

# TRAINING REGULATIONS



## ICE PLANT REFRIGERATION SERVICING NC III

HEATING, VENTILATION, AIR-CONDITIONING  
AND REFRIGERATION TECHNOLOGY SECTOR

TECHNICAL EDUCATION AND SKILLS DEVELOPMENT AUTHORITY  
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## **TRAINING REGULATIONS FOR ICE PLANT REFRIGERATION SERVICING NC III**

### **SECTION 1 ICE PLANT REFRIGERATION SERVICING NC III QUALIFICATION**

The **ICE PLANT REFRIGERATION SERVICING NC III** Qualification consist of competencies that a person must achieve to enable him/her to install, troubleshoot, service and maintain ICE PLANT Refrigeration units and components. It includes recovery and recycling of refrigerant from the system.

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:

<b>CODE NO.</b>	<b>BASIC COMPETENCIES</b>
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

<b>CODE NO.</b>	<b>COMMON COMPETENCIES</b>
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

<b>CODE NO.</b>	<b>CORE COMPETENCIES</b>
HVC723322	Survey Site for Installation of Ice Plant Refrigeration Equipment
HVC723323	Install Ice Plant Refrigeration Piping System
HVC723324	Install Ice Plant Refrigeration Electrical System
HVC723325	Install Ice Plant Refrigeration Equipment
HVC723326	Service and Maintain Ice Plant Refrigeration System
HVC723327	Troubleshoot Ice Plant Refrigeration System
HVC723328	Recover And Recycle Refrigerant from Ice Plant Refrigeration System
HVC723329	Repair and Retrofit Ice Plant Refrigeration System and Its Accessories
HVC723330	Perform Start-Up and Commissioning for Ice Plant Refrigeration System

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

- Ice Plant Refrigeration Technician

## SECTION 2 COMPETENCY STANDARDS

This section gives the details of the contents of the basic, common and core units of competency required in **ICE PLANT REFRIGERATION SERVICING 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.

<b>ELEMENT</b>	<b>PERFORMANCE CRITERIA</b> <i>Italicized</i> terms are elaborated in the Range of Variables
1. Communicate information about workplace processes	1.1. Appropriate <i>communication method</i> 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. Underpinning knowledge and Attitudes	2.1. Organization requirements for written and electronic communication methods 2.2. Effective verbal communication methods
3. Underpinning 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 <b>MUST</b> 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.

<b>ELEMENT</b>	<b>PERFORMANCE CRITERIA</b> <i>Italicized bold</i> terms are elaborated in the Range of Variables
1. Provide team leadership	1.1. <b>Work requirements</b> are identified and presented to team members 1.2. Reasons for instructions and requirements are communicated to team members 1.3. <b>Team members' queries and concerns</b> 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. <b>Monitoring of performance</b> takes place against defined performance criteria and/or assignment instructions and corrective action taken if required 4.2. Team members are provided with <i>feedback</i> , positive support and advice on strategies to overcome any deficiencies 4.3. <b>Performance issues</b> 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

<b>VARIABLE</b>	<b>RANGE</b>
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

<p>1. Critical Aspects of Competency</p>	<p>Assessment requires evidence that the candidate:</p> <ul style="list-style-type: none"> <li>1.1. Maintained or improved individuals and/or team performance given a variety of possible scenario</li> <li>1.2. Assessed and monitored team and individual performance against set criteria</li> <li>1.3. Represented concerns of a team and individual to next level of management or appropriate specialist and to negotiate on their behalf</li> <li>1.4. Allocated duties and responsibilities, having regard to individual's knowledge, skills and aptitude and the needs of the tasks to be performed</li> <li>1.5. Set and communicated performance expectations for a range of tasks and duties within the team and provided feedback to team members</li> </ul>
<p>2. Underpinning Knowledge</p>	<ul style="list-style-type: none"> <li>2.1. Company policies and procedures</li> <li>2.2. Relevant legal requirements</li> <li>2.3. How performance expectations are set</li> <li>2.4. Methods of Monitoring Performance</li> <li>2.5. Client expectations</li> <li>2.6. Team member's duties and responsibilities</li> </ul>
<p>3. Underpinning Skills</p>	<ul style="list-style-type: none"> <li>3.1. Communication skills required for leading teams</li> <li>3.2. Informal performance counseling skills</li> <li>3.3. Team building skills</li> <li>3.4. Negotiating skills</li> </ul>
<p>4. Resource Implications</p>	<p>The following resources MUST be provided:</p> <ul style="list-style-type: none"> <li>4.1. Access to relevant workplace or appropriately simulated environment where assessment can take place</li> <li>4.2. Materials relevant to the proposed activity or task</li> </ul>
<p>5. Method of Assessment</p>	<p>Competency may be assessed through:</p> <ul style="list-style-type: none"> <li>5.1. Direct observations of work activities of the individual member in relation to the work activities of the group</li> <li>5.2. Observation of simulation and/or role play involving the participation of individual member to the attainment of organizational goal</li> <li>5.3. Case studies and scenarios as a basis for discussion of issues and strategies in teamwork</li> </ul>
<p>6. Context for Assessment</p>	<ul style="list-style-type: none"> <li>6.1. Competency assessment may occur in workplace or any appropriately simulated environment</li> </ul>



**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.

<b>ELEMENT</b>	<b>PERFORMANCE CRITERIA</b> <i>Italicized bold</i> terms are elaborated in the Range of Variables
1. Plan negotiations	1.1 Information on <b>preparing for negotiation</b> is identified and included in the plan 1.2 Information on creating <b>non verbal environments</b> for positive negotiating is identified and included in the plan 1.3 Information on <b>active listening</b> is identified and included in the plan 1.4 Information on different <b>questioning techniques</b> 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	<p>Assessment requires evidence that the candidate:</p> <ul style="list-style-type: none"> <li>1.1 Demonstrated sufficient knowledge of the factors influencing negotiation to achieve agreed outcome</li> <li>1.2 Participated in negotiation with at least one person to achieve an agreed outcome</li> </ul>
2. Underpinning Knowledge and Attitude	<ul style="list-style-type: none"> <li>2.1 Codes of practice and guidelines for the organization</li> <li>2.2 Organizations policy and procedures for negotiations</li> <li>2.3 Decision making and conflict resolution strategies procedures</li> <li>2.4 Problem solving strategies on how to deal with unexpected questions and attitudes during negotiation</li> <li>2.5 Flexibility</li> <li>2.6 Empathy</li> </ul>
3. Underpinning Skills	<ul style="list-style-type: none"> <li>3.1 Interpersonal skills to develop rapport with other parties</li> <li>3.2 Communication skills (verbal and listening)</li> <li>3.3 Observation skills</li> <li>3.1 Negotiation skills</li> </ul>
4. Resource Implications	<p>The following resources <b>MUST</b> be provided:</p> <ul style="list-style-type: none"> <li>4.1 Room with facilities necessary for the negotiation process</li> <li>4.2 Human resources (negotiators)</li> </ul>
5. Methods of Assessment	<p>Competency may be assessed through:</p> <ul style="list-style-type: none"> <li>5.1 Observation/demonstration and questioning</li> <li>5.2 Portfolio assessment</li> <li>5.3 Oral and written questioning</li> <li>5.4 Third party report</li> </ul>
6. Context for Assessment	<ul style="list-style-type: none"> <li>6.1 Competency to be assessed in real work environment or in a simulated workplace setting.</li> </ul>

**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.

<b>ELEMENT</b>	<b>PERFORMANCE CRITERIA</b> <i>Italicized bold</i> 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 <b>analytical techniques</b> 1.3. <b>Problems</b> 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. <b>Action plans</b> 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

<p>1. Critical Aspects of Competency</p>	<p>Assessment requires evidence that the candidate:</p> <ol style="list-style-type: none"> <li>1.1. Identified the problem</li> <li>1.2. Determined the fundamental causes of the problem</li> <li>1.3. Determined the correct / preventive action</li> <li>1.4. Provided recommendation to manager</li> </ol> <p>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.</p>
<p>2. Underpinning Knowledge</p>	<ol style="list-style-type: none"> <li>2.1. Competence includes a thorough knowledge and understanding of the process, normal operating parameters, and product quality to recognize non-standard situations</li> <li>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             <ol style="list-style-type: none"> <li>2.2.1. Relevant equipment and operational processes</li> <li>2.2.2. Enterprise goals, targets and measures</li> <li>2.2.3. Enterprise quality, OHS and environmental requirement</li> <li>2.2.4. Principles of decision making strategies and techniques</li> <li>2.2.5. Enterprise information systems and data collation</li> <li>2.2.6. Industry codes and standards</li> </ol> </li> </ol>
<p>3. Underpinning Skills</p>	<ol style="list-style-type: none"> <li>3.1. Using range of formal problem solving techniques</li> <li>3.2. Identifying and clarifying the nature of the problem</li> <li>3.3. Devising the best solution</li> <li>3.4. Evaluating the solution</li> <li>3.5. Implementation of a developed plan to rectify the problem</li> </ol>

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	<p>Competency may be assessed through:</p> <p>5.1. Case studies on solving problems in the workplace</p> <p>5.2. Observation</p> <p>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.</p>
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.

<b>ELEMENT</b>	<b>Performance Criteria</b> <i>Italicized bold</i> 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 <b>Mathematical techniques</b> 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 <b>Appropriate action</b> 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 <del>1.4 Use of standard formulas</del>
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. Underpinning Knowledge	2.1 Fundamental operation (addition, subtraction, division, multiplication) 2.2 Measurement system 2.3 Precision and accuracy 2.4 Basic measuring tools/devices
3. Underpinning Skills	3.1 Applying mathematical computations 3.2 Using calculator 3.3 Using different measuring tools
4. Resource Implications	The following resources <b>MUST</b> 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.

<b>ELEMENT</b>	<b>PERFORMANCE CRITERIA</b> <i>Italicized bold</i> terms are elaborated in the Range of Variables
1. Study/select appropriate technology	1.1 Usage of different <b>technologies</b> 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 <b>Management concepts</b> 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 <b>industry standard operating procedure, manufacturer's operating guidelines and occupational health and safety procedure</b> 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 <b>appropriate action</b>

## 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. Underpinning 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. Underpinning 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 <b>MUST</b> 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.

<b>ELEMENT</b>	<b>PERFORMANCE CRITERIA</b> <i>Italicized bold</i> terms are elaborated in the Range of Variables
1. Identify materials	1.1 <b>Materials</b> are listed as per job requirements 1.2 Quantity and <b>description of materials</b> 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. Underpinning Knowledge	2.1 Types and uses of HVAC/R materials and tools 2.2 Different forms 2.3 Requisition procedures
3. Underpinning Skills	3.1 Preparing materials and tools 3.2 Proper handling of tools and equipment 3.3 Following Instructions
4. Resource Implications	The following resources should be provided: 4.1 Workplace location 4.2 Materials relevant to the UNIT 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.

<b>ELEMENT</b>	<b>PERFORMANCE CRITERIA</b> <i>Italicized bold</i> terms are elaborated in the Range of Variables
1. Analyze signs, symbols and data	1.1 <b>Technical plans</b> 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 <b>classification</b> or as appropriate in <b>drawing</b>
2. Interpret technical drawings and plans	2.1 Necessary <b>tools, materials</b> and equipment are identified according to the <b>plan</b> 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 <ul style="list-style-type: none"> <li>- Front view</li> <li>- Right side view/left side view</li> <li>- Top view</li> <li>- Pictorial</li> </ul> 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	<p>Assessment requires that the candidate:</p> <ol style="list-style-type: none"> <li>1.1 Identified and determined signs, symbols and data according to work plan, job requirements and classifications</li> <li>1.2 Identified tools and equipment in accordance with job requirements</li> <li>1.3 Listed supplies and materials according to blueprint specifications</li> <li>1.4 Drawn workplan following specifications</li> <li>1.5 Demonstrated ability to determine job specifications based on working/technical drawing</li> </ol>
2. Underpinning Knowledge	<ol style="list-style-type: none"> <li>2.1 <b>TRADE MATHEMATICS</b> <ul style="list-style-type: none"> <li>• Linear measurement</li> <li>• Dimension</li> <li>• Unit conversion</li> </ul> </li> <li>2.2 <b>BLUEPRINT READING AND PLAN SPECIFICATION</b> <ul style="list-style-type: none"> <li>• Electrical, mechanical plan, symbols and abbreviations</li> <li>• Drawing standard symbols</li> </ul> </li> <li>2.3 <b>TRADE THEORY</b> <ul style="list-style-type: none"> <li>• Basic Technical Drawing</li> <li>• Types Technical Plans</li> <li>• Various Types of Drawings</li> <li>• Notes and Specifications</li> </ul> </li> </ol>
3. Underpinning skills	<ol style="list-style-type: none"> <li>3.1 Interpreting drawing/orthographic drawing</li> <li>3.2 Interpreting technical plans</li> <li>3.3 Matching specification details with existing resources</li> <li>3.4 Following instructions</li> <li>3.5 Handling of drawing instruments</li> </ol>
4. Resource implications	<p>The following resources should be provided:</p> <ol style="list-style-type: none"> <li>4.1 Workplace</li> <li>4.2 Drawings and specification relevant to task</li> <li>4.3 Materials and instrument relevant to proposed activity</li> </ol>
5. Methods of assessment	<p>Competency should be assessed through:</p> <ol style="list-style-type: none"> <li>5.1 Direct Observation</li> <li>5.2 Questions/Interview</li> <li>5.3 Written test related to underpinning knowledge</li> </ol>
6. Context of assessment	<ol style="list-style-type: none"> <li>6.1 Competency assessment may occur in workplace or any appropriate simulated environment</li> <li>6.2 Assessment shall be observed while task are being undertaken whether individually or in group</li> <li>6.3 Competency assessment must be undertaken in accordance with the endorsed TESDA assessment guidelines</li> </ol>

**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.

<b>ELEMENT</b>	<b>PERFORMANCE CRITERIA</b> <i>Italicized bold</i> 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 <b>Manual</b> 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. Underpinning Knowledge	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. Underpinning Skills	3.1 Reading and comprehension skills required to identify and interpret construction manuals and specifications 3.2 Accessing information and data
4. Resource Implications	The following resources should be provided: 4.1 All manuals/catalogues relative to HVAC/R sector
5. Methods of Assessment	Competency should be assessed through: 5.1 Direct Observation 5.2 Questions/Interview  Assessment of underpinning knowledge and practical skills may be combined
6. Context 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.

