

**REPUBLIC OF KENYA**

**NATIONAL OCCUPATIONAL STANDARDS**

**FOR**

**AUTOMOTIVE ENGINEERING TECHNICIAN**

**KNQF LEVEL 6**

**PROGRAMME CODE: 0716 554A**

# 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 Automotive Engineering 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 Automotive 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 CAP.210A 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 Automotive engineering industry experts in conjunction with expert subject trainers and other related stakeholders have developed these Occupational Standards for Automotive Engineering Technician Level 6. These standards will be the basis for development of competency-based curriculum for Automotive Engineering Technician 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.

**KEY TO UNIT CODE**



**ACRONYMS**

CV Curriculum vitae

CDs Compact Disc

DVDs Digital Video Disc

HDMI High-Definition Multimedia Interface

DV I Digital visual interface

VGA Video Graphics Array

USB Universal Serial Bus

CPU Computer Processing Unit

RAM Random access memory

ICT Information and communication technology

AC Alternating current

DC Direct Current

ECU Electronic Control Unit

HVAC Heating, ventilation, and air conditioning

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# OVERVIEW

The Automotive Technician Level 6 qualification consists of competencies that a person must achieve to enable him/her to service, maintain motor vehicles in the motor vehicle industry. It includes applying digital literacy, applying communication skills, applying work ethics and practices and applying entrepreneurial skills. It also includes

Maintaining vehicle engine, maintaining vehicle transmission system, maintaining vehicle braking system, maintaining vehicle suspension and steering system, maintaining automotive electrical systems

The units of competency comprising Automotive Engineering Technician Certificate Level 6 qualifications include the following basic, common and core competencies:

**SUMMARY OF UNITS OF COMPETENCY**

|  |  |
| --- | --- |
| **BASIC UNITS OF COMPETENCY** | |
| 0611 441 01A | Apply Digital Literacy |
| 0031 441 02A | Apply Communication Skills |
| 0417 541 03A | Apply Work Ethics and Practices |
| 0413 441 04A | Apply Entrepreneurial Skills |
| **COMMON UNITS OF COMPETENCY** | |
| 0715 451 05A | Apply Workshop Technology |
| 0541 451 06A | Apply Mathematics |
| 0732 441 07A | Apply Technical Drawings |
| 0715 441 08A | Apply Mechanical Science |
| 0713 441 09A | Apply Electrical and Electronics Principles |
| 0541 541 10A | Apply Engineering Mathematics |
| 0732 551 11A | Perform Computer Aided Drawing |
| 0715 541 12A | Apply Engineering Mechanics |
| 0715 541 13A | Apply Thermodynamics and Fluid Mechanics |
| **CORE UNITS OF COMPETENCY** | |
| 0716 251 14A | Maintain Vehicle Petrol Engine |
| 0716 251 15A | Maintain Vehicle Braking System |
| 0716 351 16A | Maintain Vehicle Diesel Engine |
| 0716 351 17A | Maintain Vehicle Suspension and steering system |
| 0716 451 18A | Maintain Vehicle Fuel System |
| 0716 451 19A | Maintain Automotive Electrical Systems |
| 0716 451 20A | Maintain Vehicle Transmission System |
| 0716 551 21A | Maintain Hybrid and Electric Vehicle |
| 0716 551 22A | Maintain Vehicle Comfort System |
| 0716 551 23A | Maintain Vehicle Safety and Security 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 * News Group * 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: | * Remotask * Data annotation. Tech * Cloud worker * 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 standard 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 | * 1. ***Teams*** are formed to enhance productivity based on organization’s objectives   2. Duties are assigned to teams under the organization policy.   3. Team activities are managed and coordinated as per set objectives.   4. Team performance is evaluated based on set targets as per workplace policy.   5. ***Conflicts*** are resolved between team members in line with organization policy.   6. Gender and diversity-related issues are identified and mainstreamed in accordance with workplace policy.   7. Healthy ***relationships*** are developed and maintained in line with the workplace.   8. Adaptability and flexibility are applied in dealing with team members as per workplace policies |
| 1. Maintain professional and personal development | * 1. ***Personal growth and development*** needs are identified and assessed in line with the requirements of the job.   2. ***Training and career opportunities*** are identified and utilized based on job requirements.   3. ***Resources*** for training are mobilized and allocated based on organizations and individual skills needs.   4. Licenses and certifications relevant to the job and career are obtained and renewed as per policy.   5. Recognitions are sought as proof of career advancement in line with professional requirements.   6. Work priorities and personal commitments are balanced and managed based on the requirements of the job and personal objectives.   7. Dynamism and on-the-job learning are embraced in line with the organization’s goals and objectives. |
| 1. Apply Problem solving skills | * 1. ***Creative, innovative*** and practical solutions are developed based on the problem   2. Independence and initiative in identifying and solving problems are demonstrated based on the requirements of the job.   3. Team problems are solved as per the workplace guidelines   4. Problem-solving strategies are applied as per the workplace guidelines   5. Problems are analyzed and assumptions tested as per the context of data and circumstances |
| 1. Promote Customer Care | * 1. Customers' needs are identified based on their characteristics   2. Customer ***feedback*** is allowed and facilitated in line with organization policies.   3. Customer concerns and complaints are analyzed and resolved in line with the set organizational culture.   4. Proactive customer outreach programs are implemented as per organizational policies   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. |

**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. |

# 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 analysed 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 analysed 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

# COMMON UNITS OF COMPETENCY

# 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 performing material preservation and house keeping

**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*** are selected as per the task to be performed   4. Workshop tools and equipment are calibrated as per manufactures manual   5. Workshop tools are used as per work requirement   6. Tools and equipment are maintained as per the workplace procedures |
| 1. Perform material preservation | * 1. Safety procedures and practices are observed as per workplace requirements   2. Preservation method is selected as per work requirement   3. Preservation method is applied as per work requirement |
| 1. Perform house keeping | * 1. Safety procedures and practices are observed as per workplace requirements   2. ***Housekeeping equipment and materials*** are selected as per the task to be performed   3. Waste sorting and disposal is carried out as per workplace procedure |

**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 * Machining tools |
| 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

**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. Maintained work environment as per workplace requirement   2. Controlled workplace hazards and risks per workplace requirements   3. Managed workplace accidents and incidents as per workplace requirements   4. Selected engineering materials as per job requirement   5. Classified engineering materials as per job requirement   6. Selected workshop tools and equipment as per manufactures manual   7. Calibrated workshop tools and equipment as per manufactures manual   8. Maintained tools and equipment as per the workplace procedures   9. Applied preservation method as per work requirement   10. Carried out waste sorting and disposal as per 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 environment   3. Resources relevant to the proposed activities or tasks |
| 1. Methods of assessment | Competency in this unit may be assessed through:   1. Practical demonstration 2. Written reports 3. Case studies 4. Written examination |
| 1. Context of assessment | Competency may be assessed individually in the actual workplace or through accredited institution |
| 1. Guidance information for assessment | Holistic assessment with other units relevant to the industry sector, workplace and job role is recommended |

# 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   7. Performed resolution of vectors as per task requirement   8. Solved simultaneous equations using matrices 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. Written tests   2. Portfolio of evidence   3. 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 DRAWINGS

**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. ***Drawing equipment*** are identified according to   task requirements   * 1. ***Drawing materials*** are identified according to task requirements   2. Drawing equipment are applied 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 |
| 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 |
| 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    1. 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. Applied drawing equipment as per task requirement   2. Constructed different types of angles as per task requirement   3. Constructed different types of plane geometric forms as per task requirement   4. Developed patterns as per task requirement   5. Developed and interpenetrated solids as per task requirement   6. Constructed sections of different forms of projection as per task requirement   7. Developed and interpreted solids as per task requirement   8. Interpreted isometric curves and circles as per task requirement   9. Assembled parts on orthographic views as per task requirement   10. Produced sectional 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, analyzing 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 | * 1. Capacitors are applied as per task requirement   2. 6.2 Resistors are applied as per task requirement   3. Inductors are applied as per task requirement   4. Diodes are applied as per task requirement   5. 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. |

