COMPETENCY STANDARD

FOR

REFRIGERATIO AND AIRCONDITIONING

Level: 1

(Light Engineering Sector)

Competency Standard Code: CS-LE-RAC-L1-EN-V1

National Skills Development Authority
Prime Minister's Office
Government of the People's Republic of Bangladesh

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This Competency Standard for **Refrigeration and Air Conditioning** 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 to meet the qualification of individuals who graduated through the established standard via competency-based assessment for a relevant job.

This document has been developed by NSDA in association with **Light Engineering** Sector, industry representatives, academia, related specialist, trainer and related employee.

Public and private institutions may use the information contained in this standard for activities benefitting Bangladesh.

Introduction

The 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, employer associations and employers.

Generally, a competency standard informs curriculum, learning materials, assessment and certification of trainees enrolled in Skills training. Trainees who successfully pass the assessment will receive a qualification in the National Skills Qualification Framework (NSQF) 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 knowledge, skills 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.

Competency Standards for National Skill Certificate – 1 in Refrigeration and Air Conditioning in Light Engineering Sector

Level Descriptors of NSQF (BNQF 1-6)

Level & Job classification	Knowledge Domain	Skills Domain	Responsibility Domain
6-Mid-Level Manager/ Sub Assistant Engineer	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 analyse, compare, relate and evaluate.	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.	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.
5-Supervisor	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.	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.	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.
4-Highly Skilled Worker	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.	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.	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.
3-Skilled Worker	Moderately broad knowledge in a specific work or study area, able to perceive ideas and abstract from drawing and design according to workplace requirements.	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	Work or study under supervision with considerable autonomy. Participate in teams and responsible for group coordination.
2-Semi Skilled Worker	Basic understanding of underpinning knowledge in a specific work or study area, able to interpret and apply common occupational terms and instructions.	Skills required to carry out simple tasks, communicate with his team in the workplace presenting and discussing results of his work with required clarity.	Work or study under supervision in a structured context with limited scope of manipulation
1 –Basic Skilled Worker	Elementary understanding of ability to interpret the underpinning knowledge in a specific study area, able to interpret common occupational terms and instructions.	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.	Work under direct supervision in a structured context with limited range of responsibilities.

List of Abbreviations

CS - Competency Standard
ISC - Industry Skills Council
FPS - Foot, Pound, Second
LEISC **-** Light Engineering Industry Skills Councils
NSDA - National Skills Development Authority
RAC - Refrigeration and Air Conditioning
MKS - Meter, Kilogram, Second
NSQF - National Qualifications Framework
OSH - Occupational Safety and Health
PPE - Personal Protective Equipment
SCVC - Standards and Curriculum Validation Committee
STP - Skills Training Provider
SOP - Standard Operating Procedure
UoC - Unit of Competency

Approval of Competency Standard

Members of the Approval Committee:

Member	Signature
Dulal Krishna Saha Executive Chairman (Secretary) National Skills Development Authority (NSDA)	21.06.21
Md. Nurul Amin Member (Admin & Finance) And Member (Registration & Certification) Joint Secretary National Skills Development Authority (NSDA)	21.06.24
Alif Rudaba 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)

National Competency Standards for National Skill Certificate, Level –1 in Refrigeration and Air Conditioning for Light Engineering Sector

Course Structure

SL	Unit Code and Title		UoC Level	Nominal Hours
Generic Unit of Competencies				**30**
1.	GU-01-L1-V1	Perform Computations using mathematical concepts	1	15
2.	GU-02-L1-V1	Apply Occupational Safety and Health (OSH) practices at workplace	1	15
Sector Specific Competencies				**20**
3.	SU-LE-01-L1-V1	Work in the Light Engineering Sector	1	20
Occupation Specific Competencies				**310**
4.	OU-LE-RAC-01-L1-V1	Interpret Basic Concepts of RAC	1	30
5.	OU-LE-RAC-02-L1-V1	Interpret Technical Schematic Diagram	1	20
6.	OU-LE-RAC-03-L1-V1	Use Hand Tools and Power Tools	1	30
7.	OU-LE-RAC-04-L1-V1	Carry Out Precision Checks and Measurements	1	20
8.	OU-LE-RAC-05-L1-V1	Perform Tube Processing Operation	1	60
9.	OU-LE-RAC-06-L1-V1	Apply Electrical & Electronic Fundamentals	1	50
10.	OU-LE-RAC-07-L1-V1	Service and Repair Refrigerators & Freezers	1	80
11.	OU-LE-RAC-08-L1-V1	Carry Out Precision Checks and Measurements	1	20
			Total Learning Hours	**360**
			On-the Job	**160**
			Total Nominal Hours	**520**

Units & Elements at a Glance:

Generic Unit of Competencies (30 Hours)

Code	Unit of Competency	Elements of Competency	Duration (Hours)
GU-01-L1-V1	Perform Computations using mathematical concepts	1. Identify calculation requirements in the workplace 2. Select appropriate mathematical methods/concepts for the calculation 3. Use tools and instruments to perform calculations	15
GU-02-L1-V1	Apply Occupational Safety and Health (OSH) practices at workplace	1. Identify OSH policies and procedure 2. Follow OSH procedure 3. Report hazards and risks 4. Respond to emergencies 5. Maintain personal well-being	15
		Total Hour	**30**

Sector Specific Unit of Competencies (20 Hours)

Code	Unit of Competency	Elements of Competency	Duration (Hours)
SU-LE-01-L1-V1	Work in the Light Engineering Sector	1. Identify job roles and responsibilities; 2. Identify and observe OSH in the manufacturing industries; 3. Plan work activities; 4. Work with others;	20
		Total Hours	**20**

Occupation Specific Unit of Competencies (310 Hours)

Code	Unit of Competency	Elements of Competency	Hours
OU-LE-RAC-01-L1-V1	Interpret Basic Concepts of RAC	1. Interpret compressors 2. Interpret condensers 3. Interpret expansion devices 4. Interpret evaporators 5. Interpret accessories 6. Interpret Refrigerant with compressor oil	30
OU-LE-RAC-02-L1-V1	Interpret Technical Schematic Diagram	1. Select technical Schematic diagram 2. Interpret technical Schematic diagram 3. Interpret operation & maintenance manuals	20
OU-LE-RAC-03-L1-V1	Use Hand Tools and Power Tools	1. Inspect hand tools and power tools for usability 2. Use Hand tools 3. Use power tools 4. Operate power tools properly and safely 5. Clean/maintain hand tools and power tools after use	30
OU-LE-RAC-04-L1-V1	Carry Out Precision Checks and Measurements	1. Select the job to be checked and measured 2. Select measuring and checking tool/instrument 3. Obtain measurements and checks 4. Record/communicate measurement and check results 5. Maintain and store measuring instruments	20
OU-LE-RAC-05-L1-V1	Perform Tube Processing Operation	1. Prepare for tube processing operations 2. Cut tubes 3. Flare tube ends 4. Swage tube end 5. Bend tube 6. Join Tube using lock ring 7. Braze tubes 8. Clean and maintain workplace, tools and equipment	60
OU-LE-RAC-06-L1-V1	Apply Electrical & Electronic Fundamentals	1. Interpret electrical devices 2. Interpret electronic devices 3. Use electrical and electronic devices 4. Perform basic electrical and electronic circuit connections 5. Maintain and Store electrical and electronic tools/instruments	50
OU-LE-RAC-07-L1-V1	Service and Repair	1. Prepare for servicing and maintenance works	80

	Refrigerators & Freezers	2. Troubleshoot refrigerator and freezer 3. Repair refrigerators and deep freezers 4. Clean and store tools and equipment	
OU-LE-RAC-08-L1-V1	Check, Repair and Maintain Compressors	1. Prepare for checking and maintaining compressors 2. Diagnose faults 3. Check and maintain products 4. Test attached products	20
Total Hours			**310**

