TRAINING REGULATIONS

Heavy Equipment Servicing [Mechanical] NC II

CONSTRUCTION SECTOR

TECHNICAL EDUCATION AND SKILLS DEVELOPMENT AUTHORITY
East Service Road, South Superhighway, Taguig City, Metro Manila

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CONSTRUCTION SECTOR

Heavy Equipment Servicing [Mechanical] NC II

TRAINING REGULATIONS FOR HEAVY EQUIPMENT SERVICING [MECHANICAL] NC II

SECTION 1 HEAVY EQUIPMENT SERVICING [MECHANICAL] NC II QUALIFICATION

The Heavy Equipment Servicing [Mechanical] NC II Qualification consists of competencies that a person must achieve and that will enable him / her to check, adjust and test, troubleshoot, repair and / or replace, and measure the various parts and components of engine system, power train system, hydraulic system and undercarriage system.

This Qualification is packaged from the competency map of Construction – Civil Works sub-sector as shown in Annex A.

The Units of Competency comprising this Qualification include the following:

CODE NO.	BASIC COMPETENCIES
	Units of Competency
500311105	Participate in workplace communication
500311106	Work in a team environment
500311107	Practice career professionalism
500311108	Practice occupational health and safety procedures

CODE NO.	COMMON COMPETENCIES
	Units of Competency
CON931201	Prepare construction materials and tools
CON311201	Observe procedures, specifications and manuals of instruction
CON311202	Interpret technical drawings and plans
CON311203	Perform mensurations and calculations
CON311204	Maintain tools and equipment

CODE NO.	CORE COMPETENCIES
	Units of Competency
CON723305	Service engine system II
CON723306	Service power train system II
CON723307	Service hydraulic system II
CON723308	Service undercarriage system II

A person who has achieved this Qualification is competent to be a:

- Heavy Equipment Mechanic - NC II

SECTION 2 COMPETENCY STANDARDS

This section gives the details of the contents of the core units of competency required in **HEAVY EQUPMENT [SERVICING] MECHANICAL NC II**.

BASIC COMPETENCIES

UNIT OF COMPETENCY: PARTICIPATE IN WORKPLACE COMMUNICATION
UNIT CODE : 500311105

UNIT DESCRIPTOR : This unit covers the knowledge, skills and attitudes required to gather, interpret and convey information in response to workplace requirements.

ELEMENT	PERFORMANCE CRITERIA ***Italicized*** terms are elaborated in the Range of Variables
1. Obtain and convey workplace information	1.1 Specific and relevant information is accessed from ***appropriate sources*** 1.2 Effective questioning , active listening and speaking skills are used to gather and convey information 1.3 Appropriate ***medium*** is used to transfer information and ideas 1.4 Appropriate non- verbal communication is used 1.5 Appropriate lines of communication with supervisors and colleagues are identified and followed 1.6 Defined workplace procedures for the location and ***storage*** of information are used 1.7 Personal interaction is carried out clearly and concisely
2. Participate in workplace meetings and discussions	2.1 Team meetings are attended on time 2.2 Own opinions are clearly expressed and those of others are listened to without interruption 2.3 Meeting inputs are consistent with the meeting purpose and established ***protocols*** 2.4 ***Workplace interactions*** are conducted in a courteous manner 2.5 Questions about simple routine workplace procedures and maters concerning working conditions of employment are asked and responded to 2.6 Meetings outcomes are interpreted and implemented

3. Complete relevant work related documents	3.1 Range of ***forms*** relating to conditions of employment are completed accurately and legibly 3.2 Workplace data is recorded on standard workplace forms and documents 3.3 Basic mathematical processes are used for routine calculations 3.4 Errors in recording information on forms/ documents are identified and properly acted upon 3.5 Reporting requirements to supervisor are completed according to organizational guidelines

RANGE OF VARIABLES

VARIABLE	RANGE
1. Appropriate sources	1.1. Team members 1.2. Suppliers 1.3. Trade personnel 1.4. Local government 1.5. Industry bodies
2. Medium	2.1. Memorandum 2.2. Circular 2.3. Notice 2.4. Information discussion 2.5. Follow-up or verbal instructions 2.6. Face to face communication
3. Storage	3.1. Manual filing system 3.2. Computer-based filing system
4. Forms	4.1. Personnel forms, telephone message forms, safety reports
5. Workplace interactions	5.1. Face to face 5.2. Telephone 5.3. Electronic and two way radio 5.4. Written including electronic, memos, instruction and forms, non-verbal including gestures, signals, signs and diagrams
6. Protocols	6.1. Observing meeting 6.2. Compliance with meeting decisions 6.3. Obeying meeting instructions

EVIDENCE GUIDE

1. Critical Aspects of Competency	Assessment requires evidence that the candidate: 1.1. Prepared written communication following standard format of the organization 1.2. Accessed information using communication equipment 1.3. Made use of relevant terms as an aid to transfer information effectively 1.4. Conveyed information effectively adopting the formal or informal communication
2. Underpinning Knowledge and Attitudes	2.1. Effective communication 2.2. Different modes of communication 2.3. Written communication 2.4. Organizational policies 2.5. Communication procedures and systems 2.6. Technology relevant to the enterprise and the individual's work responsibilities
3. Underpinning Skills	3.1. Follow simple spoken language 3.2. Perform routine workplace duties following simple written notices 3.3. Participate in workplace meetings and discussions 3.4. Complete work related documents 3.5. Estimate, calculate and record routine workplace measures 3.6. Basic mathematical processes of addition, subtraction, division and multiplication 3.7. Ability to relate to people of social range in the workplace 3.8. Gather and provide information in response to workplace requirements
4. Resource Implications	4.1. Fax machine 4.2. Telephone 4.3. Writing materials 4.4. Internet
5. Methods of Assessment	5.1. Direct Observation 5.2. Oral interview and written test
6. Context of Assessment	6.1. Competency may be assessed individually in the actual workplace or through accredited institution

UNIT OF COMPETENCY: WORK IN TEAM ENVIRONMENT
UNIT CODE : 500311106

UNIT DESCRIPTOR : This unit covers the skills, knowledge and attitudes to identify role and responsibility as a member of a team.

ELEMENT	PERFORMANCE CRITERIA ***Italicized*** terms are elaborated in the Range of Variables
1. Describe team role and scope	1.1. The ***role and objective of the team*** is identified from available ***sources of information*** 1.2. Team parameters, reporting relationships and responsibilities are identified from team discussions and appropriate external sources
2. Identify own role and responsibility within team	2.1. Individual role and responsibilities within the team environment are identified 2.2. Roles and responsibility of other team members are identified and recognized 2.3. Reporting relationships within team and external to team are identified
3. Work as a team member	3.1. Effective and appropriate forms of communications used and interactions undertaken with team members who contribute to known team activities and objectives 3.2. Effective and appropriate contributions made to complement team activities and objectives, based on individual skills and competencies and ***workplace context*** 3.3. Observed protocols in reporting using standard operating procedures 3.4. Contribute to the development of teamwork plans based on an understanding of team's role and objectives and individual competencies of the members.

RANGE OF VARIABLES

VARIABLE	RANGE
1. Role and objective of team	1.1. Work activities in a team environment with enterprise or specific sector 1.2. Limited discretion, initiative and judgement maybe demonstrated on the job, either individually or in a team environment
2. Sources of information	2.1. Standard operating and/or other workplace procedures 2.2. Job procedures 2.3. Machine/equipment manufacturer's specifications and instructions 2.4. Organizational or external personnel 2.5. Client/supplier instructions 2.6. Quality standards 2.7. OHS and environmental standards
3. Workplace context	3.1. Work procedures and practices 3.2. Conditions of work environments 3.3. Legislation and industrial agreements 3.4. Standard work practice including the storage, safe handling and disposal of chemicals 3.5. Safety, environmental, housekeeping and quality guidelines

EVIDENCE GUIDE

1. Critical aspects of competency	Assessment requires evidence that the candidate: 1.1. Operated in a team to complete workplace activity 1.2. Worked effectively with others 1.3. Conveyed information in written or oral form 1.4. Selected and used appropriate workplace language 1.5. Followed designated work plan for the job 1.6. Reported outcomes
2. Underpinning Knowledge and Attitude	2.1. Communication process 2.2. Team structure 2.3. Team roles 2.4. Group planning and decision making
3. Underpinning Skills	3.1 Communicate appropriately, consistent with the culture of the workplace
4. Resource Implications	The following resources MUST be provided: 4.1. Access to relevant workplace or appropriately simulated environment where assessment can take place 4.2. Materials relevant to the proposed activity or tasks
5. Methods of Assessment	Competency may be assessed through: 5.1. Observation of the individual member in relation to the work activities of the group 5.2. Observation of simulation and or role play involving the participation of individual member to the attainment of organizational goal 5.3. Case studies and scenarios as a basis for discussion of issues and strategies in teamwork
6. Context for Assessment	6.1. Competency may be assessed in workplace or in a simulated workplace setting 6.2. Assessment shall be observed while task are being undertaken whether individually or in group

UNIT OF COMPETENCY: PRACTICE CAREER PROFESSIONALISM
UNIT CODE : 500311107

UNIT DESCRIPTOR : This unit covers the knowledge, skills and attitudes in promoting career growth and advancement.

ELEMENT	PERFORMANCE CRITERIA ***Italicized*** terms are elaborated in the Range of Variables
1. Integrate personal objectives with organizational goals	1.1 Personal growth and work plans are pursued towards improving the qualifications set for the profession 1.2 Intra- and interpersonal relationships ~~is~~ are maintained in the course of managing oneself based on performance ***evaluation*** 1.3 Commitment to the organization and its goal is demonstrated in the performance of duties
1. Set and meet work priorities	2.1 Competing demands are prioritized to achieve personal, team and organizational goals and objectives. 2.2 ***Resources*** are utilized efficiently and effectively to manage work priorities and commitments 2.3 Practices along economic use and maintenance of equipment and facilities are followed as per established procedures
2. Maintain professional growth and development	3.1 ***Trainings and career opportunities*** are identified and availed of based on job requirements 3.2 ***Recognitions*** are sought/received and demonstrated as proof of career advancement 3.3 ***Licenses and/or certifications*** relevant to job and career are obtained and renewed

RANGE OF VARIABLES

VARIABLE	RANGE
1. Evaluation	1.1 Performance Appraisal 1.2 Psychological Profile 1.3 Aptitude Tests
2. Resources	2.1 Human 2.2 Financial 2.3 Technology 2.3.1 Hardware 2.3.2 Software
3. Trainings and career opportunities	3.1 Participation in training programs 3.1.1 Technical 3.1.2 Supervisory 3.1.3 Managerial 3.1.4 Continuing Education 3.2 Serving as Resource Persons in conferences and workshops
4. Recognitions	4.1 Recommendations 4.2 Citations 4.3 Certificate of Appreciations 4.4 Commendations 4.5 Awards 4.6 Tangible and Intangible Rewards
5. Licenses and/or certifications	5.1 National Certificates 5.2 Certificate of Competency 5.3 Support Level Licenses 5.4 Professional Licenses

EVIDENCE GUIDE

1. Critical Aspects of Competency	Assessment requires evidence that the candidate: 1.1 Attained job targets within key result areas (KRAs) 1.2 Maintained intra - and interpersonal relationship in the course of managing oneself based on performance evaluation 1.3 Completed trainings and career opportunities which are based on the requirements of the industries 1.4 Acquired and maintained licenses and/or certifications according to the requirement of the qualification
2. Underpinning Knowledge	2.1 Work values and ethics (Code of Conduct, Code of Ethics, etc.) 2.2 Company policies 2.3 Company-operations, procedures and standards 2.4 Fundamental rights at work including gender sensitivity 2.5 Personal hygiene practices
3. Underpinning Skills	3.1 Appropriate practice of personal hygiene 3.2 Intra and Interpersonal skills 3.3 Communication skills
4. Resource Implications	The following resources **MUST** be provided: 4.1 Workplace or assessment location 4.2 Case studies/scenarios
5. Methods of Assessment	Competency may be assessed through: 5.1 Portfolio Assessment 5.2 Interview 5.3 Simulation/Role-plays 5.4 Observation 5.5 Third Party Reports 5.6 Exams and Tests
6. Context of Assessment	6.1 Competency may be assessed in the work place or in a simulated work place setting

UNIT OF COMPETENCY: **PRACTICE OCCUPATIONAL HEALTH AND SAFETY PROCEDURES**

UNIT CODE : **500311108**

UNIT DESCRIPTOR : This unit covers the outcomes required to comply with regulatory and organizational requirements for occupational health and safety.

