

**REPUBIC OF KENYA**

**NATIONAL OCCUPATIONAL STANDARDS**

**FOR**

**PLANT AND SERVICE ENGINEERING OPERATOR**

**LEVEL 5**



TVET CDACC

P.O BOX 15745-00100

NAIROBI

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**Council Secretary/CEO**

**TVET Curriculum Development, Assessment and Certification Council**

**P.O. Box 15745–00100 Nairobi, Kenya**

**Email: cdacc.tvet@gmail.com**

# 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 to the formulation of the Policy Framework for Reforming Education and Training. 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 was developed for the purpose of developing a competency-based curriculum for a Plant and Service Engineering Level 5. These Occupational Standards will also be the bases 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 plant mechanic sector’s growth and sustainable development.

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

# PREFACE

The TVET Curriculum Development, Assessment and Certification Council (TVET CDACC), in conjunction with Mechanical Sector Skills Advisory Committee (SSAC) have developed these Occupational Standards for a Plant and Service Operator. These standards will be the bases for development of a competency-based curriculum for plant and service Level 5. These Standards will also be the bases 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, Plant Mechanic SSAC, expert workers and all those who participated in the development of these National Occupational standards.

**Prof. CHARLES M. M. ONDIEKI, PhD, FIET (K), Con. Eng. Tech.**

**CHAIRMAN, TVET CDACC**

# ACKNOWLEDGMENT

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 Plant and Service 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 including those from Standard Gauge Railway Project and Insteel Limited.

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

**CHAIRMAN PLANT AND SERVICES ENGINEERING SECTOR SKILLS ADVISORY COMMITTEE**

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# 

# ACRONYMS

CDACC Curriculum Development, Assessment and Certification Council

CRBC China Road and Bridge Corporation

EBK Engineers Board of Kenya

EBP Engineering best practice

EHS Environment, Health and Safety

IEE Institute of Electrical Engineers

IBMS Integrated Building Management System

KEBS Kenya Bureau of Standards

NCA National Construction Authority

OSHA Occupational Safety and Health Act

PPE Personal Protective Equipment

TVET Technical and Vocational Education and Training

SOP Standard operating procedure

WIBA Work injury benefits Act

ENG Engineering

OS Occupational Standards

PS Plant and Service

BC Basic Competencies

CC Common Competencies

CR Core Competencies

# KEY TO UNIT CODE

ENG/OS/PS/BC/01/5/A

Industry or sector

Occupational Standards

Occupational area

Type of competency

Competency number

Competency level

Control Version

# OVERVIEW

Plant and service Engineering Level 5 qualification consists of competencies that a person must achieve to enable him/her to be certified as a plant and service Operator.

A plant and service operator is a person who will carry out plant mechanic duties using a given design and customer’s requirements. This work demands the operator to read and interpret drawings in plant mechanic sector so that the he/she can install the plant mechanic system according to the national and international standards. Thus, the units of competency comprising plant and service engineering Operator level 5 qualifications include the following basic, common core competencies:

**BASIC COMPETENCIES**

|  |  |
| --- | --- |
| **Unit of Competency Code** | **Unit of Competency Title** |
| ENG/OS/PS/BC/01/5/A | Demonstrate communication skills |
| ENG/OS/PS/BC/02/5/A | Demonstrate digital literacy |
| ENG/OS/PS/BC/03/5/A | Demonstrate entrepreneurial skills |
| ENG/OS/PS/BC/04/5/A | Demonstrate employability skills |
| ENG/OS/PS/BC/05/5/A | Demonstrate environmental literacy |
| ENG/OS/PS/BC/06/5/A | Demonstrate occupational safety and health practices |

**COMMON COMPETENCIES**

|  |  |
| --- | --- |
| **Unit of Competency Code** | **Unit of Competency Title** |
| ENG/OS/PS/CC/01/5/A | Apply Engineering mathematics |
| ENG/OS/PS/CC/02/5/A | Perform workshop processes and materials |
| ENG/OS/PS/CC/03/5/A | Apply mechanical science principles |
| ENG/OS/PS/CC/04/5/A | Apply fluid mechanics principles |
| ENG/OS/PS/CC/05/5/A | Apply material science and metallurgical processes |
| ENG/OS/PS/CC/06/5/A | Apply Electrical principles |
| ENG/OS/PS/CC/07/5/A | Prepare and Interpret technical drawing |

**CORE COMPETENCIES**

|  |  |
| --- | --- |
| **Unit of Competency Code** | **Unit of Competency Title** |
| ENG/OS/PS/CR/01/5/A | Install mechanical pumps and compressors |
| ENG/OS/PS/CR/02/5/A | Install hydraulic and pneumatic systems |
| ENG/OS/PS/CR/03/5/A | Perform plant maintenance |
| ENG/OS/PS/CR/04/5/A | Operate and maintain plant machinery |
| ENG/OS/PS/CR/05/5/A | Install refrigeration and air conditioning system |

# BASIC UNITS OF COMPETENCY

# DEMONSTRATE COMMUNICATION SKILLS

**UNIT CODE:** ENG/OS/PS/BC/01/5/A

**UNIT DESCRIPTION**

This unit covers the competencies required to use specialized communication skills to meet specific needs of internal and external clients, conduct interviews, facilitate discussion with groups and contribute to the development of communication strategies.

**ELEMENTS AND PERFORMANCE CRITERIA**

|  |  |
| --- | --- |
| **ELEMENT**  These describe the key outcomes which make up workplace function | **PERFORMANCE CRITERIA**  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. Meet communication needs of clients and colleagues | 1. Specific communication needs of clients and colleagues are identified and met 2. Different approaches are used to meet communication needs of clients and colleagues 3. Conflict is addressed promptly and in a timely way and in a manner which does not compromise the standing of the organization |
| 1. Contribute to the development of communication strategies | * 1. Strategies for internal and external dissemination of information are developed, promoted, implemented and reviewed as required   2. Channels of communication are established and reviewed regularly   3. Coaching ineffective communication is provided   4. Work related network and relationship are maintained as necessary   5. Negotiation and conflict resolution strategies are used where required   6. Communication with clients and colleagues is appropriate to individual needs and organizational objectives |
| 1. Conduct interviews | 1. A range of appropriate communication strategies are employed in ***interview situations*** 2. Records of interviews are made and maintained in accordance with organizational procedures 3. Effective questioning, listening and nonverbal communication techniques are used to ensure that required message is communicated |
| 1. Facilitate group discussions | * 1. Mechanisms which enhance effective group interaction is defined and implemented   2. Strategies which encourage all group members to participate are used routinely   3. Objectives and agenda for meetings and discussions are routinely set and followed   4. Relevant information is provided to group to facilitate outcomes   5. Evaluation of group communication strategies is undertaken to promote participation of all parties   6. Specific communication needs of individuals are identified and addressed |
| 1. Represent the organization | 1. When participating in internal or external forums, presentation is relevant, appropriately researched and presented in a manner to promote the organization 2. Presentation is clear and sequential and delivered within a predetermined time 3. Utilize appropriate media to enhance presentation 4. Differences in views are respected 5. Written communication is consistent with organizational standards 6. Inquiries are responded in a manner consistent with 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** |
| Communication strategies includes but not limited: | * Language switch * Comprehension check * Repetition * Asking confirmation * Paraphrase * Clarification request * Translation * Restructuring * Approximation * Generalization |
| Effective group interaction includes but not limited to: | * Identifying and evaluating what is occurring within an interaction in a non-judgmental way * Using active listening * Making decision about appropriate words, behaviour * Putting together response which is culturally appropriate * Expressing an individual perspective * Expressing own philosophy, ideology and background and exploring impact with relevance to communication * Openness and flexibility in communication |
| Situations includes but not limited to: | * Establishing rapport * Eliciting facts and information * Facilitating resolution of issues * Developing action plans * 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:

* Effective communication process
* Active listening
* Giving/receiving feedback
* Interpretation of information
* Role boundaries setting
* Negotiation
* Establishing empathy
* Openness and flexibility in communication
* Communication skills required to fulfill job roles as specified by the organization

**Required Knowledge**

The individual needs to demonstrate knowledge of:

* Communication process
* Dynamics of groups and different styles of group leadership
* Communication skills relevant to client groups
* Flexibility in communication
* Communication skills relevant to client groups
* 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:   * 1. Developed communication strategies to meet the organization requirements and applied in the workplace   2. Established and maintained communication pathways for effective communication in the workplace   3. Used communication strategies involving exchanges of complex oral information |
| 1. Resource Implications | The following resources should be provided:   * 1. Access to relevant workplace or appropriately simulated environment where assessment can take place   2. Materials relevant to the proposed activity or tasks |
| 1. Methods of Assessment | Competency in this unit may be assessed through:   * 1. Direct Observation   2. Demonstration with Oral Questioning   3. Written Examination |
| 1. Context of Assessment | Competency may be assessed individually in the actual workplace or  through accredited institution |
| 1. 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/PS/BC/02/5/A

**UNIT DESCRIPTION**

This unit covers the competencies required to effectively use digital devices such as smartphones, tablets, laptops and desktop PCs. It entails identifying and using digital devices such as smartphones, tablets, laptops and desktop computers for purposes of communication, work performance and management at the work place.

**ELEMENTS AND PERFORMANCE CRITERIA**

|  |  |
| --- | --- |
| **ELEMENT**  These describe the key outcomes which make up workplace function | **PERFORMANCE CRITERIA**  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. Identify appropriate computer software and hardware | * 1. Concepts of ICT are determined in accordance with computer equipment   2. Classifications of computers are determined in accordance with manufacturers specification   3. ***Appropriate computer software*** is identified according to manufacturer’s specification   4. ***Appropriate computer hardware*** is identified according to manufacturer’s specification   5. Functions and commands ofoperating system are determined in accordance withmanufacturer’s specification |
| 1. Apply security measures to data, hardware, software in automated environment | * 1. ***Data security and privacy are classified*** in accordance with the prevailing technology   2. ***Security threats*** areidentified, **and *control measures*** are applied in accordance with laws governing protection of ICT   3. Computer threats and crimes are detected.   4. Protection against computer crimes is undertaken in accordance with laws governing protection of ICT |
| 1. Apply computer software in solving tasks | * 1. ***Word processing concepts***are applied in resolving workplace tasks, report writing and documentation   2. ***Word processing utilities*** are applied in accordance with workplace procedures   3. Worksheet layout is prepared in accordance with work procedures   4. Worksheet is built and data manipulated in the worksheet in accordance with workplace procedures   5. Continuous data manipulated on worksheet is undertaken in accordance with work requirements   6. Database design and manipulation is undertaken in accordance with office procedures   7. Data sorting, indexing, storage, retrieval and security is provided in accordance with workplace procedures |
| 1. Apply internet and email in communication at workplace | * 1. Electronic mail addresses are opened and applied in workplace communication in accordance with office policy   2. Office internet functions are defined and executed in accordance with office procedures   3. ***Network configuration*** is determined in accordance with office operations procedures   4. Official World Wide Web is installed and managed according to workplace procedures |
| 1. Apply desktop publishing in official assignments | * 1. Desktop publishing functions and tools are identified in accordance with manufactures specifications   2. Desktop publishing tools are developed in accordance with work requirements   3. Desktop publishing tools are applied in accordance with workplace requirements   4. Typeset work is enhanced in accordance with workplace standards |
| 1. Prepare presentation packages | * 1. Types of presentation packages are identified in accordance with office requirements   2. Slides are created and formulated in accordance with workplace procedures   3. Slides are edited and run in accordance with work procedures   4. Slides and hand-outs 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** |
| Appropriate computer software includes but not limited to: | A collection of instructions or computer tools that enable the user to interact with a computer, its hardware, or perform tasks. |
| Appropriate computer hardware includes but not limited to: | Collection of physical parts of a computer system such as;   * Computer case, monitor, keyboard, and mouse * All the parts inside the computer case, such as the hard disk drive, motherboard and video card |
| Data security and privacy include but not limited to: | * Confidentiality of data * Cloud computing * Integrity -but-curious data surfing |
| Security and control measures include but not limited to: | * Counter measures against cyber terrorism * Risk reduction * Cyber threat issues * Risk management * Pass wording |
| Security threats include but not limited to: | * Cyber terrorism * Hacking |
| Word processing concepts include but not limited to: | Using a special program to create, edit and print documents |
| Network configuration include but not limited to: | Organizing and maintaining information on the components of a computer network |

**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:   * 1. Identified and controlled security threats   2. Detected and protected computer crimes   3. Applied word processing in office tasks   4. Designed, prepared work sheet and applied data to the cells in accordance to workplace procedures   5. Opened electronic mail for office communication as per workplace procedure   6. Installed internet and World Wide Web for office tasks in accordance with office procedures   7. Integrated emerging issues in computer ICT applications   8. Applied laws governing protection of ICT |
| 1. Resource Implications | * 1. Tablets   2. Laptops   3. Desktop computers   4. Calculators   5. Internet   6. Smart phones   7. Operation Manuals |
| 1. Methods of Assessment | Competency may be assessed through:   * 1. Written Test   2. Demonstration   3. Practical assignment   4. Interview/Oral Questioning |
| 1. Context of Assessment | Competency may be assessed in an off and on the job setting |
| 1. 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/PS/BC/03/5/A

**UNIT DESCRIPTION**

This unit covers the outcomes required to build and develop the enterprise to be more competitive within a changing business environment, specifically responding to consumer demands while maintaining product quality and accessibility, building a customer base and employee motivation.