# PERFORM COMPUTER AIDED DRAWING

**UNIT CODE:** 0732 551 11A

**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. Applied computer aided engineering (CAE) 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 |

# APPLY ENGINEERING MECHANICS

**UNIT CODE:** 0715 541 12A

**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 |
| 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. Oral Questioning   5. 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 AND FLUID MECHANICS

**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. It also includes applying heat transfers and exchangers, fluid mechanics concepts and operating of air compressors and 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 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 ors at 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 |
| 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   ***9.4******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. Laws of Thermodynamicsmay include but not limited to: | * First law of thermodynamics * Second law of thermodynamics * Zeroth 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 |
| 1. Fluid pump may include but not limited to: | * Reciprocating pump * Centrifugal pump |
| 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. 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. Model Lawsmay include but not limited to: | * Reynold’s Model Law * Froude Model Law * Euler’s Model Law * Weber Model Law * Mach Model Law * Model Testing of Partially Sub-merged Bodies |
| 1. Methods of dimensional analysis may include but not limited to: | * Rayleigh’s method * Buckingham’s pi-theorem. |
| 1. Derived quantities may include but not limited to: | * Fundamental * Geometric * Kinematic Quantities * Dynamic Quantities |

**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
* 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 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 7. Applied fluid pump as per work requirements 8. 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. Written tests 2. Third party report 3. 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. |

# CORE UNITS OF COMPETENCY

# MAINTAIN VEHICLE PETROL ENGINE

**UNIT CODE: 0716 251 14A**

**UNIT DESCRIPTION**

This unit specifies competencies required to maintain vehicle engine. It involves performing Servicing vehicle engine, Overhauling Vehicle Engine, Servicing vehicle engine lubrication system and Performing House keeping

**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. Service vehicle Petrol engine | 1. ***PPEs*** are adorned as per workshop procedures. 2. Work area is organised and safety measures undertaken before use as per workplace procedure 3. ***Tools, equipment and materials*** are selected as per work requirements 4. Engine inspection is carried out as per manufacturers specifications 5. Engine components are replaced/repaired according to manufacturer’s manual |
| 1. Overhaul Petrol Vehicle Engine | * 1. Work area is organised and safety measures undertaken before use as per workplace procedure.   2. ***Tools, equipment and materials*** are selected as per work requirements.   3. ***Engine components*** are dismantled according to manufacturer’s manual   4. Engine componentsare cleaned as perstandard operating procedure.   5. Engine parts are inspected according to manufacturer’s specification   6. Engine parts are serviced/Replaced according to manufacturer’s specification   7. Vehicle engine parts are reassembled according to manufacturer’s manual   8. ***Re-installation******checks*** are performed according to manufacturer’s specification |
| 1. Service vehicle Petrol engine lubrication system | 1. Work area is organised and safety measures undertaken before use as per workplace procedure. 2. ***Engine lubrication Tools, equipment*** and materials are selected as per work requirements. 3. Engine lubrication system is diagnosed as per Manufacturer’s specification 4. Engine lubrication components are inspected according to manufacturer’s manual 5. ***Engine lubrication Components*** are serviced according *to*manufacturer’s specifications***.*** 6. Engine lubrication Componentsare fitted back according tomanufacturer’s specifications 7. Engine lubrication system*is tested according to*manufacturer’s specifications |
| 1. Service Vehicle Petrol Fuel System | 1. Work area is organised and safety measures undertaken before use as per workplace procedure 2. Tools, equipment and materials are assembled as per work requirements 3. ***Vehicle Petrol Fuel*** ***system*** diagnosis is carried out as per Manufacturer’s specification 4. Vehicle Fuel system components are inspected according to manufacturer’s manual 5. Vehicle Fuel system components areserviced/Replaced according tomanufacturer’s specifications***.*** 6. Vehicle Fuel system istested according tomanufacturer’s specifications |
| 1. Perform House keeping | * 1. Engine waste is segregated and disposed as per workshop procedures   2. Tools and equipment are cleaned as per workshop procedures   3. Tools and equipment are stored as per workshop procedures   4. Housekeeping is carried out as per workplace requirements |

**RANGE**

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

|  |  |
| --- | --- |
| **Variable** | **Range** |
| 1. PPEs may include but are not limited to: | * Safety Boot * Dust Coat/Overall * Gloves * Face shield |
| 1. Tools, equipment and materials may include but are not limited to: | * Spanners * Torque wrench * Straight edge * Valve compressor * Pliers * Telescopic dial gauge * Filler gauge * Vernier callipers * Diagnostic scope * Dial gauge indicator * Compression tester * Ring squeezer * Oil * Funnels and draining pans * Cleaning materials * Plastigauge * Engineers blue |
| 1. Petrol Engine components may include but are not limited to: | * Oil seals and oil filters * Piston and piston rings * Top covers * Valves, push rods and valve lifters * Camshaft * Gasket * Crankshaft * Drive pulleys * Oil sump and oil pump * Timing gears * Timing belt * Cylinder head * Cylinder block |
| 1. Re-installation checks | * Engine ignition timing * Camshaft timing * Injector pump timing * Tappet clearance |
| 1. Petrol Engine lubrication tools, equipment and materials | * Drain pan * Feeler gauge * Oil funnels * Grease gun * Oil pump * Silicon * Oil * Grease * Rags |
| 1. Petrol Engine lubrication components | * Oil sump * Oil filters * Oil pump * Lubrication sensors * Oil galleries * PCV valves |
|  |  |

**REQUIRED KNOWLEDGE AND SKILLS**

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

* Kenyan legislation and workplace procedures relevant to:
* Health and safety
* Environment
* Personal protective equipment
* Waste management
* Engine Manufacturers Manual
* Workplace procedures for vehicle engine overhaul.
* Working to agreed time frame and keeping others informed of progress
* The relationship between time, costs and profitability
* Interpretation and use of technical information for engine service activities

**Required Skills**

*The individual needs to demonstrate the following skills*:

* Communication (verbal and written)
* Time management
* Problem solving
* Decision making
* Planning
* First aid
* Vehicle engine service
* Vehicle engine overhaul
* Vehicle engine lubrication system service
* House keeping
* Interpreting technical information

**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 learner:   1. Adorned Personal Protective Equipment as per workshop procedures 2. Inspected Engine components as per work requirements 3. Selected Engine Tools, Equipment and materials as per work requirements 4. Serviced/Replaced Engine components as per work requirements 5. Dismantled Engine components as per work requirements 6. Assembled engine components as per work requirements 7. Performed reinstallation checks as per work requirements 8. Diagnosed Lubrications system as per workshop procedures 9. Serviced lubrication system as per work requirements 10. Performed housekeeping as per workshop procedures |
| 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 assessment activity or tasks. |
| 1. 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 |
| 1. Context of Assessment | Competency may be assessed in a workplace or in a simulated workplace |
| 1. Guidance information for assessment | Holistic assessment with other units relevant to the industry sector, workplace and job role is recommended |

# MAINTAIN VEHICLE BRAKING SYSTEM

**UNIT CODE: 0716 251 15A**

**UNIT DESCRIPTION**

This unit specifies competencies required to Maintain Vehicle Braking system. It involves Assessing vehicle braking system, servicing vehicle braking system and performing house keeping