<b>ELEMENT</b>	<b>PERFORMANCE CRITERIA</b> <i>Italicized bold terms</i> 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 <b>geometric shape</b> 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 <b>measuring instruments</b> 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 <b>measurements and calculations</b> 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. Underpinning Knowledge	2.1 <b>TRADE MATHEMATICS/MENSURATION</b> <ul style="list-style-type: none"> <li>• Four fundamental operation</li> <li>• Linear measurement</li> <li>• Dimensions</li> <li>• Unit conversion</li> <li>• Ratio and proportion</li> <li>• Trigonometric functions</li> <li>• Algebraic equations</li> </ul>
3. Underpinning Skills	3.1 Performing calculation by addition, subtraction, multiplication and division: trigonometric functions and algebraic equations 3.2 Visualizing objects and shapes 3.3 Interpreting formulas for volume, areas, perimeters of plane and geometric figures 3.4 Proper handling of measuring instruments
4. Resource Implications	The following resources should be provided: 4.1 Workplace location 4.2 Problems to solve 4.3 Measuring instrument appropriate to carry out tasks 4.4 Instructional materials relevant to the propose activity  Assessment of underpinning knowledge and practical skills may be combined
5. Methods of Assessment	Competency should be assessed through: 5.1 Actual demonstration 5.2 Direct observation 5.3 Written test/questioning related to underpinning knowledge
6. Context 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.

<b>ELEMENT</b>	<b>PERFORMANCE CRITERIA</b> <i>Italicized bold</i> terms are elaborated in the Range of Variables
1. Prepare materials, tools and equipment	1.1 <b>Work plan</b> is interpreted to determine job requirements 1.2 <b>Materials, tools and equipment</b> 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 <b>Dimensions/features</b> 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 <b>Work instructions are followed</b> to ensure work safety 3.2 <b>Benchworks</b> are performed according to job requirements 3.3 Workpieces are clamped in <b>workholding device</b> 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 <b>PPE</b> 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



<b>VARIABLE</b>	<b>RANGE</b>
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

<p>1. Critical Aspects of Competency</p>	<p>Assessment requires that the candidate:</p> <ol style="list-style-type: none"> <li>1.1 Interpreted work plan to determine job requirements</li> <li>1.2 Identified and prepared supplies, materials, tools and equipment in accordance with job requirements</li> <li>1.3 Selected and used appropriate processes, tools and equipment to carry out task</li> <li>1.4 Laid-out and checked dimensions in accordance with job requirements and within the tolerances</li> <li>1.5 Followed work instructions to ensure safety</li> <li>1.6 Performed benchworks in accordance with job requirements</li> <li>1.7 Cleaned worksite and left in safe state in accordance with OSHA regulations</li> </ol>
<p>2. Underpinning Knowledge</p>	<ol style="list-style-type: none"> <li>2.1 <b>TRADE MATHEMATICS</b> <ul style="list-style-type: none"> <li>• Linear measurements</li> <li>• Dimensions</li> <li>• Unit conversion</li> </ul> </li> <li>2.2 <b>TRADE THEORY</b> <ul style="list-style-type: none"> <li>• Basic Benchwork</li> </ul> </li> <li>2.3 <b>SAFETY PREFRIGERATION TICS</b> <ul style="list-style-type: none"> <li>• PPE</li> <li>• Handling of tools, supplies and equipment</li> <li>• Good housekeeping</li> </ul> </li> </ol>
<p>3. Underpinning Skills</p>	<ol style="list-style-type: none"> <li>3.1 Performing basic benchwork</li> <li>3.2 Communicating effectively</li> <li>3.3 Work safety</li> <li>3.4 Preparing materials, tools and equipment</li> <li>3.5 Proper handling of tools and equipment</li> </ol>
<p>4. Resource Implications</p>	<p>The following resources should be provided:</p> <ol style="list-style-type: none"> <li>4.1 Workplace</li> <li>4.2 Work plan</li> <li>4.3 Materials, tools and equipment relevant to the proposed activity/task</li> </ol>
<p>5. Methods of Assessment</p>	<p>Competency may be assessed through:</p> <ol style="list-style-type: none"> <li>5.1 Demonstration</li> <li>5.2 Direct observation</li> <li>5.3 Written/questioning related to underpinning knowledge</li> </ol>
<p>6. Context of Assessment</p>	<ol style="list-style-type: none"> <li>6.1 Competency assessment may occur in workplace or any appropriate simulated environment</li> <li>6.2 Assessment shall be observed while task are being undertaken whether individually or in group</li> <li>6.3 Competency assessment must be undertaken in accordance with the endorsed TESDA assessment guidelines</li> </ol>

**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.

<b>ELEMENT</b>	<b>PERFORMANCE CRITERIA</b> <i>Italicized bold</i> terms are elaborated in the Range of Variables
1. Prepare electrical tools and test instruments	1.1 <b>Work plan</b> is interpreted to determine job requirements 1.2 <b>Electrical tools and instruments</b> 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 <b>Work instructions</b> 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 OHS&A 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

<p>1. Critical Aspects of Competency</p>	<p>Assessment requires that the candidate:</p> <ol style="list-style-type: none"> <li>1.1 Interpreted work plan to determine job requirements</li> <li>1.2 Selected and used appropriate processes, tools and equipment to carry out task</li> <li>1.3 Identified electrical tools and instruments are tested in accordance with PEC</li> <li>1.4 Replaced defective tools and instruments</li> <li>1.5 Checked power supply and electrical components in accordance with PEC</li> <li>1.6 Cleaned work place and left in safe state in line with OHSA regulations</li> <li>1.7 Completed electrical wiring in HVAC/R units based in manufacturer's specifications and PEC</li> <li>1.8 Communicated effectively to ensure safety works</li> </ol>
<p>2. Underpinning Knowledge</p>	<ol style="list-style-type: none"> <li>2.1 <b>TRADE MATHEMATICS</b> <ul style="list-style-type: none"> <li>• Linear measurements</li> <li>• Dimensions</li> <li>• Unit conversion</li> </ul> </li> <li>2.2 <b>TRADE THEORY</b> <ul style="list-style-type: none"> <li>• Basic electricity</li> </ul> </li> <li>2.3 <b>SAFETY PREFRIGERATION TICES</b> <ul style="list-style-type: none"> <li>• PPE</li> <li>• Handling of tools and equipment</li> <li>• Good housekeeping</li> </ul> </li> </ol>
<p>3. Underpinning Skills</p>	<ol style="list-style-type: none"> <li>3.1 Installing and repairing electrical fixtures</li> <li>3.2 Communicating effectively</li> <li>3.3 Work safety</li> <li>3.4 Proper handling of materials, tools and equipment</li> <li>3.5 Preparing materials, tools and equipment</li> <li>3.6 Wiring components</li> <li>3.7 Testing power supply and electrical component</li> </ol>
<p>4. Resource Implications</p>	<p>The following resources should be provided:</p> <ol style="list-style-type: none"> <li>4.1 Work place</li> <li>4.2 Work plan</li> <li>4.3 Materials, tools and equipment relevant to the proposed activity/task</li> </ol>
<p>5. Method of Assessment</p>	<p>Competency may be assessed through:</p> <ol style="list-style-type: none"> <li>5.1 Direct observation</li> <li>5.2 Written test/questioning relevant to underpinning knowledge</li> </ol>
<p>6. Context for Assessment</p>	<ol style="list-style-type: none"> <li>6.1 Competency assessment may occur in workplace or any appropriate simulated environment</li> <li>6.2 Assessment shall be observed while task are being undertaken whether individually or in group</li> </ol>

**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.

<b>ELEMENT</b>	<b>PERFORMANCE CRITERIA</b> <i>Italicized bold</i> terms are elaborated in the Range of Variables
1. Check condition of tools and equipment	1.1 <b>Materials, tools and equipment</b> 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 <b>PPE</b> 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 OSHA 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 <ul style="list-style-type: none"> <li>- Cutting tools - hacksaw, crosscut saw, rip saw</li> <li>- Boring tools - auger, brace, grinlet, hand drill</li> <li>- Holding tools - vise grip, C-clamp, bench vise</li> <li>- Threading tools - die and stock, taps</li> </ul> 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

<p>1. Critical Aspects of Competency</p>	<p>Assessment requires that the candidate:</p> <ol style="list-style-type: none"> <li>1.1 Selected and used appropriate processes, tools and equipment to carry out task</li> <li>1.2 Identified functional and non-functional tools and equipment</li> <li>1.3 Checked, lubricated and calibrated tools, equipment and instruments according to manufacturer's specifications</li> <li>1.4 Replaced defective tools, equipment and its accessories</li> <li>1.5 Observed and applied safe handling of tools and equipment and safety work practices</li> <li>1.6 Prepared and submitted inventory report, where applicable</li> <li>1.7 Maintained work place in accordance with OSHA regulations</li> <li>1.8 Stored tools and equipment safely in appropriate locations and in accordance with company practices</li> </ol>
<p>2. Underpinning Knowledge</p>	<ol style="list-style-type: none"> <li>2.1 <b>SAFETY PREFRIGERATION TICES</b> <ul style="list-style-type: none"> <li>• Use of PPE</li> <li>• Handling of tools and equipment</li> <li>• Good housekeeping</li> </ul> </li> <li>2.2 <b>MATERIALS, TOOLS AND EQUIPMENT</b> <ul style="list-style-type: none"> <li>• Types and Uses of lubricants</li> <li>• Types and Uses of cleaning materials</li> <li>• Types and Uses of measuring instruments and equipment</li> </ul> </li> <li>2.3 <b>PREVENTIVE MAINTENANCE</b> <ul style="list-style-type: none"> <li>• Methods and techniques</li> <li>• Procedures</li> </ul> </li> </ol>
<p>3. Underpinning Skills</p>	<ol style="list-style-type: none"> <li>3.1 Preparing maintenance materials, tools and equipment</li> <li>3.2 Proper handling of tools and equipment</li> <li>3.3 Performing preventive maintenance</li> <li>3.4 Following instructions</li> </ol>
<p>4. Resource Implications</p>	<p>The following resources should be provided:</p> <ol style="list-style-type: none"> <li>4.1 Work place</li> <li>4.2 Maintenance Schedule</li> <li>4.3 Maintenance materials, tools and equipment relevant to the proposed activity/task</li> </ol>
<p>5. Methods of Assessment</p>	<p>Competency should be assessed through:</p> <ol style="list-style-type: none"> <li>5.1 Direct observation</li> <li>5.2 Written test/questioning relevant to underpinning knowledge</li> </ol>
<p>6. Context for Assessment</p>	<ol style="list-style-type: none"> <li>6.1 Competency assessment may occur in workplace or any appropriate simulated environment</li> <li>6.2 Competency assessment must be undertaken in accordance with the endorsed TESDA assessment guidelines</li> </ol>



**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.

<b>ELEMENT</b>	<b>PERFORMANCE CRITERIA</b> <i>Italicized bold</i> 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

