usage is measured and recorded as per work group<br>4.3 Current purchasing strategies are analyzed and recorded according to industry procedures.<br>4.4 Current work processes to access information and data is analyzed following enterprise protocol. |
| 5. Identify environmental legislations/conventions for environmental concerns | 5.1 Environmental legislations/conventions and local ordinances are identified according to the different environmental aspects/impact<br>5.2 Industrial standard/environmental practices are described according to the different environmental concerns |
| 6. Implement specific environmental programs | 6.1 Programs/Activities are identified according to organizations policies and guidelines.<br>6.2 Individual roles/responsibilities are determined and performed based on the activities identified.<br>6.3 Problems/constraints encountered are resolved in accordance with organizations' policies and guidelines<br>6.4 Stakeholders are consulted based on company guidelines |
| 7. Monitor activities on Environmental protection/Programs | 7.1 Activities are periodically monitored and Evaluated according to the objectives of the environmental program<br>7.2 Feedback from stakeholders are gathered and considered in Proposing enhancements to the program based on consultations<br>7.3 Data gathered are analyzed based on Evaluation |

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| | requirements<br>7.4 Recommendations are submitted based on the findings<br>7.5 Management support systems are set/established to sustain and enhance the program<br>7.6 Environmental incidents are monitored and reported to<br>7.7 concerned/proper authorities |
| 8. Analyze resource use | 8.1 All resource consuming processes are Identified as per the organizational work plan<br>8.2 Quantity and nature of resource consumed is determined based on processes<br>8.3 Resource flow is analyzed as per different parts of the process.<br>8.4 Wastes are classified according to NEMA regulations on waste management. |
| 9. Develop resource Conservation plans | 9.1. Efficiency of use/conversion of resources is determined according to industry protocol.<br>9.2. Causes of low efficiency of use of resources are Determined based on industry protocol.<br>9.3. Plans for increasing the efficiency of resource use are developed based on findings. |



**RANGE**

This section provides work environments and conditions to which the performance criteria apply. It allows for different work environments and situations that will affect performance.

| **Variable** | **Range** |
|---|---|
| 1. PPE may include but not limited to | • Mask<br>• Gloves<br>• Goggles<br>• Safety hat<br>• Overall<br>• Hearing protector |

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| 2. Control measures may include but not limited to | • Methods for minimizing or stopping spread and ingestion of airborne particles<br>• Methods for minimizing or stopping spread and ingestion of gases and fumes<br>• Methods for minimizing or stopping spread and ingestion of liquid wastes |

## REQUIRED SKILLS AND KNOWLEDGE

This section describes the skills and knowledge required for this unit of competency.

### Required Skills

The individual needs to demonstrate the following skills:

- Measuring
- Recording
- Analytical
- Monitoring
- Communication
- Writing



### Required Knowledge

The individual needs to demonstrate knowledge of:

- PPEs
- Environmental regulations
- OSHS
- Pollution
- Waste management
- Principle of 3Rs
- Types of resources
- Techniques in measuring current usage of resources
- Environmental hazards
- Regulatory requirements

## EVIDENCE GUIDE

This provides advice on assessment and must be read in conjunction with the performance criteria, required skills and knowledge and range.

| | |
|---|---|
| 1. Critical Aspects of Competency | Assessment requires evidence that the candidate:<br><br>1.1 Controlled environmental hazard<br>1.2 Controlled environmental pollution<br>1.3 Demonstrated sustainable resource use<br>1.4 Evaluated current practices in relation to resource usage<br>1.5 Demonstrated knowledge of environmental legislations and local ordinances according to the different environmental issues /concerns.<br>1.6 Described industrial standard environmental practices according to the different environmental issues/concerns.<br>1.7 Resolved problems/ constraints encountered based on management standard procedures<br>1.8 Implemented and monitored environmental practices on a periodic basis as per company guidelines<br>1.9 Recommended solutions for the improvement of the program<br>1.10 Monitored and reported to proper authorities any environmental incidents |
| 2. Resource Implications | The following resources should be provided:<br><br>2.1 Workplace with storage facilities<br>2.2 Tools, materials and equipment relevant to the tasks (e.g. Cleaning tools, cleaning materials, trash bags)<br>2.3 PPE, manuals and references<br>2.4 Legislation, policies, procedures, protocols and local ordinances relating to environmental protection<br>2.5 Case studies/scenarios relating to environmental Protection |
| 3 Methods of Assessment | Competency in this unit may be assessed through:<br>3.1 Observation<br>3.2 Oral questioning<br>3.3 Written test<br>3.4 Portfolio of Evidence<br>3.5 Interview<br>3.6 Third party report |
| 4 Context of Assessment | Competency may be assessed<br>4.1 On-the-job |

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| | 4.2 Off-the –job<br>4.3 During Industrial attachment |
| 5 Guidance information for assessment | Holistic assessment with other units relevant to the industry sector, workplace and job role is recommended. |

## DEMONSTRATE OCCUPATIONAL SAFETY AND HEALTH PRACTICES

**UNIT CODE:** ENG/OS/WEF/CC/06/6/A

**UNIT DESCRIPTION**

This unit specifies the competencies required to demonstrate occupational health and safety practices. It involves identifying workplace hazards and risks, identifying and implementing appropriate control measures to hazards and risks and implementing OSH programs, procedures and policies/guidelines.

**ELEMENTS AND PERFORMANCE CRITERIA**

| **ELEMENT**<br>These describe the key outcomes which make up workplace function. | **PERFORMANCE CRITERIA**<br>These are assessable statements which specify the required level of performance for each of the elements.<br>***Bold and italicized terms are elaborated in the Range*** |
|---|---|
| 1. Identify workplace hazards and risk | 1.1 ***Hazards*** in the workplace are identified ***based their indicators***<br>1.2 Risks and hazards are evaluated based on legal requirements.<br>1.3 ***OSH concerns*** raised by workers are addressed as per legal requirements. |
| 2. Control OSH hazards | 2.1 Hazard prevention ***and control measures*** are implemented as per legal requirement.<br>2.2 Risk assessment is conducted and a risk matrix developed based on likely impact.<br>2.3 ***Contingency measures***, including ***emergency procedures*** during workplace ***incidents and emergencies*** are recognized and established in accordance with organization procedures. |
| 3. Implement OSH programs | 3.1 Company OSH program are identified, evaluated and reviewed based on legal requirements.<br>3.2 Company OSH programs are implemented as per legal requirements.<br>3.3 Workers are capacity built on OSH standards and procedures as per legal requirements<br>3.4 ***OSH-related records*** are maintained as per legal requirements. |

**RANGE**

This section provides work environments and conditions to which the performance criteria apply. It allows for different work environments and situations that will affect performance.

| Variable | Range |
|---|---|
| • Hazards may include but not limited to: | • Physical hazards – impact, illumination, pressure, noise,<br>• vibration, extreme temperature, radiation<br>• Biological hazards- bacteria, viruses, plants, parasites, mites, molds, fungi, insects<br>• Chemical hazards – dusts, fibers, mists, fumes, smoke, gasses, vapors<br>• Ergonomics<br>• Psychological factors – over exertion/ excessive force,<br>awkward/static positions, fatigue, direct pressure,<br>• varying metabolic cycles<br>• Physiological factors – monotony, personal relationship, work out cycle<br>• Safety hazards (unsafe workplace condition) – confined space, excavations, falling objects, gas leaks, electrical, poor storage of materials and waste, spillage, waste and debris<br>• Unsafe workers' act (Smoking in off-limited areas, Substance and alcohol abuse at work) |
| • Indicators may include but not limited to: | • Increased of incidents of accidents, injuries<br>• Increased occurrence of sickness or health complaints/ symptoms<br>• Common complaints of workers related to OSH<br>• High absenteeism for work-related reasons |

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| • OSH concerns may include but not limited to: | • Workers' experience/observance on presence of work hazards<br>• Unsafe/unhealthy administrative arrangements (prolonged work hours, no break time, constant overtime, scheduling of tasks)<br>• Reasons for compliance/non-compliance to use of PPEs or other OSH procedures/policies/guidelines |
| • Safety gears /PPE (Personal Protective Equipment) may include but not limited to: | • Arm/Hand guard, gloves<br>• Eye protection (goggles, shield)<br>• Hearing protection (ear muffs, ear plugs)<br>• Hair Net/cap/bonnet<br>• Hard hat<br>• Face protection (mask, shield)<br>• Apron/Gown/coverall/jump suit<br>• Anti-static suits<br>• High-visibility reflective vest |
| • Appropriate risk controls<br>may include but not limited to: | • Appropriate risk controls in order of impact are as follows:<br>• Eliminate the hazard altogether (i.e., get rid of the dangerous machine)<br>• Isolate the hazard from anyone who could be harmed (i.e., keep the machine in a closed room and operate it remotely; barricade an unsafe area off)<br>• Substitute the hazard with a safer alternative (i.e., replace the machine with a safer one)<br>• Use administrative controls to reduce the risk (i.e., train workers how to use equipment safely; train workers about the risks of harassment; issue signage)<br>• Use engineering controls to reduce the risk (i.e., attach guards to the machine to protect users)<br>• Use personal protective equipment (i.e., wear<br>• gloves and goggles when using the machine) |
| • Contingency measures may include but not limited to: | • Evacuation<br>• Isolation<br>• Decontamination<br>• (Calling designed) emergency personnel |

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| • Incidents and emergencies may include but not limited to: | • Chemical spills<br>• Equipment/vehicle accidents<br>• Explosion<br>• Fire<br>• Gas leak<br>• Injury to personnel<br>• Structural collapse<br>• Toxic and/or flammable vapors emission. |
| • OSH-related Records may include but not limited to: | • Medical/Health records<br>• Incident/accident reports<br>• Sickness notifications/sick leave application<br>• OSH-related trainings obtained |

**REQUIRED SKILLS AND KNOWLEDGE**

This section describes the skills and knowledge required for this unit of competency.

**Required Skills**

The individual needs to demonstrate the following skills:

- Communication
- Interpersonal
- Presentation
- Risk assessment
- Evaluation
- Critical thinking
- Problem solving
- Negotiation



**Required Knowledge**

The individual needs to demonstrate knowledge of:

- General OSH Principles
- Occupational hazards/risks recognition
- OSH organizations providing services on OSH evaluation and/or work environment measurements (WEM)
- National OSH regulations; company OSH policies and protocols
- Systematic gathering of OSH issues and concerns
- General OSH principles
- National OSH regulations

- Company OSH and recording protocols, procedures and policies/guidelines
- Training and/or counseling methodologies and strategies

**EVIDENCE GUIDE**

This provides advice on assessment and must be read in conjunction with the performance criteria, required skills and knowledge and range.

| | |
|---|---|
| 1. Critical Aspects of Competency | Assessment requires evidence that the candidate:<br>1.1 Identified hazards in the workplace based their indicators<br>1.2 Evaluated workplace hazards based on legal requirements.<br>1.3 Addressed OSH concerns raised by workers as per legal requirements.<br>1.4 Implemented hazard prevention and control measures as per legal requirement.<br>1.5 Conducted risk assessment as per legal requirement.<br>1.6 Developed risk matrix based on likely impact.<br>1.7 Recognized and established contingency measures in accordance with organization procedures.<br>1.8 Identified, evaluated and reviewed company OSH program based on legal requirements.<br>1.9 Implemented company OSH programs as per legal requirements.<br>1.10 Capacity built workers on OSH standards and procedures as per legal requirements<br>1.11 Maintained OSH-related records as per legal requirements. |
| 2. Resource Implications | The following resources should be provided:<br>2.3 Access to relevant workplace where assessment can take place<br>2.4 Appropriately simulated environment where assessment can take place |
| 3. Methods of Assessment | Competency in this unit may be assessed through:<br>3.1 Observation<br>3.2 Oral questioning<br>3.3 Written test<br>3.4 Portfolio of Evidence<br>3.5 Interview<br>3.6 Third party report |

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| 4. Context of Assessment | Competency may be assessed:<br>4.1 On-the-job<br>4.2 Off-the –job<br>4.3 During Industrial attachment |
| 5. Guidance information for assessment | Holistic assessment with other units relevant to the industry sector, workplace and job role is recommended. |

# COMMON UNITS OF COMPETENCY

## PREPARE AND INTERPRET TECHNICAL DRAWINGS

**UNIT CODE: ENG/OS/WEF/CC/01/6/A**

**UNIT DESCRIPTION**

This unit covers the competencies required to prepare and interpret technical drawings. It involves competencies to select, use and maintain drawing equipment and materials. It also involves producing plain geometry drawings, solid geometry drawings, pictorial and orthographic drawings of components and application of CAD packages.