**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. Assess vehicle braking system | 1. Work area is organised and safety measures undertaken before use as per workplace procedure 2. ***Tools, equipment and materials*** are selected as per work requirements 3. ***Vehicle braking system*** is assessed according to manufacturer’s specifications |
| 1. Service Vehicle braking system | 1. Work area is organised and safety measures undertaken before use as per workplace procedure 2. Tools, equipment and materials are selected as per work requirements 3. **Vehicle braking system component*s*** are inspected according to manufacturer’s manual 4. Vehicle braking system Components*are* serviced/ Replaced according tomanufacturer’s specifications***.*** 5. Vehicle Braking system is bled according to manufacturer’s manual 6. Vehicle brakingsystemis tested according *to*manufacturer’s specifications |
| 1. Carry out vehicle Braking system diagnosis | * 1. Work area is organised and safety measures undertaken before use as per workplace procedure   2. Tools, equipment and materials are assembled as per work requirements   3. Diagnostic trouble codes are interpreted as per manufacturer’s specifications   4. Faulty sensors, actuators and circuits are replaced/serviced as per manufacturer’s specifications |
| 1. Perform House keeping | * 1. Brake waste is segregated and disposed as per workshop procedures   2. Tools and equipment are cleaned as per workshop procedures   3. Tools and equipment are stored as per workshop procedures   4. Housekeeping is carried out as per workplace requirements |

**RANGE**

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

|  |  |
| --- | --- |
| **Variable** | **Range** |
| 1. Tools, equipment and materials may include but are not limited to: | * Spanners * Wheel chokes * Brake bleeder kit * Jack and jack stand * Brake pad spreader * Brake Fluid * Cloth * Detergent |
| 1. Vehicle braking system may include but are not limited to: | * Drum brakes * Disc brakes * Anti-lock braking system |
| 1. Vehicle braking system component*s* may include but are not limited to: | * Brake pedal * Brake booster * Master cylinder * Brake line * Wheel cylinder * Brake shoe * Brake pads * Compressor * Brake actuators * Brake sensors |

**REQUIRED KNOWLEDGE AND SKILLS**

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

* Kenyan legislation and workplace procedures relevant to:
* Health and safety
* Environment
* Personal and vehicle protective equipment
* Waste disposal
* Legal requirements relating to the vehicles warranty and insurance policies
* Workplace procedures for:
* Reporting the results of tests
* Reporting anticipated delays
* Working to agreed time frame and keeping others informed of progress
* The relationship between time, costs and profitability
* Interpretation and use of technical information for braking system service activities
* Importance of using the correct technical information

**Required Skills**

*The individual needs to demonstrate the following skills*:

* Communication (verbal and written)
* Time management
* Problem solving
* Decision making
* Planning
* First aid
* Vehicle braking system Assessment
* Vehicle braking system service
* House keeping
* Interpreting technical information

**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 learner:   * 1. Undertook safety measures as per workplace procedure   2. Assessed Vehicle braking system according to manufacturer’s specifications   3. Inspected vehicle braking system components according to manufacturer’s manual   4. Serviced/replaced vehicle braking system components according to manufacturer’s specifications.   5. Adjusted brake components as per workshop procedures   6. Tested vehicle braking system according to manufacturer’s manual   7. Performed Housekeeping as per workplace requirements |
| 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 assessment activity or tasks. |
| 1. 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 |
| 1. Context of Assessment | Competency may be assessed in a workplace or in a simulated workplace |
| 1. Guidance information for assessment | Holistic assessment with other units relevant to the industry sector, workplace and job role is recommended |

# MAINTAIN VEHICLE DIESEL ENGINE

**UNIT CODE: 0716 351 16A**

**UNIT DESCRIPTION**

This unit specifies competencies required to maintain vehicle engine. It involves performing vehicle engine overhaul, servicing vehicle engine cooling system, servicing vehicle lubricating system and servicing vehicle fuel 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. Perform vehicle Engine overhaul | * 1. Work area is organised and safety measures undertaken before use as per workplace procedure.   2. Engine diagnosis is carried out as per Manufacturer’s specification   3. ***Engine overhaul Tools, equipment and materials*** are assembled as per work requirements.   4. ***Engine components*** are dismantled according to manufacturer’s manual   5. Engine componentsare cleaned as perstandard operating procedure.   6. Engine parts are inspected according to manufacturer’s specification   7. Engine parts are serviced/replaced according to manufacturer’s specification   8. Vehicle engine parts are reassembled according to manufacturer’s manual   9. Engine tune up is carried out according to manufacturer’s specification   10. Engine is fitted back to vehicle according to manufacturer’s manual   11. ***Re-installation******checks*** are performed according to manufacturer’s specification   12. Engine Service documents are prepared according to workplace procedures |
| 1. Service vehicle engine cooling system | 1. Work area is organised and safety measures undertaken before use as per workplace procedure. 2. Engine cooling system is diagnosed as per Manufacturer’s specification 3. Cooling system tools, equipment and materials are assembled as per work requirements 4. Engine coolingcomponent***s*** are inspected according to manufacturer’s manual 5. ***Engine Cooling Components*** are servicedaccording *to*manufacturer’s specifications***.*** 6. Engine Cooling Componentsare fitted back according *to*manufacturer’s specifications 7. Engine Cooling systemis testedaccordingtomanufacturer’s specifications 8. Cooling system Service documents are prepared according to workplace procedures. |
| 1. Service vehicle engine lubrication system | 1. Work area is organised and safety measures undertaken before use as per workplace procedure. 2. Engine lubrication system is diagnosed as per Manufacturer’s specification 3. ***Engine lubrication tools, equipment and materials*** are assembled as per work requirements. 4. ***Engine lubrication components*** are inspected according to manufacturer’s manual 5. Engine lubrication Components are serviced according to manufacturer’s specifications. 6. Engine lubrication Components are fitted back according to manufacturer’s specifications 7. Engine lubrication system is tested according to manufacturer’s specifications 8. lubrication system service documents are prepared according to workplace procedures |
| 1. Service Vehicle Fuel system | 1. Work area is organised and safety measures undertaken before use as per workplace procedure 2. Tools, equipment and materials are assembled as per work requirements 3. ***Vehicle Fuel*** system diagnosis is carried out as per Manufacturer’s specification 4. Vehicle Fuel system components are inspected according to manufacturer’s manual 5. ***Vehicle Fuel system components are***serviced/Replaced according tomanufacturer’s specifications***.*** 6. Vehicle Fuel system istested according *to*manufacturer’s specifications 7. Vehicle Fuel system service documents are prepared 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. Engine overhaul Tools, equipment and materials | * Spanners * Torque wrench * Straight edge * Valve spring compressor * Pliers * Telescopic dial gauge * Feeler gauge * Vernier callipers * Micrometer screw gauge * Ratchet * Scan Tools * Dial indicator * Engine compression gauges * Piston ring squeezer * Timing light * Oil * Radiator pressure tester * Funnels and draining pans * Cleaning materials * Plastigage * Coolant |
| 1. Engine components | * seals and sealants * Filters * Piston and piston rings * Top covers * Valves and valve trains * Camshaft * Gaskets * Crankshaft * Drive pulleys * Oil sump and oil pump * Timing gears * Timing belt * Cylinder head * Cylinder block |
| 1. Re-installation checks | * Engine ignition timing * Software initialization * Valve timing * Injector pump timing * Tappet clearance |
| 1. Engine Cooling Components | * Radiator cap * radiator * hoses * Thermostat * Thermistor * sensors * Water pump * Fan belt * fan relay * fan |
| 1. Engine lubrication tools, equipment and materials | * Drain pan * Feeler gauge * Straight Edge * Oil funnels * Grease gun * Oil Gauge * Silicon * Oil * Grease * Rags |
| 1. Engine lubrication components | * Oil sump * Oil filters * Oil Strainer * Oil pump * Pressure regulating valve * Lubrication sensors * Oil galleries * PCV valves |
| 1. Vehicle fuel system | * Petrol fuel system * Diesel fuel system |
| 1. Vehicle Fuel system components | * Air cleaners * Mufflers * Sensors * Catalytic converters * EGR valves * Manifolds * Throttle body * Fuel Injectors * Electronic control unit * Fuel-lines * Common Rail * Supply Pump |

**REQUIRED KNOWLEDGE AND SKILLS**

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

* Kenyan legislation and workplace procedures relevant to:
* Health and safety
* Environment
* Personal protective equipment
* Waste management
* Legal requirements relating to the vehicles warranty
* Workplace procedures for vehicle engine overhaul.
* Documenting assessment and rectification information
* Working to agreed time frame and keeping others informed of progress
* The relationship between time, costs and profitability
* Interpretation and use of technical information for engine service activities
* The purpose of and how to use identification codes