**ELEMENTS AND PERFORMANCE CRITERIA**

|  |  |
| --- | --- |
| **ELEMENT**  These describe the key outcomes which make up workplace function | **PERFORMANCE CRITERIA**  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. Develop business Innovative strategies | 1. Business innovation strategies are determined in accordance with the organization strategies 2. Business innovative strategies are implemented for the purpose of business growth 3. Track record and normative capability profile of enterprise and similar businesses are reviewed and considered in setting ***strategic directions***. 4. Strengths, weaknesses, opportunities and threats are considered when developing new ideas, approaches, goals and directions 5. Decisions about enterprise strategies/directions are made after careful consideration of all relevant information 6. ***Business/corporate plan*** is developed that sets out tactics, resource implications, timeframes, production and sales target |
| 1. Develop new products/ markets | 1. Alternative product/service offerings are canvassed and studied for feasibility 2. Potential and new sources/sellers of supplies and raw materials are identified and canvassed. 3. Target markets and buyers are identified and surveyed as to their preferences and brand loyalties. |
| 1. Expand customers and product lines | * 1. Enterprise is built up and sustained through responsiveness to market demands and the regulatory environment.   2. Competitive advantage of existing products and services is maintained / enhanced through responsive advocacies and strategies.   3. Constant listening to stakeholder/client feedback is ensured to maintain loyal client base. |
| 1. Motivate staff/workers | * 1. Regular dialogue is established and maintained in all levels and relevant sections of the enterprise   2. Flow of communications in both directions is encouraged   3. Helpful mechanisms and benefits are implemented   4. Issues/problems are proactively resolved through win-win solutions wherever practicable |
| 1. Expand employed capital base | * 1. Capital employed in business is continuously reviewed as per the strategic plan   2. Business share holdings are reviewed in accordance with the type of business   3. Capital employed is expanded according to organization procedures   4. Types of shares are determined according to strategic plan   5. Shares diversification process is undertaken as per office procedures   6. Role of shareholders is determined and implemented in accordance organization procedures |
| 1. Undertake county/ regional business expansion | * 1. Regions for expansion are continuously reviewed in accordance with strategic plan and company’s expansion plan   2. County business regulations are reviewed and adhered to in accordance with set procedures   3. Regional laws and regulations are adhered to in accordance with set procedures   4. County/regional business expansion is undertaken in accordance with organization’s growth/ expansion plan |

**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** |
| Strategic directions include but not limited to: | * Business continuity and succession * Resource access security * Core competencies development * New developments e.g. technological change, new products |
| Business/Corporate plan  include but not limited to: | * Action steps and responsibilities of departments and individual workers * Resource requirements and budget * Tactics and strategies to achieve objectives |
| Helpful mechanisms include but not limited to: | * Wage and non-wage benefits * Employee awards and recognition systems * Employee rights and welfare policies * Full-disclosure/transparency policies |

**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:

* Assessing a range of alternative products and strategies
* Critically analyzing information, summarizing and making sense of previous and current market trends
* Identifying changing consumer preferences and demographics
* Thinking “outside the box”
* Ensuring quality consistency
* Reducing lead time to product/service delivery
* Managing operations/ production
* Using formal problem-solving procedures, e. g., root-cause analysis, six sigma’s
* Communication skills
* Applying motivational principles, e. g., positive stroking, behavior modification
* Assessing range of alternatives rather than choosing the easiest option
* Achieving ownership and credibility for the enterprise vision
* Critically analyzing information, summarizing and making sense of previous and current market trends
* Developing solutions and practical strategies which are “outside the box”

**Required Knowledge**

The individual needs to demonstrate knowledge of:

* Features and benefits of common operational practices, e. g., continuous improvement (kaizen), waste elimination,
* Conflict resolution
* Health, safety and environment (HSE) principles and requirements
* Public-relations strategies
* Basic cost-benefit analysis
* Basic financial management
* Business strategic planning
* Impact of change on individuals, groups and industries
* Employee assistance
* Government and regulatory processes
* Local and international market trends
* Product promotion strategies
* Mechanisms in the enterprise
* Market and feasibility studies
* Local and global supply chains Business models and strategies
* Government and regulatory processes
* Local and international business environment
* Concepts of change management
* Relevant developments in other industries
* Capital employed
* Regional/ County business expansion
* Innovation in business

**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:   * 1. Demonstrated ability to maintain a profitable and stable enterprise as shown by stakeholder feedback, employee testimonies and company financial statements   2. Demonstrated ability to conceptualize and plan a micro/small enterprise   3. Demonstrated ability to manage/operate a micro/small-scale business   4. Demonstrated basic marketing skills |
| 2. Resource Implications | The following resources should be provided:   1. Interview guide for entrepreneurs 2. Enterprise workers and third parties 3. Materials and location relevant to the proposed activity and tasks |
| 3. Methods of Assessment | 3.1 Case problems  3.2 Interview  3.3 Portfolio  3.4 Third part reports |
| 4. Context of Assessment | 1. Competency may be assessed in workplace or in a simulated workplace setting 2. Assessment shall be observed while tasks are being undertaken whether individually or in-group |
| 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/PS/BC/04/5/A

**UNIT DESCRIPTION**

This unit covers competencies required to demonstrate employability skills. It involves competencies for exuding self-awareness and dealing with everyday life challenges; demonstrating critical safe work habits and leading a workplace team; planning and organizing work activities; applying learning, creativity and innovativeness in workplace functions; pursuing professional growth and managing time effectively in the workplace.

**ELEMENTS AND PERFORMANCE CRITERIA**

|  |  |
| --- | --- |
| **ELEMENT**  These describe the key outcomes which make up workplace function. | **PERFORMANCE CRITERIA**  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. Develop self-awareness and understanding of every day demands and challenges in the workplace | 1. Personal vision, mission and goals are formulated based on potential and in relation to organization objectives 2. Emotions are managed as per workplace requirement 3. Thoughts, feelings and beliefs are expressed in direct, honest and appropriate ways. 4. Feelings are shared with others according to personal issues for healthy relations. 5. Individual performance is evaluated and monitored according to the agreed targets. 6. Assertiveness is developed and maintained based on the requirements of the job. 7. Own ideas and visions that generates excitement, enthusiasm and commitment are articulated. 8. Accountability and responsibility for own actions are demonstrated. 9. Self-esteem and a positive self-image are developed and maintained. |
| 1. Demonstrate critical safe work habits for employees in the workplace | * 1. Stress is managed at the workplace in accordance with workplace procedures.   2. Punctuality and time consciousness is demonstrated in line workplace policy.   3. Personal objectives are integrated with organization goals in accordance with organization’s strategic Plan.   4. Resources are effectively utilized in accordance with workplace policy.   5. Work priorities are set and met in according to workplace procedures.   6. Leisure time is recognized and used productively in line with organization policy.   7. Abstinence from drug and substance abuse is demonstrated as per workplace policy.   8. Awareness of HIV and AIDS is demonstrated in line with workplace requirements.   9. Safety consciousness is demonstrated in the workplace based on organization safety policy.   10. Emerging issues are dealt with in accordance with organization policy. |
| 1. Lead a workplace team | 1. Role and objectives of the team are determined in accordance workplace policy. 2. Team parameters and relationships are identified according to set rules and regulations. 3. Individual responsibilities are identified in accordance with work procedures. 4. Effective and appropriate forms of communication in a team are established according to office policy. 5. Business communication is carried out as per workplace place policy and requirements of the job. 6. Team activities are complemented in accordance with office procedures. 7. Team building activities are planned for in line with organization policy. 8. Conflicts are resolved between team members in line with organization rules and regulations. 9. ***Gender mainstreaming*** is undertaken in accordance with set regulations. 10. Human rights are adhered to in accordance with existing protocol. 11. Healthy relationships are developed and maintained for harmonious co-existence in line with workplace |
| 1. Plan and organize work | 4.1 Work schedules are developed for accomplishing given tasks within the set time lines and based on workplace policy.   * 1. Time is managed achieve workplace set goals and objectives.   2. Clear project goals and deliverables are established according to company set policies and regulations.   3. Resources are mobilized, allocated and utilized to meet project goals and deliverables.   4. Work activities are monitored and evaluated in line with organization procedures.   5. Situations that require decision making are identified within the work place and decision made in accordance with workplace policy.   6. Steps required in making effective decisions are applied within the workplace.   7. Problems arising in the course of working are identified and solved or reported according the workplace policies and procedures.   8. Values required in problem solving process are demonstrated at the work place.   9. Situations within the workplace that require negotiation identified and negotiations done to create win-win situations.   10. Negotiation techniques are developed and applied at workplace to meet clientele’s satisfaction and organizations’ objectives. |
| 5. Maintain professional growth and development in the workplace | 5.1 Personal training needs are assessed and identified in line with the requirements of the job.  5.2 ***Training and career opportunities*** are identified and availed based on job requirements.  5.3 Resources for training are mobilized and allocated based organizations skills needs.  5.4 Licensees and certifications relevant to job and career are obtained and renewed.  5.5 Personal growth is pursued towards improving the qualifications set for the profession.  5.6 Work priorities and commitments are managed based on requirement of the job and workplace policy.  5.7 ***Recognitions*** are sought as proof of career advancement in line with professional requirements. |
| 6. Demonstrate learning, creativity and innovativeness in the workplace | * 1. Time and effort is invested in learning new skills-based job requirements.   2. Willingness to learn in different context is demonstrated based on available learning opportunities arising in the workplace.   3. Learning opportunities are sought and allocated based on job requirement and in line with organization policy.   4. Application of learning is demonstrated in both technical and non-technical aspects based on requirements of the job.   5. Application of a range of basic IT skills is demonstrated based on requirements of the job.   6. Awareness of Occupational Health and Safety procedures are demonstrated in use of technology in the workplace.   7. Initiative is taken to create more effective and efficient processes and procedures in line with workplace policy.   6.7 New systems are developed and maintained in accordance with the requirements of the job.  6.8 Opportunities that are not obvious are identified and exploited in line with organization objectives.  6.9 Opportunities for performance improvement are identified proactively in area of work.  6.10 Awareness of personal role in workplace innovation is demonstrated. |

**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** |
| Drug and substance abuse includes but not limited to: | Commonly abused   * Alcohol * Tobacco * Miraa * Over-the-counter drugs * Cocaine * Bhang * Glue |
| Feedback includes but not limited to: | * Verbal * Written * Informal * Formal |
| Clients includes but not limited to: | * New clients * Existing clients * Internal clients * External clients |
| Relationships includes but not limited to: | * Man/Woman * Trainer/trainee * Employee/employer * Client/service provider * Husband/wife * Boy/girl * Parent/child * Sibling relationships |
| Communication methods include but not limited to: | * Written * Talk/presentation * Video * Audio * Graphical * Modeling |
| Team includes but not limited to: | * Small work group * Staff in a section/department * Inter-agency group |
| Personal growth includes but not limited to: | |  | | --- | | * Growth in the job * Career mobility * Gains and exposure the job gives * Net workings * Benefits that accrue to the individual as a result of noteworthy performance | |
| Personal objectives includes but not limited to: | * Long term * Short term * Broad * Specific |
| Trainings and career opportunities includes but not limited to | * Participation in training programs * Technical * Supervisory * Managerial * Continuing Education * Serving as Resource Persons in conferences and workshops |
| Resource include but not limited to: | * Human * Financial * Technology * Hardware * Software |
| Innovation include but not limited to: | * New ideas * Original ideas * Different ideas * Methods/procedures * Processes * New tools |
| Emerging issues include but not limited to: | * Terrorism * Social media * National cohesion * Open offices |