**ELEMENTS AND PERFORMANCE CRITERIA**

| ELEMENT | PERFORMANCE CRITERIA<br>*(Bold and italicized terms are elaborated in the Range)* |
|---|---|
| 1. Use and maintain drawing equipment and materials | 1.1 ***Drawing equipment*** are identified and gathered according to task requirements<br>1.2 ***Drawing materials*** are identified and gathered according to task requirements<br>1.3 Drawing equipment are used and maintained as per manufacturer's instructions<br>1.4 Drawing materials are used as per workplace procedures<br>1.5 Waste materials are disposed in accordance with workplace procedures and environmental legislations<br>1.6 ***Personal Protective Equipment*** are used according to occupational safety and health regulations(to be removed) |
| 2. Produce plain geometry drawings | 2.1 Different types of lines used in drawing and their meanings are identified according to standard drawing conventions.<br>2.2 Different types of ***geometric forms*** are constructed according to standard drawing conventions.<br>2.3 Different types of angles are constructed according to principles of trigonometry.<br>2.4 Different types of angles are measured using appropriate measuring tools<br>2.5 Angles are bisected according to standard drawing |

| | |
|---|---|
| | conventions |
| 3. Produce solid geometry drawings | 3.1 Sketches and drawings of patterns are interpreted according to standard conventions<br>3.2 Patterns are developed in accordance with standard conventions |
| 4. Produce pictorial and orthographic drawings of components | 4.1 Different symbols and abbreviations are identified, and their meaning interpreted according to standard drawing conventions.<br>4.2 Isometric sketches and drawings of components are interpreted and produced in accordance with the standard conventions of isometric drawings.<br>4.3 First and third angle orthographic sketches and drawings of components are interpreted and produced in accordance with the standard conventions of orthographic drawings.<br>3.5 Freehand sketching of different types of geometric is conducted. |
| 5. Apply CAD packages in drawing | 5.1 CAD packages are selected according to task requirements.<br>5.2 CAD packages are applied in production of electrical and electronic circuits, piping, architectural and structural support drawings |



**RANGE**

| **Variable** | **Range** |
|---|---|
| 1. Drawing equipment may include but is not limited to: | • Drawing boards<br>• T and set squares<br>• Drawing set<br>• Computers with CAD packages |
| 2. Drawing materials may include but is not limited to: | • Drawing papers<br>• Pencils<br>• Erasers<br>• Masking tapes<br>• Paper clips |

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| 3. Personal Protective Equipment may include but is not limited to: | • Dust coats<br>• Gloves<br>• closed leather shoes |
| 4. Geometric forms may include but is not limited to: | • Circles<br>• Triangles<br>• Rectangles<br>• Parallelogram<br>• Polygons<br>• Pyramids<br>• Conic sections<br>• Prisms<br>• Loci |
| 5. Standard drawing conventions may include but is not limited to: | • Anatomy of engineering drawing (title block, coordinate grid system, revision block, notes and legends)<br>• Drawing scale (paper size and drawing symbols)<br>• International drawing standards |



**REQUIRED SKILLS AND KNOWLEDGE**

This section describes the skills and knowledge required for this unit of competency.

**Required skills**

The individual needs to demonstrate the following skills:

- Critical thinking
- Drawing
- Interpretation
- Drawing equipment handling
- Analysis and synthesis
- Communication
- Inter personal

**Required knowledge**

- The individual needs to demonstrate knowledge of:
- Drawing equipment and materials
- Freehand sketching
- Lettering
- Geometrical constructions

- Types of drawings
- Types of lines
- Isometric drawing conventions, features, characteristics, components
- Orthographic drawing conventions, features, characteristics, components
- Sketches and drawings of simple patterns

**EVIDENCE GUIDE**

This provides advice on assessment and must be read in conjunction with the performance criteria, required knowledge and understanding and range.

| | |
|---|---|
| 1. Critical Aspects of Competency | Assessment requires evidence that the candidate:<br>1.1 Applied and adhered to safety procedures<br>1.2 Maintained drawing equipment<br>1.3 Interpreted circuit, assembly and lay out diagrams<br>1.4 Applied appropriate technical standards, used proper tools and equipment for a given task<br>1.5 Produced sketches and drawings<br>1.6 Applied CAD packages in production of drawings |
| 2. Resource Implications | Resources the same as that of workplace are advised to be applied.<br>2.1 Drawing room<br>2.2 Drawing equipment and materials<br>2.3 Computers<br>2.4 CAD packages |
| 3. Methods of Assessment | Competency may be assessed through:<br>3.1 Observation<br>3.2 Oral questioning<br>3.3 Written test<br>3.4 Portfolio of Evidence<br>3.5 Interview<br>3.6 Third party report |
| 4. Context of Assessment | Competency may be assessed<br>4.1 On job<br>4.2 Off job<br>4.3 During industrial attachment |
| 5. Guidance information for assessment | Holistic assessment with other units relevant to the industry sector, workplace and job role is recommended. |

## APPLY ENGINEERING MATHEMATICS

**UNIT CODE:ENG/OS/WEF/CC/02/6/A**

**UNIT DESCRIPTION:**

This unit describes the competencies required by a technician in order toapply algebra apply trigonometry and hyperbolic functions, apply complex numbers, apply coordinate geometry, carry out binomial expansion, apply calculus, solve ordinary differential equations, carry out mensuration, apply power series, apply statistics, apply numerical methods, apply vector theory and apply matrix.

**ELEMENTS AND PERFORMANCE CRITERIA**

| **ELEMENT**<br>These describe the key outcomes which make up workplace function. | **PERFORMANCE CRITERIA**<br>These are assessable statements which specify the required level of performance for each of the elements.<br>***Bold and italicized terms are elaborated in the Range.*** |
|---|---|
| 1. Apply Algebra | 1.1 Calculations involving Indices are performed as per the concept<br>1.2 Calculations involving Logarithms are performed as per the concept<br>1.3 Scientific calculator is used in solving mathematical problems in line with manufacturer's manual<br>1.4 Simultaneous equations are performed as per the rules<br>1.5 Quadratic equations are calculated as per the concept |
| 2. Apply Trigonometry and hyperbolic functions | 2.1 Calculations are performed using trigonometric rules<br>2.2 Calculations are performed using hyperbolic functions |
| 3. Apply complex numbers | 1.1 Complex numbers are represented using Argand diagrams<br>1.2 Operations involving complex numbers are performed<br>1.3 Calculations involving complex numbers are performed using De Moivre's theorem |
| 4. Apply Coordinate Geometry | 4.1 Polar equations are calculated using coordinate geometry<br>4.2 Graphs of given polar equations are drawn using the Cartesian plane<br>4.3 Normal and tangents are determined using coordinate |

| ELEMENT<br>These describe the key outcomes which make up workplace function. | PERFORMANCE CRITERIA<br>These are assessable statements which specify the required level of performance for each of the elements.<br>***Bold and italicized terms are elaborated in the Range.*** |
|---|---|
| | geometry |
| 5. Carry out Binomial Expansion | 5.1 Roots of numbers are determined using binomial theorem<br>5.2 Errors of small changes are determined using binomial theorem |
| 6. Apply Calculus | 6.1 Derivatives of functions are determined using Differentiation<br>6.2 Derivatives of hyperbolic functions are determined using Differentiation<br>6.3 Derivatives of inverse trigonometric functions are determined using Differentiation<br>6.4 Rate of change and small change are determined using Differentiation.<br>6.5 Calculation involving stationery points of functions of two variables are performed using differentiation.<br>6.6 Integrals of algebraic functions are determined using integration<br>6.7 Integrals of trigonometric functions are determined using integration<br>6.8 Integrals of logarithmic functions are determined using integration<br>6.9 Integrals of hyperbolic and inverse functions are determined using integration |
| 7. Solve Ordinary differential equations | 7.1 First order and second order differential equations are solved using the method of undetermined coefficients<br>7.2 First order and second order differential equations are solved from given boundary conditions |
| 8. Carry out Mensuration | 8.1 Perimeter and areas of figures are obtained<br>8.2 Volume and of Surface area of solids are obtained<br>8.3 Area of irregular figures are obtained<br>8.4 Areas and volumes are obtained using Pappus theorem |
| 9. Apply Power Series | 9.1 Power series are obtained using Taylor's Theorem<br>9.2 Power series are obtained using McLaurin's 's theorem |
| 10. Apply Statistics | 10.1Mean, median ,mode and Standard deviation are obtained from given data<br>10.2Calculations are performed based on Laws of probability |

| ELEMENT<br>These describe the key outcomes which make up workplace function. | PERFORMANCE CRITERIA<br>These are assessable statements which specify the required level of performance for each of the elements.<br>***Bold and italicized terms are elaborated in the Range.*** |
|---|---|
| | 10.3Calculation involving ***probability distributions*** , mathematical expectation sampling distributions are performed<br>10.4Sampling distribution methods are applied in data analysis<br>10.5Calculations involving use of standard normal table, sampling distribution, T-distribution and Estimation are done<br>10.6Confidence intervals are determined |
| 11. Apply Numerical methods | 11.1Roots of polynomials are obtained using iterative ***numerical methods***<br>11.2Interpolation and extrapolation are performed using numerical methods |
| 12. Apply Vector theory | 12.1Vectors and scalar quantities are obtained in two and three dimensions<br>12.2***Operations*** on vectors are performed<br>12.3Position of vectors is obtained<br>12.4Resolution of vectors is done |
| 13. Apply Matrix | 13.1Determinant and inverse of 3x3 matrix are obtained<br>13.2Solutions of simultaneous equations are obtained<br>13.3Calculation involving Eigen values and Eigen vectors are performed |

**RANGE**

This section provides work environments and conditions to which the performance criteria apply. It allows for different work environments and situations that will affect performance.

| Variable | Range |
|---|---|
| 1. Operations may include but not limited to: | • Addition<br>• Subtraction |
| 2. Hyperbolic functions may include but not limited to: | • Sinh x<br>• Cosh x<br>• Cosec x<br>• Coth x<br>• Tanh x<br>• Sech x |
| 3. Probability Distributions may include but not limited to: | • Binomial<br>• Poisson<br>• Normal |
| 4. Numerical Methods may include but not limited to: | • Newton Raphson<br>• Gregory Newton |



**REQUIRED SKILLS AND KNOWLEDGE**

This section describes the skills and knowledge required for this unit of competency.

**Required Skills**

The individual needs to demonstrate the following skills:

- Applying fundamental operations (addition, subtraction, division, multiplication)
- Using and applying mathematical formulas
- Logical thinking
- Problem solving
- Applying statistics
- Drawing graphs
- Using different measuring tools

**Required knowledge**

The individual needs to demonstrate knowledge of:

- Fundamental operations (addition, subtraction, division, multiplication)
- Calculating area and volume
- Types and purpose of measuring instruments
- Units of measurement and abbreviations
- Rounding techniques
- Types of fractions
- Types of tables and graphs
- Presentation of data in tables and graphs
- Vector operations
- Matrix operations

**EVIDENCE GUIDE**

This provides advice on assessment and must be read in conjunction with the performance criteria, required skills and knowledge and range.



| | |
|---|---|
| 1. Critical aspects of Competency | Assessment requires evidence that the candidate:<br>1.1 Applied Trigonometry and hyperbolic functions<br>1.2 Applied complex numbers<br>1.3 Applied Calculus<br>1.4 Solved Ordinary differential equations<br>1.5 Carried out mensuration<br>1.6 Applied Power Series<br>1.7 Applied Vector theory<br>1.8 Applied Matrix<br>1.9 Applied Numerical methods |
| 2. Resource Implications | The following resources should be provided:<br>2.1 Access to relevant workplace or appropriately simulated environment where assessment can take place<br>2.2 Measuring equipment<br>2.3 Materials relevant to the proposed activity or tasks |
| 3. Methods of Assessment | Competency in this unit may be assessed through:<br>3.1 Observation<br>3.2 Oral questioning<br>3.3 Written test<br>3.4 Portfolio of Evidence |

| | |
|---|---|
| | 3.5 Interview<br>3.6 Third party report |
| 4. Context of Assessment | Competency may be assessed<br>4.1 On job<br>4.2 Off job<br>4.3 During industrial attachment |
| 5. Guidance information for assessment | Holistic assessment with other units relevant to the industry sector, workplace and job role is recommended. |

## APPLY MECHANICAL SCIENCE PRINCIPLES

**UNIT CODE:ENG/OS/WEF/CC/03/6/A**

**UNIT DESCRIPTION**

This unit describes the competencies required by a technician in order to apply a wide range of Mechanical science principles in their work. It includes determining forces in a system, demonstrating knowledge of moments, understanding friction principles, understanding motions in engineering, describing work, energy and power, performing machine calculations, demonstrating gas principles, applying heat knowledge, applying density knowledge and applying pressure principles.