ELEMENT	PERFORMANCE CRITERIA ***Italicized*** terms are elaborated in the Range of Variables
1. Identify hazards and risks	1.1 ***Safety regulations*** and workplace safety and hazard control practices and procedures are clarified and explained based on organization procedures 1.2 ***Hazards/risks*** in the workplace and their corresponding indicators are identified to minimize or eliminate risk to co-workers, workplace and environment in accordance with organization procedures 1.3 ***Contingency measures*** during workplace accidents, fire and other emergencies are recognized and established in accordance with organization procedures
2. Evaluate hazards and risks	2.1 Terms of maximum tolerable limits which when exceeded will result in harm or damage are identified based on threshold limit values (TLV) 2.2 Effects of the hazards are determined 2.3 OHS issues and/or concerns and identified safety hazards are reported to designated personnel in accordance with workplace requirements and relevant workplace OHS legislation
3. Control hazards and risks	3.1 Occupational Health and Safety (OHS) procedures for controlling hazards/risks in workplace are consistently followed 3.2 Procedures for dealing with workplace accidents, fire and emergencies are followed in accordance with organization OHS policies 3.3 ***Personal protective equipment (PPE)*** is correctly used in accordance with organization OHS procedures and practices 3.4 Appropriate assistance is provided in the event of a workplace emergency in accordance with established organization protocol

ELEMENT	PERFORMANCE CRITERIA ***Italicized*** terms are elaborated in the Range of Variables
4. Maintain OHS awareness	4.1 ***Emergency-related drills and trainings*** are participated in as per established organization guidelines and procedures 4.2 ***OHS personal records*** are completed and updated in accordance with workplace requirements

RANGE OF VARIABLES

VARIABLE	RANGE
1. Safety regulations	May include but are not limited to: 1.1 Clean Air Act 1.2 Building code 1.3 National Electrical and Fire Safety Codes 1.4 Waste management statutes and rules 1.5 Philippine Occupational Safety and Health Standards 1.6 DOLE regulations on safety legal requirements 1.7 ECC regulations
2. Hazards/Risks	May include but are not limited to: 2.1 Physical hazards – impact, illumination, pressure, noise, vibration, temperature, radiation 2.2 Biological hazards- bacteria, viruses, plants, parasites, mites, molds, fungi, insects 2.3 Chemical hazards – dusts, fibers, mists, fumes, smoke, gasses, vapors 2.4 Ergonomics • Psychological factors – over exertion/ excessive force, awkward/static positions, fatigue, direct pressure, varying metabolic cycles • Physiological factors – monotony, personal relationship, work out cycle
3. Contingency measures	May include but are not limited to: 3.1 Evacuation 3.2 Isolation 3.3 Decontamination 3.4 (Calling designed) emergency personnel
4. PPE	May include but are not limited to: 4.1 Mask 4.2 Gloves 4.3 Goggles 4.4 Hair Net/cap/bonnet 4.5 Face mask/shield 4.6 Ear muffs 4.7 Apron/Gown/coverall/jump suit 4.8 Anti-static suits

VARIABLE	RANGE
5. Emergency-related drills and training	5.1 Fire drill 5.2 Earthquake drill 5.3 Basic life support/CPR 5.4 First aid 5.5 Spillage control 5.6 Decontamination of chemical and toxic 5.7 Disaster preparedness/management
6. OHS personal records	6.1 Medical/Health records 6.2 Incident reports 6.3 Accident reports 6.4 OHS-related training completed

EVIDENCE GUIDE

1. Critical Aspects of Competency	Assessment requires evidence that the candidate: 1.1 Explained clearly established workplace safety and hazard control practices and procedures 1.2 Identified hazards/risks in the workplace and its corresponding indicators in accordance with company procedures 1.3 Recognized contingency measures during workplace accidents, fire and other emergencies 1.4 Identified terms of maximum tolerable limits based on threshold limit value- TLV. 1.5 Followed Occupational Health and Safety (OHS) procedures for controlling hazards/risks in workplace 1.6 Used Personal Protective Equipment (PPE) in accordance with company OHS procedures and practices 1.7 Completed and updated OHS personal records in accordance with workplace requirements
2. Underpinning Knowledge and Attitude	2.1 OHS procedures and practices and regulations 2.2 PPE types and uses 2.3 Personal hygiene practices 2.4 Hazards/risks identification and control 2.5 Threshold Limit Value -TLV 2.6 OHS indicators 2.7 Organization safety and health protocol 2.8 Safety consciousness 2.9 Health consciousness
3. Underpinning Skills	3.1 Practice of personal hygiene 3.2 Hazards/risks identification and control skills 3.3 Interpersonal skills 3.4 Communication skills
4. Resource Implications	The following resources must be provided: 4.1 Workplace or assessment location 4.2 OHS personal records 4.3 PPE 4.4 Health records

5. Methods of Assessment	Competency may be assessed through: 5.1 Portfolio Assessment 5.2 Interview 5.3 Case Study/Situation
Context for Assessment	6.1 Competency may be assessed in the work place or in a simulated work place setting

COMMON COMPETENCIES

UNIT OF COMPETENCY: PREPARE CONSTRUCTION MATERIALS AND TOOLS
UNIT CODE : CON931201

UNIT DESCRIPTOR : This unit covers the knowledge, skills and attitudes on identifying, requesting and receiving construction materials and tools based on the required performance standards.

ELEMENT	PERFORMANCE CRITERIA ***Italicized*** terms are elaborated in the Range of Variable
1. Identify materials	1.1 ***Materials*** are listed as per job requirements 1.2 Quantity and ***description of materials*** conform with the job requirements 1.3 Tools and accessories are identified according to job requirements
2. Requisition materials	2.1 Materials and tools needed are requested according to the list prepared 2.2 Request is done as per ***company standard operating procedures (SOP)*** 2.3 Substitute materials and tools are provided without sacrificing cost and quality of work
3. Receive and inspect materials	3.1 Materials and tools issued are inspected as per quantity and specification 3.2 Tools, accessories and materials are checked for damages according to enterprise procedures 3.3 Materials and tools are set aside to appropriate location nearest to the workplace

RANGE OF VARIABLES

VARIABLE	RANGE
1. Materials and Tools	1.1 Electrical supplies 1.2 Structural 1.3 Plumbing 1.4 Welding/pipefitting 1.5 Carpentry 1.6 Masonry
2. Description of Materials and Tools	2.1 Brand name 2.2 Size 2.3 Capacity 2.4 Kind of application
3. Company standard procedures	3.1 Job order 3.2 Requisition slip 3.3 Borrower slip

EVIDENCE GUIDE

1. Critical aspects of competency	Assessment requires evidence that the candidate: 1.1 Listed materials and tools according to quantity and job requirements 1.2 Requested materials and tools according to the list prepared and as per company SOP 1.3 Inspected issued materials and tools as per quantity and job specifications 1.4 Tools provided with appropriate safety devices
2. Underpinning knowledge	2.1 Types and uses of construction materials and tools 2.2 Different forms 2.3 Requisition procedures
3. Underpinning skills	3.1 Preparing materials and tools 3.2 Proper handling of tools and equipment 3.3 Following instructions
4. Resource implications	The following resources should be provided: 4.1 Workplace location 4.2 Materials relevant to the unit of competency 4.3 Technical plans, drawings and specifications relevant to the activities
5. Methods of assessment	Competency in this unit must be assessed through: 5.1 Direct observation and oral questioning
6. Context of assessment	6.1 Competency may be assessed in the workplace or in a simulated workplace 6.2 Competency assessment must be undertaken in accordance with the endorsed TESDA assessment guidelines

UNIT OF COMPETENCY: **OBSERVE PROCEDURES, SPECIFICATIONS AND MANUALS OF INSTRUCTIONS**

UNIT CODE : **CON311201**

UNIT DESCRIPTOR : This unit covers the knowledge, skills and attitudes on identifying, interpreting, applying services to specifications and manuals and storing manuals.

ELEMENT	PERFORMANCE CRITERIA ***Italicized*** terms are elaborated in the Range of Variables
1. Identify and access specification/manuals	1.1 Appropriate manuals are identified and accessed as per job requirements 1.2 Version and date of manual are checked to ensure that correct specification and procedures are identified
2. Interpret manuals	2.1 Relevant sections, chapters of specifications/ manuals are located in relation to the work to be conducted 2.2 Information and procedure in the manual are interpreted in accordance with industry practices
3. Apply information in manual	3.1 ***Manual*** is interpreted according to job requirements 3.2 Work steps are correctly identified in accordance with manufacturer's specification 3.3 Manual data are applied according to the given task 3.4 All correct sequencing and adjustments are interpreted in accordance with information contained on the manual or specifications
4. Store manuals	4.1 Manual or specification is stored appropriately to prevent damage, ready access and updating of information when required in accordance with company requirements

RANGE OF VARIABLES

VARIABLE	RANGE
1. Procedures, Specifications and Manuals of Instructions	Kinds of Manuals: 1.1 Manufacturer's Specification Manual 1.2 Repair Manual 1.3 Maintenance Procedure Manual 1.4 Periodic Maintenance Manual

EVIDENCE GUIDE

1. Critical aspects of competency	Assessment requires that the candidate: 1.1 Identified and accessed specification/manuals as per job requirements 1.2 Interpreted manuals in accordance with industry practices 1.3 Applied information in manuals according to the given task 1.4 Stored manuals in accordance with company requirements
2. Underpinning knowledge	2.1 Types of manuals used in construction sector 2.2 Identification of symbols used in the manuals 2.3 Identification of units of measurements 2.4 Unit conversion
3. Underpinning skills	3.1 Reading and comprehension skills required to identify and interpret construction manuals and specifications 3.2 Accessing information and data
4. Resource implications	The following resources should be provided: 4.1 All manuals/catalogues relative to construction sector
5. Methods of assessment	Competency should be assessed through: 5.1 Direct observation 5.2 Questions/interview Assessment of underpinning knowledge and practical skills may be combined
6. Context of assessment	6.1 Competency assessment must be undertaken in accordance with the endorsed TESDA assessment guidelines 6.2 Assessment may be conducted in the workplace or a simulated environment

UNIT OF COMPETENCY:	**INTERPRET TECHNICAL DRAWINGS AND PLANS**
UNIT CODE :	**CON311202**
UNIT DESCRIPTOR :	This unit covers the knowledge, skills and attitudes on analyzing and interpreting symbols, data and work plan based on the required performance standards.

