TRAINING REGULATIONS

LAND-BASED TRANSPORT
REFRIGERATION SERVICING NC II

HEATING, VENTILATION, AIR CONDITIONING AND REFRIGERATION

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

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LAND-BASED TRANSPORT REFRIGERATION SERVICING NC II

TRAINING REGULATIONS FOR
LAND-BASED TRANSPORT REFRIGERATION SERVICING NC II

SECTION 1. LAND-BASED TRANSPORT REFRIGERATION SERVICING NC II QUALIFICATION

The **Land-Based Transport Refrigeration Servicing NC II** Qualification consists of competencies that a person must achieve to enable him/her to service, maintain, troubleshoot and repair as well as to start-up, test and commission land-based transport refrigeration systems/units.

This Qualification is packaged from the competency map of **HVAC/R Sector** as shown in Annex A.

The Units of Competency comprising this Qualification include the following:

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

CODE NO.	COMMON COMPETENCIES
HVC713201	Prepare materials and tools
HVC311202	Interpret technical drawings
HVC311201	Observe procedures, specifications and manuals of instructions
HVC311203	Perform mensuration and calculations
HVC713202	Perform basic bench works
HVC724201	Perform basic electrical works
HVC311204	Maintain tools and equipment
HVC315201	Perform housekeeping and safety practices
HVC311205	Document work accomplished

CODE NO.	CORE COMPETENCIES
HVC712304	Service and maintain transport refrigeration units
HVC712305	Troubleshoot and repair transport refrigeration systems
HVC712306	Perform start-up, test and commissioning of transport refrigeration unit

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

- Land-based Transport Refrigeration Mechanic/Serviceman

SECTION 2 COMPETENCY STANDARDS

This section gives the details of the contents of the basic, common and core units of competency required in **Land-Based Transport Refrigeration Servicing 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	REQUIRED KNOWLEDGE	REQUIRED SKILLS
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	• Effective communication • Different modes of communication • Written communication • Organizational policies • Sources of information • Types of question • Medium of communication • Flow of communication • Storage system • Telephone courtesy	• Follow simple spoken language • Performing routine workplace duties following simple written notices • Ability to relate to people of social range in the workplace • Gather and provide information in response to workplace requirements • Listening skills • Questioning skills • Workplace language skills

ELEMENT	PERFORMANCE CRITERIA ***Italicized*** terms are elaborated in the Range of Variables	REQUIRED KNOWLEDGE	REQUIRED SKILLS
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 matters concerning working conditions of employment are asked and responded to according to organizational guidelines 2.6 Meetings outcomes are interpreted and implemented	• Communication procedures and systems • Meeting protocols • Nature of workplace meetings • Barriers of communication • Workplace interactions • Nonverbal communication	• Ability to relate to people of social range in the workplace • Interpersonal communication skill • Observing meeting protocols
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	• Technology relevant to the enterprise and the individual's work • Types of workplace documents and forms • Basic mathematical concepts • Kinds of workplace report	• Apply basic mathematical processes of addition, subtraction, division and multiplication • Data recording • Report writing

RANGE OF VARIABLES

VARIABLES	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. Resource Implications	The following resources should be provided: 2.1. Fax machine 2.2. Telephone 2.3. Writing materials 2.4. Internet
3. Methods of Assessment	Competency in this unit may be assessed through: 3.1. Direct Observation 3.2. Oral interview and written test
4. Context for Assessment	4.1 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	REQUIRED KNOWLEDGE	REQUIRED SKILLS
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	• Team roles • Definition of Team • Difference between team and group • Different sources of information • Objectives and goals of team	• Describing the team role and scope
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	• Team structure • Roles and responsibility of team members • Teams in work environment • Fundamental rights at work including gender sensitivity	• Communicating appropriately, consistent with the culture of the workplace • Identifying individual role and responsibility • Identifying external relationship
1. 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 team work plans based on an understanding of team's role and objectives and individual competencies of the members	• Communication process • Group planning and decision making • Team goals and objectives • Understanding individual competencies relative to teamwork • Types of individuals • Role of leaders	• Interacting effectively with others • Setting team goals and expectations

RANGE OF VARIABLES

VARIABLES	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 judgment 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. Resource Implications	The following resources should be provided: 2.1. Access to relevant workplace or appropriately simulated environment where assessment can take place 2.2. Materials relevant to the proposed activity or tasks
3. Methods of Assessment	Competency in this unit may be assessed through: 3.1. Observation of the individual member in relation to the work activities of the group 3.2. Observation of simulation and or role play involving the participation of individual member to the attainment of organizational goal 3.3. Case studies and scenarios as a basis for discussion of issues and strategies in teamwork
4. Context for Assessment	4.1. Competency may be assessed in workplace or in a simulated workplace setting 4.2. 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	REQUIRED KNOWLEDGE	REQUIRED SKILLS
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 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	• Work values and ethics (Code of Conduct, Code of Ethics, etc.) • Understanding personal objectives • Understanding organizational goals • Difference between intra and interpersonal relationship • Performance evaluation	• Demonstrate Intra and Interpersonal skills at work • Demonstrate personal commitment in work
2. 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	• Company policies • Company operations, procedures and standards • Time management • Basic strategic planning concepts • Resource utilization and management	• Managing goals and time • Practice economic use of resources and facilities • Setting work priorities • Practice time management
3. 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	• Career development opportunities • Company recognition and incentives • Information on relevant licenses and or certifications	• Determining personal career development needs • Identifying career opportunities

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. Resource Implications	The following resources should be provided: 2.1 Workplace or assessment location 2.2 Case studies/scenarios
3. Methods of Assessment	Competency in this unit may be assessed through: 3.1 Portfolio Assessment 3.2 Interview 3.3 Simulation/Role-plays 3.4 Observation 3.5 Third Party Reports 3.6 Exams and Tests
4. Context for Assessment	4.1 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	REQUIRED KNOWLEDGE	REQUIRED SKILLS
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	• OHS procedures and practices and regulations • Hazards/risks identification and control • OHS indicators • Organizational contingency practices	• Hazards/risks identification and control skills • Practice of safety and health procedures and personal hygiene
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	• Threshold Limit Value -TLV • Effects of safety hazards	• Communication skills • Reporting safety hazards
3. Control hazards and risks	3.1 Occupational Health and Safety (OHS) procedures for controlling hazards/risks in workplace are consistently followed	• Personal hygiene practices • Organization safety and health protocol • Company emergency procedure practices	• Practice of personal hygiene • Respond to emergency

ELEMENT	PERFORMANCE CRITERIA ***Italicized*** terms are elaborated in the Range of Variables	REQUIRED KNOWLEDGE	REQUIRED SKILLS
	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		
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	• Workplace OHS personal records • Information on emergency-related drills	• Practice emergency-related drill skills in the workplace

RANGE OF VARIABLES

VARIABLES	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 2.4.1 Psychological factors – over exertion/ excessive force, awkward/static positions, fatigue, direct pressure, varying metabolic cycles 2.4.2 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. Emergency-related drills and training	4.1 Fire drill 4.2 Earthquake drill 4.3 Basic life support/CPR 4.4 First aid 4.5 Spillage control 4.6 Decontamination of chemical and toxic 4.7 Disaster preparedness/management
5. OHS personal records	5.1 Medical/Health records 5.2 Incident reports 5.3 Accident reports 5.4 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. Resource Implications	The following resources should be provided: 2.1 Workplace or assessment location 2.2 OHS personal records 2.3 PPE 2.4 Health records
3. Methods of Assessment	Competency may be assessed through: 3.1 Portfolio Assessment 3.2 Interview 3.3 Case Study/Situation
4. Context for Assessment	Competency may be assessed in the work place or in a simulated work place setting

COMMON COMPETENCIES

UNIT OF COMPETENCY: PREPARE MATERIALS AND TOOLS

UNIT CODE : HVC713201

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

ELEMENT	PERFORMANCE CRITERIA ***Italicized*** terms are elaborated in the Range of Variables	REQUIRED KNOWLEDGE	REQUIRED SKILLS
1. Identify materials	1.1 ***Materials*** are listed as per job requirements 1.2 Quantity and ***description of materials*** conformed to the job requirements 1.3 Tools and accessories are identified according to job requirements	• Types and uses of HVAC/R materials and tools • Different forms for preparation of materials, tools and accessories • Requisition procedures	• Preparing materials and tools • Proper handling of tools and equipment • Following Instructions
2. Request materials and tools	2.1 Materials and tools needed are requested according to the list prepared 2.2 Request is done as per company standard operating procedures 2.3 Substitute materials and tools are provided without sacrificing cost and quality of the work	• Standard procedures in requisition of materials and tools • Listing of different HVAC/R materials and tools • Probable substitute materials	• Preparing requisition slip • Communication skills • Identifying HVAC/R materials and tools
3. Receive and inspect materials and tools	3.1 Materials and tools issued are inspected as per quantity and specification 3.2 Tools, accessories and materials checked for damages according to RAC Code of Practices 3.3 Materials and tools are set aside to appropriate location nearest to the workplace	• Safety requirements in inspection of materials and tools • Standard procedures in checking materials and tools • 5S principles	• Applying safety procedures in the workplace • Preparing materials and tools • Proper handling of tools and equipment • Following Instructions

RANGE OF VARIABLES

VARIABLE	RANGE
1. Materials and tools	1.1 Air-conditioning 1.2 Refrigeration
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 standard operating procedures 1.3 Inspected issued materials and tools as per quantity and job specifications 1.4 Tools provided with appropriate safety devices
2. Resource Implications	The following resources should be provided: 2.1 Workplace location 2.2 Materials relevant to the unit of competency 2.3 Technical plans, drawings and specifications relevant to the activities
3. Methods of Assessment	Competency in this unit must be assessed through: Direct observation and oral questioning
4. Context for Assessment	4.1 Competency may be assessed in the workplace or in a simulated workplace 4.2 Competency assessment must be undertaken in accordance with the endorsed TESDA assessment guidelines

UNIT OF COMPETENCY: INTERPRET TECHNICAL DRAWINGS

UNIT CODE : HVC311202

UNIT DESCRIPTOR : This unit covers the knowledge, skills and attitudes and values needed to prepare/interpret diagrams, engineering abbreviation and drawings, symbols, dimension.

ELEMENT	PERFORMANCE CRITERIA ***Italicized*** terms are elaborated in the Range of Variables	REQUIRED KNOWLEDGE	REQUIRED SKILLS
1. Identify different kinds of technical drawings	1.1. Correct ***technical drawing*** is selected according to job requirements. 1.2. Technical drawings are segregated in accordance with the types and kinds of drawings	• Types of technical drawings • Applications for technical drawing • Methods of technical drawings • Symbols • Mark up/Notation of Drawings	• Reading skills required to interpret work instruction • Interpreting electrical/ electronic/RAC signs and symbols
2. Interpret technical drawing	2.1. Components, assemblies or objects are recognized as required. 2.2. ***Dimensions*** of the key features of the objects depicted in the drawing are correctly identified. 2.3. ***Symbols*** used in the drawing are identified and interpreted correctly. 2.4. Drawing is checked and validated against job requirements or equipment in accordance with standard operating procedures.	• Trade Mathematics o Linear measurement o Dimension o Unit conversion • Blueprint Reading and Plan Specification o Architectural, electrical, electronics, RAC, mechanical plan, symbols and abbreviations o Drawing standard symbols • Trade Theory o Basic technical drawing o Types technical plans o Various types of drawings o Notes and specifications	• Interpreting drawing/ orthographic drawing • Interpreting technical plans • Matching specification details with existing resources • Safety handling of drawing instruments
3. Prepare/make changes to electrical/ electronic/ RAC schematics and drawings	3.1. Electrical/electronic/RAC schematic is drawn and correctly identified. 3.2. Correct drawing is identified, equipment are selected and used in accordance with job requirements.	• Drawing conventions • Dimensioning Conventions • Mathematics o Four fundamental operations o Percentage o Fraction o Algebra o Geometry	• Reading skills required to interpret work instruction • Communication skills • Preparing/ Making electrical/ electronic/ RAC signs and symbols

ELEMENT	PERFORMANCE CRITERIA ***Italicized*** terms are elaborated in the Range of Variables	REQUIRED KNOWLEDGE	REQUIRED SKILLS
			• Computing formulas

4. Store technical drawings and equipment/ instruments	4.1. Care and maintenance of drawings are undertaken according to company procedures.
	4.2. Technical drawings are recorded and inventory is prepared in accordance with company procedures.
	4.3. Proper storage of instruments is undertaken according to company procedures.
		• Effective ways to catalogue and store technical drawings
		• Manual methods of handling, storing and maintaining paper drawings
		• Storing drawing in digital forms
		  ○ Scanner
		  ○ CAD
			• Handling and storing of drawings
			• Scanning and storing drawings in digital form
			• Matching specification details with existing resources
			• Handling of drawing instruments

RANGE OF VARIABLES

VARIABLE	RANGE
1. Technical drawings	Technical drawings include the following but not limited to: 1.1. Schematic diagrams 1.2. Charts 1.3. Block diagrams 1.4. Lay-out plans 1.5. Location plans 1.6. Process and instrumentation diagrams 1.7. Loop diagrams 1.8. System Control Diagrams 1.9. Refrigeration and Air-conditioning control and circuit diagram
2. Dimensions	Dimensions may include but not limited to: 2.1. Length 2.2. Width 2.3. Height 2.4. Diameter 2.5. Angles
3. Symbols	May include but not limited to: 3.1. Architectural 3.2. Electrical 3.3. Electronics 3.4. Refrigeration and Air Conditioning 3.5. Mechanical
4. Instruments/ Equipment	4.1. Components/dividers 4.2. Drawing boards 4.3. Rulers 4.4. T-square 4.5. Calculator

