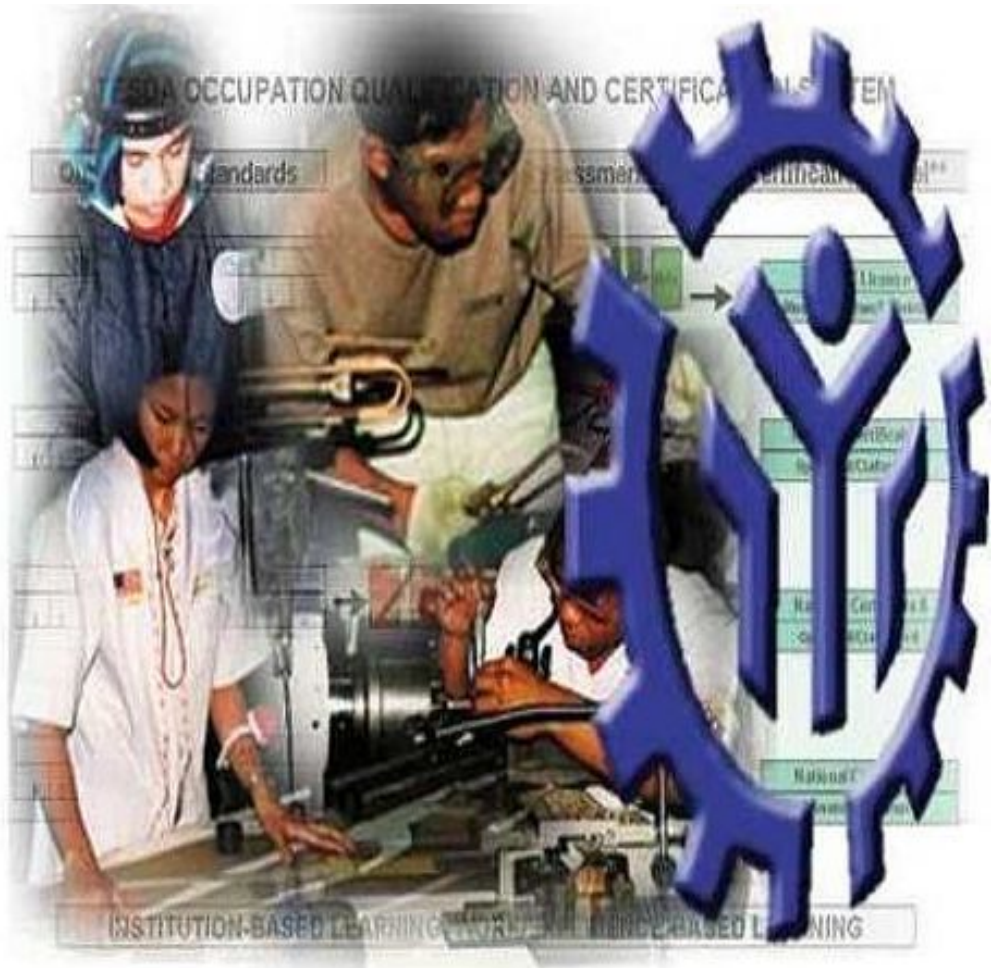
TRAINING REGULATIONS



RAC SERVICING NC III

(Package-type Air-Conditioning Unit/
Commercial Refrigeration Equipment)

HEATING, VENTILATION, AIR-CONDITIONING AND REFRIGERATION TECHNOLOGY SECTOR

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

TABLE OF CONTENTS

HVAC/R SECTOR
RAC SERVICING (PACU/CRE) NC III

TRAINING REGULATIONS FOR
REFRIGERATION AND AIR-CONDITIONING (RAC) SERVICING NC III
[Package-Type Air-Conditioning/Commercial Refrigeration]

SECTION 1 RAC SERVICING (PACU/CRE) NC III QUALIFICATION

The **RAC SERVICING (Packaged-type air-conditioning unit / Commercial refrigeration equipment (PACU/CRE) NC III** Qualification consists of competencies that a person must achieve to enable him/her to install, service, maintain, troubleshoot and repair as well as to perform start-up, test and commissioning of air-conditioning and refrigeration units in commercial environment/ establishments other than centralized air-conditioning and industrial refrigeration systems.

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
500311109	Lead Workplace Communication
500311110	Lead Small Teams
500311111	Develop and Practice Negotiation Skills
500311112	Solve Problems Related to Work Activities
500311113	Use Mathematical Concepts and Techniques
500311114	Use Relevant Technologies

CODE NO.	COMMON COMPETENCIES
HVC713201	Prepare Materials And Tools
HVC311203	Perform Mensuration and Calculation
HVC713202	Perform Basic Benchwork
HVC724201	Perform Basic Electrical Works
HVC311204	Maintain Tools And Equipment
HVC315201	Perform Housekeeping And Safety Practices
HVC311205	Document Work Accomplished

CODE NO.	CORE COMPETENCIES
HVC723340	Install PACU
HVC723341	Install CRE
HVC723342	Service and maintain PACU
HVC723343	Service and maintain CRE
HVC723344	Troubleshoot and repair PACU
HVC723345	Troubleshoot and repair CRE
HVC723346	Perform start-up, test and commissioning for PACU
HVC723347	Perform start-up, test and commissioning for CRE

A person who has achieved these competencies is Qualified to be a:

- PACU Installer
- CRE Installer
- PACU and CRE Maintenance Technician
- Commercial Refrigeration and Air-Conditioning Technician (HVAC/R Technician)

SECTION 2 COMPETENCY STANDARDS

This section gives the details of the contents of the basic, common and core units of competency required in **RAC SERVICING (PACU/CRE) NC III**.

BASIC COMPETENCIES

UNIT TITLE : **LEAD WORKPLACE COMMUNICATION**

UNIT CODE : **500311109**

UNIT DESCRIPTOR : This unit covers the knowledge, skills and attitudes required to lead in the dissemination and discussion of ideas, information and issues in the workplace.

ELEMENT	PERFORMANCE CRITERIA ***Italicized*** terms are elaborated in the Range of Variables
1. Communicate information about workplace processes	1.1. Appropriate ***communication method*** is selected 1.2. Multiple operations involving several topics areas are communicated accordingly 1.3. Questions are used to gain extra information 1.4. Correct sources of information are identified 1.5. Information is selected and organized correctly 1.6. Verbal and written reporting is undertaken when required 1.7. Communication skills are maintained in all situations
2. Lead workplace discussions	2.1. Response to workplace issues are sought 2.2. Response to workplace issues are provided immediately 2.3. Constructive contributions are made to workplace discussions on such issues as production, quality and safety 2.4. Goals/objectives and action plan undertaken in the workplace are communicated
3. Identify and communicate issues arising in the workplace	3.1. Issues and problems are identified as they arise 3.2. Information regarding problems and issues are organized coherently to ensure clear and effective communication 3.3. Dialogue is initiated with appropriate personnel 3.4. Communication problems and issues are raised as they arise

RANGE OF VARIABLES

VARIABLE	RANGE
1. Methods of communication	1.1. Non-verbal gestures 1.2. Verbal 1.3. Face to face 1.4. Two-way radio 1.5. Speaking to groups 1.6. Using telephone 1.7. Written 1.8. Internet

EVIDENCE GUIDE

1. Critical Aspects of Competency	Assessment requires evidence that the candidate: 1.1. Dealt with a range of communication/information at one time 1.2. Made constructive contributions in workplace issues 1.3. Sought workplace issues effectively 1.4. Responded to workplace issues promptly 1.5. Presented information clearly and effectively written form 1.6. Used appropriate sources of information 1.7. Asked appropriate questions 1.8. Provided accurate information
2. Required knowledge and Attitudes	2.1. Organization requirements for written and electronic communication methods 2.2. Effective verbal communication methods
3. Required Skills	3.1. Organize information 3.2. Understand and convey intended meaning 3.3. Participate in variety of workplace discussions 3.4. Comply with organization requirements for the use of written and electronic communication methods
4. Resource Implications	The following resources **MUST** be provided: 4.1. Variety of Information 4.2. Communication tools 4.3. Simulated workplace
5. Method of Assessment	Competency may be assessed through: 5.1. Competency in this unit must be assessed through 5.2. Direct Observation 5.3. Interview
6. Context for Assessment	6.1. Competency may be assessed in the workplace or in simulated workplace environment

UNIT TITLE : **LEAD SMALL TEAMS**

UNIT CODE : **500311110**

UNIT DESCRIPTOR : This unit covers the knowledge, skills and attitudes to lead small teams including setting and maintaining team and individual performance standards.

ELEMENT	PERFORMANCE CRITERIA ***Italicized bold*** terms are elaborated in the Range of Variables
1. Provide team leadership	1.1. ***Work requirements*** are identified and presented to team members 1.2. Reasons for instructions and requirements are communicated to team members 1.3. ***Team members' queries and concerns*** are recognized, discussed and dealt with
2. Assign responsibilities	2.1. Duties and responsibilities are allocated having regard to the skills, knowledge and aptitude required to properly undertake the assigned task according to company policy 2.2. Duties are allocated having regard to individual preference, domestic and personal considerations, whenever possible
3. Set performance expectations for team members	3.1. Performance expectations are established based on client needs and according to assignment requirements 3.2. Performance expectations are based on individual team members duties and area of responsibility 3.3. Performance expectations are discussed and disseminated to individual team members
4. Supervised team performance	4.1. ***Monitoring of performance*** takes place against defined performance criteria and/or assignment instructions and corrective action taken if required 4.2. Team members are provided with *feedback*, positive support and advice on strategies to overcome any deficiencies 4.3. ***Performance issues*** which cannot be rectified or addressed within the team are referenced to appropriate personnel according to employer policy 4.4. Team members are kept informed of any changes in the priority allocated to assignments or tasks which might impact on client/customer needs and satisfaction 4.5. Team operations are monitored to ensure that employer/client needs and requirements are met 4.6. Follow-up communication is provided on all issues affecting the team 4.7. All relevant documentation is completed in accordance with company procedures

RANGE OF VARIABLES

VARIABLE	RANGE
1. Work requirements	1.1. Client Profile 1.2. Assignment instructions
2. Team member's concerns	2.1. Roster/shift details
3. Monitor performance	3.1. Formal process 3.2. Informal process
4. Feedback	4.1. Formal process 4.2. Informal process
5. Performance issues	5.1. Work output 5.2. Work quality 5.3. Team participation 5.4. Compliance with workplace protocols 5.5. Safety 5.6. Customer service

EVIDENCE GUIDE

1. Critical Aspects of Competency	Assessment requires evidence that the candidate: 1.1. Maintained or improved individuals and/or team performance given a variety of possible scenario 1.2. Assessed and monitored team and individual performance against set criteria 1.3. Represented concerns of a team and individual to next level of management or appropriate specialist and to negotiate on their behalf 1.4. Allocated duties and responsibilities, having regard to individual's knowledge, skills and aptitude and the needs of the tasks to be performed 1.5. Set and communicated performance expectations for a range of tasks and duties within the team and provided feedback to team members
2. Required Knowledge and Attitude	2.1. Company policies and procedures 2.2. Relevant legal requirements 2.3. How performance expectations are set 2.4. Methods of Monitoring Performance 2.5. Client expectations 2.6. Team member's duties and responsibilities
3. Required Skills	3.1. Communication skills required for leading teams 3.2. Informal performance counseling skills 3.3. Team building skills 3.4. Negotiating skills
4. Resource Implications	The following resources MUST be provided: 4.1. Access to relevant workplace or appropriately simulated environment where assessment can take place 4.2. Materials relevant to the proposed activity or task
5. Method of Assessment	Competency may be assessed through: 5.1. Direct observations of work activities of the individual member in relation to the work activities of the group 5.2. Observation of simulation and/or role play involving the participation of individual member to the attainment of organizational goal 5.3. Case studies and scenarios as a basis for discussion of issues and strategies in teamwork
6. Context for Assessment	6.1. Competency assessment may occur in workplace or any appropriately simulated environment

UNIT TITLE : **DEVELOP AND PRACTICE NEGOTIATION SKILLS**

UNIT CODE : **500311111**

UNIT DESCRIPTOR : This unit covers the skills, knowledge and attitudes required to collect information in order to negotiate to a desired outcome and participate in the negotiation.

ELEMENT	PERFORMANCE CRITERIA ***Italicized bold*** terms are elaborated in the Range of Variables
1. Plan negotiations	1.1 Information on ***preparing for negotiation*** is identified and included in the plan 1.2 Information on creating ***non verbal environments*** for positive negotiating is identified and included in the plan 1.3 Information on ***active listening*** is identified and included in the plan 1.4 Information on different ***questioning techniques*** is identified and included in the plan 1.5 Information is checked to ensure it is correct and up-to-date
2. Participate in negotiations	2.1 Criteria for successful outcome are agreed upon by all parties 2.2 Desired outcome of all parties are considered 2.3 Appropriate language is used throughout the negotiation 2.4 A variety of questioning techniques are used 2.5 The issues and processes are documented and agreed upon by all parties 2.6 Possible solutions are discussed and their viability assessed 2.7 Areas for agreement are confirmed and recorded 2.8 Follow-up action is agreed upon by all parties

RANGE OF VARIABLES

VARIABLE	RANGE
1. Preparing for negotiation	1.1 Background information on other parties to the negotiation 1.2 Good understanding of topic to be negotiated 1.3 Clear understanding of desired outcome/s 1.4 Personal attributes 1.4.1 self awareness 1.4.2 self esteem 1.4.3 objectivity 1.4.4 empathy 1.4.5 respect for others 1.5 Interpersonal skills 1.5.1 listening/reflecting 1.5.2 non verbal communication 1.5.3 assertiveness 1.5.4 behavior labeling 1.5.5 testing understanding 1.5.6 seeking information 1.5.7 self disclosing 1.6 Analytic skills 1.6.1 observing differences between content and process 1.6.2 identifying bargaining information 1.6.3 applying strategies to manage process 1.6.4 applying steps in negotiating process 1.6.5 strategies to manage conflict 1.6.6 steps in negotiating process 1.6.7 options within organization and externally for resolving conflict
2. Non verbal environments	2.1 Friendly reception 2.2 Warm and welcoming room 2.3 Refreshments offered 2.4 Lead in conversation before negotiation begins
3. Active listening	3.1 Attentive 3.2 Don't interrupt 3.3 Good posture 3.4 Maintain eye contact 3.5 Reflective listening
4. Questioning techniques	4.1 Direct 4.2 Indirect 4.3 Open-ended

EVIDENCE GUIDE

1. Critical Aspects of Competency	Assessment requires evidence that the candidate: 1.1 Demonstrated sufficient knowledge of the factors influencing negotiation to achieve agreed outcome 1.2 Participated in negotiation with at least one person to achieve an agreed outcome
2. Required Knowledge and Attitude	2.1 Codes of practice and guidelines for the organization 2.2 Organizations policy and procedures for negotiations 2.3 Decision making and conflict resolution strategies procedures 2.4 Problem solving strategies on how to deal with unexpected questions and attitudes during negotiation 2.5 Flexibility 2.6 Empathy
3. Required Skills	3.1 Interpersonal skills to develop rapport with other parties 3.2 Communication skills (verbal and listening) 3.3 Observation skills 3.1 Negotiation skills
4. Resource Implications	The following resources **MUST** be provided: 4.1 Room with facilities necessary for the negotiation process 4.2 Human resources (negotiators)
5. Methods of Assessment	Competency may be assessed through: 5.1 Observation/demonstration and questioning 5.2 Portfolio assessment 5.3 Oral and written questioning 5.4 Third party report
6. Context for Assessment	6.1 Competency to be assessed in real work environment or in a simulated workplace setting.

