

**REPUBLIC OF KENYA**

**OCCUPATIONAL STANDARDS**

**FOR**

**MECHANICAL ENGINEERING PLANT TECHNICIAN**

**KNQF LEVEL 6**

**PROGRAMME ISCED CODE: 0715554A**

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

This policy document requires that training in TVET institutions be competency based, curriculum development be industry led, certification be based on demonstration of competence and mode of delivery to allow for multiple entry and exit in TVET programmes. These reforms demand that industry takes a leading role in occupational standards development to ensure it addresses competence needs.

It is against this background that these Occupational Standards have been developed for a competency-based Mechanical plant standard. These Occupational Standards will also be the basis for assessment of an individual for competence certification.

It is my conviction that these Occupational Standards will play a key role towards development of competent human resource for the engineering sector’s growth and development.

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

Incumbent mechanical plant industry experts in conjunction with expert subject trainers and other related stakeholders have developed these Occupational Standards for Mechanical plant level 6. These standards will be the basis for development of competency-based curriculum for Mechanical plant level 6.

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 everyone who participated in the development of these Occupational Standards.

# ACRONYMS

ICT Information and Communication Technology

KNQF Kenya National Qualifications Framework

CPU Central Processing Unit

DVDs Digital Versatile Discs

CAD Computer-Aided Design

HDMI High-Definition Multimedia Interface

AC Alternating Current

DC Direct Current

3D Three-Dimensional

A/C Air conditioning

OSH Occupational Safety and Health

ISO International Organization for Standardization

EMCA Environmental Management and Coordination Act

HVAC Heating, Ventilation, and Air Conditioning

PLC Programmable Logic Controller

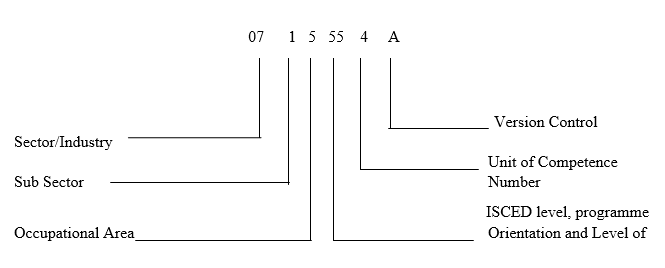
DVI Digital Visual Interface

RAM Random Access Memory

USB Universal Serial Bus

VGA Video Graphics Array

# KEY TO UNIT CODE



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# OVERVIEW

The mechanical plant technician level 6 qualification consists of competencies that an individual must achieve to design mechanical plant system, install hydraulic and pneumatic systems , maintain hydraulic and pneumatic systems, install refrigeration and air conditioning system, maintain refrigeration and air conditioning systems, install material handling system, maintain material handling systems, install mechanical pumps and compressors, maintain mechanical pumps and compressors, install steam system and maintain boiler and steam system

The Units of Competency comprising Mechanical Plant Technician level 6 qualifications include the following basic, common and core competencies:

# SUMMARY OF UNITS OF COMPETENCY

|  |  |
| --- | --- |
| **BASIC UNITS OF COMPETENCY** | |
| **UNIT CODE** | **UNIT TITLE** |
| 0611 541 01A | Apply Digital Literacy |
| 0031 541 02A | Apply Communication Skills |
| 0417 541 03A | Apply Work Ethics and Practices |
| 0413 54104A | Apply Entrepreneurial Skills |
| **COMMON UNITS OF COMPETENCY** | |
| 0715 451 05A | Apply Workshop Principles |
| 0732 441 06A | Apply Technical Drawing |
| 0713 441 07A | Apply Electrical and Electronics Principles |
| 0541 441 08A | Apply Mathematics |
| 0715 441 09A | Apply Mechanical Science Principles |
| 0541 541 10A | Apply Engineering Mathematics |
| 0715 541 11A | Apply Engineering Mechanics Principles |
| 0713 541 12A | Apply Electronics and Control Principles |
| 0715 541 13A | Apply Thermodynamics Principles |
| 0715541 14A | Apply Fluid Mechanics Principles |
| 0715 551 15A | Perform Computer Aided Drawing |
| **CORE UNITS OF COMPETENCY** | |
| 0715 451 16A | Install mechanical pumps and compressors |
| 0715 451 17A | Maintain mechanical pumps and compressors |
| 0715 451 18A | Install hydraulic and pneumatic systems |
| 0715 451 19A | Maintain hydraulic and pneumatic systems |
| 0715 451 20A | Install material handling system |
| 0715 451 21A | Maintain material handling systems |
| 0715 451 22A | Install refrigeration and air conditioning system |
| 0715 451 23A | Maintain refrigeration and air conditioning systems |
| 0715 551 24A | Design mechanical plant system |
| 0715 551 25A | Install steam system. |
| 0715 551 26A | Maintain boiler and steam system |

# BASIC UNITS OF COMPETENCY

## APPLY DIGITAL LITERACY

**UNIT CODE:** 0611 441 01A

**UNIT DESCRIPTION:**

This unit covers the competencies required to demonstrate digital literacy. It involves operating computer devices, solving tasks using the Office suite, accessing online/offline data and information, performing online communication and collaboration, applying cybersecurity skills and performing jobs online. It also involves applying job entry techniques.

**ELEMENTS AND PERFORMANCE CRITERIA**

| **ELEMENT**  These describe the key outcomes that make up workplace functions | **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. Operate computer devices | * 1. C***omputer device*** usage is determined as per workplace requirements.   2. ***Computer hardware*** is identified according to job requirements.   3. ***Computer software*** is identified according to workplace requirements.   4. Computer devices are turned on or off as per the correct workplace procedure.   5. ***Mouse techniques*** are applied in solving tasks as per workplace requirements.   6. Keyboardtechniques are applied in solving tasks as per workplace requirements.   7. Computer files and folders are created and managed as per workplace requirements.   8. ***Internet connection option***s are identified and applied in connecting computer devices to the Internet.   9. ***External devices*** are identified and connected to the computer devices as per the job requirement. |
| 1. Solve tasks using Office suite | 1. ***Word processing concepts***are applied in solving workplace tasks as per job requirements. 2. Worksheet data is entered and prepared in accordance with work procedures. 3. Worksheet data is built and edited in accordance with workplace procedures. 4. ***Data manipulation*** on a worksheet is undertaken in accordance with work requirements. 5. Worksheets are saved and printed in accordance with job requirements. 6. ***Electronic presentation concepts***are applied in solving workplace tasks as per job requirements. |
| 1. Manage data and information | * 1. Office ***internet services*** are identified and applied in accordance with office procedures.   2. ***Internet access applications*** are determined in accordance with office operation procedures.   3. Internet search is performed as per job requirements.   4. Online digital content is downloaded in accordance with workplace requirements.   5. Digital content is identified and backed up in accordance with workplace procedures. |
| 1. Perform online communication and collaborations | * 1. Netiquette principles are observed as per work requirements.   2. Electronic mail communication is executed in accordance with workplace policy.   3. Digital content copyright and licenses are identified and applied according to workplace policies and regulatory requirements.   4. ***Online*** ***collaboration tools*** are applied in accordance with workplace policies and regulatory requirements. |
| 1. Apply cybersecurity skills | * 1. ***Data protection*** and ***privacy*** is classified in accordance with workplace policies and regulatory requirements.   2. ***Internet security threats*** are identified as per workplace policies and regulatory requirements.   3. Computer threats and crimes are detected in accordance to Information Management security guidelines   4. ***Cybersecurity control measures*** are applied in accordance with workplace policies and regulatory requirements. |
| 1. Perform online jobs | * 1. ***Online job platforms*** are identified as per the job requirements.   2. Online accounts and profiles are created in accordance with the work requirements.   3. Online jobs are identified according to the bidder’s skillset.   4. Online digital identity is managed according to industry best practices.   5. Online job bidding is done as per the specific job requirements.   6. Online tasks are executed according to the job requirements.   7. Personal online payment account is managed in accordance with financial regulations. |
| 1. Apply job entry techniques | * 1. ***Job opportunities*** are sought based on competencies.   2. A winning resume/CV is developed as per job advertisement.   3. An application/cover letter is developed based on the job advertisement.   4. ***certificates and testimonials*** are organized as per resume.   5. ***Interview skills*** are demonstrated as per job advertisement. |

**RANGE**

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

| **Variable** | **Range** |
| --- | --- |
| 1. Computer devices may include but are not limited to: | * Desktops * Laptops * Smartphones * Tablets * Smartwatches |
| 1. Computer hardware may include but are not limited to: | * The System Unit E.g. Motherboard, CPU, casing, * Input Devices E.g. Pointing, keying, scanning, voice/speech recognition, direct data capture devices. * Output Devices e.g. hardcopy output and softcopy output * Storage Devices e.g. main memory e.g. RAM, secondary storage (Solid state devices, Hard Drives, CDs & DVDs, Memory cards, Flash drives * Computer Ports e.g. HDMI, DVI, VGA, USB type C |
| 1. Computer software may include but are not limited to: | * System software e.g. Operating System (Windows, Macintosh, Linux, Android, iOS) * Application Software e.g. Word Processors, Spreadsheets, Presentations etc. * Utility Software e.g. Antivirus programs |
| 1. External devices may include but are not limited to: | * Printers * Projectors * Smart Boards * Speakers * External storage drives * Digital/Smart TVs |
| 1. Word processing concepts may include but are not limited to: | * Creating word documents * Editing word documents * Formatting word documents * Saving word documents * Printing word documents |
| 1. Mouse techniques may include but are not limited to: | * Clicking * Double-clicking * Right-clicking * Drag and drop |
| 1. Internet connection options may include but are not limited to: | * Mobile Networks/Data Plans * Wireless Hotspots * Cabled (Ethernet/Fiber) * Dial-Up * Satellite * ISDN (Integrated Services Digital Network) |
| 1. Data manipulation may include but are not limited to: | * Use of formulae * Use of functions * Sorting * Filtering * Visual representation using charts |
| 1. Electronic presentation concepts may include but are not limited to: | * Creating slides * Editing slides * Formatting slides * Applying slide effects and transitions * Creating and playing slideshows * Saving presentations * Printing slides and handouts |
| 1. Internet services may include but are not limited to: | * Communication Services * Information Retrieval Services * File Transfer * World Wide Web Services * Web Services * Directory Services * Automatic Network Address Configuration * Newsgroup * Ecommerce |
| 1. Internet access applications/software may include but are not limited to: | * Browsers * Email Apps * ecommerce Apps |
| 1. Online collaboration tools may include but are not limited to: | * Online Storage * Online productivity applications * Online meetings, * Online learning environments, * Online calendars * Social networks |
| 1. Data protection and privacy may include but not limited to: | * Confidentiality of data/information * Integrity of data/information * Availability of data/information |
| 1. Internet security threats may include but not limited to: | * Malware attacks * Social engineering attacks * Software supply chain attacks * Advanced persistent threats (APT) * Distributed denial of service (DDoS) * Man-in-the-middle attack (MitM) * Password attacks * IoT Attacks * [Phishing Attacks](https://onlinedegrees.sandiego.edu/top-cyber-security-threats/#phishing-attacks) * [Ransomware](https://onlinedegrees.sandiego.edu/top-cyber-security-threats/#ransomware) |
| 1. Security threats control measures may include but not limited to: | * Counter measures against cyber terrorism * Physical Controls * Technical/Logical Controls * Operational Controls |
| 1. Online job platforms may include but are not limited to: | * Remo task * Data annotation.tech * Cloudworker * Upwork * Oneforma * Appen |
| 1. Job opportunities may include but not limited to: | * Self-employment * Service provision * product development * salaried employment |
| 1. Certificates and testimonialsmay include but not limited to: | * Academic credentials * Letters of previous employments/ services rendered * Letters of commendation * Certifications of participation * Awards |
| 1. Interview skills may include but not limited to: | * Listening skills * Grooming * Language command * Articulation of issues * Body language * Time management * Honesty * Generally knowledgeable in current affairs and technical area |

**REQUIRED KNOWLEDGE AND SKILLS**

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

**Required knowledge**

The individual needs to demonstrate knowledge of:

* Computer Hardware and Software Concepts
* Computer Security Concepts (Data security and privacy)
* Cyber security threats and control measures
* Understanding Computer Crimes
* Detection and protection against computer crimes
* Laws governing protection of ICT in Kenya
* Digital Identity Management
* Netiquette Principles
* Fundamentals of Copyright and Licenses
* Word processing;
* Functions and concepts of word processing;
* Documents and tables creation and manipulations;
* Document editing;
* Document formatting;
* Word processing utilities
* Spreadsheets;
* Meaning, types and importance of spreadsheets;
* Components of spreadsheets;
* Functions, formulae, and charts, uses and layout;
* Data formulation, manipulation and application to cells;
* Editing & formatting spreadsheets;
* Presentation Packages;
* Types of presentation Packages.
* Creating, formulating, running, editing, printing and presenting slides and handouts
* Networking and Internet;
* Internet connectivity.
* Browser and digital content management;
* Managing data, information, and digital content
* Electronic mail and World Wide Web
* Fundamentals of Online Working;
* Online Profile Management;
* e-Portfolio Management;
* Online Jobs Bidding;
* Online Payment Systems;
* Job entry techniques
* Job searching sites
* Interview preparation skills
* Interview handling

**Required skills**

The individual needs to demonstrate the following skills:

* Active listening
* Keyboard Skills
* Mouse Skills
* Analytical skills
* Creativity
* Interpretation Skills
* Communication
* Spreadsheet operations (applying fundamental operations such as addition, subtraction, division and multiplication)
* Computer Use Safety Skills
* Document Editing Skills
* Document Formatting Skills
* Document Printing Skills
* Netiquette Skills
* Internet Browsing Skills
* Problem Solving Skills
* Online Collaboration Skills
* Cybersecurity Skills
* CV writing
* grooming

**EVIDENCE GUIDE**

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

|  |  |
| --- | --- |
| 1. Critical aspects of competency | ***Assessment requires evidence that the candidate:***   * 1. Operated computer devices as per workplace policies and regulations.   2. Solved tasks using the office suite as per workplace policies and regulations.   3. Manage data and information as per workplace policies and regulations.   4. Performed online communication and collaboration as per workplace policies and regulations.   5. Applied cybersecurity skills in accordance with workplace policies and regulations.   6. Executed online tasks according to the job requirements.   7. Searched for job opportunity based on competencies.   8. Prepared job requirement documentations based on job opportunity.   9. Demonstrated interview skills based on the job opportunity. |
| 1. Resource implications | The following resources should be provided:   * 1. Appropriately simulated environment where assessment can take place.   2. Access to relevant work environments where assessment can take place.   3. Resources relevant to the proposed activities or task. |
| 1. Methods of assessment | Competency in this unit may be assessed through:   * 1. Oral assessment   2. Portfolio of evidence   3. Interviews   4. Third party report   5. Written assessment   6. Practical assessment   7. Projects |
| 1. Context of assessment | Competency may be assessed:   * 1. On the job   2. In a simulated work environment. |
| 1. Guidance information for assessment | * 1. Holistic assessment with other units relevant to the industry sector and workplace job role is recommended. |

## APPLY COMMUNICATION SKILLS

**UNIT CODE:** 0031 441 02A

**UNIT DESCRIPTION**

This unit covers the competencies required to demonstrate communication skills. It involves applying communication channels, written, non-verbal, oral, and group communication skills.