EVIDENCE GUIDE

1. Critical aspect of competencies	Assessment must show that the candidate: 1.1. selected correct technical drawing in line with job requirements 1.2. correctly identified the objects represented in the drawing 1.3. identified and interpreted symbols used in the drawing correctly 1.4. prepared/produced electrical/electronic /RAC drawings including all relevant specifications 1.5. stored diagrams/equipment
2. Method of assessment	Competency in this unit must be assessed through: 2.1. Practical tasks involving interpretation of a range of technical drawings 2.2. Oral questioning
3. Resource implication	3.1. Drawings 3.2. Diagrams 3.3. Charts 3.4. Plans
4. Context of Assessment	Assessment may be conducted in the workplace or in a simulated environment

UNIT OF COMPETENCY: OBSERVE PROCEDURES, SPECIFICATIONS AND MANUALS OF INSTRUCTION

UNIT CODE : HVC311201

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

ELEMENT	*PERFORMANCE CRITERIA* ***Italicized*** terms are elaborated in the Range of Variables	REQUIRED KNOWLEDGE	REQUIRED SKILLS
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 is checked to ensure correct specification and procedure are identified	• Types of manuals used in HVAC/R sector • Identification of symbols used in the manuals	• Identifying manuals and specifications • Accessing information and data
2. Interpret manuals	2.1 Relevant sections, chapters of specifications/ manuals are located in relations to the work to be conducted 2.2 Information and procedure in the manual are interpreted in accordance to industry practices	• Types of manuals used in HVAC/R sector • Types of symbols used in manuals • System of measurements • Unit conversion	• Interpreting symbols and specifications • Accessing information and data • Applying conversion of units of measurements
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 is 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	• Types of manuals used in HVAC/R sector • Types and application of symbols in manuals • Unit conversion	• Applying information from manuals
4. Store manuals	4.1 Manual or specification are stored appropriately to ensure prevention of damage, ready access and updating of information when required in accordance with company requirements	• Types of manuals used in HVAC/R sector • Manual storing and maintaining procedures	• Storing and maintaining manuals

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 to industry practices 1.3 Applied information in manuals according to the given task 1.4 Stored manuals in accordance with company requirements
2. Resource Implications	The following resources should be provided: All manuals/catalogues relative to HVAC/R sector
3. Methods of Assessment	Competency should be assessed through: 3.1 Direct Observation 3.2 Questions/Interview Assessment of required knowledge and practical skills may be combined
4. Context for Assessment	4.1 Competency assessment must be undertaken in accordance with the endorsed TESDA assessment guidelines 4.2 Assessment may be conducted in the workplace or a simulated environment

UNIT OF COMPETENCY: PERFORM MENSURATIONS AND CALCULATIONS

UNIT CODE : HVC311203

UNIT DESCRIPTOR : This unit covers the knowledge, skills and attitudes and values needed identify, care, handle and use measuring instruments

ELEMENT	PERFORMANCE CRITERIA ***Italicized*** terms are elaborated in the Range of Variables	REQUIRED KNOWLEDGE	REQUIRED SKILLS
1. Select measuring instruments	1.1. Object or component to be measured is identified, classified and interpreted to the appropriate regular ***geometric shape*** 1.2. Measuring tools are selected in line with job requirements 1.3. Correct specifications are obtained from relevant source 1.4. Appropriate ***measuring instrument*** is selected to achieve required outcome 1.5. Alternative measuring tools are used without sacrificing cost and quality of work	• Category of measuring instruments • Types and uses of measuring instruments • Shapes and Dimensions • Formulas for volume, areas, perimeters of plane and geometric figures	• Identifying and selecting measuring instruments • Visualizing objects and shapes
2. Carry out measurements and calculation	2.1. Accurate ***measurements and calculations*** are obtained for job 2.2. Calculation needed to complete work tasks are performed using the four basic process of addition (+), subtraction (-), multiplication (x), and division (/) 2.3. Calculation involving fractions, percentages and mixed numbers are used to complete workplace tasks. 2.4. Numerical computation is self-checked and corrected for accuracy 2.5. Instruments are read to the limit of accuracy of the tool. 2.6. Systems of measurement identified and converted according to job requirements/ISO 2.7. Work pieces are measured according to job requirements	• Calculation & measurement • Four fundamental operation • Linear measurement • Dimensions • Unit conversion • Ratio and proportion	• Performing calculation by addition, subtraction, multiplication and division; • Interpreting formulas for volume, areas, perimeters of plane and geometric figures • Handling of measuring instruments

ELEMENT	PERFORMANCE CRITERIA *Italicized* terms are elaborated in the Range of Variables	REQUIRED KNOWLEDGE	REQUIRED SKILLS
3. Maintain measuring instruments	3.1. Measuring instruments are not dropped to avoid damage 3.2. Measuring instruments are cleaned before and after using. 3.3. Proper storage of instruments undertaken according to manufacturer's specifications and standard operating procedures.	• Types of measuring instruments and their uses • Safe handling procedures in using measuring instruments • Four fundamental operation of mathematics • Formula for volume, area, perimeter and other geometric figures	• Handling and maintaining measuring instruments

RANGE OF VARIABLES

VARIABLE	RANGE	
1. Geometric Shape	Including but I 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-ohmmeter 2.16 KWH 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 3.10 Conductance 3.11 Capacitance	3.12 Displacement 3.13 Inside diameter 3.14 Circumference 3.15 Length 3.16 Thickness 3.17 Outside diameter 3.18 Taper 3.19 Out of roundness 3.20 Oil clearance 3.21 End play/thrust clearance

EVIDENCE GUIDE

1. Critical aspect of competency	Assessment must show that the candidate: 1.1. selected proper measuring instruments according to tasks 1.2. carried out measurement and calculations 1.3. maintained and stores instruments
2. Resource implication	2.1. Place of assessment 2.2. Measuring instruments 2.3. Straight edge 2.4. Torque gauge 2.5. Try square 2.6. Protractor 2.7. Combination gauge 2.8. Steel rule
3. Method of assessment	Competency should be assessed through: 3.1 Actual demonstration 3.2 Direct observation 3.3 Written test/questioning related to required knowledge
4. Context of Assessment	Assessment may be conducted in the workplace or in a simulated environment

UNIT OF COMPETENCY: PERFORM BASIC BENCHWORKS

UNIT CODE : HVC713202

UNIT DESCRIPTOR : This unit covers the knowledge, skills and attitudes in preparing materials, tools and equipment, lay-outing dimensions and performing basic benchwork based on the required performance standards.

ELEMENT	PERFORMANCE CRITERIA ***Italicized*** terms are elaborated in the Range of Variables	REQUIRED KNOWLEDGE	REQUIRED SKILLS
1. Prepare materials, tools and equipment	1.1 ***Work plan*** is interpreted to determine job requirements 1.2 ***Materials, tools and equipment*** are identified and prepared according to job requirements 1.3 Materials are checked according to the required specifications 1.4 Tools and equipment conditions are checked following the standard operating procedures (SOPs)	• Communication skills • Materials, tools and equipment; uses and specifications • Material estimation • Mensuration	• Interpretation skills • Handling of tools and materials
2. Lay-out and mark dimensions/ features on workplace	2.1 Metallic and non-metallic materials are selected according to the requirements specified in the blueprint 2.2 ***Dimensions/features*** are laid-out/marked according to job specifications/blueprint and within the required tolerance 2.3 Dimensions are checked against the actual work plan	• Measuring tools; functions and use • Trade mathematics • Mensuration • Calculation • Conversion • Plan specifications • Quality assurance	• Measuring and lay-outing • Blueprint reading • Communication skills
3. Perform required basic metal works	3.1 ***Work instructions are followed*** to ensure work safety 3.2 ***Basic metal works*** are performed applying knowledge on safety procedures and according to job requirements 3.3 Workpieces are clamped in ***workholding device*** to avoid damage and accidents 3.4 Work pieces are cut, chipped or filed according to required measurements, tolerance specified in the	• Tools and equipment: use and specifications • Grinding, cutting, drilling, filing techniques • Basic welding principles and application • Applied occupational health and safety (OH&S)	• Using tools and equipment • Basic metal works skills ○ Grinding ○ Cutting ○ Drilling ○ Filing ○ Threading ○ Reaming ○ Welding • Practice safety skills

ELEMENT	PERFORMANCE CRITERIA ***Italicized*** terms are elaborated in the Range of Variables	REQUIRED KNOWLEDGE	REQUIRED SKILLS
	blueprint and free from burrs and sharp edges 3.5 Drilling is performed according to recommended sequence and specifications 3.6 Proper usage of materials, tools and equipment is observed 3.7 Appropriate ***PPE*** and safety procedures are applied 3.8 Worksite is cleaned and cleared of all debris and left in safe state in accordance with OHS regulations		

RANGE OF VARIABLES

VARIABLE	RANGE
1. Work plan	1.1 Job requirements 1.2 Schedule of work
2. Materials	2.1 Steel brackets 2.2 Grinding disc 2.3 Drill bit 2.4 Flat/angle bars 2.5 Fastening screws 2.6 Masonry
3. Tools and equipment	3.1 Portable grinder 3.2 Hacksaw 3.3 File 3.4 Markers 3.5 Screw drivers 3.6 Ballpen hammer 3.7 L-square/steel square 3.8 Steel rule 3.9 Measuring tools 3.10 PPE 3.11 Portable electric drill 3.12 Bench wire 3.13 Tri-square
4. Metallic materials	4.1 Mild steel plate 4.2 Flat bar 4.3 Square bar 4.4 Angle bar 4.5 Round bar 4.6 G.I. sheet 4.7 B.I. sheet 4.8 Beam

VARIABLE	RANGE
5. Non-metallic materials	5.1 PVC 5.2 Rubber 5.3 Wood 5.4 Fiber glass 5.5 Plastic 5.6 Ceramics
6. Dimensions	6.1 Measurements 6.2 Tolerances
7. Work instructions	7.1 Work plan 7.2 Blueprint 7.3 Manufacturer's specifications
8. Personal Protective Equipment (PPE)	8.1 Safety shoes 8.2 Gloves 8.3 Goggles
9. Basic metal works	9.1 Sheet metal 9.2 Cutting 9.3 Filing 9.4 Drilling 9.5 Arc welding 9.6 Gas welding
10. Workholding device	10.1 Machine vise 10.2 Pliers 10.3 Vise grip
11. Manual	11.1 Procedures manual 11.2 Instructional manual

EVIDENCE GUIDE

1. Critical aspects of competency	Assessment requires that the candidate: 1.1 Interpreted work plan to determine job requirements 1.2 Identified and prepared supplies, materials, tools and equipment in accordance with job requirements 1.3 Selected and used appropriate processes, tools and equipment to carry out task 1.4 Laid-out and checked dimensions in accordance with job requirements and within the tolerances 1.5 Followed work instructions to ensure safety 1.6 Performed benchworks in accordance with job requirements 1.7 Cleaned worksite and left in safe state in accordance with OHSA regulations
2. Resource implications	The following resources should be provided: 2.1 Workplace 2.2 Work plan 2.3 Materials, tools and equipment relevant to the proposed activity/task
3. Methods of assessment	Competency should be assessed through: 3.1 Actual demonstration 3.2 Direct observation 3.3 Written/questioning related to required knowledge
4. Context of assessment	4.1 Competency assessment may occur in workplace or any appropriate simulated environment 4.2 Assessment shall be observed while task are being undertaken whether individually or in group 4.3 Competency assessment must be undertaken in accordance with the endorsed TESDA assessment guidelines

UNIT OF COMPETENCY: PERFORM BASIC ELECTRICAL WORKS

UNIT CODE : HVC724201

UNIT DESCRIPTOR : This unit covers the knowledge, skills and attitudes in preparing materials, tools and equipment, testing electrical components and basic repairing in electricity based on the required performance standards.

ELEMENT	*PERFORMANCE CRITERIA* *Italicized* terms are elaborated in the Range of Variables	REQUIRED KNOWLEDGE	REQUIRED SKILLS
1. Prepare electrical tools and test instruments	1.1 ***Work plan*** is interpreted to determine job requirements 1.2 ***Electrical tools and instruments*** are identified and prepared according to job requirements 1.3 Electrical tools and instruments are checked for conditions and calibrated as required	• Uses of tools and testing instruments • Calibration of testing instruments • Safe handling and proper care of tools and testing instruments	• Interpretation skills • Handling of tools and materials • Calibration skills • Communication skills (oral and written)
2. Test power supply and electrical components	2.1 Instruments are tested in accordance with user's manual 2.2 Power supply and electrical components are checked in accordance with manufacturer's specifications and PEC 2.3 Defects of power supply and electrical components are identified and recorded 2.4 Safe working habits is observed	• Functions and uses of testing instruments • Basic electricity • Electrical safety and hazards • Testing procedures	• Usage of testing instruments • Basic troubleshooting skills • Practice safety skills
3. Perform basic electrical repair	3.1 ***Work instructions*** are followed to ensure safety work 3.2 Loose connections are tightened in accordance with PEC 3.3 Defective electrical components are replaced and tested in accordance with PEC 3.4 Work place is cleaned and in safe state in line with OHSA regulations	• Types of electrical parts and fixtures • Testing procedures • Electrical safety and hazards • Applied occupational health & safety (OH & S) • Electrical joints and splices	• Basic electrical servicing and troubleshooting skills • Wire splicing skills • Practice safety skills

RANGE OF VARIABLES

VARIABLE	RANGE
1. Work plan	1.1 Job requirements 1.2 Schedule of work
2. Materials	2.1 Solid, stranded wire 2.2 Service plug/outlet 2.3 HVAC/R electrical components 2.4 Soldering lead 2.5 Terminal clips 2.6 Moulding 2.7 Fuses 2.8 PVC/Mold flux 2.9 Electrical tape
3. Tools and equipment	3.1 Clamp ammeter 3.2 Multi tester 3.3 Insulation tester 3.4 PPE 3.5 Soldering gun/iron 3.6 Wire stripper 3.7 Measuring tool 3.8 Markers 3.9 Crimping tools 3.10 Screw drivers 3.11 Electrician pliers 3.12 Electric drill 3.13 Long nose
4. Work instructions	4.1 Work plan 4.2 Schematic diagrams 4.3 Installation instruction

EVIDENCE GUIDE

1. Critical aspects of competency	Assessment requires that the candidate: 1.1 Interpreted work plan to determine job requirements 1.2 Selected and used appropriate processes, tools and equipment to carry out task 1.3 Identified electrical tools and instruments are tested in accordance with PEC 1.4 Replaced defective tools and instruments 1.5 Checked power supply and electrical components in accordance with PEC 1.6 Cleaned work place and left in safe state in line with OHSA regulations 1.7 Completed electrical wiring in HVAC/R units based in manufacturer's specifications and PEC 1.8 Communicated effectively to ensure safety works
2. Resource Implications	The following resources should be provided: 2.1 Work place 2.2 Work plan 2.3 Materials, tools and equipment relevant to the proposed activity/task
3. Methods of Assessment	Competency should be assessed through: 3.1 Direct observation 3.2 Written test/questioning relevant to required knowledge
4. Context of Assessment	4.1 Competency assessment may occur in workplace or any appropriate simulated environment 4.2 Assessment shall be observed while task are being undertaken whether individually or in group 4.3 Competency assessment must be undertaken in accordance with the endorsed TESDA assessment guidelines

UNIT OF COMPETENCY: MAINTAIN TOOLS AND EQUIPMENT

UNIT CODE : HVC311205

UNIT DESCRIPTOR : This unit covers the knowledge, skills and attitudes on checking condition, performing preventive maintenance and storing of HVAC/R tools and equipment.

