National Occupational Skill Standard
(NOSS)

Occupational Title : **Refrigeration and Air Conditioning Mechanic**

Level : **2**

Sector : **Mechanical**

Sub - Sector : **Refrigeration and Air Conditioning**

NOSS ID/NSCO ID :

ISCO NO :

Council for Technical Education and Vocational Training

NATIONAL SKILL TESTING BOARD

Madhyapur Thimi-17, Sanothimi, Bhaktapur, Nepal

Developed: 14-03-2023 (30-11-2079)

2045

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Approved by the Tripartite National Skill Testing Board. 1993

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The National Occupational Skill Standard Developed by:

No	Name	Designation	Organization
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Recommended by Mechanical Technical Sub Committee: 14 March 2023 (30 Falgun 2079)

1	**Occupational Title: Refrigeration and Air Conditioning Mechanic** **Level: 2**
2	**Job Description:** Refrigeration and Air Conditioning Mechanic L-2, installs, services, maintains and repairs commercial refrigeration system and installs, services, maintains and repairs commercial air conditioning system.
3	**UNITS OF COMPETENCY:** 1. Install commercial refrigeration system 2. Service, maintain and repair commercial refrigeration system 3. Install commercial air conditioning system 4. Service, maintain and repair air conditioning system 5. Perform communication 6. Develop professionalism ***Note: Units 5 and 6 are not for testing purpose.***
4	**Qualifying Notes/Prerequisites:** • Physical Requirements: Sound health • Entry Requirements: As per NSTB rules **Additional Information:** • Assessment Types: Performance and written test • Assessment Duration: 4 to 6 Hours (Single Competency: Refrigeration or Air conditioning system) 8 to 10 hours (Full Competency) • Recommended Group Size: 4 to 6 candidates

5	**Unit No:1** **Unit Title: Install commercial refrigeration system**	**Unit code:**
	Elements of competency	**Performance standards**
	1.1 Prepare tools, equipment and materials	1.1.1 ***Personal protective equipment (PPE)*** used in accordance with task requirement. 1.1.2 Tools, equipment and materials prepared as per task requirement. 1.1.3 Physical condition of refrigeration unit checked for damage and details recorded.
	1.2 Install freezer	1.2.1 ***Installation requirement*** for ***freezer unit*** inspected and prepared as per manufacturer's instruction. 1.2.2 Transportation lock of the freezer removed and freezer installed in ***suitable location.*** 1.2.3 Electrical connection of freezer connected to the respective power supply as per wiring diagram. 1.2.4 Freezer operated and tested for ***proper functioning.*** 1.2.5 ***Service data*** recorded as per industry norms.
	1.3 Install batch ice cream machine	1.3.1 Installation requirement for batch ice cream machine inspected and prepared as per manufacturer's instruction. 1.3.2 Transportation lock of the ice cream machine removed and ice cream machine installed in suitable location. 1.3.3 Electrical connection of ice cream machine connected to the respective power supply as per wiring diagram. 1.3.4 Ice cream machine operated and tested for proper functioning. 1.3.5 Service data recorded as per industry norms.

	1.4 Install air cooled instant chiller up to 5TR	1.4.1 Installation requirement for instant chiller inspected and prepared as per manufacturer's instruction. 1.4.2 Transportation lock of instant chiller removed and installed in suitable location. 1.4.3 Water pipeline and drain line connected to the machine as per manufacturer's instruction. 1.4.4 Water pump installed for required piping resistance. 1.4.5 Electrical connection connected to the respective power supply as per wiring diagram. 1.4.6 Instant chiller operated and tested for proper functioning. 1.4.7 Service data recorded as per industry norms.
	1.5 Install pre-fabricated walk-in cold/freezer room	1.5.1 Site checked and prepared as per ***design layout and specification***. 1.5.2 Walk in cold room panels assembled as per manufacturer's instruction and installed on the required position with proper alignment. 1.5.3 ***Openings*** sealed tightly using ***sealing materials*** without air leak. 1.5.4 ***Refrigeration system components*** installed as per manufacturer's instruction. 1.5.5 Entire system flushed with Oxygen Free Dry Nitrogen (OFDN). 1.5.6 Refrigeration system leak tested, evacuated and charged with correct amount of refrigerant. 1.5.7 Refrigeration system tested for normal functioning and required ***parameter*** level checked to ensure that they are within the required range.
	1.6 Install DX bulk milk cooler tank/milk chilling vat	1.6.1 ***Bulk milk cooler tank*** placed on level surface with easy access for loading milk and maintaining slope towards outlet for unloading milk.

