

**REPUBLIC OF KENYA**

**NATIONAL OCCUPATIONAL STANDARDS**

**FOR**

**MARINE ENGINEERING TECHNICIAN**

**LEVEL 5**



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 and this resulted to the formulation of the Policy Framework for Reforming Education and Training (Sessional Paper No. 4 of 2016). A key feature of this policy is the radical change in the design and delivery of the TVET training.

This policy document requires that training in TVET be competency based, curriculum development be industry led, certification be based on demonstration of competence and mode of delivery allows for multiple entry and exit in TVET programmes.

These reforms demand that Industry takes a leading role in curriculum development to ensure the curriculum addresses its competence needs. It is against this background that these Occupational Standards were developed for developing a competency-based curriculum for Marine Engineering Technician level 5. These Occupational Standards will also be the bases for assessment of an individual for competence certification.

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

The TVET Curriculum Development, Assessment and Certification Council (TVET CDACC), in conjunction with Marine Engineering Sector Skills Advisory Committee (SSAC) have developed these Occupational Standards for Marine engineering technician. These standards will be the bases for development of competency-based curriculum for Marine Engineering Technology Level 5.

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, Marine 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.**

**CHAIRPERSON, TVET CDACC**

# ACKNOWLEDGMENT

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

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

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

**CHAIRPERSON,**

**MARINE ENGINEERING SECTOR SKILLS ADVISORY COMMITTEE**

# ACRONYMS

BC Basic Competency

CC Common Competency

CR Core Competency

CDACC Curriculum Development, Assessment and Certification Council

MAR Marine

CPU Control Powering Unit

DTI Dial test indicator

ENG Engineering

ICT Information and Communication Technology

IT Information Technology

HVI High Volume Instrument

KCSE Kenya Certificate of Secondary Education

KNQF Kenya National Qualification Framework

OS Occupational Standards

OSHA Occupational Safety and Health Act

PPE Personal protective equipment

TVET Technical and Vocational Education and Training

SOP Standard Operating Procedures

# **KEY TO UNIT CODE**

**ENG/OS/MAR/BC /01/ 5/ A**

Industry or sector

Occupational Standards

Occupational area

Type of competency

Competency number

Competency level

Control Version

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# OVERVIEW

The Marine Engineering Technician Level 5 qualification consists of competencies that a person must achieve to enable him/her to work in Marine Engineering sector.

The units of competency comprising the Marine Engineering Technician level 5 qualifications include the following basic, common and core competencies:

|  |  |
| --- | --- |
| **BASIC UNITS OF COMPETENCY** | |
| **Unit of competency Code** | **Units of competency** |
| ENG/OS/MAR/BC/01/5/A | Demonstrate communication skills |
| ENG/OS/MAR/BC/02/5/A | Demonstrate digital literacy |
| ENG/OS/MAR/BC/03/5/A | Demonstrate entrepreneurial skills |
| ENG/OS/MAR/BC/04/5/A | Demonstrate employability skills |
| ENG/OS/MAR/BC/05/5/A | Demonstrate environmental literacy |
| ENG/OS/MAR/BC/06/5/A | Demonstrate occupational health and safety |
| **COMMON UNITS OF COMPETENCY** | |
| ENG/OS/MAR/CC/01/5/A | Apply mechanical science principles |
| ENG/OS/MAR/CC/02/5/A | Apply fluid mechanics principles |
| ENG/OS/MAR/CC/03/5/A | Apply thermodynamics principles |
| ENG/OS/MAR/CC/04/5/A | Apply of electrical principles |
| ENG/OS/MAR/CC/05/5/A | Apply ship construction principles |
| ENG/OS/MAR/CC/06/5/A | Monitor and evaluate ship stability |
| ENG/OS/MAR/CC/07/5/A | Apply engineering mathematics |
| ENG/OS/MAR/CC/08/5/A | Demonstrate basic safety at sea |
| ENG/OS/MAR/CC/09/5/A | Prepare and interpret engineering drawings |
| **CORE UNITS OF COMPETENCY** | |
| ENG/OS/MAR/CR/01/5/A | Install and maintain marine pumps |
| ENG/OS/MAR/CR/02/5/A | Install and maintain air compressors |
| ENG/OS/MAR/CR/03/5/A | Perform marine engine works |
| ENG/OS/MAR/CR/04/5/A | Operate marine electrical and electronic systems |
| ENG/OS/MAR/CR/05/5/A | Operate and maintain ship control and automation systems |
| ENG/OS/MAR/CR/06/5/A | Maintain marine transmission, shaft and propulsion system |
| ENG/OS/MAR/CR/07/5/A | Operate and maintain marine auxiliary systems |
| ENG/OS/MAR/CR/08/5/A | Perform engine room watch keeping duties |

# BASIC UNITS OF COMPETENCY

# **DEMONSTRATE COMMUNICATION** SKILLS

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

**UNIT DESCRIPTION**

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

**ELEMENTS AND PERFORMANCE CRITERIA**

|  |  |
| --- | --- |
| **ELEMENT**  These describe the key outcomes which make up workplace function | **PERFORMANCE CRITERIA**  These are assessable statements which specify the required level of performance for each of the elements.  ***Bold and italicized terms*** ***are elaborated in the Range*** |
| 1. Meet communication needs of clients and colleagues | 1. Specific communication needs of clients and colleagues are identified and met 2. Different approaches are used to meet communication needs of clients and colleagues 3. Conflict is addressed promptly and in a timely way and in a manner which does not compromise the standing of the organization |
| 1. Contribute to the development of communication strategies | * 1. Strategies for internal and external dissemination of information are developed, promoted, implemented and reviewed as required   2. Channels of communication are established and reviewed regularly   3. Coaching ineffective communication is provided   4. Work related network and relationship are maintained as necessary   5. Negotiation and conflict resolution strategies are used where required   6. Communication with clients and colleagues is appropriate to individual needs and organizational objectives |
| 1. Conduct interviews | 1. A range of appropriate communication strategies are employed in ***interview situations*** 2. Records of interviews are made and maintained in accordance with organizational procedures 3. Effective questioning, listening and nonverbal communication techniques are used to ensure that required message is communicated |
| 1. Facilitate group discussions | 1. Mechanisms which enhance effective group interaction is defined and implemented 2. Strategies which encourage all group members to participate are used routinely 3. Objectives and agenda for meetings and discussions are routinely set and followed 4. Relevant information is provided to group to facilitate outcomes 5. Evaluation of group communication strategies is undertaken to promote participation of all parties 6. Specific communication needs of individuals are identified and addressed |
| 1. Represent the organization | 1. When participating in internal or external forums, presentation is relevant, appropriately researched and presented in a manner to promote the organization 2. Presentation is clear and sequential and delivered within a predetermined time 3. Utilize appropriate media to enhance presentation 4. Differences in views are respected 5. Written communication is consistent with organizational standards 6. Inquiries are responded in a manner consistent with organizational standard |

**RANGE**

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

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

**Required Knowledge**

The individual needs to demonstrate knowledge of:

* Communication process
* Dynamics of groups and different styles of group leadership
* Communication skills relevant to client groups
* Flexibility in communication
* Communication skills relevant to client groups

**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. Met communication needs of clients and colleagues 2. Contributed to the development of communication strategies 3. Conducted interviews 4. Facilitated group discussions 5. Represented the organization |
| 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/MAR/BC/02/5/A**

**UNIT DESCRIPTION**

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

**ELEMENTS AND PERFORMANCE CRITERIA**

|  |  |
| --- | --- |
| **ELEMENT**  These describe the key outcomes which make up workplace function | **PERFORMANCE CRITERIA**  These are assessable statements which specify the required level of performance for each of the elements.  ***Bold and italicized terms*** ***are elaborated in the Range*** |
| 1. Identify appropriate computer software and hardware | * 1. Concepts of ICT are determined in accordance with computer equipment   2. Classifications of computers are determined in accordance with manufacturers specification   3. ***Appropriate computer software*** is identified according to manufacturer’s specification   4. ***Appropriate computer hardware*** is identified according to manufacturer’s specification   5. Functions and commands ofoperating system are determined in accordance withmanufacturer’s specification |
| 1. Apply security measures to data, hardware, software in automated environment | * 1. ***Data security and privacy are classified*** in accordance with the prevailing technology   2. ***Security threats*** areidentified, **and *control measures*** are applied in accordance with laws governing protection of ICT   3. Computer threats and crimes are detected.   4. Protection against computer crimes is undertaken in accordance with laws governing protection of ICT |
| 1. Apply computer software in solving tasks | * 1. ***Word processing concepts***are applied in resolving workplace tasks, report writing and documentation   2. ***Word processing utilities*** are applied in accordance with workplace procedures   3. Worksheet layout is prepared in accordance with work procedures   4. Worksheet is build 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   3. Desktop computers   4. Calculators   5. Internet   6. Smart phones   7. Operation Manuals |
| 1. Methods of Assessment | Competency may be assessed through:   * 1. Written Test   2. Demonstration   3. Practical assignment   4. Interview/Oral Questioning   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/MAR/BC/03/5/A**

**UNIT DESCRIPTION**

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

**ELEMENTS AND PERFORMANCE CRITERIA**

|  |  |
| --- | --- |
| **ELEMENT** | **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 3. Track record and normative capability profile of enterprise and similar businesses are reviewed and considered in setting ***strategic directions***. 4. Strengths, weaknesses, opportunities and threats are considered when developing new ideas, approaches, goals and directions 5. Decisions about enterprise strategies/directions are made after careful consideration of all relevant information 6. ***Business/corporate plan*** is developed that sets out tactics, resource implications, timeframes, production and sales target |
| 1. Develop new products/ markets | 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** |
| 1. 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 |
| 2. 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 |
| 3. 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:  2.1 Interview guide for entrepreneurs  2.2 Enterprise workers and third parties  2.3 Materials and location relevant to the proposed activity and tasks |
| 3. Methods of Assessment | 3.1 Case problems  3.2 Interview  3.3 Portfolio  3.4 Third part reports |
| 4. Context of Assessment | 4.1 Competency may be assessed in workplace or in a simulated workplace setting  4.2 Assessment shall be observed while tasks are being undertaken whether individually or in-group |
| 5. Guidance information for assessment | Holistic assessment with other units relevant to the industry sector, workplace and job role is recommended. |