**ELEMENTS AND PERFORMANCE CRITERIA**

| **ELEMENT**  These describe the key outcomes that make up workplace function | **PERFORMANCE CRITERIA**  These are assessable statements that specify the required level of performance for each of the elements.  ***Bold and italicized terms are elaborated in the Range*** |
| --- | --- |
| 1. Apply communication channels | 1. Specific communication channels are identified and applied based on workplace requirements. 2. Challenges are identified and addressed as per the operational standards of the organization. 3. Communication channels are evaluated to meet workplace needs. |
| 1. Apply written communication skills | * 1. Types of written communication are identified and applied according to the workplace requirements.   2. Written communication needs are identified and implemented according to workplace procedures.   3. Written communication guidelines are analyzed, evaluated, and revised based on workplace needs. |
| 1. Apply non-verbal communication skills | 3.1 Existing non-verbal communication techniques are identified and applied based on organization policy.  3.2 Non-verbal communication techniques are articulated to enhance inclusivity according to workplace requirements.  3.3 Non-verbal communication techniques are modeled to enhance inclusivity according to workplace requirements. |
| 1. Apply oral communication skills | 4.1 Types of oral communication are identified and established as per organization policy.  4.2 Pathways of oral communication are identified and established as per organization policy.  4.3 Pathways of oral communication are reviewed according to organization procedures.  4.4 Pathways of oral communication are maintained according to the organization standards. |
| 1. Apply group communication skills | 1. Group communication strategies are appliedbased on the workplace needs. 2. Groups are organized in accordance with workplace procedures. 3. Effective questioning, listening and non-verbal communication techniques are used as per needs.   5.4 Group communication challenges are identified and addressed according to the workplace needs. |

**RANGE**

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

| **Variable** | **Range** |
| --- | --- |
| 1. Communication strategies may include but are not limited to: | * Language switch * Comprehension check * Repetition * Asking confirmation * Paraphrasing * Clarification request * Translation * Restructuring * Generalization |
| 1. Effective group interaction may include 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 |
| 1. Situations may include but are not limited to: | * Establishing rapport * Eliciting facts and information * Facilitating resolution of issues * Developing action plans |

**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:

* Active listening
* Interpretation
* Negotiation
* Writing
* Oral skills
* Creative thinking
* Critical thinking
* Decision making
* Analytical
* Innovation
* Conflict skills
* Leadership
* Problem solving skills
* Management
* Organizational
* Teamwork

**Required Knowledge**

The individual needs to demonstrate knowledge of:

* Communication process
* Dynamics of groups
* Styles of group leadership
* Key elements of communications strategy
* Principles of effective communication
* Turn-taking techniques
* Conflict resolution techniques
* Work planning
* Work organization
* Company policies
* Company operations and procedure standards
* Fundamental rights at the workplace
* Personal hygiene
* Accountability
* Workplace problems and how to deal with them

**EVIDENCE GUIDE**

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

|  |  |
| --- | --- |
| 1. Critical aspects of Competency. | Assessment requires evidence that the candidate:   * 1. Identified and applied specific communication channels based on workplace requirements.   2. Identified and applied specific written communication correspondence according to the workplace requirements.   3. Applied and developed non-verbal strategies to communicate in all areas of the workplace requirements.   4. Established pathways of oral communication as per workplace policy.   5. Applied group communication strategies based on workplace needs. |
| 1. Resource Implications | The following resources should be provided:   1. Access to relevant workplace where assessment can take place. 2. Appropriately simulated environment where assessment can take place. 3. Resources relevant to the proposed activity or tasks. |
| 1. Methods of Assessment | Competency in this unit may be assessed through:   * 1. Oral assessment   2. Portfolio of evidence   3. Interviews   4. Third party report   5. Written assessment   6. Practical assessment   7. Projects |
| 1. Context of Assessment | Competency may be assessed:   1. On-the-job 2. In a simulated work environment |
| 1. Guidance information for assessment | Holistic assessment with other units relevant to the industry sector, workplace and job role is recommended. |

## APPLY WORK ETHICS AND PRACTICES

**ISCED UNIT CODE:** 0417 441 03A

**UNIT DESCRIPTION**

This unit covers competencies required to effectively apply work ethics and practices. It involves the ability to: conduct self-management, promote ethical work practices and values, promote teamwork, manage workplace conflicts, maintain professional and personal development, apply problem-solving and promote customer care.

**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 Range*** |
| --- | --- |
| 1. Apply self-management skills | 1. Personal vision, mission and goals are formulated based on potential and concerning organization objectives and strategic plan 2. Self-esteem and a positive self-image are developed and maintained based on value 3. Emotional intelligence and stress management are demonstrated as per workplace requirements. 4. Assertiveness is developed and maintained based on the requirements of the job. 5. Accountability and responsibility for one's actions are demonstrated based on workplace instructions. 6. Time management, attendance and punctuality are observed as per the organization’s policy. 7. Personal goals are managed as per the organization’s objective 8. Self-strengths and weaknesses are identified based on personal objectives 9. Motivation, initiative and proactivity are utilized as per the organization policy 10. Individual performance is evaluated and monitored according to the agreed targets. |
| 1. Promote ethical work practices and values | 1. Integrity is demonstrated as per acceptable norms 2. Codes of conduct is applied as per the workplace requirements 3. Policies and guidelines are observed as per the workplace requirements 4. Professionalism is exercised in line with organizational policies |
| 1. Promote Team work | 3.1 ***Teams*** are formed to enhance productivity based on organization’s objectives  3.2 Duties are assigned to teams under the organization policy.  3.3 Team activities are managed and coordinated as per set objectives.  3.4 Team performance is evaluated based on set targets as per workplace policy.  3.5 ***Conflicts*** are resolved between team members in line with organization policy.  3.6 Gender and diversity-related issues are identified and mainstreamed in accordance with workplace policy.  3.7 Healthy ***relationships*** are developed and maintained in line with the workplace.  3.8 Adaptability and flexibility are applied in dealing with team members as per workplace policies |
| 1. Maintain professional and personal development | 4.1 ***Personal growth and development*** needs are identified and assessed in line with the requirements of the job.  ***4.2 Training and career opportunities*** are identified and utilized based on job requirements.  4.3 ***Resources*** for training are mobilized and allocated based on organizations and individual skills needs.  4.4 Licenses and certifications relevant to the job and career are obtained and renewed as per policy.  4.5 Recognitions are sought as proof of career advancement in line with professional requirements.  4.6 Work priorities and personal commitments are balanced and managed based on the requirements of the job and personal objectives.  4.7 Dynamism and on-the-job learning are embraced in line with the organization’s goals and objectives. |
| 1. Apply Problem solving skills | 5.1 ***Creative, innovative*** and practical solutions are developed based on the problem  5.2 Independence and initiative in identifying and solving problems are demonstrated based on the requirements of the job.  5.3 Team problems are solved as per the workplace guidelines  5.4 Problem-solving strategies are applied as per the workplace guidelines  5.5 Problems are analyzed and assumptions tested as per the context of data and circumstances |
| 1. Promote Customer Care | 6.1 Customers' needs are identified based on their characteristics  6.2 Customer ***feedback*** is allowed and facilitated in line with organization policies.  6.3 Customer concerns and complaints are analyzed and resolved in line with the set organizational culture.  6.4 Proactive customer outreach programs are implemented as per organizational policies  6.5 Customer retention strategies are developed and implemented in line with the organizational policy |

**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. Feedback may include but not limited to: | * Verbal * Written * Informal * Formal |
| 1. Conflicts include but are not limited to: | * Interpersonal Conflict. * Intrapersonal Conflict. * Intergroup Conflict. * Intragroup Conflict. |
| 1. Relationships may include but not limited to: | * Man/Woman * Trainer/trainee * Employee/employer * Client/service provider * Husband/wife * Boy/girl * Parent/child * Sibling relationships |
| 1. Team may include but not limited to: | * Small work group * Staff in a section/department * Inter-agency group * Virtual teams |
| 1. Personal growth may include 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 |
| 1. Personal objectives may include but not limited to: | * Long term * Short term * Broad * Specific |
| 1. Trainings and career opportunities may include but not limited to | * Participation in training programs * Serving as Resource Persons in conferences and workshops * Capacity building |
| 1. Resource may include may but not limited to: | * Human * Financial * Technology |
| 1. Creative and innovative may include but not limited to: | * New ideas * Original ideas * Different ideas * Methods/procedures * Processes * New tools |
| 1. Emerging issues may include but not limited to: | * Artificial Intelligence * Data confidentiality * National cohesion * Open offices |

**REQUIRED SKILLS AND KNOWLEDGE**

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

**Required Skills**

The individual needs to demonstrate the following skills:

* Active listening
* Critical thinking
* Organizational
* Negotiation
* Monitoring
* Evaluation
* Problem solving
* Decision Making
* Leadership
* Creative/innovative thinking
* Adaptability
* Conflict management
* Emotional intelligence
* Teamwork

**Required Knowledge**

The individual needs to demonstrate knowledge of:

* Work values and ethics
* Company policies and procedures
* Company operations, procedures and standards
* Flexibility and adaptability
* Concept of time and leisure time
* Decision making
* Work planning
* Organizing work
* Monitoring and evaluation
* Record keeping
* Gender and diversity mainstreaming
* Drug and substance abuse
* Professional growth and development
* creativity
* Innovation
* problem solving
* customer care
* mentoring and coaching.
* Emerging issues

**EVIDENCE GUIDE**

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

|  |  |
| --- | --- |
| 1. Critical aspects of Competency | Assessment require evidence that the candidate:   * 1. Applied self-management skills as per organizational procedures.   2. Promoted ethical practices and values as per organizational procedures.   3. Promoted Teamwork as per workplace assignments.   4. Maintained professional and personal development as per organizational procedures.   5. Applied Problem-solving skills based on work requirements.   6. Identified customer needs based on their characteristics.   7. Gave back Customer feedback in line with organization policies. |
| 1. Resource Implications | The following resources should be provided:   1. Access to relevant workplace where assessment can take place 2. Appropriately simulated environment where assessment can take place. 3. Resources relevant to the proposed activity or tasks. |
| 1. Methods of Assessment | Competency in this unit may be assessed through:   1. Oral questioning 2. Written test 3. Portfolio of Evidence 4. Interview 5. Third party report |
| 1. Context of Assessment | Competency may be assessed:   1. On-the-job 2. In a simulated work environment |
| 1. Guidance information for assessment | Holistic assessment with other units relevant to the industry sector, workplace and job role is recommended. |

## APPLY ENTREPRENEURIAL SKILLS

**ISCED UNIT CODE:** 0413 441 04A

**UNIT DESCRIPTION**

This unit covers the competencies required to demonstrate an understanding of entrepreneurship. It involves demonstrating an understanding of financial literacy, applying entrepreneurial concepts identifying entrepreneurship opportunities, applying business legal aspects, developing business innovative strategies, and developing business plans.

**ELEMENTS AND PERFORMANCE CRITERIA**

| **ELEMENT**  These describe the key outcomes that make up workplace function. | **PERFORMANCE CRITERIA**  These are assessable statements that specify the required level of performance for each of the elements.  ***Bold and italicized terms are elaborated in Range*** |
| --- | --- |
| 1. Apply Financial Literacy | 1. **Sources of personal and business** ***funds*** are identified as per financial procedures and standards 2. Personal finances are managed as per financial procedures and standards 3. Savings are managed as per financial procedures and standards 4. Debts are managed as per financial procedures and standards 5. Investments are undertaken as per financial procedures and standards 6. Insurance services are procured as per financial procedures and standards |
| 1. Apply entrepreneurial concept | 1. Entrepreneurs and Business persons are distinguished as per principles of entrepreneurship 2. ***Types of entrepreneurs*** are identified as per principles of entrepreneurship 3. Ways of becoming an entrepreneur are identified as per principles of Entrepreneurship 4. ***Characteristics of Entrepreneurs*** are identified as per principles of Entrepreneurship 5. Salaried employment and self-employment are distinguished as per principles of entrepreneurship 6. ***Requirements for entry into self-employment*** are identified according to business procedures and standards 7. Roles of an Entrepreneur in an enterprise are determined according to business procedures and standards 8. **Contributions of entrepreneurship** to National development are identified as per business procedures and standards |
| 1. Identify entrepreneurial opportunities | 1. Business ideas are identified as per business procedures and standards 2. Factors to consider when evaluating business opportunity viability are explored based on business procedure and standards 3. Entrepreneurial opportunities are evaluated as per business procedures and standards 4. Business ideas and opportunities are generated as per business procedures and standards 5. Business life cycle is analyzed as per business procedures and standards |
| 1. Apply business legal aspects | 1. ***Forms of business ownership*** are identified as per legal procedures and practices 2. Business Registration and Licensing processes are identified as per legal procedures and practices 3. Types of Contracts and Agreements are analyzed as per legal procedures and practices 4. Employment Laws are identified as per legal procedures and practices 5. Taxation laws are identified as per legal procedures and practices |
| 1. Innovate Business strategies | 1. Business innovation strategies are determined by the organization standards 2. Creativity in business development is demonstrated in accordance with business standards 3. ***Innovative business standards***  are developed as per business principles 4. Linkages with other entrepreneurs are created as per best practice 5. ICT is incorporated in business growth and development as per best practice |
| 1. Develop Business Plan | 1. Business idea is described as per business procedures and standards 2. Business description is developed as per business plan format 3. Marketing plan is developed as per business plan format 4. Organizational/Management plan is prepared in accordance with business plan format 5. Production/operation plan is prepared in accordance with business plan format 6. Financial plan is prepared in accordance with the business plan format 7. Executive summary is prepared in accordance with business plan format 8. Business plan is presented as per best practice 9. Business ideas are incubated as per institutional policy. |

**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. Sources of personal funds mayinclude but not limited to: | * Salary/Wages * Investments * Savings * Inheritance * Government Benefits |
| 1. Sources of business finance mayinclude but not limited to: | * Equity Financing * Debt Financing, * Personal Savings/Investment * Retained Earnings * Grants and Subsidies * Crowdfunding * supplier Credit: * Leasing and Asset Financing: |
| 1. Types of entrepreneurs may include but not limited to: | * Innovators * Imitators * Craft * Opportunistic * Speculators |
| 1. Characteristics of Entrepreneurs may include but not limited to: | * Creative * Innovative * Planner * Risk taker * Networker * Confident * Flexible * Persistent * Patient * Independent * Future oriented * Goal oriented |
| 1. Requirements for entry into self-employment may include but not limited to | * Technical skills * Management skills * Entrepreneurial skills * Resources * Infrastructure |
| 1. Forms of businesses ownership may include but not limited to: | * Sole proprietorship * Partnership * Limited companies * Cooperatives |
| 1. Innovative business standards may include but not limited to: | * New products * New methods of production * New markets * New sources of supplies * Change in industrialization |

**REQUIRED SKILLS AND KNOWLEDGE**

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

**Required Skills**

The individual needs to demonstrate the following skills:

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

**Required Knowledge**

The individual needs to demonstrate knowledge of:

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

**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 Sources of personal and business finance as per financial procedures and standards 2. Managed Personal finances as per financial procedures and standards 3. Made Investment decisions as per financial procedures and standards 4. GeneratedBusiness ideas and opportunities based on business procedure and standards 5. Analysed business life cycle based on business procedure and standards 6. Determined business innovative standards as per business principles 7. Developed and presented a business plan as per regulatory framework. |
| 1. Resource Implications | The following resources should be provided:   1. Access to relevant workplace where assessment can take place 2. Appropriately simulated environment where assessment can take place |
| 1. Methods of Assessment | Competency may be assessed through:   1. Written tests 2. Oral questions 3. Third party report 4. Interviews 5. Portfolio |
| 1. Context of Assessment | Competency may be assessed:   1. On-the-job 2. In a simulated work environment |
| 1. Guidance information for assessment | Holistic assessment with other units relevant to the industry sector, workplace and job role is recommended. |

# COMMON UNITS OF COMPETENCIES

## APPLY WORKSHOP TECHNOLOGY

**UNIT CODE: 0715 451 05A**

**Unit Description**

This unit describes the competencies required by a technician in order to apply workshop practice in their work. It includes applying workshop safety, material science principles and workshop tools and equipment. It also includes carrying out metal joining processes, performing material preservation and applying workshop organization techniques.

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 workshop safety | 1. Safe work environment is maintained as per workplace requirements 2. ***Workplace hazards*** and risks are controlled as per workplace requirements 3. ***Workplace accidents*** and incidents are managed as per workplace requirements |
| 1. Apply material science principles | 1. Safety procedures and practices are observed as per workplace requirements 2. Safe handling of materials is carried out as per job requirements 3. ***Engineering materials*** are selected as per job requirement 4. Engineering materials are classified as per job requirement |
| 1. Apply Workshop tools and equipment | * 1. Safety procedures and practices are observed as per workplace requirements   2. Technical Drawing are interpreted as per job requirements   3. ***Workshop Tools, equipment*** is selected as per task requirements   4. Workshop tools and equipment are calibrated as per manufacture’s manual   5. Workshop tools are used as per work requirement   6. Tools and equipment are maintained as per workplace procedure |
| 1. Carry out metal joining processes | * 1. Safety procedures and practices are observed as per workplace requirements   2. Tools and equipment are identified as per task requirement   3. ***Material preparations*** is carried out as per task requirement   4. ***Joinery methods*** are applied as per task requirement   5. ***Metal finishing******processes*** are carried out as per task requirement |
| 1. Perform engineering material preservation | * 1. Safety procedures and practices are observed as per workplace requirements   2. Workshop tools, equipment and materials are selected as per task requirements   3. Preservation method is selected as per work requirement   4. Preservation method is applied as per work requirement |
| 1. Apply workshop organisation techniques | 1. Waste sorting and disposal is carried out as per workplace procedure 2. Workshop layout is applied as per workplace requirement 3. Management inventory is prepared as per work requirement 4. Maintenance schedules are prepared as per workplace procedure 5. Housekeeping is carried out as per work requirement |

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** |
| --- | --- |
| Workplace hazards may include but not limited to: | * Physical * Biological * Chemical * Ergonomics * safety |
| Workplace accidents may include but not limited to: | * Cuts and bleeds * fracture * fainting * electric shock |
| Engineering materials may include but not limited to: | * metals * polymers * composites * ceramic |
| Workshop Tools, equipment and materials may include but not limited to: | * Measuring tools * Marking out tools * Cutting tools * Fitting tools * Forging tools * Sheet metal tools * Arc welding machine * Gas welding equipment * Grinding machine * Soldering machine |
| Metal finishing processes may include but not limited to: | * Grinding * Filing * polishing |
| Joinery methodsmay include but not limited to: | * welding * Riveting * Soldering * Fastening |
| Preservation methods | * Protective coatings * Chemical treatments * Physical barriers |
| Material preparation may include but not limited: | * Measuring * Marking out |
| Housekeeping equipment and materials may include but not limited to: | * Brooms * Detergents * Waste clothes |

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:

* Problem solving
* Creativity
* Innovation
* Communication skills
* Management skills
* Analytical skills

**Required knowledge**

The individual needs to demonstrate knowledge of:

* Work place hazards
* Hazard measurement and control
* Work place accidents
* Accidents contingency measures
* Engineering materials
* Workshop tools, equipment and machines
* Material preservation methods
* Waste management
* Housekeeping procedures

EVIDENCE GUIDE

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

|  |  |
| --- | --- |
| 1. Critical aspects of competency | Assessment requires evidence that the candidate:   * 1. Controlled workplace hazards and risks per workplace requirements   2. Managed workplace accidents and incidents as per workplace requirements   3. Classified engineering materials as per job requirement   4. Calibrated workshop tools and equipment as per manufactures manual   5. Maintained tools and equipment as per the workplace procedures   6. Carried out materials preparation as per task requirement   7. Applied joinery methods as per task requirement   8. Applied preservation method as per work requirement   9. Applied workshop layout as per workplace requirement   10. Prepared management inventory as per work requirement   11. Prepared maintenance schedules as per workplace procedure   12. Carried out waste sorting and disposal as per workplace procedure |
| 2.Resource Implications | The following resources should be provided:   1. Access to relevant workplace where assessment can take place 2. Appropriately simulated environment where assessment can take place 3. Resources relevant to the proposed assessment activity or tasks. |
| 3. Methods of Assessment | Competency in this unit may be assessed through:   * 1. Practical   2. Project   3. Portfolio of evidence   4. Third party report   5. Written tests |
| 4.Context of Assessment | Competency may be assessed in a workplace or in a simulated workplace |
| 5. Guidance information for assessment | Holistic assessment with other units relevant to the industry sector, workplace and job role is recommended |

## APPLY MATHEMATICS

**UNIT CODE:** 0541 451 06A

**UNIT DESCRIPTION:**

This unit describes the competences required in order to apply algebra, trigonometric functions, coordinate geometry, statistics, vector theorem, matrices and to carry out mensuration.