ELEMENT	PERFORMANCE CRITERIA <i>Italicized bold</i> terms are elaborated in the Range of Variables
4. Identify and minimize/eliminate hazards	4.1 <b>Hazards</b> 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 <b>emergencies</b> are followed whenever necessary within the scope of responsibilities and competencies 4.4 <b>Safety signs and hazard warnings</b> are displayed and observed at all times in line with workplace health and safety regulations 4.5 Equipment and safety devices/ <b>PPE</b> are used/handled according to company or manufacturer's procedures and guidelines 4.6 Work areas are kept clean, free from obstacles and emergency exits are known and kept clear at all times 4.7 Safe manual handling/fighting techniques and safe equipment operation techniques are employed at all times
5. Respond and record accidents	5.1 Workplace accidents are identified 5.2 Workplace emergency <b>first-aid procedures/treatment</b> are followed/carried out correctly in accordance with <b>standards/regulations</b> 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 <b>Security policies/procedures</b> 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: <ol style="list-style-type: none"> <li>1.1 Flammable materials</li> <li>1.2 Running machinery/equipment</li> <li>1.3 Toxic substances</li> <li>1.4 Debris</li> <li>1.5 Open flames</li> <li>1.6 Loose objects/fixtures</li> <li>1.7 Chemicals</li> <li>1.8 Electrical faults</li> <li>1.9 Hot metals</li> </ol>
2. Emergencies	Emergencies may include but not limited to: <ol style="list-style-type: none"> <li>2.1 Fire</li> <li>2.2 Explosion</li> <li>2.3 Spills</li> <li>2.4 Falls</li> <li>2.5 Electrocutation</li> <li>2.6 Injuries caused by falling objects</li> <li>2.7 Injuries caused by sharp objects</li> <li>2.8 Injuries caused by wrong usage of tools</li> </ol>
3. Safety signs, symbols and hazard warnings	Safety signs and symbols include but not limited to: <ol style="list-style-type: none"> <li>3.1 Industry recognized hazard warning signs and safety symbols               <ul style="list-style-type: none"> <li>- Danger-High Voltage</li> <li>- Unauthorized Persons Keep Out</li> <li>- No Smoking</li> <li>- Poisonous Gases</li> <li>- Caution - Men working on line wires</li> </ul> </li> <li>3.2 Internationally recognized hazard warning signs and safety symbols</li> </ol>

<b>VARIABLE</b>	<b>RANGE</b>
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
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

<p>1. Critical Aspects of Competency</p>	<p>Assessment requires that the candidate:</p> <ul style="list-style-type: none"> <li>1.1 Classified materials, tools and equipment according to kind</li> <li>1.2 Cleaned workplace areas, materials, tools and equipment as per standard procedures</li> <li>1.3 Implemented systematize dispensing and retrieval of materials, tools and equipment</li> <li>1.4 Identified and described safety working practices relating to all tasks undertaken in the workplace</li> <li>1.5 Identified and selected appropriate equipment and safety devices for particular workplace tasks and activities</li> <li>1.6 Interpreted hazard warnings and safety signs correctly and described the application of these warnings and signs in the work activities</li> <li>1.7 Workplace emergency first-aid procedures/treatment are carried out in accordance with OHS standards/legislation and enterprise procedures</li> <li>1.8 Responded/maintained accidents/incidents records in accordance with SOPs</li> <li>1.9 Followed security procedures/policies in accordance with enterprise practices and legislation</li> <li>1.10 Workplace kept in safe state in accordance with safety regulations</li> </ul>
<p>2. Underpinning Knowledge</p>	<ul style="list-style-type: none"> <li>2.1 Kinds and Uses of PPE</li> <li>2.2 Identification of Safety Signs and Symbols</li> <li>2.3 5S of Good Housekeeping</li> <li>2.4 General OH&amp;S principles, responsibilities and legislations</li> <li>2.5 OH&amp;S requirements in relations to work safety</li> <li>2.6 Environmental requirements relative to work safety</li> <li>2.7 Hazard identification and avoidance in the workplace</li> <li>2.8 First-aid treatment procedures</li> <li>2.9 Kinds of emergency situations – causes and how to deal with different situations</li> <li>2.10 Kinds of injuries and effects</li> <li>2.11 Accident/hazard reporting</li> <li>2.12 Basic security procedures</li> <li>2.13 Uses of Manuals</li> </ul>
<p>3. Underpinning Skills</p>	<ul style="list-style-type: none"> <li>3.1 Wearing appropriate PPE</li> <li>3.2 Reading skills required to interpret work instruction</li> <li>3.3 Identifying safety signs and symbols</li> <li>3.4 Practice of CPR, Mouth to Mouth Resuscitation and other First-Aid Treatment</li> <li>3.5 Problem solving in emergency situation</li> <li>3.6 Handling injured worker</li> <li>3.7 Coordination of work in times of emergency</li> <li>3.8 Fire fighting procedures and techniques</li> <li>3.9 Reporting/recording accidents and potential hazards</li> </ul>

<p>4. Resource Implications</p>	<p>The following resources should be provided:</p> <ul style="list-style-type: none"> <li>4.1 Work place</li> <li>4.2 Materials, tools and equipment relevant to the proposed activity/task</li> <li>4.3 Safety signs</li> <li>4.4 Safety devices</li> <li>4.5 Accident reporting procedures</li> <li>4.6 First-aid materials and guidelines</li> </ul>
<p>5. Methods of Assessment</p>	<p>Competency should be assessed through:</p> <ul style="list-style-type: none"> <li>5.1 Direct observation while task is being undertaken</li> <li>21.1 Written test/questioning relevant to underpinning knowledge</li> <li>21.2 Assessment of underpinning knowledge and practical skills may be combined</li> </ul>
<p>6. Context for Assessment</p>	<ul style="list-style-type: none"> <li>6.1 Competency assessment may occur in workplace or any appropriate simulated environment</li> <li>6.3 Assessment shall be observed while task are being undertaken whether individually or in group in accordance with the approved industry OHS regulations</li> <li>6.4 Competency assessment must be undertaken in accordance with the endorsed TESDA assessment guidelines</li> </ul>

**UNIT TITLE** : **DOCUMENT WORK ACCOMPLISHED**

**UNIT CODE** : **HVC311205**

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

<b>ELEMENT</b>	<b>PERFORMANCE CRITERIA</b> <i>Italicized bold</i> terms are elaborated in the Range of Variables
1. Identify forms and data	1.3 <b>Forms</b> are selected based on the reports to be prepared 1.4 <b>Data</b> are collected based on the reports to be prepared
2. Prepare reports	2.1 <b>Reports</b> 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. Underpinning Knowledge	2.1 <b>SOURCES OF INFORMATION</b> <ul style="list-style-type: none"> <li>• Service manual</li> <li>• Parts catalogue</li> <li>• Service report</li> <li>• Price estimates/quotation</li> <li>• Warranty card</li> <li>• Types and Uses of Forms</li> <li>• Parts and Accessories</li> </ul>
3. Underpinning 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 underpinning 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 TITLE** : SURVEY SITE FOR INSTALLATION

**UNIT CODE** : HVC723322

**UNIT DESCRIPTOR** : This unit covers the knowledge, skills and attitudes in surveying site for installation of equipment, piping, air distribution and electrical controls and wiring for Ice plant refrigeration units.

ELEMENT	PERFORMANCE CRITERIA <i>Italicized bold</i> terms are elaborated in the Range of Variables
1. Prepare site for surveying	1.1 Work instructions are read and interpreted to determine job requirements 1.2 Materials are prepared according to specifications 1.3 Technical plan/drawing is interpreted 1.4 <b>Components</b> of Ice plant refrigeration system to be installed are identified as per plan
2. Survey site	2.1 Site is surveyed as per approved sketch/plan 2.2 Alteration/comments are prepared as per survey conducted 2.3 Result of survey is prepared and submitted to appropriate personnel/ supervisor

### RANGE OF VARIABLES

VARIABLE	RANGE
1. Components	1.1 Equipment installation 1.2 Piping installation 1.3 Air distribution installation 1.4 Electrical controls and wiring installation

## EVIDENCE GUIDE

1. Critical Aspects of Competency	Assessment requires evidence that the candidate: 1.1 Surveyed site as per approved sketch/plan 1.2 Prepared alteration/comments as per survey conducted 1.3 Applied organizational quality procedure and process within the context of surveying site for installation 1.4 Selected and used appropriate processes, tools and equipment to carry out tasks 1.5 Communicated interactively with others where applicable to ensure safe and effective work operations
2. Underpinning Knowledge	2.1 <b>DRAWING/PLAN READINGS</b> <ul style="list-style-type: none"> <li>• Electrical plans, symbols and abbreviations</li> <li>• Mechanical plans, symbols and abbreviations</li> </ul> 2.2 <b>TRADE MATHEMATICS/MENSURATION</b> <ul style="list-style-type: none"> <li>• Linear measurement</li> <li>• Dimension</li> <li>• Ratio and proportion</li> <li>• Unit conversion</li> </ul> 2.3 <b>TRADE THEORY</b> <ul style="list-style-type: none"> <li>• Basic electricity</li> <li>• Basic refrigeration cycle</li> <li>• Fundamental of refrigeration</li> <li>• How to select wire size</li> <li>• Principles of air distribution</li> <li>• Equipment selection and application</li> </ul>
3. Underpinning Skills	3.1 Interpreting plan and specifications 3.2 Preparing materials 3.3 Communication skills 3.4 Problem-solving
4. Resource Implications	The following resources <b>MUST</b> be provided: 4.1 Technical plan/drawing relevant to the task 4.2 Materials relevant to the proposed activity
5. Methods of Assessment	Competency must be assessed through: 5.1 Direct observation/Demonstration 5.2 Questions related to underpinning knowledge
6. Context for Assessment	6.1 Competency may be assessed in the work place or in a simulated work place setting

**UNIT TITLE** : **INSTALL ICE PLANT REFRIGERATION PIPING SYSTEM**

**UNIT CODE** : **HVC723323**

**UNIT DESCRIPTOR** : This unit covers the knowledge, skills and attitudes to install ice plant refrigeration piping systems according to plan. It includes preparation of piping requirements, laying out and insulation of secondary refrigerant piping

<b>ELEMENT</b>	<b>PERFORMANCE CRITERIA</b> <i>Italicized bold</i> terms are elaborated in the Range of Variables
1. Prepare piping requirements	1.1 Work instructions are read and interpreted based on job requirements 1.2 <b>Piping requirements</b> are prepared and checked for damages in accordance with plans and specifications 1.3 <b>Tools and equipment</b> are selected relevant to required tasks 1.4 Fabrication of pipe hangers and supports are checked in conformity with designs and specifications 1.5 Work is undertaken in line with safety requirements
2. Lay-out refrigerant/secondary refrigerant piping	2.1 Selection of brackets and supports are inspected in accordance with job requirements 2.2 Installation of brackets and supports are checked according to plan 2.3 Refrigerant/secondary <b>refrigerant</b> piping is laid out in conformity with design 2.4 Refrigerant/secondary refrigerant piping is installed in accordance with approved design and manufacturer's specification
3. Inspect welding of pipe joints	3.1 Tools and equipment required for pipe brazing are inspected in line with job requirements 3.2 Operation of SMAW/GTAW equipment is supervised in accordance with manufacturer's manual and safety requirements 3.3 Quality of welded pipe joints are inspected ensuring no leakage and quality finish in accordance with enterprise standards 3.4 Economical use of piping materials are ensured in accordance with approved plan and standard operating procedures

4. Perform insulation of refrigerant/ secondary refrigerant piping	4.1 Required insulating/sealing/adhesive materials are applied in accordance with manufacturer's specifications 4.2 Refrigerant /secondary refrigerant piping is insulated as per standard procedures 4.3 Joints are prepared and checked to ensure fit and air tightness in line with standard procedures
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### RANGE OF VARIABLES

VARIABLE	RANGE
1. Piping requirements	1.1 Piping 1.2 Pipe fittings 1.3 Stop and control valves 1.4 Insulation 1.5 Hangers, clamps, brackets
2. Tools	2.1 Wrenches 2.2 Pliers 2.3 Screw driver 2.4 Hammer 2.5 Pipe cutter 2.6 Chisel 2.7 Electric drill 2.8 Electric disc grinder
3. Equipment	3.1 Plasma cutter equipment 3.2 SMAW and GTAW equipment 3.3 Leak detector (Halocarbon) 3.4 Vacuum pump 3.5 Oxy-Acetylene welding equipment
4. Secondary refrigerant	4.1 Nitrogen gas 4.2 Ammonia