# DEMONSTRATE EMPLOYABILITY SKILLS

**UNIT CODE: ENG/OS/MAR/BC/04/5/A**

**UNIT DESCRIPTON**

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

**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. Conduct self-management | 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. Individual performance is evaluated and monitored according to the agreed targets. 4. Assertiveness is developed and maintained based on the requirements of the job. 5. Accountability and responsibility for own actions are demonstrated. 6. Self-esteem and a positive self-image are developed and maintained. 7. Time management, attendance and punctuality are observed as per the organization policy. 8. Goals are managed as per the organization’s objective 9. Self-strengths and weaknesses are identified as per ***personal objectives*** 10. Critics are managed as per personal objectives |
| 1. Demonstrate interpersonal communication | 1. Listening and understanding is demonstrated as per communication policy 2. Writing to the needs of the audience is demonstrated as per communication policy 3. Speaking, reading and writing is demonstrated as per communication policy 4. Empathising is demonstrated as per the communication policy 5. Internal and external customers’ needs are identified and interpreted as per the communication policy 6. Persuasion is demonstrated as per the communication policy 7. Communication nnetworks are established as per the SOPs 8. Information is shared as per communication structure |
| 1. Demonstrate critical safe work habits | * 1. Stress is managed in accordance with workplace procedures.   2. Punctuality and time consciousness is demonstrated in line with workplace policy.   3. Personal objectives are integrated with organization goals based on organization’s strategic plan.   4. Work priorities are set in accordance to workplace procedures.   5. Leisure time is recognized in line with organization policy.   6. Abstinence from ***drug and substance abuse*** is observed as per workplace policy.   7. Awareness of HIV and AIDS is demonstrated in line with workplace requirements.   8. Safety consciousness is demonstrated in the workplace based on organization safety policy.   9. ***Emerging issues*** are dealt with in accordance with organization policy. |
| 1. Lead small teams | 1. Performance expectations for the ***team*** are set as per the organization objectives 2. Tasks are assigned in accordance with the organization policy. 3. Team performance indicators are identified according to set rules and regulations. 4. ***Forms of communication*** in a team are established according to office policy. 5. Communication is carried out as per workplace place policy and requirements of the job. 6. ***Feedback*** on performance is collected and analyzed based on established team learning process 7. ***Gender mainstreaming*** is undertaken in accordance with set regulations. |
| 1. Plan and organize work | 1. Task requirements are identified as per the workplace objectives 2. Task is interpreted in accordance with safety (OHS ), environmental requirements and quality requirements 3. Work activity is organized with other involved personnel as per the SOPs 4. Resources are mobilized, allocated and utilized to meet project goals and deliverables. 5. Work activities are monitored and evaluated in line with organization procedures. 6. Job planning is documented in accordance with workplace requirements. 7. Time is managed achieve workplace set goals and objectives. |
| 1. Maintain professional growth and development | * 1. Personal training needs are identified and assessed in line with the requirements of the job.   2. ***Training and career opportunities*** are identified and availed based on job requirements.   3. Licensees and certifications relevant to job and career are obtained and renewed.   4. ***Personal growth*** is pursued towards improving the qualifications set for the profession.   5. Work priorities are identified based on requirement of the job and workplace policy.   6. Recognitions are sought as proof of career advancement in line with professional requirements. |
| 1. Demonstrate workplace learning | * 1. Own learning is managed as per workplace policy.   2. Learning opportunities are sought and allocated based on job requirement and in line with organization policy.   3. Contribution to the learning community at the workplace is carried out.   4. ***Range of media for learning*** are identified as per the training need   5. Application of learning is demonstrated in both technical and non-technical aspects based on requirements of the job   6. Enthusiasm for ongoing learning is demonstrated   7. Time and effort is invested in learning new skills-based job requirements   8. Willingness to learn in different context is demonstrated based on available learning opportunities arising in the workplace.   9. Opportunities for performance improvement are identified proactively in area of work.   10. Awareness of personal role in workplace ***innovation*** is demonstrated. |
| 1. Demonstrate problem solving skills | * 1. Problems are identified as per the context of data and circumstances   2. Problem solutions are sought based on the problem   3. Independence and initiative in identifying and solving problems is demonstrated.   4. Team problems are solved as per the workplace guidelines   5. Problem solving strategies are applied as per the workplace guidelines |
| 1. Demonstrate workplace ethics | * 1. Policies and guidelines are observed as per the workplace requirements   2. Self-worth and profession is exercised in line with personal goals and organizational policies   3. Code of conduct is observed as per the workplace requirements   4. Personal and professional integrity is demonstrated as per the personal goals   5. Commitment to jurisdictional laws is demonstrated as per the workplace requirements |

**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.

|  |  |
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| **Range** | **Variable** |
| ***Drug and substance abuse*** include 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 |
| ***Relationships*** includes but not limited to: | * Man/Woman * Trainer/trainee * Employee/employer * Client/service provider * Husband/wife * Boy/girl * Parent/child * Sibling relationships |
| ***Forms of communication*** include but not limited to: | * Written * Visual * Verbal * Non verbal * Formal and informal |
| ***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 |
| ***Range of media for learning*** include but not limited to: | * Mentoring * peer support and networking * IT and courses |

**REQUIRED SKILLS AND KNOWLEDGE**

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

**Required Skills**

The individual needs to demonstrate the following skills:

* 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. Conducted self-management   2. Demonstrated interpersonal communication   3. Demonstrated critical safe work habits   4. Led small teams   5. Planned and organized work   6. Maintained professional growth and development   7. Demonstrated workplace learning   8. Demonstrated problem solving skills   9. Demonstrated workplace ethics |
| 1. Resource Implications | |  | | --- | | The following resources should be provided: |  * 1. 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/MAR/BC/05/5/A**

**UNIT DESCRIPTION**

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

**ELEMENTS AND PERFORMANCE CRITERIA**

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

**RANGE**

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

|  |  |
| --- | --- |
| **Variable** | **Range** |
| 1. ***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. Hearing protector   2. Safety boots |
| 1. ***Environmental pollution control measures*** may include but are not limited to: | * 1. Methods for minimizing or stopping spread and ingestion of airborne particles   2. Methods for minimizing or stopping spread and ingestion of gases and fumes   3. Methods for minimizing or stopping spread and ingestion of liquid wastes |
| 1. ***Waste management procedures*** may include but are not limited to: | 3.1 Sorting  3.2 Storing of items  3.2 Recycling of items  3.3 Disposal of items |
| 1. ***Resources*** may include but are not limited to: | 4.1 Electric  4.2 Water  4.3 Fuel  4.3 Telecommunications   * 1. Supplies   4.5 Materials |
| 1. ***Workplace environmental hazards*** may include but are not limited to: | 5.1Biological hazards  5.2 Chemical and dust hazards  5.3 Physical hazards |
| 1. ***Organizational systems and procedures*** may include but are not limited to: | 6.1 Supply chain, procurement and purchasing  6.2 Quality assurance  6.3 Making recommendations and seeking approvals |

**REQUIRED SKILLS AND KNOWLEDGE**

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

**Required Skills**

The individual needs to demonstrate the following skills:

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

**Required Knowledge**

The individual needs to demonstrate knowledge of:

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

**EVIDENCE GUIDE**

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

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

# DEMONSTRATE OCCUPATIONAL SAFETY AND HEALTH PRACTICES

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

**UNIT DESCRIPTION**

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

**ELEMENTS AND PERFORMANCE CRITERIA**

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

**RANGE**

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

|  |  |
| --- | --- |
| **Variable** | **Range** |
| 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’s)*** 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 MECHANICAL SCIENCE PRINCIPLES

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

**UNIT DESCRIPTION**

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

**ELEMENTS AND PERFORMANCE CRITERIA**

| **ELEMENT**  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 and applied   3. Types of force are described and applied   4. Calculations involving forces are determined   5. 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 and applied   4. Couples are identified and applied in engineering systems. |
| 1. Understand friction principles | * 1. Friction and applications are defined   2. Laws of friction are identified and applied   3. Limiting friction is calculated   4. Forces applied at an angle to a horizontal plane are calculated   5. Coefficient of friction is calculated   6. Advantages and disadvantages of friction are identified. |
| 1. Understand motions in engineering | * 1. Motion concepts are discussed   2. Laws of motion are identified and applied   3. Motion calculations are performed   4. Displacement/time graphs are applied |
| 1. Describe work, energy and power | * 1. Work, energy and power are defined   2. Work is calculated   3. Energy is calculated   4. Power calculations are performed   5. Work, energy and power are applied |
| 1. Perform machine calculations | * 1. Machine is defined and types identified   2. Mechanics of Machines are calculated   3. ***Problems on simple machines*** are solved   4. Problems on levers are solved   5. Laws of machines are identified   6. Efficiency of machine is calculated   7. Machine Safety Factor is calculated |
| 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   4. Gas handling and transportation procedures are identified |
| 1. Apply heat knowledge | * 1. Heat concepts are discussed and applied   2. Working principle of heat is defined   3. Heat capacity is discussed   4. Heat problems are solved   5. Heat transfer and heat loss is discussed and applied |
| 1. Apply density knowledge | * 1. Density is defined   2. ***Density terminology*** are discussed   3. Density measurements are carried out   4. Density problems are solved and applied |
| 1. Apply pressure principles | * 1. Pressure is defined   2. Pressure concepts are discussed and applied   3. Working principles of pressure is discussed   4. Pressure problems are solved   5. ***Pressure applications*** are identified |
| 1. Understand Engineering Materials | 1. Types of engineering materials are identified 2. Properties and characteristics of engineering materials are discussed 3. Application of engineering materials are identified |

**RANGE**

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

|  |  |
| --- | --- |
| **Variable** | **Range** |
| 1. Forces theorems May include but not limited to: | * + Parallelogram   + Triangle   + Polygon   + Irregular Shapes   + Circular shapes |
| 1. Problems on simple machines May include but not limited to: | * + Mechanics of Machines   + Machine advantage   + Velocity ratio   + Efficiency |
| 1. Gas laws May include but not limited to: | * + Boyles law   + Charles law   + Gas equation |
| 1. Density terminology May include but not limited to: | * + Density   + Relative density |
| 1. Pressure applications May include but not limited to: | * + Vacuum pump   + Hydraulic pump   + Hydrometers   + Gravity |
| 1. Principles May include but not limited to: | * + Newton’s laws of motion   + Law of conservation of linear momentum   + Law of conservation of energy   + Archimedes’ principle |
| 1. Mechanical calculations May include but not limited to: | * + Mechanical advantage   + Efficiency   + Torque   + Power/Energy   + Work done   + Safety Factor |

**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 to SI Units
* Basic mechanical systems design
* Mechanical machine operation
* Logical thinking
* Problem solving
* Applying statistics
* Drawing graphs
* Metrology

**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
* Mechanical advantage and efficiency calculations
* Properties of materials
* Gas laws
* SI units of mechanical energy.
* Power transmission systems
* 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:   * + Determined forces in a system   + Demonstrated knowledge of moments   + Understood friction principles   + Understood motions in engineering   + Described work, energy and power   + Performed machine calculations   + Demonstrated gas principles   + Applied heat knowledge   + Applied density knowledge   + Applied pressure principles   + Applied Mechanics of Machines Principles   + Applied Thermodynamics Principles |
| 1. Resource Implications | The following resources should be provided:   * + Mechanical Engineering Laboratory and workshop   + Access to relevant workplace or appropriately simulated environment where assessment can take place   + Measuring tools and equipment   + 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   5. Projects |
| 1. Context of Assessment | Competency may be assessed individually in the actual workplace or  through accredited institution |
| 1. Guidance information for assessment | Holistic assessment with other units relevant to the industry sector, workplace and job role is recommended. |

# APPLY FLUID MECHANICS PRINCIPLES

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

**UNIT DESCRIPTION**

This unit describes the competencies required by a technician in order to apply a wide range of fluid mechanics principles in their work. 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 is defined and calculated   2. Types of flow are discussed   3. Flow rate in pipes is measured   4. Losses in pipes are determined   5. ***Causes of losses*** in pipes are determined   6. Flow losses equations are applied in problem solving   7. Methods of regulating flow rate are discussed and applied   8. Flow constant is determined |
| 1. Demonstrate knowledge in viscous flow | * 1. Viscosity is defined   2. Principles of viscosity are discussed and applied   3. Calculations on Viscosity are discussed and applied   4. Viscous flow between parallel surfaces are explained   5. Viscous flow equations between parallel surfaces are derived and applied   6. Viscous flow equations in circular pipes are derived and applied in problem solving   7. Coefficient of viscosity is derived and applied |
| 1. Perform dimensional analysis | * 1. Dimensional analysis is explained   2. Principle of dimensional homogeneity is explained   3. Fundamental dimensions are stated   4. Dimensional units are defined   5. ***Physical quantities*** are identified   6. Dimensional analysis are ***applied*** in problem solving |
| 1. Demonstrate understanding of 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   5. Pump parameters are discussed   6. Pump selection and pump types is discussed |