**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 task requirement   2. Calculations involving logarithms are performed as per task requirement   3. Scientific calculator is used in solving mathematical problems as per task requirement   4. Simultaneous equations are solved as per task requirement   5. Quadratic equations are solved as per as per task requirement |
| * 1. Apply trigonometric functions | * 1. Calculations involving trigonometry are performed as per task requirement   2. Calculations involving reciprocal trigonometric functions are performed as per task requirement   3. Pythagorean trigonometric identity is applied as per task requirement |
| * 1. Carry out mensuration | 3.1 Units of measurements and their symbols are determined as per task requirement  3.2 Conversion of units of measurement are performed as per task requirement  3.3 Calculation of length, width, height, perimeter, area and angles of figures is performed as per task requirement  3.4 Measurements and estimations of quantities is performed as per task requirement |
| * 1. Apply statistics and probability | 4.1 Presentation of data is done as per task requirement  4.2 Measures of ***central tendency*** are obtained as per task requirement  4.3 Measures of ***dispersion*** are obtained as per task requirement   * 1. Probability of occurrence of events are determined |

**RANGE**

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

| **Variable** | **Range** |
| --- | --- |
| 1. Central tendency may include but not limited to: | * 1. Mean   2. Mode   3. Median |
| 1. Dispersion may include but not limited to: | * 1. Variance   2. Standard deviation |

**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
* 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

**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. Solved simultaneous equations as per task requirement   2. Solved quadratic equations as per as per task requirement   3. Performed calculations involving trigonometry as per task requirement   4. Determined normal and tangents as per task requirement   5. Performed calculation of length, width, height, perimeter, area and angles of figures as per task requirement   6. Obtained measures of central tendency as per task requirement |
| 1. Resource Implications | The following resources should be provided:   * 1. Appropriately simulated environment where assessment can take place   2. Access to relevant work environment   3. Resources relevant to the proposed activities or tasks |
| 1. Methods of Assessment | * 1. Competency in this unit may be assessed through:   2. Written tests   3. Portfolio of evidence   4. Third party report |
| 1. Context of Assessment | Competency may be assessed in the workplace or simulated workplace |
| 1. Guidance information for assessment | Holistic assessment with other units relevant to the industry sector and workplace job role is recommended. |

## APPLY TECHNICAL DRAWING

**UNIT CODE: 0732 441 07A**

**UNIT DESCRIPTION**

This unit covers the competences required to apply technical drawings. It involves using technical drawing tools, equipment and materials, producing plane geometry drawings, orthographic drawings of components, solid geometry drawings, isometric drawings and assembly drawings.

**ELEMENTS AND PERFORMANCE CRITERIA**

| **ELEMENT** | **PERFORMANCE CRITERIA**  ***(Bold and italicized terms are elaborated in the Range)*** |
| --- | --- |
| 1. Use and maintain drawing equipment and materials | 1.1 ***Drawing equipment*** are identified and gathered according to task requirements  1.2 ***Drawing materials*** are identified and gathered according to task requirements  1.3 Drawing equipment are used as per task requirement |
| 1. Produce plane geometry drawings | * 1. Different **types of lines** used in drawing and their meanings are identified according to standard drawing conventions   2. Different **types of angles** are constructed as per task requirement   3. Angles are bisected as per task requirement   4. Different types of angles are measured using appropriate measuring tools   5. Different types of plane geometric forms are constructed as per task requirement   6. Different scales are constructed as per task requirement |
| 1. Produce orthographic drawings of components | * 1. First and third angle orthographic sketches and drawings of components are interpreted and produced as per task requirement   2. Freehand sketching of different types of geometric forms, tools, equipment, diagrams and components is conducted as per task requirement   3. Sections of different forms of projection are constructed as per task requirement   4. Dimensioning of orthographic drawings |
| 1. Produce ***solid geometry drawings*** | * 1. Sketches and drawings of patterns are produced as per task requirement   2. Solids are produced as per task requirement   3. Solids are developed and interpenetrated as per task requirement   4. Different symbols and abbreviations are applied as per task requirement   5. Auxiliary views and true shapes are produced as per task requirement |
| 1. Produce isometric drawings | 1. Isometric sketches and drawings of components are interpreted and produced as per task requirement 2. Isometric curves and circles are interpreted and produced as per task requirement 3. Oblique sketches are constructed as per task requirement 4. Oblique curves and circles are interpreted and produced as per task requirement |
| 1. Produce assembly drawings | 1. Parts are assembled on orthographic views as per task requirement 2. ***Sectional views*** are produced as per task requirement 3. Produced drawing is hatched as per task requirement 4. Part lists are identified as per task requirement |

**RANGE**

| **Variable** | **Range**  ***May include but is not limited to:*** |
| --- | --- |
| 1. Drawing equipment include but are not limited to: | * 1. Drawing boards   2. T-square   3. Set squares   4. Drawing set |
| 1. Drawing materials include but are not limited to: | * 1. Drawing papers   2. Pencils   3. Erasers   4. Masking tapes   5. Paper clips |
| 1. Types of lines include but are not limited to: | * 1. Boarder lines   2. Faint continuous lines   3. Broken lines   4. Chain lines   5. Centre lines   6. Cutting lines |
| 1. Types of angles include but are not limited to: | * 1. 30 degrees   2. 45 degrees   3. 60 degrees   4. 90 degrees   5. 180 degrees |
| 1. Symbols and abbreviations include but are not limited to: | * 1. First angle   2. Third angle   3. E.g. of abbreviations   4. Scale- 1:2   5. Diameter – D20   6. Radius -R20 |
| 1. Isometric sketches and drawings include but are not limited to: | * 1. Use of 30 degrees |
| 1. Orthographic drawings include but are not limited to: | * 1. Front view   2. End view   3. Plan view |
| 1. Pictorial views include but are not limited to: | * 1. Front view   2. End view   3. Plan view |
| 1. Sectional views include but are not limited to: | * 1. Cutting lines   2. Assembled view |
| 1. Geometric forms include but are not limited to: | * 1. Circles   2. Triangles   3. Rectangles   4. Parallelogram   5. Polygons   6. Pyramids   7. Conic sections   8. Prisms   9. Loci |

**REQUIRED SKILLS AND KNOWLEDGE**

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

**Required skills**

The individual needs to demonstrate the following skills:

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

**Required knowledge**

The individual needs to demonstrate knowledge of:

* Drawing equipment and materials
* Freehand sketching
* Lettering
* Geometrical constructions
* Types of drawings
* Types of lines
* Isometric drawing conventions, features, characteristics, components
* Orthographic drawing conventions, features, characteristics, components
* Sketches and drawings of simple patterns

**EVIDENCE GUIDE**

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

|  |  |
| --- | --- |
| 1. Critical aspects of Competency | Assessment requires evidence that the candidate:   * 1. Used drawing equipment as per task requirement   2. Developed patterns as per task requirement   3. Developed and interpenetrated solids as per task requirement   4. Constructed sections of different forms of projection as per task requirement   5. Assembled parts on orthographic views as per task requirement |
| 1. Resource Implications | The following resources should be provided:   * 1. Appropriately simulated environment where assessment can take place   2. Access to relevant work environment   3. Resources relevant to the proposed activities or tasks |
| 1. Methods of assessment | Competency in this unit may be assessed through:   * 1. Portfolio of evidence   2. Practical test   3. Third party report   4. Written tests   5. Project work |
| 1. Context of Assessment | Competency may be assessed in the workplace or simulated workplace |
| 1. Guidance information for assessment | Holistic assessment with other units relevant to the industry sector and workplace job role is recommended. |

## APPLY MECHANICAL SCIENCE

**UNIT CODE: 0715 441 08A**

**UNIT DESCRIPTION**

This unit describes the competences required in order to apply mechanical science. It includes resolving forces, determining effects of loads in mechanical systems, analysing properties of materials, determining the nature of friction in mechanical systems and solving problems related to motion.

**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. Resolve forces | * 1. Theorems of forces are applied according to job requirements   2. Forces are resolved as per force theorems   3. Resultant forces are applied as per job requirements |
| 1. Determine effects of loads in mechanical systems. | 1. ***Types of forces*** are applied as per job requirements 2. Equilibrium of forces and plane framework are calculated as per job requirements 3. Point loads are analyzed as per job requirements 4. Principle of moments is applied as per work requirements. |
| 1. Analyze properties of materials | * 1. ***Mechanical properties*** and stress are applied as per job requirements   2. Mechanical properties of materials are tested as per job requirements   3. Direct stresses are calculated as per job requirements   4. Materials are selected are as per job requirements |
| 1. Determine the nature of friction in mechanical systems | * 1. Friction is applied as per job requirements   2. Laws of friction are applied as per job requirements   3. Effects of friction are established as per job requirements   4.4 Tools and equipment are operated as per job requirements |
| 1. Solve problems related to motion. | * 1. Laws of motion are applied as per job requirements   2. Parameters of motion are calculated as per job requirements   3. Motion graphs are drawn as per job requirements   4. Relationship between linear and angular motion is established as per job 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**  ***May include but not limited to:*** |
| --- | --- |
| 1. Types of forces | 1. Friction 2. Centrifugal 3. Centripetal 4. Gravitational 5. Inertia 6. Shear |
| 1. Mechanical properties | * 1. Tensile strength   2. Young modulus   3. Brittleness   4. Compressive strength   5. Shear strength   6. Plasticity   7. Modulus of rigidity Elasticity |

**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:

* Use of basic mechanical machines
* Perform various unit conversions of engineering quantities
* Logical thinking
* Problem solving
* Drawing graphs

**Required knowledge**

The individual needs to demonstrate knowledge of:

* Newton’s laws of motion
* Laws of conservation of energy
* Laws of friction
* Types of forces
* Mechanical advantage and efficiency
* Properties of materials
* SI units of physical quantities
* Power, energy, work done, torque and safety factor

**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. Resolved forces as per force theorems   2. Applied principle of moments as per work requirements   3. Applied mechanical properties and stress as per job requirements   4. Calculated direct stresses as per job requirements   5. Applied laws of friction as per job requirements   6. Applied laws of motion as per job requirements |
| 1. Resource implications | The following resources should be provided:   * 1. Appropriately simulated environment where assessment can take place   2. Access to relevant work environment   3. Resources relevant to the proposed activities or tasks |
| 1. Methods of Assessment | Competency in this unit may be assessed through:   * 1. Portfolio of evidence   2. Practical test   3. Third party report   4. Written tests   5. Project work |
| 1. Context of Assessment | Competency may be assessed in the workplace or simulated workplace |
| 1. Guidance information for assessment | Holistic assessment with other units relevant to the industry sector and workplace job role is recommended. |

## APPLY ELECTRICAL AND ELECTRONICS PRINCIPLES

**UNIT CODE: 0713 441 09A**

**UNIT DESCRIPTION**

This unit describes the competences required in order to apply electrical and electronics principles. It involves applying basic concepts of electrical quantities, cells and batteries, magnetism and electromagnetism, basic electrical machines and electronics 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. Apply basic concepts of electrical quantities | * 1. ***SI unit***s in Electrical are identified as per task requirement   2. ***Quantitie***s of Charge, force, work and power are applied as per task requirement   3. Calculations involving Ohm’s law are performed as per task requirement   4. Measuring instruments for electrical quantities are applied as per task requirement |
| 1. Apply DC and AC circuits | 1. Calculations of DC parallel and series circuits are performed as per task requirement 2. Calculations involving series resistor, inductor and capacitors in AC circuits are performed as per task requirement 3. Calculations involving parallel resistor, inductor and capacitors in AC circuits are performed as per task requirement |
| 1. Apply the concept of cells and batteries | 1. Various sources of electricity are used as per task requirement 2. Electrolysis is applied as per task requirement 3. E.M.F and internal resistance of cells is determined as per task requirement 4. Primary and secondary cells are applied as per task requirement 5. Cells and batteries are applied as per task requirement 6. Maintenance of batteries is carried out as per task requirement |
| 1. Apply magnetism and electromagnetism | * 1. Magnetic and nonmagnetic materials are used as per task requirement   2. Magnetic field patterns are utilized as per task requirement   3. Force on current carrying conductor is applied as per task requirement   4. Magnetic circuit quantities are applied as per task requirement   5. Magnetism curve and hysteresis loop are applied as per task requirement   6. Electromagnetic induction principle is applied as per task requirement |
| 1. Apply basic electrical machines | 1. E***lectrical machines*** are applied as per task requirement 2. DC machines are applied as per task requirement 3. AC machines are applied as per task requirement |
| 1. Apply electronics components | 6.1 Capacitors are applied as per task requirement  6.2 Resistors are applied as per task requirement   * 1. Inductors are applied as per task requirement   2. Diodes are applied as per task requirement   3. Application and testing of electronics components is performed as per task requirement |

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

**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:

* Use of electrical instruments
* Power factor correction
* Logical thinking
* Problem solving
* Drawing graphs
* Using different measuring tools

**Required knowledge**

The individual needs to demonstrate knowledge of:

* Electrical power calculations
* Electrical formulas
* Power triangle
* SI units of various electrical parameters
* Types of electrical machines for various uses
* Types and purpose of measuring instruments
* Units of measurement and abbreviations

**EVIDENCE GUIDE**

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

|  |  |
| --- | --- |
| 1. Critical aspects of competency | Assessment requires evidence that the candidate:   * 1. Applied quantities of Charge, force, work and power as per task requirement   2. Performed calculations involving Ohm’s law as per task requirement   3. Performed calculations of DC parallel and series circuits as per task requirement   4. Determined E.M.F and internal resistance of cells as per task requirement   5. Applied force on current carrying conductor as per task requirement   6. Applied electrical machines as per task requirement   7. Applied capacitors as per task requirement   8. Applied resistors as per task requirement   9. Applied inductors as per task requirement |
| 1. Resource implications | The following resources should be provided:   * 1. Appropriately simulated environment where assessment can take place   2. Access to relevant work environment   3. Resources relevant to the proposed activities or tasks |
| 1. Methods of assessment | Competency in this unit may be assessed through:   * 1. Portfolio of evidence   2. Practical test   3. Third party report   4. Written tests   5. Project work |
| 1. Context of assessment | Competency may be assessed in the workplace or simulated workplace |
| 1. Guidance information for assessment | Holistic assessment with other units relevant to the industry sector and workplace job role is recommended. |

## APPLY ENGINEERING MATHEMATICS

**UNIT CODE:** 0541 541 10A

**Unit Description**

This unit describes the competences required in order to apply engineering mathematics. It enables the learner to; Apply complex numbers, Perform coordinates geometry, Carry out binomial expansion, Apply calculus, Apply vector theorem and Apply matrices.