ELEMENT	PERFORMANCE CRITERIA ***Bold and italicized*** terms are elaborated in the Range of Variables
1. Analyze signs, symbols and data	1.1 ***Technical plans*** are obtained according to job requirements 1.2 Signs, symbols and data are identified according to job specifications 1.3 Signs symbols and data are determined according to ***classification*** or as appropriate in ***drawing***
2. Interpret technical drawings and plans	2.1 Necessary ***tools, materials*** and equipment are identified according to the ***plan*** 2.2 Supplies and materials are listed according to specifications 2.3 Components, assemblies or objects are recognized as required 2.4 Dimensions are identified as appropriate to the plan 2.5 Specification details are matched with existing/available resources and in line with job requirements 2.6 Work plan is drawn following the specifications
3. Apply freehand sketching	3.1 Where applicable, correct freehand sketching is produced in accordance with the job requirements

RANGE OF VARIABLES

VARIABLE	RANGE
1. Technical plans	Including but not limited to: *1.1 Electrical plans* *1.2 Structural plans* *1.3 Architectural plans* *1.4 Plumbing plans* *1.5 Welding Procedures Specifications (WPS)*
2. Work plan	*2.1 Job requirements* *2.2 Installation instructions* *2.3 Components instruction*
3. Classification	Including but not limited to: *3.1 Electrical* *3.2 Mechanical* *3.3 Plumbing*
4. Drawing	*4.1 Drawing symbols* *4.2 Alphabet of lines* *4.3 Orthographic views* - Front view - Right side view/left side view - Top view - Pictorial *4.4 Schematic diagram* *4.5 Electrical drawings* *4.6 Structural drawings* *4.7 Plumbing drawings* - Water - Sewerage/Drainage - Ventilation *4.8 Welding symbols*
5. Tools and materials	Including but not limited to: *5.1 Compass* *5.2 Divider* *5.3 Rulers* *5.4 Triangles* *5.5 Drawing tables*

	5.6 Computer

EVIDENCE GUIDE

1. Critical aspects of competency	Assessment requires that the candidate: 1.1 Identified and determined signs, symbols and data according to work plan, job requirements and classifications 1.2 Identified tools and equipment in accordance with job requirements 1.3 Listed supplies and materials according to blueprint specifications 1.4 Drawn workplan following specifications 1.5 Determined job specifications based on working/technical drawing
2. Underpinning knowledge	2.1 **TRADE MATHEMATICS** 2.1.1 Linear measurement 2.1.2 Dimension 2.1.3 Unit conversion 2.2 **BLUEPRINT READING AND PLAN SPECIFICATION** 2.2.1 Electrical, mechanical plan, symbols and abbreviations 2.2.2 Drawing standard symbols 2.3 **TRADE THEORY** 2.3.1 Basic technical drawing 2.3.2 Types technical plans 2.3.3 Various types of drawings 2.3.4 Notes and specifications
3. Underpinning skills	3.1 Interpreting drawing/orthographic drawing 3.2 Interpreting technical plans 3.3 Matching specification details with existing resources 3.4 Following instructions 3.5 Handling of drawing instruments
4. Resource implications	The following resources should be provided: 4.1 Workplace 4.2 Drawings and specification relevant to task 4.3 Materials and instrument relevant to proposed activity

5. Methods of assessment	Competency should be assessed through: 5.1 Direct observation 5.2 Questions/interview 5.3 Written test related to underpinning knowledge
6. Context of assessment	6.1 Competency assessment may occur in the workplace or in any appropriate simulated environment 6.2 Assessment shall be observed while task are being undertaken whether individually or in group 6.3 Competency assessment must be undertaken in accordance with the endorsed TESDA assessment guidelines

UNIT OF COMPETENCY: PERFORM MENSURATIONS AND CALCULATIONS
UNIT CODE : CON311203

UNIT DESCRIPTOR : This unit covers the knowledge, skills and attitudes on identifying and measuring objects based on the required performance standards.

ELEMENT	PERFORMANCE CRITERIA ***Italicized*** *terms* are elaborated in the Range of Variable
1. Select measuring instruments	1.1 Object or component to be measured is identified, classified and interpreted according to the appropriate regular ***geometric shape*** 1.2 Measuring tools are selected/identified as per object to be measured or job requirements 1.3 Correct specifications are obtained from relevant sources 1.4 Appropriate measuring instruments are selected according to job requirements 1.5 Alternative measuring tools are used without sacrificing cost and quality of work
2. Carry out measurements and calculations	*2.1* Accurate ***measurements*** are obtained according to job requirements 2.2 Alternative measuring tools are used without sacrificing cost and quality of work 2.3 ***Calculation*** needed to complete work tasks are performed using the four basic process of addition (+), subtraction (-), multiplication (x) and division (/) including but not limited to: trigonometric functions, algebraic computations 2.4 Calculations involving fractions, percentages and mixed numbers are used to complete workplace tasks 2.5 Numerical computation is self-checked and corrected for accuracy 2.6 Instruments are read to the limit of accuracy of the tool 2.7 Systems of measurement identified and converted according to job requirements/ISO 2.8 Workpieces are measured according to job requirements

RANGE OF VARIABLES

VARIABLE	RANGE
1. Geometric shape	Including but is not limited to: 1.1 Round 1.2 Square 1.3 Rectangular 1.4 Triangle 1.5 Sphere 1.6 Conical
2. Measuring instruments	Including but not limited to: 2.1 Micrometer (In-out, depth) 2.2 Vernier caliper (out, inside) 2.3 Dial gauge with mag, std. 2.4 Straight edge 2.5 Thickness gauge 2.6 Torque gauge 2.7 Small hole gauge 2.8 Telescopic gauge 2.9 Try-square 2.10 Protractor 2.11 Combination gauge 2.12 Steel rule 2.13 Voltmeter 2.14 Ammeter 2.15 Mega-ohmeter 2.16 Kilowatt hour meter 2.17 Gauges 2.18 Thermometers
3. Measurements and calculations	3.1 Linear 3.2 Volume 3.3 Area 3.4 Wattage 3.5 Voltage 3.6 Resistance 3.7 Amperage 3.8 Frequency 3.9 Impedance

VARIABLE	RANGE
	3.10 Conductance 3.11 Capacitance 3.12 Displacement 3.16 Inside diameter 3.17 Circumference 3.18 Length 3.19 Thickness 3.20 Outside diameter 3.21 Taper 3.22 Out of roundness 3.23 Oil clearance 3.24 End play/Thrust clearance

EVIDENCE GUIDE

1. Critical aspects of competency	Assessment requires that the candidate: 1.1 Selected and prepared appropriate measuring instruments in accordance with job requirements 1.2 Performed measurements and calculations according to job requirements/ ISO
2. Underpinning knowledge	TRADE MATHEMATICS / MENSURATION 2.1 Four fundamental operation 2.2 Linear measurement 2.3 Dimensions 2.4 Unit conversion 2.5 Ratio and proportion 2.6 Trigonometric functions 2.8 Algebraic equations
3. Underpinning skills	3.1 Performing calculation by addition, subtraction, multiplication and division; trigonometric functions and algebraic equations 3.2 Visualizing objects and shapes 3.3 Interpreting formulas for volume, areas, perimeters of plane and geometric figures 3.4 Proper handling of measuring instruments
4. Resource implications	The following resources should be provided: 4.1 Workplace location 4.2 Problems to solve 4.3 Measuring instrument appropriate to carry out tasks 4.4 Instructional materials relevant to the propose activity Assessment of underpinning knowledge and practical skills may be combined
5. Methods of assessment	Competency should be assessed through: 5.1 Actual demonstration 5.2 Direct observation 5.3 Written test/questioning related to underpinning knowledge
6. Context of assessment	6.1 Competency assessment may occur in workplace or any appropriate simulated environment 6.2 Assessment shall be observed while task are being undertaken whether individually or in group 6.3 Competency assessment must be undertaken in accordance with the TESDA assessment guidelines

UNIT OF COMPETENCY: MAINTAIN TOOLS AND EQUIPMENT
UNIT CODE : CON311204

UNIT DESCRIPTOR : This unit covers the knowledge, skills and attitudes on checking condition, performing preventive maintenance and storing of tools and equipment based on the required performance standards.

ELEMENTS	PERFORMANCE CRITERIA ***Italicized*** terms are elaborated in the Range of Variables
1. Check condition of tools and equipment	1.1 ***Materials, tools and equipmen***t are identified according to classification and job requirements 1.2 Non-functional tools and equipment are segregated and labeled according to classification 1.3 Safety of tools and equipment are observed in accordance with manufacturer's instructions 1.4 Condition of ***PPE*** are checked in accordance with manufacturer's instructions
2. Perform basic preventive maintenance	2.1 Appropriate lubricants are identified according to types of equipment 2.2 Tools and equipment are lubricated according to preventive maintenance schedule or manufacturer's specifications 2.3 Measuring instruments are checked and calibrated in accordance with manufacturer's instructions 2.4 Tools are cleaned and lubricated according to standard procedures 2.5 Defective instruments, equipment and accessories are inspected and replaced according to manufacturer's specifications 2.6 Tools are inspected, repaired and replaced after use 2.7 Work place is cleaned and kept in safe state in line with OHSA regulations

3. Store tools and equipment	3.1 Inventory of tools, instruments and equipment are conducted and recorded as per company practices 3.2 Tools and equipment are stored safely in appropriate locations in accordance with manufacturer's specifications or company procedures

RANGE OF VARIABLES

VARIABLES	RANGE
1. Materials	Including but not limited to: 1.1 Lubricants 1.2 Cleaning materials 1.3 Rust remover 1.4 Rugs 1.5 Spare parts
2. Tools and equipment	Including but not limited to: 2.1 Tools Cutting tools - hacksaw, crosscut saw, rip saw Boring tools - auger, brace, grinlet, hand drill Holding tools - vise grip, C-clamp, bench vise Threading tools - die and stock, taps 2.2 Measuring instruments/equipment
3. PPE	Including but not limited to: 3.1 Goggles 3.2 Gloves 3.3 Safety shoes 3.4 Aprons/Coveralls
4. Forms	4.1 Maintenance schedule forms 4.2 Requisition slip 4.3 Inventory Form 4.4 Inspection Form 4.5 Procedures

EVIDENCE GUIDE

1. Critical aspects of competency	Assessment requires that the candidate: 1.1 Selected and used appropriate processes, tools and equipment to carry out task 1.2 Identified functional and non-functional tools and equipment 1.3 Checked, lubricated and calibrated tools, equipment and instruments according to manufacturer's specifications 1.4 Replaced defective tools, equipment and their accessories 1.5 Observed and applied safe handling of tools and equipment and safety work practices 1.6 Prepared and submitted inventory report, where applicable 1.7 Maintained workplace in accordance with OHSA regulations 1.8 Stored tools and equipment safely in appropriate locations and in accordance with company practices
2. Underpinning knowledge	2.1 SAFETY PRACTICES 2.1.1 Use of PPE 2.1.2 Handling of tools and equipment 2.1.3 Good housekeeping 2.2 MATERIALS, TOOLS AND EQUIPMENT 2.2.1 Types and uses of lubricants 2.2.2 Types and uses of cleaning materials 2.2.3 Types and uses of measuring instruments and equipment 2.3 PREVENTIVE MAINTENANCE 2.3.1 Methods and techniques 2.3.2 Procedures
3. Underpinning skills	3.1 Preparing maintenance materials, tools and equipment 3.2 Proper handling of tools and equipment 3.3 Performing preventive maintenance 3.4 Following instructions
4. Resource implications	The following resources should be provided: 4.1 Workplace 4.2 Maintenance schedule 4.3 Maintenance materials, tools and equipment relevant to the proposed activity/task
5. Methods of assessment	Competency should be assessed through: 5.1 Direct observation 5.2 Written test/questioning relevant to Underpinning knowledge

6. Context of assessment	6.1 Competency assessment may occur in workplace or any appropriate simulated environment 6.2 Competency assessment must be undertaken in accordance with the endorsed TESDA assessment guidelines

CORE COMPETENCIES

UNIT OF COMPETENCY: **SERVICE ENGINE SYSTEM (II)**
UNIT CODE: **CON723305**

UNIT DESCRIPTOR: This unit involves the knowledge, skills and attitudes in servicing engine system of heavy equipment. This unit specifically deals with the required skills for checking, testing, adjusting, troubleshooting, repairing and / or replacing the various parts and components of heavy equipment engine system.