**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. Types of flow May include but not limited to: | * + Laminar   + Turbulent |
| 1. Causes of losses May include but not limited to: | * + Friction   + Enlargement/reduction in cross-sectional areas   + Elevation and Topography   + Flow distance   + Pump rating   + Leakages |
| 1. Physical quantities May include but not limited to: | * + Mass   + Weight   + Force   + Density   + Velocity   + Acceleration   + Viscosity   + Temperature |
| 1. Applied May include but not limited to: | * + Reynolds number   + Mach number   + Froude number   + Bernoulli’s Equation   + Poiseuille’s Equation   + Chezy-Dacy Equation |
| 1. Principle of operation May include but not limited to: | * + Reciprocating   + Centrifugal   + Linear |
| 1. Reciprocating pump equation is derived May include but not limited to: | * + Coefficient of discharge   + Percentage slip   + Work done   + Acceleration head   + Pressure head in the cylinder |
| 1. Centrifugal pump equation is derived May include but not limited to: | * + Effective head   + Manometric head   + Manometric efficiency   + Mechanical efficiency   + Discharge   + Torque   + Work done unit weight   + Specific speed |

**REQUIRED SKILLS AND KNOWLEDGE**

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

**Required Skills**

The individual needs to demonstrate the following skills:

* Apply basic mechanical formulas
* Use of basic mechanical machines
* Perform various unit conversions of mechanical quantities
* Basic mechanical systems design
* Mechanical machine operation
* Logical thinking
* Problem solving
* Applying statistics
* Drawing graphs
* Metrology
* Fluid Mechanics
* Plumbing Works

**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.
* 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:   * + Identified Principlesof Fluid Mechanics   + Performed mechanical calculations of a system   + Identified types of forces in fluid flow   + Calculated resultant forces on plane framework   + Identified application of forces on the production flow   + Tested mechanical properties of fluids   + Identified tools and equipment for measuring system parameters   + Recorded and interpreted measured parameters.   + Operated fluid handling and storage systems |
| 1. Resource Implications | The following resources should be provided:   * + Mechanical Engineering Laboratory and workshop   + Access to relevant workplace or appropriately simulated environment where assessment can take place   + Measuring tools and equipment   + Sample materials to be tested |
| 1. Methods of Assessment | Competency in this unit may be assessed through:   * + Direct Observation   + Demonstration with Oral Questioning   + Case studies   + Written tests   + Projects |
| 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 THERMODYNAMICS PRINCIPLES

**UNIT CODE:** ENG/OS/MAR/CC/03/5/A

**UNIT DESCRIPTION**

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

**ELEMENTS AND PERFORMANCE CRITERIA**

| **ELEMENT**  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. Thermodynamics is defined   2. Terms used in thermodynamics are described   3. Thermodynamics processes and cycles are described   4. Laws thermodynamics are applied |
| 1. Perform steady flow processes | * 1. Steady flow is defined   2. Factors leading to steady flow are discussed   3. Steady flow energy equation is derived   4. Steady flow energy equation is applied in problem solving   5. Steady flow energy equation is applied in ***utilities*** |
| 1. Perform non-steady flow processes | * 1. Non-steady Flow is defined   2. Factors leading to non-steady flow are discussed   3. Non-steady flow energy equation is derived   4. Non-steady flow energy equation is applied in problem solving |
| 1. Understand perfect gases | * 1. Perfect Gas is defined   2. ***Perfect gas laws*** are stated   3. Gas laws experiment are carried out   4. Gas laws are applied |
| 1. Generate steam | * 1. Principle of Steam Generation is discussed and applied   2. Heat Loss and heat retention in steam generation is discussed   3. Dryness fraction is determined   4. Relationship between pressure and boiling point is determined   5. Energy balance is carried out   6. 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   5. Second Law of Thermodynamics is applied in calculations |
| 1. Understand ideal 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 understanding of 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. Principle of heat transfer is discussed   2. Heat transfer equations are derived and applied from Fourier’s law   3. Heat transfer equation is derived and applied from Newton’s law of cooling and Fourier’s law |
| 1. Understand heat exchangers | * 1. Principle of Operation of Heat Exchangers is discussed   2. Heat exchangers are classified   3. Recuperative heat exchangers are described   4. Heat equations are applied to solve heat exchanger problems |
| 1. Understand air compressors | * 1. Principle of operation of Air Compressors is discussed.   2. Air compressors are classified   3. ***Types of air compressors*** are described   4. Equations of reciprocating compressors are derived and applied |
| 1. Understand gas turbines | * 1. Principle of operation of Gas Turbines is discussed   2. Theoretical cycle for gas turbines is explained   3. Open cycle gas turbine is described   4. Closed cycle gas turbine is described   5. 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 May include but not limited to: | * + Boilers   + Condensers   + Compressors   + Nozzles   + Throttling processes |
| 1. Perfect gas laws May include but not limited to: | * + Boyle’s law   + Charles law   + Gay Lussac law |
| 1. Principles May include but not limited to: | * + Newton’s laws of motion   + Law of conservation of linear momentum   + Law of conservation of energy   + Archimedes’ principle |
| 1. Types of air compressors May include but not limited to: | * + Reciprocating   + Blowers   + Sliding valves   + Screw |
| 1. Types of Turbines May include but not limited to: | * + Compounding   + 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 Thermodynamics system design
* Mechanical machine operation
* Logical thinking
* Problem solving
* Applying statistics
* Drawing graphs
* Metrology

**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:   * + Identified Principlesof mechanical science   + Performed mechanical calculations of a system   + Identified types of forces on a system   + Identified application of forces on the production flow   + Tested mechanical properties of a materials   + Identified tools and equipment for measuring system parameters   + Recorded and interpreted measured parameters.   + Operated Thermodynamics systems |
| 1. Resource Implications | The following resources should be provided:   * + Mechanical Engineering Laboratory and workshop   + Access to relevant workplace or appropriately simulated environment where assessment can take place   + Measuring tools and equipment   + Sample materials to be tested |
| 1. Methods of Assessment | Competency in this unit may be assessed through:   * + Direct Observation   + Demonstration with Oral Questioning   + Case studies   + Written tests   + Projects |
| 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 ELECTRICAL PRINCIPLES

**UNIT CODE:** ENG/OS/MAR/CC/04/5/A

**UNIT DESCRIPTION**

This unit describes the competencies required by a technician in order to apply a wide range of Electrical principles skills 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. DC and AC power principles are discussed   2. Power factor and its importance is discussed   3. Power factor correction is discussed   4. Calculations involving parallel and series circuits are performed   5. Calculations involving DC and AC Network are performed (time domain and frequency domain)   6. DC and AC circuits are designed, developed and tested. |
| 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. Use basic electrical machines | * 1. Types of various electrical machines are identified   2. Types of Circuits in different electrical machines are discussed   3. Calculations involving single phase and three phase AC and DC Motors are performed   4. Calculations involving single and three phase AC and DC transformers are performed   5. Calculations involving single and three phase generators are performed   6. Special machines are identified   7. Calculations involving special machines are performed   8. Common faults in Electrical Machines and their remedies are discussed |
| 1. Use earthing in Electrical installations | * 1. Earthing and its importance are discussed.   2. Earthing types are identified   3. Earthing points on Electrical installation are identified   4. Calculation involved in determining the earthing type is performed   5. Test on an earthing system is performed in line with the IEE regulations |
| 1. Apply electrical system protection | * 1. Types of faults in an electrical system are identified   2. Components of protection systems are identified   3. Test to be carried out in electrical protection system are established   4. Application of electrical protection system is determined |
| 1. Apply Electromagnetic field Theory | * 1. Principle of electromagnetism is discussed   2. Electromagnetic radiation sources are identified   3. Detectors of Electromagnetic radiations are determined   4. Electromagnetic waves are applied   5. Electromagnetics Laws are Identified   6. Behaviours and effects of Electromagnetic waves are established   7. Energy conservation theorem is identified   8. Electromagnetic Energy flow is determined |
| 1. Apply Electrodynamics | * 1. Electrostatics terms are identified   2. Magnetostatics terms are identified   3. Electrodynamics laws are identified 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. SI unit | * + Power – Watts (W)   + Current – Amperes (A)   + Resistance – Ohms(Ω)   + Voltage – Volts (V) |
| 1. Quantities | * + Charge   + Force   + Work   + 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:   * + Applied the correct SI units of Electrical quantities   + Stated, Calculate and relates the quantities in Ohm’s law   + Identified the components of an earthing system   + Stated and apply various laws in Electrical system   + Differentiated between AC and DC network   + Applied correct formulas in the calculation of AC and DC machines   + Used power triangle in calculating power factor   + Applied various methods in power factor correction   + Identified types of lightening arrestors and their applications |
| 1. Resource Implications | The following resources should be provided:   * + Mechanical Engineering Laboratory and workshop   + Access to relevant workplace or appropriately simulated environment where assessment can take place   + Measuring equipment   + Materials relevant to the proposed activity or tasks |
| 1. Methods of Assessment | Competency in this unit may be assessed through:   * + Direct Observation   + Demonstration with Oral Questioning   + Written tests   + Projects |
| 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 SHIP CONSTRUCTION PRINCIPLES

**UNIT CODE:** ENG/OS/MAR/CC/05/5/A

**UNIT DESCRIPTION**

This unit describes competencies required to apply ship construction principles. It involves categorising ship types, interpreting ship drawings, identifying ship construction materials, monitoring stress effects induced on ship structures, assesing conditions of ship principle structural members, loading a ship and carrying out elementary ship yard practices

**ELEMENTS AND PERFORMANCE CRITERIA**

| **ELEMENT** | **PERFORMANCE CRITERIA**  ***(Bold and italicized terms are elaborated in the Range)*** |
| --- | --- |
| 1. Categorize ship types | * 1. Purpose or function of the ship is identified   2. ***Type of ship cargo*** is determined   3. Ships are categorised based on the type of ship load and function |
| 1. Interpret ship drawings | * 1. General Arrangement Drawing is discussed   2. Sectional Drawings are discussed   3. Plumbing and pipe work drawings are discussed   4. Electrical Drawings are discussed   5. Machineries Drawings are discussed |
| 1. Identify ship construction materials | * 1. ***Types of materials*** used in ship construction are identified   2. Properties of high tensile steel are defined   3. Properties of Aluminium are discussed   4. Properties of Fibre Glass are discussed   5. Types of steel used in hull construction are identified   6. Use of forged, rolled and cast components in hull construction is explained |
| 1. Monitor stress effects induced on ships | * 1. Correct terms to describe effects of forces exerted on ships are used   2. Various forces acting on the vessel are analysed   3. Stresses on various components of the hull are compared   4. Typical weight, load, shear force curves and bending moment diagrams are sketched |
| 1. Assess conditions of ship principle structural members | * 1. ***Ship principle structural members*** are identified   2. Functions of ship principle structural members are identified   3. Conditions of ship principle structural members are assessed based on their functioning principles |
| 1. Load a ship | * 1. Ship’s Load Chart and load Capacity are identified   2. Cargo plan is reviewed   3. Loading is prepared for as per SOPs   4. Loading is supervised based on the loading plan |
| 1. Carry out elementary ship yard practices | * 1. Ship is inspected and Work Schedule prepared   2. Ship docking plan is prepared and applied   3. Recovery and launching of vessels   4. Ship hull is painted as per SOPs   5. Ship Hull is welded as per SOPs   6. Shore power is supplied to the ship   7. Ship is resupplied with water and fuel   8. Ship is cleaned as per SOPs |

**Range**

|  |  |
| --- | --- |
| **Variable** | **Range**  *May include but is not limited to:* |
| 1. Type of ship cargo May include but not limited to: | * Livestock * Containers * Petroleum products * Weaponry |
| 1. Types of materials May include but not limited to: | * Steel * Aluminium * Wood * Zinc * Brass |
| 1. Ship principle structural members May include but not limited to: | * Hull structures * Bow and stern structures * Fittings * Rudders, propellers and shafts * Superstructure |