		1.6.2 ***Bulk milk cooler components*** installed as per manufacturer's instruction. 1.6.3 Refrigeration lines airtightly insulated without exposing copper lines. 1.6.4 Electrical connection connected to the respective power supply as per circuit diagram. 1.6.5 Entire system flushed with Oxygen Free Dry Nitrogen (OFDN). 1.6.6 Refrigeration system leak tested, evacuated and charged with correct amount of refrigerant. 1.6.7 Bulk milk cooler operated and tested for its proper functioning with water/milk. 1.6.8 Service data recorded as per industry norms.
	1.7 Clean workplace	1.7.1 Unused materials collected and stored in designated area. 1.7.2 Tools and equipment cleaned, checked for damage and stored in designated area. 1.7.3 Workplace cleaned neatly and waste disposed as per ***3R's principle*** in designated area.
6	**Task Performance Requirements (Tools, equipment, and materials):** • Freezer, ice cream machine, instant chiller, walk in cold room, bulk milk cooler tank/chilling vat, screwdriver set, spanner set, room cam lock tool, knife, silicone, silicone gun, socket wrench set, Allen key, fin comb, pliers, wire stripper, phase tester, multimeter, measuring tape, steel ruler, file set, hacksaw, hammer, adjustable wrench, scissor, Nitrogen gas cylinder with regulator, pipe/tube cutter, spirit level, sealant, chisel set, micron gauge, hand grinder, center punch, tube bender, drill machine with drill bit set, rachet, electric air blower, mallet, pipe wrench, vacuum pump, gauge manifold, flaring and swaging tool kit, electronic leak detector, water pressure gun, soldering iron, de-soldering tool, oxy-acetylene brazing set, side mirror, lock ring tool, clamp-on ampere meter, reamer, torch, nozzle, weighing scale, refrigerant, thermometer, dust bin, dust pan, flare nuts, insulating materials, brazing rod, brazing flux, emery paper, brush, cleaning agent, cotton rag, lubricants, pen, paper, register, broom, first aid kit, and personal protective equipment (PPE).	

7	**Safety and Hygiene (Occupational Health and Safety):** • Use personal protective equipment. • Safe handling of materials, tools and equipment. • Hazards involved in lifting Tools, equipment, and materials. • Unplug the refrigerator before servicing • Prevent from chemical, electrical and pressure related hazards. • Prevent from hazards involved in handling refrigerants. • Protect work area while working with Hydro carbon • Make sure the work area is well ventilated • Evacuate system before brazing and de-brazing

8	Required Knowledge		
	Technical Knowledge	**Applied Calculation**	**Graphical Information**

	• Tools, equipment, and materials
	  ○ Types
	  ○ Uses
	  ○ Safe handling
	• Fundamentals of refrigeration system
	• Components of refrigeration system
	• Pressure temperature relationship of refrigerants
	• Types of refrigerants
	• Refrigerant and environmental issues
	• Freezer
	  ○ Types
	  ○ Components and their function
	  ○ Dismantling and assembling process
	  ○ Power and control system
	  ○ Installation process
	  ○ Servicing techniques
	  ○ Common faults/defects
	  ○ Testing and operation
		• Perform conversion of pressure, temperature, volume and refrigeration unit	• Read and interpret electric circuit and drawing
			• Read and interpret workshop manual
			• Read and interpret manufacturer's specification

	• Ice cream machine
	  ○ Batch and continuous
	  ○ Components and their function
	  ○ Dismantling and assembling process
	  ○ Power and control system
	  ○ Installation process
	  ○ Servicing techniques
	  ○ Common faults/defects
	  ○ Testing and operation
	• Chiller
	  ○ Types
	  ○ Components and their function
	  ○ Dismantling and assembling process
	  ○ Power and control system
	  ○ Installation process
	  ○ Servicing techniques
	  ○ Common faults/defects
	  ○ Testing and operation
	• Walk in cold/freezer room
	  ○ Types
	  ○ Components and their function		

	○ Dismantling and assembling process ○ Power and control system ○ Installation process ○ Pressure relief technique ○ Safety push rod and alarm system ○ Servicing techniques ○ Common faults/defects • Bulk milk cooler tank ○ Types ○ Components and their function ○ Dismantling and assembling process ○ Power and control system ○ Installation process ○ Insulation and cleaning process ○ Servicing techniques ○ Common faults/defects • Units of refrigeration • Record keeping and reporting • Waste management • Occupational health and safety rules and regulations		

9	**Assessment of Competency**					
	Unit: 1 **Unit Title: Install commercial refrigeration system**					
	Candidate Details			**Assessors Detail**		
	Candidate's Name: Registration Number: Symbol No: Test Centre: Test Date:			Assessors' Name 1. 2. 3.		ID/License No:
Element of competency	**Performance Standards**			**Standard Met**	**Standard Not Met**	**Evidence Type**	**Comments**
1.1 Prepare tools, equipment and materials	1.1.1 ***Personal protective equipment (PPE)*** used in accordance with task requirement. 1.1.2 Tools, equipment and materials prepared as per task requirement. 1.1.3 Physical condition of refrigeration unit checked for damage and details recorded.						
1.2 Install freezer	1.2.1 ***Installation requirement*** for ***freezer unit*** inspected and prepared as per manufacturer's instruction. 1.2.2 Transportation lock of the freezer removed and freezer installed in ***suitable location.*** 1.2.3 Electrical connection of freezer connected to the						

	respective power supply as per wiring diagram. 1.2.4 Freezer operated and tested for proper functioning. 1.2.5 ***Service data*** recorded as per industry norms.				
1.3 Install batch ice cream machine	1.3.1 Installation requirement for batch ice cream machine inspected and prepared as per manufacturer's instruction. 1.3.2 Transportation lock of the ice cream machine removed and ice cream machine installed in suitable location. 1.3.3 Electrical connection of ice cream machine connected to the respective power supply as per wiring diagram. 1.3.4 Ice cream machine operated and tested for proper functioning. 1.3.5 Service data recorded as per industry norms.				
1.4 Install air cooled instant chiller up to 5TR	1.4.1 Installation requirement for instant chiller inspected and prepared as per manufacturer's instruction. 1.4.2 Transportation lock of instant chiller removed and installed in suitable location. 1.4.3 Water pipeline and drain line connected to the machine as per manufacturer's instruction. 1.4.4 Water pump installed for required piping resistance. 1.4.5 Electrical connection connected to the respective power supply as per wiring diagram.				

