



**COMPETENCY STANDARD**  
**FOR**  
**Refrigeration and Air Conditioning**  
**(Light Engineering Sector)**

**Level: 4**

**Competency Standard Code: LECS0008L6V1**

**National Skills Development Authority**  
**Prime Minister's Office, Bangladesh**

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## Introduction

The National Skills Development Authority (NSDA) aims to enhance an individual's employability by certifying completeness with skills. NSDA works to expand the skilling capacity of identified public and private training providers qualitatively and quantitatively. It also aims to establish and operationalize a responsive skill ecosystem and delivery mechanism through a combination of well-defined set of mechanisms and necessary technical supports.

Key priority economic growth sectors identified by the government have been targeted by NSDA to improve current job skills along with existing workforce to ensure required skills to industry standards. Training providers are encouraged and supported to work with industry to address identified skills and knowledge to enable industry growth and increased employment through the provision of market responsive inclusive skills training program **Refrigeration and Air Conditioning** is selected as one of the priority occupations of **Light Engineering Sector**. This standard is developed to adopt a demand driven approach to training with effective inputs from Industry Skills Councils (ISC's), employer associations and employers.

Generally, a competency standard informs curriculum, learning materials, assessment and certification of students enrolled in TVET. Students who successfully pass the assessment will receive a qualification in the National Technical and Vocational Qualification Framework (NTVQF) and will be listed on the NSDA's online portal.

This competency standard is developed to improve skills and knowledge in accordance with the job roles, duties and tasks of the occupation and ensure that the required skills and knowledge are aligned to industry requirements. A series of stakeholder consultations, workshops were held to develop this document.

The document also details the format, sequencing, wording and layout of the Competency Standard for an occupation which is comprised of Units of Competence and its corresponding Elements.

## Overview

A competency standard is a written specification of the knowledge, skills and attitudes required for the performance of an occupation, trade or job corresponding to the industry standard of performance required in the workplace.

The purpose of a competency standards is to:

- provide a consistent and reliable set of components for training, recognising and assessing people's skills, and may also have optional support materials
- enable industry recognised qualifications to be awarded through direct assessment of workplace competencies
- encourage the development and delivery of flexible training which suits individual and industry requirements
- encourage learning and assessment in a work-related environment which leads to verifiable workplace outcomes

Competency standards are developed by a working group comprised of representative from NSDA, Key Institutions, ISC, and industry experts to identify the competencies required of an occupation in **Light Engineering** sector.

Competency standards describe the skills, knowledge and attitude needed to perform effectively in the workplace. CS acknowledge that people can achieve technical and vocational competency in many ways by emphasizing what the learner can do, not how or where they learned to do it.

With competency standards, training and assessment may be conducted at the workplace or at training institute or any combination of these.

Competency standards consist of a number of units of competency. A unit of competency describes a distinct work activity that would normally be undertaken by one person in accordance with industry standards.

Units of competency are documented in a standard format that comprises of:

- unit title
- nominal duration
- unit code
- unit descriptor
- elements and performance criteria
- variables and range statement
- curricular content guide
- assessment evidence guides

Together, all the parts of a unit of competency:

- describe a work activity
- guide the assessor to determine whether the candidate is competent or not yet competent

The ensuing sections of this document comprise of a description of the relevant occupation, trade or job with all the key components of a unit of competency, including:

- a chart with an overview of all Units of Competency for the relevant occupation, trade or job including the Unit Codes and the Unit of Competency titles and corresponding Elements
- the Competency Standard that includes the Unit of Competency, Unit Descriptor, Elements and Performance Criteria, Range of Variables, Curricular Content Guide and Assessment Evidence Guide

## Level descriptors of NTVQF/ NSQF (BNQF 1-6)

Level & Job classification	Knowledge Domain	Skills Domain	Responsibility Domain
<p style="text-align: center;">6 Mid-Level Manager/ Sub Assistant Engineer</p>	<p>Comprehensive actual and theoretical knowledge within a specific work or study area with an awareness of the validity and limits of that knowledge, able to analyze, compare, relate and evaluate.</p>	<p>Specialised and wider range of cognitive and practical skills required to provide leadership in the development of creative solutions to defined problems. Communicate professional issues and solutions to the team and to external partners/users.</p>	<p>Work under broad guidance and self-motivation to execute strategic and operational plan/s. Lead lower-level management. Diagnose and resolve problems within and among work groups.</p>
<p style="text-align: center;">5 Supervisor</p>	<p>Broad knowledge of the underlying, concepts, principles, and processes in a specific work or study area, able to scrutinize and break information into parts by identifying motives or causes.</p>	<p>Broad range of cognitive and practical skills required to generate solutions to specific problems in one or more work or study areas. Communicate practice-related problems and possible solutions to external partners.</p>	<p>Work under guidance of management and self-direction to resolve specific issues. Lead and take responsibility for the work and actions of group/team members. Bridge between management.</p>
<p style="text-align: center;">4 Highly Skilled Worker</p>	<p>Broader knowledge of the underlying, concepts, principles, and processes in a specific work or study area, able to solve problems to new situations by comparing and applying acquired knowledge.</p>	<p>A range of cognitive and practical skills required to accomplish tasks and solve problems by selecting and applying the full range of methods, tools, materials and information. Communicate using technical terminology and IT technology with partners and users as per workplace requirements.</p>	<p>Work under minimal supervision in specific contexts in response to workplace requirements. Resolve technical issues in response to workplace requirements and lead/guide a team/ group.</p>
<p style="text-align: center;">3 Skilled Worker</p>	<p>Moderately broad knowledge in a specific work or study area, able to perceive ideas and abstract from drawing and design according to workplace requirements.</p>	<p>Basic cognitive and practical skills required to use relevant information in order to carry out tasks and to solve routine problems using simple rules and tools. Communicate with his team and limited external partners upholding the values, nature and culture of the workplace</p>	<p>Work or study under supervision with considerable autonomy. Participate in teams and responsible for group coordination.</p>
<p style="text-align: center;">2 Semi-Skilled Worker</p>	<p>Basic understanding of underpinning knowledge in a specific work or study area, able to interpret and apply common occupational terms and instructions.</p>	<p>Skills required to carry out simple tasks, communicate with his team in the workplace presenting and discussing results of his work with required clarity.</p>	<p>Work or study under supervision in a structured context with limited scope of manipulation</p>
<p style="text-align: center;">1 Basic Skilled Worker</p>	<p>Elementary understanding of ability to interpret the underpinning knowledge in a specific study area, able to interpret common occupational terms and instructions.</p>	<p>Specific Basic skills required to carry out simple tasks. Interpret occupational terms and present the results of own work within guided work environment/ under supervision.</p>	<p>Work under direct supervision in a structured context with limited range of responsibilities.</p>

## **List of Abbreviations**

**NSDA** - National Skills Development Authority

**CS** – Competency Standard

**ISC** – Industry Skills Council

**NSQF** – National Skills Qualifications Framework

**BNQF** – Bangladesh National Qualifications Framework

**NTVQF** – National Technical and Vocational Qualifications Framework

**SCVC** – Standards and Curriculum Validation Committee

**TVET** – Technical Vocational Education and Training

**UoC** – Unit of Competency

**STP** – Skills Training Provider

**OSH** – Occupational Safety and Health

**PPE** – Personal Protective Equipment

**SOP** – Standard Operating Procedures

## Approval of Competency Standard

### Members of the Approval Committee:

Member	Signature
<b>Dulal Krishna Saha</b> Executive Chairman (Secretary) National Skills Development Authority (NSDA)	 21.06.21
<b>Md. Nurul Amin</b> Member (Admin & Finance) And Member (Registration & Certification) Joint Secretary National Skills Development Authority (NSDA)	 21.06.21
<b>Alif Rudaba</b> Member (Planning & Skills Standard) Joint Secretary National Skills Development Authority (NSDA)	

  
21.06.21

**Dulal Krishna Saha**

Executive Chairman (Secretary)

National Skills Development Authority (NSDA)

## Competency Standards for National Skill Certificate – 4 in Refrigeration and Air Conditioning of Light Engineering Sector

### Course Structure

SL	Unit Code and Title		UoC Level	Nominal Duration (Hours)
<b>The Generic Competencies</b>				
<b>The Sector Specific Competencies</b>				
<b>The Occupation Specific Competencies</b>				
1	OURAC001L4V1	Apply Quality Systems and Procedures	4	20
2	OURAC002L4V1	Service & Maintain Precision Air-Conditioning Unit	4	60
3	OURAC003L4V1	Troubleshoot Precision Air-Conditioning Unit	4	40
4	OURAC004L4V1	Repair and Install Prefabricated Cold Rooms and Freezer Rooms	4	60
5	OURAC005L4V1	Check and Inspect Variable Refrigerant Flow (VRF)/Variable Refrigerant Volume (VRV) System	4	20
6	OURAC006L4V1	Prepare estimation for Repair, installations and maintenance of RAC Systems	4	20
7	OURAC007L4V1	Troubleshoot Transport Air-Conditioning System	4	40
<b>Total Nominal Learning Hours</b>				<b>260</b>