ELEMENT	PERFORMANCE CRITERIA ***Bold and Italicized*** *terms are elaborated in the Range of Variables*
1. Check engine system	1.1 Work instructions are secured from immediate superior. 1.2 ***PPE*** and ***basic/special hand tools and shop equipment*** are selected and used based on job requirements. 1.3 Equipment operation is performed following standard operating procedures. 1.4 ***Engine system and related components and parts checking procedure*** is applied following manufacturer's specifications. 1.5 ***Unexpected situations*** are responded to in line with company rules and regulations in a manner that minimizes risks to personnel and equipment. 1.6 Completion report is prepared and submitted based on standard operating procedures.

2. Test and adjust engine system	2.1 Work instructions are secured from immediate superior. 2.2 PPE and basic/special hand tools and shop equipment are selected and used based on job requirements. 2.3 Equipment operation is performed following standard operating procedures. 2.4 ***Engine system testing procedure*** is applied in accordance with manufacturer's specifications. 2.5 ***Structure and parts adjustment procedure*** is applied following manufacturer's specifications. 2.6 Unexpected situations are responded to in line with company rules and regulations in a manner that minimizes risks to personnel and equipment. 2.7 Completion report is prepared and submitted based on standard operating procedures.
3. Troubleshoot engine system	3.1 Work instructions are secured from immediate superior. 3.2 PPE and basic/special hand tools and shop equipment are selected and used based on job requirements. 3.3 Equipment operation is performed following standard operating procedures. 3.4 ***Engine system troubleshooting procedure*** is applied in accordance with manufacturer's specifications. 3.5 ***Structure and parts troubleshooting procedure*** is applied following manufacturer's specifications. 3.6 Unexpected situations are responded to in line with company rules and regulations in a manner that minimizes risks to personnel and equipment. 3.7 Completion report is prepared and submitted based on standard operating procedures.

4. Repair and / or replace engine related components and parts	4.1 Work instructions are secured from immediate superior. 4.2 PPE and basic/special hand tools and shop equipment are selected and used based on job requirements. 4.3 Equipment operation is performed following standard operating procedures. 4.4 ***Engine system and related components and parts repair and / or replacement procedure*** is applied in accordance with manufacturer's specifications. 4.5 Unexpected situations are responded to in line with company rules and regulations in a manner that minimizes risks to personnel and equipment. 4.6 Completion report is prepared and submitted based on standard operating procedures.

RANGE OF VARIABLES

VARIABLE	RANGE
1. PPE	May include but not limited to: 1.1 Working clothes 1.2 Safety shoes 1.3 Hard hats 1.4 Goggles 1.5 Gloves 1.6 Respiratory mask 1.7 Ear plugs
2. Basic / special hand tools and shop equipment	May include but not limited to: 2.1 Wrench 2.2 Pliers 2.3 Cutters 2.4 Hammer 2.5 Screw drivers 2.6 Filler gauge 2.7 Torque wrench

3. Engine system and related components and parts	3.1 Air induction and exhaust system 3.1.1 Pre-cleaner 3.1.2 Air filter (primary and secondary) 3.1.3 Air filter restriction indicator 3.1.4 Evacuator valve 3.1.5 Automatic dust ejector 3.1.6 Air filter housing 3.1.7 Intake and exhaust manifold 3.1.8 Hose and clamps 3.1.9 Turbocharger 3.1.10 Aftercooler 3.1.11 Muffler 3.1.12 Stack 3.1.13 Gaskets 3.1.14 Rain cap 3.1.15 Air breather 3.2 Cooling system 3.2.1 Water pump 3.2.2 Thermostat 3.2.3 Hoses and clamps 3.2.4 Fan belts 3.2.5 Radiator fan 3.2.6 Radiator and fan guard/shroud 3.2.7 Radiator cap 3.2.8 Reservoir/Expansion tank 3.2.9 Fan motor drive 3.2.10 Radiator 3.3 Fuel system 3.3.1 Fuel tank 3.3.2 Filler cap 3.3.3 Hose, fuel lines and fittings 3.3.4 Filter (primary and secondary) 3.3.5 Priming pump 3.3.6 Water separator 3.3.7 Fuel transfer pump 3.3.8 Injection pump and governor 3.3.9 Injector and injection nozzles

	3.4 Lubrication system 3.4.1 Oil pan 3.4.2 Oil filter (primary and secondary) 3.4.3 Hoses and tubes 3.4.4 Oil cooler 3.5 Electronic system 3.5.1 Sensors 3.5.2 Electronic control unit/module (ECU/ECM) 3.5.3 Actuators/solenoids 3.5.4 Control panel/Electronic Monitoring System (EMS)
4. Checking procedures	4.1 Visual 4.2 Actual/sensory
5. Unexpected situations	May include but not limited to: 5.1 Collapse of unstable terrain 5.2 Natural calamities 5.3 Situations arising from poor peace and order 5.4 Force majeure 5.5 Mechanic fatigue or sickness
6. Testing procedures	6.1 Sensory 6.2 Diagnostic field test
7. Engine system testing procedure	Test the following and which may include: 7.1 Air induction and exhaust system 7.1.1 Boost pressure 7.1.2 Boost temperature 7.1.3 Exhaust manifold temperature 7.1.4 Intake pressure and resistance 7.1.5 Exhaust pressure 7.1.6 Exhaust temperature 7.1.7 Blow-by pressure (crank case) 7.1.8 Compression pressure 7.1.9 Exhaust gas color condition 7.2 Cooling system 7.2.1 Thermostat condition (opening temperature) 7.2.2 Coolant flow (water pump) 7.2.3 Radiator temperature differential 7.2.4 Radiator expansion tank/relief pressure (opening pressure) 7.2.5 Fan belt tension and adjust if necessary 7.2.6 Hydraulic driven fan pressure

	7.3 Fuel system 7.3.1 Fuel pressure 7.3.2 Priming pump pressure 7.3.3 Incorrect travel distance of governor linkage and adjust if necessary 7.3.4 Injection timing 7.3.5 Fuel filter differential pressure 7.3.6 Fuel pressure regulator 7.3.7 Fuel cooler temperature differential 7.4 Lubrication system 7.4.1 Oil pressure 7.4.2 Oil cooler and filter-based by-pass valve (opening pressure) Priority valve pressure (turbocharger) and adjust if necessary Oil temperature Electronic system 7.5.1 Open, grounded, shortage, intermittent signal 7.5.1.1 Sensor, switches and senders 7.5.1.2 Temperature 7.5.1.3 Pressure 7.5.1.4 Level 7.5.1.5 Speed/timing 7.5.1.6 Throttle position 7.5.1.7 Flow
8. Structure and parts adjusting procedure	Field work adjustment is applied on the following: 8.1 Valve clearance 8.2 Injector timing/injection pump timing 8.3 Valve timing
9. Engine system troubleshooting procedure	Troubleshoot the following and which may include: 9.1 Air induction and exhaust system 9.1.1 Black (smoke) exhaust emission 9.2 Cooling system 9.2.1 Engine overheating 9.2.2 Engine overcooling 9.3 Fuel system 9.3.1 Low fuel pressure 9.3.2 Fuel knocking 9.3.3 Black smoke 9.4 Lubrication system 9.4.1 Blue smoke emission 9.4.2 Low oil pressure

10. Structure and parts troubleshooting procedure	10.1 Blue smoke emission 10.2 Low oil pressure 10.3 Blow-by (crank case) pressure
11. Engine system and related components repair and / or replacement procedure	Repair and / or replace the following and which may include: 11.1 Air induction and exhaust 11.1.1 Turbocharger 11.1.2 Manifold (intake/exhaust) 11.1.3 Hoses and clamps 11.1.4 Air filters (primary and secondary) 11.1.5 After-cooler 11.2 Cooling system 11.2.1 Water pump 11.2.2 Thermostat 11.2.3 Hose and clamps 11.2.4 Guard/shroud 11.2.5 Fan belts 11.2.6 Fan drive/hydraulic fan motor 11.2.7 Water manifold 11.2.8 Radiator 11.2.9 Cooling fan 11.2.10 Seals and gaskets 11.3 Fuel system 11.3.1 PT/injection pump 11.3.2 Unit injectors/injection nozzle 11.3.3 Priming pump 11.3.4 Transfer pump 11.3.5 Fuel lines 11.3.6 Seals and gaskets 11.3.7 Linkages 11.3.8 Fuel cooler 11.4 Lubrication system 11.4.1 Oil cooler 11.4.2 Oil pump 11.4.3 Relief valve 11.4.4 Oil filters and oil cooler by-pass valve 11.4.5 Oil line, fittings and couplings 11.4.6 Seals and gaskets

EVIDENCE GUIDE

1. Critical aspects of evidence	Assessment requires evidence that the candidate: 1.1 Demonstrated ability to perform various engine systems, components structure and parts checking, testing and adjusting troubleshooting and repairing or replacing procedures. 1.2 Demonstrated ability to read and interpret schematic diagrams, graph, drawings and symbols. 1.3 Demonstrated knowledge of parts and components of the various engine systems 1.4 Demonstrated ability to read and interpret manufacturer's specifications. 1.5 Demonstrated ability to comply with company rules and regulations.
2. Underpinning knowledge and attitude	2.1 Identify components structures and parts and functions of engine systems 2.2 Checking, testing and adjusting, and repairing and/or replacement procedures for engine systems 2.3 Types and uses of PPE 2.4 Types and uses of basic and special hand tools 2.5 Ability to understand manufacturer's specifications 2.6 Schematic diagrams, graphs, drawings and symbols 2.7 Basic shop mathematics and mensuration 2.8 Company rules and regulations 2.9 Computer literacy 2.10 Positive work values (cost, time, quality consciousness, etc.)
3. Underpinning skills	3.1 Following checking, testing and adjusting, repair and/or replacing procedures of component structures, parts and systems procedures for engine system 3.2 Using PPE 3.3 Using basic and special hand tools and shop equipment 3.4 Following manufacturer's specifications 3.5 Interpreting schematic diagrams, drawings and symbols 3.6 Applying mensuration 3.7 Operating computer 3.8 Following company rules and regulations

4. Resource implications	Things necessary for the conduct of assessment include 4.1 Access to heavy equipment 4.2 Shop and parts manual/catalogue 4.3 Basic and special hand tools and shop equipment 4.4 PPE 4.5 Materials relevant to the activity
5. Method of assessment	Competency in this unit must be assessed through 5.1 Written / oral questioning 5.2 Observation of practical demonstration 5.3 Work documents 5.4 Third party report
6. Context of assessment	6.1 Assessment may be conducted on-the-job or in a simulated venue and in accordance with safe work procedures.