**ELEMENTS AND PERFORMANCE CRITERIA**

| **ELEMENT**<br>These describe the key outcomes which make up workplace function. | **PERFORMANCE CRITERIA**<br>These are assessable statements which specify the required level of performance for each of the elements. ***Bold and italicized terms are elaborated in the Range.*** |
|---|---|
| 1. Determine forces in a system | 1.1 Forces are defined and described<br>1.2 ***Forces theorems*** are described<br>1.3 Resultant of coplanar forces are determined. |
| 2. Demonstrate knowledge of moments | 2.1 Moments are defined<br>2.2 Moments are calculated<br>2.3 Principles of moments are described<br>2.4 Couples are identified and applied in engineering systems. |
| 3. Understand friction principles | 3.1 Laws of friction are identified<br>3.2 Limiting friction is calculated<br>3.3 Forces applied at an angle to a horizontal plane are calculated<br>3.4 Coefficient of friction is calculated<br>3.5 Advantages and disadvantages of friction are identified. |
| 4. Understand motions in engineering | 4.1 Motion concepts are discussed<br>4.2 Laws of motion are identified<br>4.3 Motion calculations are performed<br>4.4 Displacement/time graphs are applied |
| 5. Describe work, energy | 5.1 Work is calculated |

| ELEMENT<br>These describe the key outcomes which make up workplace function. | PERFORMANCE CRITERIA<br>These are assessable statements which specify the required level of performance for each of the elements.<br>***Bold and italicized terms are elaborated in the Range.*** |
|---|---|
| and power | 5.2 Energy is calculated<br>5.3 Power calculations are performed |
| 6. Perform machine calculations | 6.1 ***Problems on simple machines*** are solved<br>6.2 Problems on levers are solved<br>6.3 Laws of machines are identified |
| 7. Demonstrate gas principles | 7.1 ***Gas laws*** are identified<br>7.2 Gas laws are applied in solving engineering problems<br>7.3 Uses of gases in engineering systems are identified |
| 8. Apply heat knowledge | 8.1 Heat concepts are discussed<br>8.2 Working principle of heat is defined<br>8.3 Heat capacity is discussed<br>8.4 Heat problems are solved |
| 9. Apply density knowledge | 9.1 ***Density terminology*** are discussed<br>9.2 Density measurements are carried out<br>9.3 Density problems are solved |
| 10. Apply pressure principles | 10.1 Pressure concepts are discussed<br>10.2 Working principles of pressure is discussed<br>10.3 Pressure problems are solved<br>10.4 ***Pressure applications*** are identified |



**RANGE**

This section provides work environments and conditions to which the performance criteria apply. It allows for different work environments and situations that will affect performance.

| Variable | Range |
|---|---|
| 1. Forces theorems may include but not limited to: | • Parallelogram<br>• Triangle<br>• Polygon |
| 2. Problems on simple machines may include but not limited to: | • Machine advantage<br>• Velocity ratio<br>• Efficiency |

| | |
|---|---|
| 3. Gas laws may include but not limited to: | • Boyles law<br>• Charles law<br>• Gas equation |
| 4. Density terminology may include but not limited to: | • Density<br>• Relative density |
| 5. Pressure applications may include but not limited to: | • Vacuum pump<br>• Hydraulic pump<br>• Hydrometers |
| 6. Principles may include but not limited to: | • Newton's laws of motion<br>• Law of conservation of linear momentum<br>• Law of conservation of energy<br>• Archimedes' principle |
| 7. Mechanical calculations may include but not limited to: | • Mechanical advantage<br>• Efficiency<br>• Torque<br>• Power/Energy<br>• Work done |
| 8. Laws of fluids may include but not limited to: | • Pascal's principle<br>• Gas laws |



**REQUIRED SKILLS AND KNOWLEDGE**

This section describes the skills and knowledge required for this unit of competency.

**Required Skills**

The individual needs to demonstrate the following skills:

- Apply basic mechanical formulas
- Use of basic mechanical machines
- Perform various unit conversions of mechanical quantities
- Basic mechanical systems design
- Mechanical machine operation
- Logical thinking
- Problem solving
- Applying statistics
- Drawing graphs
- Using different measuring tools

**Required knowledge**

The individual needs to demonstrate knowledge of:

- Newton's law
- Levers
- Gear trains
- Laws of conservation of energy
- Laws of friction
- Type of forces
- Thermodynamics
- Calculation of fluid pressure and flow rate
- Mechanical advantage and efficiency calculations
- Properties of materials
- Gas laws
- SI units of mechanical energy.
- Power transmission systems
- Parameters of fluid system
- Operation of mechanical machines
- Mechanical calculation of power, energy, work done, torque and safety factor
- Units of measurement, conversions and abbreviations

**EVIDENCE GUIDE**

This provides advice on assessment and must be read in conjunction with the performance criteria, required skills and knowledge and range.

| | |
|---|---|
| 1. Critical aspects of Competency | Assessment requires evidence that the candidate:<br>1.1 Determined forces in a system<br>1.2 Demonstrated knowledge of moments<br>1.3 Understood friction principles<br>1.4 Understood motions in engineering<br>1.5 Described work, energy and power<br>1.6 Performed machine calculations<br>1.7 Demonstrated gas principles<br>1.8 Applied heat knowledge<br>1.9 Applied density knowledge<br>1.10 Applied pressure principles |
| 2. Resource Implications | The following resources should be provided:<br>2.1 Access to relevant workplace or appropriately simulated environment where assessment can take place<br>2.2 Measuring tools and equipment<br>2.3 Sample materials to be tested |
| 3. Methods of Assessment | Competency in this unit may be assessed through:<br>3.1 Direct Observation<br>3.2 Demonstration with Oral Questioning<br>3.3 Case studies<br>3.4 Written tests |
| 4. Context of Assessment | Competency may be assessed<br>4.1 On job<br>4.2 Off job<br>4.3 During industrial attachment |
| 5. Guidance information for assessment | Holistic assessment with other units relevant to the industry sector, workplace and job role is recommended. |

## APPLY FLUID MECHANICS PRINCIPLES

**UNIT CODE: ENG/OS/WEF/CC/04/6/A**

**UNIT DESCRIPTION**

This unit describes the competencies required by a technician in order to apply a wide range of fluid mechanics principles in their work. It includes understanding flow of fluids, demonstrating knowledge in viscous flow, performing dimensional analysis and operating fluid pumps.

**ELEMENTS AND PERFORMANCE CRITERIA**

| **ELEMENT**<br>These describe the key outcomes which make up workplace function. | **PERFORMANCE CRITERIA**<br>These are assessable statements which specify the required level of performance for each of the elements.<br>***Bold and italicized terms are elaborated in the Range.*** |
|---|---|
| 1. Understand flow of fluids | 1.1 Flow rate in pipes is measured<br>1.2 Losses in pipes are determined<br>1.3 ***Causes of losses*** in pipes are determined<br>1.4 Flow losses equations are applied in problem solving |
| 2. Demonstrate knowledge in viscous flow | 2.1 Viscous flow between parallel surfaces are explained<br>2.2 Viscous flow equations between parallel surfaces are derived and applied<br>2.3 Viscous flow equations in circular pipes are derived and applied in problem solving |
| 3. Perform dimensional analysis | 3.1 Dimensional analysis is explained<br>3.2 Principle of dimensional homogeneity is explained<br>3.3 Fundamental dimensions are stated<br>3.4 Dimensional units are defined<br>3.5 ***Physical quantities*** are identified<br>3.6 Dimensional analysis is ***applied*** in problem solving |
| 4. Operate fluid pumps | 4.1 ***Principle of operation*** of pumps is described<br>4.2 ***Reciprocating pump equation is derived***<br>***4.3 Centrifugal pump equation is derived*** |

| ELEMENT<br>These describe the key outcomes which make up workplace function. | PERFORMANCE CRITERIA<br>These are assessable statements which specify the required level of performance for each of the elements.<br>***Bold and italicized terms are elaborated in the Range.*** |
|---|---|
| | 4.4 Pump equations are applied in problem solving |

**RANGE**

This section provides work environments and conditions to which the performance criteria apply. It allows for different work environments and situations that will affect performance.

| Variable | Range |
|---|---|
| 1. Causes of losses may include but not limited to: | • Friction<br>• Enlargement/reduction in cross-sectional areas |
| 2. Physical quantities may include but not limited to: | • Mass<br>• Force<br>• Density<br>• Velocity<br>• Acceleration |
| 3. Applied may include but not limited to: | • Reynolds number<br>• Mach number<br>• Froude number |
| 4. Principle of operation may include but not limited to: | • Reciprocating<br>• Centrifugal |
| 5. Reciprocating pump equation is derived may include but not limited to: | • Coefficient of discharge<br>• Percentage slip<br>• Work done<br>• Acceleration head<br>• Pressure head in the cylinder |
| 6. Centrifugal pump equation is derived may include but not limited to: | • Effective head<br>• Manometric head<br>• Manometric efficiency<br>• Mechanical efficiency<br>• Discharge |

| | |
|---|---|
| | • Torque<br>• Work done unit weight<br>• Specific speed |

**REQUIRED SKILLS AND KNOWLEDGE**

This section describes the skills and knowledge required for this unit of competency.

**Required Skills**

The individual needs to demonstrate the following skills:

- Apply basic mechanical formulas
- Use of basic mechanical machines
- Perform various unit conversions of mechanical quantities
- Basic mechanical systems design
- Mechanical machine operation
- Logical thinking
- Problem solving
- Applying statistics
- Drawing graphs
- Using different measuring tools



**Required knowledge**

The individual needs to demonstrate knowledge of:

- Newton's law
- Levers
- Gear trains
- Laws of conservation of energy
- Laws of friction
- Type of forces
- Thermodynamics
- Calculation of fluid pressure and flow rate
- Mechanical advantage and efficiency calculations

- Gas laws
- SI units of mechanical energy.
- Power transmission systems
- Parameters of fluid system
- Operation of mechanical machines
- Mechanical calculation of power, energy, work done, torque and safety factor
- Units of measurement, conversions and abbreviations

**EVIDENCE GUIDE**

This provides advice on assessment and must be read in conjunction with the performance criteria, required skills and knowledge and range.

| | |
|---|---|
| 1 Critical aspects of Competency | Assessment requires evidence that the candidate:<br>1.1 Identified Principles of mechanical science<br>1.2 Performed mechanical calculations of a system<br>1.3 Identified types of forces on a system<br>1.4 Calculated resultant forces on plane framework<br>1.5 Identified application of forces on the production flow<br>1.6 Tested mechanical properties of a materials<br>1.7 Identified tools and equipment for measuring system parameters<br>1.8 Recorded and interpreted measured parameters.<br>1.9 Operated Power transmission systems |
| 2. Resource Implications | The following resources should be provided:<br>2.4 Access to relevant workplace or appropriately simulated environment where assessment can take place<br>2.5 Measuring tools and equipment<br>2.6 Sample materials to be tested |
| 3. Methods of Assessment | Competency in this unit may be assessed through:<br>3.1 Observation<br>3.2 Oral questioning<br>3.3 Written test<br>3.4 Portfolio of Evidence<br>3.5 Interview<br>3.6 Third party report |
| Context of Assessment | Competency may be assessed<br>4.1 On job<br>4.2 Off job |

| | |
|---|---|
| | 4.3 During industrial attachment |
| Guidance information for assessment | Holistic assessment with other units relevant to the industry sector, workplace and job role is recommended. |

## APPLY THERMODYNAMICS PRINCIPLES

**UNIT CODE:ENG/OS/WEF/CC/05/6/A**

**UNIT DESCRIPTION**

This unit describes the competencies required by a technician in order to apply thermodynamics principles in their work. It includes understanding fundamentals of thermodynamics, performing steady flow processes, performing non-steady flow processes, understanding perfect gases, generating steam, performing thermodynamics reversibility and entropy, understanding idea gas cycle, demonstrating fuel and combustion, perform heat transfer, understanding heat exchangers, understanding air compressors, understanding gas turbines and understanding of impulse steam turbines.