UNIT TITLE : **SOLVE PROBLEMS RELATED TO WORK ACTIVITIES**

UNIT CODE : **500311112**

UNIT DESCRIPTOR : This unit of covers the knowledge, skills and attitudes required to solve problems in the workplace including the application of problem solving techniques and to determine and resolve the root cause of problems.

ELEMENT	PERFORMANCE CRITERIA ***Italicized bold*** terms are elaborated in the Range of Variables
1. Identify the problem	1.1. Variances are identified from normal operating parameters; and product quality 1.2. Extent, cause and nature are of the problem are defined through observation, investigation and ***analytical techniques*** 1.3. ***Problems*** are clearly stated and specified
2. Determine fundamental causes of the problem	2.1. Possible causes are identified based on experience and the use of problem solving tools / analytical techniques. 2.2. Possible cause statements are developed based on findings 2.3. Fundamental causes are identified per results of investigation conducted
3. Determine corrective action	3.1. All possible options are considered for resolution of the problem 3.2. Strengths and weaknesses of possible options are considered 3.3. Corrective actions are determined to resolve the problem and possible future causes 3.4. **Action *plans*** are developed identifying measurable objectives, resource needs and timelines in accordance with safety and operating procedures
4. Provide recommendation/ s to manager	4.1. Report on recommendations are prepared 4.2. Recommendations are presented to appropriate personnel. 4.3. Recommendations are followed-up, if required

RANGE OF VARIABLES

VARIABLE	RANGE
1. Analytical techniques	1.1. Brainstorming 1.2. Intuitions/Logic 1.3. Cause and effect diagrams 1.4. Pareto analysis 1.5. SWOT analysis 1.6. Gant chart, Pert CPM and graphs 1.7. Scattergrams
2. Problem	2.1. Non – routine process and quality problems 2.2. Equipment selection, availability and failure 2.3. Teamwork and work allocation problem 2.4. Safety and emergency situations and incidents
3. Action plans	3.1. Priority requirements 3.2. Measurable objectives 3.3. Resource requirements 3.4. Timelines 3.5. Co-ordination and feedback requirements 3.6. Safety requirements 3.7. Risk assessment 3.8. Environmental requirements

EVIDENCE GUIDE

1. Critical Aspects of Competency	Assessment requires evidence that the candidate: 1.1. Identified the problem 1.2. Determined the fundamental causes of the problem 1.3. Determined the correct / preventive action 1.4. Provided recommendation to manager These aspects may be best assessed using a range of scenarios / case studies / what ifs as a stimulus with a walk through forming part of the response. These assessment activities should include a range of problems, including new, unusual and improbable situations that may have happened.
2. Required Knowledge and Attitude	2.1. Competence includes a thorough knowledge and understanding of the process, normal operating parameters, and product quality to recognize non-standard situations 2.2. Competence to include the ability to apply and explain, sufficient for the identification of fundamental cause, determining the corrective action and provision of recommendations 2.2.1. Relevant equipment and operational processes 2.2.2. Enterprise goals, targets and measures 2.2.3. Enterprise quality, OHS and environmental requirement 2.2.4. Principles of decision making strategies and techniques 2.2.5. Enterprise information systems and data collation 2.2.6. Industry codes and standards
3. Required Skills	3.1. Using range of formal problem solving techniques 3.2. Identifying and clarifying the nature of the problem 3.3. Devising the best solution 3.4. Evaluating the solution 3.5. Implementation of a developed plan to rectify the problem

4. Resource Implications	4.1. Assessment will require access to an operating plant over an extended period of time, or a suitable method of gathering evidence of operating ability over a range of situations. A bank of scenarios / case studies / what ifs will be required as well as bank of questions which will be used to probe the reason behind the observable action.
5. Methods of Assessment	Competency may be assessed through: 5.1. Case studies on solving problems in the workplace 5.2. Observation The unit will be assessed in a holistic manner as is practical and may be integrated with the assessment of other relevant units of competency. Assessment will occur over a range of situations, which will include disruptions to normal, smooth operation. Simulation may be required to allow for timely assessment of parts of this UNIT TITLE. Simulation should be based on the actual workplace and will include walk through of the relevant competency components.
6. Context for Assessment	6.1. In all workplace, it may be appropriate to assess this unit concurrently with relevant teamwork or operation units.

UNIT TITLE : **USE MATHEMATICAL CONCEPTS AND TECHNIQUES**

UNIT CODE : **500311113**

UNIT DESCRIPTOR : This unit covers the knowledge, skills and attitudes required in the application of mathematical concepts and techniques.

ELEMENT	Performance Criteria ***Italicized bold*** terms are elaborated in the Range of Variables
1. Identify mathematical tools and techniques to solve problem	1.1 Problem areas are identified based on given condition 1.2 ***Mathematical techniques*** are selected based on the given problem
2. Apply mathematical procedure/solution	2.1 Mathematical techniques are applied based on the problem identified 2.2 Mathematical computations are performed to the level of accuracy required for the problem 2.3 Results of mathematical computation is determined and verified based on job requirements
3. Analyze results	3.1 Result of application is reviewed based on expected and required specifications and outcome 3.2 ***Appropriate action*** is applied in case of error

RANGE OF VARIABLES

VARIABLE	RANGE
1. Mathematical techniques	May include but are not limited to: 1.1 Four fundamental operations 1.2 Measurements 1.3 Use/Conversion of units of measurements ~~1.4~~ Use of standard formulas
2. Appropriate action	2.1 Review in the use of mathematical techniques (e.g. recalculation, re-modeling) 2.2 Report error to immediate superior for proper action

EVIDENCE GUIDE

1. Critical Aspects of Competency	Assessment requires evidence that the candidate: 1.1 Identified, applied and reviewed the use of mathematical concepts and techniques to workplace problems
2. Required Knowledge and Attitude	2.1 Fundamental operation (addition, subtraction, division, multiplication) 2.2 Measurement system 2.3 Precision and accuracy 2.4 Basic measuring tools/devices
3. Required Skills	3.1 Applying mathematical computations 3.2 Using calculator 3.3 Using different measuring tools
4. Resource Implications	The following resources **MUST** be provided: 4.1 Calculator 4.2 Basic measuring tools 4.3 Case Problems
5. Methods of Assessment	Competency may be assessed through: 5.1 Authenticated portfolio 5.2 Written Test 5.3 Interview/Oral Questioning 5.4 Demonstration
6. Context for Assessment	6.1 Competency may be assessed in the work place or in a simulated work place setting

UNIT TITLE : **USE RELEVANT TECHNOLOGIES**

UNIT CODE : **500311114**

UNIT DESCRIPTOR : This UNIT TITLE covers the knowledge, skills, and attitude required in selecting, sourcing and applying appropriate and affordable technologies in the workplace.

ELEMENT	PERFORMANCE CRITERIA ***Italicized bold*** terms are elaborated in the Range of Variables
1. Study/select appropriate technology	1.1 Usage of different ***technologies*** is determined based on job requirements 1.2 Appropriate technology is selected as per work specification
2. Apply relevant technology	2.1 Relevant technology is effectively used in carrying out function 2.2 Applicable software and hardware are used as per task requirement 2.3 ***Management concepts*** are observed and practiced as per established industry practices
3. Maintain/enhance ~~of~~ relevant technology	3.1 Maintenance of technology is applied in accordance with the ***industry standard operating procedure*****,** ***manufacturer's operating guidelines*** **and** ***occupational health and safety procedure*** to ensure its operative ability 3.2 Updating of technology is maintained through continuing education or training in accordance with job requirement *3.3* Technology failure/ defect is immediately reported to the concern/responsible person or section for ***appropriate action***

RANGE OF VARIABLES

VARIABLE	RANGE
1. Technology	May include but are not limited to: 1.1 Office technology 1.2 Industrial technology 1.3 System technology 1.4 Information technology 1.5 Training technology
2. Management concepts	May include but not limited to: 2.1 Real Time Management 2.2 KAIZEN or continuous improvement 2.3 5S 2.4 Total Quality Management 2.5 Other management/productivity tools
3. Industry standard operating procedure	3.1 Written guidelines relative to the usage of office technology/equipment 3.2 Verbal advise/instruction from the co-worker
4. Manufacturer's operating guidelines/ instructions	4.1 Written instruction/manuals of specific technology/ equipment 4.2 General instruction manual 4.3 Verbal advise from manufacturer relative to the operation of equipment
5. Occupational health and safety procedure	5.1 Relevant statutes on OHS 5.2 Company guidelines in using technology/equipment
6. Appropriate action	6.1 Implementing preventive maintenance schedule 6.2 Coordinating with manufacturer's technician

EVIDENCE GUIDE

1. Critical Aspects of Competency	Assessment requires evidence that the candidate: 1.1 Studied and selected appropriate technology consistent with work requirements 1.2 Applied relevant technology 1.3 Maintained and enhanced operative ability of relevant technology
2. Required Knowledge and Attitudes	2.1 Awareness on technology and its function 2.2 Repair and maintenance procedure 2.3 Operating instructions 2.4 Applicable software 2.5 Communication techniques 2.6 Health and safety procedure 2.7 Company policy in relation to relevant technology 2.8 Different management concepts 2.9 Technology adaptability
3. Required Skills	3.1 Relevant technology application/implementation 3.2 Basic communication skills 3.3 Software applications skills 3.4 Basic troubleshooting skills
4. Resource Implications	The following resources **MUST** be provided: 4.1 Relevant technology 4.2 Interview and demonstration questionnaires 4.3 Assessment packages
5. Methods of Assessment	Competency must be assessed through: 5.1 Interview 5.2 Actual demonstration 5.3 Authenticated portfolio (related certificates of training/seminar)
6. Context of Assessment	6.1 Competency may be assessed in actual workplace or simulated environment

COMMON COMPETENCIES

UNIT TITLE : **PREPARE MATERIALS AND TOOLS**

UNIT CODE : **HVC713201**

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

ELEMENT	PERFORMANCE CRITERIA ***Italicized bold*** terms are elaborated in the Range of Variables
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
2. Requisition materials	2.1 Materials and tools needed are requested according to the list prepared 2.2 Request is done as per company standard operating procedures 2.3 Substitute materials and tools are provided without sacrificing cost and quality of the work
3. Receive and inspect materials	3.1 Materials and tools issued are inspected as per quantity and specification 3.2 Tools, accessories and materials checked for damages according to enterprise procedures 3.3 Materials and tools are set aside to appropriate location nearest to the workplace

RANGE OF VARIABLES

VARIABLE	RANGE
1. Materials and tools	1.1 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. Required Knowledge and Attitude	2.1 Types and uses of HVAC/R materials and tools 2.2 Different forms 2.3 Requisition procedures
3. Required Skills	3.1 Preparing materials and tools 3.2 Proper handling of tools and equipment 3.3 Following Instructions
4. Resource Implications	The following resources should be provided: 4.1 Workplace location 4.2 Materials relevant to the UNIT TITLE 4.3 Technical plans, drawings and specifications relevant to the activities
5. Method of Assessment	Competency in this unit must be assessed through: 5.1 Direct observation and 5.2 Oral questioning
6. Context for Assessment	6.1 Competency may be assessed in the workplace or in a simulated workplace 6.2 Competency assessment must be undertaken in accordance with the endorsed TESDA assessment guidelines

UNIT TITLE : **INTERPRET TECHNICAL DRAWINGS AND PLANS**

UNIT CODE : **HVC311202**

UNIT DESCRIPTOR : This unit covers the knowledge, skills and attitudes in analyzing and interpreting symbols, data and work plan based on the required performance standards.