ELEMENT	PERFORMANCE CRITERIA ***Italicized*** terms are elaborated in the Range of Variables	REQUIRED KNOWLEDGE	REQUIRED SKILLS
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	• Safety Practices ○ Use of PPE ○ Handling of tools and equipment ○ Good housekeeping • Materials, Tools and Equipment ○ Types and uses of lubricants ○ Types and uses of cleaning materials ○ Types and uses of HVAC/R tools ○ Types and uses of HVAC/R equipment • Operational conditions of HVAC/R tools and equipment • HVAC/R tools and equipment defects	• Maintaining tools and equipment • Handling of tools and equipment • Identifying tools and equipment defects
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	• Safety Practices ○ Use of PPE ○ Handling of tools and equipment ○ Good housekeeping • Materials, Tools and Equipment ○ Types and uses of lubricants ○ Types and uses of cleaning materials • Preventive Maintenance ○ Methods and techniques ○ Procedures	• Handling of tools and equipment • Performing preventive maintenance

ELEMENT	PERFORMANCE CRITERIA ***Italicized*** terms are elaborated in the Range of Variables	REQUIRED KNOWLEDGE	REQUIRED SKILLS
	2.7 Work place is cleaned and kept in safe state in line with Occupational Safety and Health Standards (OSHS)		
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	• Safety Practices o Use of PPE o Handling of tools and equipment o Storing procedures and techniques o Storage conditions/ locations	• Storing tools and equipment • Handling of tools and equipment

RANGE OF VARIABLES

VARIABLE	RANGE
1. Materials	May include: 1.1 Lubricants 1.2 Cleaning materials 1.3 Rust remover 1.4 Rugs 1.5 Spare parts
2. Tools and equipment	May include: 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	May include: 3.1 Goggles 3.2 Gloves 3.3 Safety shoes 3.4 Aprons/Coveralls
4. Forms	May include: 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 instrument 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 OSHS 1.8 Stored tools and equipment safely in appropriate locations and in accordance with company practices
2. Resource implications	The following resources should be provided: 2.1 Workplace 2.2 Maintenance schedule 2.3 Maintenance materials, tools and equipment relevant to the proposed activity/task
3. Methods of assessment	Competency should be assessed through: 3.1 Direct observation 3.2 Written test/questioning relevant to Underpinning knowledge
4. Context of assessment	4.1 Competency assessment may occur in workplace or any appropriate simulated environment 4.2 Competency assessment must be undertaken in accordance with the endorsed TESDA assessment guidelines

UNIT OF COMPETENCY : PERFORM HOUSEKEEPING AND SAFETY PRACTICES FOR RAC SERVICING

UNIT CODE : HVC7315201

UNIT DESCRIPTOR : This unit covers the knowledge, skills and attitudes needed to work safely in the workplace including sorting, cleaning and dispensing materials, tools and equipment, identifying and minimizing hazards, responding and recording accidents and following basic security.

ELEMENT	PERFORMANCE CRITERIA ***Italicized*** terms are elaborated in the Range of Variables	REQUIRED KNOWLEDGE	REQUIRED SKILLS
1. Sort materials, tools and equipment	1.1 Materials, tools and equipment are classified according to its kinds 1.2 Appropriate areas for materials, tools and equipment are designated	• Classification of tools, equipment and materials • Selection of appropriate areas for storing materials, tools and equipment • Sorting procedures and considerations • 5S principles	• Applying 5S (sorting) • Identifying tools and materials
2. Clean workplace area, materials, tools and equipment	2.1 Cleaning materials are identified and used as per procedure 2.2 Workplace areas, materials, tools and equipment are cleaned as per company practices 2.3 Workplace are in safe state in accordance with safety regulations/ company practices	• Cleaning materials, types and applications. • Procedures in cleaning workplace area, tools and equipment. • Consideration of a safe workplace area, tools and equipment	• Applying 5S (cleaning)
3. Systematize dispensing and retrieval of materials, tools and equipment	3.1 Systems for requesting, borrowing and returning of materials, tools and equipment is in-place and implemented 3.2 Forms used are completely filled-up and filed 3.3 Borrowed tools, and equipment are returned to designated area 3.4 Consumable materials are requested in exact quantity	• Procedures in dispensing and retrieval of materials; tools, and equipment • Things to be considered in returning the borrowed tools and equipment.	• Applying 5S (systematize) • documentation skills
4. Identify and minimize/ eliminate hazards	4.1 ***Hazards*** in the work area are recognized and reported to designated personnel and appropriate control actions are taken 4.2 Workplace policies and procedures for controlling risks	• Composition of safety committee • Policies and procedures in controlling risk • Safety signs and first aid	• Hazard identification skills • Practice safety skills

ELEMENT	PERFORMANCE CRITERIA ***Italicized*** terms are elaborated in the Range of Variables	REQUIRED KNOWLEDGE	REQUIRED SKILLS
	are established and followed accurately 4.3 Workplace procedures for dealing with ***emergencies*** are followed whenever necessary within the scope of responsibilities and competencies 4.4 ***Safety signs and hazard warnings*** are displayed and observed at all times in line with workplace health and safety regulations 4.5 Equipment and safety devices***/PPE*** are used/ handled according to company or manufacturer's procedures and guidelines 4.6 Work areas are kept clean, free from obstacles and emergency exits are known and kept clear at all times 4.7 Safe manual handling/ fighting techniques and safe equipment operation techniques are employed at all times	• Safety signs and hazards warning preparation • Equipment and safety devices • Safe handling technique in using equipment and safe devices.	
5. Respond and record accidents	5.1 Workplace accidents are identified 5.2 Workplace emergency ***first-aid procedures/ treatment*** are followed/ carried out correctly in accordance with ***standards/regulations*** and RAC Code of Practices/policies 5.3 Medical assistance/ rescue is coordinated with concerned personnel in line with organizational policies 5.4 Accident/incident records maintained in accordance with standard operating procedures	• Types of accidents • Procedures in applying first aid/ treatment • First aid supplies • Steps in responding to and recording accidents	• First aid application skills • Coordination skills • Documentation skills
6. Follow basic security	6.1 ***Security policies***/ procedures are followed according to enterprise practices and appropriate legislation 6.2 Security related events are recorded/reported on the relevant forms 6.3 Staff are advised of enterprise security procedures and correct methods of implementation	• Basic security procedures • Security signs and symbols • Loss control management ○ Hazards ○ Safety signs	• Coordination skills • Reporting skills • Documentation skills • Practice safety skills

RANGE OF VARIABLES

VARIABLE	RANGE
1. Hazards	Hazards that may be present in the workplace include but not limited to: 1.1 Flammable materials 1.2 Running machinery/equipment 1.3 Toxic substances 1.4 Debris 1.5 Open flames 1.6 Loose objects/fixtures 1.7 Chemicals 1.8 Electrical faults 1.9 Hot metals
2. Emergencies	Emergencies may include but not limited to: 2.1 Fire 2.2 Explosion 2.3 Spills 2.4 Falls 2.5 Electrocution 2.6 Injuries caused by falling objects 2.7 Injuries caused by sharp objects 2.8 Injuries caused by wrong usage of tools
3. Safety signs, symbols and hazard warnings	Safety signs and symbols include but not limited to: 3.1 Industry recognized hazard warning signs and safety symbols 3.1.1 Danger-High Voltage 3.1.2 Unauthorized Persons Keep Out 3.1.3 No Smoking 3.1.4 Poisonous Gases 3.1.5 Caution - Men working on line wires 3.2 Internationally recognized hazard warning signs and safety symbols
4. Personal Protective Equipment (PPE)	PPE may include but not limited to: 4.1 Goggles 4.2 Gas mask 4.3 Working gloves 4.4 Safety shoes 4.5 Face shield 4.6 Insulating mat 4.7 Over-all apron 4.8 Hard hat 4.9 Safety belt 4.10 Protective eyewear

VARIABLE	RANGE
5. First-aid Treatment	First-aid treatment includes but is not limited to: 5.1 CPR 5.2 Mouth to mouth resuscitation 5.3 Application of tourniquet 5.4 Application of pressure to bleeding wounds or cuts 5.5 First-aid treatment for burned victims
6. Standards and Regulations	6.1 RAC Code of Practice 6.2 Philippine Electrical Code 6.3 Philippine OH&S Standards 6.4 Building Code 6.5 Philippine Environmental Standards 6.6 Welding Procedures Specifications 6.7 Clean Air Act
7. Security policies	7.1 Wearing of ID 7.2 Logging-in and out 7.3 Wearing of uniform 7.4 Observance of safety/security signs and symbols

EVIDENCE GUIDE

1. Critical aspects of Competency	Assessment requires that the candidate: 1.1 Classified materials, tools and equipment according to kind 1.2 Cleaned workplace areas, materials, tools and equipment as per standard procedures 1.3 Implemented systematize dispensing and retrieval of materials, tools and equipment 1.4 Identified and described safety working practices relating to all tasks undertaken in the workplace 1.5 Identified and selected appropriate equipment and safety devices for particular workplace tasks and activities 1.6 Interpreted hazard warnings and safety signs correctly and described the application of these warnings and signs in the work activities 1.7 Carried out workplace emergency first-aid procedures/ treatment are in accordance with OHSA standards/ legislation and RAC Code of Practices 1.8 Responded/maintained accidents/incidents records in accordance with SOPs 1.9 Followed security procedures/policies in accordance with enterprise practices and legislation 1.10 Kept workplace in safe state in accordance with safety Regulations
2. Resource Implications	The following resources should be provided: 2.1 Work place 2.2 Materials, tools and equipment relevant to the proposed activity/task 2.3 Safety signs 2.4 Safety devices 2.5 Accident reporting procedures 2.6 First-aid materials and guidelines
3. Methods of Assessment	Competency should be assessed through: 3.1 Direct observation while task is being undertaken 3.2 Written test/questioning relevant to required knowledge Assessment of required knowledge and practical skills may be combined
4. Context for Assessment	4.1 Competency assessment may occur in workplace or any appropriate simulated environment 4.2 Assessment shall be observed while task are being undertaken whether individually or in group in accordance with the approved industry OHSA regulations 4.3 Competency assessment must be undertaken in accordance with the endorsed TESDA assessment guidelines

UNIT OF COMPETENCY : DOCUMENT WORK ACCOMPLISHED

UNIT CODE : HVC311205

UNIT DESCRIPTOR : This unit covers the knowledge, skills and attitudes in documenting work accomplished.

ELEMENT	PERFORMANCE CRITERIA ***Italicized*** terms are elaborated in the Range of Variables	REQUIRED KNOWLEDGE	REQUIRED SKILLS
1. Identify forms and data	1.1 ***Forms*** are selected based on the reports to be prepared 1.2 ***Data*** are collected based on the reports to be prepared	• Selecting and interpreting forms • Interpreting work accomplished • Data gathering techniques	• Documentation skills • Interpretation skills • Data gathering skills
2. Prepare reports	2.1 ***Reports*** are completed using standard form as per company procedures 2.2 Reports provide details of work completed, further action to be taken and other details as per company procedures 2.3 Reports are completed and submitted within specified time to the concerned personnel/supervisor	• Details of work completion • Kinds of reports • Preparation of reports	• Documentation skills • Report preparation skills

RANGE OF VARIABLES

VARIABLE	RANGE
1. Forms	1.1 Warranty Paper Request 1.2 Operating Log Sheet 1.3 Requisition Forms
2. Data	2.1 Current draw 2.2 Operating 2.3 Unit specifications 2.4 Records of work accomplished 2.5 Further work required 2.6 Spare parts used
3. Reports	3.1 Start-up commissioning Report 3.2 Warranty Paper Request 3.3 Turn-over Report 3.4 Operating Log Sheet 3.5 Service Report 3.6 Trouble Call Report 3.7 Requisition

EVIDENCE GUIDE

1. Critical aspects of Competency	Competency requires evidence that the candidate: 1.1 Prepared reports used terminology and language appropriate to all users 1.2 Prepared reports to include alternatives, views, approaches and other findings and recommendations for consideration by the supervisor 1.3 Prepared reports are coherent and based on actual findings/analysis/results 1.4 Prepared reports are accomplished, completed as per standard format and submitted within specified time to the concerned supervisor
2. Resource Implications	Things necessary to conduct method of assessment: 2.1 Work place location 2.2 Materials relevant to the proposed activity
3. Methods of Assessment	Competency in this unit must be assessed through: 3.1. Direct observation 3.2. Questions related to required knowledge
4. Context for Assessment	Competency may be assessed in the work place or in a simulated work place setting

CORE COMPETENCIES

UNIT OF COMPETENCY : SERVICE AND MAINTAIN TRANSPORT REFRIGERATION UNITS

UNIT CODE : HVC712304

UNIT DESCRIPTOR : This unit covers the knowledge, skills and attitudes required to service and maintain transport refrigeration units of trucks and vans. This includes preparing for maintenance activities, checking and adjusting accessories, controls and operating conditions as well as maintaining lubrication, refrigeration system and air distribution systems.