**REQUIRED KNOWLEDGE**

* Elementary ship yard practices
* Ship loading
* Ship categorization
* Stress effects on ships
* Surface Preparation and painting
* Welding Technology

**SKILLS**

* Monitoring
* Interpreting
* Planning
* Communication
* Team Work
* Personnel Management
* Statistics
* Metrology

**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   * Categorized ship types * Interpreted ship drawings * Identified ship construction materials * Monitored stress effects induced on ships * Assessed conditions of ship principle structural members * Demonstrated knowledge on loading a ship * Carried out elementary ship yard practices |
| 1. Resource Implications | The following resources should be provided:   * Ship’s Drawings * Shipyard with ship * Dry docking Facility * Tools and Equipment |
| 1. Methods of Assessment | Competency may be assessed through:   * Written text * Interview * Observation |
| 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. |

# MONITOR AND EVALUATE SHIP STABILITY

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

**UNIT DESCRIPTION**

This unit describes competencies required to monitor and evaluate ship stability. It involves monitoring hydrostatic data variation, demonstrating knowledge on buoyancy, applying fresh water allowance principles, applying statistical data, determining angle of loll, determining movement of a ships centre of gravity and maintaining ship stresses within permissible limits

**ELEMENTS AND PERFORMANCE CRITERIA**

| **ELEMENT** | **PERFORMANCE CRITERIA**  ***(Bold and italicized terms are elaborated in the Range)*** |
| --- | --- |
| 1. Monitor hydrostatic variation | * 1. Principle of Hydrostatic Variation is discussed   2. Hydrostatic variation of the vessel is checked   3. Hydrostatic variation tests are prepared for   4. Tools, equipment and materials required are identified and obtained   5. Hydrostatic variation tests are carried out as per SOPs   6. Hydrostatic variation analysis is carried out |
| 1. Demonstrate knowledge on ship buoyancy | * 1. Principle of buoyancy is discussed   2. Factors affecting buoyancy are identified and analysed   3. Principles related to buoyancy are applied to job tasks   4. Apparent weight and relative density are calculated and applied |
| 1. Apply fresh water allowance principles | * 1. Vessel draft in sea water is measured   2. Vessel draft in fresh water is measured   3. Fresh water allowance is measured based on the difference in sea water and fresh water draft |
| 1. Determine angle of loll | * 1. Angle of loll is defined   2. Vessel equilibrium condition is checked   3. Causes of negative metacentric height are identified   4. ***Corrective measures*** are identified and applied |
| 1. Determine movement of a ship’s centre of gravity | * 1. Forces affecting ship’s center of gravity are identified and analysed   2. Effects of removing or discharging mass are identified and analysed   3. Effects of loading or adding mass are identified and analysed   4. Vertical and horizontal weight shifts are identified and analysed   5. Formulae for calculating movement of ship’s center of gravity are applied |
| 1. Maintain ship stresses within permissible limits | * 1. Stresses affecting ship stability are identified   2. Stresses affecting ship stability are analysed   3. Stresses identified are monitored and maintained within permissible limits |
| 1. Apply damage control principles | * 1. Damage control principles are identified and discussed   2. Damage control ***organisation*** is discussed   3. ***Damage control tools and equipment*** are identified and used appropriately   4. Damage control drills are performed |

**Range**

|  |  |
| --- | --- |
| **Variable** | **Range**  *May include but is not limited to:* |
| 1. Corrective measures May include but not limited to: | * Lowering center of gravity * Minimising free surfaces * Ballast tanks * Flooding and Counter flooding * Balancing of loads |
| 1. Organisation May include but not limited to: | * Shoring party * Leak stop party * Flooding and counter flooding party * Containment party * First aid party |
| 1. Damage control tools and equipment May include but not limited to: | * Splinter box * Wedges * Mallet * Axe * Cement * Horse clips * Flexible hose * Shore |

**REQUIRED KNOWLEDGE**

* Naval architecture
* Hydrostatics
* Statistics
* Ship stresses
* Engineering mathematics
* Ship buoyancy
* Materials Engineering
* Technical Drawing
* Welding Technology
* Non-Destructuve Tests
* Quality Control and Quality Assurance
* OSHE

**SKILLS**

* Mathematics
* Analytical
* Statistics
* Communication
* Planning
* Coordination

**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   * Demonstrated ability to monitor hydrostatic variation * Demonstrated knowledge on ship buoyancy * Applied fresh water allowance principles * Determined angle of loll * Demonstrated ability to determine movement of a ship’s center of gravity * Demonstrated ability to maintain ship stresses within permissible limits |
| 1. Resource Implications | The following resources should be provided:   * Shipyard involved in ship Construction * Active Port * Ship Design Office * Relevant Manuals * Tools and Equipment |
| 1. Methods of Assessment | Competency may be assessed through:   * Written text * Interview * Observation |
| 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. |

# APPLY ENGINEERING MATHEMATICS

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

**UNIT DESCRIPTION:**

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

**ELEMENTS AND PERFORMANCE CRITERIA**

| **ELEMENT**  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   7.2 First order and second order differential equations are solved from given boundary conditions |
| * 1. Carry out Mensuration | * 1. Perimeter and areas of figures are obtained   2. Volume and of Surface area of solids are obtained   3. Area of irregular figures are obtained   4. Areas and volumes are obtained using Pappus theorem |
| * 1. Apply Power Series | * 1. Power series are obtained using Taylor’s Theorem   2. Power series are obtained using McLaurin’s ‘s theorem |
| * 1. Apply Statistics | * 1. Mean, median, mode and Standard deviation are obtained from given data   2. Calculations are performed based on Laws of probability   3. Calculation involving ***probability distributions***, mathematical expectation sampling distributions are performed   4. Sampling distribution methods are applied in data analysis   5. Calculations involving use of standard normal table, sampling distribution, T-distribution and Estimation are done   6. Confidence intervals are determined |
| * 1. Apply Vector theory | * 1. Vectors and scalar quantities are obtained in two and three dimensions   2. ***Operations*** on vectors are performed   3. Position of vectors is obtained   4. Resolution of vectors is done |
| * 1. Apply Matrix | * 1. Determinant and inverse of 2x2 matrix are obtained   2. Solutions of simultaneous equations are obtained   3. Calculation involving Eigen values and Eigen vectors are performed |

**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. Operations | * + Addition   + Subtraction |
| 1. Hyperbolic functions | * + Sinh x   + Cosh x   + Cosec x   + Coth x   + Tanh x   + Sech x |
| 1. Probability Distributions | * + Binomial   + Poisson   + Normal |
| 1. Numerical Methods | * + Newton Raphson   + Gregory Newton |

**REQUIRED SKILLS AND KNOWLEDGE**

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

**Required Skills**

The individual needs to demonstrate the following skills:

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

**Required knowledge**

The individual needs to demonstrate knowledge of:

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

**EVIDENCE GUIDE**

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

|  |  |
| --- | --- |
| 1. Critical aspects of Competency | Assessment requires evidence that the candidate:   * + Applied Trigonometry and hyperbolic functions   + Applied complex numbers   + Applied Calculus   + Solved Ordinary differential equations   + Carried out mensuration   + Applied Power Series   + Applied Vector theory   + Applied Matrix   + Applied Numerical methods |
| 1. Resource Implications | The following resources should be provided:   * + Access to relevant workplace or appropriately simulated environment where assessment can take place   + Measuring equipment   + 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. |

# DEMONSTRATE BASIC SAFETY AT SEA

**UNIT CODE:** ENG/OS/MAR/CC/08/5/A

**UNIT DESCRIPTION**

This unit covers the competencies required to effectively demonstrate basic safety at sea. It entails identifying and being able to utilize lifesaving appliances, emergency equipment and maintenance of ship’s safety and security.

**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. Apply first aid techniques | * 1. ABCs of first aid are described   2. CPR process is described and demonstrated   3. Basic first aid procedures are described and demonstrated |
| 1. Demonstrate ability to swim | * 1. Swimming strokes are demonstrated   2. Ability to tread water is demonstrated |
| 1. Understand the maritime legislations | * 1. Role and signatories of ***maritime conventions*** are identified   2. Provisions of maritime legislations are identified |
| 1. Identify lifesaving equipment | * 1. ***Lifesaving equipment*** are described and identified   2. Contents of life saving crafts are described and identified |
| 1. Identify emergency signaling devices | * 1. ***Emergency signalling devices***are described   2. Emergency signalling devices are identified |
| 1. Use lifesaving and emergency signaling equipment | * 1. Lifesaving equipment are worn properly   2. Ability to swim 25 metres in lifesaving equipment is demonstrated   3. Proper use of emergency signalling equipment is demonstrated |
| 1. Apply proper storage and maintenance of life saving equipment | * 1. Level 1 checks on life saving equipment are demonstrated.   2. Maintenance on life saving equipment is identified |

**RANGE**

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

|  |  |
| --- | --- |
| **Variable** | **Range** |
| 1. ABCs May include but not limited to: | * Airway * Breathing * Circulation |
| 1. Lifesaving equipment may include but is not limited to | * Lifebuoy * Lifejacket * Immersion suit * Anti-exposure suit * Thermal protective aids |
| 1. Emergency signaling equipment may include but not limited to: | * Emergency Position Indicating Radio Beacon (EPIRB) * Search and Rescue Transponders (SART) * Rocket parachute flares * Hand flares * Buoyant smoke signal * Signalling mirror |
| 1. Maritime conventions | * SOLAS * MARPOL * STCW * LOAD LINE * TONNAGE * MLC |

**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:

* Observation
* Communication
* Swimming
* Time management
* Decision making
* Planning
* Multitasking
* First aid
* Team Work
* OSHE

**Required Knowledge**

The individual needs to demonstrate knowledge of:

* SOLAS manual
* ISPS Code
* Types of alarm
* Lifesaving equipment
* Emergency signalling equipment

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 basic first aid techniques in response to an emergency   2. Applied breast, back, side stroke and free style swimming techniques for 25m each   3. Treaded water for a minimum of 5 minutes unassisted   4. Identified the need for the SOLAS convention   5. Identified and applied the ISPS levels   6. Identified muster point   7. Identified general alarm and fire alarm   8. Identified and correctly wore lifesaving equipment   9. Demonstrated how to use emergency signalling equipment   10. Demonstrated proper stowage of lifesaving equipment |
| 1. Resource Implications | * 1. Swimming pool   2. Swimming instructor   3. SOLAS, ISPS, LSA Manuals   4. Lifesaving equipment   5. Emergency signalling equipment |
| 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. |

# PREPARE AND INTERPRET ENGINEERING DRAWINGS

**UNIT CODE:** ENG/OS/MAR/CC/09/5/A

**UNIT DESCRIPTION**

This unit describes competencies required to prepare and interpret engineering drawings. It involves preparing cam followers and profile drawings, sketching and labelling screw threads, identifying machine bearings, drawing gear profiles, interpreting limits and fits, interpreting plant layout design, electrical plans and diagrams, applying computer aided design packages and producing 3D drawings and animation