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

RANGE OF VARIABLES

VARIABLE	RANGE
1. Technical plans	Including but not limited to: 1.1 Electrical Plans 1.2 Architectural Plans 1.3 Welding Procedures Specifications (WPS)
2. Work plan	2.1 Job requirements 2.2 Installation instructions 2.3 Components instruction
3. Classification	Including but not limited to: 3.1 Electrical 3.2 Mechanical
4. Drawing	4.1 Drawing symbols 4.2 Alphabet of lines 4.3 Orthographic views - Front view - Right side view/left side view - Top view - Pictorial 4.4 Schematic diagram 4.5 Electrical drawings 4.6 Structural drawings 4.7 Welding symbols
5. Tools and materials	Including but not limited to: 5.1 Compass 5.2 Divider 5.3 Rulers 5.4 Triangles 5.5 Drawing tables 5.6 Computer

EVIDENCE GUIDE

1. Critical Aspects of Competency	Assessment requires that the candidate: 1.1 Identified and determined signs, symbols and data according to work plan, job requirements and classifications 1.2 Identified tools and equipment in accordance with job requirements 1.3 Listed supplies and materials according to blueprint specifications 1.4 Drawn workplan following specifications 1.5 Demonstrated ability to determine job specifications based on working/technical drawing
2. Required Knowledge and Attitude	2.1 **TRADE MATHEMATICS** • Linear measurement • Dimension • Unit conversion 2.2 **BLUEPRINT READING AND PLAN SPECIFICATION** • Electrical, mechanical plan, symbols and abbreviations • Drawing standard symbols 2.3 **TRADE THEORY** • Basic Technical Drawing • Types Technical Plans • Various Types of Drawings • Notes and Specifications
3. Required skills	3.1 Interpreting drawing/orthographic drawing 3.2 Interpreting technical plans 3.3 Matching specification details with existing resources 3.4 Following instructions 3.5 Handling of drawing instruments
4. Resource implications	The following resources should be provided: 4.1 Workplace 4.2 Drawings and specification relevant to task 4.3 Materials and instrument relevant to proposed activity
5. Methods of assessment	Competency should be assessed through: 5.1 Direct Observation 5.2 Questions/Interview 5.3 Written test related to Required knowledge
6. Context of assessment	6.1 Competency assessment may occur in workplace or any appropriate simulated environment 6.2 Assessment shall be observed while task are being undertaken whether individually or in group 6.3 Competency assessment must be undertaken in accordance with the endorsed TESDA assessment guidelines

UNIT TITLE : **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 bold*** terms are elaborated in the Range of Variables
1. Identify and access specification/manuals	1.1 Appropriate manuals are identified and accessed as per job requirements 1.2 Version and date of manual is checked to ensure correct specification and procedure are identified
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
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
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

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. Required Knowledge and Attitude	2.1 Types of manuals used in HVAC/R sector 2.2 Identification of symbols used in the manuals 2.3 Identification of units of measurements 2.4 Unit conversion
3. Required Skills	3.1 Reading and comprehension skills required to identify and interpret construction manuals and specifications 3.2 Accessing information and data
4. Resource Implications	The following resources should be provided: 4.1 All manuals/catalogues relative to HVAC/R sector
5. Methods of Assessment	Competency should be assessed through: 5.1 Direct Observation 5.2 Questions/Interview Assessment of Required knowledge and practical skills may be combined
6. Context for Assessment	6.1 Competency assessment must be undertaken in accordance with the endorsed TESDA assessment guidelines 6.2 Assessment may be conducted in the workplace or a simulated environment

UNIT TITLE : **PERFORM MENSURATION AND CALCULATION**

UNIT CODE : **HVC311203**

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

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

RANGE OF VARIABLES

VARIABLE	RANGE
1. Geometric Shape	Including but 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

VARIABLE	RANGE
	3.18 Taper 3.19 Out of roundness 3.20 Oil clearance 3.21 End play/thrust clearance

EVIDENCE GUIDE

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

UNIT TITLE : **PERFORM BASIC BENCHWORK**

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 bench work based on the required performance standards.

ELEMENT	PERFORMANCE CRITERIA ***Italicized bold*** terms are elaborated in the Range of Variables
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 are checked following the standard operating procedures (SOPs)
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
3. Perform required benchworks	3.1 ***Work instructions are followed*** to ensure work safety 3.2 ***Benchworks*** are performed 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 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 Ball peen 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	
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. Benchworks	9.1 Cutting 9.2 Filing 9.3 Drilling	
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. Required Knowledge and Attitude	2.1 **TRADE MATHEMATICS** • Linear measurements • Dimensions • Unit conversion 2.2 **TRADE THEORY** • Basic Benchwork 2.3 **SAFETY PREFRIGERATIONTICES** • PPE • Handling of tools, supplies and equipment • Good housekeeping
3. Required Skills	3.1 Performing basic benchwork 3.2 Communicating effectively 3.3 Work safety 3.4 Preparing materials, tools and equipment 3.5 Proper handling of tools and equipment
4. Resource Implications	The following resources should be provided: 4.1 Workplace 4.2 Work plan 4.3 Materials, tools and equipment relevant to the proposed activity/task
5. Methods of Assessment	Competency may be assessed through: 5.1 Demonstration 5.2 Direct observation 5.3 Written/questioning related to Required knowledge
6. Context of Assessment	6.1 Competency assessment may occur in workplace or any appropriate simulated environment 6.2 Assessment shall be observed while task are being undertaken whether individually or in group 6.3 Competency assessment must be undertaken in accordance with the endorsed TESDA assessment guidelines

UNIT TITLE : **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 bold*** terms are elaborated in the Range of Variables
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
2. Test power supply and electrical components	2.1 Instruments are tested in accordance with PEC 2.2 Power supply and electrical components are checked in accordance with manufacturer's specifications/PEC 2.3 Defects of power supply and electrical components are identified and recorded 2.4 Safe working habits is observed
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

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. Required Knowledge and Attitude	2.1 **TRADE MATHEMATICS** • Linear measurements • Dimensions • Unit conversion 2.2 **TRADE THEORY** • Basic electricity 2.3 **SAFETY PREFRIGERATIONTICES** • PPE • Handling of tools and equipment • Good housekeeping
3. Required Skills	3.1 Installing and repairing electrical fixtures 3.2 Communicating effectively 3.3 Work safety 3.4 Proper handling of materials, tools and equipment 3.5 Preparing materials, tools and equipment 3.6 Wiring components 3.7 Testing power supply and electrical component
4. Resource Implications	The following resources should be provided: 4.1 Work place 4.2 Work plan 4.3 Materials, tools and equipment relevant to the proposed activity/task
5. Method of Assessment	Competency may be assessed through: 5.1 Direct observation 5.2 Written test/questioning relevant to Required knowledge
6. Context for Assessment	6.1 Competency assessment may occur in workplace or any appropriate simulated environment 6.2 Assessment shall be observed while task are being undertaken whether individually or in group

UNIT TITLE : **MAINTAIN TOOLS AND EQUIPMENT**

UNIT CODE : **HVC311205**

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

ELEMENT	PERFORMANCE CRITERIA ***Italicized bold*** terms are elaborated in the Range of Variables
1. Check condition of tools and equipment	1.1 ***Materials, tools and equipmen***t are identified according to classification and job requirements 1.2 Non-functional tools and equipment are segregated and labeled according to classification 1.3 Safety of tools and equipment are observed in accordance with manufacturer's instructions 1.4 Condition of ***PPE*** are checked in accordance with manufacturer's instructions
2. Perform basic preventive maintenance	2.1 Appropriate lubricants are identified according to types of equipment 2.2 Tools and equipment are lubricated according to preventive maintenance schedule or manufacturer's specifications 2.3 Measuring instruments are checked and calibrated in accordance with manufacturer's instructions 2.4 Tools are cleaned and lubricated according to standard procedures 2.5 Defective instruments, equipment and accessories are inspected and replaced according to manufacturer's specifications 2.6 Tools are inspected, repaired and replaced every after use 2.7 Work place are cleaned and in safe state in line with OHSA regulations
3. Store tools and equipment	3.1 Inventory of tools, instruments and equipment are conducted and recorded as per company practices 3.2 Tools and equipment are stored safely in appropriate locations in accordance with manufacturer's specifications or company procedures

RANGE OF VARIABLES

VARIABLE	RANGE
1. Materials	Including but not limited to: 1.1 Lubricants 1.2 Cleaning materials 1.3 Rust remover 1.4 Rugs 1.5 Spare parts
2. Tools and equipment	Including but not limited to: 2.1 Tools - Cutting tools - hacksaw, crosscut saw, rip saw - Boring tools - auger, brace, grinlet, hand drill - Holding tools - vise grip, C-clamp, bench vise - Threading tools - die and stock, taps 2.2 Measuring instruments/Equipment
3. PPE	Including but not limited to: 3.1 Goggles 3.2 Gloves 3.3 Safety shoes 3.4 Aprons/Coveralls
4. Forms	4.4 Maintenance schedule forms 4.5 Requisition Slip 4.6 Inventory Form Slip 4.7 Inspection Form Slip 4.8 Procedures

EVIDENCE GUIDE

1. Critical Aspects of Competency	Assessment requires that the candidate: 1.1 Selected and used appropriate processes, tools and equipment to carry out task 1.2 Identified functional and non-functional tools and equipment 1.3 Checked, lubricated and calibrated tools, equipment and instruments according to manufacturer's specifications 1.4 Replaced defective tools, equipment and its 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 work place in accordance with OHSA regulations 1.8 Stored tools and equipment safely in appropriate locations and in accordance with company practices
2. Required Knowledge and Attitude	2.1 **SAFETY PREFRIGERATIONTICES** • Use of PPE • Handling of tools and equipment • Good housekeeping 2.2 **MATERIALS, TOOLS AND EQUIPMENT** • Types and Uses of lubricants • Types and Uses of cleaning materials • Types and Uses of measuring instruments and equipment 2.3 **PREVENTIVE MAINTENANCE** • Methods and techniques • Procedures
3. Required Skills	3.1 Preparing maintenance materials, tools and equipment 3.2 Proper handling of tools and equipment 3.3 Performing preventive maintenance 3.4 Following instructions
4. Resource Implications	The following resources should be provided: 4.1 Work place 4.2 Maintenance Schedule 4.3 Maintenance materials, tools and equipment relevant to the proposed activity/task
5. Methods of Assessment	Competency should be assessed through: 5.1 Direct observation 5.2 Written test/questioning relevant to Required knowledge
6. Context for Assessment	6.1 Competency assessment may occur in workplace or any appropriate simulated environment 6.2 Competency assessment must be undertaken in accordance with the endorsed TESDA assessment guidelines

UNIT TITLE : **PERFORM HOUSEKEEPING AND SAFETY PRACTICES FOR REFRIGERATION 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 bold*** terms are elaborated in the Range of Variables
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
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
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
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 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

ELEMENT	PERFORMANCE CRITERIA ***Italicized bold*** terms are elaborated in the Range of Variables
	4.6 Work areas are kept clean, free from obstacles and emergency exits are know and kept clear at all times 4.7 Safe manual handling/fighting techniques and safe equipment operation techniques are employed at all times
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 enterprise procedures/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
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

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 - Danger-High Voltage - Unauthorized Persons Keep Out - No Smoking - Poisonous Gases - 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 Philippine Electrical Code 6.2 Philippine OH&S Standards 6.3 Building Code 6.4 Philippine Environmental Standards 6.5 Welding Procedures Specifications 6.6 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 Workplace emergency first-aid procedures/treatment are carried out in accordance with OHSA standards/legislation and enterprise procedures 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 Workplace kept in safe state in accordance with safety regulations
2. Required Knowledge and Attitude	2.1 Kinds and Uses of PPE 2.2 Identification of Safety Signs and Symbols 2.3 5S of Good Housekeeping 2.4 General OH&S principles, responsibilities and legislations 2.5 OH&S requirements in relations to work safety 2.6 Environmental requirements relative to work safety 2.7 Hazard identification and avoidance in the workplace 2.8 First-aid treatment procedures 2.9 Kinds of emergency situations – causes and how to deal with different situations 2.10 Kinds of injuries and effects 2.11 Accident/hazard reporting 2.12 Basic security procedures 2.13 Uses of Manuals
3. Required Skills	3.1 Wearing appropriate PPE 3.2 Reading skills required to interpret work instruction 3.3 Identifying safety signs and symbols 3.4 Practice of CPR, Mouth to Mouth Resuscitation and other First-Aid Treatment 3.5 Problem solving in emergency situation 3.6 Handling injured worker 3.7 Coordination of work in times of emergency 3.8 Fire fighting procedures and techniques 3.9 Reporting/recording accidents and potential hazards

4. Resource Implications	The following resources should be provided: 4.1 Work place 4.2 Materials, tools and equipment relevant to the proposed activity/task 4.3 Safety signs 4.4 Safety devices 4.5 Accident reporting procedures 4.6 First-aid materials and guidelines
5. Methods of Assessment	Competency should be assessed through: 5.1 Direct observation while task is being undertaken 21.1 Written test/questioning relevant to Required knowledge 21.2 Assessment of Required knowledge and practical skills may be combined
6. Context for Assessment	6.1 Competency assessment may occur in workplace or any appropriate simulated environment 6.3 Assessment shall be observed while task are being undertaken whether individually or in group in accordance with the approved industry OHSA regulations 6.4 Competency assessment must be undertaken in accordance with the endorsed TESDA assessment guidelines

UNIT TITLE : DOCUMENT WORK ACCOMPLISHED

UNIT CODE : HVC311205

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

ELEMENT	PERFORMANCE CRITERIA ***Italicized bold*** terms are elaborated in the Range of Variables
1. Identify forms and data	1.3 ***Forms*** are selected based on the reports to be prepared 1.4 ***Data*** are collected based on the reports to be prepared
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

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. Required Knowledge and Attitude	2.1 **SOURCES OF INFORMATION** • Service manual • Parts catalogue • Service report • Price estimates/quotation • Warranty card • Types and Uses of Forms • Parts and Accessories
3. Required Skills	3.1 Writing skills needed to complete prepared report forms 3.2 Reading skills used to read manuals and specifications
4. Resource Implications	Things necessary to conduct method of assessment: 4.1 Work place location 4.2 Materials relevant to the proposed activity
5. Methods Of Assessment	Competency in this unit must be assessed through: 5.1 Direct observation 5.2 Questions related to Required knowledge
6. Context For Assessment	6.1 Competency may be assessed in the work place or in a simulated work place setting

CORE COMPETENCIES

UNIT OF COMPETENCY: **INSTALL PACKAGE TYPE AIR-CONDITIONING UNIT (PACU)**

UNIT CODE **: HVC723340**

UNIT DESCRIPTOR **:** This unit covers the knowledge, skills and attitudes to safely install the main packaged-type air-conditioning unit (PACU) components and units as well as accessories based on manufacturer's recommendations. It also includes site survey, installation of electrical and piping systems.