## EVIDENCE GUIDE

<p>1. Critical Aspects of Competency</p>	<p>Assessment requires evidence that the candidate:</p> <ol style="list-style-type: none"> <li>1.1 Prepared and checked piping requirements</li> <li>1.2 Ensured fabrication of pipe hangers and supports are in conformity with design and specifications</li> <li>1.3 Ensured laying-out of refrigerant/secondary refrigerant piping are in conformity with design/manufacture's installation procedures</li> <li>1.4 Inspected welding of piping joints in accordance with approved industry standards</li> <li>1.5 Checked installation of piping system in accordance with the plan and designs</li> <li>1.6 Demonstrated compliance with safety regulations applicable to worksite operations</li> <li>1.7 Identified faults and problems and made necessary action to rectify, if applicable</li> <li>1.8 Communicated interactively with others to ensure safe and effective work operations</li> </ol>
<p>2. Underpinning Knowledge</p>	<ol style="list-style-type: none"> <li>2.1 <b>SAFETY PRACTICES</b> <ul style="list-style-type: none"> <li>• Protective personal equipment/safety gears</li> <li>• Handling of tools, equipment and accessories</li> <li>• Safety signs and symbols</li> <li>• Good housekeeping</li> <li>• Rules on the safe use of scaffolds and ladders</li> </ul> </li> <li>2.2 <b>DRAWING/PLAN READINGS</b> <ul style="list-style-type: none"> <li>• Reading of drawing/plan and interpretation</li> <li>• Plan specifications</li> </ul> </li> <li>2.3 <b>MATERIALS/TOOLS AND EQUIPMENT</b> <ul style="list-style-type: none"> <li>• Proper use and care of tools needed</li> <li>• Types of insulation</li> <li>• Importance of support and bracket</li> <li>• Types of piping/sizing</li> <li>• Types of fittings</li> </ul> </li> <li>2.4 <b>TRADE THEORY</b> <ul style="list-style-type: none"> <li>• Basic refrigeration cycle</li> <li>• Pipe processing</li> <li>• Heat transfer</li> <li>• Basic arc welding</li> <li>• Basic gas welding</li> <li>• Leak testing</li> <li>• Welding procedure</li> <li>• Piping principles</li> <li>• Slope and risers</li> <li>• Principle of water treatment</li> <li>• Flushing of nitrogen</li> </ul> </li> <li>2.5 <b>LEGISLATION/TREATY</b> <ul style="list-style-type: none"> <li>• Clean Air Act (RA 8749)</li> <li>• Montreal/Kyoto Protocol</li> </ul> </li> </ol>

3. Underpinning Skills	3.1 Interpreting plan and details 3.2 Preparing materials 3.3 Welding procedures 3.4 Using of tools and equipment properly 3.5 Testing techniques on leak 3.6 Performing work safety 3.7 Setting-up of work 3.8 Pressurizing
4. Resource Implications	The following resources <b>MUST</b> be provided: 4.1 Work place location 4.2 Tools and equipment appropriate to installing Industrial Refrigeration piping 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 Demonstration 5.3 Questions related to underpinning knowledge
6. Context for Assessment	6.1 Competency may be assessed in the work place or in a simulated work place setting

**UNIT TITLE** : **INSTALL ICE PLANT REFRIGERATION ELECTRICAL SYSTEM**

**UNIT CODE** : **HVC723324**

**UNIT DESCRIPTOR:** This unit covers the knowledge, skills and attitudes to safely install electrical wiring, controls and protective devices for Ice plant refrigeration electrical systems

<b>ELEMENT</b>	<b>PERFORMANCE CRITERIA</b> <i>Italicized bold</i> terms are elaborated in the Range of Variables
1. Lay-out electrical system	1.1 Work instructions are read and interpreted to determine job requirements 1.2 <b>Electrical materials</b> are prepared and checked in consistent with job requirements 1.3 <b>Electrical systems</b> is laid out in conformity with the designs, specifications and/or approved working plan/drawing 1.4 Electrical systems are mounted/insulated/terminated as per standard operating procedures 1.5 <b>Wiring method</b> is applied as required/prescribed in the PEC
2. Install power supply wiring	2.1 Power supply wirings are inspected and checked for damages in accordance with specifications 2.2 Power supply wirings are installed as per approved working design / plan and <b>wiring diagram</b> 2.3 Termination, insulation and testing for short and grounding of wirings are performed according to established procedures
3. Install controls and protective devices	3.1 Controls and protective devices are selected in line with PEC requirements 3.2 Controls and protective devices are installed as per design/ specification/wiring diagrams 3.3 Controls/protective devices are mounted, secured and are free from physical and mechanical damage 3.4 <b>Sequence test</b> is performed according to established procedures
4. Test -run electrical system	4.1 Testing of the electrical system is performed in line with manufacturer's instruction/procedures 4.2 Report on installation and testing of electrical system is prepared 4.3 Recorded data base on the standard procedures



## RANGE OF VARIABLES

VARIABLE	RANGE
1. Electrical materials	1.1 Electrical tape 1.2 Wire connector 1.3 Wires and cables 1.4 Breaker 1.5 Terminal clips/plugs
2. Electrical system	2.1 Electrical conduits 2.2 Controls and protective devices 2.3 Electrical control wires/cables
3. Wiring methods	3.1 Raceway wiring 3.2 Cable wiring 3.3 Conduit wiring (PVC, Rigid)
4. Diagrams	4.1 Ladder 4.2 Schematic 4.3 Pictorial
5. Sequence test	5.1 Insulation test 5.2 Continuity test 5.3 Ground test 5.4 Voltage test

## EVIDENCE GUIDE

<p>1. Critical Aspects of Competency</p>	<p>Assessment requires evidence that the candidate:</p> <ol style="list-style-type: none"> <li>1.1 Prepared and checked electrical materials in consistent with job requirements</li> <li>1.2 Installed/laid-out controls/protective devices in conformity with the design/specification/approved working plan</li> <li>1.3 Inspected wiring connection for tightness and traced all wires according to the instructions</li> <li>1.4 Checked proper wiring termination as per standard operating procedures</li> <li>1.5 Demonstrated compliance with safety regulations applicable to worksite operations</li> <li>1.6 Identified faults and problems and made necessary action to rectify, if applicable</li> <li>1.7 Communicated interactively with others where applicable to ensure safe and effective work operations</li> <li>1.8 Checked installation of ICE PLANT refrigeration electrical system according to manufacturer's installation procedures</li> </ol>
<p>2. Underpinning Knowledge</p>	<ol style="list-style-type: none"> <li>2.1 <b>SAFETY PRACTICES</b> <ul style="list-style-type: none"> <li>• Protective personal equipment/safety gears</li> <li>• Safe handling of tools and equipment</li> <li>• Safety signs and symbols</li> <li>• Good housekeeping</li> <li>• Electrical safety</li> </ul> </li> <li>2.2 <b>DRAWING/PLAN AND SPECIFICATION</b> <ul style="list-style-type: none"> <li>• Reading and interpretation of drawing/plan</li> <li>• Electrical symbol</li> <li>• Electrical wiring diagram</li> </ul> </li> <li>2.3 <b>TOOLS AND MATERIALS: PARTS AND USES</b> <ul style="list-style-type: none"> <li>• Types of electrical controls</li> <li>• Classification of wire</li> <li>• Proper use and care of tools needed</li> <li>• Types of fittings</li> <li>• Types of cable tray/cable trunk/PVC pipe</li> <li>• Types and use of clamp and support</li> <li>• Size of wire and cables</li> </ul> </li> <li>2.4 <b>TRADE THEORY</b> <ul style="list-style-type: none"> <li>• Basic electricity</li> <li>• Fundamental of control</li> <li>• Principle and operation of ICE PLANT Refrigeration System</li> </ul> </li> <li>2.5 <b>PROCESSES/PROCEDURES</b> <ul style="list-style-type: none"> <li>• Soldering procedure</li> <li>• Insulation test procedure</li> <li>• Continuity test procedure</li> <li>• Wire splicing procedure</li> <li>• Power circuit installation</li> <li>• Voltage test procedure</li> <li>• Ground test procedure</li> </ul> </li> <li>2.6 <b>CODES AND REGULATIONS</b> <ul style="list-style-type: none"> <li>• Philippine Electrical Code (PEC)</li> <li>• Local rules/requirements</li> </ul> </li> </ol>

3. Underpinning Skills	3.1 Interpreting plan and details 3.2 Use of electrical materials, tools and equipment 3.3 Wiring and insulation test 3.4 Performing work safety 3.5 Setting up of work 3.6 Installing protective devices and wiring 3.7 Connecting power circuit 3.8 Connecting equipment grounding circuit 3.9 Testing power wiring
4. Resource Implications	The following resources <b>MUST</b> be provided: 4.1 Work place location 4.2 Tools and equipment appropriate to installing Industrial Refrigeration electrical system 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 underpinning knowledge
6. Context for Assessment	6.1 Competency may be assessed in the work place or in a simulated work place setting

**UNIT TITLE** : **INSTALL ICE PLANT REFRIGERATION EQUIPMENT**

**UNIT CODE** : **HVC723325**

**UNIT DESCRIPTOR** : This unit covers the knowledge, skills and attitudes to safely install the main ICE PLANT refrigeration components and units based on manufacturer's recommendations.

<b>ELEMENT</b>	<b>PERFORMANCE CRITERIA</b> <i>Italicized bold</i> terms are elaborated in the Range of Variables
1. Prepare for installation of components and units	1.1 Installation drawings and instructions are checked, read and interpreted for correct location, dimension and level in accordance with established procedures 1.2 Approval for the installation is coordinated and confirmed with appropriate authority 1.3 <b>Supplies and materials</b> needed for installation are prepared in accordance with specification and standard operating procedures 1.4 Work is undertaken in line with safety requirements, including use of appropriate PPE
2. Install components and units	2.1 <b>Ice plant components</b> to be installed are checked and prepared in accordance with drawings, designs and specifications 2.2 Compressors, shell & tube/plate heat exchangers, unit coolers, liquid receivers, intercoolers, separators, evaporative condensers and its accessories are installed according to unit manual recommendation 2.3 Pipes, fittings, stop valves, control valves and other accessories are installed in accordance with drawings, designs and specifications 2.4 Installation is completed with no damage to equipment and its components 2.5 Faults/problems are identified and necessary remedial action is taken in line with standard operating procedures
3. Test-run ice plant refrigeration system	3.1 Charging of <b>Ice Plant systems</b> and components with refrigerant and

	<p>secondary heat transfer fluid are ensured in accordance with manufacturer's standard operating procedures</p> <p>3.2 Pre-start up checks are performed in accordance with standard operating procedures</p> <p>3.3 Reports and documentation are completed based on approved format</p>
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## RANGE OF VARIABLES

VARIABLE	RANGE
1. Supplies and materials	<p>1.1 Screw/bolt/nuts</p> <p>1.2 Expansion bolt</p> <p>1.3 Sulfur stick</p> <p>1.4 Electrical tape</p> <p>1.5 Blind rivets</p> <p>1.6 B.I. pipes</p> <p>1.7 Welding rod</p> <p>1.8 Red oxide/paint</p> <p>1.9 Washer</p> <p>1.10 Cement</p> <p>1.11 Sand</p> <p>1.12 B.I. fittings</p> <p>1.13 Insulation spacers</p> <p>1.14 Nitrogen gas</p> <p>1.15 Flanges</p> <p>1.16 Oxygen-acetylene gas</p> <p>1.17 Clamps</p>
2. Ice plant refrigeration components	<p>2.1 Compressors</p> <p>2.2 Evaporator (S&amp;T, PHE, unit coolers)</p> <p>2.3 Condensers (S&amp;T, PHE &amp; evaporative condenser)</p> <p>2.4 Valves (stop, check &amp; control)</p> <p>2.5 SCADA</p> <p>2.6 Fans</p> <p>2.7 Solenoids</p> <p>2.8 Thermostats</p> <p>2.9 Switches</p> <p>2.10 Mounting base</p>
3. Ice plant refrigeration systems	<p>3.1 Refrigeration systems include:</p> <ul style="list-style-type: none"> <li>• Herring bone coil evaporator</li> <li>• Flake/plate/tube ice maker</li> <li>• Freezing tank</li> </ul>
4. Condensate drain	<p>4.1 B.I. pipe</p> <p>4.2 Stainless Steel</p>

