

**REPUBLIC OF KENYA**

**NATIONAL OCCUPATIONAL STANDARDS**

**FOR**

**INDUSTRIAL PLANT OPERATOR AND MAINTENANCE**

**LEVEL 6**



TVET CDACC

P.O. BOX 15745-00100

NAIROBI

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# FOREWORD

The provision of quality education and training is fundamental to the Government’s overall strategy for social economic development. Quality education and training will contribute to achievement of Kenya’s development blueprint, Vision 2030 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 of Kenya 2010. 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 shall be competency based, curriculum development shall be industry led, certification shall be based on demonstration of competence and mode of delivery shall allow for multiple entry and exit in TVET programmes.

These reforms demand that Industry takes a leading role in curriculum development to ensure the curriculum addresses its competence needs. It is against this background that these Occupational Standards were developed for the purpose of developing a competency-based curriculum for Industrial Plant Operations. 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 sector’s growth and sustainable development.

**PRINCIPAL SECRETARY, VOCATIONAL AND TECHNICAL TRAINING**

**MINISTRY OF EDUCATION**

# PREFACE

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

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

The TVET Curriculum Development, Assessment and Certification Council (TVET CDACC), in conjunction with Industrial Plant Operations Sector Skills Advisory Committee (SSAC) have developed these Occupational Standards for Industrial Plant Operations Technician. These standards will be the bases for development of competency-based curriculum for Industrial Plant Operations and Maintenance.

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, Mechatronic Engineering SSAC, expert workers and all those who participated in the development of these Occupational Standards.

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

**CHAIRMAN, TVET CDACC**

# ACKNOWLEDGMENT

These occupational standards have been designed for competency-based training and has independent units of learning that allow the trainee flexibility in entry and exit. In developing the curriculum, significant involvement and support was received from various organisations.

I appreciate the funding of the Government of Canada and its implementing partner Colleges and Institutes Canada (CICan) which enabled the development of these standards through the Kenya Education for Employment Program (KEFEP).

I also appreciate the Kisumu National Polytechnic and its Canadian technical partners from Humber College who collaborated to identify industry skills gaps and develop these standards.

I recognize with appreciation the role of industry partners including the National Polytechnic’s Industry Advisory Committee and the national Sector Skills Advisory Committee (SSAC) in ensuring that competencies required by the industry are addressed in these standards. I also thank all stakeholders in the sector for their valuable input and all those who participated in the process of developing these standards.

I am convinced that occupational standards will go a long way in ensuring that workers in this sector acquire competencies that will enable them to perform their work more efficiently.

**Dr. LAWRENCE GUANTAI M’ITONGA, PhD**

**COUNCIL SECRETARY/CEO**

# KEY TO UNIT CODE

ENG/CU/IPOM/BC/01/6

Industry or sector

Curriculum

Occupational area

Type of competency

Competency number

Competency level

# ACRONYMS

|  |  |
| --- | --- |
| TVET: | Technical and Vocational Education and Training |
| CDACC: | Curriculum Development, Assessment and Certification Council |
| CBET: | Competency-Based Education and Training |
| ICT: | Information Communication Technology |
| NEMA: | National Environment Management Authority |
| OSH: | Occupational Safety and Health |
| SOPs: | Standard Operating Procedures |
| NEMA: | National Environment Management Authority |
| OS: | Occupational Standards |

# COURSE OVERVIEW

Certified Industrial Plant Operator and Maintenace qualification consists of competencies that a person must achieve to enable him/her to maintain boilers, steam turbine, hydraulic systems, systems, material handling equipments and maintain pumps.

The units of competency comprising Certified Industrial Plant Operation and maintenace Level 6qualification include the following basic and core competencies:

The units of competency comprising POM Level 6 qualification include the following:

1. ***Basic Competencies***
2. Demonstrate communication skills
3. Demonstrate Numeracy skills
4. Demonstrate digital literacy
5. Demonstrate entrepreneurial skills
6. Demonstrate employability skills
7. Demonstrate environmental literacy
8. Demonstrate occupational safety and health practices
9. ***Common Competencies***
10. Apply engineering mathematics
11. Apply Electrical Principles
12. Prepare and interpret Technical Drawing
13. Apply Mechanical Science Principles
14. Apply Fluid Mechanics Principles
15. Apply thermodynamics Principles
16. Apply Material Sciences and Perform metallurgical Processes
17. ***Core Competencies***
18. Operate and Maintain Industrial Boilers
19. Operate and Maintain Industrial Steam Turbines
20. Operate and Maintain Industrial Pneumatic Systems
21. Operate and Maintain Industrial Hydraulic Systems Material Handling
22. Operate and Service and Maintain Pumps
23. Operate and Maintain Industrial Steam Distribution Lines

# BASIC UNITS OF COMPETENCIES

## DEMONSTRATE COMMUNICATION SKILLS

**UNIT CODE: ENG/OS/POM/BC/01/6**

**UNIT DESCRIPTION**

This unit covers the competencies required in meeting communication needs of clients and colleagues; developing, establishing, maintaining communication pathways and strategies. It also covers competencies for conducting interview, facilitating group discussion and representing the organization in various forums.

**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 | 1.1 Specific communication needs of clients and colleagues are identified and met  1.2 Different approaches are used to meet communication needs of clients and colleagues  1.3 Conflict is addressed promptly and in a timely way and in a manner, which does not compromise the standing of the organization |
| 1. Develop communication strategies | * 1. Strategies for effective internal and external dissemination of information are developed to meet the organization’s requirements   2. Special communication needs are considered in developing strategies to avoid discrimination in the workplace   3. Communication ***strategies*** are analyzed, evaluated and revised where necessary to make sure they are effective |
| 1. Establish and maintain communication pathways | * 1. Pathways of communication are established to meet requirements of organization and workforce   2. Pathways are maintained and reviewed to ensure personnel are informed of relevant information |
| 1. Promote use of communication strategies | * 1. Information is provided to all areas of the organization to facilitate implementation of the strategy   2. Effective communication techniques are articulated and modelled to the workforce   3. Personnel are given guidance about adapting communication strategies to suit a range of contexts |
| 1. Conduct interview | 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 discussion | * 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 | 7.1 When participating in internal or external forums, presentation is relevant, appropriately researched and presented in a manner to promote the organization  7.2 Presentation is clear and sequential and delivered within a predetermined time  7.3 Appropriate media is utilized to enhance presentation  7.4 Differences in views are respected  7.5 Written communication is consistent with organizational standards  7.6 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***  include but not limited to: | * 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 nonjudgmental way * Using active listening * Making decision about appropriate words, behavior * Putting together response which is culturally appropriate * Expressing an individual perspective * Expressing own philosophy, ideology and background and exploring impact with relevance to communication |
| ***Situations*** include 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
* 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
* Writing communications strategy
* Applying key elements of communications strategy

**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/Demonstration with Oral Questioning 2. 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/POM/BC/03/6**

**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 PCs 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 of operating system are determined in accordance with manufacturer’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*** are identified, ***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 handouts are printed according to work requirements |

**RANGE**

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

|  |  |
| --- | --- |
| **Variable** | **Range** |
| ***Appropriate computer software*** may include 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*** may include 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*** may include but not limited to: | * Confidentiality of data * Cloud computing * Integrity -but-curious data surfing |
| ***Security and control measures*** may include but not limited to: | * Counter measures against cyber terrorism * Risk reduction * Cyber threat issues * Risk management * Pass-wording |
| ***Security threats*** may include but not limited to: | * Cyber terrorism * Hacking |
| ***Word processing concepts*** may include but not limited to: | Using a special program to create, edit and print documents |
| ***Network configuration*** may 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 and   3. Desktop PCs   4. Desktop computer   5. Lap top   6. Calculator   7. Internet   8. Smart phone   9. Operations Manuals |
| 1. Methods of Assessment | Competency may be assessed through:   * 1. Written Test   2. Demonstration   3. Practical assignment   4. Interview/Oral Questioning   5. Demonstration |
| 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/POM/BC/04/6**

**UNIT DESCRPTION**

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** | **PERFORMANCE CRITERIA** |
| 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   1. Track record and normative capability profile of enterprise and similar businesses are reviewed and considered in setting ***strategic directions***. 2. Strengths, weaknesses, opportunities and threats are considered when developing new ideas, approaches, goals and directions 3. Decisions about enterprise strategies/directions are made after careful consideration of all relevant information 4. ***Business/corporate plan*** is developed that sets out tactics, resource implications, timeframes, production and sales target |
| 1. Develop new products/ markets | 2.1 Alternative product/service offerings are canvassed and studied for feasibility  2.2 Potential and new sources/sellers of supplies and raw materials are identified and canvassed.  2.3 Target markets and buyers are identified and surveyed as to their preferences and brand loyalties. |
| 1. Expand customers and product lines | 3.1 Enterprise is built up and sustained through responsiveness to market demands and the regulatory environment.  3.2 Competitive advantage of existing products and services is maintained/enhanced through responsive advocacies and strategies.  3.3 Constant listening to stakeholder/client feedback is ensured to maintain loyal client base. |
| 1. Motivate staff/workers | 4.1 Regular dialogue is established and maintained in all levels and relevant sections of the enterprise  4.2 Flow of communications in both directions is encouraged  4.3 Helpful mechanisms and benefits are implemented  4.4 Issues/problems are proactively resolved through win-win solutions wherever practicable |
| 1. Expand employed capital base | 5.1 Capital employed in business is continuously reviewed as per the strategic plan  5.2 Business share holdings are reviewed in accordance with the type of business  5.3 Capital employed is expanded according to organization procedures  5.3 Types of shares are determined according to strategic plan  5.4 Shares diversification process is undertaken as per office procedures  5.5 Role of shareholders is determined and implemented in accordance organization procedures |
| 1. Undertake county/ regional business expansion | 6.1 Regions for expansion are continuously reviewed in accordance with strategic plan and company’s expansion plan  6.2 County business regulations are reviewed and adhered to in accordance with set procedures  6.3 Regional laws and regulations are adhered to in accordance with set procedures  6.4 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: | 1.1 Business continuity and succession  1.2 Resource access security  1.3 Core competencies development  1.4 New developments e.g. technological change, new products |
| Business/Corporate plan  include but not limited to: | 2.1 Action steps and responsibilities of departments and individual workers  2.2 Resource requirements and budget  2.3 Tactics and strategies to achieve objectives |
| Helpful mechanisms include but not limited to: | 3.1 Wage and non-wage benefits  3.2 Employee awards and recognition systems  3.3 Employee rights and welfare policies  3.4 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 sigmas
* 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:  1.1 Demonstrated ability to maintain a profitable and stable enterprise as shown by stakeholder feedback, employee testimonies and company financial statements  1.2 Demonstrated ability to conceptualize and plan a micro/small enterprise  1.3 Demonstrated ability to manage/operate a micro/small-scale business  1.4 Demonstrated basic marketing skills |
| 2. Resource Implications | The following resources should be provided:   * Interview guide for entrepreneurs * Enterprise workers and third parties * Materials and location relevant to the proposed activity and tasks |
| 3. Methods of Assessment | * Case problems * Interview * Portfolio * Third part reports |
| 4. Context of Assessment | * Competency may be assessed in workplace or in a simulated workplace setting * 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/POM/BC/05/6**

**UNIT DESCRIPTON**

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 requirements 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. |
| 1. Maintain professional growth and development in the workplace | * 1. Personal training needs are assessed and identified in line with the requirements of the job.   2. ***Training and career opportunities*** are identified and availed based on job requirements.   3. Resources for training are mobilized and allocated based organizations skills needs.   4. Licensees and certifications relevant to job and career are obtained and renewed.   5. Personal growth is pursued towards improving the qualifications set for the profession.   6. Work priorities and commitments are managed based on requirement of the job and workplace policy.   7. Recognitions are sought as proof of career advancement in line with professional requirements. |
| 1. 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.   8. New systems are developed and maintained in accordance with the requirements of the job.   9. Opportunities that are not obvious are identified and exploited in line with organization objectives.   10. Opportunities for performance improvement are identified proactively in area of work.   11. 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.

|  |  |
| --- | --- |
| **Range** | **Variable** |
| ***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*** include 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:   * Oral Interview * Observation * Third Party Reports * Written |
| 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/POM/BC/06/6**

**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, analyze resource use, develop resource conservation plans and implement selected plans.