**ELEMENTS AND PERFORMANCE CRITERIA**

| **ELEMENT** | **PERFORMANCE CRITERIA**  ***(Bold and italicized terms are elaborated in the Range)*** |
| --- | --- |
| 1. Prepare cam followers and profile drawings | * 1. Basic curves are prepared   2. Modified Cam Curves are prepared   3. Polynomial and Fourier Series Curves are prepared   4. Cam Motion synthesis using spline Functions is interpreted   5. Elements of Cam Profile Geometry are identified   6. Geometry of planer cam followers is interpreted   7. Cam Mechanism Forces are identified   8. Cam Materials and lubrication is interpreted   9. Cam Manufacturing is interpreted   10. Cam system Modelling is interpreted   11. Cam System Dynamics is analysed   12. Special Cam Mechanisms are identified   13. CAD for Cams is understood   14. Free hand Sketching of cams   15. Technical Drawing of Cams is interpreted |
| 1. Sketch and label screw threads | * 1. Various types of screw threads are identified.   2. Parts of screws are identified.   3. Equipment used to measure screw thread are identified.   4. Dimensions of the screw are identified   5. Free hand sketch of the screw is drawn.   6. The Sketch dimensions are labelled. |
| 1. Identify machine bearings | * 1. Various types of bearings are identified   2. Bearing codes are interpreted   3. Various operation conditions of different bearing types are identified. |
| 1. Draw gear profiles | * 1. Various types of gears are identified   2. Gear nomenclature is identified   3. Dimensions of the gear are identified   4. Free hand sketch of the gear is made.   5. Projection and scale to be used are identified   6. Gear sketch is drawn either using CAD or on a drawing paper |
| 1. Interpret limits and fits | * 1. Importance of limit and fits in design is identified   2. Machine components that apply limits and fits are identified   3. Terminologies used in Limits and fits are defined   4. Calculations involving limits and fits are identified and solved.   5. Limits and fits table from Manufacturer is interpreted |
| 1. Interpret marine plant layout design | * 1. Different types of plants are identified   2. Purpose of each plant is identified   3. Symbols for different machines are identified   4. Schematic diagram for plant layout is interpreted. |
| 1. Prepare and interpret electrical drawing | * 1. Various electrical plants, components and modules are identified   2. Electrical symbols representing plants, components and modules are identified   3. ***Electrical drawings*** are prepared |
| 1. Apply computer aided design packages | * 1. Type of design to be done is identified   2. Free hand sketch of what is to be designed is prepared   3. Scale to be used is identified   4. Type of Projection to be used is identified   5. CAD Package to be used is identified   6. CAD Package identified is used appropriately for design. |

**Range**

|  |  |
| --- | --- |
| **Variable** | **Range**  *May include but is not limited to:* |
| 1. Electrical drawings May include but not limited to: | * Electrical plans * Electrical diagrams   + One-line diagram   + Panel wiring diagram   + Instrument wiring diagram   + Interconnection diagram   + Ladder diagram |

**REQUIRED KNOWLEDGE**

* Free hand sketching
* Technical Drawing and Design
* Computer Aided Design
* Interpretation of Engineering Drawings

**SKILLS**

* Planning
* Surveying
* Coordinating
* Communication
* Analytical
* Digital
* Critical thinking
* Problem solving
* Decision making
* Reporting
* Teamwork and Personnel Management

**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. Prepared cam followers and profile drawings 2. Sketched and labelled screw threads 3. Identified machine bearings 4. Drew gear profiles 5. Interpreted limits and fits and plant layout designs 6. Applied computer aided design packages 7. Produced 3D drawings and animations |
| 1. Resource Implications | The following resources should be provided:   1. Drawing papers 2. Drawing tables 3. Drawing studio 4. Drawing tools and Equipment 5. AutoCAD Software 6. Computers 7. Solid Works Software 8. Animation software 9. Stationery 10. Trained personnel 11. Machinery and components |
| 1. Methods of Assessment | Competency may be assessed through:   1. Written text 2. Interview 3. Assignment and completion of tasks 4. Observation |
| 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. |

# CORE COMPETENCIES

# INSTALL AND MAINTAIN MARINE PUMPS

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

**UNIT DESCRIPTION**

This unit describes competencies required to install and maintain marine pumps. It involves identifying constructional features and operating principles of pumps and pump types, installing marine pumps, diagnosing marine pump faults, maintaining marine pumps, preparing spare parts list and special maintenance tools, preparing work schedules and preparing work reports

**ELEMENTS AND PERFORMANCE CRITERIA**

| **ELEMENT** | **PERFORMANCE CRITERIA**  ***(Bold and italicized terms are elaborated in the Range)*** |
| --- | --- |
| 1. Identify constructional features and operating principles of pumps and pump types | * 1. Different ***types of pumps*** are reviewed from manufacturer’s manuals as per SOPs   2. Operating principles and theories of different types of pumps are identified and applied in line with manufacturer’s specifications   3. Functions of major components of pumps are identified from manufacturer’s manuals   4. Pump specifications are interpreted as per SOPs   5. Functions of drive components are identified form manufacturer’s manuals   6. Functions of each pump in a ship’s system are identified. |
| 1. Install marine pumps | * 1. Location and head for installation is determined according to engineering drawings   2. Base for pump is cleaned   3. Pump Mounting is prepared according to engineering drawings   4. Pump components are installed in line with standard procedures   5. Pump is positioned, levelled, aligned and secured in line with standard procedures   6. The installed pump is tested according to Manufacturer’s manual. |
| 1. Diagnose marine pump faults | * 1. Inspection of components is performed in accordance with manufacturer’s specifications and workplace procedures and the pump’s behaviour recorded.   2. Information on the description and symptoms of the problem is obtained and analysed in line with workplace procedures   3. Inspection report is linked with Manufacturer’s Maintenance and Repair Manual to ease troubleshooting.   4. Condition based monitoring routine procedures are performed as per SOPs   5. Conditions that lead to failure or breakdown of pumps are identified in line with workplace procedures   6. Diagnosis and Condition monitoring Report is made as per Manufacturer’s manual. |
| 1. Maintain marine pumps | * 1. Maintenance requirements and plans are verified according to manufacturer’s specifications   2. Defective pump Components are identified and demanded from Stores according to organization’s SOPs   3. Defective pump components are replaced/serviced according to manufacturer’s specifications   4. Fluid levels are checked and maintained in accordance with specifications   5. Suction and delivery pipe lines are inspected as per SOPs   6. Temperatures, vacuum, pressure, vibrations, leakages and flow rates are checked and maintained in accordance with specifications   7. Maintenance reports are prepared and maintained as per workplace policy and SOPs |
| 1. Prepare spare parts list and special maintenance tools | * 1. Spare parts are identified and noted based on faulty pump parts to be replaced   2. Special maintenance tools are identified based on manufacturer’s manuals   3. Spare parts list and special maintenance tools are prepared in line with workplace policy   4. Spare parts acquisition procedures are carried out |
| 1. Prepare work schedule and methodology | * 1. Maintenance activities are identified based on the scope of maintenance   2. Maintenance/work schedule is prepared based on maintenance activities identified   3. Work methodology is prepared as per SOPs |

**Range**

|  |  |
| --- | --- |
| **Variable** | **Range** |
| 1. Types of pumps May include but not limited to: | * Reciprocating piston pump * Gear pumps * Screw pump * Centrifugal pump * Diaphragm pump |

**REQUIRED KNOWLEDGE**

* Cooling and lubrication systems
* Pump drive components
* Condition-based monitoring technologies
* Condition-based monitoring tools
* Prime movers
* Fault diagnosis
* Pumping and tubing sizing and schematics

**SKILLS**

* Communication
* Problem solving
* Planning
* Organisation
* Technological
* Surveying
* Coordinating
* Analytical
* Critical thinking
* Decision making
* Reporting
* Teamwork and Personnel Management

**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 constructional features and operating principles of pumps and type of pumps 2. Installed marine pumps 3. Demonstrated ability to diagnose marine pump faults 4. Demonstrated ability to maintain marine pumps 5. Prepared spare parts list and special maintenance tools 6. Prepared work schedule |
| 1. Resource Implications | The following resources should be provided:   1. Pump Survey and Maintenance manuals 2. Pump Inspection and Maintenance Tools 3. Detailed pump engineering drawings and parts list 4. Trained personnel 5. Stationery 6. Pumps 7. Sectioned pumps |
| 1. Methods of Assessment | Competency may be assessed through:   1. Written text 2. Interview 3. Assignment and Completion of tasks 4. Observation |
| 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. |

# INSTALL AND MAINTAIN AIR COMPRESSORS

**UNIT CODE:** ENG/OS/MAR/CR/02/5/A

**UNIT DESCRIPTION**

This unit describes competencies required to install and maintain air compressors. It involves identifying operating principles of air compressors, identifying common failures of air compressors and remedies, identifying air compressor maintenance procedures, preparing spare parts list and special maintenance tools, installing air compressors, preparing work schedule and preparing work reports

**ELEMENTS AND PERFORMANCE CRITERIA**

| **ELEMENT** | **PERFORMANCE CRITERIA**  ***(Bold and italicized terms are elaborated in the Range)*** |
| --- | --- |
| 1. Identify operating principles of air compressors | * 1. Different ***types of compressors*** are reviewed   2. Operating principles and theories of different types of compressors are identified and applied in line with manufacturer’s specifications   3. Operation Instructions are identified as per Manufacturer’s operation Manual   4. Functions of major components of compressors are identified from manufacturer’s manuals   5. Condition-Monitoring parameters and limits are identified   6. Compressor specifications are interpreted as per SOPs |
| 1. Identify air compressor maintenance procedures | * 1. Common faults of air compressors and their remedies are reviewed from manufacturer’s (O & M) Operation and Maintenance manuals as per SOPs   2. Maintenance procedures for common faults are reviewed from manufacturer’s manuals as per SOPs   3. Maintenance procedures are carried out in line with manufacturer’s specifications.   4. Maintenance and Condition-Monitoring Reports are prepared. |
| 1. Prepare spare parts list and special maintenance tools | * 1. Spare parts are identified and noted based on faulty air compressor parts to be replaced   2. Special maintenance tools are identified based on manufacturer’s manuals.   3. ***Spare parts and consumables*** are classified as either running spares or breakdown spares.   4. Spares and tools are demanded as per organization’s SOPs.   5. Spare parts list and special maintenance tools are prepared in line with workplace policy |
| 1. Install and operate air compressors | * 1. Location and elevation for installation are determined according to engineering drawings   2. Tools, equipment and materials are selected in line with job requirements   3. Required pressure and plant demand are confirmed according to engineered drawings   4. Compressor mounting is prepared according to engineering drawings   5. Compressor is installed in position.   6. Delivery and suction pipes are connected in line with manufacturer’s specifications   7. ***Compressor accessories*** are installed in line with manufacturer’s specifications   8. Installed compressors are test-run and monitored for acceptance as per SOPs |
| 1. Prepare work schedule and methodology | * 1. Maintenance activities are identified based on the scope of maintenance   2. Work Methodology is stated as per SOPs   3. Maintenance/work schedule is prepared based on maintenance activities identified |
| 1. Prepare work reports | * 1. Maintenance is carried out as per manufacturer’s specifications   2. Maintenance reports are prepared and maintained in line with workplace policy |

**Range**

|  |  |
| --- | --- |
| **Variable** | **Range** |
| 1. Types of compressors May include but not limited to: | * Centrifugal * Reciprocating * Rotary screw * Rotary vane |
| 1. Spare parts and consumables May include but not limited to: | * Running spares and consumables   + Air filters   + Air dryers   + Compressor oil * Breakdown spares and consumables   + O-Rings and seals   + Pressure gauges   + Valves   + Moving/rotating parts   + Sensors and solenoids |
| 1. Compressor accessories May include but not limited to: | * Silencers * Filters * Air dryers * Lubricators * Scrubbers * Air Receivers * Valves * Limit switches * Electronic Control and Monitoring Units * Pulleys * Drive Belts * Prime mover |

**REQUIRED KNOWLEDGE**

* Compressor components
* Compressor accessories
* Compressor faults
* Compressor specifications
* Drive components (coupling and belts)
* Working Principles of Different types of Compressors
* Operation and Maintenance procedures for different types of compressors
* Installation of Compressors
* Condition-Monitoring

**SKILLS**

* Communication
* Problem solving
* Planning
* Organising
* Technological
* Surveying
* Coordinating
* Analytical
* Digital
* Critical thinking
* Decision making
* Reporting
* Teamwork and Personnel Management

**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 operating principles of air compressors 2. Identified air compressor maintenance procedures 3. Prepared spare parts list and special maintenance tools 4. Installed air compressors 5. Prepared work schedule 6. Prepared work reports 7. Prepared Work Methodology |
| 1. Resource Implications | The following resources should be provided:   1. Compressors Operation and Maintenance Manuals 2. Previous maintenance Records (for used Compressors) 3. Maintenance Tools and Equipment 4. Spare parts. 5. Stationery 6. Trained personnel 7. Compressors |
| 1. Methods of Assessment | Competency may be assessed through:   1. Written text 2. Interview 3. Assignment and Completion of tasks 4. Observation |
| 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. |

# PERFORM MARINE ENGINE WORKS

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

**UNIT DESCRIPTION**

This unit describes competencies required to perform marine engine works. It involves identifying operating principles of engines, identifying common failures of engines and remedies, carrying out engine maintenance and repair, performing engine overhaul, preparing work schedule/maintenance plan and preparing work reports.