**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:

* Personal hygiene practices
* Intra and Interpersonal skills
* Communication skills
* Knowledge management
* Interpersonal skills
* Critical thinking skills
* Observation skills
* Organizing skills
* Negotiation skills
* Monitoring skills
* Evaluation skills
* Record keeping skills
* Problem solving skills
* Decision Making skills
* Resource utilization skills
* Resource mobilization skills

**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
* Personal hygiene practices
* Workplace communication
* Concept of time
* Time management
* Decision making
* Types of resources
* Work planning
* Resources and allocating resources
* Organizing work
* Monitoring and evaluation
* Record keeping
* Workplace problems and how to deal with them
* Negotiation
* Assertiveness
* Team work
* Gender mainstreaming
* HIV and AIDS
* Drug and substance abuse
* Leadership
* Safe work habits
* Professional growth and development
* Technology in the workplace
* Learning
* Creativity
* Innovation
* Emerging issues
  + Social media
  + Terrorism
  + National cohesion

###### **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:   * 1. Attained job targets within key result areas.   2. Maintained intra- and inter-personal relationship in the course of managing oneself.   3. Completed trainings and career progression opportunities in time.   4. Was punctual and time conscious.   5. Acquired and maintained licenses and/or certifications required for the job.   6. Planned and organized resources to achieve organization goals and objectives.   7. Monitored and evaluated work activities.   8. Identified, analyzed and solved problem arising in the course of working.   9. Was conscious of health and safety while carrying out work functions.   10. Maintained a mentorship and coaching program for employees.   11. Innovatively made work processes and procedures more efficient.   12. Mainstreamed gender issues in the workplace.   13. Build a strong team of workers in the workplace.   14. Sought and allocated learning opportunities and resources in the workplace.   15. Demonstrated awareness of HIV and AIDS.   16. Abstained from drug and substance abuse.   17. Demonstrated ability to cope with emerging issues. |
| 1. Resource Implications | |  | | --- | | The following resources should be provided: |  * 1. Workplace or assessment location   2. Case studies/scenarios |
| 1. Methods of Assessment | Competency in this unit may be assessed through:   * 1. Oral Interview   2. Observation   3. Third Party Reports   4. Written tests |
| 1. Context of Assessment | * 1. Competency may be assessed in workplace or in a simulated workplace setting   2. Assessment shall be observed while tasks are being undertaken whether individually or in-group |
| 1. 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/PS/BC/05/5/A

**UNIT DESCRIPTION**

This unit specifies the competencies required to follow procedures for environmental hazard control, follow procedures for environmental pollution control, comply with workplace sustainable resource use, evaluate current practices in relation to resource usage, develop and adhere to environmental protection principles/strategies/guidelines.

**ELEMENTS AND PERFORMANCE CRITERIA**

|  |  |
| --- | --- |
| **ELEMENT**  These describe the key outcomes which make up workplace function. | **PERFORMANCE CRITERIA**  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. Control environmental hazard | * 1. ***Storage methods*** for environmentally***hazardous*** materials are strictly followed according to environmental regulations and OSHS.   2. ***Disposal methods*** of hazardous wastes are followed always according to environmental regulations and OSHS.   3. ***PPE*** is used according to OSHS. |
| 1. Control environmental Pollution control | * 1. Environmental pollution ***control measures*** are compiled following standard protocol.   2. Procedures for solid waste management are observed according to Environmental Management and Coordination Act 1999   3. Methods for minimizing ***noise pollution*** complied following environmental regulations. |
| 1. Demonstrate sustainable resource use | * 1. Methods for minimizing wastage are complied with.   2. Waste management procedures are employed following principles of 3Rs (Reduce, Reuse, Recycle)   3. Methods for economizing or reducing resource consumption are practiced. |
| 1. Evaluate current practices in relation to resource usage | * 1. Information on resource efficiency **systems and procedures** are collected and provided to the work group where appropriate.   2. Current resource usage is measured and recorded by members of the work group.   3. Current purchasing strategies are analyzed and recorded according to industry procedures.   4. Current work processes to access information and data is analyzed following enterprise protocol. |
| 1. Identify Environmental legislations/conventions for environmental concerns | * 1. Environmental ***legislations/conventions*** and local ordinances are identified according to the different ***environmental aspects/impact***   2. ***Industrial standard/environmental practices*** are described according to the different environmental concerns |
| 1. Implement specific environmental programs | * 1. Programs/Activities are identified according to organizations policies and guidelines.   2. Individual roles/responsibilities are determined and performed based on the activities identified.   3. Problems/constraints encountered are resolved in accordance with organizations’ policies and guidelines   4. Stakeholders are consulted based on company guidelines |
| 1. Monitor activities on Environmental protection/Programs | * 1. Activities are periodically monitored and evaluated according to the objectives of the environmental Program   2. Feedback from stakeholders are gathered and considered in proposing enhancements to the program based on consultations   3. Data gathered are analyzed based on evaluation requirements   4. Recommendations are submitted based on the findings   5. Management support systems are set/established to sustain and enhance the program   6. Environmental incidents are monitored and reported to concerned/proper authorities |

**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** |
| PPE include but are not limited to: | * + Mask   + Gloves   + Goggles   + Safety hat   + Overall   + Hearing protector   + Safety boots |
| Environmental pollution control measures include but are not limited to: | * + Methods for minimizing or stopping spread and ingestion of airborne particles   + Methods for minimizing or stopping spread and ingestion of gases and fumes   + Methods for minimizing or stopping spread and ingestion of liquid wastes |
| Waste management procedure include but are not limited to: | * Sorting * Storing of items * Recycling of items * Disposal of items |
| Resources may include but are not limited to: | * Electric * Water * Fuel   + Telecommunications   + Supplies * Materials |
| Workplace environmental hazards include but are not limited to: | * Biological hazards * Chemical and dust hazards * Physical hazards |
| Organizational systems and procedures include but are not limited to: | * Supply chain, procurement and purchasing * Quality assurance * Making recommendations and seeking approvals |

**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:   * 1. Controlled environmental hazard   2. Controlled environmental pollution   3. Demonstrated sustainable resource use   4. Evaluated current practices in relation to resource usage   5. Demonstrated knowledge of environmental legislations and local ordinances according to the different environmental issues /concerns.   6. Described industrial standard environmental practices according to the different environmental issues/concerns.   7. Resolved problems/ constraints encountered based on management standard procedures   8. Implemented and monitored environmental practices on a periodic basis as per company guidelines   9. Recommended solutions for the improvement of the Program   10. Monitored and reported to proper authorities any environmental incidents |
| 1. Resource Implications | The following resources should be provided:   * 1. Workplace with storage facilities   2. Tools, materials and equipment relevant to the tasks (ex. Cleaning tools, cleaning materials, trash bags, etc.)   3. PPE   4. Manuals and references   5. Legislation, policies, procedures, protocols and local ordinances relating to environmental protection   6. Case studies/scenarios relating to environmental Protection |
| 1. Methods of Assessment | Competency in this unit may be assessed through:   * 1. Demonstration   2. Oral questioning   3. Written examination   4. Interview/Third Party Reports   5. Portfolio (citations/awards from GOs and NGOs, certificate of training – local and abroad)   6. Simulations and role-plays |
| 1. Context of Assessment | Competency may be assessed on the job, off the job or a combination of these. Off the job assessment must be undertaken in a closely simulated workplace environment. |
| 1. Guidance information for assessment | Holistic assessment with other units relevant to the industry sector, workplace and job role is recommended. |

**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:

* Following storage methods of environmentally hazardous materials
* Following disposal methods of hazardous wastes
* Using PPE
* Practicing OSHS
* Complying environmental pollution control
* Observing solid waste management
* Complying methods of minimizing noise Pollution
* Complying methods of minimizing wastage
* Employing waste management procedures
* Economizing resource consumption
* Listing of resources used
* Measuring current usage of resources
* Identifying and reporting workplace environmental hazards
* Conveying all environmental issues
* Following environmental regulations
* Identifying environmental regulations
* Assessing procedures for assessing compliance
* Collecting information on environmental and resource efficiency systems and procedures, and Providing information to the work group
* Measuring and recording current resource usage
* Analysing and recording current purchasing strategies.
* Analysing current work processes to access information and data and Assisting identifying areas for improvement
* Analysing resource flow
* Determining efficiency of use/conversion of resources
* Determining causes of low efficiency of use
* Developing plans for increasing the efficiency of resource use
* Checking resource use plans
* Complying to regulations/licensing requirements
* Determining benefit/cost of plans
* Ranking proposals based on benefit/cost compared to limited resources
* Checking proposals meet regulatory requirements
* Monitoring implementation
* Adjusting plan and implementation
* checking new resource usage

**Required Knowledge**

The individual needs to demonstrate knowledge of:

* Storage methods of environmentally hazardous materials
* Disposal methods of hazardous wastes
* Usage of PPE Environmental regulations
* OSHS
* Types of pollution
* Environmental pollution control measures
* Different solid wastes
* Solid waste management
* Different noise pollution
* Methods of minimizing noise pollution
* Solid Waste Act
* Methods of minimizing wastage
* Waste management procedures
* Economizing of resource consumption
* 3Rs principle
* Types of resources
* Techniques in measuring current usage of resources
* Calculating current usage of resources
* Types of workplace environmental hazards
* Environmental regulations
* Environmental regulations applying to the enterprise.
* Procedures for assessing compliance with environmental regulations.
* Collection of information on environmental and resource efficiency systems and procedures,
* Measurement and recording of current resource usage
* Analysis and recording of current purchasing strategies.
* Analysis current work processes to access information and data Analysis of data and information
* Identification of areas for improvement
* Resource consuming processes
* Determination of quantity and nature of resource consumed
* Analysis of resource flow of different parts of the resource flow process
* Use/conversion of resources
* Causes of low efficiency of use
* Increasing the efficiency of resource use
* Inspection of resource use plans
* Regulations/licensing requirements
* Determine benefit/cost for alternative resource sources
* Benefit/costs for different alternatives
* Components of proposals
* Criteria on ranking proposals
* Regulatory requirements
* Proposals for improving resource efficiency
* Implementation of resource efficiency plans
* Procedures in monitor implementation
* Adjustments of implementation plan
* Inspection of new resource usage

# DEMONSTRATE OCCUPATIONAL SAFETY AND HEALTH PRACTICES

**UNIT CODE:** ENG/OS/PS/BC/06/5/A

**UNIT DESCRIPTION**

This unit specifies the competencies required to lead the implementation of workplace’s safety and health program, procedures and policies/guidelines.

**ELEMENTS AND PERFORMANCE CRITERIA**

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| --- | --- |
| **ELEMENT**  These describe the key outcomes which make up workplace function. | **PERFORMANCE CRITERIA**  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. Identify workplace hazards and risk | 1.1 ***Hazards*** in the workplace and/or its ***indicators*** of its presence, are identified  1.2 ***Evaluation and/or work environment*** measurements of OSH hazards/risk existing in the workplace is conducted by  Authorized personnel or agency  1.3 ***OSH issues and/or concerns*** raised by workers are  Gathered |
| 1. Identify and implement appropriate control measures | 2.1 Prevention ***and control measures***, including use of  s***afety gears / PPE (personal protective equipment)*** for specific hazards  identified and implemented  2.2 Appropriate ***risk controls*** based on result of OSH hazard evaluation is recommended.  2.3 ***Contingency measures***, including ***emergency procedures*** during workplace ***incidents and emergencies*** are recognized and established in accordance with organization procedures. |
| 1. Implement OSH programs, procedures and policies/ guidelines | 3.1 Information to work team about company OSH program, procedures and policies/guidelines are provided  3.2 Implementation of OSH procedures and policies/ guidelines are participated  3.3 Team members are trained and advised on OSH standards and procedures  3.4 Procedures for maintaining ***OSH-related records*** are implemented |