	1.4.6 Instant chiller operated and tested for proper functioning. 1.4.7 Service data recorded as per industry norms.				
1.5 Install pre-fabricated walk-in cold/freezer room	1.5.1 Site checked and prepared as per ***design layout and specification***. 1.5.2 Walk in cold room panels assembled as per manufacturer's instruction and installed on the required position with proper alignment. 1.5.3 ***Openings*** sealed tightly using ***sealing materials*** without air leak. 1.5.4 ***Refrigeration system components*** installed as per manufacturer's instruction. 1.5.5 Entire system flushed with Oxygen Free Dry Nitrogen (OFDN). 1.5.6 Refrigeration system leak tested, evacuated and charged with correct amount of refrigerant. 1.5.7 Refrigeration system tested for normal functioning and required ***parameter*** level checked to ensure that they are within the required range.				
1.6 Install DX bulk milk cooler tank/milk chilling vat	1.6.1 Bulk milk cooler tank placed on level surface with easy access for loading milk and maintaining slope towards outlet for unloading milk.				

	1.6.2 ***Bulk milk cooler components*** installed as per manufacturer's instruction. 1.6.3 Refrigeration lines airtightly insulated without exposing copper lines. 1.6.4 Electrical connection connected to the respective power supply as per circuit diagram. 1.6.5 Entire system flushed with Oxygen Free Dry Nitrogen (OFDN). 1.6.6 Refrigeration system leak tested, evacuated and charged with correct amount of refrigerant. 1.6.7 Bulk milk cooler operated and tested for its proper functioning with water/milk. 1.6.8 Service data recorded as per industry norms.				
1.7 Clean workplace	1.7.1 Unused materials collected and stored in designated area. 1.7.2 Tools and equipment cleaned, checked for damage and stored in designated area. 1.7.3 Workplace cleaned neatly and waste disposed as per ***3R's principle*** in designated area.				

WT- Written Test **OQ**- Oral Question **PT-** Practical Test **DO** – Direct Observation **SR**- Supervisor's report **SN**–Simulation

RP- Role Play **PG –**Photographs **VD**- Video **CT** – Certificates **TS** – Testimonials (Reward) **PP** – Product Produced

CS – Case Study

Range Statement

Variable	Range
Personal protective equipment (PPE)	*May include but not limited to:* • Helmet • Mask • Apron • Goggles • Gloves • Safety shoes • Ear plug • Welding face shied
Installation requirement	*May include but not limited to:* • Space requirement • Floor and wall requirement • Power requirement • Pipe work requirement • Drainage requirement • Ventilation provision
Freezer unit	*May include but not limited to:* • 1 door • 2 door • 3 door • 4 door

	• 6 door
Suitable location	*May include but not limited to:* • Dry and ventilated • Levelled floor/surface • Distance from wall • Space for servicing
Proper functioning	*May include but are not limited to:* • Sound • Vibration • Leakage • Current • Temperature • Pressure • Cooling time
Service data	*May include but not limited to:* • Installation data • Testing and commissioning data
Design layout and specification	*May include but are not limited to:* • Shape and size • Temperature range • Flooring • Shelving • Insulating • Refrigeration system

Openings	*May include but are not limited to:* • Door openings • Window openings • Holes • Seam • Joints
Sealing materials	*May include but are not limited to:* • Gasket • Rubber • Silicone • Foam • Plastic • Tape wrapping
Refrigeration system components	*May include but are not limited to:* • Compressor • Condenser • Evaporator • Refrigeration accessories: heaters, pressure relief damper, filter dryer, vibration absorber, valves, sight glass, expansion device, oil separator, liquid receiver, suction accumulator, suction filter dryer, pressure cut out switches, pressure gauges • Refrigerant lines and drain lines • Electrical panel board and connection • Anchoring

	• Safety push rod and alarm system
Parameter	*May include but are not limited to:* • Temperature • Pressure • Humidity • Current • Voltage
Bulk milk cooler tank	*May include but are not limited to:* • 500 L • 1000 L • 2000 L
Bulk milk cooler components	*May include but are not limited to:* • Agitator • Condensing unit • Refrigeration lines (Liquid and suction) • Refrigeration accessories: filter dryer, vibration absorber, valves, sight glass, expansion device, oil separator, liquid receiver, suction accumulator, pressure cut out switches, pressure gauges • Electrical panel board and connection • Spray ball for cleaning
3R's principle	*May include but are not limited to:* • Reduce • Reuse • Recycle

5	**Unit No:2** **Unit Title: Service, maintain and repair commercial refrigeration system**	**Unit code:**
	Elements of competency	**Performance standards**
	2.1 Prepare for servicing and repair	2.1.1 ***Personal protective equipment (PPE***) used in accordance with task requirement. 2.1.2 Tools, equipment, and materials are prepared as per task requirement. 2.1.3 Physical condition of refrigeration is checked and details recorded.
	2.2 Perform preventive maintenance	2.2.1 ***Components and accessories*** inspected thoroughly in order to identify any abnormality. 2.2.2 Components and accessories of commercial refrigeration unit cleaned and lubricated as per preventive maintenance schedule. 2.2.3 ***Oil parameters*** checked and corrected as per manufacturer's instruction. 2.2.4 Refrigerant lines and drain lines checked for ***abnormal condition*** and corrected. 2.2.5 Control box, wiring and connection checked and tightened. 2.2.6 Wear and tear components and accessories replaced as per manufacturer's instruction. 2.2.7 ***Controls and settings*** checked and adjusted. 2.2.8 Operation of refrigeration unit checked for ***proper functioning*** and adjusted as per manufacturer's instruction. 2.2.9 Test results and observations details recorded as per industry norms.
	2.3 Diagnose fault	2.3.1 Commercial refrigeration unit visually inspected for physical damage and abnormal condition. 2.3.2 ***Electrical parameters*** measured and verified against wiring diagram. 2.3.3 Function of major components and accessories checked as per manufacturer's instruction.