**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 | 1.1 ***Storage methods*** for environmentally hazardous materials are strictly followed according to environmental regulations and OSHS.  1.2 ***Disposal methods*** of hazardous wastes are followed at all times according to environmental regulations and OSHS.  1.3 ***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 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 | 5.1 Environmental legislations/conventions and local ordinances are identified according to the different environmental aspects/impact  5.2 Industrial standard/environmental practices are described according to the different environmental concerns |
| 1. Implement specific environmental programs | 6.1 Programs/Activities are identified according to organizations policies and guidelines.  6.2 Individual roles/responsibilities are determined and performed based on the activities identified.  6.3 Problems/constraints encountered are resolved in accordance with organizations’ policies and guidelines  6.4 Stakeholders are consulted based on company guidelines |
| 1. Monitor activities on Environmental protection/Programs | 7.1 Activities are periodically monitored and Evaluated according to the objectives of the environmental program  7.2 Feedback from stakeholders are gathered and considered in Proposing enhancements to the program based on consultations  7.3 Data gathered are analyzed based on Evaluation requirements  7.4 Recommendations are submitted based on the findings  7.5 Management support systems are set/established to sustain and enhance the program  7.6 Environmental incidents are monitored and reported to  concerned/proper authorities |
| 1. Analyze resource use | 8.1. All resource consuming processes are Identified  8.2. Quantity and nature of Resource consumed is determined  8.3. Resource flow is analyzed through different parts of the process.  8.4. Wastes are classified for possible source of resources. |
| 1. Develop resource Conservation plans | 9.1. Efficiency of use/conversion of resources is determined following industry protocol.  9.2. Causes of low efficiency of use of resources are  Determined based on industry protocol.  9.3. Plans for increasing the efficiency of resource use are developed based on findings. |

**RANGE**

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

|  |  |
| --- | --- |
| **Variable** | **Range** |
| ***PPE*** May include but are not limited to | 1.1 Mask  1.2 Gloves  1.3 Goggles  1.4 Safety hat  1.5 Overall  1.6 Hearing protector |
| ***Environmental pollution control measures*** may include but are not limited to: | 2.1 Methods for minimizing or stopping spread and ingestion of airborne particles  2.2 Methods for minimizing or stopping spread and ingestion of gases and fumes  2.4 Methods for minimizing or stopping spread and ingestion of liquid wastes |
| ***Wastes*** may include but are not limited to: | 3.1 Unnecessary waste  3.2 Necessary waste |
| ***Waste management Procedures*** may include but are not limited to: | 4.1 Sorting  4.2 Storing of items  4.2 Recycling of items  4.3 Disposal of items |
| ***Resources*** may include but are not limited to: | 5.1 Electric  5.2 Water  5.3 Fuel  5.4 Telecommunications  5.5 Supplies  5.6 Materials |
| ***Workplace environmental hazards*** may include but are not limited to: | 6.1Biological hazards  6.2 Chemical and dust hazards  6.3 Physical hazards |
| ***Organizational systems and procedures*** may include but are not limited to: | 7.1 Supply chain, procurement and purchasing  7.2 Quality assurance  7.3 Making recommendations and seeking approvals |
| ***Legislations/Conventions*** may include but are not limited to: | 8.1 EMCA 1999  8.2 Montreal Protocol  8.3 Kyoto Protocol |
| ***Environmental aspects/impacts*** may include but are not limited to: | 9.1 Air pollution  9.2 Water pollution  9.3 Noise pollution  9.4 Solid waste  9.5 Flood control  9.6 Deforestation/Denudation  9.7 Radiation/Nuclear /Radio Frequency/ Microwaves  9.8 Situation  9.9 Soil erosion (e.g. Quarrying, Mining, etc.)  9.10 Coral reef/marine life protection |
| ***Industrial standards / Environmental practices*** may include but are not limited to: | 10.1 ISO standards  10.2 Company environmental management systems (EMS) |
| ***Periodic*** may include but are not limited to: | 11.1 Hourly  11.2 Daily  11.3 Weekly  11.4 Monthly  11.5 Quarterly  11.6 Yearly |
| ***Programs/Activities*** may include but are not limited to: | 12.1 Waste disposal (on-site and off-site)  12.2 Repair and maintenance of equipment  12.3 Treatment and disposal operations  12.4 Clean-up activities  12.5 Laboratory and analytical test  12.6 Monitoring and evaluation  12.7 Environmental advocacy programs |

**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 (e.g. Cleaning tools, cleaning materials, trash bags)   3. PPE, manuals and references   4. Legislation, policies, procedures, protocols and local ordinances relating to environmental protection   5. 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-play |
| 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
* Making adjustments to 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
* Methods of minimizing wstage
* Waste management procedures
* Economizing of resource consumption
* Principle of 3Rs
* 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/POM/BC/07/6**

**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** |
| 1. ***Hazards may include*** but are not limited to: | 1.1. Physical hazards – impact, illumination, pressure, noise,  vibration, extreme temperature, radiation  1.2 Biological hazards- bacteria, viruses, plants, parasites, mites, molds, fungi, insects  1.3 Chemical hazards – dusts, fibers, mists, fumes, smoke,  gasses, vapors  1.4 Ergonomics  Psychological factors – over exertion/ excessive force, awkward/static positions, fatigue, direct pressure, varying metabolic cycles, physiological factors – monotony, personal relationship, work out cycle  1.6 Safety hazards (unsafe workplace condition) – confined space, excavations, falling objects, gas leaks, electrical, poor storage of materials and waste, spillage, waste and debris  1.7 Unsafe workers’ act (Smoking in off-limited areas, substance and alcohol abuse at work) |
| 1. ***Indicators may include*** but are not limited to: | 2.1 Increased of incidents of accidents, injuries  2.2 Increased occurrence of sickness or health complaints/ symptoms  2.3 Common complaints of workers related to OSH  2.4 High absenteeism for work-related reasons |
| 1. ***Evaluation and/or work environment measurements*** may include but are not limited to: | 3.1 Health Audit  3.2 Safety Audit  3.3 Work Safety and Health Evaluation  3.4 Work Environment Measurements of Physical and Chemical hazards |
| 1. ***OSH issues and/or concerns*** may include but are not limited to: | 4.1 Workers’ experience/observance on presence of work hazards  4.2 Unsafe/unhealthy administrative arrangements (prolonged work hours, no break time, constant overtime, scheduling of tasks)  4.3 Reasons for compliance/non-compliance to use of PPEs or other OSH procedures/policies/guidelines |
| 1. ***Prevention and control measures*** may include but are not limited to: | 5.1 Eliminate the hazard (i.e., get rid of the dangerous machine  5.2 Isolate the hazard (i.e. keep the machine in a closed room and operate it remotely; barricade an unsafe area off)  5.3 Substitute the hazard with a safer alternative (i.e., replace the machine with a safer one)  5.4 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)  5.5 Use engineering controls to reduce the risk (i.e. use safety guards to machine)  5.6 Use personal protective equipment  5.7 Safety, Health and Work Environment Evaluation  5.8 Periodic and/or special medical examinations of workers |
| 1. ***Safety gears /PPE (Personal Protective Equipment)*** may include but are not limited to: | 6.1 Arm/Hand guard, gloves  6.2 Eye protection (goggles, shield)  6.3 Hearing protection (ear muffs, ear plugs)  6.4 Hair Net/cap/bonnet  6.5 Hard hat  6.6 Face protection (mask, shield)  6.7 Apron/Gown/coverall/jump suit  6.8 Anti-static suits   * 1. High-visibility reflective vest |
| 1. ***Appropriate risk controls*** | Appropriate risk controls in order of impact are as follows:  7.1 Eliminate the hazard altogether (i.e., get rid of the dangerous machine)  7.2 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)  7.3 Substitute the hazard with a safer alternative (i.e., replace the machine with a safer one)  7.4 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)  7.5 Use engineering controls to reduce the risk (i.e., attach guards to the machine to protect users)  7.6 Use personal protective equipment (i.e., wear  gloves and goggles when using the machine) |
| 1. ***Contingency measures*** may include but are not limited to: | 8.1 Evacuation  8.2 Isolation  8.3 Decontamination  8.4 (Calling designed) emergency personnel |
| 1. ***Emergency procedures*** may include but are not limited to: | 9.1 Fire drill  9.2 Earthquake drill  9.3 Basic life support/CPR  9.4 First aid  9.5 Spillage control  9.6 Decontamination of chemical and toxic  9.7 Disaster preparedness/management  9.8 se of fire-extinguisher |
| 1. ***Incidents and emergencies*** may include but are not limited to: | 10.1 Chemical spills  10.2 Equipment/vehicle accidents  10.3 Explosion  10.4 Fire  10.5 Gas leak  10.6 Injury to personnel  10.7 Structural collapse  10.8 Toxic and/or flammable vapors emission. |
| 1. ***OSH-related Records*** may include but are not limited to: | 11.1 Medical/Health records  11.2 Incident/accident reports  11.3 Sickness notifications/sick leave application  11.4 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 counseling methodologies and strategies