**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 include but are not limited to: | * Physical hazards – impact, illumination, pressure, noise, vibration, extreme temperature, radiation * Biological hazards- bacteria, viruses, plants, parasites, mites, molds, fungi, insects * Chemical hazards – dusts, fibers, mists, fumes, smoke, * gasses, vapors * Ergonomics Psychological factors – over exertion/ excessive force, awkward/static positions, fatigue, direct pressure * varying metabolic cycles * Physiological factors – monotony, personal * relationship, work out cycle * Safety hazards (unsafe workplace condition) – * confined space, excavations, falling objects, gas * leaks, electrical, poor storage of materials and waste, spillage, waste and debris * Unsafe workers’ act (Smoking in off-limited areas, Substance and alcohol abuse at work) |
| Indicators include but are not limited to: | * Increased of incidents of accidents, injuries * Increased occurrence of sickness or health complaints/ symptoms * Common complaints of workers related to OSH * High absenteeism for work-related reasons |
| Evaluation and/or work environment measurements include but are not limited to: | * Health Audit * Safety Audit * Work Safety and Health Evaluation * Work Environment Measurements of Physical and Chemical Hazards |
| OSH issues and/or concerns include but are not limited to: | * Workers’ experience/observance on presence of work hazards * Unsafe/unhealthy administrative arrangements (prolonged work hours, no break time, constant overtime, scheduling of tasks) * Reasons for compliance/non-compliance to use of PPEs or other OSH procedures/policies/guidelines |
| Prevention and control measures include but are not limited to: | * Eliminate the hazard (i.e., get rid of the dangerous machine * Isolate the hazard (i.e. keep the machine in a closed room and operate it remotely; barricade an unsafe area off) * Substitute the hazard with a safer alternative (i.e., replace the machine with a safer one) * Use administrative controls to reduce the risk (i.e. give trainings on how to use equipment safely; OSH-related topics, issue warning signages, rotation/shifting work schedule) * Use engineering controls to reduce the risk (i.e. use safety guards to machine) * Use personal protective equipment * Safety, Health and Work Environment Evaluation * Periodic and/or special medical examinations of workers |
| Safety gears /PPE (Personal Protective Equipment’s) include but are not limited to: | * Arm/Hand guard, gloves * Eye protection (goggles, shield) * Hearing protection (ear muffs, ear plugs) * Hair Net/cap/bonnet * Hard hat * Face protection (mask, shield) * Apron/Gown/coverall/jump suit * Anti-static suits * High-visibility reflective vest |
| Appropriate risk controls include but not limited to: | * Appropriate risk controls in order of impact are as follows: * Eliminate the hazard altogether (i.e., get rid of the dangerous machine) * 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) * Substitute the hazard with a safer alternative (i.e., replace the machine with a safer one) * 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) * Use engineering controls to reduce the risk (i.e., attach guards to the machine to protect users) * Use personal protective equipment (i.e., wear   gloves and goggles when using the machine) |
| Contingency measures include but are not limited to: | * Evacuation * Isolation * Decontamination * (Calling designed) emergency personnel |
| Emergency procedures include but are not limited to: | * Fire drill * Earthquake drill * Basic life support/CPR * First aid * Spillage control * Decontamination of chemical and toxic * Disaster preparedness/management * Se of fire-extinguisher |
| Incidents and emergencies include but are not limited to: | * Chemical spills * Equipment/vehicle accidents * Explosion * Fire * Gas leak * Injury to personnel * Structural collapse * Toxic and/or flammable vapour emission. |
| OSH-related Records include but are not limited to: | * Medical/Health records * Incident/accident reports * Sickness notifications/sick leave application * 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:

* Skills on preliminary identification of workplace hazards/risks
* Knowledge management
* Critical thinking skills
* Observation skills
* Coordinating skills
* Communication skills
* Interpersonal skills
* Troubleshooting skills
* Presentation skills
* Training skills

**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 counselling 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:   1. Identifies hazards/risks in the workplace and/or its indicators 2. Requests for evaluation and/or work environment measurements of OSH hazards/risk in the workplace 3. Gathers OSH issues and/or concerns raised by workers 4. Identifies and implements prevention and control measures, including use of PPE (personal protective equipment) for specific hazards 5. Recommends appropriate risk controls based on result of OSH hazard evaluation and OSH issues gathered 6. Establish contingency measures, including emergency procedures in accordance with organization procedures 7. Provides information to work team about company OSH program, procedures and policies/guidelines 8. Participates in the implementation of OSH procedures and policies/guidelines 9. Trains and advises team members on OSH standards and procedures 10. Implements procedures for maintaining OSH-related records |
| 1. Resource Implications | The following resources should be provided:  2.1 Workplace or assessment location  2.2 OSH personal records  2.3 PPE  2.4 Health records |
| 1. Methods of Assessment | Competency may be assessed through:  3.1 Portfolio Assessment  3.2 Interview  3.3 Case Study/Situation  3.4 Observation/Demonstration and oral questioning |

# COMMON UNITS OF COMPETENCY

# APPLY ENGINEERING MATHEMATICS

**UNIT CODE:** ENG/OS/PS/CC/01/5/A

**UNIT DESCRIPTION**

This unit describes the competencies required by a plant and service Engineering operator to apply a wide range of engineering mathematics in their work. This includes applying algebraic functions, trigonometry and hyperbolic functions, complex numbers, coordinate geometry, carrying out binomial expansion, calculus, Statistics, Vector theory, Matrix, Numerical methods, probability, commercial calculations, estimations, measurements and calculations of quantities in solving problems.

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| --- | --- |
| **ELEMENTS AND PERFORMANCE CRITERIAELEMENT**  These describe the key outcomes which make up workplace function. | **PERFORMANCE CRITERIA**  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. Apply Algebra | 1. Calculations involving Indices are performed as per the concept 2. Calculations involving Logarithms are performed as per the concept 3. Scientific calculator is used in solving mathematical problems in line with manufacturer’s manual 4. Simultaneous equations are performed as per the rules 5. Quadratic equations are calculated as per the concept |
| * 1. Apply Trigonometry and hyperbolic functions | 1. Calculations are performed using trigonometric rules 2. Calculations are performed using ***hyperbolic functions*** |
| * 1. Apply complex numbers | * 1. Complex numbers are represented using Argand diagrams   2. Operations involving complex numbers are performed   3. Calculations involving complex numbers are performed using De Moivre’s theorem |
| 1. Apply Coordinate Geometry | * 1. Polar equations are calculated using coordinate geometry   2. Graphs of given polar equations are drawn using the Cartesian plane   3. Normal and tangents are determined using coordinate geometry |
| 1. Carry out Binomial Expansion | * 1. Roots of numbers are determined using binomial theorem   2. Errors of small changes are determined using binomial theorem |
| 1. Apply Calculus | * 1. Derivatives of functions are determined using Differentiation   2. Derivatives of hyperbolic functions are determined using Differentiation   3. Derivatives of inverse trigonometric functions are determined using Differentiation   4. Rate of change and small change are determined using Differentiation.   5. Calculation involving stationery points of functions of two variables are performed using differentiation.   6. Integrals of algebraic functions are determined using integration   7. Integrals of trigonometric functions are determined using integration   8. Integrals of logarithmic functions are determined using integration   9. Integrals of hyperbolic and inverse functions are determined using integration |
| 1. Apply Statistics | * 1. Identification, Collection and Organization of data is performed   2. Interpretation, analysis and presentation of data in appropriate format is performed   3. Mean, median, mode and Standard deviation are obtained from given data |
| 8. Apply Vector theory | * 1. Calculations involving vector algebra, dot and cross products using vector theory   2. Gradient, Divergence and Curl are obtained   3. Vector calculations are performed using Green’s theorem   4. Vector calculations are performed using Stoke’s theorem   5. Conservative vector fields and line and surface integrals are obtained using Gauss’s theorem |
| 1. Apply Matrix | * 1. Determinant and inverse of 2x2 matrix are obtained   2. Solutions of simultaneous equations are obtained   3. Calculation involving Eigen values and Eigen vectors are performed |
| 1. Apply Numerical methods | * 1. Roots of polynomials are obtained using iterative numerical methods   2. Interpolation and extrapolation are performed using numerical methods |
| 1. Apply concepts of probability for work | * 1. Probability events are determined from dependent, independent and mutually exclusive   2. Counting is done using permutation, combination, tree diagrams and Venn diagrams techniques |
| 1. Perform commercial calculations | * 1. Exchange rate calculations are done using devaluation and revaluation   2. Sales, stock turnover and profit and loss are determined   3. Incomes, salaries and wages are calculated |
| 1. Perform estimations, measurements and calculations of quantities | * 1. Measurement information in workplace is extracted and interpreted   2. Appropriate workplace measuring tools and equipment are identified and selected   3. Conversions are performed between units of measurement   4. Measurements are estimated and taken   5. Length, width, height, perimeter, area and angles of ***figures*** are calculated   6. Volume and surface area of figures are calculated   7. Information is recorded using mathematical language and symbols appropriate for the task |

**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. Hyperbolic functions includes but not limited to: | * + Sinh x   + Cosh x   + Cosec x   + Coth x   + Tanh x   + Sech x |
| 1. Figures include but not limited to: | * + Triangles   + Squares   + Rectangles   + Circles   + Spheres   + Cylinders   + Cubes   + Polygons   + Cuboids   + Pyramids |
| 1. Quantities include but not limited to: | * + Weight,   + Mass   + Area   + Volume   + Length   + Width   + Depth   + Perimeter |

**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, knowledge and range.

|  |  |
| --- | --- |
| 1. Critical aspects of Competency | Assessment requires evidence that the candidate:   * 1. Applied Trigonometry and hyperbolic functions   2. Applied complex numbers   3. Determined angles and length in triangles   4. Applied Calculus   5. Solved Ordinary differential equations   6. Applied Laplace transforms   7. Applied Power Series   8. Applied Fourier Series   9. Applied Vector theory   10. Applied Matrix   11. Identified and selected measuring equipment   12. Collected, Analyzed and presented data   13. Applied Numerical methods |
| * + 1. Resource Implications | The following resources should be provided:   * 1. Access to relevant workplace or appropriately simulated environment where assessment can take place   2. Measuring equipment   3. Materials relevant to the proposed activity or tasks |
| 1. Methods of Assessment | Competency in this unit may be assessed through:   * 1. Direct Observation   2. Demonstration with Oral Questioning   3. Written tests |
| 1. Context of Assessment | Competency may be assessed individually in the actual workplace or  through accredited institution |
| 1. Guidance information for assessment | Holistic assessment with other units relevant to the industry sector, workplace and job role is recommended. |

# PERFORM WORKSHOP PROCES AND MATERIAL

**UNIT CODE:** ENG/OS/PS/CC/02/5/A

**UNIT DESCRIPTION**

This unit describes the competencies required to perform workshop. Competencies include; planning work operations, selecting tools and materials, measuring and marking out dimensions on work piece, cutting and filing parts, drilling holes, producing threads, producing components using lathe machine, assembling metal parts and sub-assemblies, polishing finished work, performing housekeeping, inspecting accuracy and quality of finished work and maintaining tools and equipment.

**ELEMENTS AND PERFORMANCE CRITERIA**

| **ELEMENT**  These describe the key outcomes which make up workplace function | **PERFORMANCE CRITERIA**  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. Plan work operations | * 1. Technical drawings and geometric symbols are read and interpreted as per ***drawing standards.***   2. ***Operation Plan*** is produced as per the technical drawings.   3. Technical drawings are produced ***as*** per drawing Standards. |
| 1. Select tools and materials | * 1. Working tools, equipment and materials are selected for the task.   2. The work areas are tidied up as per organization policy. |
| 1. Measure and mark out dimensions on work pieces | * 1. Measuring tools suitable for the work are selected   2. Measuring tools are inspected and calibrated if required   3. Dimensions are marked on the workpiece as per the working drawing. |
| 1. Cat and file parts | * 1. ***Hand tools*** are selected based on operation plan   2. Workpiece is cut to specification   3. Workpiece is filed to specification   4. Part are produced to ***specifications*** |
| 1. Drill holes | * 1. Hole centers are marked and center-punched as per operation plan.   2. Drill bits are selected and mounted   3. Workpiece is mounted and clamped   4. ***Hole is drilled*** to specification   5. Holes inspected to ***specification*** |
| 1. Produced threads | * 1. Taps and dies selected based on operation plan.   2. Taps and dies are set up on the work piece   3. ***Threads are*** cut to specification |
| 1. Produce components using a lathe machine | * 1. Workpieces are turned to specification   2. Tools are selected as per the task to be carried out   3. Workpiece is selected and mounted on a lathe machine as per the task to be carried out   4. Threads are generated on a workpiece on a lathe machine as per the nature of the task   5. Machines are operated in adherence of workshop safety practices |
| 1. Assemble metal parts and sub-assemblies | * 1. Parts ***joined***, fitted and assembled   2. Final assembly inspected as per specification |
| 1. Polish finished work | * 1. ***Polishing*** material are selected   2. Finished work is cleaned   3. Finished work is polished to specification |
| 1. Perform housekeeping | * 1. Waste is segregated and disposed as per disposal guidelines.   2. Housekeeping is carried out as per workplace requirement |
| 1. Inspect accuracy and quality of finished work | * 1. Inspection tools and methods selected as per operation plan   2. Finished work is inspected as per specification   3. Adjustments are made based on inspections results |
| 1. Maintain tools and equipment | * 1. Machines and tools are inspected as per the workshop rules   2. Machines and tools are lubricated in line to their operation standards   3. Tools are ground to specification according to engineering best practice   4. Faults on machines and tools are identified and reported   5. Store tools and equipment |