		2.3.4 Refrigerant level, oil level, air flow, pressure, blockage(clogs) and leakage checked as per manufactures instructions. 2.3.5 Faults and causes of fault identified based on test results and recorded as per industry norms.
	2.4 Rectify fault	2.4.1 Electrical problems fixed as per circuit diagram. 2.4.2 Controls and settings checked and adjusted to standard performance. 2.4.3 Refrigerant recovered and stored according to standard procedure. 2.4.4 Defective parts/components replaced with appropriate equivalent ratings and assembled as per manufacturer's instruction. 2.4.5 Repaired parts/components mounted and assembled as per manufacturer's instruction. 2.4.6 Refrigeration system leak tested, evacuated and charged with correct amount of refrigerant. 2.4.7 Repaired commercial refrigeration unit operated and tested for its proper functioning. 2.4.8 All defects and problems documented as per industry norms.
	2.5 Clean workplace	2.5.1 Unused materials collected and stored in designated area. 2.5.2 Tools and equipment cleaned, checked for damage and stored in designated area. 2.5.3 Workplace cleaned neatly and waste disposed as per ***3R's principle*** in designated area.
6	**Task Performance Requirements (Tools, equipment, and materials):** • Freezer, ice cream machine, instant chiller, walk in cold room, bulk milk cooler tank/chilling vat, screwdriver set, spanner set, room cam lock tool, knife, silicone, silicone gun, socket wrench set, Allen key, fin comb, pliers, wire stripper, phase tester, multimeter, measuring tape, steel	

	ruler, file set, hacksaw, hammer, adjustable wrench, scissor, Nitrogen gas cylinder with regulator, recovery unit with cylinder, pipe/tube cutter, spirit level, sealant, chisel set, micron gauge, hand grinder, center punch, tube bender, drill machine with drill bit set, rachet, electric air blower, mallet, pipe wrench, vacuum pump, gauge manifold, flaring and swaging tool kit, electronic leak detector, water pressure gun, soldering iron, de-soldering tool, oxy-acetylene brazing set, side mirror, lock ring tool, clamp-on ampere meter, reamer, torch, nozzle, weighing scale, refrigerant, thermometer, dust bin, dust pan, flare nuts, insulating materials, brazing rod, brazing flux, emery paper, brush, cleaning agent, cotton rag, lubricants, pen, paper, register, broom, first aid kit, and personal protective equipment (PPE).
7	**Safety and Hygiene (Occupational Health and Safety):** • Use personal protective equipment. • Safe handling of materials, tools and equipment. • Hazards involved in lifting Tools, equipment, and materials. • Unplug the refrigerator before servicing • Prevent from chemical, electrical and pressure related hazards. • Prevent from hazards involved in handling refrigerants. • Protect work area while working with Hydro carbon • Make sure the work area is well ventilated • Evacuate system before brazing and de-brazing

8	Required Knowledge		
	Technical Knowledge	**Applied Calculation**	**Graphical Information**

	• Tools, equipment, and materials
	  ○ Types
	  ○ Uses
	  ○ Safe handling
	• Fundamentals of refrigeration system
	• Components of refrigeration system
	• Pressure temperature relationship of refrigerants
	• Types, properties and characteristics of refrigerants
	• Refrigerant and oil contaminants
	• Refrigerant and environmental issues
	• Electrical circuits and diagrams
	• Power supply and control systems
	• Dismantling and assembling process
	• Types and importance of maintenance
	• Servicing technique
	  ○ Visual inspection
	  ○ Cleaning
	  ○ Checking
		• Perform conversion of pressure, temperature, volume and refrigeration unit	• Read and interpret electric circuit and drawing
			• Read and interpret workshop manual
			• Read and interpret manufacturer's specification

	○ Leak detection ○ Lubrication ○ Performance testing • Testing and fault diagnose • Repair and maintenance of electrical and mechanical components • Brazing and de-brazing • Record keeping and reporting • Waste management • Occupational health and safety rules and regulations		

9	**Assessment of Competency**				
	Unit: 2 **Unit Title: Service, maintain and repair commercial refrigeration system**				
	Candidate Details		**Assessors Detail**		
	Candidate's Name: Registration Number: Symbol No: Test Centre: Test Date:		Assessors' Name 1. 2. 3.		ID/License No:

Element of competency	**Performance Standards**	**Standard Met**	**Standard Not Met**	**Evidence Type**	**Comments**
2.1 Prepare for servicing and repair	2.1.1 ***Personal protective equipment (PPE***) used in accordance with task requirement. 2.1.2 Tools, equipment, and materials are prepared as per task requirement. 2.1.3 Physical condition of refrigeration is checked and details recorded.				
2.2 Perform preventive maintenance	2.2.1 ***Components and accessories*** inspected thoroughly in order to identify any abnormality. 2.2.2 Components and accessories of commercial refrigeration unit cleaned and lubricated as per preventive maintenance schedule.				