## EVIDENCE GUIDE

<p>1. Critical Aspects of Competency</p>	<p>Assessment requires evidence that the candidate:</p> <ol style="list-style-type: none"> <li>1.1 Prepared supplies, materials and components in accordance with standard operating procedures</li> <li>1.2 Installed ice plant system and its accessories in conformity with the standard operating procedures</li> <li>1.3 Coordinated and confirmed installation arrangements with appropriate authority</li> <li>1.4 Demonstrated compliance with safety regulations applicable to worksite operations</li> <li>1.5 Selected types of electrical tools/instrument and wiring devices in accordance with specification and job requirement</li> <li>1.6 Identified faults and problems and made necessary action with enterprise regulations, if necessary</li> <li>1.7 Communicated interactively with others to ensure safe and effective work operations</li> <li>1.8 Completed installation of ice plant refrigeration system according to manufacturer's standard operating procedures</li> </ol>
<p>2. Underpinning Knowledge</p>	<ol style="list-style-type: none"> <li>2.1 <b>SAFETY PRACTICES</b> <ul style="list-style-type: none"> <li>• Protective personal equipment/safety gears</li> <li>• Handling of tools, equipment and accessories</li> <li>• Safety signs and symbols</li> <li>• Good housekeeping</li> </ul> </li> <li>2.2 <b>TRADE MATHEMATICS/MENSURATION</b> <ul style="list-style-type: none"> <li>• Linear measurements</li> <li>• Ratio and proportion</li> <li>• Dimension</li> </ul> </li> <li>2.3 <b>DRAWING/PLAN READINGS</b> <ul style="list-style-type: none"> <li>• Mechanical plans, symbols and abbreviations</li> <li>• Electrical plans, symbols and abbreviations</li> <li>• Architectural/Structural plans</li> <li>• Plumbing plans, symbols and abbreviations</li> </ul> </li> <li>2.4 <b>TRADE THEORY</b> <ul style="list-style-type: none"> <li>• Basic refrigeration cycle</li> <li>• Basic masonry</li> <li>• Basic sheet metal</li> <li>• Basic welding</li> <li>• Knowledge to understand the geographical location/site location</li> </ul> </li> <li>2.5 <b>LEGISLATION/TREATY</b> <ul style="list-style-type: none"> <li>• Clean Air Act (RA 8749)</li> <li>• Montreal/Kyoto Protocol</li> </ul> </li> </ol>

3. Underpinning 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
4. Resource Implications	The following resources <b>MUST</b> be provided: 4.1 Work place location 4.2 Tools and equipment appropriate to installing Industrial Refrigeration 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/Demonstration 5.2 Questions related to underpinning knowledge
6. Context for Assessment	6.1 Competency may be assessed in the work place or in a simulated work place setting

**UNIT TITLE** : **SERVICE AND MAINTAIN ICE PLANT REFRIGERATION SYSTEM**

**UNIT CODE** : **HVC723326**

**UNIT DESCRIPTOR** : This unit covers the knowledge, skills and attitudes in maintaining refrigeration components, lubrication, refrigerant, secondary heat transfers and distribution systems in ice plant refrigeration units.

<b>ELEMENT</b>	<b>PERFORMANCE CRITERIA</b> <i>Italicized bold</i> 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 selected based on system requirements 1.3 Tools and instruments are selected in accordance with job requirements 1.4 Personal protective equipment (PPE) is selected and prepared
2. Check and adjust refrigeration components	2.1 Evaporator/condenser are cleaned in accordance with manufacturer's maintenance manual 2.2 Refrigerant piping are checked for condition, leak, and insulation in accordance with standard testing procedures 2.3 Tightness of support/brackets are inspected according to plan 2.4 <b>Operating condition</b> and electro-mechanical controls/settings are inspected and adjusted in accordance with manufacturer's operation/service manual 2.5 <b>Refrigeration components</b> are checked and adjusted as per manufacturer's operation/service manual 2.6 Established maintenance procedures are applied according to plan
3. Maintain lubrication system in ice plant	3.1 Lubrication system variables and components are checked and adjusted based on operational specifications 3.2 Oil levels, properties and circulation balances are checked and adjusted based on operational specifications



	3.3 Oil filters are checked based on manufacturer's maintenance procedures
4. Maintain refrigerant system	4.1 Liquid supply and back pressure filters are checked as per manufacturers maintenance procedures 4.2 Refrigerant leaks are detected and rectified based on procedures 4.3 <b>Refrigerant system</b> variables and contaminants are checked and adjusted based on procedure's manual 4.4 Automatic and manual non-condensable gas purgers are checked and adjusted based on <b>operational specifications</b>
5. Maintain secondary heat transfer equipment	5.1 <b>Secondary heat transfer loop</b> is checked and findings are documented in accordance with established procedures 5.2 <b>Liquid properties</b> are checked and adjusted to meet system requirements 5.3 Follow-up action is arranged in accordance with workplace procedures

#### RANGE OF VARIABLES

VARIABLE	RANGE
1. Operating conditions	1.1 Pressures 1.2 Temperatures 1.3 Voltages 1.4 Current draws
2. Refrigeration components	2.1 Evaporator 2.2 Condenser 2.3 Refrigerant pump 2.4 Oil Filters 2.5 Refrigerant Piping 2.6 Belts 2.7 Pulley alignment/tension 2.8 Controls 2.9 Compressor 2.10 Valves 2.11 Fans/blades 2.12 Motors
3. Operational specifications	3.1 Unit settings 3.2 Unit operation procedures 3.3 Unit requirements
4. Refrigerant system	2.1 Refrigerant 2.2 Sight glass 2.3 Level control/stand pipe

5. Secondary heat transfer loop	5.1 Shell and tube condenser 5.2 Tube-and-tube 5.3 Plate-heat exchanger
6. Liquid properties	6.1 Water 6.2 Refrigerant 6.3 Glycol (ethylene or propylene) 6.4 Brine

## EVIDENCE GUIDE

1. Critical Aspects of Competency	<p>Assessment requires evidence that the candidate:</p> <ol style="list-style-type: none"> <li>1.1 Checked ice plant equipment components and devices in accordance with manufacturer's maintenance/operation manual</li> <li>1.2 Checked operating conditions and electro-mechanical controls/settings in accordance with manufacturer's operation/service manual</li> <li>1.3 Checked and adjusted lubrication and refrigerant system variables and components</li> <li>1.4 Adjusted liquid properties to meet system requirements</li> <li>1.5 Conducted test as per standard procedures</li> <li>1.6 Demonstrated compliance with safety regulations</li> <li>1.7 Applied organizational quality procedures and processes</li> <li>1.8 Selected tools/instrument and wiring devices in accordance with specification and job requirement</li> <li>1.9 Identified faults and problems and made necessary actions to rectify</li> </ol>
2. Underpinning Knowledge	<p>2.1 <b>SAFETY PRACTICES</b></p> <ul style="list-style-type: none"> <li>• Protective personal equipment/safety gear</li> <li>• Safety hazards</li> <li>• Handling of tools and equipment and accessories</li> <li>• Safety signs and symbols</li> <li>• Proper handling of refrigerant pressure testing</li> <li>• Good housekeeping</li> </ul> <p>2.2 <b>TRADE MATHEMATICS/ MENSURATIONS</b></p> <ul style="list-style-type: none"> <li>• Linear measurements</li> <li>• Dimension</li> <li>• Ratio and proportion</li> <li>• Unit conversion</li> </ul>

	<p><b>2.3 TOOLS/MATERIALS: USES AND SPECIFICATIONS</b></p> <ul style="list-style-type: none"> <li>• Proper use and care of tools needed</li> <li>• Types of electrical controls</li> <li>• Types expansion valves/motoring devices</li> <li>• Types of compressor</li> <li>• Types of refrigerant</li> <li>• Types of pulley</li> <li>• Types of belts</li> <li>• Types of fins and materials use</li> </ul> <p><b>2.4 LEGISLATION/TREATY</b></p> <ul style="list-style-type: none"> <li>• Clean Air Act (RA 8749)</li> <li>• Montreal/Kyoto Protocol</li> </ul>	<p><b>2.5 DRAWING/PLAN READINGS</b></p> <ul style="list-style-type: none"> <li>• Plan specification</li> <li>• Electrical wiring diagram</li> <li>• Electrical plans, symbols and abbreviations</li> </ul> <p><b>2.6 TRADE THEORY</b></p> <ul style="list-style-type: none"> <li>• Fundamentals of refrigeration</li> <li>• Refrigeration service valves</li> <li>• Basic electricity</li> <li>• Troubleshooting charts/service charts</li> <li>• Expansion device and low pressure side of the system</li> <li>• How to evaluate the system</li> <li>• Pump-out/pump-down procedure</li> <li>• Resistance testing procedure</li> <li>• Mechanical testing procedure</li> <li>• Compressor construction</li> <li>• Refrigerant charging procedure</li> <li>• Expansion valve adjustment procedure</li> <li>• Back pressure valve adjustment procedure</li> </ul>
3. Underpinning Skills	<p>3.1 Interpreting plans and details</p> <p>3.2 Preparing materials</p> <p>3.3 Using of electrical and mechanical tools and equipment properly</p> <p>3.4 Troubleshooting technique</p> <p>3.5 Calibrating of expansion valve</p> <p>3.6 Replacing defective part</p> <p>3.7 Troubleshooting of Industrial Refrigeration system</p> <p>3.8 Performing work safety practices</p> <p>3.9 Adjusting superheat</p> <p>3.10 Aligning belt and pulley</p> <p>3.11 Aligning door</p>	
4. Resource Implications	<p>The following resources <b>MUST</b> be provided:</p> <p>4.1 Access to work place location</p> <p>4.2 Tools and equipment appropriate to maintaining ice plant refrigeration processes</p> <p>4.3 Materials relevant to the activity</p> <p>4.4 Drawings and specifications relevant to the task</p>	
5. Methods of Assessment	<p>Competency must be assessed through:</p> <p>5.1 Direct observation/Demonstration</p> <p>5.2 Questions related to underpinning knowledge</p>	
6. Context for Assessment	<p>6.1 Competency may be assessed in the work place or in a simulated work place setting</p>	

**UNIT TITLE** : **TROUBLESHOOT ICE PLANT REFRIGERATION SYSTEM**

**UNIT CODE** : **HVC723327**

**UNIT DESCRIPTOR** : This unit covers the knowledge, skills and attitudes in troubleshooting ice plant refrigeration systems. It includes planning and preparing materials, tools and equipment and identifying and rectifying faults.

<b>ELEMENT</b>	<b>PERFORMANCE CRITERIA</b> <i>Italicized bold</i> terms are elaborated in the Range of Variables
1. Plan and prepare for troubleshooting	1.1 Appropriate wiring diagrams, charts and manuals are interpreted in line with job requirements 1.2 Appropriate materials, tools and equipment are selected and prepared based on manual 1.3 Power supply is checked to ensure compliance with nameplate rating and/or manufacturer's standard
2. Identify and rectify faults	2.1 <b>Refrigeration system components</b> are tested following correct testing procedures 2.2 Faults/problems with refrigerant system are diagnosed in accordance with established procedures 2.3 Remedial action is taken to overcome faults/problems in line system requirements 2.4 Work is completed safely in line with workplace safety guidelines 2.5 Appropriate <b>PPE</b> is selected and used in line with the job requirements 2.6 Report on testing procedure, including faults and repair, is completed in line with SOPs
3. Test-run refrigeration system	3.1 Refrigeration system is tested in line with manufacturer's instructions 3.2 System is evaluated in accordance with specifications and requirements 3.3 Report on testing refrigeration system is prepared and completed in line with enterprise procedures

## RANGE OF VARIABLES

VARIABLE	RANGE
1. Refrigeration system components	1.1 Compressor 1.2 Cooling tower 1.3 Condensers 1.3.1 Evaporative Condenser 1.3.2 Air cooled condenser 1.3.3 Water cooled condenser 1.4 Evaporator (Refrigerant Flow Control) 1.5 Metering device 1.5.1 Electrical controls 1.5.2 Thermostat 1.5.3 Timer 1.5.4 Expansion valves 1.5.5 Back pressure valves 1.6 Refrigerant circuit
2. Test	2.1 Insulation 2.2 Resistance 2.3 Mechanical 2.4 Continuity 2.5 Timing Sequence
3. PPE	Includes but not limited to: 3.1 Self Breathing Apparatus 3.2 Gas mask 3.3 Safety shoes 3.4 Safety goggles 3.5 Apron 3.6 Gloves 3.7 Mask

## EVIDENCE GUIDE

<p>1. Critical Aspects of Competency</p>	<p>Assessment requires evidence that the candidate:</p> <ol style="list-style-type: none"> <li>1.1 Ensured power supply is in compliance with nameplate rating and/or manufacturer's standard</li> <li>1.2 Selected types of electrical tools/instrument and wiring devices in accordance with specification and job requirement</li> <li>1.3 Tested refrigerant systems as per standard procedures</li> <li>1.4 Demonstrated compliance with safety regulations applicable to worksite operations</li> <li>1.5 Identified faults and problems and made necessary action to rectify</li> <li>1.6 Communicated Interactively others where applicable to ensure safe and effective work operations</li> <li>1.7 Completed troubleshooting refrigerant systems according to manufacturer's installation and standard</li> </ol>
<p>2. Underpinning Knowledge</p>	<ol style="list-style-type: none"> <li>2.1 <b>SAFETY PRACTICES</b> <ul style="list-style-type: none"> <li>• Protective personal equipment/safety gears</li> <li>• Safe handling of tools and equipment</li> <li>• Proper handling of refrigerants</li> <li>• Safety signs and symbols</li> <li>• Safety hazard</li> <li>• Good housekeeping</li> </ul> </li> <li>2.2 <b>DRAWING/PLAN AND SPECIFICATION</b> <ul style="list-style-type: none"> <li>• Electrical wiring control diagram</li> <li>• Mechanical plan/symbols and abbreviation</li> </ul> </li> <li>2.3 <b>TRADE THEORY</b> <ul style="list-style-type: none"> <li>• Basic electricity</li> <li>• Basic refrigeration cycle</li> <li>• Fundamentals of refrigeration and control</li> <li>• Interlocking control sequence</li> <li>• Fundamentals of piping</li> <li>• Fan characteristics</li> <li>• Electrical code</li> <li>• Montreal protocol</li> <li>• EMB/DENR regulations</li> <li>• Pump principles</li> <li>• Cooling tower principles</li> <li>• Evaporative condenser principle</li> </ul> </li> </ol>