**Required Skills**

*The individual needs to demonstrate the following skills*:

* Communication (verbal and written)
* ICT
* Time management
* Problem solving
* Decision making
* Planning
* First aid
* Report writing
* engine overhaul
* vehicle engine cooling system service
* vehicle engine lubrication system service
* Vehicle Fuel system service
* Interpreting technical information

**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 | 1. Undertook safety measures as per workplace procedures 2. Diagnosed Engine as per Manufacturer’s specification 3. DismantledEngine components according to manufacturer’s manual 4. Serviced/replaced engine parts according to manufacturer’s specification 5. Reassembled engine parts according to manufacturer’s manual 6. Tune up engine according to manufacturer’s specification 7. Fitted back Engine to vehicle according to manufacturer’s manual 8. Serviced engine-cooling system components according to manufacturer’s specifications. 9. Tested engine cooling system according to manufacturer’s specifications 10. Engine lubrication system is diagnosed as per Manufacturer’s specification 11. Serviced engine lubrication components according to manufacturer’s specifications. 12. Fitted Engine lubrication Components back according to manufacturer’s specifications 13. Diagnosed engine fuel system as per manufacturer’s specification 14. Serviced/replaced engine fuel system components according to manufacturer’s specifications. |
| 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 |

# MAINTAIN VEHICLE SUSPENSION AND STEERING SYSTEM

**UNIT CODE: 0716 351 17A**

**UNIT DESCRIPTION**

This unit specifies competencies required to service vehicle suspension system, Service vehicle steering system, Service vehicle wheels and tyres and carry out vehicle wheel alignment

**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. Service vehicle Independent and Non-independent suspension system | * 1. Work area is organised as per workplace procedure   2. Safety precautions are undertaken as per work procedures   3. Tools, equipment and materials are assembled as per work requirements   4. Vehicle suspension system is diagnosed as per manufacturer’s specification   5. Vehicle suspension components is inspected according to manufacturer’s manual   6. Vehicle suspension components are serviced/replaced according to manufacturer’s specifications.   7. Vehicle suspension is tested according to manufacturer’s specifications   8. Vehicle suspension system service document is prepared according to workplace procedures |
| 1. Service vehicle Manual steering system | * 1. Work area is organised as per workplace procedure   2. Tools, equipment and materials are assembled as per work requirements   3. ***Vehicle steering system*** is diagnosed as per manufacturer’s specification   4. ***Vehicle*** steering components are inspected according to manufacturer’s manual   5. Vehicle steering components are serviced/replaced according to manufacturer’s specifications.   6. Vehicle steering components are tested according to manufacturer’s specifications   7. Vehicle steering system service document are prepared according to workplace procedures |
| 1. Service vehicle wheels and tyres | * 1. Work area is organised as per workplace procedure   2. ***Wheels and tyres tools, equipment and materials*** are assembled as per work requirements   3. ***wheels and tyres*** are inspected as per manufacturer’s manual   4. Vehicle tyres are serviced according to manufacturer’s manual   5. Wheels are balanced according to manufacturer’s manual |
| 1. Carry out vehicle wheel alignment | * 1. Work area is organised as per workplace procedure   2. Tools, equipment and materials are assembled as per work requirement   3. Vehicle wheels are aligned according to manufacturer’s manual   4. Vehicle wheel alignment is tested according to manufacturer’s manual   5. Vehicle wheel alignment service document is prepared 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. Vehicle suspension system may include but not limited to; | * Independent vehicle suspension system * Dependent vehicle suspension system * Semi-independent vehicle suspension system |
| 1. Vehicle suspension components may include but not limited to; | * Springs * Dampers * Stabilizers * Bellows * Wishbones * Bushes * Radius rod |
| 1. Vehicle steering system may include but not limited to; | * Manual steering system * Power steering system * Power assisted steering system |
| 1. Vehicle steering system components may include but not limited to; | * Steering wheel * Steering column * Collapsible steering shaft * Steering gear box * Steering linkages * Kingpin * Stub-axle * Power steering pump * Reservoir * Ram cylinder * Hydraulic pipes |
| 1. Wheels and tyres may include but not limited to; | * Tubeless * Tubed tires * Radial ply tires * Cross ply wheels * Well-base wheels * Dished wheels * Wire spoke wheels * Two-piece wheels * Split wheels |
| 1. Wheels and tyres tools, equipment and materials may include but not limited to; | * Wheels * Tires * Air compressor * Tire pressure gauge * Bead breaker * Tire levers * Patches * Vulcanizing glue * Tubeless tire repair kit * Wheel balancing weight * Wheel balancing machines * Soapy water * Tire inflation cage |

**REQUIRED KNOWLEDGE AND SKILLS**

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

* Kenyan legislation and workplace procedures relevant to:
* Health and safety
* Environment
* Personal Protective Equipment
* Waste management
* Legal requirements relating to the vehicles warranty and insurance policies
* Workplace procedures for suspension system
* Documenting assessment and rectification information
* Working to agreed time frame and keeping others informed of progress
* The relationship between time, costs and profitability
* Interpretation and use of technical information

**Required Skills**

*The individual needs to demonstrate the following skills*:

* Communication (verbal and written)
* ICT
* Time management
* Problem solving
* Decision making
* Planning
* First aid
* Report writing
* vehicle suspension system
* vehicle steering system
* vehicle wheels and tyres
* vehicle wheel alignment
* Interpreting technical information

**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 | * 1. Diagnosed vehicle suspension system as per manufacturer’s specification   2. Inspected vehicle suspension components according to manufacturer’s manual   3. Serviced/replaced vehicle suspension components according to manufacturer’s specifications.   4. Tested vehicle suspension system according to manufacturer’s specifications   5. Tested vehicle steering system according to manufacturer’s manual   6. Inspected wheels and tyres as per service manual   7. Balanced wheels according to service manual   8. Aligned wheels according to service manual |
| 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 |
| 1. 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 |

# MAINTAIN VEHICLE FUEL SYSTEM

**UNIT CODE: 0716 451 18A**

**UNIT DESCRIPTION**

This unit specifies competencies required to Maintain Vehicle Fuel System. It involves Servicing Vehicle Fuel injection system, Servicing vehicle intake-Exhaust system, carrying out vehicle Engine diagnosis and Performing vehicle fuel system tune up

**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. Service Vehicle Fuel injection system. | * 1. Work area is organised as per workplace procedure   2. Safety precautions are undertaken as per workplace procedure   3. Tools, equipment and materials are assembled as per work requirements   4. Vehicle fuel system is diagnosed as per manufacturer’s specification   5. Vehicle fuel system components are inspected according to manufacturer’s manual   6. Vehicle fuel system components are Serviced/replaced according to manufacturer’s specifications   7. Vehicle fuel system is tested according to manufacturer’s specifications   8. Vehicle fuel system service documents are prepared according to workplace procedures |
| 1. Service vehicle intake-Exhaust system | 1. Work area is organised and safety measures undertaken as per workplace procedure. 2. Engine intake-Exhaust system is diagnosed as per Manufacturer’s specification 3. Tools, equipment and materials are assembled as per work requirements 4. ***Engine intake-Exhaust system components*** are inspected according to manufacturer’s manual 5. Engine intake-Exhaust system Components are serviced/replaced according to manufacturer’s specifications. 6. Engine intake-Exhaust system Components are fitted back according to manufacturer’s specifications 7. Engine intake-Exhaust system is tested according to manufacturer’s specifications 8. Engine intake-Exhaust system service documents are prepared according to workplace procedures |
| 1. Carry out vehicle Engine diagnosis | 1. Work area is organised and safety measures undertaken as per workplace procedure 2. Tools, equipment and materials are assembled as per work requirements 3. Diagnostic trouble codes are interpreted as per manufacturer’s specifications 4. Engine faulty sensors, actuators and circuits are replaced/serviced as per manufacturer’s specifications |
| 1. Perform vehicle fuel system tune up | 1. Work area is organised as per workplace procedure 2. Safety precautions are undertaken as per workplace procedure 3. Tools, equipment and materials are assembled as per work requirements 4. Vehicle fuel system is diagnosed as per manufacturer’s specification 5. Performance Parameters Vehicle fuel system are adjusted as per Manufacturer’s specification |