UNIT OF COMPETENCY: **SERVICE POWER TRAIN SYSTEM (II)**
UNIT CODE: **CON723306**

UNIT DESCRIPTOR: This unit involves the knowledge, skills and attitudes in servicing heavy equipment power train system. In particular this unit deals with the skills for checking, testing and adjusting and troubleshooting heavy equipment power train system and related components.

ELEMENT	PERFORMANCE CRITERIA ***Bold and Italicized*** *terms are elaborated in the Range of Variables*
1. Check power train system	1.1 Work instructions are secured from immediate superior. 1.2 ***PPE*** and ***basic/special hand tools and shop equipment*** are selected and used based on job requirements. 1.3 Equipment operation is performed following standard operating procedures. 1.4 ***Power train system and related components checking procedure*** is applied according to manufacturer's specifications. 1.5 ***Power train electronic system checking procedure*** is applied according to manufacturer's specifications. 1.6 ***Unexpected situations*** are responded to in line with company rules and regulations in a manner that minimizes risks to personnel and equipment. 1.7 Completion report is prepared and submitted based on standard operating procedures.

2. Test power train	2.1 Work instructions are secured from immediate superior. 2.2 PPE and basic/special hand tools and shop equipment are selected and used based on job requirements. 2.3 Equipment operation is performed following standard operating procedures. 2.4 ***Power train system testing and/or adjusting procedure*** is applied according to manufacturer's specifications. 2.5 ***Power train electronic system testing procedure*** is applied according to manufacturer's specifications. 2.6 Unexpected situations are responded to in line with company rules and regulations in a manner that minimizes risks to personnel and equipment. 2.7 Completion report is prepared and submitted based on standard operating procedures.
3. Troubleshoot power train	3.1 Work instructions are secured from immediate superior. 3.2 PPE and basic/special hand tools and shop equipment are selected and used based on job requirements. 3.3 Equipment operation is performed following standard operating procedures. 3.4 ***Power train system troubleshooting procedure*** is applied according to manufacturer's specifications. 3.5 Unexpected situations are responded to in line with company rules and regulations in a manner that minimizes risks to personnel and equipment. 3.6 Completion report is prepared and submitted based on standard operating procedures.

RANGE OF VARIABLES

VARIABLE	RANGE
1. PPE	May include but not limited to: 1.1 Working clothes 1.2 Safety shoes 1.3 Hard hats 1.4 Goggles 1.5 Gloves
2. Basic / special hand tools and shop equipment	May include but not limited to: 2.1 Wrenches 2.2 Hammers 2.3 Screw drivers 2.4 Pliers 2.5 Snap ring removers 2.6 Pullers 2.7 Pneumatic and hydraulic wrench 2.8 Bearing installer 2.9 Hydraulic press 2.10 Analog hydraulic tester 2.11 Push-full scale 2.12 Multi-tachometer 2.13 Thermistor kit 2.14 Torque multiplier/wrench

3. Power train system and related components checking procedure	Check the following: 3.1 Torque converter and divider 3.1.1 Planetary gear set 3.1.2 Impeller 3.1.3 Stator 3.1.4 Turbine 3.1.5 Output shaft 3.1.6 Housing 3.1.7 Seals 3.2 Mechanical flywheel clutch 3.2.1 Clutch disc 3.2.2 Clutch fork 3.2.3 Pressure plate 3.2.4 Release bearing 3.2.5 Bell housing 3.2.6 Hydraulic/mechanical dry clutch type 3.2.7 Hydraulic clutch booster 3.2.8 Seals 3.3 Transmission 3.3.1 Direct drive 3.3.2 Power shift drive 3.3.3 Hydrostatic/Hydraulic drive 3.3.4 Input/output shaft 3.3.5 Synchronizer gear assembly 3.3.6 Directional gears (Forward and Reverse) 3.3.7 Speed gears 3.3.8 Clutches 3.3.9 Mesh gears 3.3.10 Clutch pistons 3.3.11 Control valve 3.3.12 Planetary gear set 3.3.13 Pumps 3.3.14 Seals 3.4 Transfer gear drive 3.4.1 Planetary gear (drive, idler and driven gear) 3.4.2 Housing 3.4.3 Seals 3.4.4 Yoke 3.4.5 Shafts

	3.5 Differential axle and final drive 3.5.1 Bevel gear and ring gear 3.5.2 Differential case 3.5.3 Spider 3.5.4 Side gear 3.5.5 Pinion 3.5.6 Axle shaft and housing 3.5.7 Planetary gear set 3.5.8 Housing and cover 3.5.9 Seals 3.5.10 Bearing 3.5.11 Bull gear 3.6 Lower power train structure 3.6.1 Steering clutch (and adjust if necessary) 3.6.2 Differential steer 3.6.3 Final drive 3.6.4 Brake 3.6.5 Travel motor 3.6.6 Steering pump and motor (and adjust if necessary) 3.6.7 Suspension (gas type and mechanical) 3.6.8 Steering mechanical linkage (and adjust if necessary) 3.7 Power take-off [gear/vane/belt driven type] 3.7.1 Housing 3.7.2 Seals 3.7.3 Shafts r/vane/belt
4. Power train electronic system checking procedure	Check the following: 4.1 Sensors conditions 4.2 ECU/ECM condition 4.3 Actuators/solenoids condition 4.4 Control panel/EMS
5. Unexpected situations	May include but not limited to: 5.1 Collapse of unstable terrain 5.2 Natural calamities 5.3 Situations arising from poor peace and order 5.4 Mechanic fatigue or sickness

6. Power train system testing and / or adjusting procedure	Test / adjust the following: 6.1 Torque converter and divider 6.2 Transmission 6.3 Lower power train structure 6.4 Mechanical flywheel/clutch 6.5 Differential axle and final drive 6.6 Transfer gear drive 6.7 Power take-off (PTO)
7. Power train electronic system testing procedure	7.1 Open, grounded, shortage, intermittent signal 7.1.1 Sensor, switches and senders 7.1.1.1 Temperature 7.1.1.2 Pressure 7.1.1.3 Level 7.1.1.4 FNR position sensor 7.1.1.5 Speed sensor 7.1.2 Solenoid 7.1.3 Electronic control 7.1.4 Control panel (EMS)
8. Power train system trouble-shooting procedure	Troubleshoot the following performance problems/condition: 8.1 Torque converter and divider 8.2 Mechanical flywheel clutch 8.3 Transmission 8.3.1 Transfer gear drive 8.3.2 Power take-off (PTO) 8.3.3 Lower power train structure 8.3.4 Differential axle and final drive

EVIDENCE GUIDE

1. Critical aspects of evidence	The evidence must show that the candidate: 1.1 Demonstrated ability to perform power train system and components checking, testing and adjusting, and troubleshooting procedures. 1.2 Demonstrated ability to read and interpret schematic diagrams, graphs, drawings and symbols. 1.3 Demonstrated knowledge of parts and components of power train system 1.4 Demonstrated ability to read and interpret manufacturer's specifications. 1.6 Demonstrated ability to comply with company rules and regulations.
2. Underpinning knowledge and attitude	2.1 Parts, components and functions of power train system 2.2 Check, test and adjust, and procedures for power train system 2.3 Types and uses of PPE 2.4 Types and uses of basic and special tools 2.5 Ability to understand manufacturer's specifications 2.6 Schematic diagrams, drawings, graphs and symbols 2.7 Basic shop mathematics and mensuration 2.8 Company rules and regulations 2.9 Computer literacy 2.10 Positive work values (cost, time, quality consciousness, etc.)
3. Underpinning skills	3.1 Identifying parts, components and functions of power train 3.2 Performing checking, testing and adjusting, troubleshooting for power train system 3.3 Using PPE 3.4 Using basic and special tools 3.5 Ability to understand manufacturer's specifications 3.6 Interpreting schematic diagrams, drawings, graphs and symbols 3.7 Applying mensuration and shop Mathematics 3.8 Operating computer
4. Resource implications	Things necessary for the conduct of assessment include 4.1 Access to heavy equipment 4.2 Shop and parts manual/catalogue 4.3 Basic and special tools and shop equipment 4.4 PPE 4.5 Materials relevant to the activity

5. Method of assessment	Competency in this unit must be assessed through 5.1 Written / oral questioning 5.2 Observation of practical demonstration 5.3 Work documents 5.4 Third party report
6. Context of assessment	6.1 Assessment may be conducted on-the-job or in a simulated venue and in accordance with safe work procedures.

UNIT OF COMPETENCY:	**SERVICE HYDRAULIC SYSTEM (II)**
UNIT CODE:	**CON723307**
UNIT DESCRIPTOR:	This unit involves the knowledge, skills and attitudes in servicing hydraulic system of heavy equipment. It deals with the skills required to check, test and adjust, troubleshoot, and perform minor repair and/or replacement procedures for the various parts and components of heavy equipment hydraulic system.

ELEMENT	PERFORMANCE CRITERIA ***Bold and Italicized*** *terms are elaborated in the Range of Variables*
1. Check hydraulic system	1.1 Work instructions are secured from immediate superior. 1.2 ***PPE*** and ***basic/special hand tools and shop equipment*** are selected and used based on job requirements. 1.3 Equipment operation is performed following standard operating procedures. 1.4 ***Hydraulic system and related components checking procedure*** is applied according to manufacturer's specifications. 1.5 ***Electronic system checking procedure*** is applied according to manufacturer's specifications. 1.6 ***Unexpected situations*** are responded to in line with company rules and regulations in a manner that minimizes risks to personnel and equipment. 1.7 Completion report is prepared and submitted based on standard operating procedures.

2. Test and adjust hydraulic system	2.1 Work instructions are secured from immediate superior. 2.2 PPE and basic/special hand tools and shop equipment are selected and used based on job requirements. 2.3 Equipment operation is performed following standard operating procedures. 2.4 ***Hydraulic system and related components testing procedure*** is applied according to manufacturer's specifications. 2.5 ***Electronic system testing procedure*** is applied according to manufacturer's specifications. 2.6 Unexpected situations are responded to in line with company rules and regulations in a manner that minimizes risks to personnel and equipment. 2.7 Completion report is prepared and submitted based on standard operating procedures.
3. Troubleshoot hydraulic system	3.1 Work instructions are secured from immediate superior. 3.2 PPE and basic/special hand tools and shop equipment are selected and used based on job requirements. 3.3 Equipment operation is performed following standard operating procedures. 3.4 ***Hydraulic system and related components performance troubleshooting procedure*** is applied according to manufacturer's specifications. 3.5 Unexpected situations are responded to in line with company rules and regulations in a manner that minimizes risks to personnel and equipment. 3.6 Completion report is prepared and submitted based on standard operating procedures.

4. Repair and / or replace hydraulic system components	4.1 Work instructions are secured from immediate superior. 4.2 PPE and basic/special hand tools and shop equipment are selected and used based on job requirements. 4.3 Equipment operation is performed following standard operating procedures. 4.4 ***Hydraulic system and related components minor repair and/or replacement procedure*** is applied according to manufacturer's specifications. 4.5 Unexpected situations are responded to in line with company rules and regulations in a manner that minimizes risks to personnel and equipment. 4.6 Completion report is prepared and submitted based on standard operating procedures.