**ELEMENTS AND PERFORMANCE CRITERIA**

| **ELEMENT**  These describe the key outcomes which make up workplace function. | **PERFORMANCE CRITERIA**  These are assessable statements which specify the required level of performance for each of the elements.  ***(Bold and italicised terms are elaborated in the Range)*** |
| --- | --- |
| 1. Apply complex numbers | * 1. Complex numbers are represented on Argand diagrams as per job requirement   2. ***Operations*** involving complex numbers are performed as per job requirement   3. De Moivre’s theorem is applied as per as per job requirement |
| 1. Perform coordinates geometry | * 1. Polar equations are solved as per job requirement   2. Polar equations graphs are drawn as per job requirement   3. Normal and tangents are determined as per job requirement |
| 1. Carry out binomial expansion | * 1. Binomial series is determined as per as per job requirement   2. Roots of numbers are determined as per job requirement   3. Errors of small changes are determined as per job requirement |
| 1. Apply calculus | * 1. Derivatives of functions are determined as per job requirement   2. Differentiation is applied as per job requirement   3. Integrals of functions are determined as per job requirement   4. Integration is applied as per job requirement |
| 1. Apply vector theorem | * 1. Vectors and scalar quantities are defined as per job requirement   2. ***Operations*** on vectors are performed as per job requirement   3. Position vectors are determined as per as per job requirement   4. Resolution of vectors is performed as per job requirement   5. Vector and scalar products are obtained as per job requirement |
| 1. Apply matrices | * 1. Matrices operations are performed as per job requirement   2. Inverse of matrices are obtained as per job requirement   3. Simultaneous equations are solved using matrices as per job requirement |

**RANGE**

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

| **Variable** | **Range** |
| --- | --- |
| 1. Operations may include but not limited to: | * 1. Addition   2. Subtraction   3. Multiplication   4. Division |
| 1. binomial expansion | * 1. Powers   2. Coefficients   3. Pascals triangle   4. Expansion   5. Binomial theorem   6. Positive powers of n   7. Negative powers of n   8. Fractional powers of n (roots) |
| 1. calculus | * 1. Power   2. Product   3. Chain   4. Quotient |
| 1. vector theorem | * 1. Dot product   2. Cross product   3. Resolution of vectors   4. Analysis   5. Graphical Methods   6. Triangle theorem   7. Parallel theorem   8. Polygon theorem |

**REQUIRED KNOWLEDGE AND UNDERSTANDING**

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 and understanding of:

* Basic calculus
* Geometry
* Fundamental operations (addition, subtraction, division, multiplication)
* Calculating area and volume
* 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 understanding and range.

|  |  |
| --- | --- |
| 1. Critical aspects of competency | Assessment requires evidence that the candidate:   1. Applied complex numbers as per job requirement 2. Applied coordinates geometry as per job requirement 3. Applied calculus as per job requirement 4. Carried out binomial expansion as per job requirement 5. Applied vector as per job requirement 6. Applied matrices as per job requirement |
| 1. Resource implications | The following resources should be provided:  2.1 Access to relevant workplace where assessment can take place  2.2 Appropriately simulated environment where assessment can take place  2.3 Resources relevant to carrying out the tasks required |
| 1. Methods of assessment | Competency may be assessed through:   * 1. Written tests   2. Third party report   3. Portfolio of evidence |
| 1. Context of assessment | Competency may be assessed:   * 1. At the workplace   2. In a simulated work environment |
| 1. Guidance information for assessment | Holistic assessment with other units relevant to the industry sector, workplace and job role is recommended. |

## APPLY ENGINEERING MECHANICS

**UNIT CODE:** 0715 541 11A

**UNIT DESCRIPTION**

This unit of competency describes the competences required in order to apply engineering mechanics principles. This includes applying simple mechanisms, design belts, ropes and chain drives, design toothed gears and gear trains, design mechanical rotor dynamic machines, apply stress and strain concepts, apply simple bending theory and apply torsion theory in mechanical systems.

**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 simple mechanisms | * 1. Mechanisms are designed as per job requirement   2. Mechanisms are selected as per job requirement   3. Linkages are designed as per job requirement |
| 1. Design belts, ropes and chain drives | * 1. Belt drives are designed as per job requirement   2. Rope drives are designed as per job requirement   3. Chain drives are designed as job requirement |
| 1. Design toothed gears and gear trains | * 1. ***Toothed gears*** are designed as per job requirement   2. Toothed gears are selected as per job requirement   3. Gears are serviced as per job requirement |
| 1. Design mechanical rotor dynamic machines | * 1. Pumps are designed as per job requirement   2. Pumps are selected as per job requirement   3. Rotary compressors are designed as per job requirement   4. Fans and vanes are designed as per job requirement |
| 1. Apply stress and strain concepts in mechanical systems | * 1. Common engineering materials are selected as job requirement   2. ***Engineering components*** are designed as job requirement   3. Engineering components are selected as per job requirement |
| 1. Determine loading conditions in mechanical systems | * 1. Structures are designed as per job requirement   2. Structures are selected as per job requirement   3. Beams are designed as per job requirement   4. Beams are selected as per job requirement |
| 1. Apply simple bending theory in mechanical systems | * 1. Beams are designed as per job requirement   2. Beams are selected as per job requirement   3. Shafts are designed as per job requirement   4. Shafts are selected as per job requirement |
| 1. Apply torsion theory in mechanical systems | * 1. Torque of components is obtained as per job requirement   2. Shafts are designed as per job requirement   3. Shafts are designed as per job requirement   4. Angle of twist of components is obtained as per job requirement |

**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. Simple machines | * 1. Pulley   2. Wedge   3. Inclined plane   4. Pulley   5. Wheel and axle   6. Screw jack |
| 1. Toothed gears | * 1. Bevel gears   2. Spur gears   3. Worm gears   4. Spiral bevel gears   5. Helical gears |
| 1. Engineering components | * 1. Beams   2. Thin cylinders   3. Thin shells |

**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:

* Arithmetic skills
* Mechanical machine operation
* Critical thinking
* Analytical skills

**Required knowledge**

The individual needs to demonstrate knowledge of:

* General Physics
* Engineering Mathematics
* Measurements

**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. Designed simple machines as per job requirement   2. Selected beams and shafts as per job requirement   3. Selected mechanisms as per job requirement   4. Designed belt drives as per laws of tension   5. Selected toothed gears as per job requirement   6. Designed pumps as per job requirement   7. Designed engineering components as per job requirement   8. Designed shafts as per job requirement   9. Obtained torque of components as per job requirement |
| 2. Resource Implications | The following resources should be provided:   * 1. Appropriately simulated environment where assessment can take place   2. Access to relevant work environment   3. Resources relevant to the proposed activities or tasks |
| 3. Methods of Assessment | Competency in this unit may be assessed through:   * 1. Project   2. Practical   3. Written tests   4. Oral Questioning   5. Portfolio of evidence |
| 1. 4. Context of Assessment | Competency may be assessed in a workplace or simulated workplace |
| 1. 5. Guidance information for assessment | Holistic assessment with other units relevant to the industry sector, workplace and job role is recommended. |

## APPLY ELECTRONICS AND CONTROL PRINCIPLES

**UNIT CODE:** 0713541 12A

**UNIT DESCRIPTION**

This unit describes the competences required in order to apply electronics and control principles. This includes using basic electrical quantities and principles, D.C and A.C circuits in electrical installation, applying safety requirements for electricity, electronics, magnetism and electromagnetism, single and three phase power supply and applying sensors, transducers and control principles, Cells and batteries

**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 safety requirements for electricity | 1. Usage of ***personal protective equipment*** is demonstrated as per job requirement 2. ***Electrical hazards*** are controlled as per job requirement 3. Methods of electric hazard prevention are applied as per job requirement |
| * + 1. Apply understanding of electronics | * 1. ***Electronic component*** is identified as per job requirement   2. Functionality of the electronic components is tested as per job requirement   3. Electronic components are applied in electrical circuits as per job requirement   4. Testing of electronic circuit components is performed as per job requirement |
| * + 1. Perform single and three phase power supply | * 1. Single and three phase concept is applied in as per job requirement   2. Connections of single and three phase power supply are performed as per job requirement   3. Measurement of single and three phase power is performed as per job requirement |
| * + 1. Apply sensors and transducers principles | 1. Types of ***sensors and transducer*** are identified as per job requirement 2. Sensors and transducers mode of action are determined as per job requirement 3. Sensors and transducers components are applied as per job requirement |
| * + 1. Apply control principles | * 1. Modes of control are identified as per job requirement   2. Special features of PLC are applied as per job requirement   3. Operations of PLCs are applied as per job requirement |

**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. Electric hazard includes but not limited to: | * Shocks * Explosions * Electrocution * Burns * Fires * Electric arc |
| 1. Electrical hazard protection includes but not limited to: | * Head protection * Insulating gloves * LOTTO * Eye protection |
| 1. Electronic components includes but not limited to: | * Diodes * Capacitor * Resistors * Transistors * Fuse |
| 1. Sensors and transducermay include but not limited to: | * Temperature * Level * Displacement and proximity * Viscosity * Moisture * Humidity   Pressure |

**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
* 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
* Lightening arrestor testing
* Selecting the correct type of electrical machines for various uses
* Types and purpose of measuring instruments
* Units of measurement and abbreviations

**EVIDENCE GUIDE**

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

|  |  |
| --- | --- |
| 1. Critical aspects of competency | Assessment requires evidence that the candidate:   * 1. Performed calculations involving Ohm’s law as per job requirement   2. Performed basic electrical and electronic measurements as per job requirement   3. Performed connections involving parallel and series circuits as per job requirement   4. Carried out measurement of voltages and current in AC and DC as per job requirement   5. Controlled ***electrical hazards*** as per job requirement   6. Applied electronic components in electrical circuits as per job requirement   7. Applied concepts of magnetic fields and magnetic field distribution as per job requirement   8. Applied single and three phase concepts as per job requirement   9. Applied sensors and transducers components as per job requirement   10. Applied operations of PLCs as per job requirement   11. Applied concepts of cells and batteries as per job requirement |
| 1. Resource Implications | The following resources should be provided:   * 1. Appropriately simulated environment where assessment can take place   2. Access to relevant work environment   3. Resources relevant to the proposed activities or tasks |
| 1. Methods of Assessment | Competency in this unit may be assessed through:   * 1. Project   2. Practical   3. Written tests   4. Portfolio of evidence |
| 1. Context of Assessment | Competency may be assessed in a workplace or simulated workplace |
| 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:** 0715 541 13A

**Unit Description**

This unit describes the competences required in order to apply thermodynamics and fluid mechanics in their work. It includes applying steady flow processes, perfect gas, steam cycles, fuel and combustion, heat transfer and heat exchangers, operating of air compressors.

**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 Thermodynamic Processes | 1. Apply knowledge of basic thermodynamics 2. The ***Laws of Thermodynamics*** to a Non-flow Process and Steady Flow Process are applied as per the task requirements 3. ***Thermodynamic Processes*** are applied as per the task requirements 4. ***Thermodynamics systems*** are applied as per task requirement 5. Applying heating and expansions of gases and Work done During a Non-flow Process as per the task requirements 6. General Laws for Expansion and Compression are applied as per the task requirements 7. Application of Steady Flow Energy Equation to Engineering Systems as per the task requirements |
| 1. Apply knowledge of perfect gases | 1. ***Laws of Perfect Gases*** are applied as per the task requirements 2. General Gas Equation is derived as per the task requirements 3. Characteristic Equation of Gas is applied as per the task requirements 4. Universal Gas Constant or Molar Constant is determined as per the task requirements 5. ***Specific Heat*** is determinedas per the task requirements |
| 1. Apply knowledge of steam cycle | 1. Thermodynamics ***steam cycles*** are applied as per task requirements 2. Steam systems are controlled and determined as per task requirement 3. Energy balance is carried out in steam cycles as per work requirements. 4. Thermodynamics ***steam turbines*** are applied as per task requirements |
| 1. Apply knowledge of fuel combustion | * 1. Elements and Compounds of fuel are determined as per the task requirement   2. Combustion Equations of Fuels is applied as per the task requirement   3. ***Conversion analysis*** of fuels is determined as per the task requirement   4. Mass of Carbon in Flue Gases and Mass of Flue Gases per kg of Fuel Burnt is determined as per the task requirement   5. Excess Air Supplied is determined as per the task requirement   6. Flue Gas Analysis by Orsat Apparatus is determined as per the task requirement |
| 1. Apply heat transfer and heat exchangers in fluid | 1. ***Heat transfer media*** is selected as per work requirements. 2. *Heat exchangers* are applied as per task requirement 3. Heat transfer is regulated as per task requirement |
| 1. Operate air compressors | 1. Air Compressors are classified as per the task requirements 2. Working of Single Stage Reciprocating Air Compressor is determined as per the task requirements 3. Work-done by a Single Stage Reciprocating Air Compressor without Clearance Volume is determined as per the task requirements 4. Power Required to Drive a Single Stage Reciprocating Air Compressor is determined as per the task requirements 5. Work-done by Reciprocating Air Compressor with Clearance Volume is determined as per the task requirements 6. Multistage Compression is determined as per the task requirements 7. Power Required to Drive a Two-stage Reciprocating Air Compressor is determined as per the task requirements 8. Minimum Work Required for a Two-stage Reciprocating Air Compressor is determined as per the task requirements |

**RANGE**

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

| **Variable** | **Range** |
| --- | --- |
| 1. Laws of Thermodynamicsmay include but not limited to: | * Zeroth law of thermodynamics * First law of thermodynamics * Second law of thermodynamics |
| 1. Thermodynamic Processes may include but not limited to: | * Non-flow Process. * Constant Volume Process * Constant Pressure Process * Hyperbolic Process. * Constant Temperature Process * Adiabatic Process * Polytropic Process. |
| 1. Laws of Perfect Gases may include but not limited to: | * Boyle's Law * Charles' Law * Gay-Lussac Law * Joule's Law * Avogadro's Law |
| 1. Specific Heat may include but not limited to: | * Constant Volume * Constant Pressure |
| 1. Steam cycles may include but not limited to: | * Rankine * Carnot * reheat * regenerative |
| 1. Steam turbines may include but not limited to: | * Impulse Turbines * Reaction turbines |
| 1. Conversion analysis may include but not limited to: | * Mass to volume * Volume to mass |
| 1. Thermodynamics systems may include but not limited to: | * Boundary and surrounding * Closed systems * Open systems * Isolated systems * Adiabatic system * Homogeneous systems * Heterogeneous systems |
| 1. Heat transfer media may include but not limited to | * Composite wall * Slab * Thick Cylinder * Thick Sphere |
| 1. Heat exchangers may include but not limited to | * Double pipe heat exchanger * Shell and tube heat exchanger * Plate heat exchanger * Condenser and boiler heat exchanger |
| 1. Air compressor may include but not limited to | * Rotary compressors * Reciprocating compressors * Axial compressors * Centrifugal compressors |

**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:

* Problem solving
* Creativity and innovation
* Use of tools and equipment
* Communication skills

**Required knowledge**

The individual needs to demonstrate knowledge of:

* Thermodynamics cycles
* Thermodynamics systems
* Steady flow energy equations
* Laws of thermodynamics
* Perfect gas laws
* Compression and expansion of gases
* Power cycles
  + Rankine cycle
  + Regenerative cycle
  + Reheat cycle
  + Binary cycle
* Types of fuels
* Combustion equations
* Calorific values of fuels
* Combustion analysis
* Principles of heat transfer
* Heat transfer media
* Heat exchangers
* Types of compressors

**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 thermodynamics cycles and systems as per task requirement 2. Applied steady flow energy equations as per laws of thermodynamics. 3. Applied steam systems as per task requirement 4. Controlled fuel combustion as per task requirement 5. Applied heat exchangers as per task requirement 6. Applied air compressor as per work requirements |
| 1. Resource implications | The following resources should be provided:  2.1 Access to relevant workplace where assessment can take place  2.2 Appropriately simulated environment where assessment can take place  2.3 Resources relevant to carrying out the tasks required |
| 1. Methods of assessment | Competency may be assessed through:   1. Practical 2. Written tests 3. Third party report 4. Portfolio of Evidence |
| 1. Context of assessment | Competency may be assessed:  4.1 At the workplace  4.2 In a simulated work environment |
| 1. Guidance information for assessment | * 1. Holistic assessment with other units relevant to the industry sector, workplace and job role is recommended. |

## APPLY FLUID MECHANICS PRINCIPLES

**UNIT CODE:** 0715 541 14A

**Unit Description**

This unit describes the competences required in order to apply thermodynamics and fluid mechanics in their work. It includes applying the knowledge of the flow of fluids, viscous flow of fluids, dimensional and models 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. Apply knowledge of flow of fluids | 1. **Losses of energy in pipes** are determine as per the task requirements 2. The hydraulic gradient and total energy lines of the flowing fluids are determined as per the task requirements 3. Power Transmission of the flowing fluid Through Pipes are determine as per the task’s requirements |
| 1. Apply knowledge of viscous flow of fluids | 1. ***Flow of Viscous Fluid*** are determined as per task requirements 2. Kinetic energy correction and momentum are determined as per task requirements 3. ***power* absorbed in viscous flow** is determined as per the task requirements |
| 1. Apply dimensional and models analysis fluids | 1. ***Derived quantities*** and dimensional homogeneity are determined as per task requirements 2. ***Methods of dimensional analysis*** are determined as per the task requirements 3. ***Model Analysis*** is applied as per the task requirements 4. ***Model Laws*** are applied as per the task requirements |
| 1. Operate fluid pumps | * 1. The parts of ***Fluid pumps*** are identified as per task requirement   2. Worked done and power by the Fluid pumps are determined as per task requirement   3. Specific speed of the centrifugal pump is determined as per the task requirements   4. Variation of Velocity and Acceleration in the Suction and Delivery Pipes Due to Acceleration of the Piston in reciprocating pump is determined as per the task requirements |