	<p><b>2.4 TOOLS/MATERIALS: USES AND SPECIFICATIONS</b></p> <ul style="list-style-type: none"> <li>• Types of electrical controls</li> <li>• Types of expansion valve</li> <li>• Types of compressor motor</li> <li>• Types of condenser</li> <li>• Types of evaporator</li> <li>• Types of refrigerant</li> <li>• Types of pressure control</li> <li>• Types of defrost timer</li> <li>• Types of fan motor</li> <li>• Types of fan</li> <li>• Types of pipe</li> <li>• Types of filter drier</li> <li>• Types of filter/strainer element</li> <li>• Types of thermostat</li> <li>• Types of circuit breaker</li> <li>• Types of magnetic contactor</li> <li>• Types of unloader</li> <li>• Types of compressor</li> <li>• Types of pump</li> </ul> <p><b>2.5 MAINTENANCE</b></p> <ul style="list-style-type: none"> <li>• Preventive maintenance</li> </ul> <p><b>2.6 LEGISLATION/TREATY</b></p> <ul style="list-style-type: none"> <li>• Clean Air Act</li> <li>• Montreal/Kyot Protocol</li> </ul>	<p><b>2.7 PROCESSES/ PROCEDURES</b></p> <ul style="list-style-type: none"> <li>• Compressor test procedures</li> <li>• Power supply test procedures</li> <li>• evaporator test procedures</li> <li>• Condensing unit test procedures</li> <li>• Pump test procedures</li> <li>• Cooling tower test procedures</li> <li>• Expansion valve test procedures</li> <li>• Automatic expansion valve test procedures</li> <li>• Electrical control test procedures</li> <li>• Leak testing procedure (for refrigeration circuit and water/glycol piping)</li> <li>• Pressure testing procedure</li> <li>• Vacuum testing procedure</li> <li>• Refrigerant charging procedure</li> <li>• Pump-out/pump-down procedure</li> <li>• Crank case/oil separator heater test procedures</li> <li>• Unloading test procedures</li> <li>• Start-up procedure</li> </ul>
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3. Underpinning 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 <b>MUST</b> 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/Demonstration 5.2 Questions related to underpinning knowledge
6. Context for Assessment	6.1 Competency may be assessed in the work place or in a simulated work place setting



**UNIT TITLE** : **RECOVER AND RECYCLE REFRIGERANT IN ICE PLANT SYSTEM**

**UNIT CODE** : **HVC723328**

**UNIT DESCRIPTOR** : This unit covers the knowledge, skills and attitudes in recovering and recycling refrigerants in the ice plant system. This includes evaluation of unit for recovering/recycling, setting-up of equipment and performing recovery and recycling of refrigerant operations.

<b>ELEMENT</b>	<b>PERFORMANCE CRITERIA</b> <i>Italicized bold</i> terms are elaborated in the Range of Variables
1. Assess unit for recovery/ recycling	1.1 Relevant data are gathered on unit to be recovered/recycled as per procedure 1.2 Appropriateness of <b>unit</b> for refrigerant recovery/recycling is determined according to Clean Air Act/Montreal Protocol requirements and manufacturer's specifications
2. Set-up equipment for recovery/ recycling	2.1 <b>Equipment, instruments, tools and accessories</b> are gathered based on job requirements 2.2 Equipment, instruments and tools are checked based on operation's manual 2.3 Equipment and accessories are set-up according to recovery/recycling requirements
3. Perform refrigerant recovery/ recycling	3.1 <b>Optimum recovery</b> of refrigerant is determined in line with the Clean Air Act/ Montreal Protocol 3.2 Refrigerants recovery/recycling is performed according to <b>manufacturer's recommendations</b> 3.3 Recovered refrigerant in the tank is identified and labeled prior to recycling based on procedure 3.4 <b>Contaminants</b> are removed from the system based on instrument readings 3.5 Recovery/recycling machine is operated and maintained in accordance with manufacturer's recommendations 3.6 Safety measures in recovery/recycling of refrigerants are observed in accordance with industry requirements

## RANGE OF VARIABLES

VARIABLE	RANGE
1. Unit	1.1 Cold storage plant 1.2 Ice plant 1.3 Process refrigeration plant
2. Equipment	2.1 Recovery machine 2.2 Recycling machine
3. Instruments	3.1 Refrigerant identifier 3.2 Acid test kit
4. Tools/Materials	4.1 System analyzer 4.2 refrigeration system 4.3 Spanner 4.4 Set of wrenches 4.5 Weighing scale 4.6 Marker 4.7 Masking tape
5. Optimum recovery	5.1 Pressure reading of 30 inch/760mm Hg.
6. Manufacturer's recommendations	Includes but not limited to: 6.1 Equipment operator's manual 6.2 Equipment service manual 6.3 Nameplate data
7. Contaminants	7.1 Acid 7.2 Moisture 7.3 Foreign particles e.g. chips, burr 7.4 Non-condensable gases

## EVIDENCE GUIDE

<p>1. Critical aspects of competency</p>	<p>Assessment requires evidence that the candidate:</p> <ol style="list-style-type: none"> <li>1.1 Performed refrigerant recycling in compliance with manufacturer's recommendations, environmental regulations and safety precautions</li> <li>1.2 Achieved optimum refrigerant recovery following standard procedures/manufacturer's recommendations</li> <li>1.3 Demonstrated compliance with safety regulations applicable to worksite operations</li> <li>1.4 Selected and used appropriate processes, tools, materials and equipment to carry out tasks</li> <li>1.5 Identified faults and problems and took necessary action to rectify</li> <li>1.6 Communicated effectively with others where applicable to ensure safe and effective work operations</li> </ol>
<p>2. Underpinning Knowledge</p>	<ol style="list-style-type: none"> <li>2.1 Recovery/recycling principles, procedures and standards</li> <li>2.2 Ozone-layer depletion and its effects</li> <li>2.3 Montreal Protocol, Clean Air Act (RA 8749) and Kyoto Protocol</li> <li>2.4 Recovery/recycling equipment specifications, parts and uses</li> <li>2.5 Refrigerant types and specifications</li> <li>2.6 Safety precautions in handling refrigerants</li> <li>2.7 Refrigerant identifier instrument, specification, parts and uses</li> <li>2.8 Trade Theory             <ul style="list-style-type: none"> <li>- Basic electrical</li> <li>- Refrigeration</li> <li>- Compressor</li> <li>- Condenser</li> <li>- Expansion valve</li> <li>- Lubricant</li> <li>- Principles of Refrigeration</li> <li>- Compression</li> <li>- Condensing</li> <li>- Expansion</li> <li>- Revaporizing</li> <li>- Basic electronics</li> <li>- Basic automotive</li> <li>- Electrical and mechanical system of refrigeration</li> <li>- Heat transfer</li> </ul> </li> </ol>

3. Underpinning Skills	3.1 Installing and operating recovery and recycling machine 3.2 Interpreting manufacturer and equipment data 3.3 Estimating cost of recovery/recycling 3.4 Maintaining recovery/recycling machine 3.5 Use of refrigerant identifier
4. Resource Implications	The following resources <b>MUST</b> be provided: 4.1 Manufacturer's manual 4.2 Work place location 4.3 Materials, tools and equipment relevant to the proposed activity 4.4 Refrigeration system
5. Methods of Assessment	Competency must be assessed through: 5.3 Direct observation/Demonstration 5.2 Questions related to underpinning knowledge
6. Context for Assessment	6.1 Competency may be assessed in the work place or in a simulated work place setting

**UNIT TITLE** : **REPAIR AND RETROFIT ICE PLANT SYSTEMS AND ITS ACCESSORIES**

**UNIT CODE** : **HVC723329**

**UNIT DESCRIPTOR** : This unit covers the knowledge, skills and attitudes in repairing and retrofitting ice plant system and its accessories. It includes evaluating the condition and repairing faulty components, performing preventive maintenance and testing ice plant refrigeration system operation

<b>ELEMENT</b>	<b>PERFORMANCE CRITERIA</b> <i>Italicized bold</i> terms are elaborated in the Range of Variables
1. Evaluate condition of existing ice plant systems	1.1 Visual inspections of all refrigeration components are performed and any signs of damage, lubricant <b>leaks</b> and corrosion are reported to the authorized personnel 1.2 Refrigeration systems are checked based on manufacturer's specification 1.3 Leak test is performed based on time requirement and any leaks found are repaired according to manufacturer's specifications
2. Prepare for servicing/repairing ice plant and components	2.1 Work instructions are read and interpreted to determine job requirements 2.2 <b>Electrical materials</b> are prepared and checked in accordance with system requirements 2.3 Appropriate PPE is selected and prepared in line with the job requirements 2.4 Work safety is observed according to enterprise regulations
3. Prepare ice plant systems for retrofitting	3.1 Required tools and equipment are selected and used based on procedure 3.2 Faults identified from a visual inspection and operational check are rectified, according to system requirements 3.3 Amount of oil in the compressor crankcase/oil separator is optimized based on procedure 3.4 Optimum amount of refrigerant is recovered in accordance with manufacturer's recommendations 3.5 Refrigeration system is pump-out and <b>evacuated</b>
4. Repair/replace faulty ice plant components	4.1 Ice plant components are correctly identified based on manual

	<p>4.2 Faults are identified and diagnosed based on procedure</p> <p>4.3 Operational function of each component is inspected and tested in accordance with the standard operating procedures</p> <p>4.4 <b>Ice plant components</b> are repaired/replaced as per manufacturer's operation/repair manual</p> <p>4.5 Ice plant components are reconditioned and overhauled in accordance with workplace procedures</p>
5. Test industrial refrigeration system operation	<p>5.1 Suitable tools and compatible equipment are selected and used based on manufacturer's specifications</p> <p>5.2 Refrigeration system is checked for leaks based on procedure</p> <p>5.3 Any leaks located as a result of leak detection tests are sealed in compliance with compressor and manufacturer's instructions</p> <p>5.4 Refrigeration system is operated within compressor and manufacturer's acceptable limits of temperatures and pressures</p> <p>5.5 Safe working practices are observed throughout the task</p>
6. Undertake preventive maintenance check/adjustment on ice plant refrigeration	<p>6.1 Inspection and testing of ice plant refrigeration components is carried out with appropriate test equipment in accordance with refrigeration principles, procedures and safety requirements</p> <p>6.2 Preventive maintenance is performed according to established plan</p> <p>6.3 Maintenance records/service reports are recorded and completed in accordance with standard operating procedures</p>

## RANGE OF VARIABLES

VARIABLE	RANGE
1. Electrical materials	1.1 Electrical tape 1.2 Wire connector 1.3 Wires and cables 1.4 Breaker 1.5 Terminal clips/plugs
2. Safety precautions	2.1 Personal safety 2.2 Safety of others 2.3 Safety of equipment
3. Leaks	Include but not limited to: 3.1 Leaks on piping 3.2 Leaks around compressor 3.3 Evaporator and condenser
4. Evacuation	4.1 Minimum of 1 hour, steady vacuum of 500 microns unless otherwise specified by the compressor and manufacturer
5. Ice plant refrigeration components	5.1 Compressor 5.2 Condenser 5.3 Evaporator 5.4 Liquid Line Strainer 5.5 Metering Device 5.6 Pressure Controls 5.7 Expansion Valve 5.8 Refrigerant Piping 5.9 Defrost Controls 5.10 Fan/Fan Motor 5.11 Pipe Insulation