**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** |
| --- | --- |
| Measuring tools include but not limited to: | * + Steel rule   + Verniercaliper   + Micrometer screw gauge   + Vernier height gauge   + Combination set   + Bevels |
| Drawing Standards include but not limited to: | * + ISO   + BS   + ANSI |
| Operation Plan include but not limited to: | * + Sequence of operations   + Measuring tools   + Hand tools   + Cutting tools   + Inspection tools |
| Marking out tools include but not limited to: | * + Scribers   + Dividers   + Dot punch   + Centre punch   + Engineers square   + Straight edge   + Surface plate |
| Work holding devices include but not limited to: | * + Bench vice   + V-Block   + Angle plate   + G-clamp   + Jigs and fixtures   + Hand vice |
| Hand tools include but not limited to: | * + Files   + Saws   + Hammers   + Chisels   + Taps and dies |
| Workshop machines include but not limited to: | * + Drilling machines   + Lathe machine   + Grinding machine   + Shaper |
| Threads include but not limited to: | * + Internal and external threads   + V-profile threads   + Box profile |
| Polishing include but not limited to: | * + Emery cloth   + Polishing and burnishing machine   + Filing |
| Hole drilled include but not limited to: | * + Location   + Counter sinking   + Counter boring   + Reaming   + Boring |
| Joining include but not limited to: | * + Riveting   + Fastening   + Soldering   + Brazing   + Welding |
| Specifications include but not limited to: | * + Dimensions   + Tolerances   + Geometry   + Surface finish   + Functionality |

**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:

* Technical drawing
* Using measuring and inspection tools
* Using hand tools
* Using portable and bench drilling machines
* Soldering and brazing
* Riveting and fastening
* Basic use of the lathe machine
* Using grinding machine

**Required Knowledge**

The individual needs to demonstrate knowledge and understanding 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
* Equipment manuals
* Basic technical drawing complyingto ISO, ANSI & BS standards
* ISO 1101 Geometrical tolerance and where to use the norm
* Work Planning and documentation
* Measuring tools
* Hand tools
* Bench work
* Portable and bench drilling machines
* Lathe machine
* Grinding machine
* Inspection and quality control
* Preventive maintenance of machine tools
* Metal cutting technology
* Materials and metallurgy
* WIBA act (2007)
* 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 learner:   * 1. Observed rules and procedures in the workshop   2. Interpreted technical drawing   3. Produced operation plan   4. Produced holes on a work piece   5. Threaded using taps and dies   6. Assembled metal parts   7. Polished finished work   8. Maintained tools and equipment   9. Did housekeeping before, during and after operations |
| 1. Resource Implications | * 1. Hand measuring tools   2. Hand marking tools   3. Hand tools   4. Inspection tools and equipment   5. Hand drilling machine   6. Bench Drilling machine   7. Lathe machine   8. Grinding machine   9. Work benches   10. Bench vices   11. ISO, BS and ANSI standards   12. Rules and procedures   13. Resource materials, manuals for bench, tools and equipment   14. Materials   15. Cutting tools |
| 1. Methods of Assessment | Competency may be assessed through:   * 1. Observing the behaviour of the learner   2. Oral presentations   3. Inspection of written operation procedures   4. Inspection of finished product   5. Observing housekeeping of the work area and/or machine tool |
| 1. Context of Assessment | Competency may be assessed individually in the actual workplace or through accredited institution |
| 1. 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/PS/CC/03/5/A

**UNIT DESCRIPTION**

This unit describes the competencies required by a plant and services 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, demonstrating understanding of friction principles, demonstrating understanding of motion, understanding friction principles, understanding motions, describing work, energy and power, performing machine calculations, demonstrating understanding of gas principles, applying heat knowledge, applying density knowledge and applying pressure principles.

**ELEMENTS AND PERFORMANCE CRITERIA**

| **ELEMENT**  These describe the key outcomes which make up workplace function. | **PERFORMANCE CRITERIA**  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. Forces are defined and described   2. ***Forces theorems*** are described   3. Resultant of coplanar forces are determined. |
| 1. Demonstrate knowledge of moments | * 1. Moments are defined   2. Moments are calculated   3. Principles of moments are described   4. Couples are identified and applied in engineering systems. |
| 1. Demonstrate understanding of friction | * 1. Laws of friction are identified   2. Limiting friction is calculated   3. Forces applied at an angle to a horizontal plane are calculated   4. Coefficient of friction is calculated   5. Advantages and disadvantages of friction are identified. |
| 1. Demonstrate understand of motions in engineering | * 1. Motion concepts are discussed   2. Laws of motion are identified   3. Motion calculations are performed   4. Displacement/time graphs are applied |
| 1. Describe work, energy and power | * 1. Work is calculated   2. Energy is calculated   3. Power calculations are performed |
| 1. Perform machine calculations | * 1. ***Problems on simple machines*** are solved   2. Problems on levers are solved   3. Laws of machines are identified |
| 1. Demonstrate understanding of gas principles | * 1. ***Gas laws*** are identified   2. Gas laws are applied in solving engineering problems   3. Uses of gases in engineering systems are identified |
| 1. Apply heat knowledge | * 1. Heat concepts are discussed   2. Working principle of heat is defined   3. Heat capacity is discussed   4. Heat problems are solved |
| 1. Apply density knowledge | * 1. ***Density terminology*** are discussed   2. Density measurements are carried out   3. Density problems are solved |
| 1. Apply pressure principles | * 1. Pressure concepts are discussed   2. Working principles of pressure is discussed   3. Pressure problems are solved   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** |
| Forces theorems includes but not limited to: | * + Parallelogram   + Triangle   + Polygon |
| Problems on simple machines includes but not limited to: | * + Machine advantage   + Velocity ratio   + Efficiency |
| Gas laws includes but not limited to: | * + Boyles law   + Charles law   + Gas equation |
| Density terminology includes but not limited to: | * + Density   + Relative density |
| Pressure applications includes but not limited to: | * + Vacuum pump   + Hydraulic pump   + Hydrometers |
| Principles includes but not limited to: | * + Newton’s laws of motion   + Law of conservation of linear momentum   + Law of conservation of energy   + Archimedes’ principle |
| Mechanical calculations include but not limited to: | * + Mechanical advantage   + Efficiency   + Torque   + Power/Energy   + Work done |
| Laws of fluids includes but not limited to: | * + Pascal’s principle   + 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:   * 1. Determined forces in a system   2. Demonstrated knowledge of moments   3. Understood friction principles   4. Understood motions in engineering   5. Described work, energy and power   6. Performed machine calculations   7. Demonstrated gas principles   8. Applied heat knowledge   9. Applied density knowledge   10. Applied pressure principles |
| 1. Resource Implications | The following resources should be provided:   * 1. Access to relevant workplace or appropriately simulated environment where assessment can take place   2. Measuring tools and equipment   3. Sample materials to be tested |
| 1. Methods of Assessment | Competency in this unit may be assessed through:   * + Direct Observation   + Demonstration with Oral Questioning   + Case studies   + Written tests |
| 1. Context of Assessment | Competency may be assessed individually in the actual workplace or  through accredited institution |
| 1. 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/PS/CC/04/5/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. Competencies includes; understanding flow of fluids, demonstrating knowledge in viscous flow, performing dimensional analysis and operating fluid pumps

**ELEMENTS AND PERFORMANCE CRITERIA**

| **ELEMENT**  These describe the key outcomes which make up workplace function. | **PERFORMANCE CRITERIA**  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. Demonstrate understanding of flow in fluids | * 1. Flow rate in pipes is measured   2. Losses in pipes are determined   3. ***Causes of losses*** in pipes are determined   4. Flow losses equations are applied in problem solving |
| 1. Demonstrate knowledge in viscous flow | * 1. Viscous flow between parallel surfaces are explained   2. Viscous flow equations between parallel surfaces are derived and applied   3. Viscous flow equations in circular pipes are derived and applied in problem solving |
| 1. Perform dimensional analysis | * 1. Dimensional analysis is explained   2. Principle of dimensional homogeneity is explained   3. Fundamental dimensions are stated   4. Dimensional units are defined   5. ***Physical quantities*** are identified   6. Dimensional analysis are ***applied*** in problem solving |
| 1. Operate fluid pumps | * 1. ***Principle of operation*** of pumps is described   2. ***Reciprocating pump equation is*** ***derived***   3. ***Centrifugal pump equation is derived***   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** |
| Causes of losses includes but not limited to: | * + Friction   + Enlargement/reduction in cross-sectional areas |
| Physical quantities include but not limited: | * + Mass   + Force   + Density   + Velocity   + Acceleration |
| Applied includes but not limited to: | * + Reynolds number   + Mach number   + Froude number |
| Principle of operation includes but not limited to: | * + Reciprocating   + Centrifugal |
| Reciprocating pump equation is derived includes but not limited to: | * + Coefficient of discharge   + Percentage slip   + Work done   + Acceleration head   + Pressure head in the cylinder |
| Centrifugal pump equation is derived includes but not limited to: | * + Effective head   + Manometric head   + Manometric efficiency   + Mechanical efficiency   + Discharge   + Torque   + Work done unit weight   + 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:   * 1. Identified Principlesof mechanical science   2. Performed mechanical calculations of a system   3. Identified types of forces on a system   4. Calculated resultant forces on plane framework   5. Identified application of forces on the production flow   6. Tested mechanical properties of a materials   7. Identified tools and equipment for measuring system parameters   8. Recorded and interpreted measured parameters.   9. Operated Power transmission systems |
| 1. Resource Implications | The following resources should be provided:   * 1. Access to relevant workplace or appropriately simulated environment where assessment can take place   2. Measuring tools and equipment   3. Sample materials to be tested |
| 1. Methods of Assessment | Competency in this unit may be assessed through:   * 1. Direct Observation   2. Demonstration with Oral Questioning   3. Case studies   4. Written tests |
| 1. Context of Assessment | Competency may be assessed individually in the actual workplace or  through accredited institution |
| 1. Guidance information for assessment | Holistic assessment with other units relevant to the industry sector, workplace and job role is recommended. |