Generic Unit of Competencies

Unit Code and Title	GU-01-L1-V1: Perform Computations Using Basic Mathematical Concepts
Unit Descriptor	This unit of competency requires the knowledge, skills and attitude to perform computations using basic mathematical concepts in the workplace. It specifically includes the tasks of identifying calculation requirements the workplace, selecting appropriate mathematical method/concept for the calculation and using appropriate instruments tools to perform calculation
Nominal Hours	**15 Hours**
Elements of Competency	**Performance Criteria** **Bold & Underlined** terms are elaborated in the Range of Variables Training Components
1. Identify calculation requirements in the workplace	1.1 Job requirements are identified; 1.2 **Measurements** are selected in accordance with job requirement; 1.3 Calculation requirements are identified from **workplace information**;
2. Select appropriate mathematical methods for the calculation.	2.1 Mathematical methods are identified; 2.2 **Appropriate method** is selected to carry out the calculation requirements; 2.3 Ttolerance and clearance limits are identified and adjusted according to the job requirements;
3. Use tool/instrument to perform calculations	3.1 Work instructions are confirmed and applied to the job in hand; 3.2 Materials to be measured are identified as per job specification; 3.3 Appropriate **tool and instrument** are selected based on materials to be measured;
Range of Variables	
Variable	**Range** (may include but not limited to)
1. Measurements	1.1 Length 1.2 Width 1.3 Weight 1.4 Ttolerance
2. workplace information	2.1 Job Order 2.2 Design 2.3 Working drawing 2.4 Verbal instructions 2.5 Written Instruction
3. Appropriate method	3.1 Addition 3.2 Subtraction 3.3 Division 3.4 Multiplication 3.5 Conversion 3.6 Percentage and ratio calculation
4. Tool/ Instrument	4.1 Calculator 4.2 Scale

	4.3 Measuring tape 4.4 Marker
Evidence Guide 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 identified calculation requirements from workplace information 1.2 selected appropriate method to carry out the calculation requirements 1.3 selected measurements 1.4 selected appropriate methods 1.5 used tool/instrument 1.6 added numbers 1.7 subtracted numbers 1.8 multiplied numbers. 1.9 divided numbers. 1.10 completed calculations using appropriate tools/instruments
2. Underpinning Knowledge	2.1. Numerical concept 2.2. Basic mathematical methods such as addition, subtraction, multiplication and division and percentage. 2.3. Mathematical language, symbols and terminology. 2.4. Measuring units
3. Underpinning Skills	3.1 Interpret numerical concept 3.2 Interpret mathematical methods such as addition, subtraction, multiplication and division and percentage. 3.3 Interpret mathematical language, symbols and terminology. 3.4 Interpret measuring units
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 4.6. Communication with peers and seniors in workplace
5. Resource Implications	5.1. Work place Procedure 5.2. Materials relevant to the proposed activity 5.3. All tools, equipment, material and documentation required. 5.4. Relevant specifications or work instructions
6. Methods of Assessment	6.1. Written test 6.2. Demonstration 6.3. Oral questioning 6.4. Portfolio

7. Context of Assessment	7.1. Competency assessment must be done in a NSDA accredited assessment center 7.2. Assessment should be done by an NSDA certified/ nominated assessor

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 qualification under NSQF. Accredited providers assessing against this unit of competency must meet the quality assurance requirements set by NSDA.

Unit Code and Title	GU-02-L1-V1: Apply Occupational Safety and Health (OSH) Procedure in the Workplace
Unit Descriptor	This unit covers the knowledge, skills and attitudes (KSA) required to apply occupational safety and health (OSH) procedures in the workplace. It specifically includes the tasks of identifying OHS policies and procedures, following OSH procedure, reporting hazards and risks, responding to emergencies and maintaining personal well-being.
Nominal Hours	**15 Hours**
Elements of Competency	**Performance Criteria** **Bold & Underlined** terms are elaborated in the Range of Variables
1. Identify OSH policies and procedures.	1.1. **OHS policies** and **safe operating procedures** are accessed and stated; 1.2. **Safety signs and symbols** are identified and followed; 1.3. Emergency response, evacuation procedures and other contingency measures are determined according to workplace requirements;
2. Follow OSH procedure	2.1 **Personal protective equipment (PPE)** is selected and collected as per requirements; 2.2 Personal protective equipment (PPE) is used in accordance with organization OHS procedures and practices; 2.3 A clear and tidy workplace is maintained as per workplace standard; 2.4 PPE is maintained to keep them operational and compliant with OHS regulations;
3. Report hazards and risks.	3.1 **Hazards** and risks are identified, assessed and controlled; 3.2 Incidents arising from hazards and risks are reported to designated authority;
4. Respond to emergencies	4.1 Alarms and warning devices are responded; 4.2 Workplace **emergency procedures** are followed; 4.3 **Contingency measures** during workplace accidents, fire and other emergencies are recognized and followed in accordance with organization procedures; 4.4 Frist aid procedures is applied during emergency situations;
5. Maintain personal well-being	5.1 OHS policies and procedures are adhered; 5.2 OHS awareness programs are participated as per workplace guidelines and procedures; 5.3 Corrective actions are implemented to correct unsafe condition in the workplace;

	5.4 **"Fit to work" records** are updated and maintained according to workplace requirements;
Range of Variables	
Variables	**Range** (may include but not limited to):
1. OHS Policies	1.1. Bangladesh standards for OHS 1.2. Fire Safety Rules and Regulations 1.3. Code of Practice 1.4. Industry Guidelines
2. Safe Operating Procedures	2.1 Orientation on emergency exits, fire extinguishers, fire escape 2.2 Emergency procedures 2.3 First Aid procedures 2.4 Tagging procedures 2.5 Use of PPE 2.6 Safety procedures for hazardous substances
3. Safety Signs and symbols	3.1 Direction signs (exit, emergency exit, etc.) 3.2 First aid signs 3.3 Danger Tags 3.4 Hazard signs 3.5 Safety tags 3.6 Warning signs
4. Personal Protective Equipment (PPE)	4.1 Gas Mask 4.2 Gloves 4.3 Safety boots 4.4 Face mask 4.5 Overalls 4.6 Goggles and safety glasses 4.7 Sun block 4.8 Chemical/Gas detectors
5. Hazards	5.1 Chemical hazards 5.2 Biological hazards 5.3 Physical Hazards 5.4 Mechanical and Electrical Hazard 5.5 Mental hazard 5.6 Ergonomic hazard
6. Emergency Procedures	6.1 Fire fighting 6.2 Earthquake 6.3 Medical and first aid 6.4 Evacuation`
7. Contingency measures	7.1 Evacuation 7.2 Isolation

	7.3 Decontamination
8. “Fit to Work” records	8.1 Medical Certificate every year 8.2 Accident reports, if any 8.3 Eye vision certificate
Evidence Guide The evidence must be authentic, valid, sufficient, reliable, consistent, recent and meet all requirements of current version of the Unit of Competency	
1. Critical aspects of competency	Assessment required evidence that the candidate: 1.1 stated OHS policies and safe operating procedures 1.2 followed safety signs and symbols 1.3 used personal protective equipment (PPE) 1.4 maintained workplace clear and tidy 1.5 assessed and Controlled hazards 1.6 followed emergency procedures 1.7 followed contingency measures 1.8 implemented corrective actions
2. Underpinning knowledge	2.1 Define OHS 2.2 OHS Workplace Policies and Procedures 2.3 Work Safety Procedures 2.4 Emergency Procedures 2.5 Hazard control procedure 2.6 Different types of Hazards 2.7 PPE and there uses 2.8 Personal Hygiene Practices 2.9 OHS Awareness
3. Underpinning skills	3.1 Accessing OHS policies 3.2 Handling of PPE 3.3 Handling cleaning tools and equipment 3.4 Writing report 3.5 Responding to emergency procedures
4. Required attitude	4.1 Commitment to occupational health and safety 4.2 Sincere and honest to duties 4.3 Promptness in carrying out activities 4.4 Environmental concerns 4.5 Eagerness to learn 4.6 Tidiness and timeliness 4.7 Respect of peers and seniors in workplace 4.8 Communicate with peers and seniors in workplace
5. Resource implications	5.1 Adequate workplace 5.2 Equipment and outfits appropriate in applying safety measures

	5.3 Tools, materials and documentation required 5.4 OHS Policies and Procedures
6. Methods of assessment	6.1 Written test 6.2 Demonstration 6.3 Oral Questioning 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.