**ELEMENTS AND PERFORMANCE CRITERIA**

| **ELEMENT**<br>These describe the key outcomes which make up workplace function. | **PERFORMANCE CRITERIA**<br>These are assessable statements which specify the required level of performance for each of the elements.<br>***Bold and italicized terms are elaborated in the Range.*** |
|---|---|
| 1. Understand fundamentals of thermodynamics | 1.1 Terms used in thermodynamics are described<br>1.2 Thermodynamics processes and cycles are described<br>1.3 First law of thermodynamics is applied |
| 2. Perform steady flow processes | 2.1 Steady flow energy equation is derived<br>2.2 Steady flow energy equation is applied in problem solving<br>2.3 Steady flow energy equation is applied in ***utilities*** |
| 3. Perform non steady flow processes | 3.1 Non-flow energy equation is derived<br>3.2 Non-flow energy equation is applied in problem solving |
| 4. Understand perfect gases | 4.1 ***Perfect gas laws*** are stated<br>4.2 Gas laws experiment are carried out<br>4.3 Gas laws are applied |
| 5. Generate steam | 5.1 Dryness fraction is determined |

| ELEMENT<br>These describe the key outcomes which make up workplace function. | PERFORMANCE CRITERIA<br>These are assessable statements which specify the required level of performance for each of the elements.<br>***Bold and italicized terms are elaborated in the Range.*** |
|---|---|
| | 5.2 Relationship between pressure and boiling point is determined<br>5.3 Energy balance is carried out<br>5.4 Relationship between temperature and pressure is determined. |
| 6. Perform thermodynamics reversibility and entropy | 6.1 Thermodynamics reversibility is explained<br>6.2 Principles of heat engine are explained<br>6.3 Second law of thermodynamics is applied<br>6.4 Entropy is explained in thermodynamics cycle |
| 7. Understand idea gas cycle | 7.1 Ideal gas cycle processes are explained<br>7.2 Air standard efficiency and actual efficiency are differentiated<br>7.3 Problems are solved in ideal gas cycle |
| 8. Demonstrate fuel and combustion | 8.1 Fuels are classified<br>8.2 Properties of fuels are described<br>8.3 Combustion equation are derived<br>8.4 Combustion equation is applied to combustion and exhaust gas problems |
| 9. Perform heat transfer | 9.1 Conduction equation is derived and applied from Fourier's law<br>9.2 Heat transfer equation is derived and applied from Newton's law of cooling and Fourier's law |
| 10. Understand heat exchangers | 10.1 Heat exchangers are classified<br>10.2 Recuperative heat exchangers are described<br>10.3 Heat equations are applied to solve heat exchanger problems |
| 11. Understand air compressors | 11.1 Air compressors are classified<br>11.2 ***Types of air compressors*** are described<br>11.3 Equations of reciprocating compressors are derived and applied |
| 12. Understand gas turbines | 12.1 Theoretical cycle for gas turbines is |

| ELEMENT<br>These describe the key outcomes which make up workplace function. | PERFORMANCE CRITERIA<br>These are assessable statements which specify the required level of performance for each of the elements.<br>***Bold and italicized terms are elaborated in the Range.*** |
|---|---|
| | explained<br>12.2 Open cycle gas turbine is described<br>12.3 Closed cycle gas turbine is described<br>12.4 Gas turbine equations are derived and applied |
| 13. Understand impulse steam turbines | 13.1 ***Principles of operations*** of the impulse steam turbines is described<br>13.2 Impulse steam turbine equation is derived and applied |

**RANGE**

This section provides work environments and conditions to which the performance criteria apply. It allows for different work environments and situations that will affect performance.



| Variable | Range |
|---|---|
| 1. Utilities may include but not limited to: | • Boilers<br>• Condensers<br>• Compressors<br>• Nozzles<br>• Throttling processes |
| 2. Perfect gas laws may include but not limited to: | • Boyle's law<br>• Charle's law<br>• Joule's law |
| 3. Principles may include but not limited to: | • Newton's laws of motion<br>• Law of conservation of linear momentum<br>• Law of conservation of energy<br>• Archimedes' principle |
| 4. Types of air compressors may include but not limited to: | • Reciprocating<br>• Blowers<br>• Sliding valves |

| | |
|---|---|
| 5. Types of air compressors may include but not limited to: | • Compounding<br>• Multistage impulse turbine |

**REQUIRED SKILLS AND KNOWLEDGE**

This section describes the skills and knowledge required for this unit of competency.

**Required Skills**

The individual needs to demonstrate the following skills:

- Apply basic mechanical formulas
- Use of basic mechanical machines
- Perform various unit conversions of mechanical quantities
- Basic mechanical systems design
- Mechanical machine operation
- Logical thinking
- Problem solving
- Applying statistics
- Drawing graphs
- Using different measuring tools



**Required knowledge**

The individual needs to demonstrate knowledge of:

- Newton's law
- Levers
- Gear trains
- Laws of conservation of energy
- Laws of friction
- Type of forces
- Thermodynamics
- Calculation of fluid pressure and flow rate
- Mechanical advantage and efficiency calculations
- Gas laws

SI units of mechanical energy.

- Power transmission systems
- Parameters of fluid system

- Operation of mechanical machines
- Mechanical calculation of power, energy, work done, torque and safety factor
- Units of measurement, conversions and abbreviations

**EVIDENCE GUIDE**

This provides advice on assessment and must be read in conjunction with the performance criteria, required skills and knowledge and range.

| | |
|---|---|
| 1. Critical aspects of Competency | Assessment requires evidence that the candidate:<br>1.1 Identified Principles of mechanical science<br>1.2 Performed mechanical calculations of a system<br>1.3 Identified types of forces on a system<br>1.4 Calculated resultant forces on plane framework<br>1.5 Identified application of forces on the production flow<br>1.6 Tested mechanical properties of a materials<br>1.7 Identified tools and equipment for measuring system parameters<br>1.8 Recorded and interpreted measured parameters.<br>1.9 Operated Power transmission systems |
| 2. Resource Implications | The following resources should be provided:<br>5.1 Access to relevant workplace or appropriately simulated environment where assessment can take place<br>5.2 Measuring tools and equipment<br>5.3 Sample materials to be tested |
| 3. Methods of Assessment | Competency in this unit may be assessed through:<br>3.1 Direct Observation<br>3.2 Demonstration with Oral Questioning<br>3.3 Case studies<br>3.4 Written tests |
| 4. Context of Assessment | Competency may be assessed<br>4.1 On job<br>4.2 Off job<br>4.3 During industrial attachment |
| 5. Guidance information for assessment | Holistic assessment with other units relevant to the industry sector, workplace and job role is recommended. |

## APPLY MATERIAL SCIENCE AND PERFORM METALLURGICAL PROCESSES

**UNIT CODE: ENG/OS/WEF/CC/06/6/A**

**UNIT DESCRIPTION:**

The trainee will be introduced to performing material testing and metallurgical processes. It involves analysing properties of engineering materials, performing extraction processes, producing iron materials, ceramics, composites and alloys, performing heat treatment, material testing and identifying corrosion and its prevention.

**ELEMENTS AND PERFORMANCE CRITERIA**

| **ELEMENT**<br>These describe the key outcomes which make up workplace function | **PERFORMANCE CRITERIA**<br>These are assessable statements which specify the required level of performance for each of the elements ***(Bold and italicized terms are elaborated in the Range)*** |
|---|---|
| 1. Analyse properties of engineering materials | 1.1 Type of engineering materials is identified as per the procedures<br>1.2 ***Physical properties*** of engineering material are determined<br>1.3 ***Mechanical properties*** of engineering materials are tested<br>1.4 Crystal structure of materials are analysed |
| 2. Perform ore extraction processes | 2.1 Safety procedures are observed according OSHA<br>2.2 Method of extraction is determined as per material properties and its composition<br>2.3 Procedure in extraction process is determined as per extraction method<br>2.4 Extraction by- products are stored as per SOPs<br>2.5 Extraction by- products are disposed as per SOPs |
| 3. Produce iron materials | 3.1 Perform ore smelting according to standard operating procedures.<br>3.2 ***Composition of iron*** is determined<br>3.3 Method of producing ***iron material*** is established<br>3.4 Refinement processes are identified based on iron material required |

| | |
|---|---|
| 4. Produce alloy materials | 4.1 Materials in alloy formation are identified<br>4.2 Alloy formation process is identified based on alloy to be produced<br>4.3 Alloy tested based on alloy production requirement |
| 5. Produce non-ferrous materials | 5.1 **Non-ferrous materials** are extracted according to SOP<br>5.2 Extracted non-ferrous material is smelted and purified as per the SOP<br>5.3 Non-ferrous material is tested according to SOP<br>5.4 Alloying elements for non-ferrous materials are identified<br>5.5 Alloy formation process is identified based on alloy to be produced<br>5.6 Alloys for non-ferrous material are tested based on production requirement |
| 6. Produce ceramics materials | 6.1 Composition of **ceramic materials** is identified<br>6.2 Manufacturing process is identified<br>6.3 Ceramic materials are produced according to manufacturing processes<br>6.4 ***Finishing processes*** are identified |
| 7. Produce composite materials | 7.1 Type of composite to be produced is identified<br>7.2 Elements involve in composite formation are identified<br>7.3 Formation process of composite to be produced is identified<br>7.4 Composite is tested as per composite production requirement |
| 8. Utilise other engineering materials | 8.1 Identify and select ***engineering material*** according to production requirements.<br>8.2 Operation plan is developed according to engineering drawing.<br>8.3 Appropriate machine is set up according to manufacturer's manual<br>8.4 Production parameters are set according to production requirement<br>8.5 Production is performed |

| | |
|---|---|
| 9. Perform heat treatment | 9.1 Safety practices are observed according to OSHA 2007<br>9.2 **Heat treatment processes** are identified<br>9.3 Procedure in heat treatment processes<br>9.4 Heat treatment of metals are performed |
| 10. Perform material testing | 10.1 Safety is observed in material testing procedures<br>10.2 **Material testing methods** are identified depending on material to be tested<br>10.3 Procedure of material testing is followed as per material testing method<br>10.4 Material testing results are tabulated, calculated and interpreted<br>10.5 Material testing equipment are taken care of and maintained. |
| 11. Prevent material corrosion | 11.1 Safety is observed during corrosion prevention<br>11.2 ***Corrosion type*** is identified<br>11.3 Corrosive atmosphere is identified<br>11.4 ***Methods of corrosion prevention*** are identified<br>11.5 Corrosion is prevented |



**RANGE**

This section provides work environments and conditions to which the performance criteria apply. It allows for different work environments and situations that will affect performance.