**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. Engine overhaul Tools, equipment and materials | * Spanners * Torque wrench * Straight edge * Valve spring compressor * Pliers * Telescopic dial gauge * Feeler gauge * Vernier callipers * Micrometer screw gauge * Ratchet * Scan Tools * Dial indicator * Engine compression gauges * Piston ring squeezer * Timing light * Oil * Radiator pressure tester * Funnels and draining pans * Cleaning materials * Plastigage * Coolant |
| 1. Engine components | * seals and sealants * Filters * Piston and piston rings * Top covers * Valves and valve trains * Camshaft * Gaskets * Crankshaft * Drive pulleys * Oil sump and oil pump * Timing gears * Timing belt * Cylinder head * Cylinder block |
| 1. Re-installation checks | * Engine ignition timing * Software initialization * Valve timing * Injector pump timing * Tappet clearance |
| 1. Engine Cooling Components | * Radiator cap * radiator * hoses * Thermostat * Thermistor * sensors * Water pump * Fan belt * fan relay * fan |
| 1. Engine lubrication tools, equipment and materials | * Drain pan * Feeler gauge * Straight Edge * Oil funnels * Grease gun * Oil Gauge * Silicon * Oil * Grease * Rags |
| 1. Engine lubrication components | * Oil sump * Oil filters * Oil Strainer * Oil pump * Pressure regulating valve * Lubrication sensors * Oil galleries * PCV valves |
| 1. Vehicle fuel system | * Petrol fuel system * Diesel fuel system |
| 1. Vehicle Fuel system components | * Air cleaners * Mufflers * Sensors * Catalytic converters * EGR valves * Manifolds * Throttle body * Fuel Injectors * Electronic control unit * Fuel-lines * Common Rail * Supply Pump |

**REQUIRED KNOWLEDGE AND SKILLS**

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

* Kenyan legislation and workplace procedures relevant to:
* Health and safety
* Environment
* Personal protective equipment
* Waste management
* Legal requirements relating to the vehicles warranty
* Workplace procedures for vehicle engine overhaul.
* Documenting assessment and rectification information
* Working to agreed time frame and keeping others informed of progress
* The relationship between time, costs and profitability
* Interpretation and use of technical information for engine service activities
* The purpose of and how to use identification codes

**Required Skills**

*The individual needs to demonstrate the following skills*:

* Communication (verbal and written)
* ICT
* Time management
* Problem solving
* Decision making
* Planning
* First aid
* Report writing
* engine overhaul
* vehicle engine cooling system service
* vehicle engine lubrication system service
* Vehicle Fuel system service
* Interpreting technical information

**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 | 1. Undertook safety measures as per workplace procedures 2. Diagnosed Engine as per Manufacturer’s specification 3. DismantledEngine components according to manufacturer’s manual 4. Serviced/replaced engine parts according to manufacturer’s specification 5. Reassembled engine parts according to manufacturer’s manual 6. Tune up engine according to manufacturer’s specification 7. Fitted back Engine to vehicle according to manufacturer’s manual 8. Serviced engine-cooling system components according to manufacturer’s specifications. 9. Tested engine cooling system according to manufacturer’s specifications 10. Engine lubrication system is diagnosed as per Manufacturer’s specification 11. Serviced engine lubrication components according to manufacturer’s specifications. 12. Fitted Engine lubrication Components back according to manufacturer’s specifications 13. Diagnosed engine fuel system as per manufacturer’s specification 14. Serviced/replaced engine fuel system components according to manufacturer’s specifications. |
| 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 |

# MAINTAIN AUTOMOTIVE ELECTRICAL SYSTEMS

**UNIT CODE: 0716 451 19A**

**UNIT DESCRIPTION**

This unit specifies competencies required to service vehicle ignition system, service, and vehicle charging system, service vehicle starting system, service vehicle lighting system, service vehicle air conditioning system, service vehicle auxiliary system and service vehicle security 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. Service Vehicle ignition system | 1. work area is organised as per workplace procedure 2. Safety measures are undertaken as per workplace procedure 3. ***tools, equipment and materials are*** assembled as per work requirements 4. ***Vehicle ignition system*** is diagnosed as per manufacturer’s specification 5. Vehicle ignition ***system components*** is inspected according to manufacturer’s manual 6. Vehicle ignition system components are serviced/replaced according tomanufacturer’s specifications 7. Vehicle ignition system is tested according *to*manufacturer’s specifications 8. Vehicle ignition system service documents are prepared according to workplace procedures |
| 1. Service Vehicle Charging system | 1. Work area is organised and safety measures undertaken before use as per workplace procedure 2. Tools, equipment and materials are assembled as per work requirements 3. Vehicle charging system diagnosis is carried out as per Manufacturer’s specification 4. Vehicle charging system components are inspected according to manufacturer’s manual 5. **Vehicle charging system *components are***serviced/replaced according tomanufacturer’s specifications 6. Vehicle charging system is tested according tomanufacturer’s specifications 7. Vehicle charging system service documents are prepared according to workplace procedures |
| 1. Service Vehicle Starting system | 1. Work area is organised and safety measures undertaken before use as per workplace procedure 2. Tools, equipment and materials are assembled as per work requirements 3. Vehicle Starting system diagnosis is carried out as per Manufacturer’s specification 4. Vehicle Starting system components are inspected according to manufacturer’s manual 5. **Vehicle starting system *components are***serviced/Replaced according tomanufacturer’s specifications***.*** 6. Vehicle Starting system istested according *to*manufacturer’s specifications 7. Vehicle Starting system service documents are prepared according to workplace procedures |
| 1. Service Vehicle lighting system | 1. Work area is organised and safety measures undertaken before use as per workplace procedure 2. Tools, equipment and materials are assembled as per work requirements 3. Vehicle lighting system diagnosis is carried out as per Manufacturer’s specification 4. Vehicle lighting system components are inspected according to manufacturer’s manual 5. **Vehicle lighting system *components are***serviced/Replaced according tomanufacturer’s specifications***.*** 6. Vehicle lighting system is tested according *to*manufacturer’s specifications 7. Vehicle lighting system service documents are prepared 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**  *May include but not limited to:* |
| 1. Vehicle ignition system | * Convectional ignition system * Electronic ignition system * Distributorless ignition system |
| 1. Ignition system components | * Ignition coil * Ignition distributor * Spark plugs * High tension cables * Low tension cables * Ballast resistor * ECU * Sensors * Ignition switch * Ignition key |
| 1. Tools and equipment | * Electronic diagnostic equipment; * Multi-meters * Oscilloscope. * Timing Light * Hydrometer * High-rate discharge tester * Feeler gauge * Battery charger * Test lamp * Growler * AC charging equipment * Vacuum pump |
| 1. Vehicle charging system components | * Ignition switch * Ignition relay * Fuse box * Alternator * Regulator * Belt |
| 1. Vehicle starting system components | * Starter motor * Solenoid switch * Cables * Battery * Starter switch * Starter relay |
| 1. Vehicle lighting system components | * lamps * Bulbs * Switches * Relays * Fuses * Electrical wires * Bulb holders |

**REQUIRED KNOWLEDGE AND SKILLS**

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

* Kenyan legislation and workplace procedures relevant to:
* Health and safety
* Environment
* Personal and vehicle protective equipment
* Waste disposal
* Legal requirements relating to the vehicles warranty and insurance policies
* Workplace procedures for:
* Recording the fault, the location and fault correction activities
* Reporting the results of tests
* The referral of problems
* Reporting anticipated delays
* Documenting assessment and rectification information
* Working to agreed time frame and keeping others informed of progress
* The relationship between time, costs and profitability
* How to find, interpret and use technical information for engine service activities
* Importance of using the correct technical information
* The purpose of and how to use identification codes