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 qualification under NSQF. Accredited providers assessing against this unit of competency must meet the quality assurance requirements set by NSDA.

Sector Specific Unit of Competencies

Unit Code and Title	SU-LE-001-L1-V1: Work in the Light Engineering Sector
Unit Descriptor	This unit covers the knowledge, skills and attitudes required to work in the Light Engineering Industry. It specifically includes the tasks of identifying job roles and responsibilities, identifying and observing OSH in the manufacturing industries, planning work activities and working with others.
Nominal Hours	**20 Hours**
Elements of Competency	**Performance Criteria** **Bold and Underlined** terms are elaborated in the Range of Variables
1. Identify job roles and responsibilities;	1.1 Job roles and responsibilities in the manufacturing industry are identified; 1.2 Relationship within the manufacturing industry employees is identified;
2. Identify and observe OSH in the manufacturing industries;	2.1. OSH in the manufacturing industries is identified and observed; 2.2. Safe work practices are followed when using equipment in the work environment;
3. Plan work activities;	3.1 Common goals, objectives and tasks are identified and clarified with appropriate persons; 3.2 Individual tasks are determined and agreed on according to workplace environment;
4. Work with others;	4.1 **Effective interpersonal skills** are applied to interact with others and to contribute to activities and objectives; 4.2 Assigned tasks are performed in accordance with job requirements, specifications and workplace environment; 4.3 **Work requirements** are confirmed with colleagues;
Range of Variables	
Variable	**Range** (may include but not limited to):
1. Effective interpersonal skills	1.1 Basic listening and speaking skills, use terminology and jargon 1.2 Communication and receiving feedback 1.3 Interpretation of instructions 1.4 Basic principles of effective communication
2. Work requirements	2.1 Work requirements as directed in verbal or written in specifications or procedures;
Evidence Guide 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	1. 1 Followed job role accordance with industries requirement. 1. 2 Developed relationship with industries fellow 1. 3 Identified different types of Hazards 1. 4 Used PPE 1. 5 Applied effective interpersonal skills to achieve the goals of industry.
2. Underpinning Knowledge	2.1 Key duties/responsibilities of Manufacturing technician 2.2 Responsibilities of Supervisors 2.3 Responsibilities of Employers 2.4 Responsibilities of Workers 2.5 Common Hazards 2.6 Ways to reduce the risk 2.7 Common goals of the manufacturing Industry
3. Underpinning Skills	3.1 Improving Employee Employer Relationships 3.2 Creating a Positive Relationship with Employees 3.3 Observing OHS in manufacturing industry 3.4 Identifying OHS policies and procedures 3.5 Following personal work safety practices 3.6 Reporting hazards and risks 3.7 Responding to emergency procedures 3.8 Maintaining physical well-being in the workplace
4. Required 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	The following resources must be provided: 5.1 Workplace 5.2 Tools and equipment appropriate to workplace 5.3 Materials relevant to the proposed activity 5.4 Equipment and outfits appropriate in applying safety measures 5.5 OHS Policies and Procedures
6. Methods of Assessment	Methods of assessment may include but not limited to: 6.1 Written Test 6.2 Demonstration 6.3 Oral Questioning 6.4 Portfolio
7. Context of Assessment	7.1 Competency assessment must be done in NSDA accredited center. 7.2 Assessment should be done by NSDA certified/ nominated assessor

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Occupation Specific Unit of Competencies

Unit code and Title	OU-LE-RAC-01-L1-V1: Interpret Basic Concepts of RAC
Unit Descriptor	This unit covers the knowledge, skills and attitudes (KSA) required to interpret basic concepts of RAC in the workplace. It specifically includes the tasks of interpreting compressors, condensers, expansion devices, evaporators, accessories and refrigerant with compressor oil.
Nominal Hours	**30 Hours**
Elements of Competency	**Performance Criteria** **Bold & Underlined** terms are elaborated in the Range of Variables Training Components
1. Interpret compressors	1.1 **Compressors** are defined; 1.2 Types of compressors are identified; 1.3 Applications of compressor are interpreted;
2. Interpret condensers	2.1 **Condensers** are defined; 2.2 Size of condensers are identified; 2.3 Applications of condensers are interpreted;
3. Interpret expansion devices	1. 1 **Expansion devices** are defined; 1. 2 Size of expansion devices are identified; 1. 3 Applications of expansion devices are interpreted;
4. Interpret evaporators	4.1. **Evaporators** are defined; 4.2. Size of evaporators are identified; 4.3. Applications of evaporators are interpreted;
5. Interpret accessories	5.1 **Accessories** are defined; 5.2 Size of accessories are identified; 5.3 Applications of accessories are interpreted;
6. Interpret Refrigerant with compressor oil	5.1 **Refrigerants** are defined; 5.2 Types of **lubricants** are identified; 5.3 Handling process of refrigerant and lubricants are interpreted;
Range of Variables	
Variable	**Range** (may include but not limited to):
1. Compressor	1. 1 Rotary Screw Compressor. 1. 2 Reciprocating Air Compressor. 1. 3 Axial Compressor.

	1. 4 Centrifugal Compressor.
2. Condensers	2.1 Air cooled 2.2 Water cooled and 2.3 Evaporative
3. Expansion devices	3.1 Thermal expansion valves (TEVs) 3.2 Manual valves. 3.3 Capillary tubes. 3.4 Automatic valves. 3.5 Electronic expansion valves. 3.6 Low-pressure float valves. 3.7 High-pressure float valves.
4. Evaporators	4.1 Shell type 4.2 Circular tube type
5. Accessories	5.1 Produce drawer line 5.2 Beverage dispenser 5.3 Refrigerator alarm 5.4 Water filter 5.5 Air filter 5.6 Controlling devices
6. Refrigerant	6.1. HCFC 6.2. HFC 6.3. HC
7. Lubricant	7.1 Synthetic oil 7.2 Mineral oil
Evidence Guide 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 identified types of compressors 1. 2 identified size of condensers 1. 3 identified size of expansion devices 1. 4 identified size of evaporators 1. 5 identified size of accessories
2. Underpinning Knowledge	Define: 2.1. compressor 2.2. condensers 2.3. expansion devices 2.4. evaporators 2.5. accessories

3. Underpinning Skills	Applying the concept of: 3.1 compressor 3.2 condensers 3.3 expansion devices 3.4 evaporators 3.5 accessories
4. Underpinning Attitude	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 4.6 Communication with peers and seniors in workplace
5. Resource Implications	The following resources must be provided: 5.1 Pens 5.2 Telephone 5.3 Computer 5.4 Writing materials 5.5 Online communication
6. Methods of Assessment	Methods of assessment may include but not limited to: 6.1. Workplace observation 6.2. Demonstration 6.3. Oral Questioning 6.4. Written test 6.5. 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