## The Occupation Specific Competencies

Code	Unit of Competency	Elements of Competency	Duration (Hours)
OURAC001L4V1	Apply Quality Systems and Procedures	<ol style="list-style-type: none"> <li>1. Work within quality system</li> <li>2. Apply and monitor improvement of quality system in the workplace</li> <li>3. Take responsibility for quality work</li> <li>4. Apply standard procedures for each job</li> </ol>	20
OURAC001L4V1	Service and Maintain Precision Air Conditioning Unit	<ol style="list-style-type: none"> <li>1. Prepare for maintenance activities</li> <li>2. Inspect and adjust air-conditioning controls, parameters, and operating conditions</li> <li>3. Maintain lubrication system of precision air conditioner</li> <li>4. Maintain Refrigeration System</li> <li>5. Maintain air distribution system</li> </ol>	60
OURAC003L4V1	Troubleshoot Precision Type Air Conditioning Unit	<ol style="list-style-type: none"> <li>1. Plan and prepare for troubleshooting</li> <li>2. Identify and repair fault or problems</li> <li>3. Perform refrigerant recovery/recycling and retrofitting</li> <li>4. Observe performance of repaired or troubleshoot unit</li> </ol>	40
OURAC004L4V1	Repair and Install Prefabricated Cold Room and Freezer Rooms	<ol style="list-style-type: none"> <li>1. Identify the selected design of cold room and freezer room</li> <li>2. Install cold room and freezer room</li> <li>3. Prepare to repair cold room and freezer room</li> <li>4. Maintain / repair cold room and freezer room</li> </ol>	60
OURAC005L4V1	Check and Inspect Variable Refrigerant Flow (VRF) / Variable Refrigerant Volume (VRV) System	<ol style="list-style-type: none"> <li>1. Prepare to test and inspect VRF/VRV air-conditioning system</li> <li>2. Check and Inspect VRF/VRV air-conditioning system</li> <li>3. Complete and report Checking and Inspection activities</li> </ol>	20

OURAC006L4V1	Prepare Estimate for Repair, Installations and Maintenance of Refrigeration and Air Conditioning Systems	<ol style="list-style-type: none"> <li>1. Prepare estimate for repair &amp; maintenance works</li> <li>2. Prepare estimate for installation of air conditioning systems</li> <li>3. Prepare estimate for new installation of Refrigeration systems</li> <li>4. Prepare an estimate of relocation of Refrigeration and Air Conditioning Systems</li> </ol>	20
OURAC007L4V1	Troubleshoot Transport Refrigeration Unit	<ol style="list-style-type: none"> <li>1. Prepare for maintenance activities</li> <li>2. Identify and repair faults/ troubles</li> <li>3. Perform refrigerant recovery, recycling and retrofitting conversion on transport refrigeration unit</li> <li>4. Test-run of repaired unit</li> </ol>	40

## **The Occupation Specific Competencies**

<b>Unit Code and Title</b>	<b>OURAC001L3V1: Apply Quality Systems and Procedures</b>
<b>Nominal Hours</b>	<b>20 Hours</b>
<b>Unit Descriptor</b>	This unit covers the knowledge, skills and attitudes required to apply quality systems and procedures. It specifically includes the tasks of working within quality system, applying, and monitoring quality system improvement in the workplace, holding responsibility for quality work, and applying standard procedures for each job.
<b>Elements of Competency</b>	<b>Performance Criteria</b> <b><u>Bold and Underlined</u></b> terms are elaborated in the Range of Variables.
1. Work within quality system	1.1. Instructions and procedures are followed and duties are performed in accordance with demand of <b><u>quality improvement</u></b> ; 1.2. Conformance with specifications is ensured; 1.3. Defects are detected and reported to authority according to company procedures; 1.4. Customer's satisfaction is ensured in performing an operation or quality of product or services;
2. Apply and monitor improvement of quality system in the workplace	2.1. Performance measurement systems are identified; 2.2. Performance is assessed at regular interval; 2.3. Specifications and standard operating procedures are established and identified; 2.4. Defects are detected and reported to the higher authority according to standard operating procedures; 2.5. Process improvement procedures are applied as per standard operating procedure (SOP); 2.6. Quality of product is checked and verified according to manual; 2.7. Performance of operation or quality of product or service is monitored to ensure customer satisfaction;
3. Take responsibility for quality work	3.1. Concept of supplying product or service to meet the <b><u>customer/client requirements</u></b> is comprehend and applied accordingly; 3.2. Responsibility is taken for quality work;
4. Apply standard procedures for each job	4.1. <b><u>Quality control and quality assurance</u></b> system procedures are followed for each job; 4.2. Conformance to specification is ensured in every case at all situations;
<b>Range of Variables</b>	
<b>Variable</b>	<b>Range</b> (may include but not limited to):
1. Quality improvement	A system comprising some or all the following elements: 1.1 Quality inspection

	1.2 Quality control 1.3 Quality improvement 1.4 Quality assurance	
2. Customer / client requirements	2.1 Appropriateness of product 2.2 Appearance 2.3 Durability 2.4 Grade or quality design 2.5 Usability of life span 2.6 Conformance to Quality 2.7 Reliability 2.8 Maintainability	
3. Quality control and quality assurance	3.1. Quality control 3.1.1. Product 3.1.2. Reactive 3.1.3. Line function 3.1.4. Find the defects 3.1.5. Walk through 3.1.6. Testing 3.1.7. Inspection 3.1.8. Checklist review 3.1.9. Reporting to competent authority	3.2. Quality Assurance 3.2.1. Process 3.2.2. Pro-active 3.2.3. Staff function 3.2.4. Prevent the defects 3.2.5. Quality audit 3.2.6. Defining process 3.2.7. Selection of tools 3.2.8. Training 3.2.9. Reporting to competent authority
<b>Evidence Guide</b> The evidence must be authentic, valid, sufficient, reliable, consistent, and recent and meet the requirements of the current version of the Unit of Competency.		
1. Critical Aspects	Assessment required evidence that the candidate: <ol style="list-style-type: none"> <li>1.1. Followed instructions and procedures strictly</li> <li>1.2. Performed duties in accordance with demand of quality system</li> <li>1.3. Ensured conformance to specifications</li> <li>1.4. Detected defects and reported to authority in accordance to standard operating procedures</li> <li>1.5. Held responsibility for quality work</li> <li>1.6. Followed quality control and quality assurance system procedures for each job</li> </ol>	
2. Underpinning knowledge	<ol style="list-style-type: none"> <li>2.1. The reasons why good quality should be maintained and poor quality should be eliminated</li> <li>2.2. Meaning of the key terms - quality, quality assurance, quality control, quality inspection, quality improvement and total quality control</li> <li>2.3. Process and procedures for improving and maintaining quality</li> <li>2.4. Procedures for addressing defects</li> <li>2.5. Record keeping within the quality improvement system in workplace</li> </ol>	

	2.6. Factors, which affect successful implementation of the quality systems and procedures
3. Underpinning skills	3.1. Maintaining best quality 3.2. Eliminating poor quality 3.3. Improving and maintaining quality 3.4. Addressing defects and procedures 3.5. Maintaining record within the quality improvement system in workplace 3.6. Implementing quality systems and procedures
4. Underpinning Attitudes	4.1. Commitment to occupational health and safety 4.2. Environmental concerns 4.3. Eagerness to learn 4.4. Tidiness and timeliness 4.5. Respect for rights of peers and seniors in workplace
5. Resource implications	The following resources must be provided: 5.1. Adequate workplace (simulated or actual workplace) 5.2. Tools and equipment 5.3. Materials are relevant to the relevant to work activity 5.4. Drawing and specifications relevant to the work
6. Methods of assessment	Competency should be assessed by 6.1. Demonstration 6.2. Oral questioning 6.3. Written test 6.4. Portfolio
7. Context of assessment	7.1. Competency assessment must be done in NSDA accredited assessment centre 7.2. Assessment should be done by a NSDA certified/nominated assessor
<p><b>Accreditation Requirements</b></p> <p>Training Providers must be accredited by National Skills Development Authority (NSDA), the National Quality Assurance Body, or a body with delegated authority for quality assurance to conduct training and assessment against this unit of competency for credit towards the award of any NTVQF qualification. Accredited providers assessing against this unit of competency must meet the quality assurance requirements set by NSDA.</p>	