# APPLY MATERIAL SCIENCE AND METALLURGICAL PROCESSES

**UNIT CODE:** ENG/OS/PS/CC/06/5/A

**UNIT DESCRIPTION:**

The learner will be introduced to performing material testing and metallurgical processes. It involves analyzing 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**  These describe the key  outcomes which make up  workplace function | **PERFORMANCE CRITERIA**  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. Analyze properties of engineering materials | * 1. Type of engineering materials is identified as per the procedures   2. ***Physical properties*** of engineering material are determined   3. ***Mechanical properties*** of engineering materials are tested   4. Crystal structure of materials are analyzed |
| 1. Perform ore extraction processes | 1. Safety procedures are observed according OSHA 2. Method of extraction is determined as per material properties and its composition 3. Procedure in extraction process is determined as per extraction method 4. Extraction by- products are stored as per SOPs 5. Extraction by- products are disposed as per SOPs |
| 1. Produce iron materials | 1. Perform ore smelting according to standard operating procedures. 2. ***Composition of iron*** is determined 3. Method of producing ***iron material*** is established 4. Refinement processes are identified based on iron material required |
| 1. Produce alloy materials | * 1. Materials in alloy formation are identified   2. Alloy formation process is identified based on alloy to be produced   3. Alloy tested based on alloy production requirement |
| 1. Produce non-ferrous materials | * 1. **Non-ferrous materials** are extracted according to SOP   2. Extracted non-ferrous material is smelted and purified as per the SOP   3. Non-ferrous material is tested according to SOP   4. Alloying elements for non-ferrous materials are identified   5. Alloy formation process is identified based on alloy to be produced   6. Alloys for non-ferrous material are tested based on production requirement |
| 1. Produce ceramics materials | * 1. Composition of **ceramic materials** is identified   2. Manufacturing process is identified   3. Ceramic materials are produced according to manufacturing processes   4. ***Finishing processes*** are identified |
| 1. Produce composite materials | * 1. Type of composite to be produced is identified   2. Elements involve in composite formation are identified   3. Formation process of composite to be produced is identified   4. Composite is tested as per composite production requirement |
| 1. Utilise ***other engineering materials*** | * 1. Identify and select engineering material according to production requirements.   2. Operation plan is developed according to engineering drawing.   3. Appropriate machine is set up according to manufacturer’s manual   4. Production parameters are set according to production requirement |
| 1. Perform heat treatment | * 1. Safety practices are observed according to OSHA 2007   2. **Heat treatment processes** are identified   3. Procedures in heat treatment processes are established   4. Heat treatment of metals are performed |
| 1. Perform material testing | * 1. Safety is observed in material testing procedures   2. **Material testing methods** are identified depending on material to be tested   3. Procedure of material testing is followed as per material testing method   4. Material testing results are tabulated, calculated and interpreted   5. Material testing equipment are taken care of and maintained. |
| 1. Prevent material corrosion | * 1. Safety is observed during corrosion prevention   2. ***Corrosion type*** is identified   3. Corrosive atmosphere is identified   4. ***Methods of corrosion prevention*** are identified   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** |
| --- | --- |
| Physical properties includes but not limited to: | * Density * Color * Texture * Melting point * Thermo conductivity * Electrical resistivity |
| Mechanical properties includes but not limited: | * Ductility * Malleability * Elasticity * Toughness * Hardness * Brittleness * Plasticity * Strength |
| Composition of iron includes but not limited to: | * Iron (II) oxide * Iron (III) oxide |
| Iron materials includes but not limited to: | * + Cast iron   + Steel |
| Non-ferrous materials includes but not limited to: | * + Aluminium   + Copper |
| Ceramic materials but not limited to: | * + oxides   + nitrides   + carbides   + silica |
| Finishing processes includes but not limited to: | * + Lapping   + Fine grinding   + Polishing |
| Heat treatment processes includes but not limited to: | * + Annealing   + Tempering   + Normalizing   + Hardening   + Case hardening |
| other engineering materials includes but not limited to: | * + Rubber   + Plastics   + Wood   + Glass |
| Corrosion type | * + Galvanic   + Stress corrosion cracking |
| Methods of corrosion prevention includes but not limited to: | * + Painting   + Electroplating   + Galvinizing   + Cathodic   + 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 and understanding 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 learner   * 1. Observed safety as per work place procedures   2. Demonstrated understanding of physical, chemical and mechanical properties of engineering materials   3. Performed extraction processes   4. Produced iron materials   5. Produced ceramics   6. Produced composites   7. Produced alloys   8. Performed heat treatment   9. Performed material testing   10. Demonstrated understanding of corrosion types and its prevention |
| 1. Resource Implications | * 1. Testing materials   2. Extraction materials   3. Measuring instruments   4. Inspection tools |
| 1. Methods of Assessment | Competency may be accessed through:   * 1. Oral questioning   2. Written test   3. Practical tests |
| 1. Context of Assessment | Competency may be assessed individually in the actual workplace or through accredited institution |
| 1. Guidance information for assessment | Holistic assessment of other units relevant to the industry sector, workplace and job role is recommended. |

# 

# APPLY ELECTRICAL PRINCIPLES

**UNIT CODE:** ENG/OS/PS/CC/07/5/A

**UNIT DESCRIPTION**

This unit describes the competencies required by a technician in order to apply a wide range of Electrical principles in their work; use the concept of basic Electrical quantities, use the concepts of D.C and A.C circuits in electrical installation, use of basic electrical machine, use of earthing in Electrical installations and apply lightning protection measures

**ELEMENTS AND PERFORMANCE CRITERIA**

| **ELEMENT**  These describe the key outcomes which make up workplace function. | **PERFORMANCE CRITERIA**  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. Use the concept of basic Electrical quantities | * 1. Basic ***SI unit***s in Electrical are identified   2. ***Quantitie***s of Charge, force, work and power are identified   3. Perform calculations involving Ohm’s law i.e Current, Resistance and voltage   4. Calculations involving various electrical quantities are performed   5. Electrical quantities measuring instruments are identified |
| * + 1. Use the concepts of D.C and A.C circuits in electrical installation | * 1. Calculations involving parallel and series circuits are performed   2. Calculations involving Network theorems are performed. E.g. Kirchoff’s laws, Superposition, Thevinin’s, Norton’s   3. Photovoltaic solar system is identified   4. AC to DC and DC to AC conversion is performed |
| 1. Use of basic electrical machine | * 1. Types of various electrical machines are identified   2. Operations involving single phase and three phase AC and DC Motors are performed   3. Calculations involving single and three phase AC and DC transformers are performed   4. Operations involving single and three phase generators are performed   5. AC and DC machines are applied as per their functions |
| 1. Use of earthing in Electrical installations | * 1. Earthing types are identified   2. Earthing points on Electrical installation are identified   3. Calculation involved in determining the earthing type is performed   4. Test on an earthing system is performed in line with the IEE regulations |
| 1. Apply lightning protection measures | * 1. Types of lightening strokes are identified   2. Components of lightening protection system are identified   3. Test to be carried out in lightening protection system are established   4. Application of lightening protection system is determined |

**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** |
| SI unit includes but not limited to: | * 1. Power – Watts (W)   2. Current – Amperes (A)   3. Resistance – Ohms(Ω)   4. Voltage – Volts (V) |
| Quantities includes but not limited to: | * 1. Charge   2. Force   3. Work   4. Power |

**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 Electrical formulas
* Use of basic Electrical instruments
* Perform various unit conversions of Electrical quantities
* Electrical earthing
* Lightening arrestors
* Power factor correction
* logical thinking
* problem solving
* applying statistics
* drawing graphs
* Using different measuring tools

**Required knowledge**

The individual needs to demonstrate knowledge of:

* Electrical power calculations
* Various laws in Electrical engineering
* Electrical formulas
* Power triangle
* SI units of various electrical parameters
* Earthing testing
* Lightening arrestor testing
* Selecting the correct type of electrical machines for various uses
* Types and purpose of measuring instruments
* Units of measurement 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:   * 1. Applied the correct SI units of Electrical quantities   2. Stated, Calculate and relates the quantities in Ohm’s law   3. Identified the components of an earthing system   4. Stated and apply various laws in Electrical system   5. Differentiated between AC and DC network   6. Applied correct formulas in the calculation of AC and DC machines   7. Identified types of lightening arrestors and their applications |
| 1. Resource Implications | The following resources should be provided:   * 1. Access to relevant workplace or appropriately simulated environment where assessment can take place   2. Measuring equipment   3. Materials relevant to the proposed activity or tasks |
| 1. Methods of Assessment | Competency in this unit may be assessed through:   * 1. Direct Observation   2. Demonstration with Oral Questioning   3. Written tests |
| 1. Context of Assessment | Competency may be assessed individually in the actual workplace or  through accredited institution |
| 1. Guidance information for assessment | Holistic assessment with other units relevant to the industry sector, workplace and job role is recommended. |

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# PREPARE AND INTERPRET TECHNICAL DRAWINGS

**UNIT CODE:** ENG/OS/PS/CC/08/5/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 and application of Computer Aided Design (CAD) packages.

**ELEMENTS AND PERFORMANCE CRITERIA**

| **ELEMENT**  These describe the key outcomes which make up workplace function. | **PERFORMANCE CRITERIA**  These are assessable statements which specify the required level of performance for each of the elements.  ***(Bold and italicised 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  1.2 ***Drawing materials*** are identified and gathered according to task requirements  1.3 Drawing equipment are used and maintained as per manufacturer’s instructions  1.4 Drawing materials are used as per workplace procedures  1.5 Waste materials are disposed in accordance with workplace procedures and ***environmental legislations***  1.6 ***Personal Protective Equipment*** is used according to occupational safety and health regulations |
| * 1. Produce plane geometry drawings | * 1. Different types of lines used in drawing and their meanings are identified according to standard drawing conventions   2. Different types of ***geometric forms*** are constructed according to standard conventions   3. Different types of angles are constructed according to principles of trigonometry   4. Different types of angles are measured using appropriate measuring tools   5. Angles are bisected according to standard conventions   6. Freehand sketching of different types of geometric forms, tools, equipment, diagrams is conducted |
| * 1. Produce solid geometry drawings | * 1. Drawings of patterns are interpreted according to standard conventions   2. Patterns are developed in accordance with standard conventions |
| * 1. Produce orthographic and pictorial drawings | * 1. Symbols and abbreviations are identified and their meaning interpreted according to standard drawing conventions   2. First and third angle orthographic drawings are interpreted and produced in accordance with the standard conventions   3. Orthographic elevations are dimensioned in accordance with standard conventions   4. Isometric drawings are interpreted and produced in accordance with standard conventions   5. Assembly drawing is produced and interpreted in line with the operating standards |
| 5. Produce mechanical drawings | * 1. Mechanical symbols and abbreviations are identified and their meaning interpreted according to BS 3939   2. ***Mechanical drawings*** are produced in accordance with BS 3939 |
| 6. Apply CAD packages | * 1. CAD packages are selected according to task requirements   2. CAD packages are applied in production of electrical drawings |

**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** |
| --- | --- |
| Drawing equipment includes but not limited to: | Drawing boards, T and set squares, drawing sets, computers with CAD packages |
| Drawing materials includes but not limited to: | Drawing papers, pencils, erasers, masking tapes, paper clips |
| Environmental legislations includes but not limited to: | EMCA 1999 |
| Personal Protective Equipment includes but not limited to: | Dust coats, closed leather shoes |
| Geometric forms includes but not limited to: | Circles, triangles, rectangles, parallelogram, polygons, pyramids, conic sections, prisms, loci |
| Standard conventions includes but not limited to: | * Anatomy of engineering drawing (title block, coordinate grid system, revision block, notes and legends) * Drawing scale (paper size and drawing symbols) * International drawing standards |
| Electrical drawings includes but not limited to: | Block, schematic, circuit, line and wiring diagrams |

**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:   * 1. Applied and adhered to safety procedures   2. Cared and maintained drawing equipment   3. Interpreted drawings, assembly and lay out diagrams   4. Applied appropriate technical standards, used proper tools and equipment for a given task   5. Produced sketches and drawings   6. Applied CAD packages in production of drawings |
| 1. Resource Implications | Resources the same as that of workplace are advised to be applied.   * 1. Drawing room   2. Drawing equipment and materials   3. Computers   4. CAD packages |
| 1. Methods of Assessment | Competency may be assessed through:   * 1. Practical tests   2. Observation |
| 1. Context of Assessment | Competency may be assessed individually in the actual workplace or a simulated work place setting |
| 1. Guidance information for assessment | Holistic assessment with other units relevant to the industry sector, workplace and job role is recommended. |

# CORE UNITS OF COMPETENCY

# INSTALL MECHANICAL PUMPS AND COMPRESSORS

**UNIT CODE:** ENG/OS/PS/CR/01/5/A

**UNIT DESCRIPTION**

This unit covers the competencies required to install mechanical pumps and compressors. Competencies include; interpreting design installation layout, preparing installation layout, installing identified pumps and compressors, installing prime movers, test running installed pumps and compressors, preparing and documenting pump and compressors installation report.