| **Variable** | **Range** |
|---|---|
| 1. Physical properties may include but not limited to: | • Density<br>• Colour<br>• Texture<br>• Melting point<br>• Thermo conductivity<br>• Electrical resistivity |

| | |
|---|---|
| 2. Mechanical properties may include but not limited to: | • Ductility<br>• Malleability<br>• Elasticity<br>• Toughness<br>• Hardness<br>• Brittleness<br>• Plasticity<br>• Strength |
| 3. Composition of iron may include but not limited to: | • Iron (II) oxide<br>• 1.2 Iron (III) oxide |
| 4. Iron materials may include but not limited to: | • Cast iron<br>• Steel |
| 5. Non-ferrous materials | • Aluminium<br>• Copper |
| 6. ceramic materials may include but not limited to: | • oxides<br>• nitrides<br>• carbides<br>• silica |
| 7. Finishing processes may include but not limited to: | • Lapping<br>• Fine grinding<br>• Polishing |
| 8. engineering materials may include but not limited to: | • Rubber<br>• Plastics<br>• Wood<br>• Glass |
| 9. Corrosion type may include but not limited to: | • Galvanic<br>• Stress corrosion cracking |
| 10. Methods of corrosion prevention may include but not limited to: | • Painting<br>• Electroplating<br>• Galvinizing<br>• Cathodic<br>• Chromizing |

## REQUIRED KNOWLEDGE AND SKILLS

The individual needs to demonstrate the following skills

**Required Skills**

- Measuring and marking
- Material testing
- Use of hand tools
- Inspection and testing

## REQUIRED KNOWLEDGE AND UNDERSTANDING

The individual needs to demonstrate knowledge of:

- Occupational Health and Safety Act of Kenya laws 2007 with focus on personal safety, machine safety and workplace
- National Environment Management Authority Act, Kenya 2004
- OSH ACT 2007
- Equipment manuals
- Mathematics & science
- Physics and mechanics
- Metallurgy and materials
- Inspection and testing
- WIBA ACT
- Report writing



## EVIDENCE GUIDE

This provides advice on assessment and must be read in conjunction with the performance criteria, required skills and knowledge and range.

| | |
|---|---|
| 1. Critical Aspects of Competency | Assessment requires evidence that the candidate:<br>1.1 Observed safety as per work place procedures<br>1.2 Demonstrated understanding of physical, chemical and mechanical properties of engineering materials<br>1.3 Performed extraction processes<br>1.4 Produced iron materials<br>1.5 Produced ceramics<br>1.6 Produced composites<br>1.7 Produced alloys |

| | |
|---|---|
| | 1.8 Performed heat treatment<br>1.9 Performed material testing<br>1.10 Demonstrated understanding of corrosion types and its prevention |
| 2. Resource Implications | 2.1 Testing materials<br>2.2 Extraction materials<br>2.3 Measuring instruments<br>2.4 Inspection tools |
| 3. Methods of Assessment | Competency may be accessed through:<br>3.1 Observation<br>3.2 Oral questioning<br>3.3 Written test<br>3.4 Portfolio of Evidence<br>3.5 Interview<br>3.6 Third party report |
| 4. Context of Assessment | Competency may be assessed<br>4.1 On job<br>4.2 Off job<br>4.3 During industrial attachment |
| 5. Guidance information for assessment | Holistic assessment of other units relevant to the industry sector, workplace and job role is recommended. |

**CORE UNITS OF COMPETENCY**

## PERFORM SOLDERING AND GAS WELDING

**UNIT CODE: ENG/OS/WEF/CR/01/6/A**

**UNIT DESCRIPTION**

This unit specifies competencies required for setting up equipment and materials, carrying out soldering process, setting up gas welding equipment and materials, carrying out gas welding, setting up gas cutting equipment and materials and carrying out gas cutting operation.

**ELEMENTS AND PERFORMANCE CRITERIA**

| **ELEMENT**<br>These describe the key outcomes which make up workplace function | **PERFORMANCE CRITERIA**<br>These are assessable statements which specify the required level of performance for each of the elements<br>***(Bold and italicized terms are elaborated in the Range)*** |
|---|---|
| 1. Set up soldering equipment and materials | 1.1 Safety and health is observed as per Workplace procedures and OSHA<br>1.2 Working drawings are interpreted as per job specifications<br>1.3 Materials, tools and equipment are selected as per job specifications<br>1.4 Joints are prepared as per working drawings<br>1.5 ***Soldering equipment*** is set up as per job specifications |
| 2. Carry out soldering process | 2.1 Work pieces are soldered as per job specifications<br>2.2 Soldered joints are examined as per ISO 12224 standards<br>2.3 Housekeeping is conducted as per workplace procedures |
| 3. Set up gas welding equipment and materials | 3.1 Safety and health is observed as per Workplace procedures and OSHA<br>3.2 Working drawings are interpreted as per job specifications<br>3.3 Materials, tools and equipment are selected as per job specifications<br>3.4 Joints are prepared as per working drawings<br>3.5 ***Gas welding equipment*** is set up as per job specifications |
| 4. Carry out gas welding process | 4.1 Safety and health is observed as per Workplace procedures and OSHA<br>4.2 Work pieces are gas welded as per job |

| | |
|---|---|
| | specifications and ISO 9606-1<br>4.3 Welded joints as examined per ISO 17637 standard<br>4.4 Housekeeping is conducted in accordance with workplace procedures |
| 5. Set up gas cutting equipment and materials | 5.1 Safety and health is observed as per Workplace procedures and OSHA<br>5.2 Working drawings are interpreted as per job specifications<br>5.3 Materials, tools and equipment are selected as per job specifications<br>5.4 Gas cutting torch is set up as per job specifications |
| 6. Carry out gas cutting operation | 6.1 Safety and health is observed as per Workplace procedures and OSHA<br>6.2 Work pieces are gas cut as per job specifications and ISO 9606-1<br>6.3 Kerf is examined as per standard operating procedures<br>6.4 Housekeeping is conducted in accordance with workplace procedures |



**RANGE**

This section provides work environments and conditions to which the performance criteria apply. It allows for different work environments and situations that will affect performance.

| Variable | Range |
|---|---|
| 1. Soldering equipment may include but not limited to: | • Soldering safety gear<br>• Soldering bits/ iron<br>• Solder<br>• Heat source<br>• Soldering fluxes<br>• Brazing fluxes<br>• Brazing rods (Spelter) |
| 2. Gas welding equipment may include but not limited to: | • Gas welding PPE<br>• Gas cylinders<br>• Gas welding torch<br>• Gas cutting torch<br>• Regulators |

| Variable | Range |
|---|---|
| | • Hoses<br>• Spark lighter/ gas lighter |
| 3. Materials may include but not limited to: | • Metal tubing<br>• Metal sheets<br>• Metal plates<br>• Metal bars |

**REQUIRED SKILLS AND KNOWLEDGE**

This section describes the skills and knowledge required for this unit of competency.

**Required knowledge**

The individual needs to demonstrate knowledge of:

- Workplace procedures and OSHA
- Gas welding equipment
- Joint preparation techniques
- Welding positions
- Soldering techniques and specification procedure
- Gas welding techniques and specification procedure
- BS and ISO welded joint standards
- Workplace housekeeping procedures
- Gas cutting techniques
- Gas cutting equipment
- Gas cutting safety



**Required skills**

The individual needs to demonstrate the following skills:

- Interpreting working drawings
- Preparing joints
- Soldering
- Gas welding
- Gas cutting
- Product assessment
- Workplace housekeeping procedures

**EVIDENCE GUIDE**

This section provides advice on assessment and must be read in conjunction with the performance criteria, required skills and knowledge and range.

| | |
|---|---|
| 1. Critical aspects of competency | Assessment requires evidence that the candidate:<br>1.1 Observed safety and health as per Workplace procedures and OSHA<br>1.2 Selected materials, tools and equipment as per job specifications<br>1.3 Prepared joints as per working drawings<br>1.4 Set up soldering equipment in accordance with job specifications<br>1.5 Soldered work as per job specifications and ISO 9006-1 standard<br>1.6 Set up gas welding equipment in accordance with job specifications<br>1.7 Gas welded workpieces as per job specifications and ISO 9006-1 standard<br>1.8 Gas welded work pieces are examined as per ISO 17637<br>1.9 Set up gas cutting equipment as per job specifications<br>1.10 Gas cut workpieces as per job specifications |
| 2. Resource implications | The following resources must be provided:<br>2.1 Fully equipped soldering and gas welding workshop meeting OSHA standards<br>2.2 Soldering, gas welding and gas cutting consumables and equipment<br>2.3 Personal Protective Equipment |
| 3. Methods of assessment | Competency may be assessed through:<br>3.1 Observation<br>3.2 Oral questioning<br>3.3 Written tests<br>3.4 Projects |
| 4. Context of assessment | Candidate will be assessed<br>4.1 On job<br>4.2 Of job<br>4.3 During industrial attachment |
| 5. Guidance | Holistic assessment with other units relevant to the industry |

| | |
|---|---|
| information for assessment | sector, workplace and job role is recommended. |

## PERFORM MANUAL METAL ARC WELDING

**UNIT CODE: ENG/OS/WEF/CR/02/6/A**

**UNIT DESCRIPTION**

This unit specifies competencies required to prepare materials, set up Manual Metal Arc (MMA) equipment and apply safety in MMA welding. It involves competencies to weld in all positions using manual metal arc welding process. It is also known as Shielded Metal Arc Welding (SMAW).

**ELEMENTS AND PERFORMANCE CRITERIA**

| ELEMENT | PERFORMANCE CRITERIA<br>***(Bold and italicized terms are elaborated in the Range)*** |
|---|---|
| 1. Set up MMA equipment and materials | 1.1 Safety and health is observed as per Workplace procedures and OSHA<br>1.2 Working drawings are interpreted as per job specifications<br>1.3 Materials, tools and equipment are selected as per job specifications<br>1.4 Joints are prepared as per working drawings<br>1.5 Set up ***MMA welding equipment*** as per job specifications |
| 2. Carry out MMA welding process | 2.1 Welded workpieces using manual metal arc welding process as per job specifications and ISO 9606-1 standard<br>2.2 Post weld treatment is performed according to job specifications<br>2.3 Weld joint is examined as per ISO 17637 standards<br>2.4 Housekeeping is conducted as per workplace procedures |



**RANGE**

This section provides work environments and conditions to which the performance criteria apply. It allows for different work environments and situations that will affect performance.

| Variable | Range |
|---|---|

| Variable | Range |
|---|---|
| 1. MMA welding equipment may include but is not limited to: | • MMA welding PPE<br>• Welding machine<br>• Welding accessories e.g driers, welding containers<br>• Electrodes |
| 2. Materials may include but is not limited to: | • Metal tubing<br>• Metal sheets<br>• Metal plates<br>• Metal bars |

**REQUIRED KNOWLEDGE**

The individual needs to demonstrate knowledge of:

- Workplace procedures and OSHA
- MMA welding equipment
- Joint preparation
- Types of electrodes
- MMA welding techniques and specification procedure
- Setting current on MMA equipment
- BS and ISO welded joint standards
- Applications of MMA
- MMA cutting techniques
- MMA welding safety procedures
- Workplace housekeeping procedures



**REQUIRED SKILLS**

The individual needs to demonstrate the following skills:

- Interpreting working drawings
- Preparing joints
- MMA welding
- Manipulation of electrodes
- MMA cutting
- Product assessment
- Observation of safety
- Workplace housekeeping procedures

**EVIDENCE GUIDE**

This provides advice on assessment and must be read in conjunction with the performance criteria, required skills and knowledge and range.

| | |
|---|---|
| 1. Critical aspects of competency | Assessment requires evidence that the candidate:<br>1.1 Observed safety and health as per Workplace procedures and OSHA<br>1.2 Selected materials, tools and equipment<br>1.3 Prepared joints as per working drawing<br>1.4 Set up MMA welding equipment in accordance with job specifications<br>1.5 Welded work piece using MMA process as per job specifications and ISO 9606-1<br>1.6 Welded Work pieces are examined as per ISO 17637<br>1.7 Dressed welded joint as per standard operating procedures |
| 2. Resource implications | The following resources must be provided:<br>2.1 Fully equipped welding workshop meeting OSHA standards<br>2.2 Welding consumables and equipment<br>2.3 Personal Protective Equipment |
| 3. Methods of assessment | Competency may be assessed through:<br>3.1 Observation<br>3.2 Oral questioning<br>3.3 Written tests<br>3.4 Projects |
| 4. Context of assessment | Candidate will be assessed<br>4.1 On job<br>4.2 Off job<br>4.3 During industrial attachment |
| 5. Guidance information for | Holistic assessment with other units relevant to the industry sector, workplace and job role is recommended. |

| | |
|---|---|
| assessment. | |

## PERFORM TUNGSTEN INERT GAS (TIG) WELDING

**UNIT CODE: ENG/OS/WEF/CR/03/6/A**

**UNIT DESCRIPTION**

This unit specifies competencies required for material preparation, setting up of Tungsten Inert Gas (TIG) welding equipment and application of safety in TIG welding. It also includes competencies in thermal joining of metals using non-consumable electrodes. It is also known as Gas Tungsten Arc Welding (GTAW).