**RANGE**

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

| **Variable** | **Range** |
| --- | --- |
| 1. Losses of energy in pipesmay include but not limited to: | * Loss of Energy (or head) Due to Friction * Loss of Head Due to Sudden Enlargement * Loss of Head Due to Sudden Contraction * Loss of Head at the Entrance of a Pipe * Loss of Head at the Exit of Pipe * Loss of Head Due to an Obstruction in a Pipe * Loss of Head Due to Bend in Pipe * Loss of Head in Various Pipe Fittings |
| 1. Flow of Viscous Fluidmay include but not limited to: | * Circular pipe * Between Two Parallel Plates |
| 1. Power absorbed in viscous flowmay include but not limited to: | * Viscous Resistance of Journal Bearings * Viscous Resistance of Foot-step Bearing * Viscous Resistance of Collar Bearing * Loss of Head Due to Friction in Viscous Flow |
| 1. Derived quantities may include but not limited to: | * Fundamental * Geometric * Kinematic Quantities * Dynamic Quantities |
| 1. Methods of dimensional analysis may include but not limited to: | * Rayleigh’s method * Buckingham’s pi-theorem. |
| 1. Model Analysismay include but not limited to: | * Similitude-Types of Similarities * Types of Forces Acting in Moving Fluid * Dimensionless Numbers * Reynold’s Number (Re) * Froude’s Number (Fe) * Euler’s Number (Eu) * Weber’s Number (We) * Mach’s Number (M) |
| 1. Fluid pump may include but not limited to: | * Reciprocating pump * Centrifugal pump |

**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:

* Problem solving
* Creativity and innovation
* Use of tools and equipment
* Communication skills

**Required knowledge**

The individual needs to demonstrate knowledge of:

* Fluid flow.
* Types of fluid pumps
* Dimensional analysis

**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 losses of energy in pipes as per the task requirement. 2. Applied power absorbed by viscous fluid as per the task requirement. 3. Applied model analysis as per the task requirement. 4. Applied fluid pump as per work requirements 5. Controlled fluid flow discharge losses as per as per task requirement |
| 1. Resource implications | The following resources should be provided:  2.1 Access to relevant workplace where assessment can take place  2.2 Appropriately simulated environment where assessment can take place  2.3 Resources relevant to carrying out the tasks required |
| 1. Methods of assessment | Competency may be assessed through:   1. Practical 2. Written tests 3. Third party report 4. Portfolio of Evidence |
| 1. Context of assessment | Competency may be assessed:  4.1 At the workplace  4.2 In a simulated work environment |
| 1. Guidance information for assessment | * 1. Holistic assessment with other units relevant to the industry sector, workplace and job role is recommended. |

## PERFORM COMPUTER AIDED DRAWING

**UNIT CODE:** 0715 651 15A

**Unit Description**

This unit covers the competences required to perform computer aided drawing. It involves navigating CAD software, producing geometric, pictorial, orthographic and assembly drawings as well as designing mechanical components.

**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. Navigate CAD software | 1. Computing equipment and software are identified according to task requirement 2. Drawing ***CAD software*** is applied as per work requirements 3. CAD Software templates are identified as per drawing requirement 4. ***CAD Files*** are imported into working space as per drawing requirements 5. Symbols, codes and standards to be applied are identified according to software functionality 6. ***Drawing elements*** are applied according to task requirement 7. ***Editing tools*** are applied according to task requirement |
| 1. Produce geometric drawings | * 1. ***Drawing lines*** are identified according to standard drawing conventions   2. ***Geometrical forms*** are constructed according to standard drawing conventions   3. ***Types of angles*** are constructed according to principles of trigonometry   4. ***Geometric drawings*** are developed in accordance with standard conventions |
| 1. Produce pictorial drawings | * 1. Drawing symbols and abbreviations are applied according to standard drawing conventions   2. ***Pictorial drawings*** are produced as per work requirements   3. Pictorial drawings are saved as per work requirements |
| 1. Produce orthographic drawings. | 1. First angle orthographic drawings are developed as per standard conventions of orthographic drawings 2. Third angle orthographic drawings are developed as per standard conventions of orthographic drawings 3. Orthographic drawings are saved as per work requirements |
| 1. Produce assembly drawings | 1. Orthographic views are exploded according to standard conventions of orthographic drawings 2. Pictorial views are exploded according to standard conventions of pictorial drawings 3. Orthographic and pictorial views are assembled as per drawing specifications 4. Sectional views are produced according to standard conventions of drawing 5. Parts list is developed according to drawing schematic |
| 1. Design mechanical components | 1. Mechanical components are designed as per work requirements 2. Computer aided engineering (CAE) is applied in simulation as per work requirements 3. Improvements to increase efficiency is determined according to design analysis results 4. Manufacturing database is created according to manufacturing process 5. Improvements on designed document is achieved according the manufacturing design |

**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. CAD software may include but not limited to: | * + AutoCAD   + Inventor   + SolidWorks |
| 1. CAD Files may include but not limited to | * DWG * STL * DXF * STEP |
| 1. Drawing elements may include but not limited to: | * Points * Line angles * Circles and arcs * Planes (horizontal, vertical) * Figures and solids * Shapes |
| 1. Editing tools may include but not limited to: | * Delete, undo and redo commands * Fillet and chamfer commands * Trim, extend and break commands * Zoom and pan commands * Move, copy, and paste commands * Rotate and mirror commands * Object snapping and grouping commands * Dimension and scaling commands |
| 1. types of lines may include but not limited to: | * Dimension lines * Hidden detail lines * Extension lines * Section lines * Break lines * Chain |
| 1. types of geometric forms may include but not limited to: | * Circle * Rectangle * Triangle * Polygon |
| 1. Types of angles may include but not limited to | * Acute * Obtuse * Right |
| 1. Geometrical drawings may include but not limited to | * 2-Dimensional * 3-Dimensional * Orthographic * Isometric |
| 1. Pictorial drawings may include but not limited to | * Isometric * Oblique * Cabinet * Cavalier |
| 1. Different types of geometric forms may include but not limited to: | * Circle * Rectangle * Triangle * Polygon |
| 1. Different types of angles may include but not limited to: | * Acute * Obtuse * Right |

**REQUIRED SKILLS AND KNOWLEDGE**

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

**Required Skills**

The individual needs to demonstrate the following skills:

* Critical thinking
* Numerical skills
* Image interpretation
* Drawing synthesis
* Communication
* Computer skills
* Software navigation (manipulates drawing entities, modify dimension styles, create and use layers, manipulate the drawing origin, define and utilize symbol libraries, etc.)

**Required Knowledge**

The individual needs to demonstrate knowledge of:

* Organizational policies and procedures relevant to creating CAD drawings
* Various CAD programs their capabilities, functions and processes
* Drawing outcomes (orthographic, isometric, perspective,2D, 3D)
* Drawing elements (points, line angles, circles, arcs, planes, solids and figures, dimensions and hatchings shapes, etc.)
* Solid modeling, developing sectioned models, etc.
* Geometric constructions
* Measurement and scaling
* Engineering calculations (clearance and tolerance)
* Engineering drawing symbols
* Awareness of copyright and intellectual property issues and legislation in relation to drawing

**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 drawing CAD software as per work requirements. 2. ImportedCAD Filesinto working space as per drawing requirements. 3. Used editing tools to manipulate drawing according to customer specification 4. Developed geometric drawings according to standard drawing conventions 5. Produced pictorial drawings as per work requirements. 6. Saved Orthographic drawings as per work requirements Produced geometric drawings. 7. Assembled Orthographic and pictorial views as per drawing specifications. 8. Computer aided engineering (CAE) is applied in simulation as per work requirements. |
| 1. Resource Implications | The following resources should be provided:   1. Appropriately simulated environment where assessment can take place 2. Access to relevant work place 3. Resources relevant to the proposed activity or task. |
| 1. Methods of Assessment | Competency in this unit may be assessed through:   1. Practical assessments 2. Project 3. Third party report 4. Written examinations 5. Portfolio of Evidence |
| 1. Context of Assessment | Competency may be assessed in a work place or a simulated workplace |
| 1. Guidance information for assessment | Holistic assessment with other units relevant to the industry sector, workplace and job role is recommended |

# CORE UNITS OF COMPETENCY

## INSTALL MECHANICAL PUMPS AND COMPRESSORS

**UNIT CODE:** 0715 451 16A

**UNIT DESCRIPTION**

This unit describes the competencies required by a Mechanical Plant Technician to install mechanical pumps and compressors. It involves Preparation for pump and compressor maintenance, Conducting Preventive maintenance of pump and compressor system, conducting corrective maintenance of pump and compressor system, and testing and commissioning pumps and compressor system.

**ELEMENTS AND PERFORMANCE CRITERIA**

|  |  |
| --- | --- |
| **ELEMENT**  These describe the key outcomes which make up workplace functions | **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)*** |
| Prepare for installation of pumps and compressors | * 1. ***Safety procedures*** are adhered to according to OSH Act,2007   2. ***Site conditions*** and ***installation requirements*** are assessed according to manufacturer’s specification.   3. **Pumps and compressor** specifications are verified according to design requirements.   4. ***Tools, equipment*** and material needed for installation are selected and assembled according to site conditions and installation requirements. |
| Mount pump and compressor system | * 1. ***Safety procedures*** are adhered to according to OSH Act,2007   2. Compressor system is mounted as per manufacturer’s specifications.   3. Pump system is mounted as per manufacturer’s specifications.   4. **Compressor accessories** are mounted in their designated locations as per job specifications.   5. Housekeeping is carried out according to workplace procedure. |
| Assemble pump and compressor system | * 1. ***Safety procedures*** are adhered to according to OSH Act,2007   2. ***Pump and compressor components*** are fitted as per manufacturer’s specifications.   3. Pump and compressor piping is fitted as per job specification.   4. Electrical connections are done to the compressor and pump as per manufacturer’s specifications.   5. Assembly layout is checked according to installation manual   6. Housekeeping is carried out according to workplace procedure. |
| Test and commission pump and compressor system | 4.1 ***Safety procedures*** are adhered to according to  ***OSH Act,2007***  4.2 Pump is run and checks are made for any  a***bnormalities*** according to job specifications.  4.3 compressor systems are run and checks are made  for any a***bnormalities*** according to job  specifications.  4.4 Pump system ***troubleshooting*** is carried out  according to manufacturer’s specifications.   * 1. compressor system ***troubleshooting*** is carried out   according to manufacturer’s specifications.   * 1. Pumps and compressor system faults are fixed as   per manufacturer’s specifications.   * 1. Training pump and compressor system end user is carried out according to manufacturer’s specifications.   2. Housekeeping is carried out according to workplace procedure.   4.7 Documentation and handing over is carried out according to job requirement. |

**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.Prepare for installation of pumps and compressors | ***Safety procedures***  OSHA ACT,2007  Engineering safety Hierarchy of controls   * Physical hazard elimination * Hazard substitution * Engineering design/controls * Administrative controls * Safety signs and symbols * Trainings/drills * Toolbox talks * Personal Protective Equipment (PPEs) * Hand gloves * Overall/Dustcoat * Helmet/Head gear * Safety boots   ***Site conditions*** and ***installation requirements***  ***Site conditions*** and ***installation requirements***   * Site assessment * Regulatory approvals * NEMA * NCA * Safety regulations and standards * System design * Structural support * Electrical and power requirements * Automation and control systems * Equipment installation * Integration with existing system * Material flow consideration * Accessibility and maintenance * Training and documentation * Emergency procedures   **Pumps and compressor**   * Types of pumps * Types of compressors   ***Tools and equipment***  ***Tools, equipment*** and ***materials***  Hand tools   * Assorted spanners * Hammer * Pliers * Pipe wrench * Screw drivers * Allen keys   Power tools   * Grinders * Drill * Power saws   Equipment   * Grease gun * Chain block |
| 2. Mount pump and compressor system | **Pump/Compressor accessories**   * Air filters * Pressure regulators * Lubricators * Air hoses * Couplers and fittings * Air tanks/receiver tanks * Moisture/oil separators * After cooler * Valves * Driers |
| 3. Test and commission pump and compressor system | **Pump abnormalities/ Compressor** a**bnormalities**   * Cavitation * Excessive vibration * Overheating * Leaks * Low/no flow * Motor overload * Excessive power consumption |

**REQUIRED KNOWLEDGE AND SKILLS**

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

The individual needs to demonstrate knowledge of:

* Engineering drawing and Design.
* Material science.
* Plant Engineering Design.
* Occupational Safety and Health Practice.
* Mechanics of machine**.**
* Fluid dynamics.
* Thermodynamics.
* Industrial Organization and management
* Engineering Mathematics
* Workshop practice and technology

**Required skills**

The individual needs to demonstrate the following skills:

* Problem solving skills
* ICT
* Technical drawing.
* Engineering Design
* Communication skills.
* Technical Report writing
* Creativity
* Critical thinking
* Analytical skills

**EVIDENCE GUIDE**

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

|  |  |
| --- | --- |
| 1. Critical aspects of competency | Assessment requires evidence that the candidate:   * 1. AdheredSafety procedures to according to OSH Act,2007   2. Assessed Site conditions and installation requirements according to manufacturer’s specification   3. Mounted Compressor system as per manufacturer’s specifications.   4. Mounted Pump system as per manufacturer’s specifications.   5. Mounted Compressor accessories in their designated locations as per job specifications.   6. Carried out Pump system troubleshooting according to manufacturer’s specifications.   7. Carried out compressor system troubleshooting according to manufacturer’s specifications.   8. Carried out housekeeping according to workplace procedure |
| 1. Resource implications | The following resources should be provided:   * 1. Appropriately simulated environment where assessment can take place.   2. Access to relevant work place.   3. Resources relevant to the proposed activities or work place. |
| 1. Methods of assessment. | Competency in this unit may be assessed through:   * 1. Practical   2. Projects   3. Portfolio of evidence   4. Third party report   5. Written tests   6. Oral assessment |
| 1. Context of assessment. | 4.1 Competency may be assessed in a work place or in a simulated work place. |
| 1. Guidance information for assessment. | 5.1 Holistic assessment with other units relevant to the industry sector and workplace job role is recommended. |

## MAINTAIN MECHANICAL PUMPS AND COMPRESSORS

**UNIT CODE:** 0715 451 17A

**UNIT DESCRIPTION**

This unit describes the competencies required by a Mechanical Plant Technician to maintain mechanical pumps and compressors. It involves Preparation for pump and compressor maintenance, Conducting Preventive maintenance of pump and compressor system, conducting corrective maintenance of pump and compressor system, and testing and commissioning pumps and compressor system.