	2.2.3 ***Oil parameters*** checked and corrected as per manufacturer's instruction. 2.2.4 Refrigerant lines and drain lines checked for ***abnormal condition*** and corrected. 2.2.5 Control box, wiring and connection checked and tightened. 2.2.6 Wear and tear components and accessories replaced as per manufacturer's instruction. 2.2.7 ***Controls and settings*** checked and adjusted. 2.2.8 Operation of refrigeration unit checked for ***proper functioning*** and adjusted as per manufacturer's instruction. 2.2.9 Test results and observations details recorded as per industry norms.				
2.3 Diagnose fault	2.3.1 Commercial refrigeration unit visually inspected for physical damage and abnormal condition. 2.3.2 ***Electrical parameters*** measured and verified against wiring diagram. 2.3.3 Function of major components and accessories checked as per manufacturer's instruction. 2.3.4 Refrigerant level, oil level, air flow, pressure, blockage(clogs) and leakage checked as per manufactures				

	instructions. 2.3.5 Faults and causes of fault identified based on test results and recorded as per industry norms.				
2.4 Rectify fault	2.4.1 Electrical problems fixed as per circuit diagram. 2.4.2 Controls and settings checked and adjusted to standard performance. 2.4.3 Refrigerant recovered and stored according to standard procedure. 2.4.4 Defective parts/components replaced with appropriate equivalent ratings and assembled as per manufacturer's instruction. 2.4.5 Repaired parts/components mounted and assembled as per manufacturer's instruction. 2.4.6 Refrigeration system leak tested, evacuated and charged with correct amount of refrigerant. 2.4.7 Repaired commercial refrigeration unit operated and tested for its ***proper functioning***. 2.4.8 All defects and problems documented as per industry norms.				
2.5 Clean workplace	2.5.1 Unused materials collected and stored in designated area. 2.5.2 Tools and equipment cleaned, checked for damage and				

	stored in designated area. 2.5.3 Workplace cleaned neatly and waste disposed as per ***3R's principle*** in designated area.				

WT- Written Test **OQ**- Oral Question **PT-** Practical Test **DO** – Direct Observation **SR**- Supervisor's report **SN**–Simulation

RP- Role Play **PG –**Photographs **VD**- Video **CT** – Certificates **TS** – Testimonials (Reward) **PP** – Product Produced

CS – Case Study

Range Statement

Variable	Range
Personal protective equipment (PPE)	*May include but not limited to:* • Helmet • Mask • Apron • Goggles • Gloves • Safety shoes • Ear plug • Welding face shied
Components and accessories	*May include but not limited to:* • Compressor • Condenser • Evaporator • Thermometer • Thermostat • Refrigeration lines and drain lines • Fan blade and motor • Filter drier • Insulation • Door seal, hinge and heater • Switches

	• Electrical components • Receiver • Sight glass • Solenoid valve • Expansion device • Suction filter • Accumulator
Oil parameters	*May include but are not limited to:* • Oil level • Purity of oil
Abnormal condition	*May include but are not limited to:* • Leak • Wear and tear • Insulation crack • Loose support
Controls and settings	*May include but are not limited to:* • Temperature • Pressure • Refrigerant flow • Thermal relay • Defrost timer
Proper functioning	*May include but are not limited to:* • Temperature • Voltage

	• Current • Pressure • Air flow • Refrigerant flow • Noise level • Vibration
Electrical parameters	*May include but not limited to:* • Voltage • Resistance • Continuity • Current • Capacitance • Voltage drop • Short circuit • Open circuit
3R's principle	*May include but are not limited to:* • Reduce • Reuse • Recycle

5	**Unit No:3** **Unit Title: Install commercial air conditioning system**	**Unit code:**

Elements of competency	Performance standards
3.1 Prepare installation site	3.1.1 ***Personal protective equipment (PPE***) used in accordance with task requirement. 3.1.2 Tools, equipment, and materials prepared as per site condition and task requirement. 3.1.3 ***Suitable location*** for installing air conditioning unit selected. 3.1.4 Wall/surface marked and holes prepared in marked location in required dimension. 3.1.5 ***Supporting components*** firmly fixed in marked location of interior/exterior wall.
3.2 Install piping system	3.2.1 Supporting components firmly fixed along the pipe route as per site condition. 3.2.2 Pipe prepared through ***pipe fabrication*** and fixed on the marked location. 3.2.3 Sealing materials used to seal the joints. 3.2.4 Condensate drain line fixed with proper slope to ensure free drainage and to avoid water spillage. 3.2.5 Pipe line cleaned and tested in accordance with manufacturer's specification.
3.3 Install electrical system	3.3.1 Electrical wires laid and prepared as per circuit diagram. 3.3.2 Panel board, circuit breaker and electrical point installed as per manufacturer's instruction. 3.3.3 Electrical connection connected to respective terminals as per circuit diagram.
3.4 Install indoor and outdoor units	3.4.1 Indoor and outdoor unit firmly mounted on supporting components as per site condition and manufacturer's instruction. 3.4.2 Refrigerant pipe lines insulated without exposing copper pipes and connected to outdoor unit and indoor unit.