**ELEMENTS AND PERFORMANCE CRITERIA**

| **ELEMENT**  These describe the key outcomes which make up workplace function. | **PERFORMANCE CRITERIA**  These are assessable statements which specify the required level of performance for each of the elements.  ***(Bold and italicised terms are elaborated in the Range)*** |
| --- | --- |
| 1. Interpret design installation layout | * 1. Interpretation is performed as per the expected scale   2. Interpretation is performed in line the with the pump or compressors to be installed   3. Interpretation is performed as per the pump’s expected under-laying ground   4. Interpretation is performed in line with the ***original equipment manufacturer***   5. Interpretation is performed in line with the engineering best practice |
| 1. Prepare installation layout | * 1. Layout is prepared as per the design   2. Preparation of the layout is performed in line with the manufacturer’s manuals   3. Layout is performed according to the acceptable ***international standards***   4. Layout is prepared as per the expected limits of deviation   5. Layout preparation is performed according to the engineering best practice |
| 1. Install identified pump | * 1. Pump or compressor is installed as per the design   2. Installation is performed as per the manufactures manuals   3. Installation is conducted according to the standard operating procedures   4. Pump or compressor is installed as per the prepared layout   5. Fastening is performed within the acceptable standards   6. Pump or compressor fittings are installed according to the design and acceptable standards   7. Installation is conducted in adherence to the principles of fluid flow |
| 1. Install prime movers | * 1. Installation is performed in line with the design   2. Installation is performed as per the manufactures manuals   3. Installation is conducted according to the standard operating procedures   4. Prime mover is installed as per the prepared layout   5. Fastening is performed within the acceptable standards   6. Prime fittings are installed according to the design and acceptable standards |
| 1. Test run installed pump and compressors | * 1. Pump or compressor testing is performed in line with the expected alignment deviation   2. Testing is performed according the manufacturers manuals   3. Testing is conducted in line with pumps or compressors expected output   4. Testing is performed according to the expected vibration limits   5. Temperature test is performed within the expected limits   6. Noise test is conducting in line with the pumps or compressor designed limits   7. Testing is performed according to engineering best practice |
| 1. Prepare and document pump installed report | * 1. Installation report is prepared as per the organization approved format   2. Pump installation report is shared with the relevant parties   3. Report is filed in line with the organization filing system |

**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** |
| --- | --- |
| Original equipment manufacturer includes but not limited to: | 1. Kiloskar 2. Davis and Sharif |
| Suction limit includes but not limited to: | * 1. 6M for some centrifugal pumps |
| international standards includes but not limited to: | * 1. ISO 5199   2. ANSI B73.1   3. ISO 2858 |

**REQUIRED KNOWLEDGE AND UNDERSTANDING**

***The individual needs to demonstrate knowledge and understanding of:***

|  |
| --- |
| * Fluid mechanics * Material science * Fabrication * Thermodynamics * Basic knowledge on plumbing * Different types of pumps and their functionality and application * Drawing * Report preparation and filing * Workshop tools and material * Standard procedures in pump installation * Environmental conditions * Management of different wastes * Workmanship * Record keeping procedure * Maintenance * Data analysis and presentation * Digital Literacy * Project management * Tendering and procurement * Analysis and design methods * Automation |

**FOUNDATION SKILLS**

|  |
| --- |
| The individual needs to demonstrate the following foundation skills: |
| * Preparing assessment report * Selection of maintenance tools and equipment * Reading and interpretation of manufacturer’s manuals on work and maintenance * Lubricants * PPE at different work stations * Practicing safety practices * Troubleshooting * Waste segregation and management * Leadership * Coordination * Planning * Analysis |

**EVIDENCE GUIDE**

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

|  |  |
| --- | --- |
| 1. Critical Aspects of Competency | Assessment requires evidence that the candidate:   * 1. Conducted survey as per the clients requirements   2. Conducted site survey as per the capacity of the pumps available   3. Conducted survey line with the nature of the task to be carried out   4. Performed design in line the with the pump to be installed   5. Carried out design in accordance with the pump’s expected suction limit   6. Performed design as per the expected head limit   7. Performed design in line with the engineering best practice   8. Prepared layout as per the design   9. Performed installation as per the manufactures manuals   10. Performed fastening within the acceptable standards   11. Performed testing in accordance with the manufacturers manuals   12. Performed pump testing in line with the expected alignment deviation   13. Conducted testing in line with pumps expected output   14. Prepared installation report as per the organization approved format |
| 1. Resource Implications | Resources the same as that of workplace are advised to be applied including   * 1. Workshops   2. Fluid pumps   3. Toolboxes   4. PPE |
| 1. Methods of Assessment | Competency may be assessed through:   * 1. Observation   2. Oral questioning   3. Practical tests   4. Written tests |
| 1. Context of Assessment | Competency may be assessed individually   * 1. In the actual workplace   2. Simulated environment of the work place |
| 1. Guidance information for assessment | Holistic assessment with other units relevant to the industry sector, workplace and job role is recommended. |

# INSTALL HYDRAULIC AND PNEUMATIC SYSTEMS

**UNIT CODE:** ENG/OS/PS/CR/03/5/A

**UNIT DESCRIPTION**

This unit covers the competencies required to install hydraulic and pneumatic systems. Competencies include; Interpreting system installation layout, preparing installation layout, preparing installation components, installing identified system, performing testing of the installed system and preparing and documenting system installation report.

**ELEMENTS AND PERFORMANCE CRITERIA**

| **ELEMENT**  These describe the key outcomes which make up workplace function. | **PERFORMANCE CRITERIA**  These are assessable statements which specify the required level of performance for each of the elements.  ***(Bold and italicised terms are elaborated in the Range)*** |
| --- | --- |
| 1. Identify system to be installed | 1. System to be installed are identified as per the clients requirements 2. System is identified in line the their specifications 3. System is identified based on their functionality 4. Identification of the system is performed as per prevailing working environment 5. System is identified in line with their complexity |
| 1. Interpret system design installation layout | * 1. Interpretation is performed in line the with the system to be installed   2. Interpretation is performed in line with the original equipment manufacturer   3. Interpretation is performed in line with the engineering best practice |
| 1. Prepare installation components | * 1. Components to be installed are established based on their functionality   2. Components are prepared according to the system expected load   3. Engineering best practice is adhered in components preparation   4. Components are prepared as per the standard operating procedures   5. Safety in components handling is adhered to during components preparation |
| 1. Install identified system | * 1. Safety is adhered to in installation of the system   2. System is installed as per the designed layout   3. Installation of the system is carried out based on manufacturers manuals   4. System is installed in line with the expected load   5. Installation of the system is performed according to engineering best practices |
| 1. Perform testing of the installed system | * 1. Types of tests to be conducted as established based on the system installation   2. System is tested as per the expected output pressure and the flow rate   3. System is tested for its designed expected temperature range   4. Noise level of the system is established according to manufactures guideline   5. Testing is carried out according to ***international standards*** |
| 1. Prepare and document system installation report | * 1. System installation report is prepared as per the organization approved format   2. Installation report is shared with the relevant parties   3. System installation report is filed and document based on the organizations filing system and policies |

**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** |
| --- | --- |
| Auxiliary components includes but not limited to: | * Heat exchanger * Cooling towers * Pressure gauge * Oil levels |
| International standards includes but not limited to: | * ISO 4413:2010 * ISO 1219 * ISO 1219-2:2012 |

**REQUIRED KNOWLEDGE AND UNDERSTANDING**

The individual needs to demonstrate knowledge and understanding of:

|  |
| --- |
| * Fluid mechanics * Material science * Thermodynamic systems * Different hydraulic systems * Compressors * Plant machines * Basic instruments * Tools and equipments * Different types of pneumatic systems * Basic plumbing * Interpretation of various machines manufacturers manuals * Different workshop tools and material * Management of different wastes * Maintenance of work area * Record keeping procedure * Data analysis and presentation * Project management * Analysis and design methods |

**FOUNDATION SKILLS**

| The individual needs to demonstrate the following foundation skills: |
| --- |
| * Operating different hydraulic systems * PPE at work stations * Waste segregation and management * Maintaining work area * Practicing 5s of good housekeeping and 3Rs * Safety at work stations * Information record keeping * Troubleshooting and maintenance of hydraulic and pneumatic systems * Management * Leadership * Coordination * Problem solving; * Decision making; * Planning; * Report writing; |

###### **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:   * 1. Identified system to be installed as per the clients requirements   2. Identified the system in line with the their specifications   3. Performed design in line with the original equipment manufacturer   4. Performed design in line with the system to be installed   5. Performed design as per the expected load   6. Carried out design in consideration of the auxiliary components   7. Prepared components according to the system expected load   8. Adhered to safety in components handling during their preparation   9. Installed the system as per the designed layout   10. Carried out system installation based on manufacturers manuals   11. Tested system as per the expected output pressure and the flow rate   12. Prepared system installation report as per the organization approved format   13. Carried out testing according to international standards |
| 1. Resource Implications | Resources the same as that of workplace are advised to be applied.  Including: Hydraulic pumps, pneumatic systems, stationeries, computers, valves, lubricants, pipes, fittings. |
| 1. Methods of Assessment | Competency may be assessed through:   * 1. Observation   2. Practical demonstrations   3. Oral Questioning   4. Written tests |
| 1. Context of Assessment | Competency may be assessed individually in the actual workplace or a simulated work place setting |
| 1. Guidance information for assessment | Holistic assessment with other units relevant to the industry sector, workplace and job role is recommended. |

# OPERATE AND MAINTAIN PLANT MACHINERY

**UNIT CODE:** ENG/OS/PS/CR/05/5/A

**UNIT DESCRIPTION**

This unit covers the competencies required to operate and maintain plant machinery. Competencies includes; classifying plant machinery, identifying task and machine to be operated, operating identified plant machinery, maintaining and testing plant machinery and prepare and document plant operation and maintenance reports.

**ELEMENTS AND PERFORMANCE CRITERIA**

| **ELEMENT**  These describe the key outcomes which make up workplace function. | **PERFORMANCE CRITERIA**  These are assessable statements which specify the required level of performance for each of the elements.  ***(Bold and italicised terms are elaborated in the Range)*** |
| --- | --- |
| 1. Classify plant machinery | * 1. Plant machineries are classified as per their functionality   2. Plant machineries are classified as per their power units   3. Plant machineries are classified according to their applications   4. Plant machineries are classified as per their manufacturers   5. Machineries are classified in line with their versatility |
| 1. Identify task and machine to be operated | * 1. Machines are identified as per their power units   2. Identification is performed in line with the nature of the task to carried out   3. Machines are identified according to their efficiency and effectiveness   4. Machines are determined in line with the load size   5. Machines are identified in line with their place of operation |
| 1. Operate identified plant machinery | * 1. Operation is performed in line with the manufacturer’s manuals   2. Safety is adhered to in plant machine operations   3. Machines are operated according to the prevailing environmental conditions   4. Machineries are operated in line with the required power units   5. Machines are operating according to nature of the task being carried out   6. Machines are operated according to the expertise required and standard operating procedure   7. Relevant rules and regulations are adhered to in plant machine operations   8. Relevant certification are adhered to in plant machine operation   9. ***Engineering best practice*** is adhered to in machine operation |
| 1. Maintain and test plant machinery | * 1. ***Safety measures*** ,rules and regulations are adhered to in plant machine maintenance and testing   2. Maintenance and testing is performed in line with the manufacturers manuals   3. Maintenance and testing is conducted according engineering best practice   4. ***Troubleshooting*** is performed as per the task to be carried out and the standard operating procedures   5. Maintenance and testing is carried out in observation of organizations polices   6. EHS are adhered to in plant machine maintenance activities |
| 1. Prepare and document plant operation and maintenance reports | * 1. Maintenance report is prepare in line with the organization approved format and polices   2. Reports are shared with the relevant parties as per the organization policies   3. Reports are documented and filed as per the organization filing policies |

**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** |
| --- | --- |
| Engineering best practice includes but not limited to: | * Standards in installation, assembly, adjustments and system operations. * Standard in components graphical symbols * Standards in lubrication systems * Standards in testing |
| Safety measures includes but not limited to: | * PPE * First Aid * Safety in fire |
| Troubleshooting includes but not limited to: | * Refers to a systematic approach to problem solving that is often used to find and correct issues with plant machines |

**REQUIRED KNOWLEDGE AND UNDERSTANDING**

The individual needs to demonstrate knowledge and understanding of:

|  |
| --- |
| * Maintenance procedures * Certification in operation various plant machines * Environmental health standards * Engineering best practice * Safety measures in machine operations * Machinery starting and shutting down procedure * Troubleshooting procedure * Management of different wastes * Procedure of cleaning and checking of machineries and engine prior to storage * Maintenance of work area * Record keeping procedure * Data analysis and presentation * Digital Literacy * Mechanical Project management * Tendering and procurement * Analysis and design methods * Automation in farm machineries |

**FOUNDATION SKILLS**

|  |  |
| --- | --- |
| The individual needs to demonstrate the following additional skills: | |
| * Preparing assessment report * Determining and selecting agricultural machineries based on land and crop conditions * Reading and interpretation of manufacturer’s manuals on wok and maintenance * Using appropriate fuel and lubricant requirement * Operating different agricultural machines * Appropriate PPE at different farm work * Practicing safety practices and safe operation * Assessment of machine performance * Troubleshooting and practicing maintenance * Information record keeping * Planning * Management * Leadership * Coordination |  | * Decision making; * Report writing; |

**EVIDENCE GUIDE**

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

|  |  |
| --- | --- |
| 1. Critical Aspects of Competency | Assessment requires evidence that the candidate:   * 1. Classified plant machineries as per their power units   2. Classified plant machineries as per their functionality   3. Identified machine in line with the nature of the task that was to be carried out   4. Identified machines in line with their place of operation   5. Operated machine in line with the manufacturer’s manuals   6. Adhered to the safety in plant machine operations   7. Adhered to relevant certification in plant machine operation   8. Performed troubleshooting as per the task to be carried out and the standard operating procedures   9. Documented reports and filed as per the organization filing policies |
| 1. Resource Implications | Resources the same as that of workplace are advised to be applied  Included: Stationeries, maintenance tools and materials, computers, toolbox with relevant tools, PPE, Workshops |
| 1. Methods of Assessment | Competency may be assessed through:   * 1. Oral questioning   2. Practical demonstration   3. Observation   4. Written tests |
| 1. Context of Assessment | Competency may be assessed individually in the actual workplace or through simulated work environment |
| 1. Guidance information for assessment | Holistic assessment with other units relevant to the industry sector, workplace and job role is recommended. |

# PERFORM PLANT MAINTENANCE

**UNIT CODE:** ENG/OS/PS/CR/04/5/A

**UNIT DESCRIPTION**

This unit covers the competencies required to perform plant maintenance. Competencies includes: establishing need for plant maintenance, preparing maintenance schedule, assembling maintenance tools, equipment and materials, establishing maintenance, carrying out maintenance, testing-maintained equipment and documenting maintenance report.