**EVIDENCE GUIDE**

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

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

# COMMON COMPETENCIES

## APPLY ENGINEERING MATHEMATICS

**UNIT CODE: ENG/OS/POM/CC/01/6**

This unit describes the competencies required by an Electrical Technician to apply a wide range of engineering mathematics in their work. This includes applying algebraic functions, Complex numbers, coordinate geometry, carrying out binomial expansion, calculus, ordinary differential equations, Laplace transforms, power series, Statistics, Fourier series, Vector theory, Matrix and Numerical methods 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. Solve Ordinary differential equations | * 1. First order and second order differential equations are solved using the method of undetermined coefficients   2. First order and second order differential equations are solved from given boundary conditions |
| 1. Apply Laplace transforms | * 1. Laplace transforms are solved using initial and final value theorems   2. Inverse Laplace transforms are solved using partial fractions   3. Differential equations are solved using Laplace transforms |
| 1. Apply Power Series | * 1. Power series are obtained using Taylor’s Theorem   2. Power series are obtained using Maclaurin’s theorem |
| 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 4. Calculations are performed based on Laws of probability 5. Calculation involving probability distributions, mathematical expectation sampling distributions are performed |
| 1. Apply Fourier Series | * 1. Fourier series coefficients are obtained using Fourier series techniques   2. Fourier series for 2π to T is are obtained using Fourier series techniques   3. Fourier series for odd and even functions are obtained using Fourier series techniques   4. Harmonic analysis is performed using numerical methods |
| 12.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 3x3 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**  May include but not limited to: |
| * + 1. Hyperbolic functions | * 1. Sinh x   2. Cosh x   3. Cosec x   4. Coth x   5. Tanh x   6. Sech x |
| 1. Figures | * 1. Triangles   2. Squares   3. Rectangles   4. Circles   5. Spheres   6. Cylinders   7. Cubes   8. Polygons   9. Cuboids   10. Pyramids |
| 1. Quantities | * 1. Weight,   2. Mass   3. Area   4. Volume   5. Length   6. Width   7. Depth   8. 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 |
| Context of Assessment | Competency may be assessed individually in the actual workplace or  through accredited institution |
| Guidance information for assessment | Holistic assessment with other units relevant to the industry sector, workplace and job role is recommended. |

## APPLY ELECTRICAL PRINCIPLES

**UNIT CODE: ENG/OS/POM/CC/02/6**

**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 power factor in electrical installation, use of earthing in Electrical installations, 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 |
| * + 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 DC and AC Network theorems are performed. E.g. Kirchoff’s laws, Superposition, Thevinin’s, Norton’s |
| 1. Use of basic electrical machine | * 1. Types of various electrical machines are identified   2. Single phase and three phase motor starting methods are performed   3. DC motor starting methods are performed   4. Calculations involving single phase and three phase AC and DC Motors are performed   5. Calculations involving single and three phase AC and DC transformers are performed   6. Calculations involving single and three phase generators are performed   7. Special machines are identified   8. Calculations involving special machines are performed   9. Calculations involving Electric Drives are performed |
| 1. Demonstrate understanding of three phase power supply | * 1. Connections of three phase power supply are performed as per the standard operating procedure   2. Calculations involving three phase power supply connections are performed   3. Measurements of three phase power supply is performed   4. Interconnections of three phase power supply are performed as per the nature of the load. |
| 1. Use of power factor in electrical installation | * 1. Power triangle is identified i.e. Active, Apparent and reactive power   2. The use of power factor is performed   3. Calculations involving power factor correction is performed   4. Methods of power factor correction are applied |
| 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 |
| 1. Apply Electromagnetic field Theory | * 1. Electromagnetic radiation sources are identified   2. Detectors of Electromagnetic radiations are determined   3. Electromagnetic waves are applied   4. Electromagnetics Laws are Identified   5. Behaviours and effects of Electromagnetic waves are established |
| 1. Apply Electrodynamics | * 1. Electrostatics terms are identified   2. Magnetostatics terms are identified   3. Electrodynamics laws are identified |
| 1. Apply Energy and Momentum in Electromagnetic field | * 1. Energy conservation theorem is identified   2. Electromagnetic Energy flow is determined |
| 1. Apply transients in Electrical Circuit Analysis | * 1. Growth and decay in R-L-C circuits are determined   2. Calculations involving Growth and decay in R-L-C are performed |
| 1. Use Two Port networks | * 1. Basic passive networks are performed   2. Characteristic impedance is determined   3. Types of transmission lines and their applications are performed |
| 1. Demonstrate understanding of Refrigeration and Air conditioning | * 1. Use of Refrigeration and Air conditioning is demonstrated   2. Installation of the Refrigeration and Air conditioning system is simulated |

**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**  May include but not limited to: |
| 1. SI unit | * 1. Power – Watts (W)   2. Current – Amperes (A)   3. Resistance – Ohms(Ω)   4. Voltage – Volts (V) |
| 1. Quantities | * 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. Used power triangle in calculating power factor   8. Applied various methods in power factor correction   9. 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. |

## PREPARE AND INTERPRET TECHNICAL DRAWINGS

**UNIT CODE: ENG/OS/POM/CC/03/6**

**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 electrical drawings | * 1. Electrical symbols and abbreviations are identified, and their meaning interpreted according to BS 3939   2. ***Electrical 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**  ***May include but is not limited to:*** |
| --- | --- |
| 1. Drawing equipment | Drawing boards, T and set squares, drawing sets, computers with CAD packages |
| 1. Drawing materials | Drawing papers, pencils, erasers, masking tapes, paper clips |
| 1. Environmental legislations | EMCA 1999 |
| 1. Personal Protective Equipment | Dust coats, closed leather shoes |
| 1. Geometric forms | Circles, triangles, rectangles, parallelogram, polygons, pyramids, conic sections, prisms, loci |
| 1. Standard conventions | * Anatomy of engineering drawing (title block, coordinate grid system, revision block, notes and legends) * Drawing scale (paper size and drawing symbols) * International drawing standards |
| 1. Electrical drawings | 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 circuit, 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. |

## APPLY MECHANICAL SCIENCE PRINCIPLES

**UNIT CODE: ENG/OS/POM/CC/04/6**

**UNIT DESCRIPTION**

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

**ELEMENTS AND PERFORMANCE CRITERIA**

| **ELEMENT**  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. Understand friction principles | * 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. Understand 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 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**  ***May include but not limited to:*** |
| 1. Forces theorems | * 1. Parallelogram   2. Triangle   3. Polygon |
| 1. Problems on simple machines | * 1. Machine advantage   2. Velocity ratio   3. Efficiency |
| 1. Gas laws | * 1. Boyles law   2. Charles law   3. Gas equation |
| 1. Density terminology | * 1. Density   2. Relative density |
| 1. Pressure applications | * 1. Vacuum pump   2. Hydraulic pump   3. Hydrometers |
| 1. Principles | * 1. Newton’s laws of motion   2. Law of conservation of linear momentum   3. Law of conservation of energy   4. Archimedes’ principle |
| 1. Mechanical calculations | * 1. Mechanical advantage   2. Efficiency   3. Torque   4. Power/Energy   5. Work done |
| 1. Laws of fluids | * 1. Pascal’s principle   2. 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 |
| 2. 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. 4. Context of Assessment | Competency may be assessed individually in the actual workplace or  through accredited institution |
| 1. 5. Guidance information for assessment | Holistic assessment with other units relevant to the industry sector, workplace and job role is recommended. |

## APPLY FLUID MECHANICS PRINCIPLES

**UNIT CODE: ENG/OS/POM/CC/05/6**

**UNIT DESCRIPTION**

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

**ELEMENTS AND PERFORMANCE CRITERIA**

| **ELEMENT**  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. Understand flow of 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 is ***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**  ***May include but not limited to:*** |
| 1. Causes of losses | * 1. Friction   2. Enlargement/reduction in cross-sectional areas |
| 1. Physical quantities | * 1. Mass   2. Force   3. Density   4. Velocity   5. Acceleration |
| 1. Applied | * 1. Reynolds number   2. Mach number   3. Froude number |
| 1. Principle of operation | * 1. Reciprocating   2. Centrifugal |
| 1. Reciprocating pump equation is derived | * 1. Coefficient of discharge   2. Percentage slip   3. Work done   4. Acceleration head   5. Pressure head in the cylinder |
| 1. Centrifugal pump equation is derived | * 1. Effective head   2. Manometric head   3. Manometric efficiency   4. Mechanical efficiency   5. Discharge   6. Torque   7. Work done unit weight   8. 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 Principles of 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 |
| 4. Context of Assessment | Competency may be assessed individually in the actual workplace or through accredited institution |
| 5. Guidance information for assessment | Holistic assessment with other units relevant to the industry sector, workplace and job role is recommended. |

## APPLY THERMODYNAMICS PRINCIPLES

**UNIT CODE: ENG/OS/POM/CC/06/6**

**UNIT DESCRIPTION**

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

**ELEMENTS AND PERFORMANCE CRITERIA**

| **ELEMENT**  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. Understand fundamentals of thermodynamics | * 1. Terms used in thermodynamics are described   2. Thermodynamics processes and cycles are described   3. First law of thermodynamics is applied |
| 1. Perform steady flow processes | * 1. Steady flow energy equation is derived   2. Steady flow energy equation is applied in problem solving   3. Steady flow energy equation is applied in ***utilities*** |
| 1. Perform non steady flow processes | * 1. Non-flow energy equation is derived   2. Non-flow energy equation is applied in problem solving |
| 1. Understand perfect gases | * 1. ***Perfect gas laws*** are stated   2. Gas laws experiment are carried out   3. Gas laws are applied |
| 1. Generate steam | * 1. Dryness fraction is determined   2. Relationship between pressure and boiling point is determined   3. Energy balance is carried out   4. Relationship between temperature and pressure is determined. |
| 1. Perform thermodynamics reversibility and entropy | * 1. Thermodynamics reversibility is explained   2. Principles of heat engine are explained   3. Second law of thermodynamics is applied   4. Entropy is explained in thermodynamics cycle |
| 1. Understand idea gas cycle | * 1. Ideal gas cycle processes are explained   2. Air standard efficiency and actual efficiency are differentiated   3. Problems are solved in ideal gas cycle |
| 1. Demonstrate fuel and combustion | * 1. Fuels are classified   2. Properties of fuels are described   3. Combustion equation are derived   4. Combustion equation is applied to combustion and exhaust gas problems |
| 1. Perform heat transfer | * 1. Conduction equation is derived and applied from Fourier’s law   2. Heat transfer equation is derived and applied from Newton’s law of cooling and Fourier’s law |
| 1. Understand heat exchangers | * 1. Heat exchangers are classified   2. Recuperative heat exchangers are described   3. Heat equations are applied to solve heat exchanger problems |
| 1. Understand air compressors | * 1. Air compressors are classified   2. ***Types of air compressors*** are described   3. Equations of reciprocating compressors are derived and applied |
| 1. Understand gas turbines | * 1. Theoretical cycle for gas turbines is explained   2. Open cycle gas turbine is described   3. Closed cycle gas turbine is described   4. Gas turbine equations are derived and applied |
| 1. Understand impulse steam turbines | * 1. ***Principles of operations*** of the impulse steam turbines is described   2. Impulse steam turbine equation is derived and applied |

**RANGE**

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

|  |  |
| --- | --- |
| **Variable** | **Range**  ***May include but not limited to:*** |
| 1. Utilities | * 1. Boilers   2. Condensers   3. Compressors   4. Nozzles   5. Throttling processes |
| 1. Perfect gas laws | * 1. Boyle’s law   2. Charle’s law   3. Joule’s law |
| 1. Principles | * 1. Newton’s laws of motion   2. Law of conservation of linear momentum   3. Law of conservation of energy   4. Archimedes’ principle |
| 1. Types of air compressors | * 1. Reciprocating   2. Blowers   3. Sliding valves |
| 1. Types of air compressors | * 1. Compounding   2. Multistage impulse turbine |