		4.4.1 Refrigerant pipe lines pressure tested with OFDN, evacuated and charged with correct amount of refrigerant. 3.4.3 Condensate drain line checked for leakage and water spillage. 3.4.4 AC unit operated and tested for its ***proper functioning.*** 3.4.5 Service report prepared as per industry norms.
	3.5 Perform site clearance	3.5.1 Unused materials are collected and stored in designated area. 3.5.2 Tools and equipment are cleaned, checked for damage and stored in designated area. 3.5.3 Worksite cleaned neatly and waste disposed as per ***3R's principle*** in designated area.
6	**Task Performance Requirements (Tools, equipment, and materials):** • Air conditioner, vibration pad, chisel, marker, drill machine with drill bit set, try square, spirit level, measuring tape, bucket, water, bracket, angle frame, tube bender, power socket, power plug, circuit breaker, hacksaw, ladder, screwdriver set, spanner set, socket wrench set, adjustable wrench, Allen key, pliers, wire stripper, phase tester, multimeter, extension cord, steel ruler, file set, hammer, hand grinder, scissor, side mirror, Nitrogen gas cylinder with regulator, pipe/tube cutter, rachet, electric air blower, vacuum pump, gauge manifold, flaring and swaging tool kit, electronic leak detector, water pressure gun, soldering iron, de-soldering tool, oxy-acetylene brazing set, clamp-on ampere meter, reamer, torch, nozzle, weighing scale, refrigerant charging unit, thermometer, dust bin, dust pan, broom, clamps, screw, stud, fin comb, flare nuts, brazing rod, brazing flux, insulating materials, emery paper, brush, cleaning agent, lubricants, cotton rag, soapy water, pen, paper, register, first aid kit and personal protective equipment (PPE).	

7	**Safety and Hygiene (Occupational Health and Safety):** • Use personal protective equipment. • Safe handling of materials, tools and equipment. • Hazards involved in lifting Tools, equipment, and materials. • Prevent from chemical, electrical and pressure related hazards. • Prevent from hazards involved in handling refrigerants. • Protect work area while working with Hydro carbon. • Make sure the work area is well ventilated. • Evacuate system before brazing and de-brazing.

8	Required Knowledge		
	Technical Knowledge	**Applied Calculation**	**Graphical Information**

	• Tools, equipment, and materials:
	  ○ Types
	  ○ Uses
	  ○ Preparation
	  ○ Safe handling
	• Introduction to HVAC
	• Air Conditioner:
	  ○ Window and split AC
	  ○ Accessories, components and their types
	  ○ Function
	  ○ Types of refrigerants
	  ○ Refrigerants contaminants
	  ○ Types of oil and contaminants
	  ○ Pressure test procedures
	  ○ Handling of copper tubes
	  ○ System flushing procedures
	  ○ Evacuation procedures
	  ○ Charging procedures
	  ○ Power and control system
		• Perform conversion of pressure, temperature, volume and refrigeration unit	• Read and interpret electric circuit and drawing
			• Read and interpret workshop manual
			• Read and interpret manufacturer's specification

	○ Electrical parameters ○ Wiring diagram and connection ○ Interlocking system ○ Operation procedure ○ Performance testing procedures • Waste management • Record keeping and documentation • Occupational health and safety rules and regulations		

9	Assessment of Competency					
	Unit: 3 **Unit Title: Install commercial air conditioning system**					
	Candidate Details			**Assessors Detail**		
	Candidate's Name: Registration Number: Symbol No: Test Centre: Test Date:			Assessors' Name 1. 2. 3.		ID/License No:
Element of competency	**Performance Standards**		**Standard Met**	**Standard Not Met**	**Evidence Type**	**Comments**
3.1 Prepare installation site	3.1.1 ***Personal protective equipment (PPE***) used in accordance with task requirement. 3.1.2 Tools, equipment, and materials prepared as per site condition and task requirement. 3.1.3 ***Suitable location*** for installing air conditioning unit selected. 3.1.4 Wall/surface marked and holes prepared in marked location in required dimension. 3.1.5 ***Supporting components*** firmly fixed in marked location of interior/exterior wall.					
3.2 Install piping system	3.2.1 Supporting components firmly fixed along the pipe route					

	as per site condition. 3.2.2 Pipe prepared through ***pipe fabrication*** and fixed on the marked location. 3.2.3 Sealing materials used to seal the joints. 3.2.4 Condensate drain line fixed with proper slope to ensure free drainage and to avoid water spillage. 3.2.5 Pipe line cleaned and tested in accordance with manufacturer's specification.				
3.3 Install electrical system	3.3.1 Electrical wires laid and prepared as per circuit diagram. 3.3.2 Panel board, circuit breaker and electrical point installed as per manufacturer's instruction. 3.3.3 Electrical connection connected to respective terminals as per circuit diagram.				
3.4 Install indoor and outdoor units	3.4.1 Indoor and outdoor unit firmly mounted on supporting components as per site condition and manufacturer's instruction. 3.4.2 Refrigerant pipe lines insulated without exposing copper pipes and connected to outdoor unit and indoor unit. 3.4.3 Refrigerant pipe lines pressure tested with OFDN, evacuated and charged with refrigerant as per manufacturer's specification.				

	3.4.4 Condensate drain line checked for leakage and water spillage. 3.4.5 Operation of AC unit checked and adjusted according to manufacturer's specification. 3.4.6 Service report prepared as per industry norms.				
3.5 Perform site clearance	3.5.1 Unused materials are collected and stored in designated area. 3.5.2 Tools and equipment are cleaned, checked for damage and stored in designated area. 3.5.3 Worksite cleaned neatly and waste disposed as per ***3R's principle*** in designated area.				