<b>Unit Code and Title</b>	<b>OURAC002L4V1: Service and Maintain Precision Air Conditioning Unit</b>
<b>Nominal Hours</b>	<b>60 Hours</b>
<b>Unit Descriptor</b>	This unit covers the knowledge, skill and attitude required to service and maintain precision air conditioning unit in the workplace. It specifically includes the tasks of preparing for maintenance activities, inspecting and adjusting air-conditioning controls, parameters, and operating conditions and maintaining lubrication system of precision air conditioner, maintaining refrigeration system and air distribution system.
<b>Elements of Competency</b>	<b>Performance Criteria</b> <b>Bold and Underlined</b> terms are elaborated in the Range of Variables.
1. Prepare for maintenance activities	<p>1.1 <b><u>Personal protective equipment (PPE)</u></b> is used and OSH is followed;</p> <p>1.2 Work instructions are read and interpreted to determine job requirements;</p> <p>1.3 Service manual(s) from the manufacturer is consulted if available, nevertheless SOPs are adopted;</p> <p>1.4 <b><u>Tools and equipment</u></b> are selected as required with the job;</p> <p>1.5 Safety rules are obeyed according to workplace requirement;</p>
2. Inspect and adjust air-conditioning controls, parameters, and operating conditions	<p>2.1 Evaporator or cooling coil or both are cleaned as prescribed in the manufacturer's service manual;</p> <p>2.2 Refrigeration piping or tubing is inspected for <b><u>abnormal conditions</u></b> based on service procedure;</p> <p>2.3 <b><u>Operation or Control Settings</u></b> are checked accordingly and adjusted accordingly;</p> <p>2.4 <b><u>Accessories</u></b> are adjusted based upon maintenance or service manual;</p> <p>2.5 Procedure of maintenance specified in manufacturer's instruction is adopted;</p>
3. Maintain lubrication system of precision air conditioner	<p>3.1 Lubrication system parameters and components used are adjusted as described in manufacturer's instruction;</p> <p>3.2 <b><u>Lubrication Parameters</u></b> are inspected and tuned as per system procedure;</p> <p>3.3 Leaks and restrictions are detected and repaired based on Standard Operating Procedure;</p> <p>3.4 Used oil is disposed properly according to ASHRAE Code of practice;</p>
4. Maintain Refrigeration System	<p>4.1 <b><u>Operation Parameters</u></b> are measured and analyzed based on standard specifications;</p> <p>4.2 Pressure and Temperature drops across filter or strainers are inspected and recorded;</p>

	<p>4.3 Leak test is performed as per SOP;</p> <p>4.4 <b>Refrigeration components, accessories and consumables</b> are checked for contaminants in accordance manufacturer's manual or ASHRAE Code of Practice;</p>
5. Maintain air distribution system	<p>5.1 <b>Air distribution system</b> components are checked and air flow rates are balanced;</p> <p>5.2 Air supply systems are checked and maintained to meet operational and regulatory requirements;</p>
<b>Range of Variables</b>	
<b>Variables</b>	<b>Range (may include but not limited to):</b>
1. PPE	<p>1.1 Hand gloves.</p> <p>1.2 Safety Shoes.</p> <p>1.3 Mask</p> <p>1.4 Apron</p> <p>1.5 Helmet</p>
2. Tools	<p>2.1 Pliers</p> <p>2.2 Screwdriver</p> <p>2.3 Hacksaw</p> <p>2.4 Wrenches</p> <p>2.5 Wire stripper/crimper</p> <p>2.6 Swaging tools,</p> <p>2.7 Flaring tools</p> <p>2.8 Bench Vice</p> <p>2.9 C Clamp Hammer</p> <p>2.10 Steel wire brush</p> <p>2.11 Tube cutter</p> <p>2.12 Tube bender</p> <p>2.13 Block vice</p> <p>2.14 Reamer</p> <p>2.15 Allen key set</p>
3. Equipment	<p>3.1 Gas welding equipment</p> <p>3.2 Multimeter</p> <p>3.3 Clamp on meter</p> <p>3.4 Leak detector</p> <p>3.5 Charging station</p> <p>3.6 Weight scale</p> <p>3.7 Two stage vacuum pumps</p> <p>3.8 Dry nitrogen cylinder with two stage regulators</p> <p>3.9 Digital temperature meter</p> <p>3.10 Refrigerant charging unit</p>
4. Materials	<p>4.1 Refrigerants</p> <p>4.2 Dry nitrogen</p> <p>4.3 Charging nipple</p> <p>4.4 Copper tube</p> <p>4.5 Filler rod</p>



	<ul style="list-style-type: none"> <li>4.6 Welding flux</li> <li>4.7 Filter drier/Strainer</li> <li>4.8 Capillary tube</li> <li>4.9 Lubricating oil</li> <li>4.10 Copper and brass fittings</li> <li>4.11 Flexible cable</li> <li>4.12 Tab female connector</li> <li>4.13 Insulation tape</li> <li>4.14 Hose clamp</li> <li>4.15 Non return valve/ process tube</li> </ul>
5. Abnormal Conditions	<ul style="list-style-type: none"> <li>5.1 Leaks</li> <li>5.2 Insulation Cracks</li> <li>5.3 Looseness of supports or brackets</li> <li>5.4 Knocking</li> </ul>
6. Operation or Control Settings	<ul style="list-style-type: none"> <li>6.1 Pressures</li> <li>6.2 Temperatures</li> <li>6.3 Voltages</li> <li>6.4 Current</li> <li>6.5 Air Flow</li> <li>6.6 Noise Level</li> <li>6.7 Vibrations</li> </ul>
7. Accessories	<ul style="list-style-type: none"> <li>7.1 Ionizer</li> <li>7.2 Unloader</li> <li>7.3 Fan blades/blower</li> <li>7.4 Motors</li> </ul>
8. Lubrication Parameters	<ul style="list-style-type: none"> <li>8.1 Oil levels</li> <li>8.2 Oil properties</li> <li>8.3 Purity of oil</li> <li>8.4 Oil Viscosity</li> </ul>
9. Operation Parameters	<ul style="list-style-type: none"> <li>9.1 Operating Temperature</li> <li>9.2 Superheat</li> <li>9.3 Pressure</li> <li>9.4 Voltage</li> <li>9.5 Current</li> <li>9.6 Air Velocity</li> <li>9.7 Sound Level &amp; Vibration</li> </ul>
10. Refrigeration Components, accessories, and consumables	<ul style="list-style-type: none"> <li>10.1 Expansion Devices</li> <li>10.2 Evaporator</li> <li>10.3 Compressor</li> <li>10.4 Condenser</li> <li>10.5 Filter Drier</li> <li>10.6 Sight Glass</li> <li>10.7 Oil</li> <li>10.8 Refrigerant</li> <li>10.9 Air filter</li> </ul>

11. Air Distribution System	11.1 Air Swing 11.2 Ducting System 11.3 Air outlet / Grill 11.4 Vane 11.5 Damper 11.6 Louvers
<b>Evidence Guide</b> The evidence must be authentic, valid, sufficient, reliable, consistent, and recent and meet the requirements of the current version of the Unit of Competency	
1. Critical Aspects of Competency	Assessment required evidence that the candidate: 1.1 Air-Conditioning accessories, controls and operating conditions are checked 1.2 Applied maintenance procedures according to manufacturer's maintenance manual 1.3 Lubrication system of AC is checked and maintained 1.4 Refrigeration system is checked and maintained 1.5 Air distribution system is checked and maintained
2. Underpinning Knowledge	2.1 Safety Practices, PPE, and Safety Gear 2.2 Trade mathematics, measurements, unit conversions, dimension, ration, and proportion 2.3 Tools and materials with proper specification and usage 2.4 Clean air act, Montreal Protocol, Ozone Depleting Potentiality (ODP) and Global Warming Potentiality (GWP) 2.5 Refrigeration Cycle, Components, and accessories for Precision Air-Conditioners 2.6 Troubleshooting of precision air-conditioners 2.7 Thermostatic Expansion Valve (TXV) and Automatic Expansion Valve (AXV) Electronic Expansion Valve (EXV) adjusting procedure 2.8 Humidifier and De-humidifier servicing procedure
3. Underpinning Skills	3.1. Interpretating of plans and details 3.2. Preparing materials 3.3. Using of electrical and mechanical tools and equipment properly 3.4. Troubleshooting techniques 3.5. Calibrating expansion valves 3.6. Adjusting superheat
4. Underpinning Attitudes	4.1 Commitment to occupational health and safety 4.2 Promptness in carrying out activities 4.3 Sincere and honest to duties 4.4 Environmental concerns 4.5 Eagerness to learn 4.6 Tidiness and timeliness 4.7 Respect for rights of peers and seniors in workplace 4.8 Communication with peers and seniors in workplace