**REQUIRED SKILLS AND KNOWLEDGE**

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

**Required Skills**

The individual needs to demonstrate the following skills:

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

**Required Knowledge**

The individual needs to demonstrate knowledge of:

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

**EVIDENCE GUIDE**

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

|  |  |
| --- | --- |
| 1. Critical aspects of Competency | Assessment requires evidence that the candidate:   * 1. Identified Principles of 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 PERFORM METALLURGICAL PROCESSES

**UNIT CODE: ENG/OS/POM/CC/07/6**

**UNIT DESCRIPTION:**

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

**ELEMENTS AND PERFORMANCE CRITERIA**

| **ELEMENT**  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. Analyse 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   5. Production is performed |
| 1. Perform heat treatment | * 1. Safety practices are observed according to OSHA 2007   2. **Heat treatment processes** are identified   3. Procedure in heat treatment processes   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**  ***May include but not limited to:*** |
| --- | --- |
| 1. Physical properties | * Density * Colour * Texture * Melting point * Thermo conductivity * Electrical resistivity |
| 1. Mechanical properties | * Ductility * Malleability * Elasticity * Toughness * Hardness * Brittleness * Plasticity * Strength |
| 1. Composition of iron | * + Iron (II) oxide * Iron (III) oxide |
| 1. Iron materials | * + Cast iron   + Steel |
| 1. Non-ferrous materials | * + Aluminium   + Copper |
| 1. ceramic materials | * + Oxides   + Nitrides   + Carbides   + Silica |
| 1. Finishing processes | * + Lapping   + Fine grinding   + Polishing |
| 1. Other engineering materials | * + Rubber   + Plastics   + Wood   + Glass |
| 1. Corrosion type | * + Galvanic   + Stress corrosion cracking |
| 1. Methods of corrosion prevention | * + 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 of:

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

###### **EVIDENCE GUIDE**

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

|  |  |
| --- | --- |
| 1. Critical Aspects of Competency | Assessment requires evidence that the candidate:   * 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. The behaviour of the learner in the working environment   2. Inpection of finished product   3. Process analysis |
| 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. |

# CORE COMPETENCIES

## OPERATE AND MAINTAIN INDUSTRIAL BOILERS

**UNIT CODE: ENG/OS/POM/CR/01/6**

**UNIT DESCRIPTION**

The unit describes the skills, knowledge and attitudes required by a boiler mechanical technician in order to competently and safely overhaul and service boiler components/ equipment.

**ELEMENTS AND PERFORMANCE CRITERIA**

| **Element** | **Performance Criteria** |
| --- | --- |
| 1. Apply Industrial Boiler Operations and Maintenance Safety Procedures | * 1. Personal safety gear is used as per rules and regulations of the ***Occupational Safety Act***   2. Safety measures for the operation of the boiler are observed as per the rules and regulations of the ***Occupational Safety Act***   3. Work environment safety is adhered to as per the **Occupational Safety Act**   4. Appropriate ***personal protective equipment (PPE)*** are used in accordance with SOPs   5. Industrial boiler alarm systems are tested for functionality as per SOPs   6. Water hammer is avoided as per SOPs   7. Industrial boiler is stored in safe condition for access in accordance with the SOPs   8. Current industrial boiler ***Certificate of Inspection*** is maintained as per the regulations |
| 1. Identify Industrial Boiler Parts | * 1. Operation manuals are obtained and interpreted as per manufacturers specification and SOPs   2. The model of the boiler is identified as per manufacturer’s specification   3. Different components of the boiler are identified as per manufacturer’s specification |
| 1. Start Industrial Boiler | * 1. The pressure in the boiler is checked as per manufacturer’s specification   2. The steam stop valve is closed as per manufacturer’s specification   3. Fuel valves are opened as per manufacturer’s specification   4. Feed water valves are checked and filled with water as per manufacturer’s specification   5. The boiler is started as per manufacturer’s specification   6. The combustion chamber is monitored as per manufacturer’s specification   7. Feed water valve is opened when pressure increases as per manufacturer’s specification   8. Vent valve is closed as per manufacturer’s specification |
| 1. Monitor and Control Industrial Boiler Performance | * 1. Boiler performance is examined as per manufacturer’s specification   2. The lit and flame are checked for satisfaction as per manufacturer’s specification   3. Water level in the gauge glass is maintained for stability as per manufacturer’s specification |
| 1. Conduct industrial boiler diagnostic tests and Identify Faults | * 1. Blow down valve and safety relieve valves test is conducted as per manufacturers specification and SOPs   2. Industrial boiler water tests are performed as per SOPs   3. Industrial boiler pneumatic valves are checked for functionability as per SOPs   4. Industrial boiler conveyors are test run to ensure emergency buttons are working as per manufacturer’s specification   5. Deaerator and Alarm water level switch are checked and confirmed as per the Manufactures recommendation   6. Periodic noise levels are carried out as per manufacturer’s specification |
| 1. Perform industrial boiler service and / repair | * 1. Logs charts, daily check charts and boiler reports are implemented   2. Tools and equipment for maintenance are identified as per manufactures manual and SOPs   3. Meantime to repair time is adhered to as per laid down procedures and standards   4. Chemical and mechanical cleaning of ***boiler tubes*** are carried out to manufacturer recommendations and ***procedures***   5. Tube leaks are identified at the bank tubes and super heater tubes as per SOPs   6. Super heater tube expander is used for replacing super heaters due to tube leakages according to SOPs   7. Faulty boiler auxiliary/ component isolated and overhauled for service   8. Inventory of spares records are updated and maintained according to SOPs   9. Lubrication levels for moving parts are checked and addressed as per SOPs   10. Static and dynamic balancing for all the fans are carried out as the SOPs   11. All manholes are closed properly as per the SOPs   12. Return plant to required operational status upon completion of test |
| 1. Re-commission industrial boiler Operations | * 1. The laid down start-up procedures are followed depending on the status of the boilers, either warm or cold start-up as per manufacturer’s specification   2. Industrial boiler is tested for functionality as per manufacturer’s specification   3. The industrial boiler is re-commissioned for operation |
| 1. Stop Industrial Boiler | * 1. Boiler automatic cycle is stopped as per manufacturer’s specification   2. The boiler feed water valves are closed as per manufacturer’s specification   3. The vent valves are kept open to prevent vacuum formation inside the boiler as per manufacturer’s specification |
| 1. Perform Housekeeping Procedures | * 1. ***Polishing*** material are selected as per workplace procedure   2. Finished work is cleaned as per workplace procedure   3. Finished work is polished to specification as per workplace procedure |
| 1. Document and update Maintenance Records | * 1. Standard maintenance procedures are followed as recorded in maintenance manuals   2. Maintenance scheduling is documented according to manufacturer specifications   3. Maintenance report is developed and stored as per workplace procedure |

**RANGE**

This section provides work environment and condition to which the performance criteria (PC) apply. It allows for different work environment and situation that will affect performance.

| **Variable** | **Range**  ***May include but not limited to:*** |
| --- | --- |
| 1. Occupational Safety and Health Act 2007 | * 1. Personal safety equipment   2. Responsibility of the employee   3. Responsibility of the employer   4. Work area safety   5. Work area hazards   6. Accident reporting procedure |
| 1. Boiler | 2.1 Fixed and modulating combustion controls and a single heat source. Operation includes a battery of boilers and boilers that have a single thermal or solar heat source. |
| 1. Types of boiler | * 1. Fire tube boilers   2. Water tube boilers   3. Once through boilers   4. Waste heat boilers   5. Electrically heated boilers |
| 1. Hazards | * 1. Asbestos lagging   2. Chemical hazards   3. Thermal hazards   4. Manual handling hazards   5. Machinery guard requirements   6. Hot exposed steam pipe   7. Leakage of steam   8. Leakage of fuel   9. Odour of gas   10. Fumes from a liquid chemical spill   11. Faulty/broken ladder or hand rail   12. Working at heights   13. Flammable liquids   14. Fire and explosion   15. Electrical hazards   16. Work area, including:       1. Illumination       2. Excessive noise from machinery       3. Spillage of oil       4. Rubbish and combustibles       5. Obstruction |
| 1. Risk control methods | Risk control methods refer to the systematic process of eliminating or reducing the risk to personnel and property through the application of controls.  It includes the application of the hierarchy of control:   * 1. Elimination   2. Substitution   3. Isolation   4. Engineering controls   5. Administrative controls   6. Personal protective equipment (PPE) |
| 1. Appropriate standards | * 1. Legislation   2. Codes of practice   3. Manufacturer specifications   4. Technical standards (International)   5. Industry standards (where applicable) |
| 1. Procedures | * 1. Manufacturer guidelines (e.g. Instructions, specifications or checklists)   2. Industry operating procedures   3. Workplace procedures (e.g. Work instructions, operating procedures or checklists) |
| 1. Equipment | * 1. Gas monitoring equipment   2. Water testing equipment   3. Fire-fighting equipment   4. Workplace first aid equipment   5. Work platform and associated gear, including walkways   6. Temperature monitoring equipment |
| 1. Communication methods | * 1. Verbal and non-verbal language written instructions signage   2. Hand signals   3. Listening   4. Questioning to confirm understanding   5. Appropriate worksite protocol |
| 1. Appropriate/Relevant personnel | * 1. Production personnel   2. Maintenance personnel   3. Supervisors and managers   4. Boiler operators   5. Suppliers   6. Colleagues |
| 1. Records | * 1. Operating log books   2. Maintenance records   3. Records of faults and potential faults   4. Isolation procedures   5. Safe operating procedures   6. Daily operating inspections   7. Repairs carried out according to manufacturer recommendations and operating procedures   8. Workplace record keeping requirements   9. Details of any daily or periodic maintenance work   10. Details of yearly programmed or additional maintenance work |
| 1. Risk control measures | * 1. Barricades and controls   2. Machine guarding   3. Fall prevention   4. Pedestrian controls   5. Adequate illumination   6. Noise controls   7. Signage   8. PPE |
| 1. Personal Protective Equipment (PPE) | * 1. Thermally insulated gloves   2. Helmet   3. Ear protection (muffs or plugs)   4. Chemical resistant gloves and apron   5. Respiratory devices eye protection   6. Working protective gloves   7. Whole body fire-resistant clothing   8. Safety boots |
| 1. Communication equipment | * 1. Two-way radios   2. Mobile phones   3. Intercoms   4. Satellite phones   5. Local Area Networks |
| 1. Maintenance | * 1. Leaking steam pipe   2. Pressure gauge accuracy   3. Exposed electrical wiring   4. Defective illumination in the workplace   5. Leaking fuel pump gland   6. Leaks in high pressure feed line   7. Leaking gauge glass mounting   8. Leaking safety valve   9. Isolation procedures, hardware and equipment |
| 1. Faults | * 1. Abnormal operating conditions   2. Boiler tube failure   3. Feedwater supply and/or other major auxiliary loss   4. Wet steam   5. High dissolved oxygen   6. Ph of water   7. High conductivity   8. Actuator or valve mechanical or electrical fault/failure   9. Instruments failure   10. Steam leak   11. Insulation failure   12. Draft failure |
| 1. Diagnose | * 1. Senses, including:      1. Audio      2. Smell      3. Touch      4. Visual   2. Remote or local indicators and recorders   3. Computers and alarms, including:      1. Visible      2. Audible |
| 1. Operating logs | * 1. Date and time of checking   2. Each check, examination and results   3. Printed and signed name of person who performed the checks   4. Date and time of any lockout or equipment malfunction   5. Results of tests on boiler or feed-water   6. Changes in operation |
| 1. Valves and fittings | * 1. Safety valves   2. Gauge glasses   3. Main Steam stop valve   4. Feedwater stop valve   5. Feed check valve   6. Blow-down valve   7. Steam side/line drain valves   8. Flame failure detection device   9. Water level controller   10. Boiler steam pressure gauge |
| 1. Monitor | * 1. Water supply system   2. Checks of steam reticulation line   3. Pressure usage and supply of steam   4. Quality of steam   5. Combustion/heat source system and management   6. Feedwater system   7. Fuel system   8. Combustion air supply   9. Water level   10. Boiler steam pressure   11. Boiler and steam manifold valves (where fitted)   12. Soot blowers (where fitted)   13. Operation of control/safety devices, including control panels |
| 1. Tests | * 1. Response checks   2. Standby plant ‘cut in’ tests   3. Instruments tests   4. Valve operating checks   5. Hydrostatic tests   6. Performance tests   7. Alarm and protection test   8. Ph levels   9. Conductivity   10. Oxygen   11. Total dissolved solids (TDS)   12. Water hardness   13. Other contaminants |
| 1. Chemicals | * 1. Oxygen scavenger   2. Feedwater additives   3. Other chemicals |
| 1. Handover | * 1. Previous load requirements   2. Maintenance issue, including equipment isolated for maintenance   3. Operational incidences   4. Read operating log   5. General inspection of boiler to detect any defects   6. Accept responsibility of boiler noted defects   7. Required equipment tests |
| 1. Emergencies | * 1. Tube failure   2. Loss of water level   3. Power failure   4. Inadequate housekeeping   5. Explosion   6. Fire   7. Personal accidents   8. Chemical spills   9. Major steam leaks   10. Major water leaks and flooding   11. Natural disasters   12. Oil spills   13. Fans and pumps failure |
| 1. Appropriate emergency response | * 1. Identification of emergency   2. Isolation of heat source   3. Selection and application of appropriate fire-fighting equipment and PPE   4. Notification of downstream users   5. Operation of boiler only when safe to do so   6. Notification of appropriate regulatory authorities |
| 1. Storage mode | * 1. Wet and dry storing   2. Open or closed position |