**ELEMENTS AND PERFORMANCE CRITERIA**

| **ELEMENT** | **PERFORMANCE CRITERIA**  ***(Bold and italicized terms are elaborated in the Range)*** |
| --- | --- |
| 1. Identify operating principles, common faults and remedies of engines | * 1. Different ***types of engines*** are reviewed from manufacturer’s manuals as per SOPs   2. Operating principles and theories of different types of engines are identified and applied in line with manufacturer’s specifications   3. Functions of major ***components of engines*** are identified from manufacturer’s manuals   4. Engine specifications are interpreted as per SOPs   5. Common engine failures and their remedies are reviewed and analysed based on manufacturer’s specifications   6. Condition-monitoring parameters and their limits are identified. |
| 1. Carry out engine maintenance and repair | * 1. Engine mechanical and operational conditions are assessed as per SOPs   2. Diagnostic tests are carried out in line with SOPs   3. Lubrication, fuel and cooling systems are serviced according to manufacturer’s specifications   4. Fluids and lubricants are replenished according to manufacturer’s specifications   5. Tools and equipment required for Engine overhaul are identified and prepared.   6. Maintenance Methodology and Schedule are prepared.   7. Spare parts list is prepared and spares demanded as per service or maintenance requirement.   8. Engine parts are replaced or serviced according to manufacturer’s specifications   9. Engine maintenance and repair reports are prepared as per workplace policy   10. Engine is test-run as per SOPs |
| 1. Perform engine overhaul | * 1. ***Overhaul type*** is identified as per running hours.   2. Overhaul kit is prepared according to the type of overhaul.   3. Tools and equipment required for engine overhaul are prepared   4. Engine camshaft is replaced or serviced according to manufacturer’s specification and inspection report.   5. Engine mountings are replaced according to manufacturer’s specification   6. Engine oil seals are replaced according to manufacturer’s specification   7. Engine oil rings/ piston gudgeon pin are replaced according to manufacturer’s specification   8. Timing belts/chains are replaced according to manufacturer’s specification   9. Engine bearings are replaced according to manufacturer’s specification   10. ***Engine pulleys*** are replaced according to manufacturer’s specification   11. Engine gaskets are replaced according to manufacturer’s specification   12. Engine blocks are serviced according to manufacturer’s specification   13. Water/oil pump is replaced according to manufacturer’s specification   14. Valve seats are serviced according to manufacturer’s specification   15. Valve guides are replaced according to manufacturer’s specification and inspection report.   16. Oil sump/strainer/PCV is replaced according to manufacturer’s specification   17. Engine tune up is performed according to manufacturer’s specification   18. Tappet clearance is adjusted according to manufacturer’s specification   19. Engine tests are carried out according to Manufacturer’s specifications. |
| 1. Prepare work schedule/maintenance plan and methodology | * 1. Maintenance activities are identified based on the scope of maintenance   2. Maintenance methodology is prepared   3. Maintenance/work schedule is prepared based on maintenance activities identified |
| 1. Prepare work reports | * 1. Maintenance is carried out as per manufacturer’s specifications   2. Maintenance reports are prepared and maintained in line with workplace policy |

**Range**

|  |  |
| --- | --- |
| **Variable** | **Range** |
| 1. Overhaul type May include but not limited to: | * Top overhaul * Major overhaul |
| 1. Types of engines May include but not limited to: | * Diesel * Gas turbines * Gas (LPG) * Electrical (hybrid) * Petrol Engines * Diesel on Electrical (DOE) * Diesel on Gas Turbine (DOGT) * Diesel on Diesel |
| 1. Components of engines May include but not limited to: | * Piston and piston rings * Crankshaft * Drive pulleys * Timing gears * Cylinder head * Cylinder block * Governor * Inbuilt pumps * Turbo Chargers * Catalytic Reactors * Intake and Exhaust Manifolds * Fuel filters * Lubrication oil filters * Air cleaners * Oil coolers * Heat exchangers * Fuel Injectors * Sensors and solenoids * Breathers * Electronic Control Unit * Intercooler * Valves * Push rods * Connecting rods * Cylinder lining * Cylinder gaskets * Bearings |
| 1. Engine pulleys May include but not limited to: | * V belt * Chain and sprocket |

**REQUIRED KNOWLEDGE**

* Types of engines
* Engine components
* Engine service and repair procedures
* Engine operation
* Engine drawing interpretation
* Occupational Safety and Health
* Computer knowledge
* Basic Mechatronics
* Basic Ship Automation
* Basic Chemical Polymer Engineering
* Procurement Procedures

**SKILLS**

* Communications
* ICT
* Time management
* Problem solving
* Decision making
* Planning
* Multitasking
* First aid
* Report writing
* Team work
* Personnel Management
* Innovative

**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 operating principles, common faults and remedies of engines 2. Demonstrated ability to carry out engine maintenance and repair 3. Demonstrated ability to perform engine overhaul 4. Prepared work schedule/maintenance plan and Work Methodology. 5. Prepared work reports |
| 1. Resource Implications | The following resources should be provided:   1. Engine Operation and Maintenance Manuals 2. Tools and Equipment 3. Required Spares and kits 4. Trained personnel 5. Stationery 6. Workshop 7. Lifting equipment 8. Marine engine 9. PPE |
| 1. Methods of Assessment | Competency may be assessed through:   1. Written text 2. Interview 3. Assignment and Completion of Tasks 4. Observation |
| 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. |

# OPERATE MARINE ELECTRICAL AND ELECTRONIC SYSTEMS

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

**UNIT DESCRIPTION**

This unit describes competencies required to operate marine electrical and electronic systems. It involves monitoring AC generator operating conditions, monitor DC power, installing and testing transformers, operating shipboard power, installing and testing 3 phase motors, installing and operating DC motors, operating and maintaining electrical protection systems, monitoring high voltage installation performance, carrying out electrical components and equipment repair, preparing spare parts list and special maintenance tools, preparing work schedule/maintenance plan and preparing work reports

**ELEMENTS AND PERFORMANCE CRITERIA**

| **ELEMENT** | **PERFORMANCE CRITERIA**  ***(Bold and italicized terms are elaborated in the Range)*** |
| --- | --- |
| 1. Monitor AC generator operating conditions | * 1. Generator starting systems are checked and rectified according to SOPs   2. Generator mounting is checked as per SOPs   3. Condition-monitoring parameters and their limits are identified.   4. Lubrication systems are checked in line with manufacturer’s specifications   5. Cooling systems are checked in line with manufacturer’s specifications   6. Fuel systems are checked in line with manufacturer’s specifications   7. Exhaust systems are inspected in line with manufacturer’s specifications   8. Condition-Monitoring Reports are prepared. |
| 1. Monitor DC power operating conditions | * 1. ***DC power source*** to be monitored is identified   2. DC power ***running parameters*** to be monitored are identified   3. DC power is monitored for normal operation conditions in line with workplace policy   4. Faults in operating conditions are detected as per SOPs   5. Corrective actions are taken in accordance with workplace policy   6. Condition-monitoring reports are prepared |
| 1. Operate and test transformers | * 1. ***Transformer function*** is identified   2. Transformer is inspected before installation as per SOPs   3. Tools, hardware and equipment for use in installation and testing are identified as per job requirements   4. Transformer connections are identified and connected in line with manufacturer specifications   5. Transformer sound levels are dampened as per SOPs   6. Transformer is grounded as per SOPs   7. Transformer is inspected and tested in line with manufacturer’s specifications   8. Transformer is energized and loaded as per workplace requirements and manufacturer’s specifications |
| 1. Operate shipboard power distribution systems | * 1. Shipboard Power conditioning and distribution system is identified and characterised by source and capacity   2. Power source synchronization system and safety systems are identified.   3. Ship power requirements are identified based on the ***load characteristic*** of ship equipment   4. Shipboard power distribution circuits up to final sub-circuit layout is interpreted as per SOPs   5. Shipboard power distribution systems are operated based on ship power requirement |
| 1. Operate A.C. motors | * 1. A.C. Motor power and control wiring drawings are interpreted as per SOPs   2. Installation location is identified and prepared as per SOPs   3. Tools and equipment required are prepared.   4. A.C. Motor is tested as per manufacturer’s specifications and test reports prepared |
| 1. Operate DC motors | * 1. DC motor power and control wiring drawings are interpreted as per SOPs   2. Tools and equipment required are prepared.   3. DC motor is operated in line with manufacturer’s instructions |
| 1. Operate and maintain electrical protection system | * 1. Type of ***electrical protection system*** is identified as per SOPs   2. Manufacturer manuals are obtained and reviewed based on the type of electrical protection system   3. Working principles of electrical protection systems are identified as per manufacturer’s manuals   4. ***Condition-Monitoring*** parameters and their limits are identified   5. Maintenance records are reviewed   6. Electrical protection systems are operated in line with manufacturer’s manuals   7. Tools and equipment required are prepared.   8. Electrical protection systems are maintained in line with manufacturer’s instructions and workplace policy   9. Condition-monitoring and Maintenance Reports are prepared |
| 1. Monitor medium voltage installation performance | * 1. Medium voltage installation to be monitored is identified   2. Condition-Monitoring parameters and their limits are identified   3. Medium voltage installation is monitored for normal operation in line with installation manuals   4. Faults in performance are detected as per SOPs   5. Condition-monitoring reports are prepared |
| 1. Carry out electrical components and equipment repair | * 1. Electrical components and equipment to be monitored are identified.   2. Electrical components and equipment are inspected as per SOPs   3. Maintenance and repair schedule is prepared as per job requirements   4. List of materials, tools and equipment required is prepared based on repair needs   5. Electrical components and equipment are repaired as per SOPs and manufacturer’s instructions   6. Electrical components and equipment are tested as per SOPs   7. Maintenance Reports are prepared. |
| 1. Prepare spare parts list and special maintenance tools | * 1. Spare parts are identified and noted based on manufacturer’s manuals   2. Special maintenance tools are identified based on manufacturer’s manuals   3. Spare parts list and special maintenance tools are prepared in line with workplace policy |
| 1. Prepare work schedule/maintenance plan and work methodology | * 1. Maintenance activities are identified based on the scope of maintenance   2. Work Methodology is prepared   3. Maintenance/work schedule is prepared based on maintenance activities identified |
| 1. Prepare work reports | * 1. Maintenance is carried out as per manufacturer’s specifications   2. Maintenance reports are prepared and maintained in line with workplace policy   3. Condition-Monitoring Reports are prepared. |

**Range**

|  |  |
| --- | --- |
| **Variable** | **Range** |
| 1. DC power source may include but not limited to: | * Rechargeable batteries * Inverter |
| 1. Running parameters May include but not limited to: | * Current * Voltage * Resistance * Power |
| 1. Transformer function May include but not limited to: | * Step up * Step down |
| 1. Load characteristic May include but not limited to: | * Voltage * Frequency * KVA Rating * Power factor |
| 1. Electrical protection system May include but not limited to: | * Short circuit protection * Overload protection * Under and over frequency * Phase sequence failure protection |
| 1. Condition-Monitoring parameters May include but not limited to: | * Insulation * Earth impedance * Trip mechanism |