LEMENT	PERFORMANCE CRITERIA ***Italicized*** fonts are elaborated in the Range of Variables	REQUIRED KNOWLEDGE	REQUIRED SKILLS
1. Prepare for maintenance activities	1.1. ***Work instructions*** are read interpreted to determine job requirements 1.2. Appropriate manufacturer's manual is consulted if available; otherwise, RAC Code of Practice and/or enterprise maintenance policy procedures are adopted. 1.3. Tools and equipment are selected in accordance with job requirements 1.4. Work safety is observed according to established operating standards	• Types of maintenance works • Understanding of work/job order • Proper maintenance of tools, equipment and instruments • Understanding RAC code of practice • Understanding maintenance manufacturer's manual • Safety practices • Housekeeping	• Preparing maintenance activities • Applying safety practices • Interpreting safety signs and symbols • Interpreting work instructions
2. Check and adjust transport refrigeration accessories, controls and operating conditions	2.1 ***Operation/Controls/ Settings*** are checked and adjusted in accordance with manufacturer's specifications. 2.2 ***Transport refrigeration accessories*** are adjusted accordingly based on manufacturer's maintenance manual. 2.3 Maintenance procedures are applied according to manufacturer's maintenance manual	• Operation of transport refrigeration system • Accessories, controls and setting of transport refrigeration system • Familiarization on functions of controls and accessories • Understanding RAC code of practice • Understanding maintenance manufacturer's manual • Housekeeping	• Operating transport refrigeration unit • Identifying functions of controls and accessories • Checking, adjusting and setting of controls • Applying safety procedure in setting and adjusting of controls and accessories

LEMENT	PERFORMANCE CRITERIA ***Italicized*** fonts are elaborated in the Range of Variables	REQUIRED KNOWLEDGE	REQUIRED SKILLS
3. Maintain lubrication system in transport refrigeration	3.1. Maintenance record is checked and verified based on established maintenance procedures 3.2. Lubrication system variables and components are checked and adjusted based on manufacturer's maintenance manual 3.3. ***Oil parameters*** are checked and adjusted based on manufacturer's specifications 3.4. Oil leaks and restrictions are detected and rectified based on manufacturer's maintenance manual 3.5. Used oil is disposed properly according to RAC Code of Practice.	• Types of refrigeration oil • Refrigeration lubrication system • Oil failure switches and controls • Regulations on oil disposal • Safety in handling oil and lubricants • Housekeeping	• Identifying refrigeration oil • Adding removing oil to a system • Adjusting and setting oil pressure controls • Disposal of used oil • Apply safety in handling oil and lubricants • Performing housekeeping
4. Maintain refrigeration system in transport refrigeration	4.1 Maintenance record is checked and verified based on established maintenance procedures 4.2 Evaporator/condenser coils are cleaned in accordance with manufacturer's maintenance manual. 4.3 Refrigerant piping and fittings are checked for ***abnormal condition***s based on procedure. 4.4 ***Operating parameters*** are measured and analyzed based on manufacturer's standards and/or RAC Code of Practice. 4.5 Pressure and temperature drops are checked and recorded based on manufacturer's maintenance manual and/or RAC Code of Practice 4.6 Leak testing is performed based on RAC Code of Practice. 4.7 ***Transport refrigeration components, accessories and consumables*** are checked for contaminants in accordance manufacturer's manual or RAC Code of	• Types of evaporators • Parts and functions of evaporator and condenser assembly • Parts and functions of components and accessories • Contaminants • Tube processing operation • Compressor assembly and functions • Proper belt tension and alignment • Types of belts • Reading and use of measuring instruments • Refrigerant leakage • Housekeeping	• Assembling and disassembling evaporator and condenser assembly • Checking and cleaning of evaporator and condenser fins • Checking and cleaning components and accessories • Removing contaminants • Flaring, swaging, cutting • Measuring operating parameters • Checking procedures of magnetic clutch • Adjusting and aligning of belts and pulley • Locating leakage on

LEMENT	PERFORMANCE CRITERIA ***Italicized*** fonts are elaborated in the Range of Variables	REQUIRED KNOWLEDGE	REQUIRED SKILLS
	Practice.		tubing and fittings • Safe procedures in servicing compressor, pulley, belts, tubing and fittings • Performing housekeeping
5. Maintain air distribution system in transport refrigeration	5.1 Maintenance record is checked and verified based on established maintenance procedures 5.2 ***Air distribution system*** components are checked and ensure air flows are free from restrictions based on manufacturer's instructions. 5.3 Outdoor air supply systems are checked and maintained to meet operational and regulatory requirements.	• Fan motor assembly • Understanding schematic diagram • Different defects of fan motor and blower • Methods of maintaining fan motors and blowers • Housekeeping	• Interpreting schematic diagram • Disassembling and assembling fan motor and blower • Determining defects of fan motors and blower • Cleaning and oiling fan motors • Performing housekeeping

RANGE OF VARIABLES

VARIABLE	RANGE
1. Work instructions	May include: 1.1 Work permits 1.2 Job orders 1.3 Blueprints/Diagrams 1.4 Tools and materials requisition form/s
2. Operation/Controls/Settings	May include: 2.1 Pressures 2.2 Temperatures 2.3 Voltages 2.4 Current draws 2.5 Air flow 2.6 Noise level 2.7 Vibrations 2.8 Motor RPM 2.9 Frequency
4. Transport refrigeration accessories	May include but not limited to: 4.1 Pressure switch 4.2 Temperature control 4.3 Pulley alignment/belt tension 4.4 Unloader 4.5 Fan blades/blower 4.6 Motors 4.7 Defrost heater 4.8 Defrost timer 4.9 Crankcase heater 4.10 Solenoid valve 4.11 Oil failure switch
5. Oil parameters	May include: 5.1 Oil levels 5.2 Oil properties 5.3 Purity of oil 5.4 Oil viscosity
6 Abnormal conditions	May include: 6.1 leaks 6.2 insulation cracks 6.3 looseness of supports/brackets/fittings 6.4 vibrations 6.5 kinks

7 Operating parameters	May include but not limited to: 7.1 Operating temperature 7.2 Superheat 7.3 Pressure 7.4 Oil level 7.5 voltage 7.6 current 7.7 air velocity 7.8 sound level and vibration
8 Transport refrigeration components, accessories and consumables	May include but not limited to: 8.1 Components: 8.1.1 Expansion valves 8.1.2 Solenoid valves 8.1.3 Evaporator 8.1.4 Compressor 8.1.5 Condenser 8.2 Accessories 8.2.1 Filter drier/ strainer 8.2.2 Sight glass 8.2.3 Oil separator 8.2.4 accumulator 8.2.5 liquid receiver 8.3 Consumables 8.3.1 Oil 8.3.2 Refrigerant 8.3.3 Filter drier/ strainer
9 Air distribution system	May include: 9.1 Grilles 9.2 Louvers 9.3 Evaporator fan motor and blower 9.4 Condenser fan motor

EVIDENCE GUIDE

1 Critical aspects of competency	Assessment requires evidence that the candidate: 1.1 Prepared for maintenance activities. 1.2 Checked and adjusted transport refrigeration equipment accessories, controls and operating conditions 1.3 Applied maintenance procedures according to manufacturer's maintenance manual. 1.4 Checked and maintained lubrication system in transport refrigeration. 1.5 Checked and maintained refrigeration system in transport refrigeration. 1.6 Checked and maintained air distribution system in transport refrigeration.
2 Resource Implications	The following resources **MUST** be provided: 2.1 Work place location 2.2 Tools and equipment appropriate to maintaining transport refrigeration processes 2.3 Materials relevant to the activity 2.4 Drawings and specifications relevant to the task
3 Methods of Assessment	Competency must be assessed through: 3.1 Demonstration with oral questioning 3.2 Observation with oral questioning
4 Context for Assessment	Competency may be assessed in the work place or in a simulated work place setting

UNIT OF COMPETENCY: TROUBLESHOOT AND REPAIR TRANSPORT REFRIGERATION SYSTEMS

UNIT CODE : HVC712305

UNIT DESCRIPTOR : This unit covers the knowledge, skills and attitudes in troubleshooting and repairing transport refrigeration systems for trucks and vans. This includes planning and preparing for troubleshooting and repair, identifying and repairing faults/ troubles, performing refrigerant recovery/recycling and retrofitting/conversion on transport refrigeration unit as well as test-running the repaired unit.

ELEMENT	PERFORMANCE CRITERIA ***Italicized*** fonts are elaborated in the Range of Variables	REQUIRED KNOWLEDGE	REQUIRED SKILLS
1. Plan and prepare for troubleshooting and repair	1.1 Appropriate wiring diagrams, charts and manuals are interpreted in line with the job requirements 1.2 Appropriate materials, tools and equipment are selected based on job requirements 1.3 Work safety is observed according to established operating standards	• Schematic and pictorial diagrams of transport refrigeration o Electrical o Mechanical • Manufacturer's manual for transport refrigeration equipment • Appropriate materials, tools and equipment for troubleshooting and repair	• Interpreting schematic diagram • Preparing materials, tools and equipment • Planning skills
2. Identify and repair faults/ troubles	2.1. Appropriate ***PPE*** are selected and used in line with job requirements 2.2. ***Components*** are ***tested*** following manufacturer's manual or RAC Code of Practice 2.3. Faults/problems with components are diagnosed in line with manufacturer's manual or RAC Code of Practice 2.4. Remedial action is taken to overcome faults/problems in line manufacturer's manual or RAC Code of Practice 2.5. Work is completed safely in line with workplace safety guidelines 2.6. Report on testing procedure, including faults and minor repair, is completed in line with manufacturer's manual	• Safety procedures in troubleshooting and repairing • Troubleshooting and repair techniques • Functions and testing procedures of refrigeration parts and accessories • Processes in fault finding • Understanding service manuals • Familiarization with RAC Code of Practice • Service manuals & service report forms	• Applying safety procedure in troubleshooting and repair • Use of appropriate testing instrument • Selection of components and replacement • Applying troubleshooting and repair techniques • Preparing service report and documentation

ELEMENT	PERFORMANCE CRITERIA ***Italicized*** fonts are elaborated in the Range of Variables	REQUIRED KNOWLEDGE	REQUIRED SKILLS
	or RAC Code of Practice		
3. Perform refrigerant recovery/ recycling and retrofitting/ conversion on transport refrigeration unit	3.1 Safe working practices are observed throughout the task as per RAC Code of Practice 3.2 Suitable tools and equipment are selected and used based on job requirement 3.3 ***Refrigerants*** recovery/ recycling is performed according to manufacturer's recommendations and RAC Code of Practice 3.4 Retrofitting is performed based on RAC Code of Practice 3.5 Conversion is performed based on RAC Code of Practice Conversion Manual.	• Identification of refrigerants • Characteristics of refrigerants • Effects of refrigerants in the ozone layer and climate • Types of recovery machine • Methods of recovery/recycling of refrigerants • Evacuation procedures • Pressure/leak testing procedure • Familiarization with RAC Code of Practice • Retrofitting procedure • Conversion procedure • Charging procedure • Leak testing methods • Alternative refrigerants • Housekeeping	• Following procedures in identifying refrigerants • Performing recovery/ recycling of refrigerants • Safe handling of refrigerants • Performing evacuation procedure • Performing charging procedure • Performing pressure/ leak testing procedure • Performing retrofitting procedure • Performing conversion procedures • Identifying alternative refrigerants
4. Test-run repaired unit	4.1. Electrical and mechanical components of repaired unit are checked prior to test run 4.2. Operating parameters are checked and monitored in line with manufacturer's testing procedures 4.3. Report on repair and testing of unit is prepared in line with RAC Code of Practice or established standards procedures	• Manufacturer's testing procedures • Operating parameters • Point of location for parameter reading • Safety standards in testing repaired unit • Service report forms	4.1 Applying procedures and techniques in testing repaired units • Interpreting parameter readings • Applying safety standards • Filling up of service reports forms

RANGE OF VARIABLES

VARIABLE	RANGE
1. PPE	Includes but not limited to: 1.1. Mask 1.2. Safety shoes 1.3. Safety goggles 1.4. Working apparel 1.5. Gloves
2. Components	May include but not limited to: 2.1. Switches 2.1.1 On/Off switches 2.1.2 Change-over switches 2.1.3 Temperature selector 2.2. Thermostat 2.2.1 Mechanical 2.2.2 Electrical/Electronics 2.3. Pressure switch/sensor 2.4. Relay 2.5. Damper motors 2.6. Compressor motor 2.7. Fan motors
3. Testing	May include: 3.1. Insulation 3.2. Resistance 3.3. Mechanical 3.4. Continuity 3.5. Timing Sequence 3.6. Pressure 3.7. Temperature 3.8. Leak
4. Refrigerants	May include: 4.1 Hydrochlorofluorocarbon (HCFC) 4.2 Hydrofluorocarbon (HFC) 4.3 Hydrocarbon (HC)