**ELEMENTS AND PERFORMANCE CRITERIA**

| **ELEMENT**  These describe the key outcomes which make up workplace function. | **PERFORMANCE CRITERIA**  These are assessable statements which specify the required level of performance for each of the elements.  ***(Bold and italicised terms are elaborated in the Range)*** |
| --- | --- |
| 1. Establish need for plant maintenance | * 1. Equipment current performance rating are analysed against expected manufacturers ratings   2. Variations in performance is established based on manufacturers operation manuals   3. Equipments efficiency is determined in line with the expected output   4. Fluctuation in equipment performance is established based on their specification |
| 1. Assemble maintenance tools, equipment and materials | * 1. Checklist is prepared according to the expected inspections and examination   2. Maintenance tools, equipment and materials and are identified as per their functionality   3. Tools, equipment and materials are reconfigured as per the required standards   4. Materials are assembled as per the manufacturers guidelines   5. Manufacturers manuals are assembled as per the tasks to be carried out   6. Tools, materials and equipments are assembled in line with workshop procedures   7. Workshop safety is adhered to in tools, materials and equipment handling |
| 1. Carry out maintenance | * 1. Safety rules and regulations are adhered to in maintenance activities   2. Troubleshooting on the fault sections is conducted as per manufactures manuals   3. Maintenance is carried out as per the nature of the tasks to be performed   4. Repair/replacement of the faulty components identified and performed as per their functionality   5. Faulty parts are established in adherence to the fault diagnosis procedures   6. Calibrations of the replaced components is conducted according to expected readings   7. Waste disposal is performance in accordance to EHS standards   8. Engineering best practice is adhered to in performance of maintenance activities |
| 1. Test maintained plant equipment | * 1. Safety rules and regulations are adhered to in plant testing   2. Types of tests are identified as per the manufacturers manuals   3. Maintained equipment is tested as per their functionality   4. Testing is carried out according to the equipments manufacturers manuals |
| 1. Decommission plant equipment | * 1. Safety rules and regulations are adhered to in the plant equipment decommissioning.   2. Decommissioning is performed as per the manufacturers manual   3. Decommissioning is performed as per the organizations policy   4. Decommissioning is conducted as per the standard operating procedures |
| 1. Document plant maintenance report | * 1. Maintenance report is prepared in line with the organization approved report   2. Maintenance report is shared with the relevant parties   3. Maintenance report is documented and filed as per the organization filing systems |

**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** |
| --- | --- |
| Maintenance types may include but not limited to: | * Preventive * Breakdown * Routine * Periodic |
| Maintenance tools and equipment may include but not limited to: | * Spanners * Wrenches * Cyclic pliers * Pullers * Lathe machines * Welding machines |
| Materials may include but not limited to: | * Iron steel * Welding rods * Bearings * Grease |
| Machine components may include but not limited to: | * Gears * Shafts * Pulleys * Coupling |

**REQUIRED KNOWLEDGE AND UNDERSTANDING**

The individual needs to demonstrate knowledge and understanding of:

|  |
| --- |
| * Functionality of machines * Types lubricants * Tools and equipments used in maintenance * Material science * Safety measures and precautions during maintenance * Troubleshooting procedures * Machine nomenclature * Machinery shutting down procedure * Maintenance of work area * Record keeping procedure * Data analysis and presentation * Computer application packages |

**FOUNDATION SKILLS**

|  |  |
| --- | --- |
| The individual needs to demonstrate the following additional skills: | |
| * Communications (verbal and written); * Preparing assessment report * Determining and selecting plant machine based on functionality * Reading and interpretation of manufacturer’s manuals on wok and maintenance * Using appropriate fuel and lubricant requirement * Operating different plant machines * Use of PPE * Observing safety practices workplace * Assessment of machine performance * Troubleshooting and practicing maintenance * Information record keeping | * Decision making; * Report writing; * Creativity * Self-driven |

**EVIDENCE GUIDE**

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

|  |  |
| --- | --- |
| 1. Critical Aspects of Competency | Assessment requires evidence that the candidate:   * 1. Performed analysis of equipment current performance rating against expected manufacturers ratings   2. Determined equipment efficiency in line with the expected output   3. Prepared maintenance schedule as per the type of maintenance that was expected to be carried out   4. Prepared checklist in accordance to the expected inspections   5. Identified maintenance tools, materials and equipment as per their functionality   6. Calibrated tools, equipment and materials as per the required standards   7. Adhered to workshop safety in tools, materials and equipment handling   8. Established maintenance team based on their expertise   9. Carried out maintenance as per the nature of the tasks that was to be performed   10. Conducted troubleshooting on the fault sections as per manufactures manuals   11. Identified and performed repairing/replacement of the faulty components as per their functionality   12. Conducted calibrations of the replaced components according to expected readings   13. Established types of tests as per the manufacturers manuals   14. Prepared maintenance report in line with the organization approved report |
| 1. Resource Implications | Resources the same as that of workplace are advised to be applied  Included: Maintenance tools, Stationeries, computers, lubricants, PPE, machines. |
| 1. Methods of Assessment | Competency may be assessed through:   * 1. Oral questioning   2. Practical demonstration   3. Observation   4. Written tests |
| 1. Context of Assessment | Competency may be assessed individually in the actual workplace or through simulated work environment |
| 1. Guidance information for assessment | Holistic assessment with other units relevant to the industry sector, workplace and job role is recommended. |

# INSTALL REFRIGERATION AND AIR CONDITIONING SYSTEMS

**UNIT CODE:** ENG/OS/PS/CR/06/5/A

**UNIT DESCRIPTION**

This unit covers the competencies required to safely install refrigeration and air conditioning systems. Competencies includes; assembling refrigeration and air conditioning tools, equipment and materials, installing electrical wiring for refrigeration and air conditioning system, installing refrigeration and air conditioning system, testing installed system and documenting refrigeration and air conditioning installation report.

**ELEMENTS AND PERFORMANCE CRITERIA**

|  |  |
| --- | --- |
| **ELEMENT**  These describe the key outcomes which make up workplace function. | **PERFORMANCE CRITERIA**  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. Assemble refrigeration and air conditioning tools, equipment and materials | * 1. Tools, equipment and materials and are identified as per their functionality   2. Tools, equipment and materials are reconfigured as per the required standards   3. Materials are assembled as per the manufacturers guidelines   4. Manufacturers manuals are assembled as per the tasks to be carried out   5. Tools, materials and equipment are assembled in line with workshop procedures   6. Workshop safety is adhered to in tools, materials and equipment handling |
| 1. Install electrical wiring for refrigeration and air conditioning | * 1. Electrical cabling and ***wiring devices*** are selected and safely installed in line with manufacturer's instructions   2. Power wiring is installed in accordance with applicable Electrical Code provisions   3. Electrical circuit is tested in accordance with applicable Electrical Code provisions |
| 1. Install refrigeration and air conditioning system | * 1. Tools equipment and materials are assembled according to work place procedures   2. ***Unit*** and components are prepared based on work place procedures   3. Refrigeration unit is installed according to work place procedures   4. Brackets, hangers and frames are installed in accordance with manufacturer’s specifications   5. Unit is positioned and leveled in line with manufacturer's specifications   6. ***Sealing materials*** are installed in line with manufacturer's instructions and specifications   7. ***Condensate drain*** is installed in accordance with manufacturer’s instructions and specifications   8. Safe manual handling techniques are employed in line with work place ***OS&H procedures***   9. 5s is exercised in line with work place policy |
| 1. Test installed system | * 1. Voltage and current are measured according to unit power requirements.   2. Ttemperature and velocity of air are measured based on unit specifications.   3. Sound and vibration are checked based on unit specifications   4. System is handed over to user as per work place procedures   5. ***Service report*** is prepared in line with work place policies and procedures. |
| 1. Document refrigeration and air conditioning installation report | * 1. Report is prepared in line with the organization’s requirements   2. Report is shared according to the organizations policy   3. Report is documented in line with the organization’s filing system |

**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** |
| Site conditions includes but not limited to: | * + Availability of power source and unit’s electrical provisions   + Wall and floor finishing provisions   + Drainage provisions   + Air circulation/ ventilation provision |
| Installation requirements includes but not limited to: | May include but not limited to:   * + Location   + wall and floor finishing   + Electrical requirements * A/C plug and outlet * Wire size * Protection devices * Grounding |
| Tools and equipment includes but not limited to: | * + Measuring tools   + Spirit level   + Plumb bob   + Clear/Transparent water hose   + Screw drivers   + Chisel   + Hammers (claw and ballpeinn)   + Hacksaws   + Files   + Grinders   + Electric drills   + Drill bits   + Cross cut saws   + Rip saws   + Arc welding equipment   + Brazing equipment   + Lok ring tools   + Masonry tools (e.g. trowel, spade, level, etc.) |
| Materials includes but not limited to: | * + Expansion bolt   + Welding electrode (rod)   + Sealant   + Electrical cable   + Convenience outlets   + Electrical rails   + Circuit breakers   + Switches   + Masonry materials(e.g. cement, sand, etc.) |
| Wiring devices includes but not limited to: | * + Service grounding   + Service outlet   + Service plug |
| Unit includes but not limited to: | * + Window type air-conditioner   + Split type air- conditioner   + Refrigeration unit (e.g. refrigerator, water cooler, household freezer, etc.) |
| Sealing materials includes but not limited to: | * + Rubber gasket   + Armaflex   + Foam   + Plastic   + Silicone |
| Condensate drain includes but not limited to: | * + PVC pipe   + Plastic tubing   + Galvanized (G.I) pipe   + Metal tubing |
| OS&H procedures includes but not limited to: | * + Wearing of PPE   + Lifting procedures   + Ladder safety   + Housekeeping |
| Service report includes but not limited to: | * + Installation report   + Inspection report   + Testing report   + Commissioning report |

**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:

* Interpreting plans and details
* Preparing materials
* Proper handling of tools and equipment
* Working safely
* Installing window-type and split-type air-conditioning and domestic refrigeration unit
* Testing power supply
* Connecting power circuit
* Operating window-type and split-type air-conditioning unit and domestic refrigeration unit
* Communicating effectively
* Decision making

**Required Knowledge**

The individual needs to demonstrate knowledge of:

* Personal protective equipment/safety gears
* Handling of tools, equipment and accessories
* Safety signs and symbols
* Good housekeeping
* Linear measurements
* Ratio and proportion
* Unit conversion
* Electrical plans, symbols and abbreviations
* Types of sealant
* Types of insulation
* Types of wires, conduits and fittings
* Types of wiring devices
* Basic refrigeration cycle
* Refrigeration and air conditioning components
* Basic electricity
* Basic masonry
* Basic carpentry
* Basic plumbing
* Basic arc welding
* Preventive Maintenance
* Relevant legislations

**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:   * 1. Adhered to safety procedures   2. Identified tools, equipment and materials   3. Assessed site conditions for air conditioning and refrigeration installation   4. Installed electrical wiring for refrigeration and air conditioning   5. Installed refrigeration system   6. Tested the installed refrigeration system   7. Performed housekeeping |
| 1. Resource implications | The following resources must be provided:  2.1 Work place location/installation area  2.2 Tools and equipment appropriate for installation  2.3 Materials relevant to the proposed activity/task  2.4 Drawings and specifications relevant to the task |
| 1. Methods of assessment | Competency may be assessed through:   * 1. Demonstration   2. Direct observation with oral questioning   3. Written tests   4. Portfolio   5. Third party reports |
| 1. Context for assessment | Competency may be assessed on the job, off the job or a combination of these. Off the job assessment must be undertaken in a closely simulated workplace environment. |
| 1. Guidance information for assessment | Holistic assessment with other units relevant to the industry sector, workplace and job role is recommended. |