**REQUIRED KNOWLEDGE**

* AC machines
* DC machines
* Medium voltage installations
* Electrical protection systems
* Single phase and 3 phase systems
* Shipboard power distribution systems

**SKILLS**

* Communications
* ICT
* Time management
* Problem solving
* Decision making
* Planning
* Multitasking
* First aid
* Report writing
* Team work
* Personnel Management
* Innovative
* Electronics

**EVIDENCE GUIDE**

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

|  |  |
| --- | --- |
| 1. Critical Aspects of Competency | Assessment requires evidence that the candidate   1. Demonstrated ability to monitor AC generator operating conditions 2. Demonstrated ability to monitor DC power operating conditions 3. Demonstrated ability to install and test transformers 4. Demonstrated ability to operate shipboard power distribution systems 5. Demonstrated ability to install and test 3 phase motors 6. Demonstrated ability to install and operate DC motors 7. Demonstrated ability to operate and maintain electrical protection system 8. Demonstrated ability to monitor high voltage installation performance 9. Carried out electrical components and equipment repair 10. Prepared spare parts list and special maintenance tools 11. Prepared work schedule/maintenance plan 12. Prepared work reports |
| 1. Resource Implications | The following resources should be provided:   * Electrical Systems Schematic Drawings * Manufacturer’s Manuals * Electrical tools, measuring devices and equipment * Stationery * Trained personnel * AC and DC machines * Sectioned electrical motors |
| 1. Methods of Assessment | Competency may be assessed through:   1. Written text 2. Assignment and Completion of tasks 3. Interview 4. Observation |
| 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. |

# OPERATE AND MAINTAIN SHIP CONTROL AND AUTOMATION SYSTEMS

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

**UNIT DESCRIPTION**

This unit describes competencies required to operate and maintain ship control and automation systems. It involves monitoring and operating measuring instruments, maintaining and repairing automatic control system components, operating ship open loop control system, operating and maintaining ship sequential control systems, monitoring proportional-integral-derivative control systems performance, operating, maintaining and repairing manipulator elements, operating, maintaining and repairing signal transmitting components, installing and operating a monitoring system, preparing work schedule/maintenance plan, preparing work reports and installing, operating and updating monitoring system

**ELEMENTS AND PERFORMANCE CRITERIA**

| **ELEMENT** | **PERFORMANCE CRITERIA**  ***(Bold and italicized terms are elaborated in the Range)*** |
| --- | --- |
| 1. Monitor, measure, transduce and transmit measures parameters | * 1. Parameters to be measured and their limits are identified.   2. Type of ***measuring instrument*** is identified as per SOPs   3. Control signals and respective methods of transducing and transmission are identified   4. Manufacturer manuals are obtained and reviewed based on the type of measuring instrument   5. Working principles of measuring instruments are identified as per manufacturer’s manuals   6. Measuring instruments are operated in line with manufacturer’s manuals   7. Measuring instruments are maintained in line with manufacturer’s instructions and workplace policy |
| 1. Maintain and repair automatic control system components | * 1. Working principles of ***automatic control systems*** are identified as per manufacturer’s manuals   2. Automatic control system components are identified in line with manufacturer’s manuals   3. Faults in automatic control system components are identified as per SOPs   4. Automatic control system components are maintained in line with manufacturer’s instructions and workplace policy   5. Automatic control system components are repaired in line with manufacturer’s instructions and workplace policy.   6. Maintenance reports are prepared. |
| 1. Operate, maintain and repair correcting units | * 1. Type of correcting unit is identified as per SOPs   2. Manufacturer manuals are obtained and reviewed based on the type of correcting unit   3. Working principles of correcting unit are identified as per manufacturer’s manuals   4. Correcting units are operated in line with manufacturer’s manuals   5. Correcting units are maintained in line with manufacturer’s instructions and workplace policy   6. Correcting units are repaired in line with manufacturer’s instructions and workplace policy   7. Condition-monitoring and maintenance reports are prepared. |
| 1. Prepare work schedule/maintenance plan and methodology | * 1. Maintenance activities are identified based on the scope of maintenance   2. Maintenance/work schedule is prepared based on maintenance activities identified |
| 1. Prepare work reports | * 1. Maintenance is carried out as per manufacturer’s specifications   2. Condition-monitoring reports are prepared.   3. Maintenance reports are prepared and maintained in line with workplace policy |

**Range**

|  |  |
| --- | --- |
| **Variable** | **Range** |
| 1. Measuring instrument May include but not limited to: | * Sensors * Limit switch * Meters |
| 1. Automatic control system May include but not limited to: | * Process variable * Desired value * Control difference * Control output * Manipulating variable * Manipulation range * Sensors * Actuators * Analogue to digital converters * Digital to analogue converters * Input * Output * Open loop control system * Closed loop control system * Controller * Controller logic |

**REQUIRED KNOWLEDGE**

* Measuring instruments
* Automatic control systems
* Ship open loop control system
* Ship sequential control systems
* Proportional-Integral-Derivative (PID) control systems
* Manipulator elements
* Signal transmitting components
* Monitoring systems
* Automation and Control softwares

**SKILLS**

* Communications
* ICT
* Time management
* Problem solving
* Decision making
* Planning
* Multitasking
* First aid
* Report writing
* Surveying
* Software operation
* Coordinating
* Analytical
* Digital
* Critical thinking
* Reporting
* Teamwork and Personnel Management

**EVIDENCE GUIDE**

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

|  |  |
| --- | --- |
| 1. Critical Aspects of Competency | Assessment requires evidence that the candidate   1. Demonstrated ability to monitor and operate measuring instruments 2. Demonstrated ability to maintain and repair automatic control system components 3. Operated open loop control system 4. Demonstrated ability to operate and maintain ship sequential control systems 5. Demonstrated ability to monitor PID control system performance 6. Demonstrated ability to operate, maintain and repair manipulator elements 7. Demonstrated ability to operate, maintain and repair signal transmitting components 8. Demonstrated ability to install, update and operate a monitoring system 9. Prepared work schedule/maintenance plan 10. Prepared work reports |
| 1. Resource Implications | The following resources should be provided:   1. Manufacturer operation and maintenance manuals 2. Manufacturer electrical and electronic drawings 3. Parts list 4. Tools and equipment. 5. Stationery 6. Trained personnel 7. Sensors 8. Actuators 9. Programmable Logic Controller (PLC) 10. PLC simulator |
| 1. Methods of Assessment | Competency may be assessed through:   1. Written text 2. Interview 3. Assignment and completion of tasks 4. Observation |
| 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. |

# MAINTAIN MARINE TRANSMISSION, SHAFT AND PROPULSION SYSTEM

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

**UNIT DESCRIPTION**

This unit decribes competencies required to maintain marine transmission, shaft and propulsion system. It involves identifying working principles of gearboxes and propellers, identifying maintenance procedures of gearboxes, shafts and propellers, preparing spare parts list and special maintenance tools, preparing work schedule/maintenance plan, carrying out maintenance procedures and preparing work reports

**ELEMENTS AND PERFORMANCE CRITERIA**

| **ELEMENT** | **PERFORMANCE CRITERIA**  ***(Bold and italicized terms are elaborated in the Range)*** |
| --- | --- |
| 1. Identify working principles of gearboxes, shafts and propellers | * 1. Different types of gearboxes, shafts and propellers are reviewed from manufacturer’s manuals as per SOPs   2. Operating principles and theories of different types of gearboxes, shafts and propellers are identified and applied in line with manufacturer’s specifications   3. Functions of major components of gearboxes, shafts and propellers are identified from manufacturer’s manuals   4. Gearbox, shaft and propeller specifications are interpreted as per SOPs   5. Gearbox and control systems are identified.   6. Shaft alignment principle is identified as per manufacturer’s manuals |
| 1. Identify maintenance procedures of gearboxes, shafts and propellers | * 1. Common faults of gearboxes, ***shafts*** and ***propellers*** and their remedies are reviewed from manufacturer’s manuals as per SOPs   2. Maintenance procedures for common faults are reviewed from manufacturer’s manuals as per SOPs   3. Maintenance and condition-monitoring records are reviewed as per SOPs.   4. Maintenance procedures are carried out as per manufacturer’s specifications   5. Maintenance reports are prepared as per workplace policy |
| 1. Prepare spare parts list and special maintenance tools | * 1. Manufacturer’s parts list manual is reviewed.   2. Spare parts are identified and noted based on faulty gearbox, shaft and propeller parts to be replaced   3. Special maintenance tools are identified based on manufacturer’s manuals   4. Spare parts list and special maintenance tools are prepared in line with workplace policy |
| 1. Prepare work schedule/maintenance plan, work methodology and work report | * 1. Maintenance activities are identified based on the scope of maintenance   2. Work methodology is prepared   3. Maintenance/work schedule is prepared based on maintenance activities identified   4. Work report is prepared and shared as per work requirements |

**Range**

|  |  |
| --- | --- |
| **Variable** | **Range**  *May include but is not limited to:* |
| 1. Shaft | * Alignment * Bearings * Lubrication system * Coupling |
| 1. Propeller | * Propeller type * Maintenance |

**REQUIRED KNOWLEDGE**

* Working principles of gearboxes, shafts and propellers
* Occupational Safety and Health
* Operation of transmission, shaft and propulsion systems
* Maintenance procedures
* Transmission, shaft and propulsion components
* Gearbox, shaft and propeller survey

**SKILLS**

* Communications
* ICT
* Time management
* Problem solving
* Decision making
* Planning
* Multitasking
* First aid
* Report writing
* Surveying
* Software operation
* Coordinating
* Analytical
* Digital
* Critical thinking
* Reporting
* Teamwork and Personnel Management

**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 working principles of gearboxes and propellers 2. Identified maintenance procedures of gearboxes, shaft and propellers 3. Prepared spare parts list and special maintenance tools 4. Prepared work schedule/maintenance plan 5. Carried out maintenance procedures 6. Prepared Condition monitoring reports 7. Interpreted drawings 8. Identified coupling systems |
| 1. Resource Implications | The following resources should be provided:   1. Manufacturer’s Operation and Maintenance Manuals 2. Engineering Drawings 3. Parts list 4. Tools and equipment 5. Gearboxes, shafts and propellers 6. Workshop |
| 1. Methods of Assessment | Competency may be assessed through:   1. Written text 2. Interview 3. Assignment and Completion of tasks 4. Observation |
| 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. |

# OPERATE AND MAINTAIN MARINE AUXILIARY SYSTEMS

**UNIT CODE:** ENG/OS/MAR/CR/07/5/A

**UNIT DESCRIPTION**

This unit describes competencies required to operate and maintain marine auxiliary systems. It involves operating and monitoring marine boiler systems and steam turbines, operating and maintaining refrigeration and air conditioning systems, heat exchangers and oil coolers, fresh water generation, storage and reticulation systems, ship steering system, ship stabiliser, anchor system, ship firefighting sytsem, ship ventilation sewage systems, bow thruster system, ship’s crane, ship cargo access doors, hatches and ramps