EVIDENCE GUIDE

1. Critical aspects of competency	Assessment requires evidence that the candidate: 1.1 Planned and prepared for troubleshooting and repair 1.2 Identified and repaired faults/troubles 1.3 Performed refrigerant recovery/recycling and retrofitting/ conversion on transport refrigeration unit 1.4 Tested-run repaired unit
4. Resource Implications	The following resources must be provided: 2.1 access to work place location and mockup unit 2.2 Tools and equipment appropriate to troubleshooting and repair 2.3 Materials relevant to the proposed activity 2.4 Drawings and specifications relevant to the task
5. Methods of Assessment	Competency must be assessed through: 3.1 Demonstration with oral questioning 3.2 Direct observation with oral questioning
6. Context for Assessment	Competency may be assessed in the work place or in a simulated work place setting

UNIT OF COMPETENCY: PERFORM START-UP, TEST AND COMMISSIONING OF TRANSPORT REFRIGERATION UNIT

UNIT CODE : HVC712306

UNIT DESCRIPTOR : This unit covers the knowledge, skills and attitudes to perform start-up, testing and commissioning of transport refrigeration unit for trucks and vans. This includes preparing for start-up, test and commissioning of transport refrigeration unit, conducting start-up, test and commissioning of transport refrigeration unit,

ELEMENT	PERFORMANCE CRITERIA ***Italicized*** fonts are elaborated in the Range of Variables	REQUIRED KNOWLEDGE	REQUIRED SKILLS
1. Prepare for start-up, test and commissioning of transport refrigeration unit	1.1. Work instructions are read and interpreted to determine job requirements 1.2. Tools and equipment are selected in accordance with job requirements 1.3. Pre-start-up, testing and commissioning checks are completed and complied with manufacturer's manuals. 1.4. Commissioning method, procedures and recording sheets are prepared in accordance with manufacturer's manuals. 1.5. PPEs are selected in line with job requirements	• Safety signs and symbols • Forms: o work instruction sheet o job order sheet o data sheet o manufacturer's manual • Tools and testing instruments • Personal protective equipment	• Interpret work instructions • Selection of forms for commissioning • Selection and safe handling of tools and testing instruments • selection of proper personal protective equipment
2. Conduct start-up, test and commissioning of transport refrigeration unit	2.1 ***Electrical related checks*** are performed based on manufacturer's manuals. 2.2 ***Refrigerant piping and fitting connection related checks*** are performed based on manufacturer's manuals. 2.3 ***Compressor unit related checks*** are performed based on	• Basic electricity • Operation of generator • Electrical control test procedures • Interlocking control sequence • Fundamentals of piping • Compressor test procedures • Power supply test procedures	• Performing electrical related testing • Performing pipe and tubing leak testing • Performing compressor tests • Performing evaporator/ condenser motor and blower test • Performing

ELEMENT	PERFORMANCE CRITERIA ***Italicized*** fonts are elaborated in the Range of Variables	REQUIRED KNOWLEDGE	REQUIRED SKILLS
	manufacturer's manuals. 2.4 Temperature and airflow check is performed based on manufacturer's manual 2.5 ***Control panel related checks*** are performed based on manufacturer's manuals 2.6 Sensing bulb and sensors are checked for correct position based on manufacturer's manuals 2.7 System operating pressure and temperature are checked in accordance with manufacturer's manual 2.8 Start-up, testing and commissioning reports are accomplished in line with enterprise policies and procedures.	• Condenser/ evaporator motor and blower test procedures • expansion valve test procedures • Leak testing procedure • Refrigerant type test procedure • Start-up and commissioning forms	expansion valve test • Performing identification of refrigerants • Filling-up of start-up and commissioning reports

RANGE OF VARIABLES

VARIABLE	RANGE
1. Electrical related checks	This includes: 1.1 Power supply source checks 1.2 Safety and circuit protection checks 1.3 Wiring insulations checks 1.4 Grounding and short circuit checks
2. Refrigerant piping and fitting connection related checks	May include: 2.1 Leak testing 2.2 Pipe insulation inspection 2.3 Pipe and fittings inspection 2.4 Clamps and brackets inspection
3. Compressor unit related checks	May include: 3.1 Belt tension and pulley alignment 3.2 Terminal connection inspection 3.3 Mounting and alignment inspection
4. Control panel related checks	May include but not limited to: 4.1 main switch 4.2 Control switch (on/off) 4.3 indicator lights 4.4 temperature display indicator 4.5 fuse, relays and sockets/connectors 4.6 meter indicators 4.7 wire harness

EVIDENCE GUIDE

1. Critical aspects of competency	Assessment requires evidence that the candidate: 1.1 Prepared for start-up, testing and commissioning of transport refrigeration unit 1.2 Conducted start-up, testing and commissioning of transport refrigeration unit
2. Resource Implications	The following resources **MUST** be provided: 2.1 Work place location 2.2 Tools and equipment appropriate in performing start-up, testing and commissioning refrigeration and air-conditioning systems 2.3 Materials relevant to the proposed activity 2.4 Drawings and specifications relevant to the task
3. Methods of Assessment	Competency must be assessed through: 3.1. Demonstration with oral questioning 3.2. Direct observation with oral questioning
4. Context for Assessment	Competency may be assessed in the work place or in a simulated work place setting

SECTION 3 TRAINING ARRANGEMENTS

These guidelines 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 Land-Based Transport Refrigeration NC II.

This includes information on curriculum design; training delivery; trainee entry requirements; tools and equipment; training facilities; and trainer's qualification and institutional assessment.

3.1 CURRICULUM DESIGN

TESDA shall provide the training on the development of competency-based curricula to enable training providers develop their own curricula with the components mentioned below.

Delivery of knowledge requirements for the basic, common and core units of competency specifically in the areas of mathematics, science/technology, communication/language and other academic subjects shall be contextualized. To this end, TVET providers shall develop a Contextual Learning Matrix (CLM) to accompany their curricula.

Course Title: **LAND-BASED TRANSPORT REFRIGERATION SERVICING** NC Level: **NC II**

Nominal Training Duration:
18 Hours (Basic)
34 Hours (Common)
488 Hours (Core)
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540 Hour - Total training duration

Course Description:

This course is designed to equip individual with operational skills in transport refrigeration servicing which covers the basic and common competencies in addition to the core competencies such as servicing and maintaining transport refrigeration unit, troubleshooting and repairing transport refrigeration systems as well as performing testing and commissioning for transport refrigeration systems.

To obtain this, all units prescribed for this qualification must be achieved:

BASIC COMPETENCIES

(18 hours)

Unit of Competency	Learning Outcomes	Learning Activities	Methodology	Assessment Approach	Nominal Duration
1. Participate in workplace communication	1.1 Obtain and convey workplace information	• Describe Organizational policies	• Group discussion	• Oral evaluation	1 Hour
		Read: o Effective communication o Written communication o Communication procedures and systems • Identify: o Different modes of communication o Medium of communication o Flow of communication o Available technology relevant to the enterprise and the individual's work responsibilities	• Lecture	• Written examination	
		• Prepare different Types of question • Gather different sources of information • Apply storage system in establishing workplace information • Demonstrate Telephone courtesy	• Demonstration	• Observation	
	1.2 Complete relevant work related documents	• Describe Communication procedures and systems	• Group discussion	• Oral evaluation	2 Hours
		• Read: o Meeting protocols o Nature of workplace meetings o Workplace interactions o Barriers of communication	• Lecture	• Written examination	

Unit of Competency	Learning Outcomes	Learning Activities	Methodology	Assessment Approach	Nominal Duration
		• Complete work related documents	• Demonstration	• Observation	
		• Read instructions on work related forms/documents	• Lecture	• Written examination	
		• Practice: ○ Estimate, calculate and record routine workplace measures ○ Basic mathematical processes of addition, subtraction, division and multiplication	• Demonstration	• Observation	
		• Demonstrate office activities in: ○ workplace meetings and discussions scenario • Perform workplace duties scenario following simple written notices	• Role play	• Oral evaluation • Observation	
		• Follow simple spoken language	• Demonstration	• Observation	
		• Identify the different Non-verbal communication	• Lecture	• Written examination	
		• Demonstrate ability to relate to people of social range in the workplace	• Demonstration	• Observation	
		• Gather and provide information in response to workplace requirements	• Demonstration	• Observation	
	1.3 Participate in workplace meeting and discussion	• Identify: ○ types of workplace documents and forms ○ kinds of workplace report ○ Available technology relevant to the enterprise and the individual's work responsibilities • Read and follow instructions in applying basic mathematical concepts	• Lecture	• Written examination	1 Hour

Unit of Competency	Learning Outcomes	Learning Activities	Methodology	Assessment Approach	Nominal Duration
		• Follow simple spoken language • Demonstrate ability to relate to people of social range in the workplace • Gather and provide information in response to workplace requirements	• Demonstration	• Observation	
2. Work in a team environment	2.1 Describe and identify team role and responsibility in a team.	• Describe the team role and scope	• Group discussion	• Oral evaluation	2 Hours
		• Read ○ Definition of Team ○ Difference between team and group ○ Objectives and goals of team • Identify different sources of information	• Lecture	• Written examination	
	2.2 Describe work as a team	• Describe team goals and objectives	• Group discussion	• Oral evaluation	2 Hours
		• Perform exercises in setting team goals and expectations scenario	• Role play	• Oral evaluation • Observation	
		• Identify individual role and responsibility	• Lecture	• Written examination	
		• Practice Interacting effectively with others	• Group discussion	• Oral evaluation	
		• Read: ○ Fundamental rights at work including gender sensitivity ○ Understanding individual competencies relative to teamwork ○ Types of individuals ○ Role of leaders	• Lecture	• Written examination	

Unit of Competency	Learning Outcomes	Learning Activities	Methodology	Assessment Approach	Nominal Duration
3. Practice career professionalism	3.1 Integrate personal objectives with organizational goals	• Describe performance evaluation	• Group discussion	• Oral evaluation	1 Hour
		• Read: ○ Work values and ethics (Code of Conduct, Code of Ethics, etc.) ○ Understanding personal objectives ○ Understanding organizational goals	• Lecture	• Written examination	
		• Demonstrate Intra and Interpersonal skills at work • Demonstrate personal commitment in work	• Demonstration	• Observation	
	3.2 Set and meet work priorities	• Describe company policies, operations, procedures and standards	• Group discussion	• Oral evaluation	2 Hours
		• Read: ○ Time Management ○ Basic strategic planning concepts ○ Resource utilization and management	• Lecture	• Written examination	
		• Apply managing goals and time • Practice: ○ economic use of resources and facilities ○ time management	• Demonstration	• Observation	
	3.3 Maintain professional growth and development	• Describe company recognition and incentives	• Group discussion	• Oral evaluation	1 Hour
		• Read: ○ Career development opportunities ○ Information on relevant licenses and or certifications ○ personal career development needs • Identify career opportunities	• Lecture	• Written examination	
		• Determine personal career development needs	• Group discussion	• Oral evaluation	

Unit of Competency	Learning Outcomes	Learning Activities	Methodology	Assessment Approach	Nominal Duration
4. Practice occupational health and safety	4.1 Identify hazard and risks	• Describe OHS procedures, practices and regulations	• Group discussion	• Oral evaluation	1 Hour
		• Read OHS indicators • Read organizational contingency practices • Identify hazards/risks identification and control	• Lecture	• Written examination	
	4.2 Evaluate hazard and risks	• Describe effects of safety hazards	• Group discussion	• Oral evaluation	1 Hour
		• Read Threshold Limit Value –TLV	• Lecture	• Written examination	
		• Practice reporting safety hazards	• Role play	• Observation	
		• Demonstrate evaluating hazards and risks using communication equipment	• Demonstration	• Observation	
	4.3 Control hazards and risks	• Describe : o Organization safety and health protocol o Company emergency procedure practices	• Group discussion	• Oral evaluation	2 Hours
		• Practice personal hygiene • Practice drills on responding to emergency	• Demonstration • Simulation	• Observation • Observation	
	4.4 Maintain occupational health and safety awareness	• Identify emergency-related drills information	• Lecture	• Written examination	2 Hours
		• Practice occupational safety and health standards on personal records in the workplace	• Role play	• Observation	
		• Practice emergency related drills in the workplace	• Demonstration • Simulation	• Observation	

COMMON COMPETENCIES
34 Hours

Unit of Competency	Learning Outcomes	Learning Activities	Methodologies	Assessment Approach	Nominal Duration

1. Prepare materials and tools	1.1 Identify materials and tools	• Read and familiarize
		  ○ Different work specifications
		  ○ Types, uses and description of HVAC/R materials and accessories
		  ○ Types, uses and description of HVAC/R tools
		  ○ List of materials as per company standards
		• Identify and prepare tools according to the job requirements
		• Identify and prepare materials and accessories according to the job requirements
			• Lecture-demonstration
			• Group discussion
			• PowerPoint presentation
				• Written
				• Practical / Performance Test
					1 hour

	1.2 Request materials and tools	• Read and familiarize
		  ○ Work requirements
		  ○ Types and uses of HVAC/R materials and tools
		  ○ Material take-off
		  ○ Requisition procedures
		• Prepare material take-off
		• Request materials and tools
			• Simulation/ Demonstration
			• Discussion
				• Written
				• Practical / Performance Test
					1 hour