5. Resource Implications	<p>The following resources must be provided:</p> <p>5.1 Workplace (simulated or actual)</p> <p>5.2 Tools and equipment appropriate for work activities</p> <p>5.3 Materials for work activities</p>
6. Methods of Assessment	<p>Methods of assessment may include but not limited to:</p> <p>6.1 Written Test</p> <p>6.2 Demonstration</p> <p>6.3 Oral Questioning</p> <p>6.4 Portfolio</p>
7. Context of Assessment	<p>7.1 Competency assessment must be done in NSDA accredited assessment centre</p> <p>7.2 Assessment should be done by a NSDA certified/nominated assessor</p>
<p><b>Accreditation Requirements</b></p> <p>Training Providers must be accredited by National Skills Development Authority (NSDA), the National Quality Assurance Body, or a body with delegated authority for quality assurance to conduct training and assessment against this unit of competency for credit towards the award of any NTVQF qualification. Accredited providers assessing against this unit of competency must meet the quality assurance requirements set by NSDA.</p>	

<b>Unit Code and Title</b>	<b>OURAC003L4V1: Troubleshoot Precision Type Air Conditioning Unit</b>
<b>Nominal Hours</b>	<b>40 Hours</b>
<b>Unit Descriptor</b>	This unit covers the knowledge, skill and attitude required to troubleshooting of Precision Air Conditioning Unit in the workplace. It specifically includes tasks of planning and preparing for troubleshoot, identifying and repairing faults or problems, performing refrigerant recovery/recycling and retrofitting, and observing performance of repaired or troubleshoot unit
<b>Elements of Competency</b>	<b>Performance Criteria</b> <b>Bold and Underlined</b> terms are elaborated in the Range of Variables.
1. Plan and prepare for troubleshooting	1.1 <b><u>Personal protective equipment (PPE)</u></b> is used and OSH is followed; 1.2 Work instructions are read and interpreted to determine job requirements; 1.3 Appropriate materials, tools and equipment are selected based on job requirements; 1.4 Safety rules are obeyed according to workplace requirement;
2. Identify and repair fault or problems	2.1 <b><u>Refrigeration system components</u></b> are tested following manufacturer's manual, ASHARE code of practice and/or enterprise troubleshooting policy; 2.2 <b><u>Faults/Problems</u></b> with refrigerant system are diagnosed; 2.3 Practiced ASHARE code and troubleshooting procedure; 2.4 Remedial action is taken to rectify faults/problems in line with manufacturer's manual; 2.5 Testing procedure, faults, corrections as per industry/client requirement and as reported;
3. Perform refrigerant recovery/recycling and retrofitting	3.1 Suitable <b><u>tools</u></b> and <b><u>equipment</u></b> are selected and used based on job requirement; 3.2 Refrigerant recovery is performed as per clean air act and <b><u>manufacturer's recommendations</u></b> ; 3.3 Retrofitting is performed it necessary;
4. Observe performance of repaired or troubleshoot unit	4.1 Air-Conditioning unit is tested as per industry requirement; 4.2 Report on testing air-conditioning unit is performed in a prescribed manner defined by manufacturer;
<b>Range of Variables</b>	
<b>Variables</b>	<b>Range</b> (may include but not limited to):
1. PPE	1.1 Hand gloves. 1.2 Safety Shoes.

	<ul style="list-style-type: none"> <li>1.3 Mask</li> <li>1.4 Apron</li> <li>1.5 Helmet</li> </ul>
2. Tools	<ul style="list-style-type: none"> <li>2.1 Pliers</li> <li>2.2 Screwdriver</li> <li>2.3 Hacksaw</li> <li>2.4 Wrenches</li> <li>2.5 Wire stripper</li> <li>2.6 Crimper</li> <li>2.7 Swaging tools,</li> <li>2.8 Flaring tools</li> <li>2.9 Bench Vice</li> <li>2.10 C Clamp</li> <li>2.11 Hammer</li> <li>2.12 Steel wire brush</li> <li>2.13 Tube cutter</li> <li>2.14 Tube bender</li> <li>2.15 Block vice</li> <li>2.16 Reamer</li> <li>2.17 Allen key set</li> </ul>
3. Equipment	<ul style="list-style-type: none"> <li>3.1 Gas welding equipment</li> <li>3.2 Multimeter</li> <li>3.3 Clamp on meter</li> <li>3.4 Leak detector</li> <li>3.5 Charging station</li> <li>3.6 Weight scale</li> <li>3.7 Two stage vacuum pumps</li> <li>3.8 Dry nitrogen cylinder with two stage regulators</li> <li>3.9 Digital temperature meter</li> </ul>
4. Materials	<ul style="list-style-type: none"> <li>4.1 Refrigerants</li> <li>4.2 Dry nitrogen</li> <li>4.3 Charging nipple</li> <li>4.4 Copper tube</li> <li>4.5 Filler rod</li> <li>4.6 Welding flux</li> <li>4.7 Filter drier/Strainer</li> <li>4.8 Capillary tube</li> <li>4.9 Lubricating oil</li> <li>4.10 Copper and brass fittings</li> <li>4.11 Flexible cable</li> <li>4.12 Tab female connector</li> <li>4.13 Insulation tape</li> <li>4.14 Hose clamp</li> <li>4.15 Non return valve/ process tube</li> </ul>
5. Faults/problems in diagnosing	<ul style="list-style-type: none"> <li>5.1 Leakage</li> <li>5.2 Contamination</li> </ul>

	<ul style="list-style-type: none"> <li>5.3 Fractionation</li> <li>5.4 Restriction</li> <li>5.5 Condensing and evaporating temperature</li> <li>5.6 System pressure</li> </ul>
6. Manufacturer's Recommendation	<ul style="list-style-type: none"> <li>6.1 Equipment operator's manual</li> <li>6.2 Equipment service manual</li> <li>6.3 Name plate data</li> </ul>
7. Refrigeration System Components	<ul style="list-style-type: none"> <li>7.1 Expansion Devices</li> <li>7.2 Evaporator</li> <li>7.3 Compressor</li> <li>7.4 Condenser</li> <li>7.5 Filter Drier</li> <li>7.6 Sight Glass</li> <li>7.7 Oil</li> <li>7.8 Refrigerant</li> </ul>
<p><b>Evidence Guide</b></p> <p>The evidence must be authentic, valid, sufficient, reliable, consistent, and recent and meet the requirements of the current version of the Unit of Competency</p>	
1. Critical Aspects of Competency	<p>Assessment required evidence that the candidate:</p> <ul style="list-style-type: none"> <li>1.1 Appropriate wiring diagrams, charts and manuals are interpreted</li> <li>1.2 Checked power supply in compliance with nameplate rating or manufacturer's standard</li> <li>1.3 Troubleshoot faults that are diagnosed</li> <li>1.4 Performed refrigerant recovery, recycling or retrofitting as necessary</li> </ul>
2. Underpinning Knowledge	<ul style="list-style-type: none"> <li>2.1 Safety Practices, PPE, and Safety Gear</li> <li>2.2 Trade mathematics, measurements, unit conversions, dimension, ration, and proportion</li> <li>2.3 Tools and materials with proper specification and usage</li> <li>2.4 Clean air act, Montreal Protocol, ODP and GWP</li> <li>2.5 Refrigeration Cycle, Components, and accessories for Precision Air-Conditioners</li> <li>2.6 Troubleshooting of precision air-conditioners</li> <li>2.7 TXV and AXV adjusting procedure</li> <li>2.8 Proper handling of refrigerants</li> <li>2.9 Interlocking sequence of control</li> </ul>
3. Underpinning Skills	<ul style="list-style-type: none"> <li>3.1. Interpreting of plans and details</li> <li>3.2. Preparing materials</li> <li>3.3. Using of electrical and mechanical tools and equipment properly</li> <li>3.4. Performing electrical test and repair works</li> <li>3.5. Performing mechanical test and repair works</li> </ul>
4. Underpinning Attitudes	<ul style="list-style-type: none"> <li>4.1 Commitment to occupational health and safety</li> <li>4.2 Promptness in carrying out activities</li> <li>4.3 Sincere and honest to duties</li> </ul>

	<ul style="list-style-type: none"> <li>4.4 Environmental concerns</li> <li>4.5 Eagerness to learn</li> <li>4.6 Tidiness and timeliness</li> <li>4.7 Respect for rights of peers and seniors in workplace</li> <li>4.8 Communication with peers and seniors in workplace</li> </ul>
5. Resource Implications	<p>The following resources must be provided:</p> <ul style="list-style-type: none"> <li>5.1 Workplace (simulated or actual)</li> <li>5.2 Tools and equipment appropriate for work activities</li> <li>5.3 Materials for work activities</li> </ul>
6. Methods of Assessment	<p>Methods of assessment may include but not limited to:</p> <ul style="list-style-type: none"> <li>6.1 Written Test</li> <li>6.2 Demonstration</li> <li>6.3 Oral Questioning</li> <li>6.4 Portfolio</li> </ul>
7. Context of Assessment	<ul style="list-style-type: none"> <li>7.1 Competency assessment must be done in NSDA accredited assessment centre</li> <li>7.2 Assessment should be done by a NSDA certified/nominated assessor</li> </ul>
<p><b>Accreditation Requirements</b></p> <p>Training Providers must be accredited by National Skills Development Authority (NSDA), the National Quality Assurance Body, or a body with delegated authority for quality assurance to conduct training and assessment against this unit of competency for credit towards the award of any NTVQF qualification. Accredited providers assessing against this unit of competency must meet the quality assurance requirements set by NSDA.</p>	