RANGE OF VARIABLES

VARIABLE	RANGE
1. PPE	May include but not limited to: 1.1 Protective working clothes 1.2 Safety shoes 1.3 Hard hats 1.4 Goggles 1.5 Face mask 1.6 Gloves 1.7 Ear plugs
2. Basic / special tools and shop equipment	May include but not limited to: 2.1 Wrenches 2.2 Pliers 2.3 Cutters 2.4 Hammer 2.5 Screw drivers 2.6 Measuring tape 2.7 Pressure gauge 2.8 Stop watch 2.9 Software type diagnostic tool 2.10 Thermal gun or infrared

3. Hydraulic system and related components checking procedure	Check the following and which may include but not limited to: 3.1 Pumps 3.2 Control valves 3.3 Cylinders / Rod 3.4 Motor 3.5 Lines / fittings / couplings 3.6 Tank 3.7 Filters / Strainers 3.8 Relief / Bypass valves 3.9 Oil 3.10 Oil cooler
4. Electronic system checking procedure	Check the following and which may include but not limited to: 4.1 Sensors, switches and senders 4.2 ECU/ECM 4.3 Actuators/solenoids 4.4 Control panel/EMS 4.5 Wiring and connectors
5. Unexpected situations	May include but not limited to: 5.1 Collapse of unstable terrain 5.2 Natural calamities 5.3 Situations arising from poor peace and order 5.4 Force majeure 5.5 Mechanic fatigue or sickness
6. Hydraulic system and related components testing procedures	Test the following and which may include but not limited to: 6.1 Pumps 6.2 Control valves 6.3 Cylinders / Rod 6.4 Motors 6.5 Tank 6.6 Oil cooler 6.7 Lines, fittings and couplings
7. Electronic system testing procedure	Test the following and which may include but not limited to: 7.1 Sensors, switches and senders 7.2 Controls (ECU/ECM) 7.3 Actuators/solenoids 7.4 Alert/warning indicators (monitoring panel) 7.5 Harness

8. Hydraulic system and related components troubleshooting procedure	Troubleshoot the following: 8.1 Pumps 8.2 Control valves 8.3 Cylinders / Rod 8.4 Motor 8.5 Lines, fittings and couplings 8.6 Tanks 8.7 Filters 8.8 Oil cooler 8.9 Relief / By pass valves
9. Hydraulic system and related components minor repair and/or replacement procedure	Minor repair and/or replace the following and which may include but not limited to: 9.1 Pumps 9.2 Control valves 9.3 Cylinders / Rod 9.4 Motor 9.5 Lines, fittings and couplings 9.6 Tanks 9.7 Filters 9.8 Oil cooler 9.9 Relief / By pass valves

EVIDENCE GUIDE

1. Critical aspects of evidence	The evidence must show that the candidate: 1.1 Demonstrated ability to perform hydraulic system components checking, testing and adjusting, troubleshooting and minor repair and / or replacement procedures. 1.2 Demonstrated ability to read and interpret schematic diagrams, graphs, drawings and symbols. 1.3 Demonstrated knowledge of parts and components of hydraulic system 1.4 Demonstrated ability to read and interpret manufacturer's specifications. 1.6 Demonstrated ability to comply with company rules and regulations.
2. Underpinning knowledge and attitude	2.1 Parts, components and functions of hydraulic system 2.2 Check, test, adjust and minor repair and / or replacement procedures for hydraulic system and components 2.3 Types and uses of PPE 2.4 Types and uses of basic and special tools 2.5 Ability to understand manufacturer's specifications 2.6 Schematic diagrams, graphs, drawings and symbols 2.7 Basic shop mathematics and mensuration 2.8 Company rules and regulations 2.9 Computer literacy 2.10 Positive work values (cost, time, quality consciousness, etc.)
3. Underpinning skills	3.1 Identifying parts, components and functions of hydraulic system 3.2 Performing inspection, checking, testing and adjusting, minor repair and / or replacement procedures for hydraulic system and components 3.3 Using PPE 3.4 Using basic and special tools 3.5 Ability to understand manufacturer's specifications 3.6 Interpreting schematic diagrams, graphs, drawings and symbols 3.7 Applying mensuration 3.8 Operating computer

4. Resource implications	Things necessary for the conduct of assessment include 4.1 Access to heavy equipment 4.2 Shop and parts manual/catalogue 4.3 Basic and special tools and shop equipment 4.4 PPE 4.5 Materials relevant to the activity
5. Method of assessment	Competency in this unit must be assessed through 5.1 Written / oral questioning 5.2 Observation of practical demonstration 5.3 Work documents 5.4 Third party report
6. Context of assessment	6.1 Assessment may be conducted on-the-job or in a simulated venue and in accordance with safe work procedures.

UNIT OF COMPETENCY: **SERVICE UNDERCARRIAGE SYSTEM (II)**
UNIT CODE: **CON723308**

UNIT DESCRIPTOR: This unit describes the outcomes required for servicing the undercarriage system of heavy equipment. It deals with the skills required for checking, testing, measuring and repairing or replacing the undercarriage system and components for heavy equipment.

ELEMENT	PERFORMANCE CRITERIA ***Bold and Italicized*** *terms are elaborated in the Range of Variables*
1. Check undercarriage system	1.1 Work instructions are secured from immediate superior. 1.2 ***PPE*** and ***basic/special tools and shop equipment*** are selected and used based on job requirements. 1.3 Equipment operation is performed following standard operating procedures. 1.4 ***Undercarriage system and related components checking procedure*** is applied according to manufacturer's specifications. 1.5 ***Unexpected situations*** are responded to in line with company rules and regulations in a manner that minimizes risks to personnel and equipment. 1.6 Completion report is prepared and submitted based on standard operating procedures.

2. Test undercarriage system	2.1 Work instructions are secured from immediate superior. 2.2 PPE and basic/special hand tools and shop equipment are selected and used based on job requirements. 2.3 Equipment operation is performed following standard operating procedures. 2.4 ***Undercarriage system testing procedure*** is applied according to job requirements. 2.5 Unexpected situations are responded to in line with company rules and regulations in a manner that minimizes risks to personnel and equipment. 2.6 Completion report is prepared and submitted based on standard operating procedures.
3. Measure wear of undercarriage and related components	3.1 Work instructions are secured from immediate superior. 3.2 PPE and basic/special hand tools and shop equipment are selected and used based on job requirements. 3.3 Equipment operation is performed following standard operating procedures. 3.4 ***Undercarriage system measuring procedure*** is applied according to manufacturer's specifications. 3.5 Unexpected situations are responded to in line with company rules and regulations in a manner that minimizes risks to personnel and equipment. 3.6 Completion report is prepared and submitted based on standard operating procedures.

4. Repair and/or replacement of undercarriage components/parts	4.1 Work instructions are secured from immediate superior. 4.2 PPE and basic/special hand tools and shop equipment are selected and used based on job requirements. 4.3 Equipment operation is performed following standard operating procedures. 4.4 ***Undercarriage system and related components/parts repair and/or replacement procedure*** is applied according to manufacturer's specifications. 4.5 Unexpected situations are responded to in line with company rules and regulations in a manner that minimizes risks to personnel and equipment. 4.6 Completion report is prepared and submitted based on standard operating procedures.

RANGE OF VARIABLES

VARIABLE	RANGE
1. PPE	May include but not limited to: 1.1 Working clothes 1.2 Safety shoes 1.3 Hard hats 1.4 Goggles 1.5 Gloves 1.6 Respiratory mask 1.7 Ear plugs
2. Basic / special tools and shop equipment	May include but are not limited to: 2.1 Wrench 2.2 Pliers 2.3 Cutters 2.4 Hammer 2.5 Pry bar 2.6 Hydraulic Jack 2.7 Measuring Tool Kit 2.8 Ultrasonic 2.9 Multi scale 2.10 Straight gauge 2.11 Depth gauge 2.12 Outside/inside caliper 2.13 Steel rule 2.14 Vernier caliper 2.15 Hydraulic press (push/pull) 2.16 Impact/Torque wrench 2.17 Grease gun

3. Undercarriage system and related components checking procedure	3.1 Track Group 3.1.1Track Shoe 3.1.2 Bolts / nuts 3.1.3 Pin and Bushing 3.1.4 Link 3.1.5 Master Pin/Link 3.2 Idler 3.2.1 Bearing 3.2.2 Cover 3.2.3 Seals 3.2.4 Bushing 3.2.5 Pin 3.2.6 Gasket 3.2.7 Shim 3.2.8 Bolts 3.2.9Cap 3.3 Track and Carrier Roller 3.3.1 Packing seals 3.3.2 Pin 3.3.3 Bushing 3.3.4 Cover/collar 3.3.5 Bolts and nuts 3.3.6 Protective guard 3.3.7 Cap 3.4 Track frame and related components 3.4.1 Protective guard 3.4.2 Bolts/nuts 3.4.3 Equalizer bar 3.4.4 Pivot Shaft 3.4.5 Shim 3.4.6 Bushing 3.4.7 Diagonal brace and beam 3.4.8 Spring 3.4.9 Yoke 3.4.10 Roller guard 3.4.11 Trunion holder 3.5 Track adjuster cylinder 3.5.1 Cylinder housing 3.5.2 Cover 3.5.3 Packing seals 3.5.4 Rod 3.5.5 Spring 3.5.6 Fittings 3.5.7 Bolts and nuts 3.5.8 bushing

4. Unexpected situations	May include but not limited to: 4.1 Collapse of unstable terrain 4.2 Natural calamities 4.3 Situations arising from poor peace and order 4.4 Force majeure 4.5 Mechanic fatigue or sickness
5. Undercarriage group testing procedures	May include but not limited to: 5.1 Test system operations and functions 5.1.1 Rotations and movements 5.1.2 Alignments 5.1.3 Leakages 5.1.4 Bolts and nuts
6. Undercarriage system measuring procedure	Measure the following: 6.1 Track group 6.1.1 Track shoe 6.1.2 Grouser height 6.1.3 Plate thickness 6.2 Link 6.2.1 Height 6.2.2 Pitch 6.2.3 Width 6.3 Bushing 6.3.1 Diameter (inside and outside) 6.4 Tension 6.4.1 Sag / clearance 6.5 Idler 6.5.1 Flange height and width 6.5.2 Outside diameter 6.6 Sprocket 6.6.1 Wear pattern 6.7 Carrier and track roller 6.7.1 Flange height and width 6.7.2 Outside diameter 6.8 Track adjuster cylinder 6.9 Clearance between yoke and frame

7. Undercarriage system and related components / parts repair and/or replacement procedures	7.1 Track Group 7.1.1 Track Shoe 7.1.2 Bolts/nuts 7.1.3 Pin and Bushing 7.1.4 Link 7.1.5 Master Pin/Link 7.2 Idler 7.2.1 Bearing 7.2.2 Cover 7.2.3 Seals 7.2.4 Bushing 7.2.5 Pin 7.2.6 Gasket 7.2.7 Shim 7.2.8 Bolts 7.2.9 Cap 7.3 Track and Carrier Roller 7.3.1 Packing seals 7.3.2 Pin 7.3.3 Bushing 7.3.4 Cover/collar 7.3.5 Bolts and nuts 7.3.6 Protective guard 7.3.7 Cap 7.4 Track frame and related components 7.4.1 Protective guard 7.4.2 Bolts/nuts 7.4.3 Equalizer bar 7.4.4 Pivot Shaft 7.4.5 Shim 7.4.6 Bushing 7.4.7 Diagonal brace and beam 7.4.8 Spring 7.4.9 Yoke 7.4.10 Roller guard 7.4.11 Trunion holder 7.5 Track adjuster cylinder 7.5.1 Cylinder housing 7.5.2 Cover 7.5.3 Packing seals 7.5.4 Rod 7.5.5 Spring 7.5.6 Fittings 7.5.7 Bolts and nuts 7.5.8 Bushing