**REQUIRED KNOWLEDGE SKILLS**

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

**Required Knowledge**

The trainee needs to demonstrate knowledge of:

|  |
| --- |
| * Occupational Safety and Health Act of Kenya laws 2007 with focus on personal safety, equipment safety and workplace |
| * Types of boiler |
| * Boiler auxiliaries and mountings |
| * Preventative maintenance |
| * Steam generation process |
| * Fuels |
| * Start-up and shut-down procedure of the boiler |
| * First Aid |
|  |

**Required Skills**

|  |  |
| --- | --- |
| The trainee needs to demonstrate the following fundamental skills | |
| * Communication skills | * Environmental Literacy |
| * Numeracy skills | * Employability skills |
| * Digital literacy skills | * Entrepreneurship skills |
| * Occupational health safety and Practices |  |

**EVIDENCE GUIDE**

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

|  |  |
| --- | --- |
| 1. Critical Aspects of Competency | * 1. Observed safety at workplace   2. Identified different types of boiler   3. Conducted routine maintenance   4. Conducted Preventative/ Condition-based maintenance |
| 1. Resource Implications | * 1. Boiler/model boiler   2. Boiler manuals   3. OSHA   4. Workshop tools |
| 1. Methods of Assessment | Competency may be assessed through:   * 1. Observed behavior of the candidate   2. Inspection of written operation procedures   3. Inspection of log books |
| 1. Context of Assessment | Competency will 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 |

## OPERATE AND MAINTAIN INDUSTRIAL STEAM TURBINES

**UNIT CODE: ENG/OS/POM/CR/02/6**

**UNIT DESCRIPTION**

The unit describes the skills, knowledge and attitudes required by a steam turbine mechanical technician in order to competently and safely overhaul and service boiler components/ equipment.

**ELEMENTS AND PERFORMANCE CRITERIA**

| **Element** | **Performance Criteria** |
| --- | --- |
| 1. Apply Steam Turbine Operations and Maintenance Safety Procedures | * 1. Personal safety gear is prescribed as per rules and regulations of the ***Occupational Safety Act***   2. Safety measures for the maintenance of the steam turbines are defined as the rules and regulations of the ***Occupational Safety Act***   3. Industrial steam alarm systems are tested for functionality as per SOPs   4. Water hammer is avoided as per SOPs   5. Periodic noise levels are performed |
| 1. Identify Industrial Steam Turbine parts | * 1. Operation manuals are obtained and interpreted as per manufacturers specification and SOPs   2. The model of industrial steam turbine is identified as per manufacturer’s specification   3. Different components of the industrial steam turbine are identified as per manufacturer’s specification |
| 1. Start Industrial Steam Turbine | * 1. The turbo generator lube oil sump is checked and drained for water as per manufacturer’s specification   2. The lube oil priming pump is started, and the lube oil pressure is checked as per manufacturer’s specification   3. The turbine generator vacuum pump operating water tank is filled to normal level as per manufacturer’s specification   4. The vacuum condenser condensate level is checked from the condensate pump as per manufacturer’s specification   5. Steam drain valve is operated to drain any condensate water from the steam as per manufacturer’s specification   6. Main steam inlet valve for the turbo generator is opened as per manufacturer’s specification   7. Turbo generator is started as per manufacturer’s specification |
| 1. Monitor and Control Industrial Steam Turbine Performance | * 1. Steam turbine performance is examined as per manufacturer’s specification   2. Vacuum condenser condensate level is maintained all the time as per manufacturer’s specification   3. Turbo generator speed, voltage, frequency, vacuum and condenser level are controlled to the required parameters as per manufacturer’s specification |
| 1. Conduct industrial steam turbine diagnostic tests and Identify Faults | * 1. Pre-operational checks are conducted on the steam turbine in accordance to the manufacturers’ recommendations and SOPs   2. Exhaust steam discharge valves are checked for functionability according to SOPs   3. Non-drive end and drive-end bearing temperatures are checked using infra-red thermometer and recorded in the log book   4. Water Strainers (online and standby) are serviced according to SOPs   5. Any fault is identified and noted as per manufacturer’s specification |
| 1. Perform industrial steam turbine Service and or/ Repair | * 1. Logs charts, daily check charts and steam turbine reports are implemented   2. Tools and equipment for maintenance are identified as per manufactures manual and SOPs   3. Speed governors are serviced according to SOPs   4. Tube / pipe leaks are fixed according to SOPs   5. Oil leaks are addressed according to SOPs   6. Vacuum cleaning is carried out on the steam turbine panels according to SOP   7. Tools and material inventory updated |
| 1. Conduct Industrial Steam Turbine pretest procedures | * 1. The laid down start-up procedures are followed depending on the status of the steam turbine as per manufacturer’s specification   2. Industrial steam turbine is tested for functionality as per manufacturer’s specification   3. The industrial steam turbine is re-commissioned for operation as per manufacturer’s specification |
| 1. Stop Industrial Turbine | * 1. The industrial steam turbine is stopped as per manufacturer’s specification   2. The turning gear is engaged as per manufacturer’s specification   3. All the drain valves are opened as per manufacturer’s specification   4. The isolating valves to the steam supply line are shut off as per manufacturer’s specification   5. The condenser vacuum is broken as per manufacturer’s specification   6. The turbine is given time to cool down as per manufacturer’s specification |
| 1. Perform Housekeeping Procedures | * 1. ***Polishing*** material are selected as per workplace procedure   2. Finished work is cleaned as per workplace procedure   3. Finished work is polished to specification as per workplace procedure |
| 1. Document and Update Maintenance Records | * 1. Standard maintenance procedures are followed as recorded in maintenance manuals   2. Maintenance scheduling is documented according to manufacturer’s specifications   3. Maintenance report is developed and stored as per workplace procedure |

**RANGE**

This section provides work environment and condition to which the performance criteria (PC) apply. It allows for different work environment and situation that will affect performance.

| **Variable** | **Range**  ***May include but not limited to:*** |
| --- | --- |
| 1. Occupational Safety and Health Act 2007 | * 1. Personal safety equipment   2. Responsibility of the employee   3. Responsibility of the employer   4. Work area safety   5. Work area hazards   6. Accident reporting procedure |
| 1. Types of turbines | * 1. Impulse turbine   2. Reaction turbine |
| 1. Plant/Equipment | * 1. Turbine and auxiliary plant   2. Turbine lubrication and power/control oil systems   3. Turbine by-pass system plant   4. Condensate and feed water system plant to boiler economizer inlet NRV   5. Condensate polishing plant   6. High- and low-pressure heating systems   7. Steam condensing and cooling systems   8. Condenser vacuum raising equipment   9. Turbine gland sealing equipment   10. Cooling water systems plant   11. Boiler feed water desecrating equipment   12. Condensate and feed water chemical treatment equipment   13. Electricity generation and distribution systems A.C and D.C   14. Station water distribution systems   15. Hydraulic oil system   16. Pumps   17. Computers with equipment control functions   18. Supervisory, alarm, protection and control equipment |
| 1. Hazards | * 1. Asbestos lagging   2. Chemical hazards   3. Thermal hazards   4. Manual handling hazards   5. Machinery guard requirements   6. Leakage of steam   7. Fumes from a liquid chemical spill   8. Faulty/broken ladder or hand rail   9. Flammable liquids   10. Fire and explosion   11. Electrical hazards   12. Work area, including:       1. Illumination       2. Excessive noise from machinery       3. Spillage of oil       4. Rubbish and combustibles       5. Obstruction |
| 1. Risk control methods | Risk control methods refer to the systematic process of eliminating or reducing the risk to personnel and property through the application of controls.  It includes the application of the hierarchy of control:   * 1. Elimination   2. Substitution   3. Isolation   4. Engineering controls   5. Administrative controls   6. Personal protective equipment (PPE) |
| 1. Safety Standards | * 1. Relevant sections of Occupational Health and Safety legislation   2. Industry standards   3. Manufacturers’ recommendations   4. National standards for plant and relevant state legislation. |
| 1. Procedures | * 1. Manufacturer guidelines (e.g. instructions, specifications or checklists)   2. Industry operating procedures   3. workplace procedures (e.g. work instructions, operating procedures or checklists) |
| 1. Information and Documentation | * 1. Verbal or written communications   2. Industry safety rules documentation   3. Industry operating instructions   4. Manufacturer operational and maintenance manuals   5. Equipment and alarm manuals   6. Industry log books   7. Dedicated computer equipment   8. Plant notes. |
| 1. Communication | * 1. Telephone and/or mobile phones   2. Two-way radio   3. Computer (electronic mail)   4. Operating log (written or verbal). |
| 1. Appropriate/Relevant personnel | * 1. Production personnel   2. Maintenance personnel   3. Supervisors/Team leaders and managers or equivalent   4. Technical and engineering officers or equivalent   5. Operating staff and contractor staff.   6. Other coordinators of energy production or equivalent |
| 1. Technical and operational indicators | * 1. Stimuli (audio, smell, touch, visual)   2. Remote or local indicators and recorders   3. Computers and alarms (visible and or audible). |
| 1. Tests | * 1. Loss of a major auxiliary controls’ response checks   2. Stand-by plant “cut-in” tests   3. Valves operating checks   4. On-load turbine valve and emergency governor operation test   5. Performance tests   6. Condenser pressure test   7. Heater leak checks   8. Alarm and protection tests. |
| 1. Personal Protective Equipment (PPE) | * 1. Thermally insulated gloves   2. Helmet   3. Ear protection (muffs or plugs)   4. Working protective gloves   5. Whole body heat-resistant clothing   6. Safety boots |
| 1. Faults/ abnormal operating conditions | * 1. Loss of a major auxiliary   2. Loss of electrical Generation to auxiliaries   3. Turbine water ingress   4. Excessively high turbine and turbine valves heating/cooling rates/differentials   5. High condenser vacuum   6. Condenser tube leak   7. High dissolved oxygen, conductivity   8. High turbine bearing temperatures/vibration   9. High/low bearing oil temperature   10. Loss of turbine bearing oil flow/pressure   11. Low/high pressure heaters malfunctions   12. Actuator/valve mechanical/electrical faults/failure   13. Failed field devices   14. Turbine protection |
| 1. Appropriate emergency response | * 1. Identification of emergency   2. Isolation of heat source   3. Selection and application of appropriate fire-fighting equipment and PPE   4. Notification of downstream users   5. Operation of boiler only when safe to do so   6. Notification of appropriate regulatory authorities |