**Required Skills**

*The individual needs to demonstrate the following skills*:

* Communication (verbal and written)
* ICT
* Time management
* Problem solving
* Decision making
* Planning
* First aid
* Report writing
* Driving
* Vehicle Starting system service
* Vehicle lighting system service
* vehicle Air conditioning system service
* Vehicle Auxiliary system service
* Vehicle security system service
* Interpreting technical information
* Handling tools and equipment

|  |  |
| --- | --- |
| 1. Critical Aspects of Competency | ***Assessment requires evidence that the candidate:***   * 1. Diagnosed vehicle electrical system as per work requirements   2. Serviced vehicle ignition system as per work requirements   3. fitted vehicle electrical accessories as per work requirements   4. Serviced vehicle charging systems as per work requirements   5. Serviced vehicle starting systems as per work requirements   6. Serviced vehicle lighting system as per work requirements   7. Serviced vehicle HVAC system as per work requirements   8. Service vehicle auxiliary system as per work requirements   9. Serviced vehicle security system as per work requirements |
| 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 assessment activity or tasks. |
| 1. 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 |
| 1. Context of Assessment | Competency may be assessed in a workplace or in a simulated workplace |
| 1. Guidance information for assessment | Holistic assessment with other units relevant to the industry sector, workplace and job role is recommended |

# MAINTAIN VEHICLE TRANSMISSION SYSTEM

**UNIT CODE: 0716 451 20A**

**UNIT DESCRIPTION**

This unit specifies competencies required to maintain vehicle transmission system.

It involves Diagnosing vehicle transmission system, overhauling vehicle clutch assembly, overhauling vehicle gearbox unit, servicing vehicle drive shaft, overhauling vehicle transfer case and overhauling vehicle final drive.

**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. Diagnose vehicle transmission system | 1. Work area is organised and safety measures undertaken as per workplace procedure 2. Tools, equipment and materials are assembled as per work requirements 3. ***Vehicle transmission system*** is assessed according to manufacturer’s specifications 4. Job card is prepared according to workshop procedure |
| 1. Overhaul Vehicle clutch assembly | 1. Work area is organised and safety measures undertaken as per workplace procedure. 2. Vehicle clutch assembly is diagnosed as per Manufacturer’s specification 3. Tools, equipment and materials are assembled as per work requirement 4. Vehicle clutch assembly is dismantled according to manufacturer’s manual 5. ***Vehicle clutch assembly parts*** are inspected according to manufacturer’s specification 6. Vehicle clutch assembly parts are serviced/Replaced according to manufacturer’s specification 7. Vehicle clutch assembly parts are reassembled according to manufacturer’s manual 8. ***Vehicle clutch assembly adjustment*** is carried out according to manufacturer’s specification 9. Vehicle clutch assembly service documents are prepared according to workplace procedures |
| 1. Overhaul Vehicle gearbox unit | * 1. Work area is organised and safety measures undertaken as per workplace procedure.   2. ***Vehicle gearbox*** unit diagnosis is carried out as per Manufacturer’s specification   3. Tools, equipment and materials are assembled as per work requirements   4. ***Vehicle gearbox components*** are overhauled according to manufacturer’s manual   5. Vehicle gearbox parts are inspected according to manufacturer’s specification   6. Vehicle gearbox parts are serviced/Replaced according to manufacturer’s specification   7. Vehicle gearbox parts are reassembled according to manufacturer’s manual   8. Vehicle gearbox unit is fitted back to vehicle according to manufacturer’s manual   9. Re-installation checks are performed according to manufacturer’s specification   10. Vehicle gearbox unit service documents are prepared according to workplace procedures |
| 1. Service Vehicle drive shaft | * 1. Work area is organised and safety measures undertaken as per workplace procedure.   2. ***Vehicle drive shafts*** are diagnosed as per Manufacturer’s specification   3. Tools, equipment and materials are assembled as per work requirements   4. Vehicle drive shafts components are inspected according to manufacturer’s manual   5. ***Vehicle drive shaft components*** are serviced/Replaced according to manufacturer’s specifications   6. Vehicle driveshaft components are fitted back according to manufacturer’s specifications   7. Vehicle drive shafts are tested according to manufacturer’s specifications   8. Vehicle drive shaft service documents are prepared according to workplace procedures |
| 1. Overhaul Vehicle Transfer case | 1. Work area is organised and safety measures undertaken as per workplace procedure. 2. ***Vehicle Transfer case*** diagnosis is carried out as per manufacturer’s specification 3. Tools, equipment and materials are assembled as per work requirements 4. ***Vehicle Transfer case components*** are dismantled according to manufacturer’s manual 5. Vehicle Transfer case components are inspected according to manufacturer’s specification 6. Vehicle Transfer case components are serviced/replaced according to manufacturer’s specification 7. Vehicle Transfer case components are reassembled according to manufacturer’s manual 8. Vehicle Transfer case unit is fitted back to vehicle according to manufacturer’s manual 9. Re-installation checks are performed according to manufacturer’s specification 10. Vehicle Transfer case unit service documents are prepared according to workplace procedures |
| 1. Overhaul vehicle final drive | 1. Work area is organised and safety measures undertaken as per workplace procedure. 2. ***Vehicle final drive*** diagnosis is carried out as per manufacturer’s specification 3. Tools, equipment and materials are assembled as per work requirements 4. **Vehicle final drive** ***components*** are dismantled according to manufacturer’s manual 5. Vehicle final drive componentsare cleaned as perstandard operating procedure 6. Vehicle final drive parts are inspected according to manufacturer’s specification 7. Vehicle final drive parts are serviced/replaced according to manufacturer’s specification 8. Vehicle final drive parts are reassembled according to manufacturer’s manual 9. Vehicle final drive unit is fitted back to vehicle according to manufacturer’s manual 10. Re-installation checks are performed according to manufacturer’s specification 11. Vehicle final drive unit service documents are prepared 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. Vehicle transmission system may include but not limited to; | * Manual vehicle transmission system * Automatic vehicle transmission system * Continuous variable transmission (CVT) * Semi-automatic transmission system * Dual clutch transmission system (DCT) |
| 1. Vehicle clutch assembly parts may include but not limited to; | * Pressure plates * Clutch disc * Release bearings * Flywheel * Clutch fork * Torque converter * Fluid flywheel |
| 1. Vehicle clutch assembly adjustment may include but not limited to; | * Free play * Clutch bleeding * Pedal travel |
| 1. Vehicle gearbox may include but not limited to; | * Sliding mesh gearbox * Constant mesh gearbox * Synchro mesh gearbox * Automatic gearbox * Splitter gearbox * Twin lay shaft * Transfer gearbox * Range gearbox |
| 1. Vehicle Transfer case may include but not limited to; | * wheel drive * 4-wheel drive |
| 1. Vehicle gearbox components may include but not limited to; | * Gears * Bearings * Input shafts * Output shafts * Lay shaft * Oil pump * Valve body * Oil pan * Torque converter * Shift lever * Sensors |
| 1. Vehicle drive shafts may include but not limited to; | * Propeller shafts * Constant velocity (CV) shafts * Half shafts |
| 1. Vehicle drive shaft components may include but not limited to; | * Constant velocity (CV) joints * Centre bearing * Slip joint * Universal joint * Flanges * Dust boots |
| 1. Vehicle final drive may include but not limited to; | * Worm and wheel final drive * Hyphoid final drive * Double- reduction final drive * Two speed final drive * Helical final drive * Bevel final drive |
| 1. Vehicle final drive components may include but not limited to; | * Differential unit * Differential lock assembly * Half shafts * Differential housing |

REQUIRED KNOWLEDGE AND SKILLS

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

* Kenyan legislation and workplace procedures relevant to:
* Health and safety
* Environment
* Personal and vehicle protective equipment
* Waste disposal
* Legal requirements relating to the vehicles warranty
* Workplace procedures for vehicle transmission system
* Gear mechanism
* Documenting assessment and rectification information
* Working to agreed time frame and keeping others informed of progress.
* The relationship between time, costs and profitability
* Interpretation and use of technical information.