<b>Unit Code and Title</b>	<b>OURAC004L4V1: Repair and Install Prefabricated Cold Room and Freezer Rooms</b>
<b>Nominal Hours</b>	<b>60 Hours</b>
<b>Unit Descriptor</b>	<p>This unit covers the knowledge, skill and attitude require to repair and install prefabricated cold room and freezer room in the workplace.</p> <p>It specifically includes the tasks of identifying the selected design, installing, repairing, and maintaining of cold room and freezer room.</p>
<b>Elements of Competency</b>	<p><b>Performance Criteria</b>  <b><u>Bold and Underlined</u></b> terms are elaborated in the Range of Variables.</p>
1. Identify the selected design of cold room and freezer room	<p>1.1. Client's requirements are identified, noted and location of installation is inspected;</p> <p>1.2. Specifications of selected system is checked to ensure matching with selected design of the unit;</p> <p>1.3. <b><u>Service manuals</u></b> are identified as per job requirement;</p> <p>1.4. <b><u>Service information</u></b> is identified as per job requirement;</p> <p>1.5. Necessary <b><u>Tools, equipment,</u></b> and <b><u>material</u></b> are selected required for the work;</p>
2. Install cold room and freezer room	<p>2.1. Appropriate <b><u>PPE</u></b> is selected and used in line with job requirements;</p> <p>2.2. <b><u>Components of refrigeration</u></b> the system are selected according to requirements for the installation;</p> <p>2.3. Floor is prepared and leveled to install cold room/ freezer room according to lay out plans;</p> <p>2.4. Cold room / freezer room is installed according to following manufacturers specification;</p> <p>2.5. Refrigeration equipment including piping &amp; electrical items are installed according to specification;</p> <p>2.6. System is <b><u>checked and tested</u></b> before commissioning, as per specifications and manufacturer's instructions;</p> <p>2.7. Commissioning data indicating system pressures, electrical data, humidity &amp; temperatures of outside and inside cold room, are recorded and filed for future use;</p>
3. Prepare to repair cold room and freezer room	<p>3.1 Cold room and freezer room checked and extent of repair / or maintenance ascertained and recorded;</p> <p>3.2 Equipment, material, and accessories are selected as required for the job;</p> <p>3.3 All components of the electrical / electronic circuits checked according to standard practice and manufacturers specifications;</p> <p>3.4 All electro-mechanical safety cut outs checked and performance ensured according to manufacturer's specifications;</p>



	<p>3.5 All components of the refrigeration circuit are checked and defects are identified for repairing according to manufacturer's specifications;</p> <p>3.6 Body mounts checked and restored to the required condition;</p> <p>3.7 System pressure and gas leaks are tested using specified test instrument;</p>
4. Maintain and repair cold room and freezer room	<p>4.1 System evacuated using vacuum pump and gas recharged by weight using specified equipment according to specifications;</p> <p>4.2 Door heaters, door gaskets and thermostat are serviced / or repaired where necessary to ensure proper functioning;</p> <p>4.3 Interior cooler space is checked and cleaned to ensure dust / debris free;</p> <p>4.4 In case of ice plants, water source is checked and serviced according to specifications;</p> <p>4.5 Plant is operated, checked, and tested to ensure satisfactory performance according to manufacturer's specifications;</p> <p>4.6 Recorded readings / data is obtained during operation of the plant and checked against manufacturers specifications;</p>
<b>Range of Variables</b>	
<b>Variables</b>	<b>Range (may include but not limited to):</b>
1. PPE	<p>1. 1 Hand gloves</p> <p>1. 2 Safety Shoes</p> <p>1. 3 Apron</p> <p>1. 4 Safety Goggles</p> <p>1. 5 Helmet</p> <p>1. 6 Mask</p>
2. Service manuals	<p>2. 1 Service manual/schematic diagram/parts list</p> <p>2. 2 Operating instructions/User's/Owner's manual</p>
3. Service Information	<p>3.1 Job Report Sheets</p> <p>3.2 Customer index</p> <p>3.3 Service flowchart</p> <p>3.4 Stock and inventory record</p> <p>3.5 Requisition slips (for acquisition of parts)</p> <p>3.6 Supplier Index</p>
4. Tools	<p>4.1 Pliers</p> <p>4.2 C Clamp</p> <p>4.3 Screwdriver</p> <p>4.4 Hammer</p> <p>4.5 Hacksaw</p> <p>4.6 Steel wire brush</p> <p>4.7 Wrenches</p> <p>4.8 Tube cutter</p> <p>4.9 Wire stripper</p> <p>4.10 Crimper</p> <p>4.11 Tube bender</p>

	<ul style="list-style-type: none"> <li>4.12 Swaging tools,</li> <li>4.13 Block vice</li> <li>4.14 Flaring tools</li> <li>4.15 Reamer</li> <li>4.16 Bench Vice</li> <li>4.17 Ellen key set</li> <li>4.18 Masonry tools (e.g., trowel, spade, level, etc.)</li> </ul>
5. Equipment	<ul style="list-style-type: none"> <li>5.1 Electric hand drill</li> <li>5.2 Gas welding equipment</li> <li>5.3 Multimeter</li> <li>5.4 Clamp on ammeter</li> <li>5.5 Leak detector</li> <li>5.6 Megger</li> <li>5.7 Gage manifold with hose pipe</li> <li>5.8 Charging station</li> <li>5.9 Weighing scale</li> <li>5.10 Two stage rotary type vacuum pumps</li> <li>5.11 Psychrometer/ Hygrometer</li> <li>5.12 Air side equipment (duct, filter, grill, damper, diffuser, register, fan unit)</li> </ul>
6. Materials	<ul style="list-style-type: none"> <li>6.1 Drill bits</li> <li>6.2 Fitting and mounting bolt</li> <li>6.3 Filler rod</li> <li>6.4 Electrical cable</li> <li>6.5 Rawal plugs</li> <li>6.6 Circuit breaker/switch</li> <li>6.7 Masonry materials (e.g., cement, sand, etc.)</li> <li>6.8 Refrigerants</li> <li>6.9 Support structure materials</li> <li>6.10 Copper tube</li> <li>6.11 Plastic tubing/clamp</li> <li>6.12 Dry nitrogen</li> <li>6.13 Charging nipple</li> <li>6.14 Welding flux</li> <li>6.15 Filter drier/Strainer</li> <li>6.16 Capillary tube</li> <li>6.17 Lubricating oil</li> <li>6.18 Copper and brass fittings</li> <li>6.19 Insulation materials</li> </ul>
7. Components of Electrical Circuit	<ul style="list-style-type: none"> <li>7.1 Compressor motor</li> <li>7.2 Relays</li> <li>7.3 Thermostat/ Temperature controller</li> <li>7.4 Heating elements</li> <li>7.5 Timers</li> </ul>

	<ul style="list-style-type: none"> <li>7.6 Electrical controls accessories</li> <li>7.7 Fan</li> <li>7.8 Refrigerant flow controller</li> </ul>
8. Components of refrigeration	<ul style="list-style-type: none"> <li>8.1. Electrical controls</li> <li>8.2. Fan motors Refrigerant circuit Evaporator Condenser</li> <li>8.3. Metering device (refrigerant flow controller), filter / drier, pipe and fittings, moisture indicators and other accessories.</li> <li>8.4. Auger unit</li> </ul>
9. Test & Check	<ul style="list-style-type: none"> <li>9.1. Insulation resistance</li> <li>9.2. Gas Welding</li> <li>9.3. Continuity</li> <li>9.4. Timing Sequence</li> <li>9.5. Leak</li> <li>9.6. Motor Terminal</li> <li>9.7. Current drawn while running</li> <li>9.8. Current drawn on starting</li> <li>9.9. Temperature Test</li> <li>9.10. Brine test</li> </ul>
<p><b>Evidence Guide</b>  The evidence must be authentic, valid, sufficient, reliable, consistent, and recent and meet the requirements of the current version of the Unit of Competency.</p>	
1. Critical aspects of competency	<p>Assessment required evidence that the candidate:</p> <ul style="list-style-type: none"> <li>1.1 Applied safety rules and procedures</li> <li>1.2 Identified the selected design of cold room /freezer room for installation</li> <li>1.3 Prepared and leveled the location to install</li> <li>1.4 Installed cold room/ freezer room with different fittings</li> <li>1.5 Checked and prepared to maintain / repair cold room / freezer room</li> <li>1.6 Operated the plant and checked for satisfactory performance</li> </ul>
2. Underpinning knowledge	<ul style="list-style-type: none"> <li>2.1. Refrigeration cycle</li> <li>2.2. Single and 3 phase electrical power supply system</li> <li>2.3. Fault finding procedures</li> <li>2.4. Type of refrigerants and their applications</li> <li>2.5. Procedure of testing performances</li> <li>2.6. Testing procedures &amp; adjustments in central air conditioning systems</li> <li>2.7. Method of de-frosting</li> </ul>
3. Underpinning skills	<ul style="list-style-type: none"> <li>3.1 Interpretation of manufacturer's manuals and specifications</li> <li>3.2 Selection of refrigerants according to the type of system</li> <li>3.3 Charging refrigerants using specified equipment</li> <li>3.4 Cutting, bending &amp; joining refrigerant lines using correct tools</li> </ul>