ELEMENT	PERFORMANCE CRITERIA ***Italicized*** terms are elaborated in the Range of Variables
1. Survey site for installation	1.1 Work instructions /technical plans/drawings are interpreted as per job requirements 1.2 ***Installation requirements*** are verified in line with site conditions 1.3 Alteration/comments are prepared as per survey conducted 1.4 Result of survey is prepared in line with enterprise procedures.
2. Install PACU piping systems	2.1 ***Piping materials*** are prepared consistent with the approved designs and specifications 2.2 Brackets and supports are mounted in accordance with site conditions 2.3 Piping are installed, cleaned and tested in accordance with manufacturer's specifications, recommendations and RAC Code of Practice 2.4 Correct insulation and sealing/adhesive materials are used and installed in accordance with manufacturer's specifications
3. Install PACU electrical systems	3.1 ***Electrical materials*** are prepared consistent with job requirements and are checked for damage 3.2 Appropriate PPE is selected in line with the job requirements 3.3 ***Electrical system*** is laid-out and installed in accordance with the approved designs, specifications, working plans, drawings and applicable provisions of the latest edition of PEC 3.4 Electrical system is tested/energized in line with applicable provisions of the latest edition of PEC 3.5 Report on testing/energization of electrical system is prepared in line with enterprise procedures

4. Install indoor and outdoor unit and accessories	4.1 ***Indoor units*** and air-cooled condensing units (ACCUs) are mounted in accordance with site conditions and manufacturer's specifications 4.2 ***Accessories*** are installed according to manufacturer's specifications 4.3 ***Refrigerant lines*** are connected in accordance with manufacturer's specifications 4.4 Field wiring connections are terminated in accordance with manufacturer's specifications 4.5 ***Condensate drain*** line is installed in accordance with manufacturer's specification. 4.6 Faults/problems arising from installation are corrected in line with standard operating procedures 4.7 ***Pre-start up checks*** are undertaken in accordance with manufacturer's specifications and enterprise policies

RANGE OF VARIABLES

VARIABLE	RANGE
1 Installation requirements	May include: 1.1 Piping requirements 1.2 Electrical requirements 1.3 Drain location 1.4 Mounting location 1.5 Equipment requirements
2 Piping materials	May include: 2.1 Pipes and fittings 2.2 Tubing 2.3 Insulations 2.4 Hangers, clamps, brackets
3 Electrical materials	May include: 3.1 Electrical tape 3.2 Wire connector 3.3 Wires and cables 3.4 Breaker 3.5 Terminal clips/plugs
4 Electrical system	May include: 4.1 Electrical conduits 4.2 Controls and protective devices 4.3 Electrical control wires/cables 4.4 Power supply
5 Indoor units	**May include:** 5.1 Package-type air-con 5.2 Split-type air-con 5.2.1 Cassette type 5.2.2 Ceiling (free-blow) 5.2.3 Ceiling concealed 5.2.4 Wall type 5.2.5 Floor mounted
6 Refrigerant lines	May include: 6.1 Gas lines (vapor lines) 6.2 Liquid lines
7 Condensate drain	May include: 7.1 PVC pipe/clamp 7.2 Plastic tubing/clamp 7.3 G.I. or metal tubing/clamp
8 Accessories	May include: 8.1 filter drier (soldered/flared) 8.2 sight glass or moisture indicator 8.3 solenoid valve (optional)
9 Pre-start up checks	May include: 9.1 Insulation 9.2 Termination 9.3 Sequence test 9.4 Refrigerant leakage 9.5 Equipment

EVIDENCE GUIDE

1. Critical aspects of competency	Assessment requires evidence that the candidate: 1.1 Conducted survey of site for installation of the unit. 1.2 Prepared and installed piping materials correctly. 1.3 Used and installed correct insulation and sealing/adhesive materials. 1.4 Prepared, laid out and installed electrical system correctly. 1.5 Tested/Energized electrical system in line with applicable provision of latest edition of PEC. 1.6 Installed indoor and outdoor units and accessories accordingly. 1.7 Corrected faults/problems arising from installation. 1.8 Undertook pre-start up checks.
2. Required Knowledge and Attitude	2.1 **SAFETY PRACTICES** • Protective personal equipment/safety gears • Handling of tools, equipment and accessories • Safety signs and symbols • Good housekeeping 2.2 **TRADE MATHEMATICS/MENSURATION** • Linear measurements • Ratio and proportion • Dimension 2.3 **BLUEPRINT READINGS** • Mechanical plans, symbols and abbreviations • Electrical plans, symbols and abbreviations • Architectural/Structural plans • Plumbing plans, symbols and abbreviations 2.4 **TRADE THEORY** • Basic refrigeration cycle • Basic masonry • Basic sheet metal • Basic welding • Basic electricity • Basic plumbing • Fundamental of refrigeration • How to select wire size • Principles of air distribution • Equipment selection and application • Knowledge to understand the geographical location/site location 2.5 **LEGISLATION** • Clean Air Act (RA 8749) • Montreal Protocol/DENR rules • Ozone Depleting Refrigerants (ODRs)

3. Required Skills	3.1 Interpreting plan and details 3.2 Preparing materials 3.3 Proper handling of tools and equipment 3.4 Performing work safety practices 3.5 Work set-up and planning 3.6 Basic electrical installation 3.7 Tube processing 3.8 Plumbing works Communication skills
4. Resource Implications	The following resources **MUST** be provided: 4.1 Technical plan/drawing relevant to the task Work place location 4.2 Tools and equipment appropriate to installing PACU processes 4.3 Materials relevant to the proposed activity 4.4 Drawings and specifications relevant to the task
5. Methods of Assessment	Competency must be assessed through: 5.1 Direct observation 5.2 Demonstration 5.3 Questions related to Required knowledge
6. Context for Assessment	6.1 Competency may be assessed in the work place or in a simulated work place setting

UNIT OF COMPETENCY: INSTALL COMMERCIAL REFRIGERATION EQUIPMENT (CRE)

UNIT CODE : HVC723341

UNIT DESCRIPTOR : This unit covers the knowledge, skills and attitudes to safely install the main commercial refrigeration equipment (CRE) components as well as accessories based on manufacturer's recommendations. It also includes site survey, installation of electrical and piping systems.

ELEMENT	PERFORMANCE CRITERIA ***Italicized*** terms are elaborated in the Range of Variables
1. Survey site for installation	1.1 Work instructions /technical plans/drawings are interpreted as per job requirements 1.2 ***Installation requirements*** are verified in line with site conditions 1.3 Alteration/comments are prepared as per survey conducted 1.4 Result of survey is prepared in line with enterprise procedures.
2. Install CRE piping systems	2.1 ***Piping materials*** are prepared consistent with the approved designs and specifications 2.2 Brackets and supports are mounted in accordance with site conditions 2.3 Piping are installed, cleaned and tested in accordance with manufacturer's specifications, recommendations and RAC Code of Practice 2.4 Correct insulation and sealing/adhesive materials are used and installed in accordance with manufacturer's specifications
3. Install CRE electrical systems	3.1 ***Electrical materials*** are prepared consistent with job requirements and are checked for damage 3.2 Appropriate PPE is selected in line with the job requirements 3.3 ***Electrical system*** is laid-out and installed in accordance with the approved designs, specifications, working plans, drawings and applicable provisions of the latest edition of PEC 3.4 Electrical system is tested/energized in line with applicable provisions of the latest edition of PEC 3.5 Report on testing/energization of electrical system is prepared in line with enterprise procedures

4. Install indoor and outdoor unit and accessories	4.1 ***Indoor units*** and air-cooled condensing units (ACCUs) are mounted in accordance with site conditions and manufacturer's specifications 4.2 ***Accessories*** are installed according to manufacturer's specifications 4.3 ***Refrigerant lines*** are connected in accordance with manufacturer's specifications 4.4 Electrical connections are terminated in accordance with manufacturer's specifications 4.5 ***Condensate drain*** line is installed in accordance with manufacturer's specification. 4.6 Faults/problems arising from installation are corrected in line with standard operating procedures 4.7 ***Pre-start up checks*** are undertaken in accordance with manufacturer's specifications and enterprise policies

RANGE OF VARIABLES

VARIABLE	RANGE
1 Installation requirements	May include: 1.1 Piping requirements 1.2 Electrical requirements 1.3 Drain location 1.4 Mounting location 1.5 Equipment requirements
2 Piping materials	May include: 2.1 Pipes and fittings 2.2 Tubing 2.3 Insulations 2.4 Hangers, clamps, brackets
3 Electrical materials	May include: 3.1 Electrical tape 3.2 Wire connector 3.3 Wires and cables 3.4 Breaker 3.5 Terminal clips/plugs
4 Electrical system	May include: 4.1 Electrical conduits 4.2 Controls and protective devices 4.3 Electrical control wires/cables 4.4 Power supply
5 Indoor units	**Indoor units may include:** 5.1 Walk-in cooler/freezer evaporator 5.2 Reach-in chiller/freezer evaporator
6 Refrigerant lines	May include: 6.1 Gas lines (vapor lines) 6.2 Liquid lines
7 Condensate drain	May include: 7.1 PVC pipe/clamp 7.2 Plastic tubing/clamp 7.3 G.I. or metal tubing/clamp
8 Accessories	May include: 8.1 filter drier (soldered/flared) 8.2 sight glass or moisture indicator 8.3 solenoid valve 8.4 high pressure control (HPC) 8.5 low pressure control (LPC) 8.6 defrost timer 8.7 evaporator pressure regulator (EPR) 8.8 non-return valve
9 Pre-start up checks	9.1 Insulation 9.2 Termination 9.3 Sequence test 9.4 Refrigerant leakage 9.5 Equipment

EVIDENCE GUIDE

1. Critical aspects of competency	Assessment requires evidence that the candidate: 1.1 Conducted survey of site for installation of the unit. 1.2 Prepared and installed piping materials correctly. 1.3 Used and installed correct insulation and sealing/adhesive materials. 1.4 Prepared, laid out and installed electrical system correctly. 1.5 Tested/Energized electrical system in line with applicable provision of latest edition of PEC. 1.6 Installed indoor and outdoor units and accessories accordingly. 1.7 Corrected faults/problems arising from installation. 1.8 Undertook pre-start up checks.
2. Required Knowledge and Attitude	2.1 **SAFETY PRACTICES** • Protective personal equipment/safety gears • Handling of tools, equipment and accessories • Safety signs and symbols • Good housekeeping 2.2 **TRADE MATHEMATICS/MENSURATION** • Linear measurements • Ratio and proportion • Dimension 2.3 **BLUEPRINT READINGS** • Mechanical plans, symbols and abbreviations • Electrical plans, symbols and abbreviations • Architectural/Structural plans • Plumbing plans, symbols and abbreviations 2.4 **TRADE THEORY** • Basic refrigeration cycle • Basic masonry • Basic sheet metal • Basic welding • Basic electricity • Basic plumbing • Knowledge to understand the geographical location/site location 2.6 **LEGISLATION** • Clean Air Act (RA 8749) • Montreal Protocol/DENR rules • Ozone Depleting Refrigerants (ODRs)

3. Required Skills	3.1 Interpreting plan and details 3.2 Preparing materials 3.3 Proper handling of tools and equipment 3.4 Performing work safety practices 3.5 Work set-up and planning 3.6 Basic electrical installation 3.7 Tube processing 3.8 Plumbing works
4. Resource Implications	The following resources **MUST** be provided: 4.1 Work place location 4.2 Tools and equipment appropriate to installing CRE processes 4.3 Materials relevant to the proposed activity 4.4 Drawings and specifications relevant to the task
5. Methods of Assessment	Competency must be assessed through: 5.4 Direct observation 5.5 Demonstration 5.6 Questions related to Required knowledge
6. Context for Assessment	6.1 Competency may be assessed in the work place or in a simulated work place setting

UNIT OF COMPETENCY: SERVICE AND MAINTAIN PACKAGE TYPE AIR-CONDITIONING UNIT (PACU)

UNIT CODE : HVC723342

UNIT DESCRIPTOR : This unit covers the knowledge, skills and attitudes in maintaining air-conditioner system, components and accessories including lubrication and air-distribution systems PACU.