Accreditation Requirements

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Unit Code and Title	OU-LE-RAC-02-L1-V1: Interpret Technical Schematic Diagram
Unit Descriptor	This unit covers the knowledge, skill and attitude required to interpreting technical schematic diagram in the RAC industries. It includes the tasks of selecting technical schematic diagram, interpreting technical Schematic diagram and interpreting operation & maintenance manuals.
Nominal Hours	**20 Hours**
Elements of Competency	**Performance Criteria** **Bold and Underlined** terms are elaborated in the Range of Variables.
1. Select schematic diagram	1.1 **Schematic diagram** is selected and checked to ensure that it conforms to the job requirements; 1.2 Schematic diagram is validated;
2. Interpret schematic diagram	2.1 Schematic diagram components, assemblies are identified; 2.2 Dimensions are identified according to job requirement; 2.3 Clearances/tolerances are checked in accordance with workplace standard; 2.4 **Instructions** are identified and followed accurately; 2.5 Material **specifications** are interpreted; 2.6 Symbols in drawing are interpreted;
3. Interpret operation & maintenance manuals	3.1 Operation and maintenance manuals are collected and interpreted; 3.2 Operation and maintenance manuals are followed;
Range of Variables	
Variables	**Range** (may include but not limited to):
1. Schematic diagram	1.1 Technical schematic 1.2 Sketches 1.3 Manuals
2. Instructions	2.1 Notes to be taken 2.2 Instruction 2.3 Special instruction 2.4 Precaution
3. Specifications	3.1 Device specifications 3.2 Component specifications 3.3 Materials specifications
Evidence Guide 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 identified dimension according to job requirement

	1.2 maintained clearances and tolerances according to workplace requirement. 1.3 interpreted schematic symbols 1.4 interpreted operation & maintenance manuals
2. Underpinning knowledge	2.1 Technical Schematic diagram interpretation 2.2 Sequence of Schematic diagram 2.3 Methods of checking and applying drawing for work 2.4 Schematic diagram selection and checking method to ensure conformity with the job requirements. 2.5 Schematic diagram components, assemblies 2.6 Identification of dimensions according to job requirement 2.7 Procedure of checking clearances/tolerances 2.8 Work instructions 2.9 Material specifications 2.10 Schematic diagram's symbols interpretation 2.11 Use of operation and maintenance manuals
3. Underpinning skills	3.1 Practicing workplace safety 3.2 Interpreting schematic diagram, following operation and maintenance manuals, 3.3 Performing jobs in accordance with the Schematic diagram 3.4 Selecting and checking of drawing to ensure conformity with the job requirements. 3.5 Identifying Schematic diagram components and assemblies 3.6 Identifying dimensions according to job requirement 3.7 Checking clearances/tolerances in accordance with workplace standard 3.8 Following operation and maintenance manuals when operating and maintaining the equipment
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	5.1 Pens 5.2 Telephone 5.3 Computer 5.4 Writing materials 5.5 Online communication
6. Methods of assessment	6.1 Workplace observation 6.2 Demonstration 6.3 Oral questioning

	6.4 Written test 6.5 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

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 qualification under NSQF. Accredited providers assessing against this unit of competency must meet the quality assurance requirements set by NSDA.

Unit Code and Title	OU-LE-RAC-03-L1-V1: Use Hand Tools and Power Tools
Unit Descriptor	This unit covers the knowledge, skills and attitudes (KSA) required to use hand tools and powering tools in the workplace. It specifically includes the tasks of inspecting hand tools and power tools for usability, using hand tools, using power tools, operating power tools properly and safely, Cleaning /maintaining hand tools and power tools after use.
Nominal Hours	**30 Hours**
Elements of Competency	**Performance Criteria** **Bold and Underlined** terms are elaborated in the Range of Variables.
1. Inspect hand tools and power tools for usability	1.1. Appropriate tools are selected; 1.2. Application of tools to job requirement is determined and demonstrated; 1.3. Usability of tools are checked and verified; 1.4. **Hand tools** and **power tools** are prepared; 1.5. Sources of power supply for power tools are identified;
2. Use Hand tools	2.1. Appropriate hand tools for the job are used; 2.2. Proper and safe use/operation of different hand tools is demonstrated; 2.3. **Safety precautions** is maintained when using hand tools; 2.4. Unsafe or faulty tools are identified and marked for repair;
3. Use power tools	3.1 Power tools are identified and selected conforming to the task requirements; 3.2 Proper sequence of operation is applied in using power tools to produce results; 3.3 All safety requirements are compiled before, during and after use; 3.4 Unsafe or faulty tools are identified and marked for repairing /rejecting; 3.5 Operational maintenance of tools, including hand sharpening, is undertaken according to standard procedures; 3.6 Power tools are stored safely in appropriate location according to standard workshop procedures and manufacturers' recommendations;
4. Operate power tools properly and safely	4.1 Power supply outlet and electrical cord are inspected for use in accordance with workplace safety requirements; 4.2 Sequence of operation is applied in using power tools to produce results; 4.3 Power tools are used safely in accordance with manufacturer's operating specification/instruction;

5. Clean/maintain hand tools and power tools after use	5.1 Dust and foreign materials are removed from power tools in accordance with workplace standard; 5.2 Condition of tools is checked after use; 5.3 Lubricant is applied after use and prior to storage; 5.4 Defective tools, instruments, power tools and accessories are inspected and corrected or replaced;	
Range of Variables		
Variables	**Range** (May include but not limited to):	
1. Hand tools	1.1 Ball pin hammer 1.2 Cross pin hammer. 1.3 Straight pin hammer. 1.4 Mallet/soft hammer. 1.5 Bench vise. 1.6 Soft jaw. 1.7 Rough file. 1.8 Medium file. 1.9 Smooth file. 1.10 Punches. 1.11 Chisels. 1.12 Wrenches. 1.13 Pliers. 1.14 Scriber. 1.15 Scraper. 1.16 Screw drivers. 1.17 Dividers. 1.18 Trammels. 1.19 Surface plate 1.20 Marking table. 1.21 Height gauge. 1.22 Layout tools. 1.23 Tap sets. 1.24 Die sets. 1.25 Tap handle 1.26 Die handle 1.27 Hacksaw 1.28 Paint Brushes 1.29 Drill bits 1.30 Tap extruder. 1.31 Screw Extruder. 1.32 Rivet Gun 1.33 Sledge Hammers 1.34 Sockets	1.35 Spanners 1.36 Vice grip 1.37 Wire Cutters 1.38 Wire stripper 1.39 Wood Planners 1.40 Hand drill machine. 1.41 Hand grinding machine. 1.42 Powered screw driver. 1.43 Hand shear. 1.44 Clamps 1.45 Jacks. 1.46 Soldering iron. 1.47 Allen key set. 1.48 Drift punches 1.49 Whole saw cutter 1.50 Locking Plier 1.51 Ratchet Wrench 1.52 Scissors 1.53 Spirit Level 1.54 Fins Straightening 1.55 Comb Set 1.56 Tube Cutter 1.57 Reamer/ Deburring tool 1.58 Flaring and Swaging Tool Kit 1.59 Tube Benders (Spring Type and Pulley Bender Type) 1.60 Pinch of Tools 1.61 Capillary Cutter
2. Power Tools	2.1 Power drills 2.2 Power rivet gun.	

	2.3 Hand grinders 2.4 Pneumatic wrenches 2.5 Press machine 2.6 Jack hammer 2.7 Planers 2.8 Pedestal drills
3. Safety precautions	3.1 Use of appropriate PPEs. 3.2 Proper hand, feet and eye coordination 3.3 Safe condition of electrical outlets, cords and lamps 3.4 Working environment 3.5 Safe operating condition of hand tools and power tools. 3.6 Awareness to OHS requirements
Evidence Guide 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 Used required hand tool for the job. 1.2 Maintained safety precautions when using hand tools. 1.3 Used power tools safely in accordance to manufacturer's operating specification. 1.4 Checked the condition of tools after use. 1.5 Applied appropriate lubricant on hand tools and power tools after use and prior to storage. 1.6 Inspected and corrected or replaced defective tools, instruments, power tools and accessories. 1.7 Stored hand tools and power tools safely in appropriate location.
2. Underpinning knowledge	2.1 Types of tools, functions, and use 2.2 Types of Hand tools and their proper use and techniques 2.3 Types of Power tools, use and safe handling method 2.4 Technical application of tools 2.5 Procedures in the use of hand tools and power tools 2.6 Policies and procedures for occupational health and safety 2.7 Handling of tools and equipment 2.8 Reporting and documentation 2.9 Preventive maintenance 2.10 Storage procedures
3. Underpinning skills	3.1 Using appropriate hand tool for the job. 3.2 Observing safety precautions when using hand tools. 3.3 Using power tools correctly and safely in accordance with manufacturers is operating instruction. 3.4 Checking condition of tools after use. 3.5 Applying appropriate lubricant on hand tools and power tools after use and prior to storage.