	<ul style="list-style-type: none"> <li>3.5 Swaging and flaring of tubes</li> <li>3.6 Welding &amp; brazing</li> <li>3.7 Preparing and leveling the location for installing</li> <li>3.8 Installing cold room/ freezer room with different fittings</li> <li>3.9 Pressure testing and evacuating &amp; charging of refrigeration systems</li> <li>3.10 Detection and repair of gas leaks</li> <li>3.11 Checking and repairing de-frosting system</li> </ul>
4. Underpinning attitudes	<ul style="list-style-type: none"> <li>4.1 Commitment to occupational safety and health</li> <li>4.2 Environmental concerns</li> <li>4.3 Eagerness to learn</li> <li>4.4 Tidiness and timeliness</li> <li>4.5 Respect for rights of peers and seniors in workplace</li> </ul>
5. Resource implications	<p>The following resources must be provided</p> <ul style="list-style-type: none"> <li>5.1 Standard workplaces</li> <li>5.1 Tools required as per job requirements</li> <li>5.2 Operating Manuals, Codes, Standards, and reference materials</li> <li>5.3 Materials to perform work activities</li> </ul>
6. Methods of assessment	<p>Competency should be assessed by</p> <ul style="list-style-type: none"> <li>6.1 Written Test</li> <li>6.2 Demonstration</li> <li>6.3 Oral Questioning</li> <li>6.4 Portfolio</li> </ul>
7. Context of assessment	<ul style="list-style-type: none"> <li>7.1 Competency assessment must be done in NSDA accredited assessment centre</li> <li>7.2 Assessment should be done by a NSDA certified/nominated assessor</li> </ul>

**Accreditation Requirements**

Training Providers must be accredited by National Skills Development Authority (NSDA), the National Quality Assurance Body, or a body with delegated authority for quality assurance to conduct training and assessment against this unit of competency for credit towards the award of any NTVQF qualification. Accredited providers assessing against this unit of competency must meet the quality assurance requirements set by NSDA.

<b>Unit Code and Title</b>	<b>OURAC005L4V1: Check and Inspect Variable Refrigerant Flow (VRF) / Variable Refrigerant Volume (VRV) System</b>
<b>Nominal Hours</b>	<b>20 Hours</b>
<b>Unit Descriptor</b>	This unit covers the knowledge, skills and attitudes required to check and inspect Variable Refrigerant Flow (VRF) or Variable Refrigerant Volume (VRV) air-conditioning system in the workplace. It specifically includes the tasks of prepare to test and inspect VRF/VRV air-conditioning system, check VRF/VRV air-conditioning system, complete and report checking and inspection activities.
<b>Elements of Competency</b>	<b>Performance Criteria</b> <b>Bold and Underlined</b> terms are elaborated in the Range of Variables.
1. Prepare to test and inspect VRF/VRV air-conditioning system	<p>1.1 Work health and safety (WHS)/OHS procedures are obtained and implemented in accordance with workplace procedures;</p> <p>1.2 WHS/OHS risk control measures and procedures for work are followed;</p> <p>1.3 Safety hazards not previously identified are documented and risk control measures implemented;</p> <p>1.4 System operating parameters are identified by reviewing system specifications and component technical data;</p>
2. Check and Inspect VRF/VRV air-conditioning system	<p>2.1 <b><u>Testing/measuring devices</u></b> are connected and set up in accordance with requirements for a particular system;</p> <p>2.2 Measurements and adjustments are made to equipment components and controls to provide optimum system performance in accordance with system specifications and regulatory requirements;</p> <p>2.3 Unplanned situations are responded to in accordance with workplace procedures in a manner that minimizes risk to personnel and equipment;</p> <p>2.4 <b><u>Checking and Inspection</u></b> is carried out efficiently without waste of materials or damage to apparatus, the surrounding environment or services applying sustainable energy principles;</p>
3. Complete and report Checking and Inspection activities	<p>3.5 Worksite is cleaned and made safe in accordance with workplace procedures;</p> <p>3.6 Adjustment settings and results of commissioning work are documented and appropriate person/s are notified in accordance with workplace procedures;</p>
<b>Range of Variables</b>	
<b>Variables</b>	<b>Range</b> (may include but not limited to):
1. Testing/measuring devices	<p>1.1 Digital Thermometer with probe</p> <p>1.2 Pressure Gauge or Gauge Manifold</p>

	<ul style="list-style-type: none"> <li>1.3 Refrigerant Analyzer</li> <li>1.4 Multimeter (Volt, Amps, Capacitance, Inductance)</li> <li>1.5 Anemometer</li> <li>1.6 Hygrometer</li> <li>1.7 Psychrometer</li> </ul>
2. Checking and Inspection	<ul style="list-style-type: none"> <li>2.1 Phase Sequence</li> <li>2.2 Incoming Voltages (Outdoor)</li> <li>2.3 Incoming Voltages (Indoor)</li> <li>2.4 System Addresses (Short Circuit Pin)</li> <li>2.5 Indoor Fan Speed</li> <li>2.6 Indoor Air and Coil Temperature</li> <li>2.7 Outdoor Fan Speed</li> <li>2.8 Outdoor Coil Temperature</li> <li>2.9 Temperature at Compressor inlet and outlet</li> <li>2.10 Compressor Temperature</li> <li>2.11 Refrigerant Pressure at suction and discharge</li> <li>2.12 Air-Leakage at Conditioned Space</li> <li>2.13 Refrigerant Leakage</li> </ul>
<p><b>Evidence Guide</b> The evidence must be authentic, valid, sufficient, reliable, consistent, and recent and meet the requirements of the current version of the Unit of Competency</p>	
1. Critical Aspects of Competency	<p>Assessment required evidence that the candidate:</p> <ul style="list-style-type: none"> <li>1.1 Prepared for inspection activities</li> <li>1.2 Checked and inspected Air-Conditioning accessories, controls, and operating conditions</li> <li>1.3 Checked and inspected Refrigeration system as per industry requirement</li> <li>1.4 checked inspected Air distribution system as manufacturer's guideline</li> <li>1.5 Made interactive communication where applicable to ensure safe and effective work operations</li> </ul>
2. Underpinning Knowledge	<ul style="list-style-type: none"> <li>2.1 OSH regulations and Safety Practices</li> <li>2.2 Refrigeration &amp; Air-Conditioning Principles</li> <li>2.3 VRF/VRV along with Multiple Evaporation unit basics</li> <li>2.4 Operation of Multimeter, Pressure Gauges, Anemometer</li> <li>2.5 Circuit and Circuit Symbols</li> <li>2.6 Cable addressing</li> </ul>
3. Underpinning Skills	<ul style="list-style-type: none"> <li>3.1. Interpreting plans and details</li> <li>3.2. Preparing for work</li> <li>3.3. Using of electrical and mechanical tools and equipment properly</li> <li>3.4. Checking and inspecting of VRF/VRV</li> <li>3.5. Calibrating measuring devices</li> <li>3.6. Documenting and reporting of checking and inspection results</li> </ul>
4. Underpinning Attitudes	<ul style="list-style-type: none"> <li>4.1 Commitment to occupational health and safety</li> <li>4.2 Promptness in carrying out activities</li> </ul>