ELEMENT	PERFORMANCE CRITERIA ***Italicized*** terms are elaborated in the Range of Variables
1 Prepare for maintenance activities	1.1 Work instructions are read and interpreted to determine job requirements 1.2 Appropriate manufacturer's manual is consulted if available; otherwise, standard maintenance procedures are adopted. 1.3 Tools and equipment are selected in accordance with job requirements 1.4 Work safety is observed according to enterprise regulations
2 Check and adjust air-conditioning accessories, controls and operating conditions	2.1 Evaporator/condenser coils are cleaned in accordance with manufacturer's maintenance manual. 2.2 Refrigerant piping is checked for ***abnormal condition***s based on procedure. 2.3 ***Operation/Controls/Settings*** are checked and adjusted in accordance with manufacturer's specifications. 2.4 ***Air-conditioning accessories*** are adjusted accordingly based on manufacturer's maintenance manual. 2.5 Maintenance procedures are applied according to manufacturer's maintenance manual
3 Maintain lubrication system in PACU	3.1 Lubrication system variables and components are checked and adjusted based on manufacturer’s maintenance manual 3.2 ***Oil parameters*** are checked and adjusted based on manufacturer’s specifications 3.3 Oil leaks and restrictions are detected and rectified based on standard maintenance procedures 3.4 Used oil is disposed properly according to RAC Code of Practice.
4 Maintain refrigeration system in PACU	4.1 ***Operating parameters*** are measured and analyzed based on standard specifications 4.2 Pressure and temperature drops across strainer, filters and filter driers are checked and recorded based on standard maintenance procedures 4.3 Leak testing is performed based on RAC Code of Practice. 4.4 ***Refrigeration components, accessories and consumables*** are checked for contaminants in accordance manufacturer’s manual or RAC Code of Practice.
5 Maintain air distribution system in PACU	5.1 ***Air distribution system*** components are checked and air flows are balanced based on manufacturer’s specifications 5.2 Outdoor air supply systems are checked and maintained to meet operational and regulatory requirements

RANGE OF VARIABLES

VARIABLE	RANGE
1. Abnormal conditions	May include: 1.1 leaks 1.2 insulation cracks 1.3 looseness of supports/brackets
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
3. Air-conditioning accessories	May include: 3.1. Pulley alignment/belt tension 3.2. Unloader 3.3. Fan blades/blower 3.4. Motors
4. Oil parameters	May include: 4.1 Oil levels 4.2 Oil properties 4.3 Purity of oil 4.4 Oil viscosity
5. Operating parameters	May include: 5.1. Operating temperature 5.2. Superheat 5.3. pressure 5.4. voltage 5.5. current 5.6. air velocity 5.7. sound level and vibration
6. Refrigeration components, accessories and consumables	6.1. Components: 6.1.1. Expansion valves 6.1.2. Evaporator 6.1.3. Compressor 6.1.4. Condenser 6.2. Accessories 6.2.1. Filter/dryer 6.2.2. Sight glass 6.3. Consumables 6.3.1. Oil 6.3.2. Refrigerant
7. Air distribution system	May include: 7.1. Air swing 7.2. Ducting system 7.3. Grilles 7.4. Louvers

EVIDENCE GUIDE

1. Critical aspects of competency	Assessment requires evidence that the candidate: 1.1 Prepared for maintenance activities. 1.2 Checked and adjusted air-conditioning accessories, controls and operating conditions 1.3 Applied maintenance procedures according to manufacturer's maintenance manual. 1.4 Checked and maintained lubrication system in PACU. 1.5 Checked and maintained refrigeration system in PACU. 1.6 Checked and maintained air distribution system in PACU. 1.7 Communicated interactively with others where applicable to ensure safe and effective work operations

2. Required Knowledge and Attitude	2.1 **SAFETY PRACTICES**
	• Protective personal equipment/safety gear
	• Safety hazards
	• Handling of tools and equipment and accessories
	• Safety signs and symbols
	• Proper handling of refrigerant pressure testing
	• Good housekeeping
	2.2 **TRADE MATHEMATICS/ MENSURATIONS**
	• Linear measurements
	• Dimension
	• Ratio and proportion
	• Unit conversion
	2.3 **TOOLS/MATERIALS: USES AND SPECIFICATIONS**
	• Proper use and care of tools needed
	• Types of electrical controls
	• Types expansion valves/motoring devices
	• Types of compressor
	• Types of refrigerant
	• Types of pulley
	• Types of belts
	• Types of latches
	• Types of door hinges
	• Types of coil cleaner
	• Types of fins and materials use
	2.4 **LEGISLATION**
	• Clean Air Act (RA 8749)
	• Montreal Protocol/ DENR rules
	• Ozone Depleting Refrigerants (ODRs)
	• Chemical Control Orders (CCOs) and other issuances relating to ozone-depleting substances (ODS):
	  • R.A. 6969 – Toxic substances and hazardous and nuclear wastes control act of 1990.
	  • DENR-AO 1992-29 - IRR of R.A. 6969
	  • DENR-AO 2004-08 – Revised CCO for ODS
	  • EMB MC 2005-03 – Alternatives to ODS
	2.5 **BLUEPRINT READINGS**
	• Plan specification
	• Electrical wiring diagram
	• Electrical plans, symbols and abbreviations

	2.6 **TRADE THEORY** • Fundamentals of refrigeration • Basic refrigeration cycle • Refrigeration service valves • Basic electricity • Understanding of troubleshooting charts/service charts • Expansion device and low pressure side of the system • How to charge the system • How to evaluate the system • Pump down procedure • Resistance testing procedure • Mechanical testing procedure • Compressor construction • Refrigerant charging procedure • TXV adjustment procedure • AXV adjustment procedure • Humidifier equipment servcing
3. Required Skills	3.1 Interpreting plans and details 3.2 Preparing materials 3.3 Using of electrical and mechanical tools & equipment properly 3.4 Troubleshooting technique 3.5 Calibrating of expansion valve 3.6 Replacing defective part 3.7 Troubleshooting of PACU system 3.8 Performing work safety practices 3.9 Adjusting superheat 3.10 Aligning belt and pulley
4. Resource Implications	The following resources **MUST** be provided: 4.1 Work place location 4.2 Tools and equipment appropriate to maintaining PACU processes 4.3 Materials relevant to the activity 4.4 Drawings and specifications relevant to the task
5. Methods of Assessment	Competency must be assessed through: 5.1 Direct observation 5.2 Demonstration 5.3 Questions related to Required knowledge
6. Context for Assessment	6.1 Competency may be assessed in the work place or in a simulated work place setting

UNIT OF COMPETENCY: SERVICE AND MAINTAIN COMMERCIAL REFRIGERATION EQUIPMENT (CRE)

UNIT CODE : HVC723343

UNIT DESCRIPTOR : This unit covers the knowledge, skills and attitudes in maintaining refrigeration system, components and accessories including lubrication and air-distribution systems in CRE.

ELEMENT	PERFORMANCE CRITERIA ***Italicized*** terms are elaborated in the Range of Variables
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 enterprise regulations
2. Check and adjust refrigeration accessories, controls and operating conditions	2.1. Evaporator/condenser coils are cleaned in accordance with manufacturer's maintenance manual. 2.2. Refrigerant piping is checked for ***abnormal condition***s based on procedure. 2.3. ***Operation/Controls/Settings*** are checked and adjusted in accordance with manufacturer's specifications. 2.4. ***Refrigeration accessories*** are adjusted accordingly based on manufacturer's maintenance manual. 2.5. Maintenance procedures are applied according to manufacturer's maintenance manual
3. Maintain lubrication system in CRE	3.1. Lubrication system variables and components are checked and adjusted based on manufacturer’s maintenance manual 3.2. Oil parameters are checked and adjusted based on manufacturer’s specifications 3.3. Oil leaks and restrictions are detected and rectified based on manufacturer’s maintenance manual 3.4. Used oil is disposed properly according to RAC Code of Practice.
4. Maintain refrigeration system in CRE	4.1. ***Operating parameters*** are measured and analyzed based on manufacturer’s standards and/or RAC Code of Practice. 4.2. Pressure and temperature drops across strainer, filters and filter driers are checked and recorded based on manufacturer’s maintenance manual and/or RAC Code of Practice 4.3. Leak testing is performed based on RAC Code of Practice. 4.4. ***Refrigeration components, accessories and consumables are*** checked for contaminants in accordance manufacturer’s manual or RAC Code of Practice.
5. Maintain air distribution system in CRE	5.1 ***Air distribution system*** components are checked and air flows are balanced based on manufacturer’s specifications. 5.2 Outdoor air supply systems are checked and maintained to meet operational and regulatory requirements.

RANGE OF VARIABLES

VARIABLE	RANGE
1. Work instructions	May include: 1.1 Work permits 1.2 Job orders 1.3 Blueprints
2. Abnormal conditions	May include: 1.8 leaks 1.9 insulation cracks 1.10 looseness of supports/brackets
3. Operation/Controls/Settings	May include: 3.1 Pressures 3.2 Temperatures 3.3 Voltages 3.4 Current draws 3.5 Air flow 3.6 Noise level 3.7 Vibrations
4. Refrigeration accessories	May include: 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
5. Oil parameters	May include: 5.1 Oil levels 5.2 Oil properties 5.3 Purity of oil 5.4 Oil viscosity
6. Operating parameters	May include: 6.1 Operating temperature 6.2 Superheat 6.3 pressure 6.4 voltage 6.5 current 6.6 air velocity 6.7 sound level and vibration

7. Refrigeration components, accessories and consumables	May include: 7.1 Components: 7.1.1 Expansion valves 7.1.2 Evaporator 7.1.3 Compressor 7.1.4 Condenser 7.2 Accessories 7.2.1 Filter/dryer 7.2.2 Sight glass 7.3 Consumables 7.3.1 Oil 7.3.2 Refrigerant
8. Air distribution system	May include: 8.1 Grilles 8.2 Louvers 8.3 Evaporator blower

EVIDENCE GUIDE

1 Critical aspects of competency	Assessment requires evidence that the candidate: 1.1 Prepared for maintenance activities. 1.2 Checked and adjusted 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 CRE. 1.5 Checked and maintained refrigeration system in CRE. 1.6 Checked and maintained air distribution system in CRE. 1.7 Communicated interactively with others where applicable to ensure safe and effective work operations

2 Required Knowledge and Attitude	2.1 **SAFETY PRACTICES**
	• Protective personal equipment/safety gear
	• Safety hazards
	• Handling of tools and equipment and accessories
	• Safety signs and symbols
	• Proper handling of refrigerant pressure testing
	• Good housekeeping
	2.2 **TRADE MATHEMATICS/ MENSURATIONS**
	• Linear measurements
	• Dimension
	• Ratio and proportion
	• Unit conversion
	2.3 **TOOLS/MATERIALS: USES AND SPECIFICATIONS**
	• Proper use and care of tools needed
	• Types of electrical controls
	• Types expansion valves/motoring devices
	• Types of compressor
	• Types of refrigerant
	• Types of pulley
	• Types of belts
	• Types of latches
	• Types of door hinges
	• Types of coil cleaner
	• Types of fins and materials use
	2.4 **LEGISLATION**
	• Clean Air Act (RA 8749)
	• Montreal Protocol/ DENR rules
	• Ozone Depleting Refrigerants (ODRs)
	• Chemical Control Orders (CCOs) and other issuances relating to ozone-depleting substances (ODS):
	  • R.A. 6969 – Toxic substances and hazardous and nuclear wastes control act of 1990.
	  • DENR-AO 1992-29 - IRR of R.A. 6969
	  • DENR-AO 2004-08 – Revised CCO for ODS
	  • EMB MC 2005-03 – Alternatives to ODS
	2.5 **BLUEPRINT READINGS**
	• Plan specification
	• Electrical wiring diagram
	• Electrical plans, symbols and abbreviations

	2.6 **TRADE THEORY** • Fundamentals of refrigeration • Basic refrigeration cycle • Refrigeration service valves • Basic electricity • Understanding of troubleshooting charts/service charts • Expansion device and low pressure side of the system • How to charge the system • How to evaluate the system • Pump down procedure • Resistance testing procedure • Mechanical testing procedure • Compressor construction • Refrigerant charging procedure • TXV adjustment procedure • AXV adjustment procedure
3 Required Skills	3.1 Interpreting plans and details 3.2 Preparing materials 3.3 Using of electrical and mechanical tools and equipment properly 3.4 Troubleshooting technique 3.5 Calibrating of expansion valve 3.6 Replacing defective part 3.7 Troubleshooting of PACU/CRE system 3.10 Performing work safety practices 3.11 Adjusting superheat 3.10 Aligning belt and pulley 3.11 Aligning door
4 Resource Implications	The following resources **MUST** be provided: 4.1 Work place location 4.2 Tools and equipment appropriate to maintaining PACU/CRE processes 4.3 Materials relevant to the activity 4.4 Drawings and specifications relevant to the task
5 Methods of Assessment	Competency must be assessed through: 1.1 Direct observation 1.2 Questions related to Required knowledge
6 Context for Assessment	6.1 Competency may be assessed in the work place or in a simulated work place setting

UNIT OF COMPETENCY: TROUBLESHOOT AND REPAIR PACKAGE TYPE AIR-CONDITIONING UNIT (PACU)

UNIT CODE : HVC723344

UNIT DESCRIPTOR : This unit covers the knowledge, skills and attitudes in troubleshooting and repairing air-conditioning systems. It includes planning troubleshooting and repair, preparing materials, tools and equipment and identifying and repairing faults as well as recover/recycle and retrofit PACU.

This standard covers only split and package type air-conditioning unit with capacity range from 1 to 10 TR direct expansion type.

ELEMENT	PERFORMANCE CRITERIA ***Italicized*** terms are elaborated in the Range of Variables
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 Power supply is checked to ensure compliance with nameplate rating and/or manufacturer's specifications
2. Identify and repair faults/problems	2.1 Appropriate ***PPE*** is selected and used in line with the job requirements 2.2 ***Refrigeration system components*** are tested following manufacturer's manual, RAC Code of Practice and/or enterprise troubleshooting policy 2.3 ***Faults/problems*** with refrigerant system are diagnosed in line with manufacturer's manual, RAC Code of Practice and/or enterprise troubleshooting policy 2.4 Remedial action is taken to overcome faults/problems in line with manufacturer's manual, RAC Code of Practice and/or enterprise troubleshooting policy 2.5 Work is completed safely in line with enterprise safety guidelines 2.6 Report on testing procedure, including faults and repair, is completed in line with RAC Code of Practice and/or enterprise troubleshooting policies.