**ELEMENTS AND PERFORMANCE CRITERIA**

| ELEMENT | PERFORMANCE CRITERIA<br>*(Bold and italicized terms are elaborated in the Range)* |
|---|---|
| 1. Set up TIG welding equipment and materials | 1.1 Interpreted working drawings as per job specifications<br>1.2 Materials, tools and equipment are selected as per job specifications<br>1.3 Joints are prepared as per working drawings<br>1.4 Set up ***TIG welding equipment*** as per job specifications |
| 2. Carry out TIG welding | 2.1 Safety and health is observed as per Workplace procedures and OSHA<br>2.2 Welded work pieces using TIG process as per job specifications and ISO 9606-01 standard<br>2.3 Examined weld joint as per ISO 17637 standard<br>2.4 Housekeeping is conducted as per workplace procedures |



**RANGE**

This section provides work environments and conditions to which the performance criteria apply. It allows for different work environments and situations that will affect performance.

| Variable | Range |
|---|---|
| 1. TIG welding equipment may include but is not limited to: | • TIG welding PPE<br>• TIG Welding machine<br>• TIG welding accessories<br>• Electrodes |

| Variable | Range |
|---|---|
| 2. Materials may include but is not limited to: | • Metal tubing<br>• Metal sheets<br>• Metal plates<br>• Metal bars |

**REQUIRED KNOWLEDGE**

The individual needs to demonstrate knowledge of:

- Workplace procedures and OSHA
- TIG welding equipment
- Joint preparation
- TIG welding techniques and specification procedure
- Setting of wire feed rate
- BS and ISO standards
- TIG welding safety procedures
- Applications of TIG
- Workplace housekeeping procedures



**REQUIRED SKILLS**

The individual needs to demonstrate the following skills:

- Interpreting working drawings
- Preparing joints
- TIG welding techniques and specification procedure
- Product assessment
- TIG electrode manipulation
- Observation of safety
- Workplace housekeeping procedures

**EVIDENCE GUIDE**

This provides advice on assessment and must be read in conjunction with the performance criteria, required skills and knowledge and range.

| | |
|---|---|
| 1. Critical aspects of competency | Assessment requires evidence that the candidate:<br>1.1 Observed safety as per Workplace procedures and OSHA<br>1.2 Selected materials, tools and equipment<br>1.3 Prepared joints as per working drawings<br>1.4 Set up TIG welding equipment in accordance with job specifications<br>1.5 Welded workpieces using TIG process as per job specifications and ISO 9606-1 standard<br>1.6 Welded work pieces are examined as per ISO 17637 standard<br>1.7 Conducted housekeeping as per workplace procedures |
| 2. Resource implications | The following resources must be provided:<br>2.1 Fully equipped welding workshop meeting OSHA standards<br>2.2 TIG welding consumables, non-consumables and equipment<br>2.3 Personal Protective Equipment |
| 3. Methods of assessment | Competency may be assessed through:<br>3.1 Observation<br>3.2 Oral questioning<br>3.3 Written tests<br>3.4 Projects |
| 4. Context of Assessment. | Candidate will be assessed<br>4.1 On job<br>4.2 Off job<br>4.3 During industrial attachment |
| 5. Guidance | Holistic assessment with other units relevant to the industry |

| | |
|---|---|
| information for assessment. | sector, workplace and job role is recommended. |

## PERFORM METAL ACTIVE GAS (MAG) WELDING

**UNIT CODE: ENG/OS/WEF/CR/04/6/A**

**UNIT DESCRIPTION**

This unit specifies competencies required for material preparation, setting up of Metal Active Gas (MAG) welding equipment and application of safety in MAG welding. It involves competencies in thermal joining of metals using consumable electrodes.

**ELEMENTS AND PERFORMANCE CRITERIA**

| ELEMENT | PERFORMANCE CRITERIA *(Bold and italicized terms are elaborated in the Range)* |
|---|---|
| 1. Set up MAG welding equipment and materials | 1.1 Interpreted working drawings as per job specifications<br>1.2 Materials, tools and equipment are selected as per job specifications<br>1.3 Joints are prepared as per working drawings<br>1.4 Set up ***MAG welding equipment*** as per job specifications |
| 2. Carry out MAG welding | 2.1 Observed safety as per workplace procedures and OSHA<br>2.2 Welded work pieces using MAG process as per job specifications and ISO 9606-1 standard<br>2.3 Examined the weld joint as per ISO 17637 standard<br>2.4 Housekeeping is conducted as per workplace procedures |



**RANGE**

This section provides work environments and conditions to which the performance criteria apply. It allows for different work environments and situations that will affect performance.

| Variable | Range |
|---|---|
| 1. MAG welding equipment may include but is not limited to: | • MAG welding PPE<br>• MAG welding machine<br>• MAG welding accessories<br>• Feed wire |

| Variable | Range |
|---|---|
| 2. Materials may include but is not limited to: | • Metal tubing<br>• Metal sheets<br>• Metal plates<br>• Metal bars |

**REQUIRED KNOWLEDGE**

The individual needs to demonstrate knowledge of:

- Workplace procedures and OSHA
- MAG welding equipment
- Joint preparation
- MAG welding techniques and specification procedure
- Setting of wire feed rate
- BS and ISO standards
- MAG welding safety procedures
- Applications of MAG
- Workplace housekeeping procedures



**REQUIRED SKILLS**

The individual needs to demonstrate the following skills:

- Interpreting working drawings
- Preparing joints
- MAG welding techniques
- Product quality assessment
- Manipulation of MAG feed rate
- Observation of safety
- Workplace housekeeping procedures

**EVIDENCE GUIDE**

This provides advice on assessment and must be read in conjunction with the performance criteria, required skills and knowledge and range.

| | |
|---|---|
| 1. Critical aspects of competency | Assessment requires evidence that the candidate:<br>1.1 Observed safety as per workplace procedures and OSHA<br>1.2 Selected materials, tools and equipment<br>1.3 Prepared joints as per working drawings<br>1.4 Set up MAG welding equipment in accordance with job specifications<br>1.5 Welded work pieces using MAG process as per job specifications and ISO 9606-1 standard<br>1.6 Welded work pieces are examined as per ISO 17637<br>1.7 Conducted housekeeping as per workplace procedures |
| 2. Resource implications | The following resources must be provided:<br>2.1 Fully equipped welding workshop meeting OSHA standards<br>2.2 MAG welding consumables and equipment<br>2.3 Personal Protective Equipment |
| 3. Methods of assessment | Competency may be assessed through:<br>3.1 Observation<br>3.2 Oral questioning<br>3.3 Written tests<br>3.4 Projects |
| 4. Context of Assessment | Candidate will be assessed<br>4.1 On job<br>4.2 Off job<br>4.3 During industrial attachment. |
| 5. Guidance information for assessment | Holistic assessment with other units relevant to the industry sector, workplace and job role is recommended.. |

## PERFORM SPOT AND SEAM RESISTANCE WELDING

**UNIT CODE: ENG/OS/WEF/CR/05/6/A**

**UNIT DESCRIPTION**

This unit of competency specifies competencies required for material preparation, setting up of spot and seam welding equipment and application of safety in spot and seam welding. It also includes competencies in thermal joining of metals using two copper electrodes and pressure.

**ELEMENTS AND PERFORMANCE CRITERIA**

| ELEMENT | PERFORMANCE CRITERIA<br>*(Bold and italicized terms are elaborated in the Range)* |
|---|---|
| 1. Set up spot welding equipment and materials | 1.1 Interpreted working drawings as per job specifications<br>1.2 Materials, tools and equipment are selected as per job specifications<br>1.3 Prepared surface joint as per the working drawings<br>1.4 Set up ***spot welding equipment*** as per job specifications |
| 2. Carry out spot welding | 2.1 Safety and health is observed as per Workplace procedures and OSHA<br>2.2 Welded workpieces using spot process as per job specifications and ISO 9606-1 standard<br>2.3 Examined weld joint as per ISO 17637 standard<br>2.4 Housekeeping is conducted in accordance with workplace procedures as workplace procedures |
| 3. Set up seam welding equipment and materials | 3.1 Working drawings are interpreted as per job specifications<br>3.2 Materials, tools and equipment are selected as per job specifications<br>3.3 Joints are prepared as per working drawings<br>3.4 Set up ***seam welding equipment*** as per job specifications |
| 4. Carry out seam welding | 4.1 Observed safety as per workplace procedures and OSHA<br>4.2 Performed seam weld process as per job specification and ISO 9606-1 standard<br>4.3 Examined the weld joint as per ISO 17637 standards |

| | |
|---|---|
| | 4.4 Housekeeping is conducted as per workplace procedures |

**RANGE**

This section provides work environments and conditions to which the performance criteria apply. It allows for different work environments and situations that will affect performance.

| Variable | Range |
|---|---|
| 1. Spot welding equipment may include but is not limited to: | • Spot welding PPE<br>• Spot welding machine<br>• Spot welding accessories |
| 2. Seam welding equipment may include but is not limited to: | • Seam welding PPE<br>• Seam welding machine<br>• Seam welding accessories |
| 3. Materials may include but is not limited to: | • Mild steel |



**REQUIRED KNOWLEDGE**

The individual needs to demonstrate knowledge of:

- Workplace procedures and OSHA
- Spot welding equipment
- Seam welding equipment
- Surface preparation
- Spot welding operation and specification procedure
- Seam welding operation and specification procedure
- BS and ISO welding standards
- Spot and seam welding safety procedures
- Application of spot and seam welding

- Spot and seam welding workplace housekeeping procedures

**REQUIRED SKILLS**

The individual needs to demonstrate the following skills:

- Interpreting working drawings
- Preparing surfaces for welding
- Spot welding techniques
- Seam welding techniques
- Product assessment
- Workplace housekeeping procedures

**EVIDENCE GUIDE**

This provides advice on assessment and must be read in conjunction with the performance criteria, required skills and knowledge and range.

| | |
|---|---|
| 1. Critical Aspects of Competency | ***Assessment requires evidence that the candidate***:<br>1.1 Observed safety and health as per Workplace procedures and OSHA<br>1.2 Selected materials, tools and equipment<br>1.3 Prepared surfaces as per working drawings<br>1.4 Set up spot welding equipment in accordance with job specifications<br>1.5 Set up seam welding equipment in accordance with job specifications<br>1.6 Welded workpieces using spot process as per job specification and ISO 9606-1 standard<br>1.7 Welded workpieces using seam process as per job specification and ISO 9606-2 standard<br>1.8 Welded work pieces are examined as per ISO 17637 standard<br>1.9 Conducted housekeeping according to work place procedures |
| 2. Resource | ***The following resources must be provided:*** |

| | |
|---|---|
| Implications | 2.1 Fully equipped welding workshop meeting OSHA standards<br>2.2 Spot welding equipment<br>2.3 Seam welding equipment<br>2.4 Personal Protective Equipment |
| 3. Methods of Assessment. | Competency may be assessed through:<br>3.1 Observation<br>3.2 Oral questioning<br>3.3 Written tests<br>3.4 Projects |
| 4. Context of Assessment. | Candidate will be assessed<br>4.1 On job<br>4.2 Off job<br>4.3 During industrial attachment |
| 5. Guidance information for assessment. | Holistic assessment with other units relevant to the industry sector, workplace and job role is recommended.. |



**PERFORM UNDERWATER ARC WELDING**

**UNIT CODE: ENG/OS/WEF/CR/06/6/A**

**UNIT DESCRIPTION**

This unit specifies competencies required to prepare mild steel, set up for underwater arc welding equipment, and application of safety in underwater arc welding. It also includes competencies for using arc welding process in underwater fabrication and repair works.