	<ul style="list-style-type: none"> <li>4.3 Sincere and honest to duties</li> <li>4.4 Environmental concerns</li> <li>4.5 Eagerness to learn</li> <li>4.6 Tidiness and timeliness</li> <li>4.7 Respect for rights of peers and seniors in workplace</li> <li>4.8 Communication with peers and seniors in workplace</li> </ul>
5. Resource Implications	<p>The following resources must be provided:</p> <ul style="list-style-type: none"> <li>5.1 Workplace (simulated or actual)</li> <li>5.2 Tools and equipment appropriate for work activities</li> <li>5.3 Materials for work activities</li> </ul>
6. Methods of Assessment	<p>Competency should be assessed by</p> <ul style="list-style-type: none"> <li>6.1 Demonstration</li> <li>6.2 Oral questioning</li> <li>6.3 Written test</li> <li>6.4 Portfolio</li> </ul>
7. Context of Assessment	<ul style="list-style-type: none"> <li>7.1 Competency assessment must be done in NSDA accredited assessment centre</li> <li>7.2 Assessment should be done by a NSDA certified/ nominated assessor</li> </ul>
<p><b>Accreditation Requirements</b></p> <p>Training Providers must be accredited by National Skills Development Authority (NSDA), the National Quality Assurance Body, or a body with delegated authority for quality assurance to conduct training and assessment against this unit of competency for credit towards the award of any NTVQF qualification. Accredited providers assessing against this unit of competency must meet the quality assurance requirements set by NSDA.</p>	

<b>Unit Code and Title</b>	<b>OURAC006L4V1: Prepare Estimate for Repair, Installations and Maintenance of Refrigeration and Air Conditioning Systems</b>
<b>Nominal Hours</b>	<b>20 Hours</b>
<b>Unit Descriptor</b>	This unit covers the knowledge, skill and attitude required to prepare estimate for repair, installations and maintenance of refrigeration and Air conditioning systems in the workplace. It specifically includes the tasks of preparing estimate for repair, maintenance, install and relocating of refrigeration and air conditioning systems.
<b>Elements of Competency</b>	<b>Performance Criteria</b> <u><b>Bold and Underlined</b></u> terms are elaborated in the Range of Variables.
1. Prepare estimate for repair & maintenance works	1.1. Required <u><b>Tools, equipment and material</b></u> and estimated man hours for job is prepared for the estimate; 1.2. Replacement parts and components for repair/ maintenance of system are listed out; 1.3. Cost of materials, parts, and components to be replaced and consumed is estimated based on market price; 1.4. Cost of man hour is worked out in accordance with job requirement; 1.5. Cost of transport of service personnel is worked out; 1.6. Overall overhead costs and taxes are estimated; 1.7. Finance cost are estimated; 1.8. <u><b>Total estimate</b></u> including a profit margin is worked out;
2. Prepare estimate for installation of air conditioning systems	2.1. Power requirement of <u><b>air conditioner unit</b></u> , availability and adequacy of supply power is checked; 2.2. Measurements of space to be air conditioned and its volume is calculated and noted down; 2.3. Cost of man hour necessary to install and cost of transport for service personnel, material, parts, and components are worked out based on work requirement; 2.4. Overall overhead costs including taxes and man hour costs to be worked out, along with financial cost; 2.5. Total estimate for installation of air conditioning system to be worked out;
3. Prepare estimate for new installation of Refrigeration systems	3.1 Power requirement of refrigeration unit, and availability and adequacy of power supply to be checked; 3.2 Correct type of refrigeration system/or unit are selected to suit customer's requirements; 3.3 Cost of man hour necessary to install refrigeration equipment is worked out;



	<p>3.4 Cost of transport, material, parts &amp; components are worked based on work requirement;</p> <p>3.5 Overhead costs including taxes is worked out along with financial cost;</p> <p>3.6 Total estimate for installation of refrigeration system / unit including a profitmargin are worked out;</p>
4. Prepare an estimate of relocation of Refrigeration and Air Conditioning Systems	<p>4.1 <b>System / Unit</b> is checked and its new location is identified;</p> <p>4.2 Power requirement of refrigeration unit / Air conditioner, and availability and adequacy of supply power are checked as per capacity of the units;</p> <p>4.3 Refrigerant tubing, other parts &amp; components necessary for relocation of system / or unit are listed out and estimated in accordance with market price;</p> <p>4.4 Cost of blanking of existing location, recovery of gas pumped out is estimated;</p> <p>4.5 Cost of labor, transport and materials is worked out as per work requirement;</p> <p>4.6 Total estimate including a profit margin is worked out;</p> <p>4.7 Estimate is submitted to relevant authority / or client and approval obtained;</p>
<b>Range of Variables</b>	
<b>Variables</b>	<b>Range (may include but not limited to):</b>
1. Tools	<p>1.1 Pliers</p> <p>1.2 C Clamp</p> <p>1.3 Screwdriver</p> <p>1.4 Hammer</p> <p>1.5 Hacksaw</p> <p>1.6 Steel wire brush</p> <p>1.7 Wrenches</p> <p>1.8 Tube cutter</p> <p>1.9 Wire stripper</p> <p>1.10 Crimper</p> <p>1.11 Tube bender</p> <p>1.12 Swaging tools,</p> <p>1.13 Flaring tools</p> <p>1.14 Block vice</p> <p>1.15 Bench Vice</p> <p>1.16 Reamer</p> <p>1.17 Allen key set</p> <p>1.18 Rotary hammer drill</p>
2. Equipment	<p>2.1 Testing &amp; measuring</p> <p>2.2 Magger</p> <p>2.3 Charging station</p> <p>2.4 Personal safety equipment</p>

	<ul style="list-style-type: none"> <li>2.5 Weighing scale</li> <li>2.6 Gas welding equipment</li> <li>2.7 Measuring equipment Multimeter</li> <li>2.8 Two stage vacuum Pump</li> <li>2.9 Clamp on ammeter</li> <li>2.10 Psychrometer/ Hygrometer Leak detector</li> <li>2.11 Digital temperature meter</li> <li>2.12 Dry nitrogen cylinder with two stage regulators</li> </ul>
3. Materials	<ul style="list-style-type: none"> <li>3.1 Expansion bolt</li> <li>3.2 Masonry materials (e.g.</li> <li>3.3 Drill bits cement, sand, etc.)</li> <li>3.4 Welding rod</li> <li>3.5 Refrigerants and dry</li> <li>3.6 Electrical cable nitrogen</li> <li>3.7 Rawal plugs</li> <li>3.8 Support structure</li> <li>3.9 Circuit breaker/switch materials</li> <li>3.10 Plastic tubing/clamp</li> <li>3.11 Insulation materials</li> <li>3.12 Filler rod</li> <li>3.13 Copper tube</li> <li>3.14 Welding flux</li> <li>3.15 VC pipe/clamp</li> <li>3.16 Filter drier/Strainer</li> <li>3.17 Lubricating oil</li> <li>3.18 Copper and brass fittings</li> <li>3.19 Capillary tube</li> </ul>
4. Preparation of Estimate	<ul style="list-style-type: none"> <li>4.1 Referring to records on details of equipment, items &amp; material and the</li> <li>4.2 estimated number of man hours needed for the job</li> <li>4.3 Referring to layout plans &amp; manufacturer's specifications /instructions</li> <li>4.4 Current market prices of Refrigeration/or Air Conditioning systems/or Units Costing of material required for installation / repair / servicing/transport cost / financial cost / overhead cost</li> <li>4.5 Cost of man / taxes / contingencies/overhead / transport / profit margin</li> </ul>
5. System/Units	<ul style="list-style-type: none"> <li>5.1 Window type air conditioners</li> <li>5.2 Split type air conditioners</li> <li>5.3 Packaged type Air Conditioners</li> <li>5.4 Domestic Refrigerators / Freezers</li> <li>5.5 Commercial Refrigerators / Freezers &amp; Coolers</li> </ul>
<b>Evidence Guide</b>	

The evidence must be authentic, valid, sufficient, reliable, consistent, and recent and meet the requirements of the current version of the Unit of Competency.	
1. Critical aspects of competency	<p>Assessment required evidence that the candidate:</p> <ul style="list-style-type: none"> <li>1.1 listed out replacement parts and components</li> <li>1.2 Estimated cost of man hour, transport of service personnel, material, parts &amp; components overhead, taxes and profit margin</li> <li>1.3 Prepared estimate for new installation of air conditioning systems</li> <li>1.4 Prepared estimate for new installation of Refrigeration systems</li> <li>1.5 Prepared an estimate of relocation of Refrigeration / or Air Conditioning Systems</li> </ul>
2. Underpinning knowledge	<ul style="list-style-type: none"> <li>2.1. Market prices of refrigeration/air conditioning units spares &amp; material</li> <li>2.2. Relevant elements of costing</li> <li>2.3. Direct and indirect cost</li> <li>2.4. Identification of electronic components and their applications</li> </ul>
3. Underpinning skills	<ul style="list-style-type: none"> <li>3.1. Interpreting manufacturer's manuals, drawings, sketches pertaining to installation/repair/servicing of refrigerators and air conditioners</li> <li>3.2. Calculating areas &amp; volumes</li> <li>3.3. Using techniques to estimate supplies and fittings</li> <li>3.4. Preparing estimate man hour cost</li> <li>3.5. Preparing estimate for transport cost</li> <li>3.6. Preparing an estimate consumable material</li> <li>3.7. Estimating total cost with profit margin</li> </ul>
4. Underpinning attitudes	<ul style="list-style-type: none"> <li>4.1 Commitment to occupational safety and health</li> <li>4.2 Environmental concerns</li> <li>4.3 Eagerness to learn</li> <li>4.4 Tidiness and timeliness</li> <li>4.5 Respect for rights of peers and seniors in workplace</li> </ul>
5. Resource implications	<p>The following resources must be provided</p> <ul style="list-style-type: none"> <li>5.1 Standard workplaces</li> <li>5.2 Tools required as per job requirements</li> <li>5.3 Operating Manuals, Codes, Standards, and reference materials</li> <li>5.4 Materials to perform work activities</li> </ul>
6. Methods of assessment	<p>Competency should be assessed by</p> <ul style="list-style-type: none"> <li>6.1 Demonstration</li> <li>6.2 Oral questioning</li> <li>6.3 Written test</li> <li>6.4 Portfolio</li> </ul>