EVIDENCE GUIDE

1. Critical aspects of evidence	The evidence must show that the candidate: 1.1 Demonstrated ability to perform undercarriage components checking, testing and adjusting, measuring, and repair or replacement procedures. 1.2 Demonstrated ability to read and interpret drawings 1.3 Demonstrated knowledge of structure and components/parts of undercarriage 1.4 Demonstrated ability to read and interpret manufacturer's specifications. 1.5 Demonstrated ability to comply with company rules and regulations.
2. Underpinning knowledge and attitude	2.1 Structure, components/parts and functions of undercarriage 2.2 Checking, testing and adjusting, measuring and repair or replacement procedures for undercarriage and components / parts 2.3 Types and uses of PPE 2.4 Types and uses of basic and special tools 2.5 Ability to understand manufacturer's specifications 2.6 Interpretation of drawings 2.7 Basic shop mathematics and mensuration 2.8 Company rules and regulations 2.9 Computer literacy 2.10 Positive work values (cost, time, quality consciousness, etc.)
3. Underpinning skills	3.1 Identifying parts, components and functions of undercarriage 3.2 Performing checking, testing and adjusting, measuring, repair or replacement procedures for undercarriage and components / parts 3.3 Using PPE 3.4 Using basic and special hand tools 3.5 Ability to understand manufacturer's specifications 3.6 Interpreting drawings 3.7 Applying mensuration 3.8 Operating computer

4. Resource implications	Things necessary for the conduct of assessment include 4.1 Access to heavy equipment 4.2 Shop and parts manual/catalogue 4.3 Basic and special tools and shop equipment 4.4 PPE 4.5 Materials relevant to the activity
5. Method of assessment	Competency in this unit must be assessed through 5.1 Written / oral questioning 5.2 Observation of practical demonstration 5.3 Work documents 5.4 Third party report
6. Context of assessment	6.1 Assessment may be conducted on-the-job or in a simulated venue and in accordance with safe work procedures.

SECTION 3. TRAINING STANDARDS

These standards are set to provide technical and vocational education and training (TVET) providers with information and other important requirements to consider when designing training programs for Heavy Equipment Servicing (Mechanical) II.

3.1 CURRICULUM DESIGN

Course Title: **HEAVY EQUIPMENT SERVICING (MECHANICAL)** NC Level: **II**

Suggested Nominal Training Duration: **18 hours (Basic)**
24 hours (Common)
320 hours (Core)

Course Description:

This course is designed to enhance the knowledge, positive work attitudes and skills in Heavy Equipment Servicing (Mechanical) II, in accordance with industry standards. It covers basic, common and core competencies. It includes basic skills in participate in workplace communication, work in a team environment, demonstrate work values, and practice housekeeping.

The common competencies are Interpret technical drawings and plans, observe procedures, specifications and manuals of instructions, perform mensurations and calculation, and maintain tools and equipment. The core competencies include service engine systems, service power train systems, service hydraulic systems, and service undercarriage systems.

BASIC COMPETENCIES

Unit of Competency	Learning Outcomes	Methodology	Assessment Approach
1. Participate in workplace communication	1.1 Obtain and convey workplace Information 1.2 Complete relevant work related documents 1.3 Participate in workplace meetings and discussions	Lecture Practical exercises	Observation Demonstration Written test

2. Work in a team environment	2.1 Describe team role and Scope 2.2 Identify own role and responsibility within team 2.3 Work as a team member	Lecture Practical exercises	Observation Demonstration Written test
3. Demonstrate work values	3.1 Apply work values/ethics 3.2 Maintain integrity of conduct in the workplace	Lecture Demonstration Practical exercises	Observation and oral questioning Written test
4. Practice house keeping procedures	4.1 Sort recyclable and remove unnecessary materials 4.2 Store materials 4.3 Maintain work are, tools and equipment	Lecture Demonstration Practical exercises	Demonstration and oral questioning Written test

COMMON COMPETENCIES

Unit of Competency	Learning Outcomes	Methodology	Assessment Approach
1. Interpret technical drawings and plans	1.1 Read / Interpret blueprints and plans 1.2 Perform freehand sketching	Lecture Demonstration Practical exercises	Demonstration and oral questioning Written test
2. Observe procedures, specifications and manuals of instructions.	2.1 Identify and access specifications / technical manuals 2.2 Interpret technical manuals 2.3 Apply information in technical manual 2.4 Store technical manual	Lecture Demonstration Practical exercises	Demonstration and oral questioning Written test
3. Perform mensurations and calculations	3.1 Select measuring instruments 3.2 Carryout measurement and calculations	Lecture Demonstration Practical exercises	Demonstration and oral questioning Written test
4. Maintain tools and equipment	4.1 Check condition of tools and equipment 4.2 Perform preventive maintenance 4.3 Store tools and equipment	Lecture Demonstration Practical exercises	Demonstration and oral questioning Written test

5. Prepare construction materials and tools	5.1 Identify Materials 5.2 Requisition Materials 5.3 Receive and inspect materials	Audio Visual Simulation Discussion Practical Exercise Demonstration	Direct observation Questions or interview Portfolio (credentials) Written / Oral Test Demonstration

CORE COMPETENCIES

Unit of Competency	Learning Outcomes	Methodology	Assessment Approach
1. Service Engine system (II)	1.1 Check engine systems 1.2 Test and adjust engine system 1.3 Troubleshoot engine system 1.4 Repair / Replace engine components	Lecture Practical exercises OJT	Observation Demonstration Written test
2. Service Power Train system (II)	2.1 Check power train system 2.2 Test power train 2.3 Troubleshoot power train 2.4 Remove and install power train components system	Lecture Practical demonstration OJT	Observation Demonstration Written test
3. Service Hydraulic system (II)	3.1 Check hydraulic system 3.2 Test and adjust hydraulic system 3.3 Troubleshoot hydraulic system 3.4 Repair or replace hydraulic system components	Lecture Practical exercises OJT	Observation Demonstration Written test

4. Service undercarriage system (II)	4.1 Check under carriage system 4.2 Test undercarriage system 4.3 Measure wear of undercarriage related components 4.4 Repair and replace undercarriage components/parts	Lecture Practical exercises, OJT	Observation Demonstration Written test

3.2 TRAINING DELIVERY

The delivery of training should adhere to the design of the curriculum. Delivery should be guided by the 10 basic principles of competency-based TVET.

- The training is based on curriculum developed from the competency standards;
- Learning is modular in its structure;
- Training delivery is individualized and self-paced;
- Training is based on work that must be performed;
- Training materials are directly related to the competency standards and the curriculum modules;
- Assessment is based in the collection of evidence of the performance of work to the industry required standard;
- Training is based both on and off-the-job components;
- Allows for recognition of prior learning (RPL) or current competencies;
- Training allows for multiple entry and exit; and
- Approved training programs are Nationally Accredited

The competency-based TVET system recognizes various types of delivery modes, both on and off-the-job as long as the learning is driven by the competency standards specified by the industry. The following training modalities may be adopted when designing training programs:

- The dualized mode of training delivery is preferred and recommended. Thus programs would contain both in-school and in-industry training or fieldwork components. Details can be referred to the Dual Training System (DTS) Implementing Rules and Regulations.
- Modular/self-paced learning is a competency-based training modality wherein the trainee is allowed to progress at his own pace. The trainer just facilitates the training delivery.
- Peer teaching/mentoring is a training modality wherein fast learners are given the opportunity to assist the slow learners.
- Supervised industry training or on-the-job training is an approach in training designed to enhance the knowledge and skills of the trainee through actual experience in the workplace to acquire specific competencies prescribed in the training regulations.
- Distance learning is a formal education process in which majority of the instruction occurs when the students and instructor are not in the same place. Distance learning may employ correspondence study, audio, video or computer technologies.

3.3 TRAINEE ENTRY REQUIREMENTS

This section specifies the qualifications of trainees and educational experience. Other requirements like health and physical requirements are also stated. Passing entry written examinations may also be indicated if necessary. Trainees or students wishing to gain entry into this course should possess the following requirements:

- completed training in heavy equipment servicing (mechanical) I or a holder of Heavy Equipment NC I certificate or completed diesel mechanic course
- physically and mentally fit
- with good moral character

3.4 LIST OF TOOLS, EQUIPMENT AND MATERIALS

Recommended list of tools, equipment and materials for the training of 25 trainees for Heavy Equipment Servicing (Mechanical) II.

TOOLS		EQUIPMENT		MATERIALS	
QTY		QTY		QTY	
5 sets	wrenches (box and open-end 8-24 mm-metric & 7/16 –1" - English)	1 unit	Heavy Equipment Mechanic II(MOA /rental)	10 kls.	Multi-purpose grease
5 sets	hammer ballpeen (3-4 lbs)	1 unit	hydraulic/air impact wrench	50 liters	engine oil (SAE 15W40)
2pcs.	Sledge hammer 8 lbs.			200 liters	diesel fuel
5 sets	pliers(mechanical 10 ")	1 unit	high pressure washer	2 cans	penetrating oil (250 ml)
pcs	adjustable wrench (18 ")	1 unit	Portable electric air compressor	20 kls.	Cotton rugs
5pcs.	adjustable wrench 10"	1 set	Hydraulic tools for undercarriage	5 liters	Cleaning solvent
2 pcs.	grease gun	1 set	Chain block with "A" frame (3 tons)	50 liters	Hydraulic / steering fluid (TELLUS 68/10W)
5 sets	screw driver (10 " flat & Philips)	1 unit.	Transmission undercarriage jack (5 tons)	20 liters	Final drive/differential (gear oil GP90/140)
5 pcs.	putty knife	1 unit	Crocodile jack (5 tons)	20 liters	Transmission oil (ATF)
3 sets	socket wrench ½" drive (8- 32 mm 0r English equivalent)	1 unit `	Hydraulic vertical jack (10 tons)	1 set	shop work cleaning tool(one each kind)
2 sets	socket wrench ¾" drive (30- 60 mm 0r English equivalent)	1 unit	Hydraulic press (20 tons)	25 pairs	working clothes
2 sets	socket wrench 1" drive (22- 60 mm 0r English equivalent)	1 unit	Parts cleaner	25 pairs	Safety shoes
2 sets	allen wrench L- type (4-17 mm or English equivalent)	1 unit	Pallet truck (5 tons)	25 pairs	Gloves

1 pc.	Torque multiplier ¾ “ drive with (Mechanical Advantage X4)	5 units	Working bench with attached vises	25 pairs	Goggles
1 pc.	Torx wrench ½ “ drive (12-19 mm or English equivalent)	1 unit	Bench grinder	5 pcs	Shop repair manual
2 sets	allen wrench socket type (12- 27 mm or English equivalent)	1 unit	Drill press	25 pcs	Hard hat
5 pcs.	Filter wrench	1 unit	Vertical hydraulic test bench		
5 pcs.	hacksaw	1 unit	Injection pump calibration stand with nozzle injector tester		
3 pcs.	pry bar (heavy duty)	1 unit	Engine dynamometer		
5pcs.	Pipe wrench (12”)	1 unit	Valve spring tester		
5 pcs.	Vise grip (12 “)	1 unit	Engine stand		
1 pc.	Torque wrench ½” drive (0-30 kg./m)				
1 pc.	Torque wrench ¾ ” drive (0-70 kg./m)				
2 sets	Thermometer				
2 set s	tachometer				
2 sets	Timing tool				
2 sets	Caliper (inside & outside)				
2 sets	Micrometer caliper				
2 sets	Vernier caliper				
1 set	Cylinder gauge				
1 set	Compression tester				
1 set	Blow by tester				
1 set	Hydraulic pressure gauge				
1 set	Vacuum tester				
1 set	Multi- scale tester for undercarriage				
1 pc	Straight edge rule (1 Meter)				
1 pc	Stop watch				
2 sets	Feller gauge				

3.5 TRAINING FACILITIES
HEAVY EQUIPMENT SERVICING (MECHANICAL) II

The Heavy Equipment Servicing (Mechanical) II workshop must be made of reinforced concrete or steel structure. The size must be suited on the requirements of the competencies. The class size of 25 students/trainees is reserved for the lecture room and the practical demonstration area for carrying out minor Heavy Equipment Servicing and parts maintenance. Most of the learning activities are performed individually in the students/trainees work area.