	3.6 Inspecting and correcting or replacing defective tools, instruments, power tools and accessories. 3.7 Storing Tools and power tools safely in appropriate location.
4. Underpinning attitudes	4.1 Commitment to occupational safety and health 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 Standard workplaces 5.2 Tools required as per job requirements 5.3 Operating Manuals, Codes, Standards and reference materials 5.4 Materials to perform work activities
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

Accreditation Requirements

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Unit Code and Title	OU-LE-RAC-04-L1-V1: Carry Out Precision Checks and Measurements
Unit Descriptor	This unit covers the knowledge, skills and attitudes required to carry out precision checks and measurements in the workplace. It specifically includes the tasks of selecting the job to be measured, using measuring instrument appropriately, obtaining measurements, recording, and communicating measurements obtained, cleaning, maintaining, and storing measuring instruments.
Nominal Hours	**20 Hours**
Elements of Competency	**Performance Criteria** **Bold and Underlined** terms are elaborated in the Range of Variables.
1. Select the job to be checked and measured	1.1. Safe work practices observed and personal proactive equipment (PPE) worn as required for the work performed; 1.2. Job is selected for measuring and checking; 1.3. Required **dimension of measurement** is determined in accordance with drawing/plan; 1.4. Required physical condition of job is identified in accordance with drawing/plan; 1.5. Job drawing is used to select the measuring instruments;
2. Select measuring and checking tool/instrument	2.1 Required measuring instruments is selected in accordance with job requirement; 2.2 **Measuring instruments** and Checking instrument are identified; 2.3 Applications of measuring device is determined; 2.4 Usability and accuracy of measuring device is checked and verified; 2.5 Measuring device is prepared for measurement; 2.6 Fits, Tolerance, clearance, and limits are identified according to job requirements;
3. Obtain measurements and checks	3.1 Measurements are obtained using appropriate measuring instrument; 3.2 **Systems of measurements** are identified and converted where necessary; 3.3 Measurement is kept accurately in accordance to specification; 3.4 Measurement is checked against job requirement; 3.5 Physical conditions are checked in accordance with job requirement;
4. Record/communicate measurement and check results	4.1 Measurements are recorded in accordance with workplace procedure;

	4.2 Measurement is interpreted, recorded, and communicated to authority;
5. Maintain and store measuring instruments	5.1 Dust and dirt are removed from the measuring instruments; 5.2 Condition of measuring instruments are checked; 5.3 Appropriate lubricant is applied after use and prior to storage; 5.4 Measuring instruments are checked and calibrated; 5.5 Measuring instruments are stored in accordance with workplace procedure;
Range of Variables	
Variables	**Range** (Not limited to):
1. Dimension of measurement	1.1. Length 1.2. Width 1.3. Depth 1.4. Diameter 1.5. Radius 1.6. Height 1.7. Weight
2. Measuring instruments.	2.1. AVO meter 2.2. Voltmeter 2.3. Ammeter 2.4. Oscilloscope 2.5. Measuring tape 2.6. Steel rule 2.7. Electronic Leak Detector 2.8. Noise Level Meter 2.9. Anemometer 2.10. Digital Clamp-On Ampere Meter 2.11. Laser Distance Measuring Device 2.12. Weight scale (high precision) 2.13. Micron gauge 2.14. Double gauge Manifold 2.15. Measuring Tape 2.16. Digital Vernier slide calliper 2.17. Micro meter (inch/millimetre)
3. Systems of measurements	3.1 Length 3.2 Width 3.3 Depth

	3.4 Diameter 3.5 Radius 3.6 Height
Evidence Guide 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 evidences that the candidate: 1.1 Determined required dimensional measurements, physical conditions, and geometrical dimensions in accordance with plan and workplace instruction. 1.2 Measured and checked linear and geometrical dimensions within the required tolerance in accordance to specification. 1.3 Checked physical conditions using appropriate checking tool. 1.4 Identified and converted systems of measurements where necessary. 1.5 Recorded measurements in accordance with workplace procedure. 1.6 Interpreted and communicated measurement to authority. 1.7 Applied appropriate lubricant on measuring and checking tools and instruments after use and prior to storage
2. Underpinning knowledge	2.1. Difference between measuring and checking 2.2. Types of measuring tools and their applications 2.3. Types of checking tools and their applications 2.4. Geometrical dimensions and tolerances 2.5. Method, procedure, and techniques when taking linear Measurements 2.6. Methods, procedures, and techniques when checking physical conditions of work pieces 2.7. Methods, procedures, and techniques when checking geometrical dimensions of work pieces 2.8. Measurement conversion systems 2.9. Workplace record keeping procedures 2.10. Preventive maintenance for measuring and checking tools 2.11. Calibration and adjustment procedures for measuring and checking tools
3. Underpinning Skills	3.1 Determining required dimensional measurements, physical conditions, and geometrical dimensions in accordance with drawing/plan and workplace specification 3.2 Measuring and checking linear and geometrical dimensions within the required tolerance in accordance to specification 3.3 Checking physical conditions using appropriate checking tool 3.4 Identifying and converting systems of measurements where necessary.

	3.5 Recording measurements in accordance with workplace procedure 3.6 Interpreting and communicating measurement to authority 3.7 Applying appropriate lubricant on measuring and checking tools and instruments after use and prior to storage 3.8 Checking condition of measuring instruments, calibrating, and storing in accordance with workplace procedure
4. Underpinning attitudes	4.1 Commitment to occupational safety and health 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 Workplace location. 5.2 Tools and equipment are available. 5.3 Materials relevant to work activity. 5.4 Drawing and specifications relevant to the task.
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

Accreditation Requirements

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Unit Code and Title	OU-LE-RAC-05-L1-V1: Perform Tube Processing Operation
Unit Descriptor	This unit covers the knowledge, skills and attitudes required for a worker to perform tube processing operation when performing refrigeration and air conditioning works. It specifically includes the tasks of preparing for tube processing operations, cutting tubes, flaring tube ends, swaging tube end, bending copper/aluminum tube, brazing copper and aluminum tubes.
Nominal Hours	**60 Hours**
Elements of Competency	**Performance Criteria** **Bold and Underlined** terms are elaborated in the Range of Variables.
1. Prepare for tube processing operations	1.1 **PPE** are selected and used; 1.2 **Tools, equipment & materials** are gathered; 1.3 Tools, equipment & materials are checked for usability and operability; 1.4 **Tube dimensions** and **fittings** are identified and gathered; 1.5 Measurements and pipe runs are identified in accordance with workplace requirements/specifications;
2. Cut tubes	2.1 **Tubes** are measured and marked in accordance with specification; 2.2 Tubes are cut using by appropriate cutting method and tool; 2.3 Tubes are reamed on its ends after cutting to remove burrs; 2.4 Tube ends are sealed to ensure non contamination with dirt and **foreign materials;** 2.5 Appropriate **sealing material** is used on tube ends;
3. Flare tube ends	3.1. Tube ends are flared using appropriate flaring tool; 3.2. Flared tube end is checked for quality; 3.3. Flared tube ends are sealed to ensure non-contamination with dirt and foreign materials;
4. Swage tube end	4.1 Tube ends are swaged using appropriate swaging tool; 4.2 Swaged tube end is checked for quality; 4.3 Swaged tube end is sealed to ensure non-contamination with dirt and foreign materials;
5. Bend tube	5.1. Tube is bended using appropriate bending tool; 5.2. Bended copper/aluminum tube is checked for quality in accordance with specifications; 5.3. Bended copper/aluminum tubes are sealed to ensure non-contamination with dirt and foreign materials;
6. Join Tube using lock ring	6.1. Tube is cut according to dimension; 6.2. Tube is cleaned; 6.3. Lock ring is inserted with tube; 6.4. Sealant/ prep is applied;