	1.3 Receive and inspect materials and tools	• Read and familiarize
		  ○ Policy on receiving material deliveries
		  ○ Material and tools quality and defects
		  ○ Material handling
		• Check and inspect materials and tools
		• Store/ stack tools and materials
			• Lecture/ discussion
			• Demonstration
				• Written / Oral Test
				• Demonstration
				• Practical Exercise
					1 hour

Unit of Competency	Learning Outcomes	Learning Activities	Methodologies	Assessment Approach	Nominal Duration
2. Interpret technical drawings	2.1 Identify different kinds of technical drawings	• Read and familiarize o Blueprint reading and plan specifications - Electrical plan, symbols and abbreviations o Written communication o Signs and symbols - Electrical - Mechanical o Parts and specification • Identify signs and symbols • Interpret different type of plans	• Lecture/ Discussion • Demonstration	• Written • Practical / Performance Test	1 hour
	2.2 Interpret technical drawing	• Read and familiarize o Alphabet of lines o Orthographic drawings o Perspective view o Trade mathematics/Mensuration o Types technical plans o Notes and specifications • Perform drawing exercises • Perform technical plan interpretation • Follow measuring procedures	• Lecture/ Discussion • Demonstration • PowerPoint presentation	• Written • Practical / Performance Test	1 hour
	2.3 Prepare/make changes to electrical/ electronic/ RAC schematics and drawings	• Read and familiarize o Drawing conventions o Dimensioning Conventions o Trade mathematics • Trace electrical/electronic/RAC schematics and drawings • Perform measurement • Sketch drawings and plans • Sketch pictures • Compute formulas • Use drawing instruments	• Discussion • Lecture • demonstration	• Written • Practical / Performance Test	1 hour

Unit of Competency	Learning Outcomes	Learning Activities	Methodologies	Assessment Approach	Nominal Duration

	2.4 Store technical drawings and equipment/ instruments	• Read and familiarize
		  ○ Methods and techniques in storing technical drawings
		  ○ Digitizing technical drawings
		  ○ Proper storage of instruments/equipment
		• Scan and properly store drawings
		• Apply proper handling and storing of drawing instruments
			• Discussion
			• Lecture
			• Modular
				• Written
				• Practical / Performance Test
					1 hour

3. Observe procedures, specifications and manuals of instructions	3.1 Identify and access specifications and manuals	• Read and familiarize
		  ○ Types of manuals used in HVAC/R
		  ○ Identification of symbols used in the manuals
		• Identify manuals and specifications
		• Access information and data
			• Discussion
			• Lecture
				• Oral questioning
				• Written Test
					1 hour

	3.2 Interpret manuals	• Read and familiarize
		  ○ Types of manuals used in HVAC/R
		  ○ Types of symbols used in manuals
		  ○ System of measurements
		  ○ Unit conversion
		• Interpret symbols and specifications
		• Access information and data
		• Compute/Determine conversion of units of measurements
			• Discussion
			• Lecture
			• Modular
				• Written
				• Practical / Performance Test
					1 hour

	3.3 Apply information in manuals	• Read and familiarize
		  ○ Types of manuals used in HVAC/R
		  ○ Types and application of symbols in manuals
		  ○ Unit conversion
		• Apply information from manuals
			• Discussion
			• Lecture
			• Demonstration
			• Group discussion
				• Demonstration (able to impart knowledge and skills)
				• Practical and oral exam
					1 hour

Unit of Competency	Learning Outcomes	Learning Activities	Methodologies	Assessment Approach	Nominal Duration
	3.4 Store Manual	• Read and familiarize o types of manuals used in HVAC/R o Manual storing and maintenance procedures • Store and maintain manuals	• Demonstration • Group discussion	• Demonstration • Practical and oral exam	1 hour
4. Perform mensuration and calculation	4.1 Select measuring instruments;	▪ Identify category and types of measuring tools and its uses ▪ Select measuring instruments as per category ▪ Interpret shapes and dimensions of objects/components	▪ Lecture ▪ Group discussion	▪ Written examination ▪ Oral evaluation	1 hour
	4.2 Carry-out measurements and calculations	▪ Read o Measurements - Linear measurement - Geometrical measurement o Trade Mathematics - Unit conversion - Ratio and proportion - Area ▪ Interpret formulas for volume, areas, perimeters of plane and geometric figures ▪ Perform measurement ▪ Compute measurement formulas	▪ Lecture ▪ Group discussion ▪ Problem analysis	▪ Written examination ▪ Oral evaluation ▪ Problem solving	1 hour
	4.3 Maintain measuring instruments	▪ Identify and practice safe handling procedures in using measuring instruments ▪ Describe procedures on maintenance of measuring instruments ▪ Demonstrate proper cleaning and storage of measuring instruments	▪ Lecture ▪ Demonstration ▪ Group discussion ▪ Simulation	▪ Written examination ▪ Oral evaluation	1 hour

Unit of Competency	Learning Outcomes	Learning Activities	Methodologies	Assessment Approach	Nominal Duration

5. Perform basic bench work	5.1 Prepare materials, tools and equipment	• Read and familiarize
		  ○ Communication methods
		  ○ Work plan interpretation
		  ○ Materials, tools and equipment; uses and specifications
		• Interpret work plan
		• List and prepare materials, tools and equipment needed
			• Self-paced instruction
			• Film viewing
			• Direct laboratory experience
			• Group discussion
				• Written test/ examination
				• Demonstration
				• Direct Observation
					1 hour

	5.2 Lay-out and mark dimensions/ features on workplace	• Read and familiarize
		  ○ Measuring tools; functions and use
		  ○ Communication principles
		  ○ Trade mathematics
		  ○ Mensuration
		  ○ Calculation
		  ○ Conversion
		  ○ Plan specifications
		• Plan drawing/lay-outing activity
		• Perform measuring activity
		• Perform marking and labeling activity
			• Self-paced instruction
			• Film viewing
			• Direct laboratory experience
			• Group discussion
			• Industry Immersion
				• Interview
				• Demonstration
				• Direct Observation
					1 hour

	5.3 Perform required basic metal works	• Read and familiarize
		  ○ Tools and equipment: use and specifications
		  ○ Grinding, cutting, drilling, filing techniques
		  ○ Basic welding principles and application
		  ○ Applied occupational health and safety (OH&S)
		• Perform measuring activity
		• Perform grinding activity
		• Perform cutting activity
		• Perform drilling activity
		• Perform filing activity
		• Perform welding activity
			• Self -paced Instruction
			• Film viewing
			• Direct laboratory experience
			• Group discussion
				• Interview
				• Written test/ examination
				• Observation with questioning
				• Demonstration with questioning
					2 hours

Unit of Competency	Learning Outcomes	Learning Activities	Methodologies	Assessment Approach	Nominal Duration
6. Perform basic electrical works	6.1 Prepare electrical tools and test instruments	• Read and familiarize o Uses of tools and testing instruments o Calibration of testing instruments o Safe handling and proper care of tools and testing instruments o Communication (oral and written) • Calibrate and testing of instruments • Interpret work plans • Identify and prepare electrical tools and test instruments	• Self -paced Instruction • Film viewing • Direct laboratory experience • Group discussion • Industry immersion	• Interview • Written test/ examination • Observation with questioning • Demonstration with questioning	1 hour
	6.2 Test power supply and electrical components	• Read and familiarize o Functions and uses of testing instruments o Basic electricity o Electrical safety and hazards o Testing procedures • Perform resistance reading • Perform voltage reading • Perform continuity testing • Perform current reading • Perform ground testing	• Self -paced Instruction • Film viewing • Group discussion	• Interview • Written test/ examination • Observation with questioning • Demonstration with questioning	1 hour
	6.3 Perform basic electrical repair	• Read and familiarize o Types of electrical fixtures o Electrical joints and splices o Electrical safety and hazards o Applied occupational health & safety (OH&S) • Repair minor electrical system troubles • Test simple electrical components and connections	• Self-paced instruction • Film viewing • Direct laboratory experience • Industry Immersion • E-learning	• Interview • Written test/ examination • Observation with questioning • Demonstration with questioning	2 hours

Unit of Competency	Learning Outcomes	Learning Activities	Methodologies	Assessment Approach	Nominal Duration
7. Maintain tools and equipment	7.1 Check the conditions of tools and equipment;	• Read and familiarize safety practices o handling of tools and equipment o good housekeeping o materials, tools and equipment ▪ types and uses of cleaning materials ▪ types and uses of HVAC/R tools ▪ types and uses of HVAC/R equipment o operational conditions of HVAC/R tools and equipment o HVAC/R tools and equipment defects o Maintaining tools and equipment • Observe proper handling of tools and equipment • Identify tools and equipment defects	• Small Group Discussion • Demonstration of Practical Skills	• Observation and Oral questioning • Demonstration and Oral questioning • Written test	1 hour
	7.2 Perform basic preventive maintenance	• Read and familiarize safety practices o use of PPE o good housekeeping o usage of materials, tools and equipment ▪ types and uses of lubricants ▪ types and uses of cleaning materials ▪ types and uses of HVAC/R equipment o Preventive maintenance on tools and equipment ▪ Methods and techniques ▪ Procedures • Practice proper handling of tools and equipment • Perform preventive maintenance on tools and equipment	• Simulation • Group discussion • Practical Lab • Demonstration	• Observation and Oral questioning • Demonstration and Oral questioning • Written test	2 hours

Unit of Competency	Learning Outcomes	Learning Activities	Methodologies	Assessment Approach	Nominal Duration

	7.3 Store tools and equipment	• Read and familiarize safety practices
		  ○ Handling of tools and equipment
		  ○ good housekeeping
		  ○ Storing procedures and techniques
		  ○ Storage conditions/ locations
		• Store tools and equipment
			• Demonstration
			• Group discussion
			• Practical Lab
				• Practical exam
				• Direct observation
				• Written test
					1 hour

8. Perform housekeeping and safety practices	8.1 Sort materials, tools and equipment	• Read and familiarize
		  ○ Classification of tools, equipment and materials
		  ▪ Consideration in the selection of appropriate areas for storing materials, tools and equipment
		  ▪ Sorting procedures and considerations
		  ▪ Identify tools, equipment and materials
		  ▪ Perform sorting activities
			• Self-paced instruction
			• Film viewing
			• Direct laboratory experience
			• Group discussion Industry Immersion
				• Interview
				• Written test/ examination
				• Observation with questioning
				• Demonstration with questioning
					1 hour

	8.2 Clean workplace area, materials, tools and equipment	• Read and familiarize
		  ○ Cleaning materials, types and applications.
		  ○ Procedures in cleaning workplace area, tools and equipment.
		  ○ Consideration of a safe workplace area, tools and equipment
		  ○ Identification of cleaning materials and its applications
		• Apply procedures in cleaning workplace area, tools and equipment
			• Self-paced instruction
			• Film viewing
			• Direct laboratory experience
			• Group discussion
			• Immersion
				• Interview
				• Written test/ examination
				• Observation with questioning
				• Demonstration with questioning
					1 hour

	8.3 Systematize dispensing and retrieval of materials, tools and equipment	• Read and familiarize
		  ○ Procedures in dispensing and retrieval of materials; tools, and equipment
		  ○ Things to be considered in returning the borrowed tools and equipment.
			• Self-paced instruction
			• Film viewing
			• Direct
				• Interview
				• Written test/ examination
				• Observation with
					1 hour

Unit of Competency	Learning Outcomes	Learning Activities	Methodologies	Assessment Approach	Nominal Duration
		• Apply procedures in dispensing and retrieval of materials; tools, and equipment	laboratory experience • Group discussion • Immersion	questioning • Demonstration with questioning	
	8.4 Identify and minimize/ eliminate hazards	• Read and familiarize o Composition of safety committee o Policies and procedures in controlling risk o Basic first aid procedure o Safety signs and hazards warning preparation o Equipment and safety devices o Safe handling technique in using equipment and safe devices. o roles of safety committee • Identify safety signs and workplace hazards • Demonstrate the first aid procedure • Demonstrate safe handling of equipment and safety devices	• Self-paced instruction • Film viewing • Direct laboratory experience • Group discussion • Industrial/Plant visit	• Interview • Written test/ examination • Observation with questioning • Demonstration with questioning	1 hour
	8.5 Respond and record accidents	• Read and familiarize o Types of accidents o Procedures in applying first aid /treatment o First aid supplies o Steps in responding to and recording accidents • Demonstrate first aid/ treatment procedures • Prepare incident/ accident report	• Self-paced instruction • Film viewing • Direct laboratory experience • Group discussion	• Interview • Written test/ examination • Observation with questioning • Demonstration with questioning	1 hour
	8.6 Follow basic securities	• Read and familiarize o Basic security procedures o Security signs and symbols o Loss control management ▪ Hazards	• Small Group Discussion • Demonstration of Practical Skills	• Actual demonstration • Written test/exam • Observation • Oral questioning	1 hour

Unit of Competency	Learning Outcomes	Learning Activities	Methodologies	Assessment Approach	Nominal Duration
		▪ Safety signs • Apply basic security procedures • Prepare incident/ accident report	• Modular • Self-paced instruction • Film viewing • Demonstration Group discussion		
9. Document work accomplished	9.1 Identify forms and data	• Read and familiarize o Selecting and interpreting forms o Interpreting work accomplished o Data gathering techniques • Identify and interpret forms and data	• Lecture • Discussion • Group work	• Interview • Written • demonstration with questioning	1 hour
	9.2 Prepare reports	• Read and familiarize o Details of work completion o Kinds of reports o Preparation of reports • Prepare completion/ accomplishment reports	• Lecture • Discussion • Group work	• demonstration with questioning	1 hour

CORE COMPETENCIES

488 Hours (248 Hours in-school + 240 Hours Dualized training program*)

Unit of Competency	Learning Outcomes	Learning Activities	Methodologies	Assessment Approach	Nominal Duration
1. Service and maintain transport refrigeration unit	1.1 Prepare for maintenance activities	• Read and familiarize o Types of maintenance o Proper maintenance tools, equipment and instruments o Safety practices o Housekeeping o Understanding RAC code of practice o Understanding maintenance manufacturer's manual • Interpret work/job order • Interpret safety signs and symbols • Prepare maintenance activities • Apply safety practices	• Lecture • Demonstration • Trainee Hands-on • *Dualized-training program*	• Direct Observation • Question • Demonstration	16 hours *10 hours*
	1.2 Check and adjust transport refrigeration accessories, controls and operating conditions	• Read and familiarize: o Operation of transport refrigeration system o Functions, adjustment and setting of controls and accessories o Maintenance manuals • Set, adjust and test of controls and accessories • Apply safety procedure in setting, testing and adjusting of controls and accessories • Evaluate maintenance schedules as per manufacturer's recommendation	• Lecture • Demonstration • Trainee Hands-on • *Dualized-training program*	• Direct Observation • Question • Demonstration	24 hrs *20 hours*

*__Note:__ Dualized training program –exposure in actual work environment is included in the nominal training duration for Core Competencies.