**REQUIRED KNOWLEDGE AND SKILLS**

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

**Required Skills**

**The trainee needs to demonstrate knowledge of:**

|  |
| --- |
| * Relevant environmental, occupational health and safety legislation and regulations |
| * Classification of turbines |
| * Turbine construction and operating principles |
| * Plant drawings |
| * Steam Turbine Preventative maintenance |
| * Introduction to and typical arrangements of power production plant |
| * Relevant plant and equipment, its location and operating parameters |
| * Pump types and characteristics |
| * Recording procedures |
| * Turbine speed control equipment |
| * The system components and their interaction with other plant and equipment external to that covered by this competency |
| * Steam distribution systems |
| * Turbine by-pass system |
| * Vacuum raising and turbine gland sealing systems |
| * Lubrication and bearings |
| * Turbine lubrication and oil systems, types and characteristics |
| * Condensate and feed water systems |
| * Fire protection control systems |
| * First aid |

**Skills Required**

|  |  |  |
| --- | --- | --- |
| **The trainee needs to demonstrate the following fundamental skills;** | | |
| * Communication skills | * Environmental Literacy | |
| * Numeracy skills | | * Employability skills |
| * Digital literacy skills | | * Occupational health safety and Practices |
| * Entrepreneurship skills | |  |

**EVIDENCE GUIDE**

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

|  |  |
| --- | --- |
| 1. Critical Aspects of Competency | * 1. Observed safety at workplace and sound housekeeping   2. Identified different types of steam turbine   3. Identified turbine components   4. Operated and monitored steam turbine performance   5. Conducted basic preventative maintenance   6. Conducted basic First Aid and Emergency evacuation |
| 1. Resource Implications | * 1. Steam Turbine/model of Steam Turbine   2. Steam Turbine manuals   3. Relevant legislations, e.g. OSHA, Environmental Act; and regulations   4. Workshop tools |
| 1. Methods of Assessment | Competency may be assessed through:   * 1. Observed behavior of the learners   2. Inspection of written operation procedures   3. Inspection of log books |
| 1. Context of Assessment | Competency will 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 |

## OPERATE AND MAINTAIN INDUSTRIAL HYDRAULICS SYSTEMS

**UNIT CODE: ENG/OS/POM/CR/03/6**

**UNIT DESCRIPTION**

The unit describes the skills, knowledge and attitudes required by a Hydraulic system technician in order to competently and safely overhaul and service hydraulic system components.

**ELEMENTS AND PERFORMANCE CRITERIA**

| **Element** | **Performance Criteria** |
| --- | --- |
| 1. Apply Industrial Hydraulic Systems Operations and Maintenance Safety Procedures | * 1. Personal safety gear is used as per rules and regulations of the ***Occupational Safety Act***   2. Safety measures for the maintenance of the hydraulic system is defined as per OSHA and SOPs   3. Work place safety measures are adhered to according to SOPs |
| 1. Identify Industrial Hydraulic System parts | * 1. Operation manuals are obtained and interpreted as per manufacturers specification and SOPs   2. The model of the industrial hydraulic system is identified as per manufacturer’s specification   3. Different components of the industrial hydraulic system are identified as per manufacturer’s specification |
| 1. Run Industrial Hydraulic System | * 1. The level of the hydraulic fluid in the reservoir of the hydraulic system is checked and re-filled with hydraulic oil as per manufacturer’s specification   2. The pump is primed as per manufacturer’s specification   3. The hydraulic system is started as per manufacturer’s specification   4. The hydraulic system is stopped after operations as per manufacturer’s specification |
| 1. Conduct Industrial Hydraulic System Diagnostic test and Identify Faults | * 1. Pre-operational checks are conducted on the industrial hydraulic system in accordance to the manufacturers’ recommendations and SOPs   2. The functionality of the components for the hydraulic system is checked as per manufacturer’s specifications   3. Troubleshooting is done to identify faults on the hydraulic system components |
| 1. Perform industrial hydraulic system Service and or/repair | * 1. Logs books, daily check charts and hydraulic system reports are implemented   2. Tools and equipment for maintenance are identified as per manufactures manual and SOPs   3. O-rings, seals, Circlip rings, gaskets and Cotter pins are serviced and or replaced according to SOPs   4. Oil Viscosity and chemical degradation of the fluid is checked according to SOPs   5. Filters are serviced and or replaced as per the manufacture’s recommendation and SOPs   6. Pressure gauges’ calibrations are undertaken according to manufactures recommendation SOPs   7. Hydraulic fittings and auxiliaries are serviced and or replaced according to SOPs   8. Control valves and non-return valves are serviced and or replaced according to SOPs   9. Tools and material inventory updated |
| 1. Perform Housekeeping procedures | * 1. ***Polishing*** material are selected as per workplace procedure   2. Finished work is cleaned as per workplace procedure   3. Finished work is polished to specification as per workplace procedure |
| 1. Document and Update Maintenance records | * 1. Standard maintenance procedures are followed as recorded in maintenance manuals   2. Maintenance scheduling is documented according to manufacturer’s specifications   3. Maintenance report is developed and stored as per workplace procedure |

**RANGE**

This section provides work environment and condition to which the performance criteria (PC) apply. It allows for different work environment and situation that will affect performance.

| **Variable** | **Range**  ***May include but not limited to:*** |
| --- | --- |
| 1. Hydraulic components | * 1. Rams   2. Actuators   3. Relays   4. Hydraulic operated tools   5. Governors and relays   6. Pumps   7. Directional valves   8. Piping   9. Seals   10. Manifolds |
| 1. Maintenance | * 1. Repair   2. Inspection and modification   3. Overhaul   4. Lubrication   5. Servicing   6. Test running |
| 1. Work completion details | * 1. Plant and maintenance records   2. Job cards   3. Check sheets   4. On device labeling updates   5. Reporting and/or documenting equipment defects. |
| 1. Isolations | Electrical/mechanical or other associated processes |
| 1. Regulations, Polices and Standards | * 1. Occupational Safety and Health Act   2. Company policies   3. Manufacturers’ specifications |
| 1. Potential failures /Indication of failures | * 1. Noise   2. Vibration   3. Odour   4. Cracks   5. Leaks   6. Loss of performance   7. Unintended motion |
| 1. Safety equipment | * 1. Pressure relief valve   2. Safety valve   3. Non return valve |
| 1. PPE | * 1. Gloves   2. Safety boots |
| 1. Hazards | * 1. Burns from hot, high-pressure fluid   2. Injection of fluid into the skin   3. Fire Hazards   4. Bruises, cuts or abrasions from flailing hydraulic lines   5. Injury of people due to unexpected movement of equipment   6. During maintenance of equipment and their parts.   7. Injury due to sudden release of residual pressurized oil.   8. Slippage due to oily floor area.   9. Electric shock from electrical motors/ A.C. Solenoids |

**REQUIRED KNOWLEDGE AND SKILLS**

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

**Required Skills**

**The trainee needs to demonstrate knowledge of:**

|  |
| --- |
| * Relevant environmental, occupational health and safety legislation and regulations |
| * Personal protective equipment (PPE) and safety equipment. |
| * Hand and portable power tools |
| * Assess potential hazards. |
| * Scheduled and preventative maintenance on the system. |
| * Technical Drawing, Hydraulic circuit diagrams and data |
| * Uses documentation. |
| * Hydraulic principles |
| * Pre- and post-operational inspections. |
| * Completes daily equipment logbook. |
| * Troubleshooting and basic repairs on equipment |
| * Emergency procedures. |
| * Identification and selection of tools and materials |
| * Identify and use relevant test equipment |
| * Testing techniques |
| * Dismantle and assemble components to specified tolerances |
| * Communicate effectively |
| * Basic First aid |

**Required Skills**

|  |  |
| --- | --- |
| **The trainee needs to demonstrate the following fundamental skills** | |
| * Communication skills | * Environmental Literacy |
| * Numeracy skills | * Employability skills |
| * Digital literacy skills | * Entrepreneurship skills |
| * Occupational health safety and Practices |  |

**EVIDENCE GUIDE**

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

|  |  |
| --- | --- |
| 1. Critical Aspects of Competency | * 1. Observed safety at workplace and sound housekeeping   2. Identified different types of oil used in hydraulic systems   3. Identified hydraulic components and attachments   4. Selected and correctly use tools and equipment   5. Operated and monitor hydraulic system   6. Conducted scheduled and basic preventative maintenance   7. Performed pre- and post-operational tests   8. Conducted basic First Aid and Emergency evacuation |
| 1. Resource Implications | * 1. Hydraulic system/model   2. Hydraulic simulation   3. Relevant legislations, e.g. OSHA, Environmental Act; and regulations   4. Workshop tools and equipment   5. Hydraulic manuals |
| 1. Methods of Assessment | Competency may be assessed through:   * 1. Observed behavior of the learners at workplace   2. Inspection of written operation procedures   3. Inspection of log books |
| 1. Context of Assessment | Competency will 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 |

## OPERATE AND MAINTAIN INDUSTRIAL PNEUMATIC SYSTEMS

**UNIT CODE: ENG/OS/POM/CR/04/6**

**UNIT DESCRIPTION**

The unit describes the skills, knowledge and attitudes required by a Pneumatic system technician in order to competently and safely overhaul and service hydraulic system components.