	6.5. Tube is joined as per standard;
7. Braze tubes	7.1. **Brazing equipment** is checked for usability and safety condition; 7.2. Tubes are brazed using required brazing equipment; 7.3. Brazed joints are checked for quality; 7.4. Brazed connection is tested in accordance with workplace requirements/specification;
8. Clean/maintain workplace, tools and equipment	8.1. Workplace is cleaned and materials are stored in accordance with workplace requirements; 8.2. Tools and equipment are cleaned, checked for damaged and lubricated (if necessary) and stored in accordance with workplace conditions; 8.3. Damaged/defective tools and equipment are reported for repair/replacement;
Range of Variables	
Variable	**Range** (Not limited to):
1. PPE	1.1 Safety helmet 1.2 Safety belt 1.3 Safety shoes 1.4 Hand gloves 1.5 Apron 1.6 Safety eye glass 1.7 Goggles 1.8 Welding face mask
2. Tools, equipment & materials	2.1 Tools; 2.1.1 Measuring steel tape 2.1.2 Ball pin hammer 2.1.3 Tube cutter 2.1.4 Hand hacksaw 2.1.5 Swaging tool set 2.1.6 Flaring tool set 2.1.7 Bending tool 2.1.8 Files 2.1.9 Bench vice 2.1.10 Lock ring wrench 2.2 Equipment 2.2.1. Oxy-acetylene welding set 2.2.2. Drill press 2.2.3. Lock ring wrench 2.2.4. High frequency welding machine 2.3 Materials 2.3.1. Copper tubes 2.3.2. Aluminum tubes 2.3.3. Steel tube

	2.3.4. Brazing flux 2.3.5. Cotton rag 2.3.6. Brazing filler materials 2.3.7. Lock ring 2.3.8. Sealant
3. Tube dimensions	3.1 Tube size 3.2 Length 3.3 Radius/diameter 3.4 Angle of bend
4. Fittings	4.1 Flare nut 4.2 Coupling 4.3 Elbow 4.4 Tube plug/cap 4.5 Union
5. Tubes	5.1. Copper tube 5.2. Aluminum tube 5.3. Steel tubes
6. Foreign materials	6.1. Water 6.2. Sand 6.3. Dust 6.4. Metal filings 6.5. Copper filings 6.6. Aluminum filings 6.7. Oil
7. Sealing material	7.1. Tapes 7.2. Tube plug 7.3. Tube caps
8. Brazing equipment	8.1. Oxy-acetylene welding set 8.2. Air-LPG gas brazing set 8.3. Blow torch
Evidence Guide 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. Cut tubes using appropriate cutting method and tool 1.2. Sealed tube ends to ensure non contamination with dirt and foreign materials 1.3. Flared tube ends using appropriate flaring tool 1.4. Checked flared tube end for quality 1.5. Swaged tube end using appropriate swaging tool 1.6. Bended copper/aluminum tube using appropriate bending tools

	1.7. Brazed copper and aluminum tubes using appropriate brazing equipment
2. Underpinning Knowledge	2.1. Tube cutting tools and their application 2.2. Tube cutting procedure and techniques 2.3. Types of tubes seals and their use 2.4. Tube flaring tools and their application 2.5. Procedure of tube flaring 2.6. Method of checking flared tube quality 2.7. Swaging tool and its application 2.8. Procedure of swaging tube 2.9. Types of tube benders and application 2.10. Procedure and technique of bending copper/aluminum/steel tubes 2.11. Types of equipment used for brazing and their application 2.12. Copper tube brazing procedure and techniques 2.13. Aluminum tube brazing procedure and technique 2.14. Checking quality of brazed joint 2.15. Procedure of testing brazed connection
3. Underpinning Skills	3.1. Cutting tubes using appropriate cutting method and tool 3.2. Sealing tube ends to ensure non contamination with dirt and foreign materials 3.3. Flaring tube ends using appropriate flaring tool 3.4. Checking flared tube end for quality 3.5. Swaging tube end using appropriate swaging tool 3.6. Bending copper/aluminum tube using appropriate bending tool 3.7. Brazing copper tubes using appropriate brazing equipment 3.8. Brazing aluminum tubes using appropriate brazing equipment 3.9. Checking brazed joints for quality 3.10. Testing brazed connection in accordance with workplace requirements/specification.
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 Respect for rights of peers and seniors in workplace.
5. Resource implications	The following resources must be provided: 5.1. Adequate workplace. 5.2. Tools and equipment appropriate to work activities. 5.3. Materials relevant to the proposed activity. 5.4. Drawings and specifications relevant to the task.

6. Methods of assessment	Competency should be assessed by: 6.1. Oral questioning 6.2. Written test 6.3. Demonstration 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

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Unit Code and Title	OU-LE-RAC-06-L1-V1: Apply Electrical and Electronics Fundamentals
Unit Descriptor	This unit covers the knowledge, skills and attitudes required for a worker to apply electrical and electronics fundamentals in refrigeration and air conditioning works. It specifically includes the tasks of explaining the fundamental principles of electricity and electronics, solving basic problems in electrical and electronic circuits, using electrical tools, instruments and equipment, maintaining and storing electrical tools/instruments.
Nominal Hours	**50 Hours**
Elements of Competency	**Performance Criteria** **Bold and Underlined** terms are elaborated in the Range of Variables.
1. Interpret electrical devices	1.1 **Fundamental principles/theories** of electricity are described; 1.2 Electrical devices used in RAC are listed; 1.3 Use of electrical devices are interpreted;
2. Interpret electronic devices	2.1. Fundamental principles/theories of electronics are described; 2.2. Electronics devices used in RAC are listed; 2.3. Use of electronic devices are interpreted;
3. Use electrical and electronic devices	3.1 **Electrical and electronic devices** are identified; 3.2 Electrical and electronic devices are tested; 3.3 Electrical and electronic devices are used;
4. Perform basic electrical and electronic circuit connections	4.1 **Electrical and electronic circuit** diagram is interpreted; 4.2 Work instructions are followed as per standard; 4.3 Series-parallel circuits are made, connected; 4.4 Circuit is tested for proper operation in accordance with work instruction/circuit design; 4.5 Faults are identified and corrected;
5. Maintain and Store electrical/electronic tools/instruments	5.1 Electrical/ electronic tools/instruments are checked for proper operation; 5.2 Electrical/ electronic tools/instruments are maintained in accordance to manufacturer's specification; 5.3 Electrical/ electronic tools/instruments stored in accordance to workplace procedures/policy;
Range of Variables	
Variable	**Range** (Not limited to):
1. Fundamental principles/theories	1. 1 Ohms Law 1. 2 Principles and theory of AC/DC circuits 1. 3 Series and parallel circuits 1. 4 Law of conductivity 1. 5 Law of resistivity