WT- Written Test **OQ**- Oral Question **PT-** Practical Test **DO** – Direct Observation **SR**- Supervisor's report **SN**–Simulation
RP- Role Play **PG –**Photographs **VD**- Video **CT** – Certificates **TS** – Testimonials (Reward) **PP** – Product Produced
CS – Case Study

Range Statement

Variable	Range
Personal protective equipment (PPE)	*May include but not limited to:* • Helmet • Mask • Apron • Goggles • Gloves • Safety shoes • Ear plug • Welding face shied
Suitable location	*May include but not limited to:* • Dry and ventilated • Levelled floor/surface • Distance from wall • Space for servicing
Supporting components	*May include but not limited to:* • Bracket • Mounting plate • Hanger • Frame • Suspension bolts • Clamps

Pipe fabrication	*May include but not limited to:* • Pipe cutting • Pipe bending • Expansion • Swaging • Flaring • Brazing • Pipe insulating
Sealing materials	*May include but not limited to:* • Gasket • Rubber • Silicone • Foam • Plastic • Tape wrapping
Proper functioning	*May include but are not limited to:* • Temperature • Voltage • Current • Air flow • Noise level • Vibration
3R's principle	*May include but are not limited to:* • Reduce

	• Reuse • Recycle

5	**Unit No:4** **Unit Title: Service, maintain and repair commercial air conditioning system**	**Unit code:**
	Elements of competency	**Performance standards**
	4.1 Prepare for servicing	4.1.1 ***Personal protective equipment (PPE***) used in accordance with task requirement. 4.1.2 Tools, equipment, and materials are prepared as per task requirement. 4.1.3 Physical condition of air conditioning unit is checked and details recorded.
	4.2 Perform preventative maintenance	4.2.1 Indoor and outdoor unit inspected thoroughly in order to identify any abnormality. 4.2.2 Components and accessories of commercial air conditioning unit cleaned and lubricated as per preventive maintenance schedule. 4.2.3 Refrigerant lines and drain lines checked for ***abnormal condition*** and corrected. 4.2.4 Control box, electrical wiring and connection checked and tightened. 4.2.5 Wear and tear components and accessories replaced as per manufacturer's instruction. 4.2.6 Operation of air conditioning unit checked for ***proper functioning*** and adjusted as per manufacturer's instruction. 4.2.7 Test results and observations details recorded as per industry norms.
	4.3 Diagnosis fault	4.3.1 Commercial air conditioning unit visually inspected for physical damage and abnormal condition. 4.3.2 ***Electrical parameters*** measured and verified against wiring diagram. 4.3.3 Function of major components and accessories checked. 4.3.4 Refrigerant level, oil level, air flow, pressure, blockage(clogs) and leakage checked as per manufactures instructions.

		4.3.5 Faults and causes of fault identified based on test results and recorded as per industry norms.
	4.4 Rectify fault	4.4.1 Electrical problems fixed as per circuit diagram. 4.4.2 ***Controls and settings*** checked and adjusted to standard performance. 4.4.3 Refrigerant recovered and stored according to standard procedure. 4.4.4 Defective parts/components replaced with appropriate equivalent ratings and assembled as per manufacturer's instruction. 4.4.5 Repaired parts/components mounted and assembled as per manufacturer's instruction. 4.4.6 System leak tested, evacuated and charged with correct amount of refrigerant. 4.4.7 Repaired commercial air conditioning unit operated and tested for its proper functioning. 4.4.8 All defects and problems documented as per industry norms.
	4.5 Clean workplace	4.5.1 Unused materials are collected and stored in designated area. 4.5.2 Tools and equipment are cleaned, checked for damage and stored in designated area. 4.5.3 Workplace and window unit cleaned neatly and waste disposed as per ***3R's principle*** in designated area.
6	**Task Performance Requirements (Tools, equipment, and materials):** • Commercial air conditioner, screwdriver set, spanner set, knife, socket wrench set, Allen key, fin comb, pliers, wire stripper, phase tester, multimeter, measuring tape, steel ruler, file set, hacksaw, hammer, adjustable wrench, scissor, Nitrogen gas cylinder with regulator, recovery unit with cylinder, pipe/tube cutter, spirit level, sealant, chisel set, micron gauge, hand grinder, center punch, tube bender, drill machine with	

	drill bit set, rachet, electric air blower, mallet, pipe wrench, vacuum pump, gauge manifold, flaring and swaging tool kit, electronic leak detector, water pressure gun, soldering iron, de-soldering tool, oxy-acetylene brazing set, side mirror, lock ring tool, clamp-on ampere meter, reamer, torch, nozzle, weighing scale, refrigerant, thermometer, dust bin, dust pan, flare nuts, insulating materials, brazing rod, brazing flux, emery paper, brush, cleaning agent, cotton rag, lubricants, pen, paper, register, broom, first aid kit, and personal protective equipment (PPE).
7	**Safety and Hygiene (Occupational Health and Safety):** • Use personal protective equipment. • Safe handling of materials, tools and equipment. • Hazards involved in lifting Tools, equipment, and materials. • Prevent from chemical, electrical and pressure related hazards. • Prevent from hazards involved in handling refrigerants. • Protect work area while working with Hydro carbon • Make sure the work area is well ventilated • Evacuate system before brazing and de-brazing