**ELEMENTS AND PERFORMANCE CRITERIA**

| **Element** | **Performance Criteria** |
| --- | --- |
| 1. Apply Industrial Pneumatic Systems Operations and Maintenance Safety Procedures | * 1. Personal safety gear is prescribed as per rules and regulations of the ***Occupational Safety Act***   2. Safety measures for the maintenance of the pneumatic system is defined as per OSHA and SOPs   3. Work place safety measures are adhered to according to SOPs |
| 1. Identify Industrial Pneumatic System Parts | * 1. Operation manuals are obtained and interpreted as per manufacturer’s specification and SOPs   2. The model of the industrial pneumatic system is identified as per manufacturer’s specification   3. Different components of the industrial pneumatic system are identified |
| 1. Run Industrial Pneumatic System | * 1. The compressor is run to fill reservoir tank with compressed air as per manufacturer’s specification   2. The valves are opened to allow flow of compressed air to supply lines as per manufacturer’s specification   3. The pneumatic system is run according to the user needs   4. The pneumatic system is stopped after operation as per manufacturer’s specification   5. The valves are closed to cut flow of compressed air to supply lines as per manufacturer’s specification |
| 1. Conduct Industrial Pneumatic System Diagnostic test and Identify Faults | * 1. Pre-operational checks are conducted on the industrial pneumatic system in accordance to the manufacturers’ recommendations and SOPs   2. The functionality of the components for the pneumatic system is checked as per manufacturer’s specifications   3. Troubleshooting is done to identify faults on the pneumatic system components |
| 1. Perform industrial Pneumatic system Service and or/ Repair | * 1. Logs books, daily check charts and Pneumatic system reports are implemented   2. Tools and equipment for maintenance are identified as per manufactures manual and SOPs   3. O-rings, seals, Circlip rings, gaskets and Cotter pins are serviced and or replaced according to SOPs   4. Filters are serviced and or replaced as per the manufacturer’s recommendation and SOPs   5. Pressure gauges’ calibrations are undertaken according to manufactures recommendation SOPs   6. Pneumatic fittings and auxiliaries are serviced and or replaced according to SOPs   7. Control valves and non-return valves are serviced and or replaced according to SOPs   8. Tools and material inventory updated |
| 1. Perform Housekeeping procedures | * 1. ***Polishing*** material are selected as per workplace procedure   2. Finished work is cleaned as per workplace procedure   3. Finished work is polished to specification as per workplace procedure |
| 1. Document and Update Maintenance records | * 1. Standard maintenance procedures are followed as recorded in maintenance manuals   2. Maintenance scheduling is documented according to manufacturer’s specifications   3. Maintenance report is developed and stored as per workplace procedure |

**RANGE**

This section provides work environment and condition to which the performance criteria (PC) apply. It allows for different work environment and situation that will affect performance

| **Variable** | **Range**  ***May include one or more but not limited to:*** |
| --- | --- |
| 1. Pneumatic components | * 1. Rams   2. Linear and Rotary Actuators   3. Relays   4. Pneumatic operated tools   5. Directional/Control valves   6. Seals   7. Piping   8. Manifold |
| 1. Types of Compressors | * 1. Positive displacement      1. Reciprocating Compressors      2. Rotary Compressors   2. Dynamic flow compressor      1. Axial flow compressors      2. Radial flow compressors |
| 1. Compressor Accessories | * 1. Intercoolers and after-coolers   2. Intake filters   3. Compressor controls |
| 1. Maintenance | * 1. Repair   2. Inspection and modification   3. Overhaul   4. Lubrication   5. Servicing   6. Test running |
| 1. Work completion details | * 1. Plant and maintenance records   2. Job cards   3. Check sheets   4. On device labeling updates   5. Reporting and/or documenting equipment defects. |
| 1. Isolations | Electrical/mechanical or other associated processes |
| 1. Regulations, Polices and Standards | * 1. Occupational Safety and Health Act   2. Company policies   3. Manufacturers’ specifications |
| 1. Potential failures /Indication of failures | * 1. Noise   2. Vibration   3. Odour   4. Cracks   5. Leaks   6. Loss of performance   7. Unintended motion   8. Color of lubricant |
| 1. Safety equipment | * 1. Pressure relief valve   2. Safety valve   3. Non return valve |
| 1. PPE | * 1. Ear protection (muffs or plugs)   2. Working protective gloves   3. Safety boots |
| 1. Hazards | * 1. Burns from high-pressure fluid   2. Injection of fluid into the skin   3. Fire Hazards   4. Bruises, cuts or abrasions from failing pneumatic lines   5. Injury of people due to unguarded rotating part   6. During maintenance of equipment and their parts.   7. Injury due to sudden release of residual pressurized air.   8. Slippage due to oily floor area.   9. Electric shock from electrical motors/ A.C. Solenoids |

**REQUIRED KNOWLEDGE AND SKILLS**

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

**Required Knowledge**

|  |
| --- |
| * Relevant environmental, occupational health and safety legislation and regulations |
| * Personal protective equipment (PPE) and safety equipment. |
| * Types of compressor |
| * Compressor parts and accessories |
| * Hand and portable power tools |
| * Assess potential hazards. |
| * Scheduled and preventative maintenance on the system. |
| * Technical Drawing, pneumatic circuit diagrams and data |
| * Uses documentation. |
| * Pneumatic principles |
| * Pre- and post-operational inspections. |
| * Completes daily equipment logbook. |
| * Troubleshooting and basic repairs on equipment |
| * Emergency procedures. |
| * Identification and selection of tools and materials |
| * Identify and use relevant test equipment |
| * Testing techniques |
| * Dismantle and assemble components to specified tolerances |
| * Communicate effectively |
| * Basic First aid |

**Required Skills**

|  |  |
| --- | --- |
| **The trainee needs to demonstrate the following fundamental skills** | |
| * Communication skills | * Environmental Literacy |
| * Numeracy skills | * Employability skills |
| * Digital literacy skills | * Entrepreneurship skills |
| * Occupational health safety and Practices |  |

**EVIDENCE GUIDE**

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

|  |  |
| --- | --- |
| 1. Critical Aspects of Competency | * 1. Observed safety at workplace and sound housekeeping   2. Identified different types of oil used in hydraulics   3. Identified pneumatic components and attachments   4. Selected and correctly used tools and equipment   5. Operated and monitored pneumatic system   6. Conducted and scheduled basic preventative maintenance   7. Performed pre- and post-operational tests   8. Conducted basic First Aid and Emergency evacuation |
| 1. Resource Implications | * 1. Air Compressor   2. Pneumatic system/model   3. Pneumatic simulation   4. Relevant legislations, e.g. OSHA, Environmental Act; and regulations   5. Workshop tools and equipment   6. Pneumatic manuals |
| 1. Methods of Assessment | Competency may be assessed through:   * 1. Observed behavior of the learners at workplace   2. Inspection of written operation procedures   3. Inspection of log books |
| 1. Context of Assessment | Competency will 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 |

## MAINTAIN INDUSTRIAL PUMPS

**UNIT CODE: ENG/OS/POM/CR/05/6**

**UNIT DESCRIPTION**

The unit describes the skills, knowledge and attitudes required by industrial pump technician in order to competently and safely overhaul and service a pump.

**ELEMENTS AND PERFORMANCE CRITERIA**

| **Element** | **Performance Criteria** |
| --- | --- |
| 1. Apply Industrial Pumps Maintenance Safety Procedures | * 1. Personal safety gear is prescribed as per rules and regulations of the ***Occupational Safety Act***   2. Safety measures for the maintenance of the Industrial pumps is defined as per OSHA and SOPs   3. Work place safety measures are adhered to according to SOPs |
| 1. Identify Industrial Pump Components | * 1. Operation manuals are obtained and interpreted as per manufacturer’s specification and SOPs   2. The model of the industrial pump is identified as per manufacturer’s specification   3. Different components of the pump are identified |
| 1. Conduct Industrial Pump Diagnostic test and Identify Faults | * 1. Pre-operational checks are conducted on the pump in accordance to the manufacturers’ recommendations and SOPs   2. The functionality of the components for the pump is checked as per manufacturer’s specifications   3. Troubleshooting is done to identify faults on the pump components |
| 1. Perform industrial pumps Service and or/Repair | * 1. Logs books, daily check charts and pump reports are implemented   2. Working check card for pump are generated according to SOPs   3. Spare inventory record maintained according to SOPs   4. All clearances and tolerances are restored to the manufacturer’s specifications   5. Seals, O-rings, glands, main shafts, impeller lock nuts, impeller, both drive-end and non-drive -end ***bearings*** are serviced and or replaced according to SOPs   6. Right lubrication (food grade or non-food grade) identified according to manufactures specifications   7. Cracks are identified through dye penetrant methods within the volute casing and pedestral foundation according to SOPs   8. Impeller balancing (Static) is carried out according to SOPs   9. Pumps next due date for service is updated on the check card and pump schedule as per SOPs   10. The cost element of pump maintenance is generated according to SOPs   11. Tools and material inventory is updated according SOPs |
| 1. Perform Housekeeping procedures | * 1. ***Polishing*** material are selected as per workplace procedure   2. Finished work is cleaned as per workplace procedure   3. Finished work is polished to specification as per workplace procedure |
| 1. Document and Update Maintenance records | * 1. Standard maintenance procedures are followed as recorded in maintenance manuals   2. Maintenance scheduling is documented according to manufacturer’s specifications   3. Maintenance report is developed and stored as per workplace procedure |