3. Perform refrigerant recovery/ recycling and retrofitting on air conditioning systems	3.1 Safe working practices are observed throughout the task as per enterprise procedure 3.2 Suitable tools and equipment are selected and used based on job requirement 3.3 Optimum recovery of refrigerant is performed in line with RAC Code of Practice 3.4 Refrigerants recovery/recycling is performed according to ***manufacturer's recommendations*** and RAC Code of Practice 3.5 Retrofitting is performed based on RAC Code of Practice
4. Test run air-conditioning unit	4.1 ***Air-conditioning unit*** is tested in line with manufacturer's instructions 4.2 Report on testing air-conditioning unit is prepared in line with enterprise procedures

RANGE OF VARIABLES

VARIABLE	RANGE
1. PPE	Includes but is not limited to: 1.1. Mask 1.2. Safety shoes 1.3. Safety goggles 1.4. Apron 1.5. Gloves
2. Refrigeration system components	2.1. Components: 2.1.1. Expansion valves 2.1.2. Evaporator 2.1.3. Compressor 2.1.4. Condenser 2.2. Accessories 2.2.1. Filter/dryer 2.2.2. Sight glass 2.3. Consumables 2.3.1. Oil 2.3.2. Refrigerant
3. Faults/problems in diagnosing	May include: 3.1. Leakage 3.2. Contamination 3.3. Fractionation 3.4. Restriction
4. Manufacturer's recommendations	Includes but not limited to: 4.1. Equipment operator's manual 4.2. Equipment service manual 4.3. Nameplate data
5. Air-conditioning unt	5.1. Split type 5.2. Package type

EVIDENCE GUIDE

1. Critical aspects of competency	Assessment requires evidence that the candidate: 1.1 Interpreted appropriate wiring diagrams, charts and manuals. 1.2 Checked power supply in compliance with nameplate rating and/or manufacturer's standard 1.3 Tested refrigerant system components as per standard procedures 1.4 Diagnosed and repaired faults/problems. 1.5 Demonstrated compliance with safety regulations applicable to worksite operations 1.6 Performed refrigerant recovery/recycling and retrofitting accordingly. 1.7 Test run air-conditioning unit in line with manufacturer's instruction. 1.8 Communicated Interactively others where applicable to ensure safe and effective work operations
2. Required Knowledge and Attitude	2.1 **SAFETY PRACTICES** • Protective personal equipment/safety gears • Safe handling of tools and equipment • Proper handling of refrigerants • Safety signs and symbols • Safety hazard • Good housekeeping 2.2 **BLUEPRINT READING AND PLAN SPECIFICATION** • Electrical wiring control diagram • Mechanical plan/symbols and abbreviation 2.3 **TRADE THEORY** • Basic electricity • Basic refrigeration cycle • Fundamentals of refrigeration and control • Interlocking control sequence • Fundamentals of piping • Fan characteristics • Electrical code • Montreal protocol • EMB/DENR regulations • Pump principles • Cooling tower principles

	2.4 **TOOLS/MATERIALS: USES AND SPECIFICATIONS**
	• Types of electrical controls
	• Types of expansion valve
	• Types of compressor motor
	• Types of condenser
	• Types of evaporator
	• Types of refrigerant
	• Types of pressure control
	• Types of defrost timer
	• Types of fan motor
	• Types of fan
	• Types of pipe
	• Types of filter drier
	• Types of filter/strainer element
	• Types of thermostat
	• Types of circuit breaker
	• Types of magnetic contactor
	• Types of unloader
	• Types of compressor
	• Types of pump
	2.5 **MAINTENANCE**
	• Preventive maintenance
	2.6 **LEGISLATION**
	• Clean Air Act
	• Montreal Protocol
	• Ozone Depleting Refrigerants (ODRs)
	• Chemical Control Orders (CCOs) and other issuances relating to ozone-depleting substances (ODS):
	  • R.A. 6969 – Toxic substances and hazardous and nuclear wastes control act of 1990.
	  • DENR-AO 1992-29 - IRR of R.A. 6969
	  • DENR-AO 2004-08 – Revised CCO for ODS
	  • EMB MC 2005-03 – Alternatives to ODS
		2.7 **PROCESSES/ PROCEDURES**
		• Compressor test procedures
		• Power supply test procedures
		• Cooler/evaporator test procedures
		• Condensing unit test procedures
		• Pump test procedures
		• Cooling tower test procedures
		• Thermostatic expansion valve test procedures
		• Automatic expansion valve test procedures
		• Electrical control test procedures
		• Leak testing procedure (for refrigeration circuit and water piping)
		• Pressure testing procedure
		• Vacuum testing procedure
		• Refrigerant charging procedure
		• Pumpdown procedure
		• Crank case heater test procedures
		• Unloading test procedures
		• Start-up procedure

3. Required Skills	3.1 Interpreting plan and details 3.2 Preparing materials 3.3 Following work safety 3.4 Using electrical tools and testing equipment 3.5 Performing electrical testing 3.6 Performing mechanical testing 3.7 Communicating skills
4. Resource Implications	The following resources **MUST** be provided: 4.1 Work place location 4.2 Tools and equipment appropriate to troubleshooting refrigerant system 4.3 Materials relevant to the proposed activity 4.4 Drawings and specifications relevant to the task
5. Methods of Assessment	Competency must be assessed through: 5.1 Direct observation 5.2 Questions related to Required knowledge
6. Context for Assessment	6.1 Competency may be assessed in the work place or in a simulated work place setting

UNIT OF COMPETENCY: TROUBLESHOOT AND REPAIR COMMERCIAL REFRIGERATION EQUIPMENT (CRE)

UNIT CODE : HVC723345

UNIT DESCRIPTOR : This unit covers the knowledge, skills and attitudes in troubleshooting and repairing refrigeration systems. It includes planning troubleshooting and repair, preparing materials, tools and equipment and identifying and repairing faults. This standard covers refrigeration equipment used in commercial applications.

ELEMENT	PERFORMANCE CRITERIA ***Italicized*** terms are elaborated in the Range of Variables
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 Power supply is checked to ensure compliance with nameplate rating and/or manufacturer's specifications
2. Identify and repair faults/troubles	2.1 Appropriate ***PPE*** is selected and used in line with the job requirements 2.2 ***Refrigeration system components*** are tested following manufacturer's manual, RAC Code of Practice and/or enterprise troubleshooting policy 2.3 ***Faults/problems*** with refrigerant system are diagnosed in line with manufacturer's manual, RAC Code of Practice and/or enterprise troubleshooting policy 2.4 Remedial action is taken to overcome faults/problems in line with manufacturer's manual, RAC Code of Practice and/or enterprise troubleshooting policy 2.5 Work is completed safely in line with enterprise safety guidelines 2.6 Report on testing procedure, including faults and repair, is completed in line with RAC Code of Practice and/or enterprise troubleshooting policies.

3. Perform refrigerant recovery/ recycling and retrofitting on commercial refrigeration systems	3.1 Safe working practices are observed throughout the task as per enterprise procedure 3.2 Suitable tools and equipment are selected and used based on job requirement 3.3 Optimum recovery of refrigerant is performed in line with RAC Code of Practice 3.4 Refrigerants recovery/recycling is performed according to ***manufacturer's recommendations*** and RAC Code of Practice 3.5 Retrofitting is performed based on RAC Code of Practice
4. Test run CRE	4.1 Equipment is tested in line with manufacturer's instructions 4.2 Report on testing equipment is prepared in line with enterprise procedures

RANGE OF VARIABLES

VARIABLE	RANGE
1. PPE	Includes but is not limited to: 1.1. Mask 1.2. Safety shoes 1.3. 1Safety goggles 1.4. Apron 1.5. Gloves
2. Refrigeration system components	2.1. Components: 2.1.1. Expansion valves 2.1.2. Evaporator 2.1.3. Compressor 2.1.4. Condenser 2.2. Accessories 2.2.1. Filter/dryer 2.2.2. Sight glass 2.3. Consumables 2.3.1. Oil 2.3.2. Refrigerant
3. Faults/problems in diagnosing	May include: 3.1 Leakage 3.2 Contamination 3.3 Fractionation 3.4 Restriction
4. Manufacturer's recommendations	Includes but not limited to: 4.1. Equipment operator's manual 4.2. Equipment service manual 4.3. Nameplate data

EVIDENCE GUIDE

1. Critical aspects of competency	Assessment requires evidence that the candidate: 1.1 Interpreted appropriate wiring diagrams, charts and manuals. 1.2 Checked power supply in compliance with nameplate rating and/or manufacturer's standard 1.3 Tested refrigerant system components as per standard procedures 1.4 Diagnosed and repaired faults/problems. 1.5 Demonstrated compliance with safety regulations applicable to worksite operations 1.6 Performed refrigerant recovery/recycling and retrofitting accordingly. 1.7 Test run air-conditioning unit in line with manufacturer's instruction. 1.8 Communicated Interactively others where applicable to ensure safe and effective work operations
2. Required Knowledge and Attitude	2.1 **SAFETY PRACTICES** • Protective personal equipment/safety gears • Safe handling of tools and equipment • Proper handling of refrigerants • Safety signs and symbols • Safety hazard • Good housekeeping 2.2 **BLUEPRINT READING AND PLAN SPECIFICATION** • Electrical wiring control diagram • Mechanical plan/symbols and abbreviation 2.3 **TRADE THEORY** • Basic electricity • Basic refrigeration cycle • Fundamentals of refrigeration and control • Interlocking control sequence • Fundamentals of piping • Fan characteristics • Electrical code • Montreal protocol • EMB/DENR regulations • Pump principles • Cooling tower principles

	2.4 **TOOLS/MATERIALS: USES AND SPECIFICATIONS**
	• Types of electrical controls
	• Types of expansion valve
	• Types of compressor motor
	• Types of condenser
	• Types of evaporator
	• Types of refrigerant
	• Types of pressure control
	• Types of defrost timer
	• Types of fan motor
	• Types of fan
	• Types of pipe
	• Types of filter drier
	• Types of filter/strainer element
	• Types of thermostat
	• Types of circuit breaker
	• Types of magnetic contactor
	• Types of unloader
	• Types of compressor
	• Types of pump
	2.5 **MAINTENANCE**
	• Preventive maintenance
	2.6 **LEGISLATION**
	• Clean Air Act
	• Montreal Protocol
	• Ozone Depleting Refrigerants (ODRs)
	RAC Code of Practice
	• Chemical Control Orders (CCOs) and other issuances relating to ozone-depleting substances (ODS):
	  • R.A. 6969 – Toxic substances and hazardous and nuclear wastes control act of 1990.
	  • DENR-AO 1992-29 - IRR of R.A. 6969
	  • DENR-AO 2004-08 – Revised CCO for ODS
	  • EMB MC 2005-03 – Alternatives to ODS
		2.7 **PROCESSES/ PROCEDURES**
		• Compressor test procedures
		• Power supply test procedures
		• Cooler/evaporator test procedures
		• Condensing unit test procedures
		• Pump test procedures
		• Cooling tower test procedures
		• Thermostatic expansion valve test procedures
		• Automatic expansion valve test procedures
		• Electrical control test procedures
		• Leak testing procedure (for refrigeration circuit and water piping)
		• Pressure testing procedure
		• Vacuum testing procedure
		• Refrigerant charging procedure
		• Pumpdown procedure
		• Crank case heater test procedures
		• Unloading test procedures
		• Start-up procedure

3. Required Skills	3.1 Interpreting plan and details 3.2 Preparing materials 3.3 Following work safety 3.4 Using electrical tools and testing equipment 3.5 Performing electrical testing 3.6 Performing mechanical testing 3.7 Communicating skills
4. Resource Implications	The following resources **MUST** be provided: 4.1 Work place location 4.2 Tools and equipment appropriate to troubleshooting refrigerant system 4.3 Materials relevant to the proposed activity 4.4 Drawings and specifications relevant to the task
5. Methods of Assessment	Competency must be assessed through: 5.1 Direct observation 5.2 Questions related to Required knowledge
6. Context for Assessment	6.1 Competency may be assessed in the work place or in a simulated work place setting

UNIT OF COMPETENCY: PERFORM START-UP, TEST AND COMMISSIONING FOR PACKAGE-TYPE AIR-CONDITIONING UNIT

UNIT CODE : HVC723346

UNIT DESCRIPTOR : This unit covers the knowledge, skills and attitudes in performing start-up, test and commissioning in the package type air-conditioning unit (PACU).

ELEMENT	PERFORMANCE CRITERIA ***Italicized*** terms are elaborated in the Range of Variables
1. Prepare for start-up, test and commissioning of PACU	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 and program are produced and recording sheets are prepared in accordance with manufacturer's manuals. 1.5. ***Commissioning instruments*** are calibrated in accordance with system documents 1.6. PPEs are selected in line with job requirements
2. Conduct start-up, test and commissioning of PACU	2.1. ***Electrical related checks*** are performed based on manufacturer's manuals. 2.2. ***Refrigerant piping related checks*** are performed based on manufacturer's manuals. 2.3. ***Condensing unit related checks*** are performed based on manufacturer's manuals. 2.4. ***Compressor unit related checks*** are performed based on manufacturer's manuals. 2.5. ***Indoor unit related checks*** are performed based on manufacturer's manuals and site conditions 2.6. ***Metering device related checks*** are performed based in manufacturer's manuals 2.7. Systems are charged with the correct refrigerant to system specifications and in accordance with manufacturer's manual 2.8. Appropriate lubricating oil is added to the air-conditioning systems in accordance with standard operating procedures 2.9. Start-up, testing and commissioning reports are accomplished in line with enterprise policies and procedures.