**ELEMENTS AND PERFORMANCE CRITERIA**

| **ELEMENT** | **PERFORMANCE CRITERIA** ***(Bold and italicized terms are elaborated in the Range)*** |
|---|---|
| 1. Set up underwater arc welding equipment and materials | 1.1 Interpreted ***drawings*** as per job specifications<br>1.2 Selected ***materials***, tools and equipment as per the job specifications<br>1.3 Prepared joints and surfaces as per the working drawing<br>1.4 Set up ***underwater arc welding equipment*** as per job specifications |
| 2. Carry out underwater arc welding | 2.1 Safety and health is observed as per Workplace procedures and OSHA<br>2.2 Weld workpieces using underwater arc process as per job specifications<br>2.3 Examined the weld joint as per ISO standards<br>2.4 Housekeeping is conducted as per workplace procedures |



**RANGE**

This section provides work environments and conditions to which the performance criteria apply. It allows for different work environments and situations that will affect performance.

| **Variable** | **Range** |
|---|---|
| 1. Drawings may include but is not limited to: | • Ships<br>• Boats<br>• Pipes submerged in water |
| 2. Underwater arc welding equipment may include but is not limited to: | • Underwater arc welding PPE<br>• Underwater arc welding machine<br>• Underwater arc welding accessories |
| 3. Materials may include but is not limited to: | • Metal tubing<br>• Metal sheets |

| Variable | Range |
|---|---|
| | • Metal plates<br>• Metal bars |

**REQUIRED KNOWLEDGE**

The individual needs to demonstrate knowledge of:

- Workplace procedures and OSHA
- Underwater arc welding equipment and accessories
- Joint and surface preparation techniques
- Underwater arc welding techniques
- BS and ISO welding standards
- Applications of underwater arc welding
- Underwater arc welding safety procedures
- Underwater arc welding housekeeping procedures



**Required skills**

The individual needs to demonstrate the following skills:

- Diving
- Interpreting drawings
- Preparing joints and surfaces
- Underwater arc welding techniques
- Product assessment
- Underwater workplace housekeeping procedures

**EVIDENCE GUIDE**

This provides advice on assessment and must be read in conjunction with the performance criteria, required skills and knowledge and range.

| | |
|---|---|
| 1. Critical aspects of | Assessment requires evidence that the candidate: |

| | |
|---|---|
| competency | 1.1 Observed safety and health as per Workplace procedures and OSHA<br>1.2 Selected materials, tools and equipment<br>1.3 Prepared joints as per drawings<br>1.4 Set up underwater arc welding equipment in accordance with job specifications<br>1.5 Welded workpieces using underwater process as per job specifications<br>1.6 Welded work pieces are examined as per ISO 17637 standard |
| 2. Resource implications | The following resources must be provided:<br>2.1 Fully equipped welding workplace meeting OSHA standards<br>2.2 Underwater arc welding consumables and equipment<br>2.3 Personal Protective Equipment<br>2.4 Simulated environment for underwater arc welding process |
| 3. Methods of assessment | Competency may be assessed through:<br>3.1 Observation<br>3.2 Oral questioning<br>3.3 Written tests<br>3.4 Projects |
| 4. Context of assessment | Candidate will be assessed<br>4.1 On job<br>4.2 Off job<br>4.3 During industrial attachment |
| 5. Guidance information for assessment | Holistic assessment with other units relevant to the industry sector, workplace and job role is recommended. |

## PERFORM SUBMERGED ARC WELDING

**UNIT CODE:** ENG/OS/WEF/CR/07/6/A

**UNIT DESCRIPTION**

This unit specifies competencies required to prepare materials, set up for submerged arc welding equipment and application of safety in submerged arc welding. It also includes competencies for welding with an electric arc beneath a bed of granulated flux.

**ELEMENTS AND PERFORMANCE CRITERIA**

| ELEMENT | PERFORMANCE CRITERIA<br>*(Bold and italicized terms are elaborated in the Range)* |
|---|---|
| 1. Set up submerged arc welding equipment and materials | 1.1 Interpreted drawings as per job specifications<br>1.2 Materials, tools and equipment are selected as per job specifications<br>1.3 Joints are prepared as per working drawings<br>1.4 Set up ***submerged arc welding equipment*** as per job specifications |
| 2. Carry out submerged arc welding | 2.1 Observed safety as per workplace procedures and OSHA<br>2.2 Cut workpieces using submerged arc process as per job specifications and ISO 9606-1<br>2.3 Examined the weld joint as per ISO 17637 standard<br>2.4 Housekeeping is conducted as per workplace procedures |
| 3. Set up electro-slag arc welding equipment and materials | 3.1 Interpreted drawings as per job specifications<br>3.2 Materials, tools and equipment are selected as per job specifications<br>3.3 Joints are prepared as per working drawings<br>3.4 Set up ***electro-slag arc welding equipment*** as per job specifications |
| 4. Carry out electro-slag arc welding | 4.1 Safety and health is observed as per Workplace procedures and OSHA<br>4.2 Welded workpieces using electro-slag arc process as per job specifications and ISO 9606-1<br>4.3 Examined weld joint as per ISO 17637 standards<br>4.4 Housekeeping is conducted in accordance with workplace procedures as workplace procedures |

**RANGE**

This section provides work environments and conditions to which the performance criteria apply. It allows for different work environments and situations that will affect performance.

| Variable | Range |
|---|---|
| 1. Submerged arc welding equipment may include but is not limited to: | • Submerged arc welding PPE<br>• Submerged arc welding machine<br>• Submerged arc welding accessories |
| 2. Electro-slag arc welding equipment may include but is not limited to: | • Electro-slag arc welding PPE<br>• Electro-slag arc welding machine<br>• Electro-slag arc welding accessories |
| 3. Materials may include but is not limited to: | • Metal tubing<br>• Metal sheets<br>• Metal plates<br>• Metal bars |



**REQUIRED KNOWLEDGE**

The individual needs to demonstrate knowledge of:

- Workplace procedures and OSHA
- Submerged arc welding equipment and accessories
- Electro-slag arc welding equipment and accessories
- Joint preparation techniques
- Submerged welding techniques and specification procedure
- Electro-slag welding techniques and specification procedure
- BS and ISO welding standards
- Submerged arc welding workplace housekeeping procedures
- Submerged arc welding safety procedures
- Electro-slag arc welding safety procedures
- Applications of submerged and electro-slag arc welding

- Electro-slag arc welding workplace housekeeping procedures

**Required skills**

The individual needs to demonstrate the following skills:

- Interpreting working drawings
- Preparing joints for submerged arc welding
- Preparing joints for electro-slag arc welding
- Product assessment
- Submerged arc welding workplace housekeeping procedures
- Electro-slag arc welding workplace housekeeping procedures
- Electrode manipulation
- Observation of safety

**EVIDENCE GUIDE**

This provides advice on assessment and must be read in conjunction with the performance criteria, required skills and knowledge and range.



| | |
|---|---|
| 1. Critical Aspects of Competency | ***Assessment requires evidence that the candidate***:<br>1.1 Observed safety and health as per Workplace procedures and OSHA<br>1.2 Selected materials, tools and equipment<br>1.3 Prepared joints as per working drawings<br>1.4 Set up submerged arc welding equipment in accordance with job specifications<br>1.5 Set up electro-slag arc welding equipment in accordance with job specifications<br>1.6 Welded workpieces using submerged arc welding process as per job specifications and ISO 9606-1 standard<br>1.7 Welded workpieces using electro-slag arc welding process as per job specifications and ISO 9606-2 standard<br>1.8 Welded work pieces are examined as per ISO 17637 standard<br>1.9 Housekeeping is conducted as per workplace procedures |
| 2. Resource | ***The following resources must be provided:*** |

| | |
|---|---|
| Implications | 2.1 Fully equipped welding workshop meeting OSHA standards<br>2.2 Submerged arc welding consumables and equipment<br>2.3 Electro-slag arc welding consumables and equipment<br>2.4 Personal Protective Equipment<br>2.5 Simulated environment for submerged and electro-slag arc welding processes<br>2.6 Housekeeping is conducted as per workplace procedures |
| 3. Methods of Assessment. | Competency may be assessed through:<br>3.1 Observation<br>3.2 Oral questioning<br>3.3 Written tests<br>3.4 Projects |
| 4. Context of Assessment. | Trainee will be assessed<br>4.1 On job<br>4.2 Off job<br>4.3 During industrial attachment.<br>4.4 |
| 5. Guidance information for assessment. | Holistic assessment with other units relevant to the industry sector, workplace and job role is recommended. |

## PERFORM PLASMA AND LASER BEAM WELDING

**UNIT CODE: ENG/OS/WEF/CR/08/6/A**

**UNIT DESCRIPTION**

This unit of competency specifies competencies required to prepare materials, set up plasma and laser beam equipment, application of safety in use of constricted arc at high velocities and elevated temperatures (plasma) in welding and cutting. It also includes competencies for use of concentrated light energy (laser beam) in welding and cutting.

**ELEMENTS AND PERFORMANCE CRITERIA**

| ELEMENT | PERFORMANCE CRITERIA<br>*(Bold and italicized terms are elaborated in the Range)* |
|---|---|
| 1. Set up plasma welding equipment and materials | 1.1 Interpreted working drawings as per job specifications<br>1.2 Materials, tools and equipment are selected as per job specifications<br>1.3 Joints are prepared as per working drawings<br>1.4 Set up ***plasma welding equipment*** as per job specifications |
| 2. Carry out plasma welding | 2.1 Safety and health is observed as per Workplace procedures and OSHA<br>2.2 Welded workpieces using plasma process as per job specifications<br>2.3 Examined weld joint as per ISO standards<br>2.4 Housekeeping is conducted as per workplace procedures |
| 3. Set up plasma cutting equipment and materials | 3.1 Interpreted working drawings as per job specifications<br>3.2 Materials, tools and equipment are selected as per job specifications<br>3.3 Prepared workpieces as per the working drawings<br>3.4 Set up ***plasma cutting equipment*** as per job specifications |
| 4. Carry out plasma cutting | 4.1 Observed safety as per workplace procedures and OSHA<br>4.2 Cut workpieces using plasma process as per job specifications<br>4.3 Examined kerf as per ISO standards<br>4.4 Housekeeping is conducted as per workplace procedures |

| | |
|---|---|
| 5. Set up laser welding equipment and materials | 5.1 Interpreted working drawings as per job specifications<br>5.2 Materials, tools and equipment are selected as per job specifications<br>5.3 Joints are prepared as per working drawings<br>5.4 Set up ***laser beam welding equipment*** as per job specifications |
| 6. Carry out laser beam welding | 6.1 Safety and health is observed as per Workplace procedures and OSHA<br>6.2 Welded work pieces using plasma process as per job specifications<br>6.3 Housekeeping is conducted as per workplace procedures |
| 7. Set up laser beam cutting equipment and materials | 7.1 Interpreted working drawings as per job specifications<br>7.2 Materials, tools and equipment are selected as per job specifications<br>7.3 Prepared workpieces as per the working drawings<br>7.4 Set up ***laser beam cutting equipment*** as per job specifications |
| 8. Carry out laser beam cutting | 8.1 Observed safety as per workplace procedures and OSHA<br>8.2 Cut workpieces using laser beam process as per job specifications<br>8.3 Examined kerf as per ISO standards<br>8.4 Housekeeping is conducted as per workplace procedures |



**RANGE**

This section provides work environments and conditions to which the performance criteria apply. It allows for different work environments and situations that will affect performance.

| Variable | Range |
|---|---|
| 1. Plasma welding equipment may include but is not limited to: | • Plasma welding PPE<br>• Plasma welding machine<br>• Plasma welding accessories |
| 2. Laser beam welding equipment may include | • Laser beam welding PPE<br>• Laser beam welding machine |

| Variable | Range |
|---|---|
| but is not limited to: | • Laser beam welding accessories |
| 3. Materials may include but is not limited to: | • Metal tubing<br>• Metal sheets<br>• Metal plates<br>• Metal bars |

**REQUIRED KNOWLEDGE**

The individual needs to demonstrate knowledge of:

- Workplace procedures and OSHA.
- Plasma welding equipment and accessories
- Laser beam welding equipment and accessories
- Plasma cutting parameters
- Laser beam cutting parameters
- BS and ISO plasma and Laser beam kerf standards
- Plasma cutting safety procedures
- Laser beam cutting safety procedures
- Applications of plasma and laser beam welding
- Plasma and laser beam welding workplace housekeeping procedures



**REQUIRED SKILLS**

The individual needs to demonstrate the following skills:

- Observation of safety
- Interpreting working drawings
- Plasma welding, specification procedure , cutting techniques
- Laser beam welding, specification procedure and cutting techniques
- Manipulation of plasma spray
- Product assessment
- Workplace housekeeping procedures

**EVIDENCE GUIDE**

This provides advice on assessment and must be read in conjunction with the performance criteria, required skills and knowledge and range.

| | |
|---|---|
| 1. Critical Aspects of Competency | Assessment requires evidence that the candidate:<br>1.1 Observed safety and health as per Workplace procedures and OSHA<br>1.2 Selected materials, tools and equipment<br>1.3 Set up plasma welding and cutting equipment in accordance with job specifications<br>1.4 Set up laser beam welding and cutting equipment in accordance with job specifications<br>1.5 Weld and cut workpieces using plasma process as per job specifications and<br>1.6 Weld and cut workpieces using laser beam process as per job specifications<br>1.7 Weld workpieces are examined as per job specification |
| 2. Resource Implications | The following resources must be provided:<br>2.1 Fully equipped welding workshop meeting OSHA standards<br>2.2 Plasma welding and cutting equipment<br>2.3 Laser beam welding and cutting equipment<br>2.4 Personal Protective Equipment |
| 3. Methods of assessment | Competency may be assessed through:<br>3.1 Observation<br>3.2 Oral questioning<br>3.3 Written tests<br>3.4 Projects |
| 4. Context of Assessment | Candidate will be assessed<br>4.1 On job<br>4.2 Off job<br>4.3 Industrial attachment |
| 5. Guidance information for assessment | Holistic assessment with other units relevant to the industry sector, workplace and job role is recommended. |

## PERFORM WELDING INSPECTION AND QUALITY CONTROL

**UNIT CODE: ENG/OS/WEF/CR/09/6/A**

**UNIT DESCRIPTION**

This unit of competency specifies competencies required to perform quality control and inspection on welded products and structures while observing safety. It also includes competencies to document test results.

**ELEMENTS AND PERFORMANCE CRITERIA**

| ELEMENT | PERFORMANCE CRITERIA *(Bold and italicized terms are elaborated in the Range)* |
|---|---|
| 1. Set up testing equipment and accessories | 1.1 Prepare the workpieces as per standard testing procedures<br>1.2 Prepare testing materials, tools and equipment<br>1.3 Set up testing equipment as per standard testing procedures |
| 2. Carry out weld tests and inspection | 2.1 Carry out the ***non-destructive tests*** as per the ISO standards<br>2.2 Carry out the ***destructive tests*** as per the ISO standards<br>2.3 Document test results as per workplace procedures<br>2.4 Conduct housekeeping as per workplace procedures |



**RANGE**

This section provides work environments and conditions to which the performance criteria apply. It allows for different work environments and situations that will affect performance.

| Variable | Range |
|---|---|
| 1. Destructive tests may include but is not limited to: | • Tensile test ( When D ≤ 25mm)<br>• Bend test (ISO 5173)<br>• Fracture test (ISO 9017) |
| 2. Non-destructive tests may include but is not limited to: | • Visual inspection ( ISO 17637)<br>• Ultrasonic (Ferrite steel t ≥ 8mm)<br>• Radiographic test(ISO 17637) |

**REQUIRED KNOWLEDGE**

The individual needs to demonstrate knowledge of:

- Safety procedures in carrying out weld tests
- Welding defects
- Qualities of good weld
- BS and ISO welding standards
- Destructive test techniques
- Non-destructive test techniques
- Documentation procedures

**REQUIRED SKILLS**

The individual needs to demonstrate the following skills:

- Identifying weld defects
- Conducting destructive tests
- Conducting non-destructives tests
- Documenting of test results



**EVIDENCE GUIDE**

This provides advice on assessment and must be read in conjunction with the performance criteria, required skills and knowledge and range.

| | |
|---|---|
| 1. Critical Aspects of Competency | ***Assessment requires evidence that the candidate***:<br>1.1 Prepared the workpieces as per standard testing procedures<br>1.2 Prepared testing materials, tools and equipment<br>1.3 Set up testing equipment as per standard testing procedures<br>1.4 Carried out the destructive tests as per the standard testing procedures<br>1.5 Carried out the non-destructive tests as per the standard testing procedures |

| | |
|---|---|
| | 1.6 Documented test results as per workplace procedures<br>1.7 Housekeeping is conducted as per workplace procedures |
| 2. Resource implications | The following resources must be provided:<br>2.1 Testing equipment<br>2.2 PPE |
| 3. Methods of assessment | Competency may be assessed through:<br>3.1 Observation<br>3.2 Oral questioning<br>3.3 Written tests<br>3.4 Projects |
| 4. Context of assessment | Candidate will be assessed<br>4.1 On job<br>4.2 Off job<br>4.3 During industrial attachment |
| 5. Guidance information for assessment. | Holistic assessment with other units relevant to the industry sector, workplace and job role is recommended. |

## DESIGN PRODUCTS AND STRUCTURES

**UNIT CODE: ENG/OS/WEF/CR/10/6/A**

**UNIT DESCRIPTION**

This unit specifies competencies required for developing models and prototypes of products and structures, developing jigs and fixtures and planning production process.

**ELEMENTS AND PERFORMANCE CRITERIA**

| ELEMENT | PERFORMANCE CRITERIA<br>*(Bold and italicized terms are elaborated in the Range)* |
|---|---|
| 1. Develop models and prototypes of products and structures | 1.1. Models and prototypes of products and structures are designed as per the standard procedures<br>1.2 Working drawings are developed as per ***standard procedures***<br>1.3 Models and prototypes are tested according to standard operating procedures<br>1.4 ***Models and prototypes*** are developed as per drawing specifications |
| 2. Develop jigs and fixtures | 2.1 Designed jigs and fixtures as per the job specifications.<br>2.2 Developed jigs and fixtures as per job specifications |
| 3. Plan production process | 3.1 Performed Job costing as per job specifications.<br>3.2 Scheduled for production as per the costing plan<br>3.3 ***Controlled production*** as per the schedule |



**RANGE**

This section provides work environments and conditions to which the performance criteria apply. It allows for different work environments and situations that will affect performance.

| Variable | Range |
|---|---|
| 1. Standard procedures may include but is not limited to: | • ISO Technical Drawing standards<br>• BS4500 limits and fits |
| 2. Models and prototypes may include but is not limited to:<br>. | • Metallic chairs<br>• Metallic doors<br>• Metallic girders<br>• Metallic windows<br>• Trusses and portal frames |
| 3. Controlled production may include but is not limited to: | • Material control<br>• Production flow<br>• Quality control<br>• Material handling |



**Required knowledge**

The individual needs to demonstrate knowledge of:

- BS and ISO drawing standards.
- Reading of tolerance and dimension charts
- Scale drawing
- Use of jigs and fixtures
- Features of a quality design
- Computer aided design software
- Simulation software
- Cost analysis
- Work scheduling
- Methods of product control
- Features of quality control
- Material handling control

**Required skills**

The individual needs to demonstrate the following skills:

- Interpret working drawing

- Apply tolerance and dimensioning
- Apply scale drawing
- Design jigs and fixtures
- Apply jigs and fixtures
- Apply scale drawing
- Design models and prototypes
- Job costing
- Plan for production

**EVIDENCE GUIDE**

This provides advice on assessment and must be read in conjunction with the performance criteria, required skills and knowledge and range.

| | |
|---|---|
| 1. Critical aspects of competency | Assessment requires evidence that the candidate:<br>1.1 Developed working drawings<br>1.2 Developed models and prototypes<br>1.3 Simulated models and prototypes<br>1.4 Designed prototypes of jigs and fixtures<br>1.5 Developed jigs and fixtures<br>1.6 Prepared production plan |
| 2. Resource implications | The following resources must be provided:<br>2.1 Fully equipped drawing room meeting OSHA standards<br>2.2 Drawing software (Solid works, AutoCAD and Inventor)<br>2.3 Simulation software |
| 3. Methods of assessment | Competency may be assessed through:<br>3.1 Observation<br>3.2 Oral questioning<br>3.3 Written tests<br>3.4 Projects |
| 4. Context of assessment | Candidate will be assessed<br>4.1 On job<br>4.2 Off job<br>4.3 During industrial attachment |
| 5. Guidance information for assessment | Holistic assessment with other units relevant to the industry sector, workplace and job role is recommended. |

## FABRICATE PRODUCTS AND STRUCTURES

**UNIT CODE: ENG/OS/WEF/CR/11/6/A**

**UNIT DESCRIPTION**

This unit specifies competencies required for laying out components and producing components and products

**ELEMENTS AND PERFORMANCE CRITERIA**

| ELEMENT | PERFORMANCE CRITERIA *(Bold and italicized terms are elaborated in the Range)* |
|---|---|
| 1. Lay out component | 1.1 Safety and health is observed as per Workplace procedures and OSHA<br>1.2 Selected ***materials***, ***tools and equipment*** as per job specifications<br>1.3 Measured and marked out components as per job specifications |
| 2. Produce components and products | 2.1 Cut work profiles in accordance with working drawings<br>2.2 Worked profiles to size as per working drawings<br>2.3 Component is fabricated as per job specifications<br>2.4 ***Finishing processes*** are selected as per job specifications<br>2.5 Finishing processes are applied as per job specifications<br>2.6 Product is inspected as per standard operating procedures |



**RANGE**

This section provides work environments and conditions to which the performance criteria apply. It allows for different work environments and situations that will affect performance.

| Variable | Range |
|---|---|
| 1. Materials may include but is not limited to: | • Metal tubing<br>• Metal sheets<br>• Metal plates<br>• Metal bars |

| Variable | Range |
|---|---|
| 2. Tools and Equipment may include but is not limited to: | • Hand tools<br>• Powered hand tools<br>• Power saws |
| 3. Finishing processes may include but is not limited to: | • Deburring<br>• Polishing<br>• Painting<br>• Varnishing<br>• Oil blackening<br>• Bluing<br>• Buffing<br>• Electroplating<br>• Enamelling |

**Required Knowledge**

The individual needs to demonstrate knowledge of:

- Material composition and properties
- Types and use of:
    - marking out tools
    - measuring and checking tools
    - cutting tools and equipment
    - Forming tools
    - Finishing tools
- Finishing processes



**Required Skills**

The individual needs to demonstrate the following skills:

- Selecting materials and tools
- Testing materials
- Cutting and sizing the workpieces
- Applying finishing processes

**EVIDENCE GUIDE**

This provides advice on assessment and must be read in conjunction with the performance criteria, required skills and knowledge and range.

| | |
|---|---|
| 1. Critical aspects of competency | Assessment requires evidence that the candidate:<br>1.1 Observed safety procedures as per Workplace procedures and OSHA<br>1.2 Selected materials, tools and equipment as per job specifications<br>1.3 Tested materials as per job specifications<br>1.4 Measured and marked out workpieces<br>1.5 Sized workpieces as per job specifications<br>1.6 Assembled the workpieces to produce the products<br>1.7 Applied finishing processes as per job specifications<br>1.8 Applied housekeeping as per workplace procedures |
| 2. Resource implications | ***The following resources must be provided:***<br>2.1 Fabrication workplace meeting OSHA standards<br>2.2 Tools and equipment relevant to the tasks |
| 3. Methods of assessment | Competency may be assessed through:<br>3.1 Observation<br>3.2 Oral questioning<br>3.3 Written tests<br>3.4 Projects |
| 4. Context of assessment | Candidate will be assessed<br>4.1 On job<br>4.2 Off job<br>4.3 During industrial attachment<br>4.4 |
| 5. Guidance information for assessment. | Holistic assessment with other units relevant to the industry sector, workplace and job role is recommended. |