**Required Skills**

The individual needs to demonstrate the following skills:

* Communication
* ICT
* Time management
* Problem solving
* Decision making
* Planning
* First aid
* Report writing
* Interpreting technical information
* Servicing vehicle transmission system components
* Serving vehicle transfer case  
  servicing vehicle final drive
* Servicing vehicle drive shaft
* Overhauling vehicle clutch assembly
* Overhauling vehicle gearbox

**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. Organised work area as per workplace procedure   2. Undertook safety measures as per workplace procedures   3. Assessed vehicle transmission system according to manufacturer’s specifications   4. Dismantled vehicle clutch assembly according to manufacturer’s manual   5. Serviced/replaced vehicle clutch assembly parts according to manufacturer’s specification   6. Adjusted vehicle clutch assembly according to manufacturer’s specification   7. Diagnosed vehicle gearbox unit as per manufacturer’s specification   8. Overhauled gearbox components according to manufacturer’s manual   9. Serviced/replaced vehicle gearbox parts according to manufacturer’s specification   10. Reassembled vehicle gearbox parts according to manufacturer’s manual   11. Diagnosed vehicle drive shafts as per manufacturer’s specification   12. Serviced/replaced vehicle drive shaft components according to manufacturer’s specifications   13. diagnosed vehicle final drive as per manufacturer’s specification   14. Dismantled vehicle final drive components according to manufacturer’s manual   15. Serviced/replaced vehicle final drive components according to manufacturer’s specification   16. Reassembled vehicle final drive parts according to manufacturer’s manual |
| 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 |
| 1. 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 |

# MAINTAIN HYBRID AND ELECTRIC VEHICLE

**UNIT CODE: 0716 551 21A**

**UNIT DESCRIPTION**

This unit specifies competencies required to maintain electric vehicle power train. It includes servicing high voltage batteries, servicing electric vehicle Convertor system, servicing electric vehicle controllers and servicing electric vehicle transmission 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. Service Electric Vehicle Batteries | 1. Work area is organized and safety measures undertaken before use as per workplace procedure 2. Tools, equipment and materials are assembled as per work requirements 3. ***Electric Vehicle batteries Components*** are inspected as per manufactures specification 4. Electric Vehicle batteries are serviced as per manufactures guidelines 5. Electric Vehicle aretested accordingtomanufacturer’s specifications 6. Electric Vehicle batteries arediagnosed accordingtomanufacturer’s specifications 7. Electric vehicle batteries quality control checks are performed as per manufacturers specifications. 8. High-voltage components are disposed/recycled as EMCA regulations |
| 1. Service Electric Vehicle Low Voltage Systems | 1. Work area is organized and safety measures undertaken before use as per workplace procedure 2. Tools, equipment and materials are assembled as per work requirements 3. ***Electric Vehicle Low Voltage Systems*** are inspected according to manufacturer’s manual 4. Electric Vehicle Low Voltage Systemsare serviced/replaced according to manufacturer’s manual 5. Electric Vehicle Low Voltage Systems are tested according to manufacturer’s manual 6. Electric Vehicle Low Voltage Systems quality control checks are performed as per manufacturers specifications |
| 1. Service Electric Vehicle High Voltage Systems | 1. Work area is organized and safety measures undertaken as per workplace procedure 2. Tools, equipment and materials are assembled as per work requirements 3. ***Electric Vehicle High Voltage Systems*** are inspected according to manufacturer’s manual 4. Electric Vehicle High Voltage Systemsare serviced/replaced according to manufacturer’s manual 5. Electric Vehicle High Voltage Systems are tested according to manufacturer’s manual 6. Electric Vehicle High Voltage Systems quality control checks are performed as per manufacturers specifications |
| 1. Service Electric Vehicle Electronic Systems | 1. Work area is organized and safety measures undertaken as per workplace procedure 2. Tools, equipment and materials are assembled as per work requirements 3. ***Electric Vehicle Electronic Systems*** are inspected according to manufacturer’s manual 4. Electric Vehicle Electronic Systems are serviced/replaced according to manufacturer’s manual 5. Electric Vehicle Electronic Systems are tested according to manufacturer’s manual 6. Electric Vehicle Electronic Systems quality control checks are performed as per manufacturers specifications. |

**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. Electric Vehicle batteries Components may include but not limited; | * Battery management system * Battery control unit * Battery cells * Mechanical packaging * System control electronics * Battery connectors * Battery software and controls |
| 1. Electric Vehicle Low Voltage Systems may include but not limited; | * 12/6v battery * DC to DC converter * Alternator * Electrical components   + Lights   + wiring harness   + Indicators   + Wipers   + Power windows   + Audio system   + Telematics   + Infotainment systems |
| 1. Electric Vehicle High Voltage Systems may include but not limited; | * High voltages battery pack * Battery Management System (BMS) * Traction motor * Inverter/controller * Onboard charger * High voltage wiring harness * Electric powertrain |
| 1. Electric Vehicle Electronic Systems may include but not limited; | * Power Electronics   + Battery Management System (BMS)   + Inverters   + Onboard charger   + DC-DC converter * Motor Control Unit (MCU) * Telematics and Connectivity * Basic advanced driver assist system * Human machine interface |

**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:

* Strict safety protocols and using proper PPE.
* International and regional standards for electrical safety and performance
* Operation of Electric vehicle system
* Diagnosing malfunctions of the EV system
* Repair and maintenance of EV system
* Secure data and communication between high-voltage system components
* Properly dispose of and recycle high-voltage components

**Required skills**

The individual needs to demonstrate the following skills:

* Proficient in ICT
* Time management
* Problem solving
* Communications (verbal and written)
* Planning
* Decision making
* First aid
* Analytical skills
* Troubleshooting and repairing infrastructure charging systems
* Preventive maintenance on insulation, connectors, and cables
* Electric vehicle high voltage system service
* Electric vehicle low voltage system service
* High voltage batteries service
* Electric vehicle power train system service
* Report writing

**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. Undertook Work area organizing and safety measures as per workplace procedure 2. Serviced Electric Vehicle batteries as per manufactures guidelines 3. Serviced Electric Vehicle Low Voltage Systems as per manufactures guidelines 4. Serviced Electric Vehicle High Voltage Systems as per manufactures guidelines 5. Serviced Electric Vehicle Electronic Systems as per manufactures guidelines 6. Disposed/recycled high-voltage components as EMCA regulations |
| 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 carrying out the tasks required |
| 1. Methods of assessment | Competency may be assessed through:   1. Project 2. Practical 3. Written tests 4. Third party report 5. Portfolio of Evidence |
| 1. Context of Assessment | Competency may be assessed individually   1. in an actual workplace or 2. work-simulated conditions within accredited institutions |
| 1. Guidance information for assessment | 1. This unit may be assessed on an integrated basis with others within this occupational sector. |

# MAINTAIN VEHICLE COMFORT SYSTEM

**UNIT CODE: 0716 551 22A**

**UNIT DESCRIPTION**

This unit specifies the competencies required to maintain vehicle comfort system. It includes to Service vehicle Heating, ventilation and Air conditioning system, Servicing vehicle infotainment system and carrying out vehicle Comfort system diagnosis