**ELEMENTS AND PERFORMANCE CRITERIA**

|  |  |
| --- | --- |
| **ELEMENT**  These describe the key outcomes which make up workplace functions | **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. Prepare for pump and compressor maintenance | * 1. ***Safety procedures*** are adhered to according to OSH Act,2007   2. Pump and compressor maintenance requirements are assessed according to manufacturer’s specification.   3. Maintenance schedules are developed according to manufacturer’s specification.   4. ***Tools, equipment*** and ***materials*** needed for installation are selected according to site conditions and maintenance requirements. |
| 1. Conduct Preventive maintenance of pump and compressor system. | * 1. ***Safety procedures*** are adhered to according to OSH Act,2007   2. Pump and compressor system preventive maintenance activities are identified as per manufacturing specification.   3. Pump and compressor system. Preventive maintenance schedule is developed as per manufacturer’s specifications.   4. Preventive maintenance activities are carried out as per manufacturer’s specifications.   5. Housekeeping is carried out according to workplace procedure. |
| 1. Conduct corrective maintenance of pump and compressor system | * 1. ***Safety procedures*** are adhered to according to OSH Act,2007   2. Pump and compressor system troubleshooting is carried out in adherence to manufacturer’s manuals.   3. Pump and compressor system faulty components are rectified as per manufacturer’s specifications   4. Housekeeping is carried out according to workplace procedure. |
| 1. Test and commission pumps and compressor system | * 1. ***Safety procedures*** are adhered to according to ***OSH Act,2007***   2. Pump and compressor system is run and checks are made for ***abnormalities*** according to job requirement.   3. Pump and compressor system end user training is carried out according to manufacturer’s specifications.   4. Housekeeping is carried out according to workplace procedure.   5. Documentation and handing over is carried out according to job specifications. |

**REQUIRED KNOWLEDGE AND SKILLS**

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

**Required knowledge**

The individual needs to demonstrate knowledge of:

* Occupational Safety and Health Practice.
* Mechanics of machine**.**
* Material science.
* Fluid dynamics.
* Thermodynamics.
* Industrial Organization and management
* Workshop practice and technology

**Required skills**

The individual needs to demonstrate the following skills:

* Problem solving skills
* ICT
* Communication skills.
* Technical Report writing
* Creativity
* Critical thinking
* Analytical skills

**EVIDENCE GUIDE**

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

|  |  |
| --- | --- |
| 1.Critical aspects of competency | Assessment requires evidence that the candidate:   * 1. AdheredSafety procedures to according to OSH Act,2007   2. Carried out Preventive maintenance activities are as per manufacturer’s specifications.   3. Carried out Housekeeping according to workplace procedure   4. Troubleshoot pump and compressor system according to manufacturer’s manuals.   5. Rectified pump and compressor system faulty components as per manufacturer’s specifications   6. Checked Pump and compressor system for abnormalities according to job requirement. |
| 1. Resource implications | The following resources should be provided:   * 1. Appropriately simulated environment where assessment can take place.   2. Access to relevant work place.   3. Resources relevant to the proposed activities or work place. |
| 1. Methods of assessment. | Competency in this unit may be assessed through:   * 1. Practical   2. Projects   3. Portfolio of evidence   4. Third party report   5. Written tests   6. Oral assessment |
| 1. Context of assessment. | 4.1 Competency may be assessed in a work place or in a simulated work place. |
| 1. Guidance information for assessment. | 5.1 Holistic assessment with other units relevant to the industry sector and workplace job role is recommended. |

**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.Prepare for pumps and compressor maintenance | ***Safety procedures***  OSHA ACT,2007  Engineering safety Hierarchy of controls   * Physical hazard elimination * Hazard substitution * Engineering design/controls * Administrative controls * Safety signs and symbols * Trainings/drills * Toolbox talks * Personal Protective Equipment (PPEs) * Hand gloves * Overall/Dustcoat * Helmet/Head gear * Safety boots * Safety regulations and standards * System design   **Tools, equipment and materials**  **Pumps and compressor**   * Types of pumps * Types of compressors   ***Tools and equipment***  ***Tools, equipment*** and ***materials***  Hand tools   * Assorted spanners * Hammer * Pliers * Pipe wrench * Screw drivers * Allen keys   Power tools   * Grinders * Drill * Power saws   Equipment   * Grease gun * Chain block |
| 1. .Test and commission pumps and compressor system | **Pump abnormalities/ Compressor** a**bnormalities**   * Cavitation * Excessive vibration * Overheating * Leaks * Low/no flow * Motor overload * Excessive power consumption |

## INSTALL HYDRAULIC AND PNEUMATIC SYSTEMS

**UNIT CODE:** 0715 451 18A

**UNIT DESCRIPTION**

This unit describes the competencies required by a Mechanical Plant Technician to install hydraulic and pneumatic systems. it involves preparation for hydraulic and pneumatic systems installation, installing hydraulic systems, installing pneumatic system, and testing and commissioning hydraulic and pneumatic systems.

**ELEMENTS AND PERFORMANCE CRITERIA**

|  |  |
| --- | --- |
| **ELEMENT**  These describe the key outcomes which make up workplace functions | **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. Prepare for hydraulic and pneumatic systems installation | * 1. ***Safety procedures*** are adhered to according to OSH Act,2007.   2. ***Site conditions*** and ***installation requirements*** are assessed according to manufacturer’s specification.   3. Hydraulic and Pneumatic system components specifications are verified according to design requirements.   4. ***Tools, equipment*** and ***materials*** needed for installation are selected according to site conditions and site installation requirements. |
| 1. Install hydraulic system | * 1. Safety procedures are adhered to according to OSH Act,2007   2. Installation manuals are interpreted according to manufacturer’s specifications.   3. Hydraulic system components are mounted according to the manufacturer’s specifications.   4. Hydraulic system pipes and hoses are connected according to manufacturer’s specifications.   5. Hydraulic system components are assembled according to manufacturer’s specifications.   6. Housekeeping is carried out according to workplace procedure. |
| 1. Install Pneumatic system | * 1. Safety procedures are adhered to according to OSH Act,2007   2. Installation manuals are interpreted according to manufacturer’s specifications.   3. Pneumatic system components are mounted according to the manufacturer’s specifications.   4. Pneumatic system pipes and hoses are connected according to manufacturer’s specifications.   5. Pneumatic system components are assembled according to manufacturer’s specifications.   6. Housekeeping is carried out according to workplace procedure. |
| 1. Test and commission Hydraulic and Pneumatic system | 4.1 Safety procedures are adhered to according to OSH Act,2007  4.2 Assembly layout is checked according to installation manual  4.3 Machine is run and checks are made for any abnormalities  according to job specifications.  4.4 Machine troubleshooting is carried out according to  manufacturer’s specifications.  4.5 Training of machine end user is carried out according to  manufacturer’s specifications.  4.6 Documentation and handing over is carried out according to  manufacturer’s specifications.  4.7 Housekeeping is carried out according to workplace procedure. |

**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. Safety procedures may include but not limited to: | * Wearing PPEs * Safety barriers installation in work site * Correct use of tools and equipment |
| 1. Site conditions and Installation requirements may include but not limited to: | * Temperature * Structure support * Topography * Humidity * Ventilation |
| 1. Tools, equipment and materials may include but not limited to: | Tools:   * Assorted spanners * Crimping tools * Assorted pliers * Allen keys   Equipment:   * Chain block * Greasing gun * Pressure gauges   Materials:   * Grease * Hydraulic oil |

**REQUIRED KNOWLEDGE AND SKILLS**

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

**Required knowledge**

The individual needs to demonstrate knowledge of:

* Fluid mechanics
* Occupational Safety and Health Practice
* Mechanics of machine
* Control and instrumentation

**Required skills**

The individual needs to demonstrate the following skills:

* Analytical thinking
* Technical Report writing
* Communication skills
* Critical thinking

**EVIDENCE GUIDE**

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

|  |  |
| --- | --- |
| 1. Critical aspects of competency | Assessment requires evidence that the candidate:   * 1. Selected tools, equipment and materials needed for installation according to site conditions and site installation requirements.   2. Assembled hydraulic system components according to manufacturer’s specifications   3. Mounted hydraulic system components according to the manufacturer’s specifications.   4. Mounted pneumatic system components according to the manufacturer’s specifications.   5. Assembled pneumatic system components according to manufacturer’s specifications   6. Ran and checked machine for any abnormalities according to job specifications. |
| 1. Resource implications | The following resources should be provided:   * 1. Appropriately simulated environment where assessment can take place.   2. Access to relevant work place.   3. Resources relevant to the proposed activities or work place. |
| 1. Methods of assessment | Competency in this unit may be assessed through:   * 1. Practical   2. Projects   3. Portfolio of evidence   4. Third party report   5. Written tests   6. Oral assessment |
| 1. Context of assessment | 4.1 Competency may be assessed in a work place or in a simulated work place. |
| 1. Guidance information for assessment | 5.1 Holistic assessment with other units relevant to the industry sector and workplace job role is recommended. |

## MAINTAIN HYDRAULIC AND PNEUMATIC SYSTEMS

**UNIT CODE:** 0715 451 19A

**UNIT DESCRIPTION**

Thisis unit describes the competencies required by a mechanical plant technician to maintain hydraulic and pneumatic systems. It involves conducting preventive maintenance on hydraulic system, conducting corrective maintenance on hydraulic system, conducting preventive maintenance on pneumatic system, conducting corrective maintenance on pneumatic system, and testing and commission hydraulic and pneumatic system

**ELEMENTS AND PERFORMANCE CRITERIA**

|  |  |
| --- | --- |
| **ELEMENT**  These describe the key outcomes which make up workplace functions | **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 Preventive Maintenance on hydraulic system | * 1. ***Safety procedures*** are adhered to according to OSH Act, 2007.   2. ***Hydraulic system*** ***components*** are visually checked according to manufacturer’s specifications.   3. Hydraulic system oil is replenished as per manufacturer’s specifications.   4. Hydraulic system is cleaned and lubricated according to manufacturer’s specifications.   5. Hydraulic system tests are conducted as per manufacturer’s specifications.   6. Hydraulic systems maintenance activities and findings are documented as per workplace procedures. |
| 1. Conduct Corrective Maintenance on hydraulic system | * 1. Safety procedures are adhered to according to OSH Act, 2007.   2. Troubleshooting of hydraulic system is carried out as per manufacturer’s specifications.   3. Hydraulic system faulty components are identified as per manufacturer’s specifications.   4. Hydraulic system faulty components rectified according to manufacturer’s specifications.   5. Hydraulic system oil is replenished as per manufacturer’s specifications.   6. Hydraulic system is tested as per manufacturer’s specifications.   7. Housekeeping is carried out according to workplace procedures. |
| 1. Conduct Preventive Maintenance on pneumatic system | * 1. Safety procedures are adhered to according to OSH Act, 2007.   2. ***Pneumatic system*** ***components*** are visually checked according to manufacturer’s specifications.   3. Pneumatic system is cleaned and lubricated according to manufacturer’s specifications.   4. Pneumatic system fluid is replenished as per manufacturer’s specifications.   5. Pneumatic system tests are conducted as per manufacturer’s specifications.   6. Pneumatic systems maintenance activities and findings are documented as per workplace procedures |
| 1. Conduct Corrective Maintenance on pneumatic system | * 1. Safety procedures are adhered to according to OSH Act, 2007.   2. Troubleshooting of pneumatic system is carried out as per manufacturer’s specifications.   3. Pneumatic system faulty components are identified as per manufacturer’s specifications.   4. Pneumatic system faulty components are rectified according to manufacturer’s specifications.   5. Pneumatic system fluid is replenished as per manufacturer’s specifications.   6. Pneumatic system is tested as per manufacturer’s specifications.   7. Housekeeping is carried out according to workplace procedures. |
| 1. Test and commission hydraulic and pneumatic system | * 1. Safety procedures are adhered to according to OSH Act, 2007   2. Hydraulic and pneumatic testing equipment are selected according to manufacturer’s specifications.   3. Housekeeping is carried out according to set workplace procedures.   4. Documentation and handing over is done according to workplace procedures. |

**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.Safety procedures may include but not limited to: | * Wearing PPEs * Safety barriers installation in work site * Correct use of tools and equipment |
| 2.Hydraulic system components may include but not limited to: | * Actuators * Valves * Hydraulic pump * Reservoirs * Filters |
| 3.Pneumatic system components may include but not limited to: | * Air compressor * Intercoolers |

**REQUIRED KNOWLEDGE AND SKILLS**

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

**Required knowledge**

The individual needs to demonstrate knowledge of:

* Fluid mechanics
* Thermodynamics
* Occupational Safety and Health Practice
* Mechanics of machine
* Control and instrumentation

**Required skills**

The individual needs to demonstrate the following skills:

* Analytical skills
* Technical Report writing skills
* Communication skills
* Problem solving skills
* Critical thinking

**EVIDENCE GUIDE**

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

|  |  |
| --- | --- |
| * + - 1. Critical aspects of competency | Assessment requires evidence that the candidate:   * 1. Adhered to safety procedures according to OSH Act, 2007.   2. checked hydraulic system components according to manufacturer’s specifications.   3. Replenished hydraulic system oil as per manufacturer’s specifications.   4. Rectified hydraulic system faulty components according to manufacturer’s specifications.   5. Rectified pneumatic system faulty components according to manufacturer’s specifications. |
| * + - 1. Resource implications | The following resources should be provided:   * 1. Appropriately simulated environment where assessment can take place.   2. Access to relevant work place.   3. Resources relevant to the proposed activities or work place. |
| * + - 1. Methods of assessment | Competency in this unit may be assessed through:   * 1. Practical   2. Projects   3. Portfolio of evidence   4. Third party report   5. Written tests   6. Oral assessment |
| * + - 1. Context of assessment | 4.1 Competency may be assessed in a work place or in a simulated work place. |
| * + - 1. Guidance information for assessment | 5.1 Holistic assessment with other units relevant to the industry sector and workplace job role is recommended. |

## INSTALL MATERIAL HANDLING SYSTEM

**UNIT CODE:** 0715 451 20A

**UNIT DESCRIPTION**

This unit describes the competencies required by a mechanical plant technician in order to install material handling systems in their work. It involves preparation for installation, assembly, testing and commissioning of material handling system.

**ELEMENTS AND PERFORMANCE CRITERIA**

|  |  |
| --- | --- |
| **ELEMENT**  These describe the key outcomes which make up workplace functions | **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. Prepare for installation of Material Handling system | * 1. ***Safety procedures*** are adhered to according to OSH Act,2007   2. ***Site conditions*** and ***installation requirements*** *for*Material Handling Installation are assessed according to manufacturer’s specification.   3. ***Material handling machinery*** ***components*** specifications are verified according to design requirements.   4. ***Tools, equipment*** and ***materials*** needed for installation of Material Handling are selected and assembled according to site conditions and installation requirements.   5. ***Housekeeping*** is carried out according to workplace procedure. |
| 2. Assemble Material Handling System parts. | * 1. Safety procedures are adhered to according to OSH Act,2007   2. ***Material handling system*** ***components*** are assembled according to manufacturer’s requirement.   3. ***Material handling system*** is mounted according to job requirements   4. ***Housekeeping*** is carried out according to workplace procedure. |
| 3. Test and Commission  Material Handling system | * 1. Safety procedures are adhered to according to OSH Act,2007   2. Material handling system functional Testing is carried out according to job requirements   3. ***Material handling system troubleshooting*** is carried out *according* to manufacturer’s requirements.   4. Material handling system fault correction is carried out as per manufacturer’s specifications.   5. Material handling system end user training is carried out according to manufacturer’s specifications.   6. Material handling system *documentation* and handing over is carried out according to job requirement   7. ***Housekeeping*** is carried out according to workplace procedure. |

**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. Safety requirements   may include but are not limited to; | OSHA ACT,2007  Engineering safety Hierarchy of controls   * Physical hazard elimination * Hazard substitution * Engineering design/controls * Administrative controls * Safety signs and symbols   + Trainings/drills   + Toolbox talks * Personal Protective Equipment (PPEs)   + Hand gloves   + Overall/Dustcoat   + Helmet/Head gear   + Safety boots   + Goggles   + Ear muffs   + Face shield |
| 1. Material handling equipment may include but are not limited to: | * Fork lift * Cranes * Reach stacker * Lifting trolley * Hoist * Lifting chain * Chain block * Lifting rock * Topper * Conveyor’s system * Pallets |
| 1. Housekeeping may include but not limited to: | Housekeeping   * Waste segregation * Bench cleaning * Keeping workplace neat and orderly * Consumables and inventory * Tool rack * Tool box |
| 1. Material handling Tools may include but not limited to: | Hand tools   * Assorted spanners * Hammer * Pliers * Pipe wrench * Screw drivers * Allen keys   Power tools   * Grinders * Drill * Power saws   Equipment   * Grease gun * Chain block |
| 1. Material handling system documentation may include but not limited to: | * Operation and service manuals * Drawings * Technical reports |
| 1. Material handling system faults may include but not limited to: | Conveyor belt issues   * Slipping * Misalignment * Tearing   Sensor failures   * Incorrect readings or system errors   Control system failures  Power supply problems   * Voltage fluctuations * Power failures   Mechanical failures   * Gearbox failure * Bearing issues * Material jams and blockages * Human related errors |
| 1. Material handling system components may include but not limited to; | * Clutch * Gearboxes * Chains * Motors * Lever * Wheels |
| 1. Installation requirements may include but not limited to; | * Site assessment * Regulatory approvals * NEMA * NCA * Safety regulations and standards * System design * Structural support * Electrical and power requirements * Automation and control systems * Equipment installation * Integration with existing system * Material flow consideration * Accessibility and maintenance * Training and documentation * Emergency procedures * Quality assurance and testing |
| 1. Material handling materials and resources may include but not limited to; | Consumables   * Hydraulic oil * Conveyors * Oil seals * Bearings * Chains * Grease * Oil filters * Air filters * Cleaning detergents |

**REQUIRED KNOWLEDGE AND SKILLS**

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

**Required knowledge**

The individual needs to demonstrate knowledge of:

* Engineering drawing and Design.
* Material science.
* Plant Engineering Design.
* Occupational Safety and Health Practice.
* Mechanics of machine**.**
* Industrial Organization and management
* Engineering Mathematics
* Workshop practice and technology
* Fluid mechanics
* Fabrication
* Thermodynamics
* Interpret technical drawing
* Basic knowledge on plumbing
* Report preparation and filing
* Workshop tools and material
* Standard procedures in pump installation
* Environmental conditions
* Management of different wastes
* Workmanship
* Record keeping procedure
* Maintenance
* Data analysis and presentation
* Digital Literacy
* Project management
* Tendering and procurement
* Analysis and design methods
* Automation

**Required skills**

The individual needs to demonstrate the following skills:

* Critical thinking
* Problem solving
* Analytical
* Problem solving skills
* ICT
* Technical drawing.
* Engineering Design
* Communication skills.
* Technical Report writing
* CAD
* Creativity
* Logical thinking
* Analytical thinking
* Communication skills
* Troubleshooting
* Decision making
* Writing skills
* Team player
* Organizational skills Creativity.
* Interpersonal Skills

**EVIDENCE GUIDE**

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

|  |  |
| --- | --- |
| 1. Critical aspects of competency | Assessment requires evidence that the candidate:   * 1. Interpreted manufacturers’ drawing and manuals as per the SOP   2. selected and assembled tools, equipment and materials needed for installation of Material Handling according to site conditions and installation requirements   3. Assembled material handling system components according to manufacturer’s requirements.   4. Troubleshoot on Material handling system according to manufacturer’s requirements.   5. Corrected material handling system fault as per manufacturer’s specifications. |
| 1. Resource implications | The following resources should be provided:   * 1. Appropriately simulated environment where assessment can take place.   2. Access to relevant work place.   3. Resources relevant to the proposed activities or work place. |
| 1. Methods of assessment | Competency in this unit may be assessed through:   * 1. Practical   2. Projects   3. Portfolio of evidence   4. Third party report   5. Written tests   6. Oral assessment |
| 1. Context of assessment | 4.1 Competency may be assessed in a work place or in a simulated work place. |
| 1. Guidance information for assessment | 5.1 Holistic assessment with other units relevant to the industry sector and workplace job role is recommended. |

## MAINTAIN MATERIAL HANDLING SYSTEMS

**UNIT CODE:** 0715 451 21A

**UNIT DESCRIPTION**

This unit describes the competencies required by a mechanical plant technician in order to maintain material handling systems in their work. It involves preparation for material handling system maintenance, conducting material handling system planned maintenance, troubleshooting material handling equipment faults, carrying out material handling systems preventive maintenance, conducting material handling system breakdown maintenance, and testing and commissioning of material handling systems.