2. Electrical and electronic devices	2.1. Split phase Motor 2.2. Thermostat switch 2.3. Relay 2.4. Overload protector 2.5. Capacitor 2.6. Defrost Thermostat (cooling overload) 2.7. Defrost heater 2.8. Timer motor 2.9. Thermal Fuse 2.10. Door Switch 2.11. Cooling fan 2.12. Shaded pole motor 2.13. Cabinet lamp and holder 2.14. Selector switch 2.15. Remote controller 2.16. Universal AC circuit 2.17. Swing motor 2.18. Blower fan motor 2.19. Variac 2.20. Socket 2.21. Cables 2.22. circuit breaker 2.23. Magnetic contactor 2.24. Auto control panel
3. Electrical and electronic circuit diagram	3.1 Series circuit 3.2 Parallel circuit 3.3 Series-parallel circuit 3.4 Doorbell circuit 3.5 Lamp circuits 3.6 Refrigerator circuit 3.7 Window air conditioner circuit 3.8 Deep freezer circuit
Evidence Guide 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 Measured electrical properties/parameters using appropriate measuring tool/instrument 1.1. Used electrical/electronic measuring tools and testing instruments safely/properly 1.2. Tested power supply and electrical components in accordance with manufacturer's specifications

	1.3. Terminated electrical/electronic circuit components in accordance with given diagram 1.4. Tested circuit for proper operation in accordance with work instruction/circuit design
2. Underpinning Knowledge	2.1. Fundamental theories of electricity 2.2. Principles and theory of AC/DC current 2.3. Types of DC circuits and their application 2.4. AC circuits and their application 2.5. Differential electrical/electronic circuit diagrams applied in refrigeration and air conditioning 2.6. Circuit wiring, installation and maintenance 2.7. Electrical measurement and testing methods and techniques 2.8. Safety precautions when working with electrical circuits 2.9. Basic wiring circuits and their application 2.10. Electrical lighting systems on auxiliary outlets 2.11. National and international electrical code
3. Underpinning Skills	3.1. Carrying out basic electrical circuit diagramming and wiring 3.2. Describing relationships of the different types of electrical properties 3.3. Measuring electrical properties/parameters using appropriate measuring tool/instrument 3.4. Using electrical/electronic measuring tools and testing instruments safely/properly 3.5. Testing power supply and electrical/electronic components in accordance with manufacturer's specifications 3.6. Terminating electrical/electronic circuit components in accordance with given diagram 3.7. Testing circuit for proper operation in accordance with work instruction/circuit design 3.8. Storing electrical tools/instruments in accordance to workplace procedures/policy
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 Respect for rights of peers and seniors in workplace.
5. Resource implications	The following resources must be provided: 5.1. Adequate workplace. 5.2. Tools and equipment appropriate to work activities. 5.3. Materials relevant to the proposed activity. 5.4. Drawings and specifications relevant to the task.
6. Methods of assessment	Competency should be assessed by: 6.1. Written test

	6.2. Demonstration 6.3. Oral questioning 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

Accreditation Requirements

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Unit Code and Title	OU-LE-RAC-07-L1-V1: Service and Repair Refrigerators and Freezers
Unit Descriptor	This unit covers the knowledge, skills and attitudes (KSA) required to service and maintain refrigerators and freezers in the workplace. It specifically includes the tasks of preparing for servicing and maintenance works, performing troubleshoot of refrigerator/freezer and repairing refrigerators and deep freezers
Nominal Hours	**80 Hours**
Elements of Competency	**Performance Criteria** **Bold and Underlined** terms are elaborated in the Range of Variables.
1. Prepare for servicing and maintenance works	1.1 **Personal protective equipment (PPE)** is used and OSH is followed; 1.2 Work instructions are interpreted to determine job requirements; 1.3 **Tools and equipment** are selected in accordance with job requirements; 1.4 Workplace is prepared for servicing activities; 1.5 Repairing instruments are calibrated as per work requirement; 1.6 **Materials** are selected as per job requirement;
2. Troubleshoot refrigerator/freezer	2.1 **Relevant information** regarding trouble/problem is asked from user/owner of unit; 2.2 Electrical wiring circuit is checked and traced; 2.3 Refrigerator/freezer is started and operated, if possible, and observed operation; 2.4 **Electrical, electronic** and **technical parameters** are observed and recorded; 2.5 **System trouble/problem** is identified and results/findings are recorded; 2.6 Electronic soldering circuit is checked and traced; 2.7 Body, cabinet and mounts are checked and restored to the required condition;
3. Repair refrigerators and deep freezers	3.1 System is evacuated using vacuum pump recovered refrigerant stored in recovery unit; 3.2 Refrigerant is charged by weight using specified equipment according to specifications; 3.3 Door heaters, thermostat, door gasket is checked and serviced where necessary; 3.4 Interior space checked and cleaned as per standard procedure;

	3.5 Units are operated and **tested & checked** to ensure satisfactory performance according to manufactures specifications;
4. Clean and store tools and equipment	4.1 Tools and equipment are maintained and cleaned as per instruction manual; 4.2 Work place is cleaned in accordance with environmental requirement; 4.3 Tools and equipment are stored safely in appropriate location according to standard workshop procedures;
Range of Variables	
Variables	**Range** (may include but not limited to):
1. PPE	1.1 Hand gloves. 1.2 Safety Shoes. 1.3 Mask 1.4 Apron 1.5 Helmet
2. Tools	2.1 Pliers 2.2 Screwdriver 2.3 Hacksaw 2.4 Wrenches 2.5 Wire stripper/crimper 2.6 Swaging tools, 2.7 Flaring tools 2.8 Bench Vice 2.9 C Clamp Hammer 2.10 Steel wire brush 2.11 Tube cutter 2.12 Tube bender 2.13 Block vice Reamer 2.14 Allen key set
3. Equipment	3.1 Gas welding equipment 3.2 Multimeter 3.3 Clamp on meter 3.4 Leak detector 3.5 Charging station 3.6 Weight scale 3.7 Two stage vacuum pumps 3.8 Dry nitrogen cylinder with two stage regulators 3.9 Digital temperature meter
4. Materials	4.1 Refrigerants 4.2 Dry nitrogen 4.3 Charging nipple 4.4 Copper tube 4.5 Filler rod

	4.6 Welding flux 4.7 Filter drier/Strainer 4.8 Capillary tube 4.9 Lubricating oil 4.10 Copper and brass fittings 4.11 Flexible cable 4.12 Tab female connector 4.13 Insulation tape 4.14 Hose clamp 4.15 Non return valve/ process tube
5. Relevant Information	5.1 Power supply 5.2 Electrical/electronic circuit 5.3 System operation 5.4 Compressor 5.5 Evaporator 5.6 Condenser 5.7 Expansion valve 5.8 Refrigerant charge 5.9 Leaks 5.10 Incidents prior to occurrence of problem
6. Electrical, electronic and technical parameters	6.1 **Electrical parameters;** ▪ input voltage ▪ motor rated voltage ▪ Motor full load current ▪ Cycle ▪ Motor phase; (single phase, three phase) 6.2 **Mechanical parameters**; ▪ High side pressure ▪ Low side pressure ▪ Type of refrigerant ▪ Type of expansion valve (refrigerant flow control) ▪ Type of condenser, (Serpentine, compact, static, forced circulation) ▪ Type of evaporator; (serpentine, compact, static, forced circulation) 6.3 **Electronic parameters;** ▪ Capacitance ▪ Resistance ▪ Inductance ▪ Reactance
7. System trouble/problem	7.1 Input electrical/electronic problem 7.2 Faulty Electrical/electronic circuit 7.3 Faulty compressor 7.4 Faulty refrigerant charge 7.5 System leakage 7.6 Faulty mechanical system components