ELEMENTS AND PERFORMANCE CRITERIA

|  |  |
| --- | --- |
| **ELEMENT**  These describe the key outcomes which make 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. Service vehicle Heating, ventilation and Air conditioning system | 1. Work area is organized and safety measures undertaken before use as per workplace procedure 2. Tools, equipment and materials are assembled as per work requirements 3. ***Vehicle heating and ventilation components*** is assessed according to manufacturer’s manual 4. ***Vehicle Air conditioning components*** is assessed according to manufacturer’s manual 5. Vehicle Heating, ventilation and Air conditioning components are serviced/replaced according to manufacturer’s manual 6. Vehicle Heating, ventilation and Air conditioning system service documents are prepared according to workplace procedures |
| 1. Service Vehicle infotainment system | 1. Work area is organized and safety measures undertaken before use as per workplace procedure 2. Tools, equipment and materials are assembled as per work requirements 3. ***Vehicle infotainment components*** are assessed according to manufacturer’s manual 4. Vehicle infotainment components are serviced/replaced according to manufacturer’s manual 5. Vehicle infotainment system service documents are prepared according to workplace procedures |
| 1. Carry out Vehicle Comfort system diagnosis | 1. Tools, equipment and materials are assembled as per work requirements 2. ***Vehicle Comfort components*** are assessed according to manufacturer’s specifications 3. Diagnostic trouble codes are interpreted as per manufacturer’s specifications 4. Vehicle Comfort system faulty sensors, actuators and circuits are replaced/serviced as per manufacturer’s specifications 5. Vehicle Comfort system service documents are prepared 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. Vehicle heating and ventilation components may include but not limited to; | * Heater core * Ducts * Blower * Heat exchanger * Thermostat * Air filters * Vents * Switch * Hoses * HVAC module |
| 1. Vehicle Air conditioning components may include but not limited to; | * Condenser * Drier * Air compressor * Evaporator * Expansion valve * Delivery pipes * Fan * Drive belt |
| 1. Vehicle infotainment components may include but not limited to; | * Audio player * Camera system * Gesture controls * Voice Recognition * Navigation * Smart phone integration * Television |
| 1. Vehicle Comfort components may include but not limited to; | * In car functions * Sun roof * Heated seats * Convertible roofs * Cruise Control * Active Head rest |

**REQUIRED KNOWLEDGE AND SKILLS**

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

**Required knowledge**

* Legislative and organizational requirements and procedures
* Kenyan legislation and workplace procedures relevant to
* Health, safety, environment and quality
* the environment (including waste oil and spent refrigeration gas disposal
* Personal and vehicle protective equipment.
* Workplace procedures for:
* recording fault location and correction activities;
* reporting the results of tests;
* the referral of problems;
* The importance of working to recognized assessment and rectification procedures and obtaining the correct information for rectification.
* The importance of documenting assessment and rectification information.
* The importance of working to agreed timescales and keeping others informed of progress.
* The relationship between time, costs and profitability.

**Required skills**

The individual needs to demonstrate the following skills:

* Proficient in ICT;
* Time management;
* Problem solving;
* Communications (verbal and written);
* Planning;
* Decision making;
* First aid;
* Diagnosis
* Analytical
* Vehicle Heating, ventilation and Air conditioning system service
* Service Vehicle infotainment system service
* Vehicle Comfort system diagnosis
* Report writing;

**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. Organized work area and safety measures undertaken before use as per workplace procedure 2. Assessed ***Vehicle heating and ventilation components*** according to manufacturer’s manual 3. ***A***ssessed ***vehicle Air conditioning components*** according to manufacturer’s manual 4. Serviced/replaced vehicle Heating, ventilation and Air conditioning components according to manufacturer’s manual 5. Assessed ***vehicle infotainment components*** according to manufacturer’s manual 6. Serviced/replaced vehicle infotainment components according to manufacturer’s manual 7. Assessed ***Vehicle Comfort components*** according to manufacturer’s specifications 8. Interpreted Diagnostic trouble codes as per manufacturer’s specifications 9. Replaced/serviced Vehicle Comfort system faulty sensors, actuators and circuits as per manufacturer’s specifications |
| 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 carrying out the tasks required |
| 1. Methods of assessment | Competency may be assessed through:   1. Project 2. Practical 3. Written tests 4. Third party report 5. 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 | Holistic assessment with other units relevant to the industry sector, workplace and job role is recommended. |

# MAINTAIN VEHICLE SAFETY AND SECURITY SYSTEM

**UNIT CODE: 0716 551 23A**

**UNIT DESCRIPTION**

This unit specifies the competencies required to maintain vehicle safety and security system. it includes servicing vehicle safety system, servicing vehicle security system and carrying out vehicle safety and security system diagnosis

**ELEMENTS AND PERFORMANCE CRITERIA**

|  |  |
| --- | --- |
| **ELEMENT**  These describe the key outcomes which make 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. Service Vehicle safety system | 1. Work area is organized and safety measures undertaken before use as per workplace procedure 2. Tools, equipment and materials are assembled as per work requirements 3. ***Vehicle safety*** ***components*** are assessed according to manufacturer’s manual 4. Vehicle safety components are serviced/replaced according to manufacturer’s manual 5. ***Vehicle safety system*** service documents are prepared according to workplace procedures |
| 1. Service Vehicle security system | 1. Work area is organized and safety measures undertaken before use as per workplace procedure 2. Tools, equipment and materials are assembled as per work requirements 3. Vehicle security components are assessed according to manufacturer’s manual 4. Vehicle security components are serviced/replaced according to manufacturer’s manual 5. ***Vehicle security system*** service documents are prepared according to workplace procedures |
| 1. Carry out vehicle safety and security system diagnosis | 1. Tools, equipment and materials are assembled as per work requirements 2. Vehicle safety and security components are assessed according to manufacturer’s specifications 3. Diagnostic trouble codes are interpreted as per manufacturer’s specifications 4. Vehicle safety and security system faulty sensors, actuators and circuits are replaced/serviced as per manufacturer’s specifications 5. Vehicle safety and security system service documents are prepared 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** |
| Vehicle safety system may include but not limited to; | * Traction control * Parking assistance * Telematics * Camera |
| Vehicle safety components may include but not limited to; | * Air bags * Belts * Proximity sensor |
| Vehicle security system may include but not limited to; | * GPS tracking system * Central door locking * Transponder and Immobilizers * Alarm |

**REQUIRED KNOWLEDGE AND SKILLS**

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

**Required knowledge**

* Legislative and organizational requirements and procedures
* Kenyan legislation and workplace procedures relevant to
* Health, safety, environment and quality
* the environment (including waste oil and spent refrigeration gas disposal
* Personal and vehicle protective equipment.
* Workplace procedures for:
* recording fault location and correction activities;
* reporting the results of tests;
* the referral of problems;
* Requirements relating to vehicle body building
* The importance of working to recognized assessment and rectification procedures and obtaining the correct information for rectification.
* The importance of documenting assessment and rectification information.
* The importance of working to agreed timescales and keeping others informed of progress.
* The relationship between time, costs and profitability.

**Required skills**

The individual needs to demonstrate the following skills:

* Proficient in ICT
* Time management
* Problem solving
* Communications
* Planning;
* Decision making;
* First aid
* Diagnosis
* Analytical
* Vehicle safety system service
* Vehicle security system service
* Vehicle safety and security system diagnosis

**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. Assessed v***ehicle safety*** ***components*** according to manufacturer’s manual 2. Serviced/replaced vehicle safety components according to manufacturer’s manual 3. Assessed ***vehicle security*** ***components*** according to manufacturer’s manual 4. Serviced/replaced vehicle security components according to manufacturer’s manual 5. Assessed vehicle safety and security components according to manufacturer’s specifications 6. Interpreted diagnostic trouble codes as per manufacturer’s specifications 7. Replaced/serviced vehicle safety and security system faulty sensors, actuators and circuits as per manufacturer’s specifications |
| 1. Resource Implications | The following resources should be provided:  2.1 Workplace: Real or simulated work area  2.2 Appropriate Tools & equipment  2.3 Materials relevant to the activity |
| 1. Methods of Assessment. | ***Competency may be assessed through:***   1. Project 2. Practical 3. Written tests 4. Third party report 5. Portfolio of Evidence |
| 1. Context of Assessment. | Competency may be assessed individually in an actual workplace or in work-simulated conditions within accredited institutions. |
| 1. Guidance information for assessment. | This unit may be assessed on an integrated basis with others within this occupational sector. |