RANGE OF VARIABLES

VARIABLE	RANGE
1 Commissioning instruments	Including but is not limited to: 1.1 Manifold gauge 1.2 Clampmeter 1.3 Multi-tester 1.4 Psychrometer 1.5 Thermometer 1.6 Electronic leak detector 1.7 Balometer
3. Electrical related checks	This includes: 3.1 Power supply source checks 3.2 Power supply isolation checks 3.3 Safety and circuit protection checks 3.4 Wirings and piping checks 3.5 Grounding systems checks
4. Refrigerant piping related checks	May include: 4.1 Inspection of U-traps/ pipe riser installation 4.2 Leak testing 4.3 Pipe insulation inspection 4.4 Pipe and fittings inspection
5. Condensing unit related checks	May include: 5.1 Leveling and dimension validation 5.2 Spacing and positioning validation 5.3 Verification of access for servicing
6. Compressor unit related checks	May include: 6.1 Connection of cranked- case heater 6.2 Oil level verification 6.3 Terminal connection inspection
7. Indoor related checks	May include but not limited to: 7.1 PACU 7.1.1 Condensate drain pipe inspection 7.1.2 Leveling and dimension verification 7.1.3 Air flow parameters verification 7.1.4 Temperature check 7.1.5 Verification of the installation quality of unit
8. Metering device related checks	May include but not limited to: 8.1 Sensing valve tightness and location verification 8.2 Vibration check

EVIDENCE GUIDE

1. Critical aspects of Competency	Assessment requires evidence that the candidate: 1.1 Completed pre-start-up, testing and commissioning checks and complied with manufacturer's manuals. 1.2 Performed electrical related checks. 1.3 Performed refrigerant piping related checks. 1.4 Performed condensing unit related checks. 1.5 Performed compressor unit related checks. 1.6 Performed indoor unit related checks. 1.7 Performed metering device related checks. 1.8 Charged air-conditioning system with the correct refrigerant 1.9 Tested and set electrical, pneumatic and other controls to meet specified and safety performance requirements 1.10 Communicated interactively with others where applicable to ensure safe and effective work operations 1.11 Completed commissioning and starting-up procedures in accordance with the standard procedures
2. Required Knowledge and Attitude	2.1 **SAFETY PRACTICES** • Protective personal equipment/safety gears • Safe handling of tools and equipment • Proper handling of refrigerants • Safety signs and symbols • Safety hazard • Good housekeeping 2.2 **BLUEPRINT READING AND PLAN SPECIFICATION** • Electrical wiring control diagram • HVAC-R plan/symbols and abbreviation 2.3 **TOOLS/MATERIALS: USES AND SPECIFICATIONS** • Types of electrical controls • Types of expansion valve • Types of compressor motor • Types of condenser • Types of evaporator • Types of refrigerant • Types of pressure control • Types of defrost timer • Types of fan motor • Types of fan • Types of pipe • Types of filter drier • Types of filter/strainer element • Types of thermostat • Types of circuit breaker • Types of magnetic contactor • Types of unloader • Types of compressor • Types of pump 2.4 **MAINTENANCE** • Preventive maintenance

	2.5 **TRADE THEORY**
	• Basic electricity
	• Basic refrigeration cycle
	• Fundamentals of air-conditioning and control
	• Interlocking control sequence
	• Fundamentals of piping
	• Fan characteristics
	• Pump principles
	• Cooling tower principles
	2.6 **PROCESSES/ PROCEDURES**
	• Compressor test procedures
	• Power supply test procedures
	• Cooler/evaporator test procedures
	• Condensing unit test procedures
	• Pump test procedures
	• Cooling tower test procedures
	• Thermostatic expansion valve test procedures
	• Automatic expansion valve test procedures
	• Electrical control test procedures
	• Leak testing procedure (for refrigeration circuit and water piping)
		• Pressure testing procedure
		• Vacuum testing procedure
		• Refrigerant charging procedure
		• Pumpdown procedure
		• Crank case heater test procedures
		• Unloading test procedures
		• Start-up procedure
		2.7 **LEGISLATION**
		• Clean Air Act (RA 8749)
		• Montreal Protocol
		• Ozone Depleting Refrigerants (ODRs)
		• HVAC-R Code of Practice
		• Chemical Control Orders (CCOs) and other issuances relating to ozone-depleting substances (ODS):
		  • R.A. 6969 – Toxic substances and hazardous and nuclear wastes control act of 1990.
		  • DENR-AO 1992-29 - IRR of R.A. 6969
		  • DENR-AO 2004-08 – Revised CCO for ODS
		  • EMB MC 2005-03 – Alternatives to ODS

3. Required Skills	3.1 Interpreting plan and details 3.2 Preparing materials 3.3 performing work safety 3.4 Proper handling of electrical tools and testing equipment 3.5 Performing pre-start-up activity 3.6 Performing electrical testing 3.7 Performing mechanical testing 3.8 Performing commissioning activity 3.9 Communicating effectively	
4. Resource Implications	The following resources **MUST** be provided: 4.1 Work place location 4.2 Tools and equipment appropriate in performing start-up, testing and commissioning refrigeration and air-conditioning systems 4.3 Materials relevant to the proposed activity 4.4 Drawings and specifications relevant to the task	
5. Methods of Assessment	Competency must be assessed through: 5.1 Direct observation 5.2 Questions related to Required knowledge	
6. Context for Assessment	6.1 Competency may be assessed in the work place or in a simulated work place setting	

UNIT OF COMPETENCY: PERFORM START-UP, TEST AND COMMISSIONING FOR COMMERCIAL REFRIGERATION EQUIPMENT

UNIT CODE : HVC723347

UNIT DESCRIPTOR : This unit covers the knowledge, skills and attitudes in performing start-up, test and commissioning in the commercial refrigeration equipment (CRE).

ELEMENT	PERFORMANCE CRITERIA ***Italicized*** terms are elaborated in the Range of Variables
1. Prepare for start-up, test and commissioning of CRE	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 and program are produced and recording sheets are prepared in accordance with manufacturer's manuals. 1.5. ***Commissioning instruments*** are calibrated in accordance with system documents 1.6. PPEs are selected in line with job requirements
2. Conduct start-up, test and commissioning of CRE	2.1. ***Electrical related checks*** are performed based on manufacturer's manuals. 2.2. ***Refrigerant piping related checks*** are performed based on manufacturer's manuals. 2.3. ***Condensing unit related checks*** are performed based on manufacturer's manuals. 2.4. ***Compressor unit related checks*** are performed based on manufacturer's manuals. 2.5. ***Indoor unit related checks*** are performed based on manufacturer's manuals and site conditions 2.6. ***Metering device related checks*** are performed based in manufacturer's manuals 2.7. Systems are charged with the correct refrigerant to system specifications and in accordance with manufacturer's manual 2.8. Appropriate lubricating oil is added to the refrigeration systems in accordance with standard operating procedures 2.9. Start-up, testing and commissioning reports are accomplished in line with enterprise policies and procedures.

RANGE OF VARIABLES

VARIABLE	RANGE
1 Commissioning instruments	Including but is not limited to: 1.1 Manifold gauge 1.2 Clampmeter 1.3 Multi-tester 1.4 Psychrometer 1.5 Thermometer 1.6 Electronic leak detector 1.7 Balometer
2 Electrical related checks	This includes: 2.1 Power supply source checks 2.2 Power supply isolation checks 2.3 Safety and circuit protection checks 2.4 Wirings and piping checks 2.5 Grounding systems checks
3 Refrigerant piping related checks	May include: 3.1 Inspection of U-traps/ pipe riser installation 3.2 Leak testing 3.3 Pipe insulation inspection 3.4 Pipe and fittings inspection
4 Condensing unit related checks	May include: 4.1 Leveling and dimension validation 4.2 Spacing and positioning validation 4.3 Verification of access for servicing
5 Compressor unit related checks	May include: 5.1 Connection of cranked- case heater 5.2 Oil level verification 5.3 Terminal connection inspection
6 Indoor related checks	May include but not limited to: 6.1 CRE 6.1.1 Condensate drain pipe inspection 6.1.2 Leveling and dimension verification 6.1.3 Temperature and pressure check 6.1.4 Verification of the installation quality of unit 6.1.5 Air leakage check (i.e. door hinges alignment, door gasket)
7 Metering device related checks	May include but not limited to: 7.1 Sensing valve tightness and location verification 7.2 Vibration check

EVIDENCE GUIDE

1. Critical aspects of Competency	Assessment requires evidence that the candidate: 1.1 Completed pre-start-up, testing and commissioning checks and complied with manufacturer's manuals. 1.2 Performed electrical related checks. 1.3 Performed refrigerant piping related checks. 1.4 Performed condensing unit related checks. 1.5 Performed compressor unit related checks. 1.6 Performed indoor unit related checks. 1.7 Performed metering device related checks. 1.8 Charged refrigeration system with the correct refrigerant 1.9 Tested and set electrical, pneumatic and other controls to meet specified and safety performance requirements 1.10 Communicated interactively with others where applicable to ensure safe and effective work operations 1.11 Completed commissioning and starting-up procedures in accordance with the standard procedures
2. Required Knowledge and Attitude	2.1 **SAFETY PRACTICES** • Protective personal equipment/safety gears • Safe handling of tools and equipment • Proper handling of refrigerants • Safety signs and symbols • Safety hazard • Good housekeeping 2.2 **BLUEPRINT READING AND PLAN SPECIFICATION** • Electrical wiring control diagram • HVAC-R plan/symbols and abbreviation 2.3 **TOOLS/MATERIALS: USES AND SPECIFICATIONS** • Types of electrical controls • Types of expansion valve • Types of compressor motor • Types of condenser • Types of evaporator • Types of refrigerant • Types of pressure control • Types of defrost timer • Types of fan motor • Types of fan • Types of pipe • Types of filter drier • Types of filter/strainer element • Types of thermostat • Types of circuit breaker • Types of magnetic contactor • Types of unloader • Types of compressor • Types of pump 2.4 **MAINTENANCE** • Preventive maintenance

	2.5 **TRADE THEORY**
	• Basic electricity
	• Basic refrigeration cycle
	• Fundamentals of refrigeration and control
	• Interlocking control sequence
	• Fundamentals of piping
	• Fan characteristics
	• Pump principles
	• Cooling tower principles
	2.6 **PROCESSES/ PROCEDURES**
	• Compressor test procedures
	• Power supply test procedures
	• Cooler/evaporator test procedures
	• Condensing unit test procedures
	• Pump test procedures
	• Cooling tower test procedures
	• Thermostatic expansion valve test procedures
	• Automatic expansion valve test procedures
	• Electrical control test procedures
	• Leak testing procedure (for refrigeration circuit and water piping)
	• Pressure testing procedure
		• Vacuum testing procedure
		• Refrigerant charging procedure
		• Pumpdown procedure
		• Crank case heater test procedures
		• Unloading test procedures
		• Start-up procedure
		2.8 **LEGISLATION**
		• Clean Air Act (RA 8749)
		• Montreal Protocol
		• Ozone Depleting Refrigerants (ODRs)
		• HVAC-R Code of Practice
		• Chemical Control Orders (CCOs) and other issuances relating to ozone-depleting substances (ODS):
		  • R.A. 6969 – Toxic substances and hazardous and nuclear wastes control act of 1990.
		  • DENR-AO 1992-29 - IRR of R.A. 6969
		  • DENR-AO 2004-08 – Revised CCO for ODS
		  • EMB MC 2005-03 – Alternatives to ODS

3. Required Skills	3.1 Interpreting plan and details 3.2 Preparing materials 3.3 performing work safety 3.4 Proper handling of electrical tools and testing equipment 3.5 Performing pre-start-up activity 3.6 Performing electrical testing 3.7 Performing mechanical testing 3.8 Performing commissioning activity 3.9 Communicating effectively	
4. Resource Implications	The following resources **MUST** be provided: 4.1 Work place location 4.2 Tools and equipment appropriate in performing start-up, testing and commissioning refrigeration and air-conditioning systems 4.3 Materials relevant to the proposed activity 4.4 Drawings and specifications relevant to the task	
5. Methods of Assessment	Competency must be assessed through: 5.3 Direct observation 5.4 Questions related to Required knowledge	
6. Context for Assessment	6.1 Competency may be assessed in the work place or in a simulated work place setting	

SECTION 3. - TRAINING STANDARDS

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 RAC Servicing (PACU/CRE) NC III.

3.1 CURRICULUM DESIGN

Course Title : RAC SERVICING (PACU/CRE) NC III
PTQF : NC III

Nominal Training Duration: 18 Hours (Basic)
28 Hours (Common)
180 Hours (Core)

Course Description:

This course is designed to equip individual with operational skills in RAC Servicing which install, service and maintain, troubleshoot and repair as well as starting-up, testing and commissioning package-type air-conditioning unit (PACU) and commercial refrigeration equipment (CRE).

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

BASIC COMPETENCIES

UNIT TITLE	Learning Outcomes	Methodology	Assessment Approach
1. Lead workplace communication	1.1 Communicate information about workplace processes 1.2 Lead workplace discussion 1.3 Identify and communicate issues arising in the workplace	Group discussion Interaction	Demonstration Observation Interviews/ questioning
2. Lead small teams	2.1 Provide team leadership 2.2 Assign responsibilities 2.3 Set performance expectations for team members 2.4 Supervise team performance	Discussion Interaction	Demonstration Observation Interviews/ questioning

UNIT TITLE	Learning Outcomes	Methodology	Assessment Approach
3. Develop and practice negotiation skills	3.1 Plan negotiations 3.2 Participate in negotiations	Discussion Interaction	Demonstration Observation Interviews/ questioning
4. Solve problems related to work activities	4.1 Identify the problem 4.2 Determine fundamental cause of problem 4.3 Determine corrective/ preventive action 4.4 Provide/Convey recommendations to manager	Discussion Case study Symposium	Observation Interview
5. Use mathematical concepts and techniques	5.1 Identify mathematical tools and techniques to solve problems 5.2 Apply mathematical computation 5.3 Analyze the result of mathematical application	Discussion Case study Contextual learning	Questioning (oral and written)
6. Use relevant technologies	6.1 Study/Select appropriate technology 6.2 Apply relevant technology 6.3 Maintain/Enhance relevant technology	Discussion Case study Symposium	Observation Interview Case study

COMMON COMPETENCIES

UNIT TITLE	Learning Outcomes	Methodology	Assessment Approach
1. Prepare materials and tools	1.1 Identify materials and tools 1.2 Request materials and tools 1.3 Receive and inspect materials and tools	Self-paced/ Modular Demonstration Group Discussion	Written Practical / Performance Test
2. Observe procedures, specifications and manuals of instructions	2.1 Identify and access specifications and manuals 2.2 Interpret manuals 2.3 Apply information in manuals	Discussion Lecture Modular	Written Practical / Performance Test
3. Perform mensuration and calculation	3.1 Select measuring instruments 3.2 Carry-out measurements and calculations	Self-paced/ Modular Demonstration Group Discussion	Written/Oral Examination Practical Demonstration