7. Context of assessment	<p>7.1 Competency assessment must be done in NSDA accredited assessment centre</p> <p>7.2 Assessment should be done by a NSDA certified/nominated assessor</p>
<p><b>Accreditation Requirements</b></p> <p>Training Providers must be accredited by National Skills Development Authority (NSDA), the National Quality Assurance Body, or a body with delegated authority for quality assurance to conduct training and assessment against this unit of competency for credit towards the award of any NTVQF qualification. Accredited providers assessing against this unit of competency must meet the quality assurance requirements set by NSDA.</p>	

Unit Code and Title	OURAC007L4V1: Troubleshoot Transport Refrigeration Unit
Nominal Hours	40 Hours
Unit Descriptor	This unit covers the knowledge, skills and attitudes required to Troubleshoot Transport Refrigeration Unit. It specifically includes the tasks of preparing for maintenance activities, identifying, and repairing faults/ troubles, performing refrigerant recovery, recycling, and retrofitting conversion on transport refrigeration unit and testing and running repaired unit.
Elements of Competency	<b>Performance Criteria</b> <b>Bold and Underlined</b> terms are elaborated in the Range of Variables.
1. Prepare for maintenance activities	1.1 Appropriate wiring diagrams, chart and manual are interpreted in line with the job requirements; 1.2 Appropriate <b>materials, tools and equipment</b> are selected based on job requirements; 1.3 Works' safety is observed according to established operating standards;
2. Identify and repair faults/ troubles	2.1 <b>Components</b> are <b>tested</b> following man following manufacturer's manual or ASHARE Code of practice; 2.2 Faults/problems with components are diagnosed in line with manufacturer's manual or ASHARE Code of practice; 2.3 Remedial action is taken to overcome faults/problems in line manufacturer's manual; 2.4 Work is completed safely in line with workplace safety guidelines 2.5 Report on testing procedure, faults identified and correction process adopted;
3. Perform refrigerant recovery, recycling and retrofitting conversion on transport refrigeration unit	3.1 Suitable tools and equipment are selected and used based on job requirement; 3.2 <b>Refrigerant's</b> recovery/recycling is performed according to manufacturer's recommendations and ASHARE Code of Practice; 3.3 Retrofitting is performed based on ASHARE Code of practice; 3.4 Conversion is performed based on industry standard;
4. Test-run of repaired unit	4.1 Electrical and mechanical components of repaired unit are checked prior to test run; 4.2 Operating parameters are checked and monitored in line with manufacturer's testing procedures; 4.3 Repair and testing procedure is reported to concern authority;
<b>Range of Variables</b>	
<b>Variables</b>	<b>Range</b> (may include but not limited to):
1. PPE	1.1 Hand gloves 1.2 Safety Shoes

	<ul style="list-style-type: none"> <li>1.3 Mask</li> <li>1.4 Apron</li> <li>1.5 Helmet</li> </ul>
2. Tools	<ul style="list-style-type: none"> <li>2.1 Pliers</li> <li>2.2 Screwdriver</li> <li>2.3 Hacksaw</li> <li>2.4 Wrenches</li> <li>2.5 Wire stripper</li> <li>2.6 Crimper</li> <li>2.7 Swaging tools,</li> <li>2.8 Flaring tools</li> <li>2.9 Bench Vice</li> <li>2.10 C Clamp</li> <li>2.11 Hammer</li> <li>2.12 Steel wire brush</li> <li>2.13 Tube cutter</li> <li>2.14 Tube bender</li> <li>2.15 Block vice Reamer</li> <li>2.16 Allen key set</li> </ul>
3. Equipment	<ul style="list-style-type: none"> <li>3.1 Gas welding equipment</li> <li>3.2 Multimeter</li> <li>3.3 Clamp on meter</li> <li>3.4 Leak detector</li> <li>3.5 Charging station</li> <li>3.6 Weight scale</li> <li>3.7 Two stage vacuum pumps</li> <li>3.8 Dry nitrogen cylinder with two stage regulators</li> <li>3.9 Digital temperature meter</li> </ul>
4. Materials	<ul style="list-style-type: none"> <li>4.1 Refrigerants</li> <li>4.2 Dry nitrogen</li> <li>4.3 Charging nipple</li> <li>4.4 Copper tube</li> <li>4.5 Filler rod</li> <li>4.6 Welding flux</li> <li>4.7 Filter drier/Strainer</li> <li>4.8 Capillary tube</li> <li>4.9 Lubricating oil</li> <li>4.10 Copper and brass fittings</li> <li>4.11 Flexible cable</li> <li>4.12 Tab female connector</li> <li>4.13 Insulation tape</li> <li>4.14 Hose clamp</li> <li>4.15 Non return valve/ process tube</li> </ul>
5. Refrigerants	<ul style="list-style-type: none"> <li>5.1 Hydrochlorofluorocarbon (HCFC)</li> <li>5.2 Hydrofluorocarbon (HFC)</li> <li>5.3 Hydrocarbon (HC)</li> </ul>

<b>Evidence Guide</b>	
The evidence must be authentic, valid, sufficient, reliable, consistent, and recent and meet the requirements of the current version of the Unit of Competency	
1. Critical Aspects of Competency	<p>Assessment required evidence that the candidate:</p> <ul style="list-style-type: none"> <li>1.1 Planned and prepared for troubleshooting and repair</li> <li>1.2 Identified and repaired faults/troubles</li> <li>1.3 Refrigerant recovery/recycling and retrofitting/conversion on transport refrigeration.</li> <li>1.4 Repaired unit is run and tested.</li> </ul>
2. Underpinning Knowledge	<ul style="list-style-type: none"> <li>2.1 Troubleshooting and repair techniques</li> <li>2.2 Functions and testing procedures of refrigeration plants</li> <li>2.3 Processes in fault findings</li> <li>2.4 Understanding service manuals</li> <li>2.5 Identification of refrigerants</li> <li>2.6 Characteristics of refrigerants</li> <li>2.7 Recovery machine and operation method</li> <li>2.8 Evacuation procedures</li> <li>2.9 Pressure and leak testing procedure</li> <li>2.10 Retrofitting, charging procedures</li> <li>2.11 Alternative refrigerants</li> </ul>
3. Underpinning Skills	<ul style="list-style-type: none"> <li>3.1 Interpreting schematic diagram, preparing materials</li> <li>3.2 Using appropriate testing instrument, selection of components and replacement</li> <li>3.3 Applying troubleshooting and repair techniques</li> <li>3.4 Preparing service report and documents</li> <li>3.5 Following procedures in identifying refrigerants</li> <li>3.6 Performing leak test procedures</li> <li>3.7 Performing recover/recycling or refrigerants</li> <li>3.8 Performing evacuation process</li> <li>3.9 Applying testing procedure</li> <li>3.10 Performing retrofitting or conversion procedures</li> </ul>
4. Underpinning Attitudes	<ul style="list-style-type: none"> <li>4.1 Commitment to occupational health and safety</li> <li>4.2 Promptness in carrying out activities</li> <li>4.3 Sincere and honest to duties</li> <li>4.4 Environmental concerns</li> <li>4.5 Eagerness to learn</li> <li>4.6 Tidiness and timeliness</li> <li>4.7 Respect for rights of peers and seniors in workplace</li> <li>4.8 Communication with peers and seniors in workplace</li> </ul>
5. Resource Implications	<p>The following resources must be provided:</p> <ul style="list-style-type: none"> <li>5.1 Work place location</li> <li>5.2 Tools and equipment appropriate to maintaining transport refrigeration system</li> <li>5.3 Materials relevant to the activity</li> <li>5.4 Drawings and specifications relevant to the task</li> </ul>

## Copyright

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This Competency Standard for **Refrigeration and Airconditioning** is a document for the development of curricula, teaching and learning materials, and assessment tools. It also serves as the document for providing training consistent with the requirements of industry in order for individuals who graduated through the established standard via competency-based assessment to be suitably qualified for a relevant job.

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