Unit of Competency	Learning Outcomes	Learning Activities	Methodologies	Assessment Approach	Nominal Duration

	1.3 Maintain lubrication system in transport refrigeration	• Read and familiarize
		  ○ Types of transport refrigeration oil and lubricants
		  ○ Oil failure switches and controls
		  ○ Regulations on oil disposal
		  ○ Safe handling of used oil and lubricants
		  ○ Identification of refrigeration oil and lubricants
		• Adjust and set oil failure switches and controls
		• Dispose used oil in accordance with regulations
		• Handle used oil safely
			• Lecture
			• Demonstration
			• Trainee Hands-on
			
			• *Dualized-training program*
				• Direct Observation
				• Question
				• Demonstration
					16 hours
					
					10 hours

	1.1 Maintain refrigeration system in transport refrigeration	• Read and familiarize
		  ○ Evaporators and condensers
		  ○ Effects of inefficient evaporators and condensers
		  ○ Pressure and temperature analysis
		  ○ Tube processes and piping system
		  ○ Leak test systems and procedures
		• Check, clean, disassemble and assemble evaporators and condensers
		• Remove contaminants in the system
		• Remove, replace, align adjust belts and pulleys
			• Lecture
			• Demonstration
			• Trainee Hands-on
			
			• *Dualized-training program*
				• Direct Observation
				• Question
				• Demonstration
					16 hours
					
					20 hours

	1.2 Maintain air distribution system in transport refrigeration	• Read and familiarize
		  ○ Schematic diagrams
		  ○ Fan motor assembly its function and operation
		  ○ Defects of fan motors
		  ○ Maintaining fan motors
		• Remove, clean, disassemble and assemble fan motors
		• Check and replace fan motors
		• Disassemble and assemble fan motors
		• Determine defects of fan motors
		• Interpret schematic diagrams
			• Lecture
			• Demonstration
			• Trainee Hands-on
			
			• *Dualized-training program*
				• Direct Observation
				• Question
				• Demonstration
					16 hours
					
					20 hours

Unit of Competency	Learning Outcomes	Learning Activities	Methodologies	Assessment Approach	Nominal Duration
2. Troubleshoot and repair transport refrigeration systems	2.1. Plan and prepare for troubleshooting and repair	• Read and familiarize ○ schematic and pictorial diagrams of transport refrigeration ▪ Electrical ▪ Mechanical ○ Manufacturer's manual for transport refrigeration equipment ○ Appropriate materials, tools and equipment for troubleshooting and repair • Interpret schematic diagram • Prepare materials, tools and equipment • Prepare troubleshooting and repair work	• Lecture • Demonstration • Trainee Hands-on • *Dualized-training program*	• Direct Observation • Questioning • Demonstration	16 hours *10 hours*
	2.2. Identify and repair faults/troubles	• Read and familiarize ○ safety procedures in troubleshooting and repairing ○ functions and testing procedures of refrigeration parts and accessories ○ processes in fault finding ○ service manuals ○ RAC Code of Practice ○ service manuals and service report forms • Apply safety procedure in troubleshooting and repair • Use appropriate testing instrument • Select components and replacement • Repair defective/faulty components	• Lecture • Demonstration • Trainee Hands-on • *Dualized-training program*	• Direct Observation • Question • Demonstration	24 hours *30 hours*
	2.3. Perform refrigerant recovery/ recycling on transport refrigeration unit	• Read and familiarize ○ Effects of refrigerants in the ozone layer and climate ○ Identification of refrigerants ○ Types of recovery machine ○ Methods of recovery/ recycling of refrigerants ○ Evacuation procedures	• Lecture • Demonstration • Trainee Hands-on • *Dualized-*	• Direct Observation • Question • Demonstration	24 hours *20 hours*

Unit of Competency	Learning Outcomes	Learning Activities	Methodologies	Assessment Approach	Nominal Duration
		○ RAC Code of Practice ○ Procedures in identifying refrigerants • Apply safe handling of refrigerants • Perform recovery/recycling of refrigerants • Perform evacuation procedure	*training program*		
	2.4. Retrofit transport refrigeration	• Read and familiarize ○ RAC Code of Practice ○ Retrofitting procedure ○ Alternative refrigerants and lubricants ○ Parameters of retrofitted units • Retrofit refrigeration system • Apply safety precautions in retrofitting • Identify refrigerants	• Lecture • Demonstration • Trainee Hands-on • *Dualized-training program*	• Direct Observation • Question • Demonstration	24 hours *30 hours*
	2.5. Convert transport refrigeration	• Read and familiarize ○ RAC Code of Practice ○ Conversion procedure ○ Alternative refrigerants and lubricants ○ Parameters of converted units • Convert refrigeration system • Apply safety precautions in conversion • Identify refrigerants	• Lecture • Demonstration • Trainee Hands-on • *Dualized-training program*	• Direct Observation • Question • Demonstration	24 hours *30 hours*
	2.6. Test-run repaired transport refrigeration unit	• Read and familiarize ○ Enterprise testing procedure ○ Point of location for parameter reading ○ Service report form • Test-runt repaired unit • Read and Interpret parameter readings • Fill up service reports forms	• Lecture • Demonstration • Trainee Hands-on • *Dualized-training program*	• Direct Observation • Question • Demonstration	16 hours *10 hours*

Unit of Competency	Learning Outcomes	Learning Activities	Methodologies	Assessment Approach	Nominal Duration
3. Perform start-up, test and commissioning of transport refrigeration unit	3.1. Prepare for start-up, test and commissioning of transport refrigeration unit	• Read and familiarize o Schematic diagrams and symbols o Service report forms o Testing instruments • Interpret schematic diagram • Interpret service report form data • Prepare testing instruments	• Lecture • Demonstration • Trainee Hands-on • *Dualized-training program*	• Direct Observation • Questioning • Demonstration	8 hours *10 hours*
	3.2. Conduct start-up, test and commissioning of transport refrigeration unit	• Read and familiarize: o Testing points & procedures (electrical/mechanical) o operation sequence o Commissioning forms • Perform: o compressor test procedures o power supply test procedures o evaporator assembly test procedures o condenser assembly test procedures o thermostatic expansion valve test procedures o electrical control test procedures o leak testing procedure o pressure testing procedure • Fill up commissioning report forms	• Lecture • Demonstration • Trainee Hands-on • *Dualized-training program*	• Direct Observation • Question • Demonstration	24 hours *20 hours*

3.2 TRAINING DELIVERY

1. The delivery of training shall adhere to the design of the curriculum. Delivery shall be guided by the principles of competency-based TVET.

    a. Course design is based on competency standards set by the industry or recognized industry sector; (Learning system is driven by competencies written to industry standards)

    b. Training delivery is learner-centered and should accommodate individualized and self-paced learning strategies;

    c. Training can be done on an actual workplace setting, simulation of a workplace and/or through adoption of modern technology.

    d. Assessment is based in the collection of evidence of the performance of work to the industry required standards;

    e. Assessment of competency takes the trainee's knowledge and attitude into account but requires evidence of actual performance of the competency as the primary source of evidence.

    f. Training program allows for recognition of prior learning (RPL) or current competencies;

    g. Training completion is based on satisfactory performance of all specified competencies.

2. 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 and their variations/components may be adopted singly or in combination with other modalities when designing and delivering training programs:

    2.1. Institution- Based:

    - **Dual Training System (DTS)/Dualized Training Program (DTP)** which contain both in-school and in-industry training or fieldwork components. Details can be referred to the Implementing Rules and Regulations of the DTS Law and the TESDA Guidelines on the DTP;

    - The **traditional classroom-based or in-center instruction** may be enhanced through use of learner-centered methods as well as laboratory or field-work components..

2.2. Enterprise-Based:

- **Formal Apprenticeship** – Training within employment involving a contract between an apprentice and an enterprise on an approved apprenticeable occupation.

- **Enterprise-based Training-** where training is implemented within the company in accordance with the requirements of the specific company. Specific guidelines on this mode shall be issued by the TESDA Secretariat.

3.3 TRAINEE ENTRY REQUIREMENTS

Trainees or students should possess the following requirements:

- Must have completed at least 10 yrs. basic education or an ALS certificate of achievement with grade 10 equivalent holder
- Can communicate both oral and written
- Can perform basic mathematical computation

This list does not include specific institutional requirements such as educational attainment, appropriate work experience, and others that may be required of the trainees by the school or training center delivering the TVET program.

3.4 LIST OF TOOLS, EQUIPMENT AND MATERIALS LAND-BASED TRANSPORT REFRIGERATION SERVICING NC II

Recommended list of tools, equipment and materials for the training of 25 trainees for Land-based Transport Refrigeration Servicing NC II.

TOOLS		EQUIPMENT		MATERIALS	
QTY.	**Description**	**QTY**	**Description**	**Qty.**	**Description**
6 sets	System Analyzer	2 units	Recovery/recycling machine with recovery cylinder	1 pc	Refrigerant tank/ cylinder R 404A
6 sets	Hacksaw	3 units	Vacuum pump	5 pcs	Expansion valve
6 pcs	Rubber mallet	2 sets	Nitrogen cylinder w/ regulator	1 pc	Refrigerant tank/ cylinder R 134a
3 sets	Open end wrench	1 unit	Refrigerant identifier	1 gal	Mineral oil, 3GS, 5GS
3 sets	Box wrench	2 units	Oxyacetylene unit	1 gal	Synthetic oil
3 sets	Allen wrench	2 sets	Pressure washer	1 roll	Copper tube, 3/8”
6 pcs	Adjustable wrench, 12”	4 sets	Charging cylinder, R134a and R404A	1 roll	Flexible pipe, discharge line
6 pcs	Adjustable wrench, 8”	5 units	Compressor, R134a/R404A	1 roll	Flexible pipe, suction line
5 pcs	Ballpen hammer	1 unit	Portable welding machine	10 pcs	Fittings, discharge line
10 pcs	Files, assorted	1 unit	Air compressor	10 pcs	Fittings, suction line
3 sets	Socket wrench	5 units	Evaporator assembly	1 roll	Automotive wire #12
3 sets	Tinner’s snip	5 units	Condenser assembly	1roll	Automotive wire #14
3 sets	Screw drivers	4 units	Digital weighing scale	5 rolls	Electrical tape
5 pcs.	Long nose plier	2 units	Transport refrigeration Trainer (*can be trailer van simulator*)	100 pcs	Assorted types of clamps
5 pcs	Side Cutter			10 L	Universal flushing agent
5 pcs	Crimping tools			2 9-kg. cyl	Alternative refrigerant, HC
5 pcs	Vise grip			100 pcs	Assorted types of flare nuts
1 set	Hole saw			100 pcs	Assorted types of bolts and nuts
2 sets	Oil pump			100 pcs	Terminal clips
5 sets	Flaring tools			50 pcs	Silver rod
5 sets	Swaging tool			50 pcs	Aluminum rod
5 pcs	Tube cutter			5 cans	Aluminum flux
5 pcs	Tube bender, lever type, ¼”, 5/16, 3/8, ½			3 pcs	Thermostat, electronic w/ thermistor
5 sets	Tube bender, spring type			3 pcs	Thermostat, for transport refrigeration
5 pcs.	Refrigeration ratchet			2 cyls	Nitrogen gas
5 pcs	Push pull rule			5 boxes	Rags
5 pcs	Steel rule			5 boxes	Soap
5 sets	Soldering iron			10 pcs	Sand paper
2 units	Portable drill			5 pcs	Sealant

TOOLS		EQUIPMENT		MATERIALS	
QTY.	Description	QTY	Description	Qty.	Description
1 unit	Portable grinder			5 pcs	Pressure switch
1 set	Puncher			100 pcs	O-rings, assorted
5 sets	Multi-tester				
5 sets	Thermometer, digital				
10 pcs	Service cylinder, 2.5 kg				
3 pcs	Refractometer				
3 units	Vacuum gauge				

3.5 TRAINING FACILITIES
LAND-BASED TRANSPORT REFRIGERATION SERVICING NC II

The building must be in compliance with occupational health and safety guidelines.

Based on a class intake of 25 students/trainees.

SPACE REQUIREMENTS	Space (m)	Area in Sq. Meters	Total Area in Sq. Meters
A. LECTURE AREA	5 x 8	40	40
B. WORKSHOP AREA (with provision of trailer van simulator) *	10x6	60	60
C. LEARNING RESOURCE AREA	4 x 5	20	20
D. TOOL/STORAGE AREA	4 x 4	16	16
E. WASH, TOILET AND LOCKER ROOM	3 x 4	12	12
TOTAL			148
F. FACILITIES/EQUIPMENT/ CIRCULATION**			44
TOTAL AREA			**192**

* Workshop area must be well-ventilated
** Common facilities for all HVAC/R Courses.