UNIT TITLE	Learning Outcomes	Methodology	Assessment Approach
4. Perform basic bench work	4.1 Prepare materials, tools and equipment for layout 4.2 Layout features in workplace 4.3 Cut sheets, plates and bars 4.4 Smooth sheets plates and bars 4.5 Drill holes in sheets, plates and bars 4.6 Bore holes in sheet plates and bars 4.7 Bend sheets, plates and bars 4.8 Join sheets, plates and bars	Modular Film Showing Demonstration On-the-job training	Interview Demonstration Direct Observation
5. Perform basic electrical works	5.1 Measure and analyze circuit and load resistance in electrical system 5.2 Measure and analyze voltage in electrical system 5.3 Measure and analyze current in electrical system 5.4 Test simple electrical components and connections 5.5 Repair minor electrical system troubles	Modular Computer-based training (Simulation) Demonstration On- the-job training	Interview Computer-based assessment (Simulation) Demonstration Direct Observation
6. Maintain tools and equipment	6.1 Check the conditions of tools and equipment 6.2 Perform basic preventive maintenance 6.3 Store tools and equipment	Small Group Discussion Demonstration of Practical Skills Modular	Observation and Oral questioning Demonstration and Oral questioning Written test
7. Perform housekeeping and safety practices	7.1 Sort materials, tools and equipment 7.2 Clean workplace area, materials, tools and equipment 7.3 Systematize dispensing and retrieval of materials, tools and equipment 7.4 Identify and minimize/ eliminate hazards 7.5 Respond and record accidents 7.6 Follow basic securities	Small Group Discussion Demonstration of Practical Skills Modular	Observation and Oral questioning Demonstration and Oral questioning Written test
8. Document work accomplished	8.1 Identify forms and data 8.2 Prepare reports	Lecture Demonstration of Practical Skills Modular	Demonstration and Oral questioning Written Test

CORE COMPETENCIES

Unit of Competency	Learning Outcome	Methodology	Assessment Approach
1 Install package type air-conditioning unit (PACU)	1.1 Survey site for installation 1.2 Install PACU piping systems 1.3 Install PACU electrical systems 1.4 Install indoor and outdoor unit and accessories	Discussion Demonstration Trainee Hands-on	Direct observation and Questioning Demonstration
2 Install Commercial Refrigeration Equipment (CRE)	2.1 Survey site for installation 2.2 Install CRE piping systems 2.3 Install CRE electrical systems 2.4 Install indoor and outdoor unit and accessories	Discussion Demonstration Trainee Hands-on	Direct observation and Questioning Demonstration
3 Service and Maintain PACU	3.1 Prepare for maintenance activities 3.2 Check and adjust air-conditioning accessories, controls and operating conditions 3.3 Maintain lubrication system in PACU 3.4 Maintain refrigeration system in PACU 3.5 Maintain air distribution system in PACU	Discussion Demonstration Trainee Hands-on	Direct observation and Questioning Demonstration
4 Service and Maintain CRE	4.1 Prepare for maintenance activities 4.2 Check and adjust refrigeration accessories, controls and operating conditions 4.3 Maintain lubrication system in CRE 4.4 Maintain refrigeration system in CRE 4.5 Maintain air distribution system in CRE	Discussion Demonstration Trainee Hands-on	Direct observation and Questioning Demonstration

Unit of Competency	Learning Outcome	Methodology	Assessment Approach
5 Troubleshoot and repair PACU	5.1 Plan and prepare for troubleshooting and repair 5.2 Identify and repair faults/problems 5.3 Perform refrigerant recovery/ recycling and retrofitting on air conditioning systems 5.4 Test run air-conditioning unit	Discussion Demonstration Trainee hands-on	Direct observation and Questioning Demonstration
6 Troubleshoot and repair CRE	6.1 Plan and prepare for troubleshooting and repair 6.2 Identify and repair faults/problems 6.3 Perform refrigerant recovery/ recycling and retrofitting on commercial refrigeration systems 6.4 Test run CRE	Discussion Demonstration Trainee hands-on	Direct observation and Questioning Demonstration
7 Perform start-up test and commissioning for PACU	7.1 Prepare for pre-start-up, test and commissioning for PACU 7.2 Conduct pre-start-up, testing and commissioning for PACU	Discussion Demonstration Trainee Hands-on	Direct observation and Questioning Demonstration
8 Perform start-up test and commissioning for CRE	8.1 Prepare for pre-start-up, test and commissioning for CRE 8.2 Conduct pre-start-up, testing and commissioning for CRE	Discussion Demonstration Trainee Hands-on	Direct observation and Questioning Demonstration

3.2 TRAINING DELIVERY

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

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

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

- The dualized mode of training delivery is preferred and recommended. Thus programs would contain both in-school and in-industry training or fieldwork components. Details can be referred to the Dual Training System (DTS) Implementing Rules and Regulations.

- Modular/self-paced is a competency-based training modality wherein the trainee is allowed to progress at his own pace. The trainer facilitates the training delivery.

- Peer teaching/mentoring is a training modality wherein fast learners are given the opportunity to assist the slow learners.

- Supervised Industry Training or On-the-Job Training is an approach in training designed to enhance the knowledge and skills of the trainee through actual experience in the workplace to acquire specific competencies prescribed in the training regulations.

- Distance learning is a formal education process in which majority of the instruction occurs when the students and instructor are not in the same place. Distance learning may employ correspondence study, or audio, video or computer technologies.

- Project-based instruction is an authentic instructional model or strategy in which students plan, implement and evaluate projects that have real world applications.

3.3 TRAINEE ENTRY REQUIREMENTS

This section specifies the qualifications of trainees and educational experience. Other requirements like health and physical requirements may be included. Passing entry written examinations may also be indicated if necessary.

Before entering this course, the learner:

- Must have undergone RAC Servicing (DomRAC) Training or a holder of RAC Servicing NC II or with at least one-year work experience in RAC servicing
- Can communicate both oral and written
- Good moral character
- Can perform basic mathematical computation
- Physically and mentally fit

3.4 LIST OF TOOLS, EQUIPMENT AND MATERIALS RAC SERVICING (PACU/CRE) NC III

Recommended list of tools, equipment and materials for the training of 25 trainees for RAC Servicing (PACU/CRE) NC III.

TOOLS		EQUIPMENT		MATERIALS	
QTY.	**Description**	**QTY**	**Description**	**Qty.**	**Description**
10 sets	Push and Pull Rule	5 units	Masonry drill	2 rms	Form Report
10 sets	Meter stick	5 units	Motor compressor	25 sets	Blueprint
10 sets	Spirit level/water level	5 units	Fan motor	25 sets	Manufacturer's manual
10 sets	Screw driver	2 units	High Pressure water	25 sets	Sealant
10 sets	Pliers	2 units	High Pressure water	25 sets	Condensate draine
10 sets	Wrench Box	5 units	Refrigerator units	10 sets	Electrical wire
10 sets	Screw driver	5 units	Vacuum pump	5 units	Circuit breaker/safety switch
10 sets	Crimping tools	5 sets	Evaporator fan and motor	25 sets	Wiring diagrams
10 sets	Bending tool	5 units	Oxy-Acetylene welding outfit	25 sets	Courseware (Learning elements and Manuals)
10 sets	Swaging tool	5 units	Evaporator fan and motor	10 sets	Switch
10 sets	Flaring tool	5 units	Defective air-swing motor	10 sets	Capacitor

TOOLS		EQUIPMENT		MATERIALS	
QTY.	**Description**	**QTY**	**Description**	**Qty.**	**Description**
10 sets	Tube cutters	5 units	Good condition air-swing motors	10 sets	Relay
10 units	Vernier caliper	5 units	Refrigerator and air-conditioning unit with leak piping	5 sets	Philippine Electrical Code
10 units	Adjustable wrench			10 sets	Electrical tape
10 sets	Open end wrench	2 units	Overload protector	15 sets	Air filters
10 units	Multi-tester	5 units	Package type A/C unit	25 sets	Requisition slip
10 sets	Clamp ammeter	3 units	Arc welding machine	5 liters	Oil
5 sets	Megger tester	5 units	Recovery/recycling machine	5 units	Grease
5 units	Leak detector	5 units	Commercial Refrigeration units	10 boxes	Rags
5 units	Defrost heater	5 pcs.	Condenser fan motor	10 boxes	Soap
5 units	Door strip heater			25 sets	Sand paper
10 units	Room thermometer			5 units	Refrigerant cylinder
10 units	System analyzer			5 units	Nitrogen gas
10 units	Digital thermometer			25 sets	Personal protective equipment
				25 sets	Tubes (Copper steel, Aluminum relevant to required activity task.
				25 sets	Filler rolls (Bronze , Steel, Aluminum Relevant to required activity/ task
				10 sets	Fluxes (Borax, Aluminum and Silver)
				25 boxes	Fittings
				5 sets	Nitrogen regulator
				25 sets	Googles
				2 units	High pressure washer
				15 units	Strike lighter
				10 sets	Defective electrical controls
				10 sets	Relays
				5 sets	Timer

TOOLS		EQUIPMENT		MATERIALS	
QTY.	Description	QTY	Description	Qty.	Description
				10 sets	Rotary switch
				10 units	Pull-push switch
				10 units	Thermostant
				10 sets	Refrigerator switch
				10 sets	Good condition electrical controls
				10 sets	Switch pull-push/rotary
				10 sets	Defective capacitators
				25 sets	Terminal connector (female)
				5 sets	Defective defrost heater
				5 sets	Good condition defrost heater
				25 sets	Filter
				5 sets	Borax
				25 sets	Filter drier
				25 sets	Tapelone tape
				10 pcs.	Copper elbow 5/8” OD
				10 pcs.	Copper elbow ½” OD
				10 pcs.	Copper onion5/8 OD
				10 pcs.	Copper onion ½” OD
				10 pcs.	Copper elbow 3/8” OD
				10 pcs.	Copper elbow 5/16” OD
				10 pcs.	Filter drier 3/8” Connection
				10 pcs.	Filter drier 5/16” Connection
				5 pcs.	Sight glass/ moisture indicator 3/8 “Connection

3.5 TRAINING FACILITIES
RAC SERVICING (PACU/CRE) NC III

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*	4.00 x 8.00	32.00	32.00
B. LEARNING RESOURCE AREA	4.00 x 6.00	24.00	24.00
C. TOOL/STORAGE AREA*	4.00 x 4.00	16.00	16.00
D. WASH, TOILET AND LOCKER ROOM*	3.00 x 4.00	12.00	12.00
TOTAL			84
E. FACILITIES/ EQUIPMENT/ CIRCULATION			25
TOTAL AREA			**109**

*Common facilities for all HVAC/R Courses

3.6 TRAINER'S QUALIFICATION FOR HVAC/R SECTOR
RAC SERVICING (PACU/CRE) NC III

- Must be National TVET Trainers Certificate (NTTC) Level 1 Holder
- Good moral character
- Must be physically and mentally fit
- Must be computer literate
- Must be a Civil Service eligible (*for government position or appropriate professional license issued by the Professional Regulatory Board*)
- *Must have at least two (2) years job/industry experience

*Optional: Only when required by the hiring institution
Reference: TESDA Board Resolution No. 2004-03

3.7 INSTITUTIONAL ASSESSMENT

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

SECTION 4 NATIONAL ASSESSMENT AND CERTIFICATION ARRANGEMENTS

4.1 To attain the National Qualification of **RAC Servicing (PACU/CRE) NC III**, the candidate must demonstrate competence covering all the units listed in Section 1. Successful candidates shall be awarded a National Certificate signed by the TESDA Director General.

4.2 The qualification of **RAC Servicing (PACU/CRE) NC III** may be attained through:

4.2.1 Accumulation of Certificates of Competency (COCs) in the following clusters of competencies:

C.O.C 1 - Installing and servicing packaged-type air-conditioning unit (PACU)

- Install PACU
- Service and maintain PACU
- Troubleshoot and repair PACU
- Perform start-up, testing and commissioning for PACU

C.O.C. 2 - Installing and servicing commercial refrigeration equipment (CRE)

- Install CRE
- Service and maintain CRE
- Troubleshoot and repair CRE
- Perform start-up, testing and commissioning for CRE

Successful candidates shall be awarded Certificates of Competency (COCs).

4.2.2 For individuals, who already possess National Certificate (NC) or Certificate of Competency (COC) along RAC servicing, portfolio assessment is applicable, provided they are already employed and have related experience for the past three (3) years or more along the qualification. However, if the assessor finds the evidences presented inadequate, he may still require the candidate to undergo the practical demonstration or present other evidences in the form of Third Party Report, etc. depending on the need for supplementary evidences.

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

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

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

4.4.2 Experienced Workers (wage employed or self-employed)

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

ANNEX A

COMPETENCY MAP - HVAC/R Sector
RAC Servicing (PACU/CRE) NC III

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 n 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**	

COMMON COMPETENCIES

Prepare materials and tools	**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**	**Interpret technical drawings and plans**	

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:

1) **Air Cooled Condensing Unit (ACCU)/OUTDOOR UNIT** – an equipment that condenses refrigerant vapor using air as the condensing medium. It consist of compressor, condenser coil and fan motor

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

3) **Air Handling Unit (AHU)/INDOOR UNIT** – an air-conditioning component that consists of a fan motor and an evaporator coil. It is this equipment used in air-conditioning that absorbs heat from the space

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

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

6) **Commercial Refrigeration** - covers water coolers/ display coolers, vendo machine, beverage machine icedrop/ice cream/ice cube vending machines

7) **Commissioning** - process by which an equipment, facility, or plant (*which is installed, or is complete or near completion*) is tested to verify if it functions according to its design objectives or specifications.

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

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

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

11) **Evaporator** – the component in a refrigeration system where liquid refrigerant is changed into a vapor by the absorption of heat

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

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

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

15) **Hot Gas Defrost** – component part used to remove frosting on the evaporator coil using hot gas refrigerant from the compressor

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

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

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

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

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

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

21) **Package Air-conditioning Unit (PACU)**– an air-conditioning unit that contains the compressor, water-cooled condenser, metering device and evaporator all of which is in one casing.

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

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

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

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

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

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

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

29) **Split-type Air-conditioner** – an air conditioning system that comes in two pieces: one piece contains the compressor, condenser, and a fan; the other unit contains the evaporator and a fan. The condenser, installed outside the house, connects to several evaporators, one in each room to be cooled, mounted inside the house. Each evaporator is individually controlled, allowing different rooms or zones to be cooled to varying degrees.

30) **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

31) **Transport Air-conditioning Unit –** refers to an air-conditioning 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.

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

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

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

35) **Window Type Air-conditioning Unit** – is a self-contained air-conditioning unit house in a single casing mounted in a wall or window opening

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

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