8	Required Knowledge		
	Technical Knowledge	**Applied Calculation**	**Graphical Information**

	• Tools, equipment, and materials:
	  ○ Introduction
	  ○ Types
	  ○ Preparation
	  ○ Safe handling
	• Introduction of HVAC
	• Introduction and types of commercial air conditioning unit
	• Types, properties and characteristics of refrigerants
	• Oil and refrigerants contaminants
	• System flushing, evacuation and charging procedures
	• Refrigerant and environmental issues
	• Electrical circuits and diagrams
	• Power supply and control systems
	• Dismantling and assembling process
	• Types and importance of maintenance
	• Servicing technique
	  ○ Visual inspection
	  ○ Cleaning
		• Perform conversion of refrigeration unit	• Read and interpret electric circuit and drawing
			• Read and interpret workshop manual
			• Read and interpret manufacturer's specification

	○ Checking ○ Leak detection ○ Lubrication ○ Performance testing • Testing and fault diagnose • Repair and maintenance of electrical and mechanical components • Brazing and de-brazing • Servicing and maintenance of air conditioner • Diagnosing and troubleshooting of air conditioner • Waste management • Recordkeeping and reporting • Occupational health and safety rules and regulations		

9	**Assessment of Competency**				
	Unit: 4 **Unit Title: Service, maintain and repair commercial air conditioning system**				
	Candidate Details		**Assessors Detail**		
	Candidate's Name: Registration Number: Symbol No: Test Centre: Test Date:		Assessors' Name 1. 2. 3.		ID/License No:

Element of competency	**Performance Standards**	**Standard Met**	**Standard Not Met**	**Evidence Type**	**Comments**
4.1 Prepare for servicing	4.1.1 ***Personal protective equipment (PPE***) used in accordance with task requirement. 4.1.2 Tools, equipment, and materials are prepared as per task requirement. 4.1.3 Physical condition of air conditioning unit is checked and details recorded.				
4.2 Perform preventative maintenance	4.2.1 ***Components and accessories*** inspected thoroughly in order to identify any non-compliance with manufacturer's instruction. 4.2.2 Components and accessories of commercial air conditioning unit cleaned and lubricated as per preventive				

	maintenance schedule. 4.2.3 ***Oil parameters*** checked and corrected as per manufacturer's instruction. 4.2.4 Refrigerant lines and drain lines checked for ***abnormal condition*** and corrected. 4.2.5 Control box, electrical wiring and connection checked and tightened. 4.2.6 Wear and tear components and accessories replaced as per manufacturer's instruction. 4.2.7 Temperature and defrost settings checked and adjusted. 4.2.8 Operation of air conditioning unit checked for ***proper functioning*** and adjusted as per manufacturer's instruction. 4.2.9 Test results and observations details recorded as per industry norms.				
4.3 Diagnosis fault	4.3.1 Commercial air conditioning unit visually inspected for physical damage and abnormal condition. 4.3.2 ***Electrical parameters*** measured and verified against wiring diagram. 4.3.3 Function of major components and accessories checked as per manufacturer's instruction.				

	4.3.4 Refrigerant level, oil level, air flow, pressure, blockage(clogs) and leakage checked as per manufactures instructions. 4.3.5 Faults and causes of fault identified based on test results and recorded as per industry norms.				
4.4 Rectify fault	4.4.1 Electrical problems fixed as per circuit diagram. 4.4.2 ***Controls and settings*** checked and adjusted to standard performance. 4.4.3 Refrigerant recovered and stored according to standard procedure. 4.4.4 Defective parts/components replaced with appropriate equivalent ratings and assembled as per manufacturer's instruction. 4.4.5 Repaired parts/components mounted and assembled as per manufacturer's instruction. 4.4.6 System leak tested, evacuated and charged with correct amount of refrigerant. 4.4.7 Repaired commercial air conditioning unit operated and tested for its proper functioning. 4.4.8 All defects and problems documented as per industry norms.				

4.5 Clean workplace	4.5.1 Unused materials are collected and stored in designated area. 4.5.2 Tools and equipment are cleaned, checked for damage and stored in designated area. 4.5.3 Workplace and window unit cleaned neatly and waste disposed as per ***3R's principle*** in designated area.				

WT- Written Test **OQ**- Oral Question **PT-** Practical Test **DO** – Direct Observation **SR**- Supervisor's report **SN**–Simulation

RP- Role Play **PG –**Photographs **VD**- Video **CT** – Certificates **TS** – Testimonials (Reward) **PP** – Product Produced

CS – Case Study

Range Statement

Variable	Range
Personal protective equipment (PPE)	*May include but not limited to:* • Helmet • Mask • Apron • Goggles • Gloves • Safety shoes • Ear plug • Welding face shied
Abnormal condition	*May include but are not limited to:* • Leak • Wear and tear • Insulation crack • Loose support
Proper functioning	*May include but are not limited to:* • Temperature • Voltage • Current • Air flow • Noise level • Vibration

Electrical parameters	*May include but not limited to:* • Voltage • Resistance • Continuity • Current • Capacitance • Voltage drop • Short circuit • Open circuit
Controls and settings	*May include but are not limited to:* • Temperature • Pressure • Refrigerant flow • Thermal relay • Timer
3R's principle	*May include but are not limited to:* • Reduce • Reuse • Recycle