8. tested & checked	8.1 Insulation 8.2 Resistance 8.3 Mechanical 8.4 Continuity 8.5 Timing Sequence 8.6 Leak 8.7 The pressures in the refrigerator and deep freezer circuit (suction & discharge) 8.8 The temperature at specified places, including ambient Temperature. 8.9 Current drawn while running. 8.10 Current drawn on starting
Evidence Guide 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 Applied safety rules and procedures 1.2 Ensured satisfactory performance of the system 1.3 Selected appropriate processes, tools, materials, and equipment based on job requirements 1.4 Checked Refrigerators & deep freezers to identify fault 1.5 Evacuated system using vacuum pump, 1.6 Recovered refrigerant stored in recovery unit 1.7 Charged gas is by weighing scale 1.8 Demonstrated compliance with safety regulations applicable to worksite operation
2. Underpinning Knowledge	2.1. Refrigeration cycle 2.2. Single and 3 phase electrical power supply system 2.3. Fault finding procedures 2.4. Evacuation procedure 2.5. Method of charging of Refrigerants 2.6. Procedure of testing performance
3. Underpinning Skills	3.1. Checking power supply and electrical/electronic circuits 3.2. Measuring Voltage and Current using electrical test 3.3. Handling tools & equipment 3.4. Cutting, bending, swaging and flaring of tubes 3.5. Welding and brazing 3.6. Selection correct type of refrigerant 3.7. Evacuating & charging of refrigeration systems 3.8. Detection and repair of leaks 3.9. Charging of refrigerants and commissioning of Refrigerator & deep freezer 3.10. Performance testing and adjustments in refrigerators & deep freezers

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	The following resources must be provided: 5.1 Workplace (simulated or actual) 5.2 Tools and equipment appropriate for work activities 5.3 Materials for work activities
6. Methods of Assessment	Methods of assessment may include but not limited to: 6.1. Written test 6.2. Demonstration 6.3. Oral questioning 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

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 qualification under NSQF. Accredited providers assessing against this unit of competency must meet the quality assurance requirements set by NSDA.

Unit Code and Title	OU-LE-RAC-08-L1-V1: Check, Repair and Maintain Compressors
Unit Descriptor	This unit covers the knowledge, skills and attitudes required to check and maintain compressors. It specifically includes the tasks of preparing for checking and maintaining compressors, diagnosing faults, checking, and maintaining products, testing attached products.
Nominal Hours	**20 Hours**
Elements of Competency	**Performance Criteria** **Bold and Underlined** terms are elaborated in the Range of Variables.
1. Prepare for checking and maintaining compressors	1.1 **Personal protective equipment** (**PPE**) is used and OSH is followed; 1.2 **Service manuals** and **service information** required for maintenance are identified and collected; 1.3 Workplace is prepared for maintaining compressor as per standard; 1.4 **Necessary tools, equipment** and test instruments are prepared as per job requirements; 1.5 Necessary **materials** are selected as per job requirement;
2. Diagnose faults	2.1. Systematic **pre-testing procedure** is observed in accordance with manufacturer's instructions; 2.2. Symptoms of system faults are identified as per standard procedures; 2.3. Refrigerant is recovered as per workplace procedure; 2.4. Continuity of compressor motor is checked as per standard procedures; 2.5. Results of diagnosis and testing are documented as per workplace procedure;
3. Check and maintain products	3.1. Defective parts/components are checked and replaced as per standard; 3.2. Control settings and adjustments are performed as per requirement; 3.3. Care and precaution in handling the unit is observed as per procedures; 3.4. Cleaning of unit is performed in accordance with standard procedures;

4. Test attached products	4.1. Attached products is checked in accordance with standard; 4.2. Attached units are subjected to final **testing** and cleaning in conformity with manufacturer's specifications **environmental requirements** procedure; 4.3. Units are assembled and attached to the system in accordance with system requirement. 4.4. Waste materials are disposed in accordance with workplace standard;
Range of Variables	
Variable	**Range** (may include but not limited to):
1. PPE	1.1 Hand gloves. 1.2 Safety goggles. 1.3 Safety Shoes. 1.4 Apron/Boiler shoot 1.5 Mask
2. Tools	2.1 Pliers 2.2 C Clamp 2.3 Screwdriver 2.4 Hammer 2.5 Hacksaw 2.6 Steel wire brush 2.7 Wrenches 2.8 Tube cutter 2.9 Wire stripper/crimper 2.10 Swaging tools, 2.11 Tube bender 2.12 Flaring tools 2.13 Block vice 2.14 Bench Vice 2.15 Reamer 2.16 Allen key set
3. Equipment	3.1 Multimeter 3.2 Clamp on meter 3.3 Compressor 3.4 Gas welding equipment 3.5 Gauge manifold set 3.6 Recovery unit
4. Material	4.1 Filler rod 4.2 Welding flux 4.3 lubricating oil Refrigerants 4.4 Lock ring
5. Service manuals	5.1 Service manual/schematic diagram/parts list

	5.2 Operating instructions/User's/Owner's manual
6. Service Information	6.1 Job Report Sheets 6.2 Customer index 6.3 Service flowchart 6.4 Stock and inventory record 6.5 Suppliers' information
7. Pre-testing procedures	7.1 Visual inspection of the unit without operating the unit 7.2 Customer complaint 7.3 Operate the unit according to manual to confirm defects
8. Testing	8.1. Visual inspection of the unit without operating the unit 8.2. Insulation 8.3. Continuity 8.4. Pumping test 8.5. Current drawn while running. 8.6. Current drawn on starting
9. Environmental Requirements	9.1. Proper disposal of refrigerant and components shall be based on existing requirements of the law and chemical waste management 9.2. Non-biodegradable parts or materials shall be packed and Labeled properly for disposal and stored in designated place.
Evidence Guide 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. Applied safety rules and procedures 1.2. Identified faults and defects in accordance with testing procedures 1.3. Repaired or replaced parts/components of compressor 1.4. Restored unit to normal operating condition 1.5. Disposed waste materials
2. Underpinning Knowledge	2.1. Types and function of compressor 2.2. Single and 3 phase electrical power supply system 2.3. Testing and repairing procedures 2.4. Type of refrigerants and their applications. 2.5. Types and application of refrigerant lubricants
3. Underpinning Skills	3.1. Interpreting manufacturer's manuals, specifications. 3.2. Checking power supply 3.3. Performing continuity test. 3.4. Taking measurement of electrical quantities (volt, ampere, resistance and capacitance etc.) 3.5. Cutting, bending, reaming, swaging of tubes 3.6. Welding and brazing

	3.7. Flashing system 3.8. Pump testing, evacuating of refrigeration systems 3.9. Detection and repair of leakage
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 Respect for rights of peers and seniors in workplace.
5. Resource implications	The following resources must be provided: 5.1. Adequate workplace. 5.2. Tools and equipment appropriate to work activities. 5.3. Materials relevant to the proposed activity. 5.4. Drawings and specifications relevant to the task.
6. Methods of assessment	Competency should be assessed by: 6.1. Written test 6.2. Demonstration 6.3. Oral questioning 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

Accreditation Requirements

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Development of Competency Standard by Technical Sub-Committee (TSC)

The Competency Standards for National Skills Certificate in **"Refrigeration and Air-conditioning" NSQF L- 1** Qualification is Developed by TSC and approved by NSDA.

Respectable members:

Refrigeration and Air-conditioning		
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12.	Md. Amir Hossain, Process Expert (CS and Curriculum), NSDA. Cell: 01631670445, Email: razib.consultant@yahoo.com	Member
13.	Md. Quamruzzaman, Director (Skills Standard), NSDA, Cell: 01819189320 Email: qzaman40@yahoo.com	Member
14.	Engr. B.M. Shariful Islam, Deputy Director (Skill Standard), Cell: +880 01715010321, Email: sharif9375@gmail.com	Member

Validation Of Competency Standard by Standard and Curriculum Validation Committee (SCVC)

The Competency Standards for National Skills Certificate in **"Refrigeration and Air-conditioning",** is validated by SCVC on 01-02 June 2021 and approved by NSDA.

Respectable members of the SCVC:

Refrigeration and Air-conditioning		