## EVIDENCE GUIDE

<p>1. Critical aspects of competency</p>	<p>Assessment requires evidence that the candidate:</p> <p>1.1 Performed visual inspection of all refrigeration components</p> <p>1.2 Selected types of electrical tools/instrument and wiring devices, equipment and materials in accordance with specification and job requirement</p> <p>1.3 Identified and diagnosed faults in accordance with the standard operating procedures</p> <p>1.4 Reported and repaired any signs of damage, lubricant leaks and corrosion</p> <p>1.5 Repaired/replaced ice plant refrigeration components as per manufacturer's operation/repair manual</p> <p>1.6 Reconditioned/overhauled ice plant refrigeration components in accordance with workplace procedures</p> <p>1.7 Tested refrigeration system operation according to manufacturer's specifications and standard operating procedures</p> <p>1.8 Performed preventive maintenance in accordance with manufacturer's specifications</p> <p>1.9 Recorded and completed maintenance/service reports in accordance with standard operating procedures</p> <p>1.10 Demonstrated compliance with safety regulations applicable to worksite operations</p>	
<p>2. Underpinning Knowledge</p>	<p>2.1 <b>SAFETY PRACTICES</b></p> <ul style="list-style-type: none"> <li>• Protective personal equipment/safety gear</li> <li>• Safe handling of tools and equipment</li> <li>• Proper handling of refrigerants/pressure testing and welding gases</li> <li>• Safety signs and symbols</li> <li>• Safety hazard</li> <li>• Good housekeeping</li> </ul> <p>2.2 <b>DRAWING/PLAN AND SPECIFICATION</b></p> <ul style="list-style-type: none"> <li>• Electrical wiring control diagram</li> <li>• Mechanical plan/symbols and abbreviations</li> <li>• Electrical plans, symbols and abbreviations</li> </ul>	<p>2.3 <b>TRADE THEORY</b></p> <ul style="list-style-type: none"> <li>• Basic electricity</li> <li>• Basic refrigeration cycle</li> <li>• Fundamentals of control</li> <li>• Principle and operation of auxiliary parts of refrigeration system</li> <li>• Principle and operation of refrigeration system</li> <li>• Principle and operation of interlocking control</li> <li>• Fan characteristics</li> <li>• Electrical code</li> <li>• Refrigeration system</li> <li>• Basic welding</li> <li>• Installation procedures</li> <li>• Selection of unit and components</li> <li>• Heat transfer</li> </ul>



	<p><b>2.4 TOOLS/MATERIALS: USES AND SPECIFICATIONS</b></p> <ul style="list-style-type: none"> <li>• Types of electrical controls</li> <li>• Types of expansion valves/metering devices</li> <li>• Types of compressor electric motor</li> <li>• Types of condenser</li> <li>• Types of evaporator</li> <li>• Types of refrigerant</li> <li>• Types of pressure control</li> <li>• Types of defrost timer</li> <li>• Types of fan motor</li> <li>• Types of fan</li> <li>• Types of pipe</li> <li>• Types of strainer</li> <li>• Types of thermostat</li> <li>• Types of circuit breaker</li> <li>• Types of magnetic contractor</li> <li>• Types of unloader</li> <li>• Types of compressor</li> <li>• Types of pump</li> <li>• Phase sequence tester</li> </ul> <p><b>2.5 TRADE MATHEMATICS/ MENSURATION</b></p> <ul style="list-style-type: none"> <li>• Linear measurements</li> <li>• Dimensions</li> <li>• Ratio and proportion</li> <li>• Unit conversion</li> </ul> <p><b>2.6 LEGISLATION</b></p> <ul style="list-style-type: none"> <li>• Clean Air Act (RA 8749)</li> <li>• Montreal Protocol</li> <li>• Ozone Depleting Refrigerants (ODRs)</li> </ul> <p><b>2.7 MAINTENANCE</b></p> <ul style="list-style-type: none"> <li>• Preventive Maintenance</li> </ul>	<p><b>2.8 PROCESSES/ PROCEDURES</b></p> <ul style="list-style-type: none"> <li>• Electrical control calibration procedures</li> <li>• Repair/replace/assemble compressor procedure</li> <li>• Repair/replace defective condenser procedure</li> <li>• Replace liquid line strainer element procedure</li> <li>• Replace metering device procedure</li> <li>• Replace pressure controls procedure</li> <li>• Replace thermostat procedure</li> <li>• Repair/replace refrigerant piping procedure</li> <li>• Welding procedure</li> <li>• Refrigerant recovery procedures</li> <li>• Follow the general procedure for checking-out Refrigeration control</li> <li>• Pump-out/pump-down procedures</li> <li>• Replace defrost controls procedure</li> <li>• Repair/replace fan/fan motor procedures re: evaporator/condenser</li> <li>• Refrigerant charging procedures</li> <li>• Leak testing procedures</li> <li>• Mechanical testing</li> <li>• Latest update on refrigerant types and usage in relation to environmental issues</li> </ul>
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3. Underpinning Skills	3.1 Reading and interpreting schematic diagram, plans, drawings, specifications and manuals 3.2 Preparing materials 3.3 Installing equipment, components and accessories 3.4 Fabricating brackets 3.5 Proper Use of electrical tools and materials 3.6 Safe manual handling 3.7 Testing electrical/mechanical 3.8 Troubleshooting technique 3.9 Replacing defective parts 3.10 Preparing reports 3.11 Literacy and language skills needed to read and interpret manufacturer's manual
4. Resource Implications	The following resources <b>MUST</b> be provided: 4.1 Work place location 4.2 Refrigeration system 4.3 Refrigerant 4.4 Materials, tools and equipment appropriate to repairing/retrofitting processes 4.5 Drawings and specifications relevant to the task
5. Methods of Assessment	Competency must be assessed through: 5.1 Direct observation/Demonstration 5.2 Questions related to underpinning knowledge
6. Context for Assessment	6.1 Competency may be assessed in the work place or in a simulated work place setting

**UNIT TITLE : PERFORM START-UP AND COMMISSIONING OF ICE PLANT SYSTEM**

**UNIT CODE : HVC723330**

**UNIT DESCRIPTOR :** This unit covers the knowledge, skills and attitudes in testing, starting up and ensuring fitness of ice plant system for operation.

<b>ELEMENT</b>	<b>PERFORMANCE CRITERIA</b> <i>Italicized bold</i> terms are elaborated in the Range of Variables
1. Prepare for commissioning of an ice plant systems	2.1 Work instructions are read and interpreted prior to commissioning 2.2 Tools and equipment are selected in accordance with job requirements 2.3 Pre-commissioning checks are completed and complied with procedures laid down in <b>system documents</b> 2.4 Commissioning method and program are secured and recording sheets are prepared in accordance with established procedures 2.5 <b>Commissioning instruments</b> are prepared and calibrated in accordance with system documents
2. Assess ice plant system operation	2.1 Systems are checked safely in accordance with standard operating procedures 2.2 Pressures and temperature are determined and recorded in accordance with established procedures 2.3 Faults are isolated to component level and appropriate corrective action is applied 2.4 Refrigeration systems are checked for leaks and contamination safely in accordance with standard operating procedures
3. Recover refrigerant from the system	3.1 Refrigerant system is evacuated using appropriate method and techniques in accordance with prescribed codes and regulations 3.2 Refrigerant evacuated from the refrigeration are contained/ disposed of in accordance with standard operating procedures 3.3 Amount of refrigerant reclaimed from refrigeration system are recorded/ reported in accordance with established procedures
4. Charge the refrigeration system	4.1 Systems are charged with required refrigerant according to system specifications and manufacturer's instruction

	<p>4.2 Appropriate lubricating oil is added to the refrigeration systems in accordance with standard operating procedures</p> <p>4.3 Refrigeration systems are checked for leaks using appropriate tools and techniques in accordance with established operating procedures</p>
5. Perform pre-start checks	<p>5.1 Electrical, pneumatic and other controls are tested and set to meet specified and safety performance requirements</p> <p>5.2 Electrical systems are checked based on procedure and safety requirement</p> <p>5.3 Motor, motor ratings and pump rotation directions are verified against fuse ratings and overload settings based on manual</p> <p>5.4 Fluid flows are tested and balanced based on specifications</p> <p>5.5 Noise and vibration levels are confirmed within limits</p>

## RANGE OF VARIABLES

VARIABLE	RANGE
1. System documents	<p>1.1 Operating and maintenance procedures/instructions for the system</p> <p>1.2 Manufacturer's specifications</p> <p>1.3 Company-prepared operating and maintenance manuals</p>
2. Commissioning instruments	<p>Including but is not limited to:</p> <p>2.1 System analyzer</p> <p>2.2 Manifold gauge</p> <p>2.3 Clamp meter</p> <p>2.4 Multi-tester</p> <p>2.5 Thermometer</p> <p>2.6 Electronic leak detector (Halocarbon)</p> <p>2.7 Sulfur Stick (Ammonia)</p>

## EVIDENCE GUIDE

<p>1. Critical Aspects of Competency</p>	<p>Assessment requires evidence that the candidate:</p> <ol style="list-style-type: none"> <li>1.1 Checked refrigeration system in accordance with standard operating procedures</li> <li>1.2 Isolated faults to component level and applied appropriate corrective action</li> <li>1.3 Checked refrigeration for leaks and contamination safely</li> <li>1.4 Recorded/Reported recovery of refrigerant from the systems in accordance with relevant codes and regulation</li> <li>1.5 Charged systems with the correct refrigerant based on system specifications</li> <li>1.6 Tested and set electrical and other controls to meet specified performance requirements</li> <li>1.7 Identified faults and problems and made necessary action to rectify</li> <li>1.8 Communicated interactively with others to ensure safe and effective work operations</li> <li>1.9 Completed commissioning and starting-up procedures in accordance with the standard procedures</li> </ol>
<p>2. Underpinning Knowledge</p>	<ol style="list-style-type: none"> <li>2.1 <b>SAFETY PRACTICES</b> <ul style="list-style-type: none"> <li>• Protective personal equipment/safety gears</li> <li>• Safe handling of tools and equipment</li> <li>• Proper handling of refrigerants</li> <li>• Safety signs and symbols</li> <li>• Safety hazard</li> <li>• Good housekeeping</li> </ul> </li> <li>2.2 <b>DRAWING/PLAN AND SPECIFICATION</b> <ul style="list-style-type: none"> <li>• Electrical wiring control diagram</li> <li>• Mechanical plan/symbols and abbreviation</li> </ul> </li> </ol>

	<p><b>2.3 TOOLS/MATERIALS: USES AND SPECIFICATIONS</b></p> <ul style="list-style-type: none"> <li>• Types of electrical controls</li> <li>• Types of expansion valve</li> <li>• Types of compressor electric motor</li> <li>• Types of condenser</li> <li>• Types of evaporator</li> <li>• Types of refrigerant</li> <li>• Types of pressure control</li> <li>• Types of defrost timer</li> <li>• Types of fan motor</li> <li>• Types of fan</li> <li>• Types of pipe</li> <li>• Types of strainer</li> <li>• Types of thermostat</li> <li>• Types of circuit breaker</li> <li>• Types of magnetic contactor</li> <li>• Types of unloader</li> <li>• Types of compressor</li> <li>• Types of pump</li> </ul>	<p><b>2.4 MAINTENANCE</b></p> <ul style="list-style-type: none"> <li>• Preventive maintenance</li> </ul> <p><b>2.5 TRADE THEORY</b></p> <ul style="list-style-type: none"> <li>• Basic electricity</li> <li>• Basic refrigeration cycle</li> <li>• Fundamentals of refrigeration and control</li> <li>• Interlocking control sequence</li> <li>• Fundamentals of piping</li> <li>• Fan characteristics</li> <li>• Pump principles</li> <li>• Cooling tower principles</li> <li>• Evaporative condenser principles</li> </ul>
	<p><b>2.6 PROCESSES/ PROCEDURES</b></p> <ul style="list-style-type: none"> <li>• Compressor test procedures</li> <li>• Power supply test procedures</li> <li>• Evaporator test procedures</li> <li>• Condensing unit test procedures</li> <li>• Pump test procedures</li> <li>• Cooling tower test procedures</li> <li>• Expansion valve test procedures</li> <li>• Automatic expansion valve test procedures</li> <li>• Electrical control test procedures</li> <li>• Leak testing procedure (for refrigeration circuit and water/glycol piping)</li> <li>• Pressure testing procedure</li> </ul>	<ul style="list-style-type: none"> <li>• Vacuum testing procedure</li> <li>• Refrigerant charging procedure</li> <li>• Pump-out/pump-down procedure</li> <li>• Crank case heater test procedures</li> <li>• Unloading test procedures</li> <li>• Start-up procedure</li> </ul> <p><b>2.7 LEGISLATION/TREATY</b></p> <ul style="list-style-type: none"> <li>• Clean Air Act (RA 8749)</li> <li>• Montreal/Kyoto Protocol</li> </ul>

3. Underpinning 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 electrical testing 3.6 Performing mechanical testing 3.7 Communicating effectively
4. Resource Implications	The following resources MUST be provided: 4.1 Work place location 4.2 Tools and equipment relevant to commissioning of refrigeration 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/Demonstration 5.2 Questions related to underpinning 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 ICE PLANT Refrigeration Servicing NC III.