**RANGE**

This section provides work environment and condition to which the performance criteria (PC) apply. It allows for different work environment and situation that will affect performance

| **Variable** | **Range**  ***May include one or more but not limited to:*** |
| --- | --- |
| 1. Occupational Safety and Health Act 2007 | * 1. Personal safety equipment   2. Responsibility of the employee   3. Responsibility of the employer   4. Work area safety   5. Work area hazards   6. Accident reporting procedure |
| 1. Types of pump | * 1. Centrifugal pump   2. Reciprocating Pump      1. Piston Pump      2. Diaphragm Pump   3. Rotary Pump      1. Lobe Pump      2. Screw Pump |
| 1. Types of Bearing | * 1. Plain/ Journal bearing   2. Ball Bearings   3. Roller bearings   4. Thrust bearings |
| 1. Types of Seals | * 1. Mechanical seals   2. Gaskets   3. O-rings   4. Gland packing |
| 1. Pump Auxiliaries | * 1. Pump lubrication oil systems   2. Valves   3. Pump prime movers including A.C and D.C motors, steam turbines, oil engines |
| 1. Hazards | * 1. Liquid spillage   2. Unguarded rotating parts   3. High temperature   4. Explosion   5. Pump vibrations   6. Electrical shock   7. Electromagnetic emissions |
| 1. Safety Standards | * 1. Relevant sections of Occupational Health and Safety legislation   2. Industry standards   3. Manufacturers’ recommendations   4. National standards for plant and relevant state legislation. |
| 1. Procedures | * 1. Manufacturer guidelines (e.g. instructions, specifications or checklists)   2. Industry operating procedures   3. Workplace procedures (e.g. work instructions, operating procedures or checklists) |
| 1. Appropriate/Relevant personnel | * 1. Production personnel   2. Maintenance personnel   3. Supervisors/Team leaders and managers or equivalent   4. Technical and engineering officers or equivalent   5. Operating staff and contractor staff. |
| 1. Tests | * 1. Valves operating checks   2. Performance tests   3. Leak checks   4. Cavitations checks   5. Vibration tests |
| 1. Personal Protective Equipment (PPE) | * 1. Thermally insulated gloves   2. Ear protection (muffs or plugs)   3. Working protective gloves   4. Safety boots |
| 1. Faults/ abnormal operating conditions | * 1. Loss of pumping capacity   2. Electrical power failure   3. Tubing occlusion   4. Cavitations   5. Vibration   6. Noise   7. Misalignment   8. Load faults   9. Leakages |
| 1. Appropriate emergency response | * 1. Identification of emergency   2. Isolation of power source   3. Selection and application of appropriate fire-fighting equipment and PPE   4. Notification of downstream users   5. Notification of appropriate regulatory authorities |

**REQUIRED KNOWLEDGE AND SKILLS**

**Required Knowledge**

|  |
| --- |
| * Relevant environmental, occupational health and safety legislation and regulations |
| * Classification of pumps |
| * Pump construction and operating principles |
| * Pump Diagrams |
| * Pump Preventative maintenance |
| * Pump Installation |
| * Recording procedures |
| * Pump speed control equipment |
| * Pump fittings |
| * Lubrication and bearings |
| * Fire protection control systems |
| * First aid |

**Required Skills**

|  |  |
| --- | --- |
| **The trainee needs to demonstrate the following fundamental skills** | |
| * Communication skills | * Environmental Literacy |
| * Numeracy skills | * Employability skills |
| * Digital literacy skills | * Entrepreneurship skills |
| * Occupational health safety and Practices |  |

**EVIDENCE GUIDE**

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

|  |  |
| --- | --- |
| 1. Critical Aspects of Competency | * 1. Observed safety at workplace and sound housekeeping   2. Identified different types of pump   3. Identified parts of pumps   4. Identified pump fittings   5. Operated and monitored pumps performance   6. Conducted basic preventative maintenance   7. Conducted basic First Aid and Emergency evacuation |
| 1. Resource Implications | * 1. Various pumps   2. Pump simulations   3. Pump manuals   4. Relevant legislations, e.g. OSHA, Environmental Act; and regulations   5. Workshop tools |
| 1. Methods of Assessment | Competency may be assessed through:   * 1. Observed behavior of the learners   2. Inspection of written operation procedures   3. Inspection of log books |
| 1. Context of Assessment | Competency will 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 |

## MAINTAIN INDUSTRIAL STEAM DISTRIBUTION LINE

**UNIT CODE: ENG/OS/POM/CR/06/6**

**UNIT DESCRIPTION**

The unit describes the skills, knowledge and attitudes required by a steam distribution mechanical technician in order to competently and safely maintain steam distribution system.

**ELEMENTS AND PERFORMANCE CRITERIA**

| **Element** | **Performance Criteria** |
| --- | --- |
| 1. Apply Industrial Steam Distribution Line Safety Procedures | * 1. Personal safety gear is observed as per rules and regulations of the ***Occupational Safety Act***   2. Safety measures for the maintenance of the industrial steam line distribution is defined as per OSHA and SOPs   3. Work place safety measures are adhered to according to SOPs |
| 1. Identify Steam Distribution Line Components | * 1. Operation manuals are obtained and interpreted as per manufacturer’s specification and SOPs   2. The design of the steam distribution line is identified as per manufacturer’s specification   3. Different components of the steam distribution line are identified |
| 1. Conduct Steam Distribution Line Diagnostic test and Identify Faults | * 1. Pre-operational checks are conducted on the steam distribution line in accordance to the manufacturers’ recommendations and SOPs   2. The functionality of the components for the steam distribution line is checked as per manufacturer’s specifications   3. Troubleshooting is done to identify faults on the steam distribution line components |
| 1. Perform Steam Distribution Line Service and or/ Repair | * 1. Leakages are tagged and reports generated according to SOPs   2. Wear are identified through thickness tester as per the SOPs   3. Steam traps are serviced and maintained periodically according to SOPs   4. Valve seats and valve landings at the headers are checked and serviced periodically as per SOPs   5. Tags and reports are implemented   6. The bolts joining steam line flanges are regularly sprayed using penetrating oil as per SOPs   7. Identification and classification of steam line bolts and nuts are carried out as per SOPs   8. Identification and classification of steam line pipes and bents are carried out as per SOPs   9. Total length of all various diameters of steam line is updated in the inventory as per SOPs |
| 1. Perform Housekeeping procedures | * 1. ***Polishing*** material are selected as per workplace procedure   2. Finished work is cleaned as per workplace procedure   3. Finished work is polished to specification as per workplace procedure |
| 1. Document and Update Maintenance records | * 1. Standard maintenance procedures are followed as recorded in maintenance manuals   2. Maintenance scheduling is documented according to manufacturer’s specifications   3. Maintenance report is developed and stored as per workplace procedure |

**RANGE**

This section provides work environment and condition to which the performance criteria (PC) apply. It allows for different work environment and situation that will affect performance

| **Variable** | **Range**  ***May include one or more but not limited to:*** |
| --- | --- |
| 1. Occupational Safety and Health Act 2007 | * 1. Personal safety equipment   2. Responsibility of the employee   3. Responsibility of the employer   4. Work area safety   5. Work area hazards   6. Accident reporting procedure |
| 1. Components on distribution line | * 1. Steam traps   2. Steam separators   3. Steam pipes   4. Drain points Strainer and filters   5. Air vents   6. Pressure reducing valves   7. Expansion joint   8. Flow counters   9. Condensate recovery system   10. Valves |
| 1. Hazards | * 1. Asbestos lagging   2. Thermal hazards   3. Manual handling hazards   4. Leakage of steam   5. Fumes from a liquid chemical spill   6. Faulty/broken ladder or hand rail   7. Flammable liquids   8. Fire and explosion   9. Electrical hazards   10. Work area, including:       1. illumination       2. excessive noise from machinery       3. spillage of oil       4. rubbish and combustibles       5. obstruction |
| 1. Risk control methods | Risk control methods refer to the systematic process of eliminating or reducing the risk to personnel and property through the application of controls.  It includes the application of the hierarchy of control:   * 1. elimination   2. substitution   3. isolation   4. engineering controls   5. administrative controls   6. personal protective equipment (PPE) |
| 1. Safety Standards | * 1. Relevant sections of Occupational Health and Safety legislation   2. Industry standards   3. Manufacturers’ recommendations   4. National standards for plant and relevant state legislation. |
| 1. Procedures | * 1. Manufacturer guidelines (e.g. instructions, specifications or checklists)   2. Industry operating procedures   3. workplace procedures (e.g. work instructions, maintenance procedures or checklists) |
| 1. Information and Documentation | * 1. Verbal or written communications   2. Industry safety rules documentation   3. Industry operating instructions   4. Manufacturer operational and maintenance manuals   5. Equipment and alarm manuals   6. Industry log books   7. Dedicated computer equipment   8. Plant notes. |
| 1. Communication | * 1. Telephone and/or mobile phones   2. Two-way radio   3. Computer (electronic mail)   4. Operating log (written or verbal). |
| 1. Appropriate/Relevant personnel | * 1. Production personnel   2. Maintenance personnel   3. Supervisors/Team leaders and managers or equivalent   4. Technical and engineering officers or equivalent   5. Operating staff and contractor staff.   6. Other coordinators of energy management or equivalent |
| 1. Technical and operational indicators | * 1. Stimuli (audio, smell, touch, visual)   2. Remote or local indicators and recorders   3. Computers and alarms (visible and or audible). |
| 1. Tests | * 1. Flow test   2. Inspection check list   3. Leak test   4. Pressure tests   5. Quality assurance (QA) audit   6. Energy management audit |
| 1. Personal Protective Equipment (PPE) | * 1. Thermally insulated gloves   2. Helmet   3. Ear protection (muffs or plugs)   4. Working protective gloves   5. Whole body heat-resistant clothing   6. Safety boots |
| 1. Abnormal system conditions | * 1. Excessive pressure drop   2. Water hummer   3. Steam loss   4. Poor dryness fraction of steam   5. Ingress of non-condensable gases   6. Over- or Under-heating   7. Steam locking   8. Corrosion |
| 1. Appropriate emergency response | * 1. Identification of emergency   2. Isolation of heat source   3. Selection and application of appropriate fire-fighting equipment and PPE   4. Notification of downstream users   5. Notification of appropriate regulatory authorities |

**REQUIRED KNOWLEDGE AND SKILLS**

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

**Required Skills**

**The trainee needs to demonstrate knowledge of:**

|  |
| --- |
| * Relevant environmental, occupational health and safety legislation and regulations |
| * Components of steam distribution system components |
| * Plant drawings |
| * Preventative maintenance on the system components |
| * Introduction to and typical arrangements of steam plant |
| * Relevant component, its location and operating parameters |
| * Recording procedures |
| * The system components and their interaction with other equipment to that covered by this competency |
| * Steam distribution systems |
| * Condensate recovery system |
| * Steam pipeline |
| * Steam traps |
| * Condensate and feed water systems |
| * Fire protection control systems |
| * First aid |

**Skills Required**

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| --- | --- | --- |
| **The trainee needs to demonstrate the following fundamental skills;** | | |
| * Communication skills | * Environmental Literacy | |
| * Numeracy skills | | * Employability skills |
| * Digital literacy skills | | * Entrepreneurship skills |
| * Occupational health safety and Practices | |  |

**EVIDENCE GUIDE**

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

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| 1. Critical Aspects of Competency | * 1. Observed safety at workplace and sound housekeeping   2. Identified components of steam distribution system   3. Monitored steam distribution components performance   4. Conducted preventative and breakdown maintenance   5. Conducted basic First Aid and Emergency evacuation |
| 1. Resource Implications | * 1. Steam separators   2. Steam traps   3. Steam strainers   4. Pressure Reducing valve   5. Isolation valves e.g. gate valves, non-return valve (NRV)   6. Insulation e.g. felt, rock wool, fiber glass   7. Relevant legislations, e.g. OSHA, Environmental Act; and regulations   8. Workshop tools |
| 1. Methods of Assessment | Competency may be assessed through:   * 1. Observed behavior of the learners   2. Inspection of written report   3. Inspection of log books |
| 1. Context of Assessment | Competency will 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 |