**ELEMENTS AND PERFORMANCE CRITERIA**

|  |  |
| --- | --- |
| **ELEMENT**  These describe the key outcomes which make up the workplace function | **PERFORMANCE CRITERIA**  These are measurable statements that specify the required level of performances for each of the elements  ***Bold and italicized items are determined in the Range*** |
| 1. Prepare for material handling system maintenance | * 1. ***Safety procedures*** are adhered to according to OSH Act,2007.   2. Material handling system maintenance schedule is prepared as per manufacturer’s specifications.   3. *Material* handling system maintenance checklist is prepared as per manufacturer’s specifications.   4. **Material handling system maintenance** ***tools and equipment*** are selected and assembled as per maintenance manual |
| 1. Conduct material handling system planned maintenance | * 1. ***Safety procedures*** are adhered to according to OSH Act,2007.   2. Material handling system maintenance Data and information to guide maintenance is collected and analyzed.   3. ***Material*** handling system ***planned maintenance activities*** are conducted as per maintenance manual.   4. ***Repainting*** of defaced Material handling system components and storage areas is done as per job requirements.   5. Material control system is kept up to date as per plant guidelines   6. Housekeeping is done as per plant guidelines. |
| 1. Trouble shoot material handling equipment faults | * 1. ***Safety requirements*** are observed according to workplace procedure   2. ***Material handling equipment*** are identified as per standard operating procedures (SOP)   3. Manufacturers’ drawing and manuals equipment are interpreted as per SOP   4. ***Material handling equipment* *fault/malfunction*** are identified as per manufacturer’s specifications   5. ***Material* handling equipment fault report** is prepared as per workplace procedures |
| 1. Carry out material handling systems preventive maintenance | * 1. Maintenance schedule is prepared as per workplace procedures   2. Material handling equipment are identified as per maintenance schedule   3. Material handling equipment/system are isolated as per SOPs.   4. Material handling equipment is inspected as per manufacturer’s specifications   5. Material handling equipment planned maintenance is carried out as per job requirement and following OHS standards   6. Material handling systems maintenance checklist is completed as per job requirement |
| 1. Conduct material handling system breakdown maintenance. | * 1. ***Safety procedures*** are adhered to according to OSH Act,2007.   2. ***Material* handling system troubleshooting** is done as per maintenance manual.   3. Material handling system troubleshooting fault report is interpreted as per manufacturer’s specification   4. ***Material*** handling system ***breakdown maintenance activities*** are conducted as per maintenance manual.   5. ***Housekeeping*** is done as per plant guidelines |
| 1. Test and commission material handling system. | * 1. ***Safety procedures*** are adhered to according to OSH Act,2007.   2. ***Testing*** material handling system is done as per manufacturer’s specifications.   3. Material handling system is commissioned and handed over as per job requirements.   4. Material handling equipment testing and commissioning report is prepared as per workplace procedures   5. Proper storage of prepared reports is done. |

**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. Safety requirements * may include but are not limited to: | * OSHA ACT,2007 * Engineering safety Hierarchy of controls * Physical hazard elimination * Hazard substitution * Engineering design/controls * Administrative controls * Safety signs and symbols * Trainings/drills * Toolbox talks * Personal Protective Equipment (PPEs) * Hand gloves * Overall/Dustcoat * Helmet/Head gear * Safety boots * Goggles * Ear muffs |
| * 2.Material handling equipment may include but are not limited to: | * + Fork lift   + Cranes   + Reach stacker   + Lifting trolley   + Hoist   + Lifting chain   + Chain block   + Lifting rock   + Topper   + Conveyor’s system   + Pallets |
| * 3.Housekeeping may include but not limited to: | * Housekeeping * Waste segregation * Bench cleaning * Keeping workplace neat and orderly * Consumables and inventory * Tool rack * Tool box |
| * 4. Material handling Tools may include but not limited to: | * Assorted spanners * Hammer * Pliers * Pipe wrench * Screw drivers * Allen keys * Grinders * Drill * Power saws * Grease gun * Chain block |
| * 5.Material handling system documentation may include but not limited to: | * Operation and service manuals * Drawings * Technical reports |
| * 6.Material handling equipment fault/malfunctionmay include but are not limited to: | * Misalignment * Oil leakage * Worn oil seals * Motor coupling and linkages * Bearing worn out * Conveyor belt worn out * Conveyor gears/sprockets * Vibration * Unusual sounds |
| * 7.Material handling system components may include but not limited to; | * Clutch * Gearboxes * Chains * Motors * Lever * Wheels |
| * 8.Consumable materials may include but are not limited to: | * Hydraulic oil * Conveyors * Oil seals * Bearings * Chains * Grease * Oil filters * Air filters * Cleaning detergents |

**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:

* Logical thinking
* Problem solving
* Analytical thinking
* Communication skills
* Troubleshooting
* Decision making
* Writing skills
* Team player
* Organizational skills Creativity.
* Interpersonal Skills
* Critical Thinking
* Problem Solving
* Customer Service Skills
* Communication

**Required Knowledge**

The individual needs to demonstrate knowledge of:

* Material handling machines
* Maintenance tools and equipment
* Machine drives (Electrical/Mechanical)
* Technical drawing interpretation
* Preventive maintenance scheduling
* Report writing
* Manufacturer’s specifications interpretation
* Health Safety and Environment
* Operation of machines

**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 aspect of competency | Assessment requires evidence that the candidate:   1. Interpreted manufacturers’ drawing and manuals as per the SOP 2. Identified material handling equipment fault/malfunction as per manufacturer specifications 3. Prepared report on fault as per workplace procedures 4. Carried out planned maintenance as per workplace procedures 5. Interpreted troubleshooting fault report as per manufacturer’s specification 6. Performed repairs as per job requirement 7. Tested equipment performance as per workplace procedures 8. Prepared maintenance checked as per job requirement 9. Performed housekeeping as per workplace procedures |
| 1. Resource implications | The following resources should be provided:   * 1. Appropriately simulated environment where assessment can take place.   2. Access to relevant work place.   3. Resources relevant to the proposed activities or work place. |
| 1. Methods of assessment | Competency in this unit may be assessed through:   * 1. Practical   2. Projects   3. Portfolio of evidence   4. Third party report   5. Written tests   6. Oral assessment |
| 1. Context of assessment | 4.1 Competency may be assessed in a work place or in a simulated work place. |
| 1. Guidance information for assessment | 5.1 Holistic assessment with other units relevant to the industry sector and workplace job role is recommended. |

## INSTALL REFRIGERATION AND AIR CONDITIONING SYSTEM

**UNIT CODE:** 0715 451 21A

**UNIT DESCRIPTION**

Thisis unit describes the competencies required by a mechanical plant technician to install refrigeration and air conditioning system. It involves preparing for installation of refrigeration and air conditioning systems, installing refrigeration system, installing air conditioning system, and testing and commissioning refrigeration and air conditioning systems.

**ELEMENTS AND PERFORMANCE CRITERIA**

|  |  |
| --- | --- |
| **ELEMENT**  These describe the key outcomes which make up workplace functions | **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. Prepare for Installation of Refrigeration and Air Conditioning | * 1. ***Safety procedures*** are adhered to according to OSH Act,2007   2. ***Site conditions*** and ***installation requirements*** are assessed according to manufacturer’s specification.   3. ***Refrigeration and air conditioning system components*** specifications are verified according to design requirements.   4. ***Tools, equipment*** and ***materials*** needed for installation are selected according to site conditions and site installation requirements.   5. Housekeeping is carried out according to workplace procedure. |
| 2. Install Refrigeration system | 2.1 Safety procedures are adhered to according to OSH Act,2007.  2.2 Installation manuals are interpreted according to manufacturer’s specifications.  2.3 Refrigeration system components are mounted according to the manufacturer’s specifications.  2.4 Refrigeration system pipes and hoses are connected according to manufacturer’s specifications.  2.5 Refrigeration system components are assembled according to manufacturer’s specifications.  2.6. Pressure testing is carried out as per manufacturer’s specifications.  2.7 Deep evacuation of refrigeration system is carried out as per manufacturer’s specifications.  2.8 Refrigeration system is charged with refrigerant as per manufacturer’s specifications.  2.9 Housekeeping is carried out according to workplace procedure. |
| 1. Install Air Conditioning system. | * 1. Safety procedures are adhered to according to OSH Act,2007   2. Installation manuals are interpreted according to manufacturer’s specifications.   3. Vents and ducts are installed as per design specifications.   4. Air Conditioning system components are mounted according to the manufacturer’s specifications.   5. Air Conditioning system pipes and hoses are connected according to manufacturer’s specifications.   6. Pressure testing is carried out as per manufacturer’s specifications.   7. Deep evacuation of air conditioning system is carried out as per manufacturer’s specifications.   8. Air Conditioning system is charged with ***refrigeran***t as per manufacturer’s specifications.   9. Housekeeping is carried out according to workplace procedure. |
| 1. Test and commission refrigeration and air conditioning system | * 1. Safety procedures are adhered to according to OSH Act,2007   2. Assembly layout is checked according to installation manual.   3. Refrigeration and air conditioning system is run and checks are made for any a***bnormalities*** according to job specifications.   4. ***Refrigeration and air conditioning system troubleshooting*** is carried out according to manufacturer’s specifications.   5. Training refrigeration and air conditioning system end user is carried out according to manufacturer’s specifications.   6. Documentation and handing over is carried out according to manufacturer’s specifications.   7. Housekeeping is carried out according to workplace procedure. |

**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. Safety procedures may include but not limited to: | * Wearing PPEs * Demarcation of site * Turning off of equipment * Proper use of tools and equipment |
| 2.Site conditions and installation requirements may include but not limited to: | * Humidity * Topography * Ventilation * Access to electricity |
| 3.Refrigeration and air conditioning system components may include but not limited to: | * Compressor * Expansion valve * Evaporator * Condenser * Separator |
| 4.Tools, equipment and materials may include but not limited to: | * Tube expansion kit * Gas welding kit * Gas gauge * Refrigerant * Compressor lubricant oil |
| 5.Abnormalities may include but not limited to: | * Failure to achieve set temperature * Noise * Overheating * Stoppage of system * Leakages |
| 6.Refrigeration and air conditioning system troubleshooting may include but not limited to: | * Checking system refrigerant pressure * Checking compressor status * Examining electrical components |
| 7.Refrigerant may include but not limited to: | * R134a * R410 * Ammonia * R407 * R600 * R290 |

**REQUIRED KNOWLEDGE AND SKILLS**

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

**Required knowledge**

The individual needs to demonstrate knowledge of:

* Fluid mechanics
* Occupational Safety and Health Practice
* Mechanics of machines
* Electrical machines
* Thermodynamics

**Required skills**

The individual needs to demonstrate the following skills:

* Analytical skills
* Technical Report writing
* Communication skills
* Problem solving skills
* Critical thinking

**EVIDENCE GUIDE**

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

|  |  |
| --- | --- |
| 1. Critical aspects of competency | Assessment requires evidence that the candidate:   * 1. Selected tools, equipment and materials needed for installation according to site conditions and site installation requirements.   2. Assembled refrigeration system components according to manufacturer’s specifications   3. Charged refrigeration system with refrigerant as per manufacturer’s specifications   4. Connected air Conditioning system pipes and hoses according to manufacturer’s specifications.   5. Ran and checked refrigeration and air conditioning system for any abnormalities according to job specifications. |
| 2. Resource implications | The following resources should be provided:   * 1. Appropriately simulated environment where assessment can take place.   2. Access to relevant work place.   3. Resources relevant to the proposed activities or work place. |
| 3. Methods of assessment | Competency in this unit may be assessed through:   * 1. Practical   2. Projects   3. Portfolio of evidence   4. Third party report   5. Written tests   6. Oral assessment |
| 1. Context of assessment | 4.1 Competency may be assessed in a work place or in a simulated work place. |
| 1. Guidance information for assessment | 5.1 Holistic assessment with other units relevant to the industry sector and workplace job role is recommended. |

## MAINTAIN REFRIGERATION AND AIR CONDITIONING SYSTEMS

**UNIT CODE:** 0715 451 22A

**UNIT DESCRIPTION**

This unit covers the competencies required to maintain automobile air conditioning units. It involves preparing for refrigeration and air conditioning system maintenance, conducting refrigeration system preventive maintenance, conducting refrigeration system corrective maintenance, conducting air conditioning system preventive maintenance, conducting air conditioning system corrective maintenance and testing and commissioning refrigeration and air conditioning system.

**ELEMENTS AND PERFORMANCE CRITERIA**

|  |  |
| --- | --- |
| **ELEMENT**  These describe the key outcomes which make up workplace functions | **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. Prepare for refrigeration and air conditioning system maintenance. | * 1. ***Safety procedures*** are adhered to according to ***OSH Act,2007***   2. Refrigeration and air conditioning systems requirements are identified according to manufacturer’s specification.   3. ***Refrigeration and air conditioning Tools and equipment*** are selected according to maintenance manual. |
| 2. Conduct refrigeration system preventive maintenance | * 1. Safety procedures are adhered to according to OSH Act,2007   2. Refrigeration system preventive maintenance activities are identified as per manufacturing specification.   3. Refrigeration system Preventive maintenance schedule is developed as per manufacturer’s specifications.   4. Preventive maintenance activities are carried out as per manufacturer’s specifications.   5. Housekeeping is carried out according to workplace procedure. |
| 3. Conduct refrigeration system corrective maintenance | * 1. Safety procedures are adhered to according to OSH Act,2007   2. Refrigeration system troubleshooting is carried according to manufacturer’s specifications.   3. Refrigerant is recovered from refrigeration system as per manufacturer’s specifications.   4. Faulty refrigeration system components are rectified as per manufacturer’s specifications.   5. Refrigeration system pressure testing is carried out as per manufacturer’s specifications   6. Refrigeration system is evacuated as per manufacturer’s specifications.   7. Refrigeration system is charged as per manufacturer’s specifications.   8. Housekeeping is carried out according to workplace procedure. |
| 4. Conduct air conditioning system preventive maintenance | * 1. Safety procedures are adhered to according to OSH Act,2007   2. Air conditioning system preventive maintenance activities are identified as per manufacturer’s specification.   3. Air conditioning system Preventive maintenance schedule is developed as per manufacturer’s specifications.   4. Preventive maintenance activities are carried out as per manufacturer’s specifications.   5. Housekeeping is carried out according to workplace procedure. |
| 5. Conduct air conditioning system corrective maintenance | * 1. Safety procedures are adhered to according to OSH Act,2007   2. Air conditioning troubleshooting is carried according to manufacturer’s specifications.   3. Refrigerant is recovered from air conditioning system as per manufacturer’s specifications.   4. Faulty air conditioning system components are rectified as per manufacturer’s specifications.   5. Air conditioning system pressure testing is carried out as per manufacturer’s specifications   6. Air conditioning system is evacuated as per manufacturer’s specifications.   7. Air conditioning system is charged as per manufacturer’s specifications.   8. Housekeeping is carried out according to workplace procedure. |
| 1. Test and commission refrigeration and air conditioning system | * 1. Safety procedures are adhered to according to OSH Act,2007   2. ***Refrigeration and air conditioning system test*** is carried out according to manufactures specification.   3. Housekeeping is carried out according to workplace procedure.   4. Refrigeration and air conditioning maintenance report is written according to workplace requirement. |