### 3.1 CURRICULUM DESIGN

**Course Title :** ICE PLANT REFRIGERATION SERVICING  
**PTQF :** NC III

**Nominal Training Duration:** 184 hours (Basic)  
216 hours (Common)  
272 hours (Core)

**Course Description:**

This course is designed to equip individual with operational skills in ICE PLANT Refrigeration Servicing. It includes installation, servicing and maintaining, troubleshooting and repairing Ice Plant Refrigeration System.

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



<b>UNIT TITLE</b>	<b>Learning Outcomes</b>	<b>Methodology</b>	<b>Assessment Approach</b>
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**

<b>UNIT TITLE</b>	<b>Learning Outcomes</b>	<b>Methodology</b>	<b>Assessment Approach</b>
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

<b>UNIT TITLE</b>	<b>Learning Outcomes</b>	<b>Methodology</b>	<b>Assessment Approach</b>
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

<b>Unit of Competency</b>	<b>Learning Outcome</b>	<b>Methodology</b>	<b>Assessment Approach</b>
1. Survey site for installation	1.1 Prepare for surveying site 1.2 Survey site	Discussion Demonstration Hands-on Industry visit	Demonstration/ Observation with Questioning Written report
2. Install ICE PLANT refrigeration piping system	2.1 Prepare piping requirements 2.2 Lay out refrigerant secondary refrigerant piping system 2.3 Perform insulation of refrigerant/secondary refrigerant piping	Discussion Demonstration Hands-on Industry visit	Demonstration/ Observation with Questioning
3. Install ICE PLANT refrigeration electrical system	3.1 Lay out electrical system 3.2 Install power supply wiring 3.3 Install controls and protective devices 3.4 Test run electrical system	Discussion Demonstration Hands-on Industry visit	Demonstration/ Observation with Questioning
4. Install ICE PLANT refrigeration equipment	4.1 Perform pre installation activities 4.2 Install ICE PLANT refrigeration system components and units 4.3 Test run ICE PLANT refrigeration system	Discussion Demonstration Hands-on Industry visit	Demonstration/ Observation with Questioning
5. Service and maintain ICE PLANT refrigeration system	5.1 Inspect/Adjust ICE PLANT refrigeration components 5.2 Maintain lubrication system 5.3 Maintain refrigerant system 5.4 Maintain secondary heat transfer equipment	Discussion Demonstration Hands-on Industry visit	Demonstration/ Observation with Questioning
6. Troubleshoot ICE PLANT refrigeration system	6.1 Prepare for troubleshooting 6.2 Diagnose faults 6.3 Troubleshoot electrical system 6.4 Troubleshoot mechanical system 6.5 Test run refrigeration system	Discussion Demonstration Hands-on Industry visit	Demonstration/ Observation with Questioning
7. Recover and recycle refrigerant from ICE PLANT refrigeration system	7.1 Assess the unit for recovery/recycling 7.2 Set up equipment for recovery/recycling activities 7.3 Recovery/recycle refrigerant	Discussion Demonstration Hands-on Industry visit	Demonstration/ Observation with Questioning

<b>Unit of Competency</b>	<b>Learning Outcome</b>	<b>Methodology</b>	<b>Assessment Approach</b>
8. Repair and retrofit ICE PLANT refrigeration system and its accessories	8.1 Evaluate condition of existing refrigeration system 8.2 Plan for servicing/repairing refrigeration plant and components 8.3 Prepare the system for retrofitting 8.4 Repair/replace faulty components 8.5 Test refrigeration system operation	Discussion Demonstration Hands-on Industry visit	Demonstration/ Observation with Questioning
9. Perform start-Up and commissioning for ICE PLANT refrigeration systems	9.1 Prepare for commissioning ICE PLANT refrigeration system 9.2 Assess the system operation 9.3 Recover refrigerant from the system 9.4 Charge the system 9.5 Perform pre-start up checks	Discussion Demonstration Hands-on Industry visit	Demonstration/ Observation with Questioning

### 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 be able to:

- install PACU/CRE components, piping system, and electrical system
- service and maintain PACU/CRE
- troubleshoot PACU/CRE

### 3.4 LIST OF TOOLS, EQUIPMENT AND MATERIALS ICE PLANT REFRIGERATION SERVICING NC III

Recommended list of tools, equipment and materials for the training of 25 trainees for ICE PLANT Refrigeration Servicing 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

TOOLS		EQUIPMENT		MATERIALS	
QTY.	Description	QTY	Description	Qty.	Description
10 sets	Pliers	5 units	Vacuum pump	25 sets	Condensate drain
10 sets	Wrench Box	5 sets	Evaporator fan and motor	10 sets	Electrical wire
10 sets	Screw driver	5 units	Oxy-Acetylene welding outfit	5 units	Circuit breaker/safety switch
10 sets	Crimping tools	5 units	Evaporator fan and motor	25 sets	Wiring diagrams
10 sets	Bending tool	5 units	Condenser fan motor	25 sets	Courseware (Learning elements and Manuals)
10 sets	Swaging tool	2 units	Overload protector	10 sets	Switch
10 sets	Flaring tool	3 units	Arc welding machine	10 sets	Capacitor
10 sets	Tube cutters	5 units	Recovery/recycling machine	10 sets	Relay
10 units	Vernier caliper			5 sets	Philippine Electrical Code
10 units	Adjustable wrench			10 sets	Electrical tape
10 sets	Open end wrench			15 sets	Air filters
10 units	Multi-tester			25 sets	Requisition slip
10 sets	Clamp ammeter			5 liters	Oil
5 sets	Megger tester			5 units	Grease
5 units	Leak detector			10 boxes	Rags
10 units	System analyzer			10 boxes	Soap
10 units	Digital thermometer			25 sets	Sand paper
				5 units	Refrigerant cylinder
				5 units	Nitrogen gas
				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)

TOOLS		EQUIPMENT		MATERIALS	
QTY.	Description	QTY	Description	Qty.	Description
				25 boxes	Fittings
				5 sets	Nitrogen regulator
				2 units	High pressure washer
				15 units	Strike lighter
				10 sets	Defective electrical controls
				10 sets	Relays
				5 sets	Timer
				10 sets	Rotary switch
				10 units	Pull-push switch
				10 units	Thermostant
				10 sets	Good condition electrical controls
				10 sets	Switch pull-push/rotary
				10 sets	Defective capacitors
				25 sets	Filter
				5 sets	Borax
				25 sets	Filter drier
				25 sets	Tapelone tape
				30 pcs.	Copper elbow
				20 pcs.	Copper onion
				10 pcs.	Copper elbow 3/8" OD
				20 pcs.	Filter drier connection



**3.5 TRAINING FACILITIES  
ABSORPTION REFRIGERATION SERVICING NC III**

Based on a class intake of 25 students/trainees.

<b>SPACE REQUIREMENTS</b>	<b>Space (m)</b>	<b>Area in Sq. Meters</b>	<b>Total Area in Sq. Meters</b>
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
<b>TOTAL</b>			<b>84</b>
E. FACILITIES/ EQUIPMENT/ CIRCULATION			25
<b>TOTAL AREA</b>			<b>109</b>

\*Common facilities for all HVAC/R Courses

### **3.6 TRAINER'S QUALIFICATION FOR HVAC/R SECTOR**

#### **ICE PLANT REFRIGERATION SERVICING NC III**

##### **TRAINER QUALIFICATION III (TQ III)**

- Must have undergone training on Training Methodology III or equivalent training/experience
- He must be a holder of Ice Plant Refrigeration Servicing NC III or equivalent training/experience
- 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

### **3.12 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 **ICE PLANT Refrigeration Servicing 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 Assessment shall focus on the core units of competency. The basic and common units shall be integrated or assessed concurrently with the core units.
  
- 4.3 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)
  
- 4.4 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)".

## DEFINITION OF TERMS:

1. **Alternate Refrigerant** -replacement refrigerant that can accomplish the same task as the one being replaced, but may require that refrigeration or air-conditioning equipment be redesigned or replaced
2. **Brazed Tube** -tube made from sheet or strip with a longitudinal brazed joint
3. **Capillary Tube** -small bore tube used for metering by controlling length and bore size. In refrigeration, a tube of small internal diameter used as a refrigerant pressure and flow control between high and low sides  
-tube used to transmit pressure from the sensitive bulb of some temperature controls to the operating element
4. **Compression Ratio** -the ratio determined by dividing the discharge pressure, in psia, by the suction pressure, psia
5. **Crankcase** -the casing or covering for the crankshaft of the reciprocating compressor
6. **Evaporator Unit** -assembly of refrigerating compressor, evaporator, and necessary accessories attached to one base
7. **Expansion Valve** -a valve designed to meter the flow of liquid refrigerant to an evaporator
8. **Filter** -a very fine strainer for removing foreign matter and dirt from the refrigerant
9. **Gas Tungsten-Arc Welding (GTAW)** -arc-welding process wherein coalescence is produced by heating with an arc between a single tungsten (non consumable) electrode and the work.  
*Note:* Shielding is obtained from a gas or gas mixture. Pressure may or may not be added
10. **Insulation** -any material intended to reduce the flow of heat
11. **Liquid Receiver** -vessel, permanently connected to a refrigerating system by inlet and outlet pipes, for storage of liquid refrigerant
12. **Nitrogen Purge** -procedure in which nitrogen gas is bled into piping as it is welded, brazed, or soldered; or after, to displace gases within the piping. The nitrogen displaces the air from inside the pipe, minimizing oxidation and resultant scale formation

<b>13. Ohm's law</b>	-direct current flowing in an electric circuit is directly proportional to the voltage applied to the circuit; it is valid for metallic circuits and many circuits containing an electrolytic resistance
<b>14. Oil separator</b>	-a device for separating out oil and returning it to the compressor crankcase entrained in the discharge gas from a compressor
<b>15. Pressure Gage</b>	-instrument for measuring pressure above or below atmospheric pressure
<b>16. Propylene Glycol</b>	-clear, colorless liquid used to depress the freezing point of water for use as a secondary coolant in HVAC&R systems
<b>17. Pull-Down Test</b>	-first operational check on a refrigerating installation to measure the time taken to pull the temperature down to the desired conditions, while also measuring the temperatures, pressures, and associated data
<b>18. Pump Down</b>	-of refrigerant, withdrawal of all refrigerant from the low side of a system by pumping it to either the condenser or the liquid receiver
<b>19. Qualification Test</b>	-procedure used to verify the accuracy of the measurement techniques (temperature, airflow rates, duct heat calibration) employed in determination of heating or cooling effect
<b>20. Rating</b>	-assigned value of those performance characteristics (under standard rating conditions) by which a unit may be selected to fit its application <i>Note:</i> These values apply to all units of like (nominal) size and type (identification) produced by the same manufacturer
<b>21. Refrigerating Capacity (gross)</b>	-total rate of heat removal from all sources by the evaporator of a refrigerating system at stated conditions. It is numerically equal to the system refrigerating effect
<b>22. Refrigerating System Contaminants</b>	-contaminants include water (most important and universal contaminant); dirt; particles; organic materials such as waxes, acids, and sludges; or other products of chemical reactions taking place while the system is operating
<b>23. Refrigeration Cycle</b>	-The complete operation involved in providing refrigeration

24. **Repair** -to restore to good or sound condition, within the following constraints: operation must be fully restored without embellishment; and failure must have occurred
25. **Retrofit** -modification of existing equipment, systems, or buildings to incorporate improved performance, updated operation, or both. Derived from retroactive refit
26. **Risers** -a vertical tube or pipe that carries refrigerant in any form from a lower to a higher level
27. **Shielded Metal-Arc Welding (SMAW)** - arc-welding process wherein coalescence is produced by heating with an electric arc between a covered metal electrode and the work  
*Note:* Shielding is obtained from decomposition of the electrode covering. Pressure is not used and filler metal is obtained from the electrode
28. **Sludge** -product of decomposition of oil resulting from impurities, moisture, or chemical reactions and favored by excessive temperature. Sludge may be mushy, gummy, or hard
29. **Suction Lift** -combination of static suction lift and friction head in suction piping when the source of liquid is below the pump centerline
30. **Superheat** -The temperature increase above saturation temperature or above boiling point
31. **Symbol** -letter, figure, other character or mark, or combination of letters used to represent a specific thing
32. **Time Defrosting** -defrosting process automatically and intermittently operated for a predetermined period
33. **Ton (of refrigeration)** -time rate of cooling equal to 12,000 Btu/h (approximately 3517 W)

## ACKNOWLEDGEMENTS

The Technical Education and Skills Development Authority (TESDA) wishes to extend thanks and appreciation to the many representatives of business, industry, academe and government agencies who donated their time and expertise to the development and validation of these Training Regulations.

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