**ELEMENTS AND PERFORMANCE CRITERIA**

| **ELEMENT** | **PERFORMANCE CRITERIA**  ***(Bold and italicized terms are elaborated in the Range)*** |
| --- | --- |
| 1. Operate and monitor marine boiler systems and steam turbines | * 1. Type of ***marine boiler systems*** and steam turbine is identified as per SOPs   2. Manufacturer manuals are obtained and reviewed based on the type of marine boiler and steam turbine   3. Working principles of marine boiler system and steam turbine are identified as per manufacturer’s manuals   4. Marine boiler and steam turbines are operated in line with manufacturer’s manuals   5. Marine boiler and steam turbines are monitored in line with manufacturer’s instructions and workplace policy   6. Condition monitoring reports are prepared according to standard requirements |
| 1. Operate and maintain HVAC (Heating Ventilation and Air Conditioning) systems | * 1. Type of refrigeration and ***air conditioning*** is identified as per SOPs   2. Manufacturers’ manuals are obtained and reviewed based on the type of refrigeration and air conditioning   3. Working principles of refrigeration and air conditioning are identified as per manufacturer’s manuals   4. Refrigeration and air conditioning are operated in line with manufacturer’s manuals   5. Refrigeration and air conditioning are maintained in line with manufacturer’s instructions and workplace policy   6. Maintenance and Condition monitoring reports are prepared |
| 1. Operate and maintain heat exchangers and oil coolers | * 1. Type of ***heat exchangers*** and oil coolers is identified as per SOPs   2. Manufacturers’ manuals are obtained and reviewed based on the type of heat exchangers and oil coolers   3. Working principles of heat exchangers and oil coolers are identified as per manufacturer’s manuals   4. Heat exchangers and oil coolers are operated in line with manufacturer’s manuals   5. Heat exchangers and oil coolers are maintained in line with manufacturer’s instructions and workplace policy   6. Maintenance and Condition monitoring reports are prepared |
| 1. Operate and maintain fresh water generation, storage and reticulation systems | * 1. Type of reverse osmosis system is identified as per SOPs   2. Manufacturer manuals are obtained and reviewed based on the type of reverse osmosis system   3. Working principles of reverse osmosis system are identified as per manufacturer’s manuals   4. Reverse osmosis systems are operated in line with manufacturer’s manuals   5. Reverse osmosis systems are maintained in line with manufacturer’s instructions and workplace policy   6. Maintenance and Condition monitoring reports are prepared |
| 1. Operate and maintain ship steering system | * 1. Types of ***ship steering gear systems*** is identified as per SOPs   2. Manufacturers’ manuals are obtained and reviewed based on the type of ship steering gear system   3. Working principles of ship steering system are identified as per manufacturer’s manuals   4. Ship steering systems are operated in line with manufacturer’s manuals   5. Ship steering system are maintained in line with manufacturer’s instructions and workplace policy   6. Maintenance and Condition monitoring reports are prepared |
| 1. Operate and maintain ship stabilizer | * 1. Types of ***ship stabilizer system*** is identified as per SOPs   2. Manufacturer manuals are obtained and reviewed based on the type of ship stabilizer system   3. Working principles of ship stabilizer system are identified as per manufacturer’s manuals   4. Ship stabilizer system are operated in line with manufacturer’s manuals   5. Ship stabilizer system are maintained in line with manufacturer’s instructions and workplace policy   6. Maintenance and Condition monitoring reports are prepared |
| 1. Operate and maintain anchor system | * 1. Types of ***ship anchor system*** is identified as per SOPs   2. Manufacturer manuals are obtained and reviewed based on the type of ship anchor system   3. Working principles of ship anchor system are identified as per manufacturer’s manuals   4. Anchor system is operated in line with manufacturer’s manuals   5. Anchor system is maintained in line with manufacturer’s instructions and workplace policy   6. Maintenance and Condition monitoring reports are prepared |
| 1. Operate and maintain ship firefighting system | * 1. Fire triangle, types of fire and method of detection and extinguishing are identified   2. Types of ship firefighting system is identified as per SOPs   3. Manufacturer manuals are obtained and reviewed based on the type of ship firefighting system   4. Working principles of ship firefighting system are identified as per manufacturer’s manuals   5. Ship firefighting system are operated in line with manufacturer’s manuals   6. Ship firefighting system are maintained in line with manufacturer’s instructions and workplace policy   7. Maintenance and Condition monitoring reports are prepared |
| 1. Operate and maintain sewage systems | * 1. Maritime regulations on waste treatment and disposal are identified   2. Type of sewage and toilet/ bathroom systems is identified as per SOPs   3. Manufacturer manuals are obtained and reviewed based on the type of sewage and toilet/ bathroom systems   4. Working principles of sewage and toilet/ bathroom systems are identified as per manufacturer’s manuals   5. Sewage and toilet/ bathroom systems are operated in line with manufacturer’s manuals   6. Sewage and toilet/ bathroom systems are maintained in line with manufacturer’s instructions and workplace policy   7. Maintenance and Condition monitoring reports are prepared |
| 1. Operate and maintain bow thruster system | * 1. Types of bow thruster system is identified as per SOPs   2. Manufacturer manuals are obtained and reviewed based on the type of bow thruster system   3. Working principles of bow thruster system are identified as per manufacturer’s manuals   4. Bow thruster system are operated in line with manufacturer’s manuals   5. Bow thruster system are maintained in line with manufacturer’s instructions and workplace policy   6. Maintenance and Condition monitoring reports are prepared |
| 1. Operate and maintain ship crane | * 1. Type of ships crane are identified as per SOPs   2. Manufacturer manuals are obtained and reviewed based on the type of ship sea crane   3. Working principles of ship’s crane are identified as per manufacturer’s manuals   4. Ship crane are operated in line with manufacturer’s manuals   5. Ship crane are maintained in line with manufacturer’s instructions and workplace policy   6. Maintenance and Condition monitoring reports are prepared |
| 1. Operate and maintain ship cargo access doors, hatches and ramp system | * 1. Type of ship visor door and ramp system is identified as per SOPs   2. Manufacturer manuals are obtained and reviewed based on the type of ship visor door and ramp system   3. Working principles of ship visor door and ramp system are identified as per manufacturer’s manuals   4. Ship visor door and ramp system are operated according to manufacturer’s manuals   5. Ship cargo access doors, hatches and ramps system are maintained in line with manufacturer’s instructions and workplace policy   6. Maintenance and Condition monitoring reports are prepared as per SOPs |

**Range**

|  |  |
| --- | --- |
| **Variable** | **Range** |
| 1. Marine boiler systems May include but not limited to: | * Composite boiler * Radiant-type boiler * Reheat boiler * Double evaporation boiler * ESD II and ESD III type boiler |
| 1. Air conditioning May include but not limited to: | * Evaporative air conditioners * Refrigerant air conditioners |
| 1. Heat exchangers May include but not limited to: | * Plate * Shell and tube |
| 1. Ship steering gear system May include but not limited to: | * Hydraulic * Electro-hydraulic type |
| 1. Ship stabiliser system May include but not limited to: | * Bow thrusters * Fin stabilisers and stabilising systems * Folding fin stabiliser * Retractable fin stabiliser * Tank stabilisers * Sea keeper |
| 1. Ship anchor system May include but not limited to: | * Stockless * BBI-Delta * Kedge Admiralty |

**REQUIRED KNOWLEDGE**

* Refrigeration and Air Conditioning
* Hydraulics and Pneumatics
* Boiler Technology
* Plumbing
* Crane Operation
* Electromechanical Systems

**SKILLS**

* Communications
* ICT
* Time management
* Problem solving
* Decision making
* Planning
* Multitasking
* First aid
* Report writing
* Surveying
* Team Work
* Personnel Management
* OSHE

**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. Assessment requires evidence that the candidate 2. Demonstrate ability to operate and maintain boiler systems and steam turbines 3. Demonstrated ability to operate and maintain refrigeration and air conditioning systems 4. Demonstrated ability to operate and maintain HVAC systems 5. Demonstrated ability to operate and maintain reverse osmosis plant and fresh water generation, storage and reticulation systems 6. Demonstrated ability to operate and maintain ship steering system 7. Demonstrated ability to operate and maintain ship stabilizer 8. Demonstrated ability to operate and maintain anchor system 9. Demonstrated ability to operate and maintain ship firefighting system 10. Demonstrated ability to operate and maintain sewage and toilet/ bathroom systems 11. Demonstrated ability to operate and maintain bow thruster system 12. Demonstrated ability to operate and maintain ship sea crane 13. Demonstrated ability to operate and maintain ship visor door and ramp system |
| 1. Resource Implications | The following resources should be provided:   1. Manufacturer’s manuals 2. Engineering Drawings 3. Parts List 4. Tools and Equipment 5. Auxiliary systems or simulator 6. Workshop |
| 1. Methods of Assessment | Competency may be assessed through:   1. Written text 2. Interview 3. Assignment and Completion of tasks 4. Observation |
| 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. |

# PERFORM ENGINE ROOM WATCHKEEPING

**UNIT CODE:** ENG/OS/MAR/CR/08/5/A

**UNIT DESCRIPTION**

This unit describes competencies required to perform engine room watch keeping duties. These include watch routines, Contributing to safe engineering watch, keeping a boiler watch, contributing the monitoring and controlling of engine room watch, bilge and ballast operations, handling of stores and application of occupational health and safety procedures.

**ELEMENTS AND PERFORMANCE CRITERIA**

| **ELEMENT** | **PERFORMANCE CRITERIA**  ***(Bold and italicized terms are elaborated in the Range)*** |
| --- | --- |
| 1. Carry out a watch routine | * 1. Engine-room watch keeping procedures are identified according to standard requirements   2. Safe working practices are identified as per engine room operations procedures   3. Appropriate internal communication systems are used in accordance with SOPs   4. ***Engine-room alarm systems*** are identified as per standard requirements   5. Various alarms are distinguished with special reference to fire‑extinguishing gas alarms. |
| 1. Keep safe engine‑room watch | * 1. Orders and communications are followed according to watch keeping requirements   2. Procedures for the relief, maintenance and handover of a watch are followed as per watch keeping requirements   3. Information required to maintain a safe watch is interpreted based on watch keeping requirements   4. Main propulsion and auxiliary machinery control pressures, temperatures and levels are maintained as per standard requirements   5. Correct water levels and steam pressures for marine boiler maintained as per standard requirement |
| 1. Perform bilge and ballast operations | * 1. Measurement and reporting of tank levels is done according to SOP   2. Reporting of incidents associated with transfer operations is done in accordance with SOPs |
| 1. Handle ship stores | * 1. Risk assessment is carried out according to SOPs   2. Selection of suitable ***loading equipment*** is undertaken as per ship store requirements |

**Range**

|  |  |
| --- | --- |
| **Variable** | **Range** |
| Engine-room alarm systems may include but is not limited to: | * Fire alarms * General alarms * CO2 alarms * Machine navigation alarm * Mob overboard alarm * Machinery space alarm |
| Loading equipment may include but is not limited to: | * Cranes * Trolleys * Pulleys * Winch * Conveyors * Chain blocks * Pumps |

**REQUIRED KNOWLEDGE**

* OSHA
* Safe handling, storage and securing of stores
* Ship stores
* Information on watch keeping
* Bilge and ballast operations
* Ship loading
* Loading equipment
* SOLAS Manual
* Types of alarm
* Emergency signalling equipment
* Life-saving equipment

**SKILLS**

* Communications
* Time management
* Troubleshooting
* Multitasking
* First aid
* Report writing
* Team Work

**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. Carried out a watch routine 2. Kept safe engine‑room watch 3. Performed bilge and ballast operations 4. Handle ship stores 5. Demonstrated understanding of alarm systems 6. Demonstrated understanding and application of OSHA 7. Demonstrated understanding of ship stores |
| 1. Resource Implications | The following resources should be provided:   1. Manufacturer’s manuals 2. Assessment location 3. Loading tools and equipment 4. Auxiliary systems or simulators 5. Engine room simulator 6. Stationery |
| 1. Methods of Assessment | Competency may be assessed through:   1. Written text 2. Interview/ Oral test 3. Assignment and Completion of tasks 4. Observation |
| 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. |