**RANGE**

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

|  |  |
| --- | --- |
| **Variable** | **Range** |
| 1. ***Safety procedures*** may include but not limited to: | * Personal protective equipment’s * Correct use of tool and equipment * Switching off of equipment * Electrical isolation |
| 1. ***Refrigeration and air conditioning Tools and equipment*** may include but not limited to: | * Pliers * Screwdrivers * Hammers * Chisels * Files * Fin combs * Nut drivers * Socket wrenches * Brazing equipment * Arc welding equipment * Multi-meters * Leak detectors * System analyzers * Recovery units * Vacuum pumps * Vacuum gauges * Weighing balance * Refrigerant identifier |
| 1. ***Refrigeration and air conditioning system test*** may include but not limited to: | * Pressure test * Temperature test * Voltage and current test |

**REQUIRED SKILLS AND KNOWLEDGE**

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

**Required Skills**

The individual needs to demonstrate the following skills:

* Interpreting diagrams
* Preparing materials
* Handling of tools, equipment and instruments
* Testing electrical systems
* Tube processing
* Safe handling of refrigerants and lubricants
* Recovering refrigerants
* Pressure testing
* System evacuation
* Charging refrigerant
* Retrofitting and conversion
* Brazing
* Other methods of pipe joining
* Maintenance of A/C units
* Troubleshooting

**Required Knowledge**

The individual needs to demonstrate knowledge of:

* Personal protective equipment
* Uses and handling of tools, equipment and instruments
* Safety signs and symbols
* Housekeeping
* Interpretation of diagrams
* Uses and specifications of refrigerants, Air conditioning oil and Air conditioning components
* Safe handling of hydrocarbons (In line with EN 378, ISO 5149 and EN 13313 standards)
* Fundamentals of electrical installation
* Basic electronics
* Basic welding
* Basic Masonry
* Air Conditioning principles
* Recovery process
* Pressure testing
* System evacuation
* Retrofitting and conversion process
* Motor insulation testing procedure
* Wiring resistance testing procedure
* Compressor operations
* Motor starters
* Motors protection
* Relevant legislation
* Environmental legislation (EMCA 2020)
* Emerging industrial controls
* Licensing of workshops and industries dealing with HVAC
* Certification of RAC technicians (EU F-Gas Certification)

**EVIDENCE GUIDE**

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

|  |  |
| --- | --- |
| 1. Critical aspects of competency | Assessment requires evidence that the candidate:   1. Adhered to safety procedures. 2. Diagnosed refrigeration and Air conditioning faults. 3. Recovered refrigerants. 4. Carried out pressure strength test. 5. Carried out pressure tightness test. 6. Carried out Unit evacuation. 7. Repaired and retrofitted refrigeration and Air conditioning unit. 8. Tested and commissioned refrigeration and Air conditioning unit. |
| 1. Resource implications | The following resources should be provided:   * 1. Appropriately simulated environment where assessment can take place.   2. Access to relevant work place.   3. Resources relevant to the proposed activities or work place. |
| 1. Methods of assessment | Competency in this unit may be assessed through:   * 1. Practical   2. Projects   3. Portfolio of evidence   4. Third party report   5. Written tests   6. Oral assessment |
| 1. Context for assessment | 4.1 Competency may be assessed in a work place or in a simulated work place. |
| 1. Guidance information for assessment | 5.1 Holistic assessment with other units relevant to the industry sector and workplace job role is recommended. |

## DESIGN MECHANICAL PLANT SYSTEM

**UNIT CODE:** 0715 551 24A

**Unit Description**

This unit describes the competencies required by a Mechanical Plant Technician to design mechanical plant system. It involves analyzing plant system requirements, selecting mechanical Plant Equipment, and designing Mechanical Plant Layout.

**ELEMENTS AND PERFORMANCE CRITERIA**

|  |  |
| --- | --- |
| **ELEMENT**  These describe the key outcomes which make up workplace functions | **PERFORMANCE CRITERIA**  These are assessable statements which specify the required level of performance for each of the elements  ***(Bold and italicized terms are elaborated in the range)*** |
| 1. Analyse plant System Requirements | * 1. Mechanical Plant system requirements are identified and translated into system needs as per job specifications.   2. Existing regulations and conditions in proposed plant site are evaluated as per design requirements.   3. Mechanical Plant system critical parameters are calculated as per job requirements. |
| 1. Select Mechanical Plant Equipment | * 1. ***Mechanical plant system equipment*** is selected based on process needs, operating conditions, and industry standards.   2. Mechanical plant system equipment calculations and sizing are performed as per job requirements.   3. Mechanical plant equipment options are selected as per system and job requirements. |
| 1. Design Mechanical Plant Layout | * 1. Mechanical plant block layout is developed, as per job requirements.   2. Mechanical plant system detailed layout is developed, as per job requirements.   3. Mechanical plant system ***models*** are simulated and analysed as per key performance indicators.   4. Detailed mechanical plant layout drawings are reviewed based on optimized model.   5. Detailed mechanical plant layout final drawings are prepared based on optimized model.   6. ***Design documents*** are presented to relevant personnel |

**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. Mechanical plant system equipment may include but not limited to: | * Pumps * Compressors * Boiler * Tanks * Motors * Gauges * Heat exchangers * Reservoirs * Control system * Pipes * Valves |
| 2. Models may include but not limited to: | * 3D models done by CAD software * Physical models |
| 3. Design documents may include but not limited to: | * Drawings * Bill of quantities * Process flow charts |

**REQUIRED KNOWLEDGE AND SKILLS**

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

**Required knowledge**

The individual needs to demonstrate knowledge of:

* Engineering drawing and Design.
* Mechanics of machines**.**
* Fluid dynamics.
* Thermodynamics.
* Industrial Organization and management
* Engineering Mathematics
* Material science

**Required skills**

The individual needs to demonstrate the following skills:

* Problem solving skills
* Engineering Design and CAD
* Technical Report writing
* Creativity
* Critical thinking
* Analytical skills

**EVIDENCE GUIDE**

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

|  |  |
| --- | --- |
| * + - 1. Critical aspects of competency | Assessment requires evidence that the candidate:   * 1. Identified mechanical Plant system requirements and translated them into system needs as per job specifications.   2. Calculated mechanical plant system critical parameters as per job requirements.   3. Performed mechanical plant system equipment calculations and sizing as per job requirements.   4. Developed mechanical plant block layout as per job requirements.   5. Developed mechanical plant system detailed layout as per job requirements.   6. Selected mechanical plant system equipment based on process needs, operating conditions, and industry standards.   7. Developed mechanical plant system detailed layout, as per job requirements |
| 2. Resource implications | The following resources should be provided:   * 1. Appropriately simulated environment where assessment can take place.   2. Access to relevant work place.   3. Resources relevant to the proposed activities or work place. |
| 3. Methods of assessment | Competency in this unit may be assessed through:   * + Practical   + Projects   + Portfolio of evidence   + Third party report   + Written tests   + Oral assessment |
| 1. Context of assessment | 4.1 Competency may be assessed in a work place or in a simulated work place. |
| 1. Guidance information for assessment | 5.1 Holistic assessment with other units relevant to the industry sector and workplace job role is recommended. |

## INSTALL STEAM SYSTEM

**UNIT CODE:** 0715 551 25A

**UNIT DESCRIPTION**

This unit covers the competencies required to install Steam systems. It involves preparing for installation of steam system, assembling boiler systems, fitting steam distribution system, and testing and commissioning steam system.

**ELEMENTS AND PERFORMANCE CRITERIA**

|  |  |
| --- | --- |
| **ELEMENT**  These describe the key outcomes which make up workplace functions | **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. Prepare for installation of Steam system. | * 1. ***Safety procedures*** are adhered to according to OSH Act,2007   2. ***Site conditions*** and ***installation requirements*** are assessed according to manufacturer’s specification.   3. ***Steam system*** ***components*** specifications are verified according to design requirements.   4. ***Tools, equipment*** and ***materials*** needed for installation are selected and assembled according to site conditions and site installation requirements.   5. Housekeeping is carried out according to workplace procedure. |
| * + - 1. Assemble boiler system | * 1. Safety procedures are adhered to according to OSH Act,2007   2. Boiler is mounted as per manufacturer’s specifications.   3. ***Boiler components*** are fitted as per manufacturer’s specifications.   4. Feed water system is fitted as per manufacturer’s specifications.   5. Fuel system is fitted as per manufacturer’s specifications.   6. Flue gas system is fitted as per manufacturer’s specifications.   7. ***Auxiliary*** ***components*** are fitted as per manufacturer’s specifications.   8. Housekeeping is carried out according to workplace procedure. |
| * + - 1. Fit steam distribution system | * 1. Safety procedures are adhered to according to OSH Act,2007   2. Piping of steam distribution system is done as per job specifications.   3. ***Steam distribution accessories*** are fitted in place as per manufacturer’s specification.   4. ***Lagging and cladding*** is carried out as per manufacturer’s specification.   5. Housekeeping is carried out according to workplace procedure. |
| * + - 1. Test and commission steam system | * 1. Safety procedures are adhered to according to OSH Act,2007   2. Assembly layout is checked according to installation manual   3. Steam system is run and checks are made for any ***abnormalities*** according to job specifications.   4. ***Steam system troubleshooting*** is carried out according to manufacturer’s specifications.   5. Training steam system end user is carried out according to manufacturer’s specifications.   6. ***Documentation and handing over*** is carried out according to manufacturer’s specifications.   7. Housekeeping is carried out according to workplace procedure. |

**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.Safety procedures may include but not limited to: | * Wearing of PPEs * Proper use of work tools * Demarcation of work site |
| 2.Site conditions and installation requirements | * Site size * Availability of electricity and water * Surrounding structures * Topography * Humidity |
| 3. Steam system components may include but not limited to: | * Boiler * Steam header * Steam receiver * Steam pipes * Fuel system * Stack pipe * Steam traps * Safety valves |
| 4.Tools, equipment and materials may include but not limited to: | * Pipe wrenches * Ladders * Chain blocks * Forklifts * Assorted spanners |
| 5. Boiler components may include but not limited to: | * Sight glasses * Pressure gauges * Safety valves * Blow down valve * Water level sensors |
| 6.Auxiliary components may include but not limited to: | * Feed water pump * Steam header * Feed water tank * Feed water conditioning unit * Economizer |
| 7.Steam distribution accessories may include but not limited to: | * Steam pipes * Steam traps * Safety valves * Condensate pump * Steam valves |
| 8.Lagging and cladding may include but not limited to: | * Steam pipe insulation * Element holding insulation material ­(steel, aluminium) |
| 9.Steam system troubleshooting may include but not limited to: | * Checking fuel preheaters * Checking thermostat * Checking burner nozzles * Checking fuel filters * Checking boiler water level |
| 10.Documentation and handing over may include but not limited to: | * Engineering drawings * Installation report * Certificate of warranty * Training of operators |

**REQUIRED KNOWLEDGE AND SKILLS**

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

**Required knowledge**

The individual needs to demonstrate knowledge of:

* Engineering drawing and Design.
* Occupational Safety and Health Practice.
* Fluid dynamics.
* Thermodynamics.

**Required skills**

The individual needs to demonstrate the following skills:

* Technical drawing.
* Communication skills
* Technical Report writing
* Analytical skills

**EVIDENCE GUIDE**

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

|  |  |
| --- | --- |
| * + - 1. Critical aspects of competency | Assessment requires evidence that the candidate:   * 1. Selected and assembled tools, equipment and materials needed for installation according to site conditions and site installation requirements.   2. Fitted boiler components as per manufacturer’s specifications.   3. Fitted steam distribution accessories in place as per manufacturer’s specification.   4. Run and checked steam for any abnormalities according to job specifications. |
| * + - 1. Resource implications | The following resources should be provided:   * 1. Appropriately simulated environment where assessment can take place.   2. Access to relevant work place.   3. Resources relevant to the proposed activities or work place. |
| * + - 1. Methods of assessment | Competency in this unit may be assessed through:   * 1. Practical   2. Projects   3. Portfolio of evidence   4. Third party report   5. Written tests   6. Oral assessment |
| * + - 1. Context of assessment | 4.1 Competency may be assessed in a work place or in a simulated work place. |
| * + - 1. Guidance information for assessment | 5.1 Holistic assessment with other units relevant to the industry sector and workplace job role is recommended. |

## MAINTAIN BOILER AND STEAM SYSTEM

**UNIT CODE:** 0715 551 26A

**UNIT DESCRIPTION**

This unit covers the competencies required to maintain boiler and steam systems. It involves carrying out boiler planned maintenance, carrying out boiler corrective maintenance, carrying out steam system planned maintenance, and carrying out steam system corrective maintenance.

**ELEMENTS AND PERFORMANCE CRITERIA**

|  |  |
| --- | --- |
| **ELEMENT**  These describe the key outcomes which make up workplace functions | **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. Carry out boiler planned maintenance | * 1. ***Safety procedures*** are adhered to according to OSH Act,2007   2. Statutory inspection of boiler is done according to OSH Act, 2007.   3. Boiler planned maintenance is done according to manufacturer’s maintenance manual.   4. Boiler test running is done according to manufacturer’s manual.   5. Housekeeping is done according to workplace procedure. |
| 1. Carry out boiler corrective maintenance | * 1. Safety procedures are adhered to according to OSH Act,2007   2. Boiler corrective maintenance tools are identified according to maintenance requirement   3. Boiler troubleshooting is done according to manufacturer’s maintenance manual.   4. Boiler corrective maintenance is done according to manufacturer’s maintenance manual.   5. Housekeeping is done according to workplace procedure   6. Maintenance report is done according to workplace requirement. |
| 1. Carry out steam system planned maintenance | * 1. Safety procedures are adhered to according to OSH Act,2007   2. ***Steam system*** maintenance tools are identified according to maintenance requirement.   3. Steam system planned maintenance is done according to manufacturer’s maintenance manual.   4. Steam system test running is done as per manufacturers manual and design requirement   5. Housekeeping is done according to workplace procedure |
| 1. Carry out steam system corrective maintenance | * 1. Safety procedures are adhered to according to OSH Act, 2007.   2. Steam system corrective maintenance tools are identified according to maintenance requirement.   3. Steam system corrective maintenance is done according to manufacturer’s maintenance manual.   4. Steam system test running is done as per manufacturers manual and design requirement.   5. Steam system troubleshooting is done according to manufacturer’s maintenance manual.   6. Housekeeping is done according to workplace procedure. |

**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. ***Safety procedures*** may include but not limited to: | * Personal protective equipment’s * Correct use of tool and equipment * Switching off of equipment * Electrical isolation |
| 1. ***Steam system*** may include but not limited to: | * Heat exchanger. * Steam traps. * Separators. * Condensate recovery system * Condensate lifting pump * Hot well. * Assorted valves. * Economizer. * Super heater. * Strainers. |

**REQUIRED SKILLS AND KNOWLEDGE**

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

**Required Skills**

The individual needs to demonstrate the following skills:

* Communication skills.
* Creativity.
* Team Player.
* Critical Thinking
* Honesty.
* Problem solving.
* Time management.
* Writing.
* Planning.

**Required Knowledge**

The individual needs to demonstrate knowledge of:

* Boiler and steam system housekeeping.
* Boiler and steam system Calibration and inspection.
* Boiler and steam system Measuring equipment.
* Boiler and steam system Steam operations.
* Interpretation of boiler and steam system drawings
* Boiler and steam system preventive and corrective maintenance
* Occupational health and safety guidelines.
* Applied thermal fluid principles.

**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 aspect of competency | Assessment requires evidence that the candidate:   1. Wore personal protective equipment as per workplace procedures. 2. Identified faulty Boiler and steam system components as per workplace procedure. 3. Carried out checks as per the maintenance schedule. 4. Tested the boiler/Steam System as per the job requirement. 5. Repaired boiler and steam system components as per workplace procedures. 6. Inspected Boiler safety components for testing as per workplace procedures. 7. Carried out the boiler start up procedure as per workplace procedures. 8. Shut down the boiler/steam system as per workplace procedures. 9. Isolated the boiler/steam system as per workplace procedures. 10. Monitored boiler operating parameters as per workplace procedures. |
| 1. Resource implications | The following resources should be provided:   * 1. Appropriately simulated environment where assessment can take place.   2. Access to relevant work place.   3. Resources relevant to the proposed activities or work place. |
| 1. Methods of assessment | Competency in this unit may be assessed through:   * 1. Practical   2. Projects   3. Portfolio of evidence   4. Third party report   5. Written tests   6. Oral assessment |
| 1. Context of assessment | 4.1 Competency may be assessed in a work place or in a simulated work place. |
| 1. Guidance information for assessment | 5.1 Holistic assessment with other units relevant to the industry sector and workplace job role is recommended. |

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