3.6 TRAINER'S QUALIFICATION FOR HVAC/R SECTOR

LAND-BASED TRANSPORT REFRIGERATION SERVICING NC II

- Must be a holder of National TVET Trainers Certificate Level I in Land-based Transport Refrigeration Servicing NC II

- Must have at least two (2) years related HVAC/R job/industry experience

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.

The result of the institutional assessment may be considered as evidence for the assessment for national certification. As a matter of policy, graduates of programs registered with TESDA under these training regulations are required to undergo mandatory national competency assessment upon completion of the program.

SECTION 4 NATIONAL ASSESSMENT AND CERTIFICATION ARRANGEMENTS

4.1 To attain the National Qualification of **Land-Based Transport Refrigeration Servicing NC II**, the candidate must demonstrate competence in all the units listed in Section 1. Successful candidates shall be awarded a National Certificate II signed by the TESDA Director General.

4.2 The qualification of **Land-Based Transport Refrigeration Servicing NC II** can be attained through demonstration of competence through project-type assessment covering all 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 and non-formal including enterprise-based education/training programs/courses

4.4.2 Experienced Workers (wage employed or self-employed)

4.5 For individuals, holders of National Certificate of Transport RAC Servicing NC II shall be converted to Land-Based Transport Refrigeration Servicing NC II upon renewal**,** provided they are already employed and have related experience in transport refrigeration for the past three (3) years along the qualification.

4.6 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 Competency Assessment and Certification System (PTCACS)".

COMPETENCY MAP - HVAC/R Sector

Land-based Transport Refrigeration Servicing NC II

CORE COMPETENCIES

Install window- type AC/ domestic refrigeration units	Service & maintain window-type AC/ domestic refrigeration units	Troubleshoot window-type AC/domestic refrigeration systems	Recover & recycle refrigerant in window-type AC/domestic refrigeration systems	Repair & retrofit window-type AC/ domestic refrigeration systems
Perform Testing and commissioning for window-type AC/domestic refrigeration	Install package-type air-conditioning unit (PACU) / commercial refrigeration equipment (CRE)	Install PACU/CRE electrical systems	Install PACU/CRE piping systems	Service & maintain PACU/CRE units
Survey site for installation	Troubleshoot PACU/CRE systems	Recover / recycle refrigerant in PACU/ CRE systems	Repair & retrofit PACU/CRE systems & its accessories	Perform start-up, testing and commissioning for PACU/CRE
Install transport air-conditioning & refrigeration units	Service & maintain transport AC & refrigeration units	Recover & recycle refrigerant in transport AC & refrigeration systems	Troubleshoot transport air-conditioning & refrigeration systems	Perform testing & commissioning for transport AC & refrigeration
Repair & retrofit transport ac & refrigeration systems & its accessories	Install package-type air-conditioning unit (PACU)	Install commercial refrigeration equipment (CRE)	Service & maintain PACU	Service & maintain CRE
Troubleshoot and repair PACU	Troubleshoot and repair CRE	Perform start-up, test and commissioning for PACU	Perform start-up, test and commissioning for CRE	Service and maintain Land-based Transport MAC units
Install Domestic RAC units	Service & maintain Domestic RAC units	Troubleshoot & Repair Domestic RAC systems	Troubleshoot and repair Land-based Transport MAC systems	Perform start-up, testing and commissioning for Land-based Transport MAC systems
Service and maintain transport refrigeration units	**Troubleshoot and repair transport refrigeration systems**	**Perform start-up, test and commissioning of transport refrigeration unit**		

COMMON COMPETENCIES

Prepare materials and tools	**Interpret technical drawings**	**Observe procedures, specifications & manuals of instructions**	**Perform mensurations & calculations**	**Perform basic benchwork**
Perform basic electrical works	**Maintain tools and equipment**	**Perform housekeeping and safety practices**	**Document work accomplished**	

BASIC COMPETENCIES

Receive and Respond to Workplace Communication	Work with Others	Demonstrate work values	Practice basic housekeeping procedures	Participate in Workplace Communication
Work in a Team Environment	Practice career professionalism	Practice occupational health and safety procedures	**Lead Workplace Communication**	**Lead Small Team**
Develop and practice negotiation skills	**Solve Problems Related to Work Activities**	**Use mathematical concepts and techniques**	**Use relevant technologies**	Utilize Specialist Communication Skills
Develop Team and Individuals	Apply Problem Solving Techniques in the Workplace	Collect, analyze and organize information	Plan and Organize Work	Promote environmental protection

DEFINITION OF TERMS

GENERAL

1) **Certification -** is the process of verifying and validating the competencies of a person through assessment

2) **Certificate of Competency (COC)** – is a certification issued to individuals who pass the assessment for a single unit or cluster of units of competency

3) **Common Competencies** - are the skills and knowledge needed by all people working in a particular industry

4) **Competency** - is the possession and application of knowledge, skills and attitudes to perform work activities to the standard expected in the workplace

5) **Competency Assessment -** is the process of collecting evidence and making judgments on whether competency has been achieved

6) **Competency Standard (CS)** - is the industry-determined specification of competencies required for effective work performance

7) **Context of Assessment** - refers to the place where assessment is to be conducted or carried out

8) **Core Competencies -** are the specific skills and knowledge needed in a particular area of work - industry sector/occupation/job role

9) **Critical aspects of competency -** refers to the evidence that is essential for successful performance of the unit of competency

10) **Elective Competencies -** are the additional skills and knowledge required by the individual or enterprise for work

11) **Elements** - are the building blocks of a unit of competency. They describe in outcome terms the functions that a person performs in the workplace.

12) **Evidence Guide** - is a component of the unit of competency that defines or identifies the evidences required to determine the competence of the individual. It provides information on critical aspects of competency, underpinning knowledge, underpinning skills, resource implications, assessment method and context of assessment

13) **Level -** refers to the category of skills and knowledge required to do a job

14) **Method of Assessment** - refers to the ways of collecting evidence and when, evidence should be collected

15) **National Certificate (NC)** – is a certification issued to individuals who achieve all the required units of competency for a national qualification defined under the Training Regulations. NCs are aligned to specific levels within the PTQF

16) **Performance Criteria** - are evaluative statements that specify what is to be assessed and the required level of performance

17) **Qualification** - is a cluster of units of competencies that meets job roles and is significant in the workplace. It is also a certification awarded to a person on successful completion of a course in recognition of having demonstrated competencies in an industry sector

18) **Range of Variables** - describes the circumstances or context in which the work is to be performed

19) **Recognition of Prior Learning (RPL)** – is the acknowledgement of an individual's skills, knowledge and attitudes gained from life and work experiences outside registered training programs

19) **Resource Implication -** refer to the resources needed for the successful performance of the work activity described in the unit of competency. It includes work environment and conditions, materials, tools and equipment

20) **Basic Competencies -** are the skills and knowledge that everyone needs for work

21) **Training Regulations (TR)** – refers to the document promulgated and issued by TESDA consisting of competency standards, national qualifications and training guidelines for specific sectors/occupations. The TR serves as basis for establishment of qualification and certification under the PTQF. It also serves as guide for development of competency-based curricula and instructional materials including registration of TVET programs offered by TVET providers

22) **Underpinning Knowledge -** refers to the competency that involves in applying knowledge to perform work activities. It includes specific knowledge that is essential to the performance of the competency

23) **Underpinning Skills** - refers to the list of the skills needed to achieve the elements and performance criteria in the unit of competency. It includes generic and industry specific skills

24) **Unit of Competency** – is a component of the competency standards stating a specific key function or role in a particular job or occupation; it is the smallest component of achievement that can be assessed and certified under the PTQF

SECTOR SPECIFIC

1) **Accumulator** – is used on systems that accommodate an orifice tube to meter refrigerants into the evaporator. It is connected directly to the evaporator outlet and stores excess liquid refrigerant. The chief role of the accumulator is to isolate the compressor from any damaging liquid refrigerant. Accumulators, like receiver-driers, also remove debris and moisture from a system.

2) **Air Conditioning** - is the cooling, heating, dehumidification, and filtration of the air located within the passenger compartment of a vehicle.

3) **Air Cooled Condenser** – an equipment that condenses refrigerant vapor using air as the condensing medium

4) **Air Distribution** – the process of distributing conditioned air into a confined space

5) **Charge** - A specific amount of refrigerant or compressor oil by weight. The vehicle manufacturer for individual A/C system applications specifies this.

6) **Charging -** The process of placing a specified amount of refrigerant and compressor oil into an A/C or refrigeration system.

7) **Check** – to verify, inspect, or test an HVAC/R component for satisfactory condition with the use of an instrument or a device

8) **Compressor** - commonly referred to as the heart of the system, the compressor is a belt driven pump that is fastened to the engine. It is responsible for compressing and transferring refrigerant gas.

9) **Condenser** - is the area in which heat dissipation occurs. The condenser is designed to radiate heat. As hot compressed gasses are introduced into the top of the condenser, they are cooled off. As the gas cools, it condenses and exits the bottom of the condenser as a high pressure liquid.

10) **Conversion –** Is a process of applying a flammable, non-ozone depleting substance and low global warming potential refrigerant to a system that ordinarily uses non-flammable, ozone depleting substance and high global warming potential refrigerant. It not only deals with refrigerant replacement but taking into consideration how to mitigate the flammability risk of the process.

11) **Dehydration** – the process of removing moisture from a refrigeration system

12) **Electric Heat Defrost** – use of electric resistance heating coils to melt ice or frost from evaporators

13) **Evacuation** – removal of air/any gas and moisture from a refrigeration system

14) **Evaporator** – is located in the interior of the vehicle. Its primary function is to transfer heat contained in the passenger compartment air, into the refrigerant, which is circulated by the compressor, through the evaporator coil. During this process the air is also filtered and dehumidified.

15) **Fan** – a mechanical device for **moving** air

16) **Fan Coil Unit (FCU)** – an air-conditioning component that consists of a fan motor and an evaporator coil

17) **Filter Drier** – the component part used in air-conditioning or refrigeration system to filter and dehydrates refrigerant in the system

18) **Idler Pulley** – a pulley used to maintain proper belt tension

19) **Inspect** – determine the actual condition of HVAC/R component without the use of instrument

20) **Interlocking** – it is the action of interconnecting electric control wires to achieve a sequential action

21) **Leak Test** – the procedure of determining/pin pointing leaks in a pressurized system

22) **Liquid Line Solenoid Valve** – electrically operated valve that shuts-off the flow of the refrigerant to the evaporator.

23) **Manifold Gauge Set** – provides access to and monitors pressures within the system. Manifold gauge sets are available in different configurations and styles. 3--way or 4--way, liquid filled gauges, with or without a sight glass, 3 hoses or 4 hoses, 1/4 inch or 3/8 inch manifold connections, etc.

24) **Metering Device** – it is one of the major components in a refrigeration system used to regulate the flow of refrigerant into the evaporator

25) **REFRIGERATION unit** – see Transport refrigeration unit.

26) **Pull-out** – to remove from a place of installation

27) **Pressure Switches --** the systems use high and low pressure switches wired in series to control the power circuit of the compressor clutch relay. If either pressure switch opens, interrupting the circuit to the clutch relay, the operation of the compressor will stop. When conditions return to normal the switch will automatically reset and the compressor will resume operating. The switches are non--adjustable.

28) **Pressure Test** – a procedure whereby pressure is applied to the piping system, the purpose of which is to determine its soundness and stability

29) **Pump down** – a process of using the compressor to pump and contain all the refrigerant charge into the condenser and/or receiver

30) **Recovery/Recycle Machine (R134a) -** Recovers and recycles R134a refrigerant that is present within the air conditioning system.

31) **Refrigerant --** is a material that is used to move heat from the passenger compartment to the outside air. It is a substance that gives up heat by condensing at high temperature and pressures and absorbs heat by evaporating at low temperatures and pressures. The heat transfer properties exhibited when refrigerant changes state is the foundation of the refrigerant cycle. Most Transport MAC systems use R134a.

32) **Refrigerant Charging** – the process of introducing into the system the proper amount of refrigerant

33) **Refrigerant Cylinder** -- Storage tank for R134a.

34) **Refrigerant Scale** -- Accurately weighs the transfer of refrigerant into the air--conditioning system.

35) **Retrofit** - the process of changing or converting an R12 A/C system to R134a. This may require the replacement of certain components depending on the application.

36) **Retrofitting** – a process of upgrading existing equipment or system using ozone depleting substances to environmental friendly refrigerant

37) **Service Mechanic** – worker who possess basic skills related to HVAC/R system

38) **Sight Glass/Liquid Line Moisture Indicator** – indicates refrigerant quality and charge

39) **Supervised Industry Training** – similar to on-the-job training – 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.

40) **Thermostat Expansion Valve (TXV**) – a refrigerant control valve connected before an evaporator that regulates flow of refrigerant. Operated by temperature and pressure, and reacts to the degree of gas superheat at the evaporator outlet through a feeler bulb

41) **Transport Refrigeration Unit –** refers to refrigeration unit driven directly from the turning axle of the vehicle when they are in motion, or by the vehicle engine itself, or by a separate gasoline/diesel engine and/or electric motor mounted on the same vehicle. It covers the land and marine/sea transports.

42) **Troubleshoot** – the process of analyzing system defect or malfunction

43) **Vacuum** – pressure lower than atmospheric pressure measured in inches of mercury. Complete vacuum is 29.92 in. mercury or at least 500 microns

44) **Vacuum Pump –** Removes moisture and air from the air conditioning system in order to obtain required micron level.

45) **Water Treatment** – the use of chemicals in water to prevent corrosion, formation of scales, algae growth and formation of slime

46) **Workmanlike-manner** – quality of work within the accepted industry standard

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