SPACE REQUIREMENT	SIZE IN METERS	AREA IN SQ. METERS	TOTAL AREA IN SQ. METERS
Student/Trainee's Working Space		4 (sq.m per student)	100.0 sq.m.
Lecture Room		48.0	48.0
Learning Resource Center		24.0	24.0
tool/storeroom		12.0	12.0
			184
Facilities/Equipment/ Circulation Area	-	-	52
TOTAL WORK AREA	-		**236**

3.6 TRAINERS' QUALIFICATION
HEAVY EQUIPMENT SERVICING (MECHANICAL) II

TRAINER QUALIFICATION (TQ III)

Must be a holder of NC III Heavy Equipment Servicing (Mechanical)
Must have undergone training on Training Methodology III (TM III)
Must be computer literate
Must be physically and mentally fit
*Must have at least 5 years job/industry experience
Must be a civil service eligible (for government position or appropriate professional license issued by the Professional Regulatory Commission)

* Optional. Only when required by the hiring institution.

Reference: TESDA Board Resolution No. 2004 03

3.7 INSTITUTIONAL ASSESSMENT

Institutional assessment is undertaken by trainees to determine their achievement of units of competency. A certificate of achievement is issued for each unit of competency.

SECTION 4 NATIONAL ASSESSMENT AND CERTIFICATION ARRANGEMENTS

4.1. To attain the National Qualification of **Heavy Equipment Servicing (Mechanical) - NC II**, the candidate must demonstrate competence through project-type assessment covering all the units listed in Section 1. Successful candidates shall be awarded a National Certificate signed by the TESDA Director General.

4.2. The qualification of Heavy Equipment Servicing (Mechanical) - NC II can be attained through:

4.2.2 Demonstration of competence through project-type assessment covering all the required units of the qualification

4.3. Assessment shall focus on the core units of competency. The basic and common units shall be integrated or assessed concurrently with the core units.

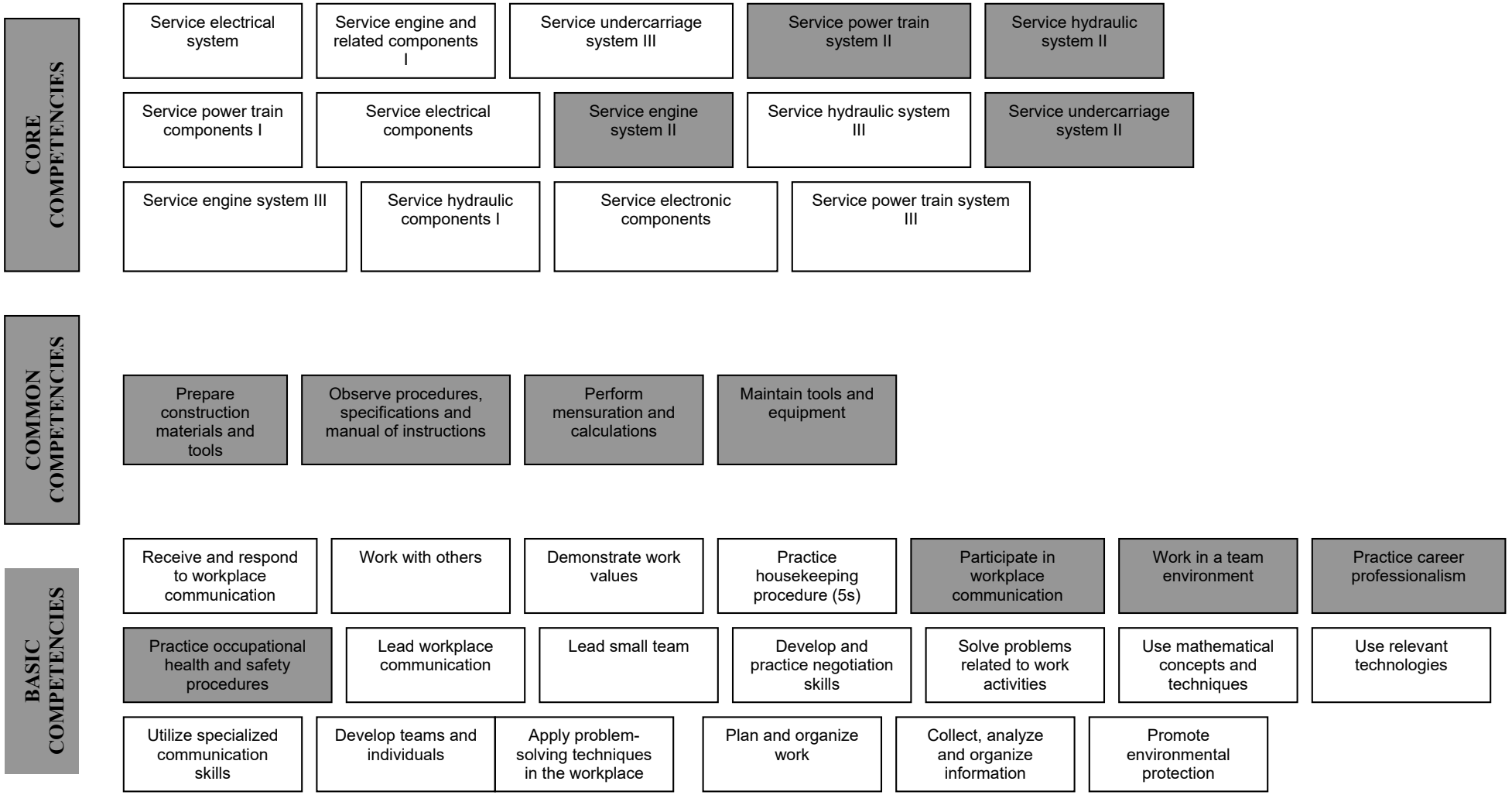
4.4. The following are qualified to apply for assessment and certification:

4.4.1 Graduates of formal, non-formal and informal including enterprise-based training programs

4.4.2 Experienced Workers (wage employed or self-employed)

4.5. The guidelines on assessment and certification are discussed in detail in the Procedures Manual on Assessment and Certification and guidelines on the Implementation of the Philippine TVET Qualification and Certification System (PTQCS).

COMPETENCY MAP
CONSTRUCTION-HEAVY EQUIPMENT SERVICING - SUB- SECTOR



DEFINITION OF TERMS

1. Adjusting	Is the act of putting back the equipment to operating standard by way of adjustments
2. Certification	Refers to the process of verifying and validating competencies of a person through assessment.
3. Checking	Refers to the visual and sensory inspection of parts or components
4. Competency	Is the application of knowledge, skills and attitudes to perform work activities to the standard expected in the workplace.
5. Electronic system checking procedure	Refers to the inspection of electronic related components used in the hydraulic systems.
6. Electronic system testing procedure	Refers to the methods and steps in functionality testing of electronic components used in the hydraulic systems as per manufacturer's recommendations and standards.
7. Element	Refers to the building blocks of a unit of competency. It describes in outcome terms the functions that a person who works in a particular area of work is able to perform.
8. Engine system and related components and parts checking procedure	Refers to the visual and/or sensory inspection conducted to the engine and its sub-components.
9. Engine system and related components and parts repair and / or replacement procedure	Is a procedure in the removal, correction, component or parts replacement and its installation based on manufacturer's recommendations
10. Engine system and related components and parts	Are subsystems and parts related to the engine system
11. Engine system testing procedure	Refers to procedural steps or techniques recommended by the equipment manufacturer in testing engine and its sub-components
12. Engine system troubleshooting procedure	Refers to the correct method and steps in locating and correcting defects/troubles based on manufacturer's standards.

13.	Evidence Guide	It is a guide for assessment that provides information on critical aspects of competency, underpinning knowledge, underpinning skills, resource implications, context of assessment and assessment method.
14.	Hydraulic system and related components checking procedure	Refers to the visual inspection of hydraulic components such as pumps, valves, cylinder, etc.
15.	Hydraulic system and related components testing procedure	Refers to methods and steps in testing for functionality of hydraulic components based on manufacturer's recommendations and standards.
16.	Hydraulic system and related components minor repair and/or replacement procedure	Refers to the correction of trouble by method of changing with new or reconditioned components or parts of the hydraulic system
17.	Hydraulic system and related components performance troubleshooting procedure	Refers to the procedure in locating and correcting defects/ troubles of hydraulic system components
18.	Level	Refers to the category following the level of difficulty and complexity of skills and knowledge required to do the job.
19.	Philippine TVET Qualification Framework	Refers to a comprehensive, nationally consistent framework for qualifications in the TVET sector. It also provides the parameter for the integration of learning and assessment in the middle skills development.
20.	Power train electronic system checking procedure	Refers to the inspection of electronic components used in power train systems.
21.	Power train electronic system testing procedure	Refers to functionality related test to electronic components used in the power train system as per manufacturer's recommendations.

22.	Power train system testing and/or adjusting procedure	Refers to the testing of components to check its functionality based on manufacturer's recommendations.
23.	Power train system and related components checking procedure	Refers to the visual and/or sensory inspection conducted to the power train system and related components.
24.	Power train system troubleshooting procedure	Refers to the methods and steps in locating and correcting defects and troubles to power train components.
25.	Qualification	Refers to the national certificate issued by the TESDA or its accredited industry organizations in recognition that a person has achieved competencies relevant to a trade or industry.
26.	Range of Variable	It describes the circumstances or context in which the work is to be performed.
27.	Repairing	Refers to a corrective action to put back a component or part to operating condition or standard.
28.	Replacing	Is the act of dismounting defective part or component and changing it with a new or repaired/reconditioned part or component
29.	Structure and parts adjustment procedure	Are steps in setting clearances and timings based on manufacturer's standards
30.	Structure and parts troubleshooting procedure	Refers to method and steps in locating troubles from engine lubricating system
31.	Testing	Is an inspection using procedural techniques and/or testing equipment
32.	Troubleshooting	Refers to the process of locating defects and subsequently applying corrective actions.
33.	Unit of Competency	Refers to a discrete aspect of work, which would normally be performed by only one person.
34.	Undercarriage system and related components checking procedure	Refers to the visual inspection conducted on undercarriage components and/or parts for damage.

35.	Undercarriage system measuring procedure	Refers to mensuration and recommended measuring method and/or technique as per manufacturer to determine useful remaining life of the undercarriage components.
36.	Undercarriage system and related components /parts repair and/or replacement procedure	Refers to recommended removal, disassembly/assembly, and installation of new or reconditioned components or parts of the undercarriage based on manufacturer's recommendations.
37.	Undercarriage system testing procedure	Refers to functionality verification by using test methods recommended by the manufacturer.

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