National Occupational Skill Standard (NOSS)

Occupational Title : Refrigeration and Air Conditioning Mechanic

Level :3

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: 25-05-2023 (11-02-2080)



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Approved by the Tripartite National Skill Testing Board. 1993





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Recommended by Mechanical Technical Sub Committee: 25 May 2023 (11 Jestha 2080)





1	Occupational Title: Re Level: 3	frigeration and Air Conditioning Med	hanic			
2	Job Description:					
	Variable Refrigerar	Air Conditioning Mechanic L-3, repairs nt Flow (VRF) air conditioning system; ins stationary refrigeration system; re	installs, repairs and maintains	Air Handling Unit (AHU)/Fan Coil		
3	UNITS OF COMPETEN					
	Repair and mai	ntain automobile air conditioning sys	tem			
	2. Install, repair a	nd maintain Variable Refrigerant Flow	v (VRF) air conditioning system	1		
	3. Install, repair a	nd maintain Air Handling Unit (AHU)/	Fan Coil Unit (FCU)			
	4. Install, repair a	nd maintain stationary refrigeration s	ystem			
	5. Repair and mai	ntain transport refrigeration system				
	6. Perform comm	unication				
	7. Develop profes	sionalism				
	*Note: Units 6 and 7	are not for testing purpose.				
4	Qualifying Notes/Prer	equisites:				
4		rements: Sound health				
	, ,	nents: As per NSTB rules				
	Additional Inform	•				
	Assessment Type	pes: Performance and written test				
	Assessment Du	ration: 8 to 10 Hours (Single Compet	•	ditioning system)		
\wedge	Recommended	Group Size: 3 to 5 candidates				TEV
>Q	NOSS ID: #	Developed Date: 2023-05-25	Revision Number: ##	Revised Date: dd/mm/yy	Page:4	TRADE OPPORT





5	Unit No:1 Unit Title: Repair and maintain automobile air cond	ditionin	g system	Unit code:			
	Elements of competency		Performance standards				
		1.1.1	Personal prote	ective equipment (PPE) used in accordance with task requirement.			
	1.1 Prepare tools, equipment and materials	1.1.2	Tools and equ	pment collected as per task requirement.			
		1.1.3	Materials colle	ected and prepared as per task requirement.			
		1.2.1	Materials requ	ired for servicing/repair listed.			
	1.2 Estimate cost	1.2.2	Servicing/repa	ir cost calculated as per industry norms.			
		1.2.3	Client informe	d about estimated cost and risk factor.			
		1.3.1	Air conditionir	ng system inspected through <i>general inspection and testing</i> .			
		1.3.2	Components of	and accessories of air conditioning unit cleaned, inspected and lubricated			
			as per prevent	ive maintenance schedule.			
		1.3.3	Refrigerant lin	es and drain lines checked for abnormal condition and fixed.			
		1.3.4	Control box, e	lectrical wiring and connection checked and tightened.			
		1.3.5	Damaged or w	orn-out components and accessories replaced in specific time interval as			
	1.3 Service air conditioning system		per manufactu	rer's instruction.			
		1.3.6	Refrigerant sy	stem leak tested, evacuated and charged with correct amount of			
			refrigerant.				
		1.3.7	Performance of	of air conditioning system checked and adjusted as per manufacturer's			
			instruction.				
		1.3.8	Servicing deta	ils recorded as per industry norms.			





	4.44 Fe la little and the state of the state
	1.4.1 Faulty history collected from clients and recorded as per industry norms.
	1.4.2 <i>Electrical parameters</i> measured and verified against manufacturer's specification
	1.4.3 Fault in air conditioning identified through general inspection and testing.
	1.4.4 Air conditioning system dissembled sequentially as per manufacturer's specification
	components tagged.
	1.4.5 Components of air conditioning system inspected, cleaned and foreign materials
	removed.
1.4 Repair air conditioning system	1.4.6 Refrigerant recovered and stored according to standard procedure.
	1.4.7 Damaged components repaired or replaced with new components of correct
	specification.
	1.4.8 Air conditioning system reassembled as per manufacturer's specification.
	1.4.9 Refrigeration system flushed with Oxygen Free Dry Nitrogen (OFDN).
	1.4.10 Refrigeration system leak tested, evacuated and charged with correct amount of
	refrigerant.
	1.4.11 Post repair testing carried out as per the checklist.
	1.5.1 Unused materials collected and stored in designated area.
1.5 Clean workplace	1.5.2 Tools and equipment cleaned, checked for damage and stored in designated area
	1.5.3 Workplace cleaned neatly and waste disposed as per <i>3R's principle</i> in designated a

Task Performance Requirements (Tools, equipment, and materials):

Automobile air conditioning system, screwdriver set, spanner set, knife, silicone, silicone gun, socket wrench set, Allen key, fin comb, pliers,



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circlip 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, charging unit, refrigerant, compressor oil, thermometer, refrigerant recovery unit, tachometer, megger, anemometer, sound meter, ladder, extension cord, 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.



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8	Technical Knowledge		Applied (Calculation	Graphical Information
	Tools, equipment, and materials Types Uses Preparation Safe handling Automobile air conditioning system Mechanical components and the Electrical and electronic components function Dismantling and assembling process Insulation and cleaning process Servicing techniques Common faults/defects Electrical testing procedure Mechanical testing procedure Mechanical testing procedure Troubleshooting technique Preventive maintenance Maintaining electrical system Maintaining mechanical system	ents and their	Perform corefrigeration	onversion of on unit ost of installation,	Read and interpret electric circuit and drawing Read and interpret workshop manual Read and interpret manufacturer's specification
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Refrigerant	
o Types	
 Evacuation 	
o Charging	
o Recovery	
 Pressure temperature relationship of refrigerants 	
Ozone depleting substances, refrigerant and environmental	
issues	
Basic automotive related to air conditioning system	
Costing and estimation	
Record keeping	
Waste management	
Occupational health and safety rules and regulations	





9	Assessment of Competency						
	Unit: 1						
	Unit Title: Repair and	maintair	n automobile air conditioning system				
			Candidate Details		As	ssessors De	tail
	Candidate's Name:			Assessors'	Name		ID/License No:
	Registration Number:			1.			
	Symbol No:			2.			
	Test Centre:		Test Date:	3.			
Elei	ment of competency		Performance Standards	Standard Met	Standard Not Met	Evidence Type	Comments
		1.1.1	Personal protective equipment (PPE) used in accordance				
1.1	Prepare tools, equipment and materials		with task requirement.				
		1.1.2	Tools and equipment collected as per task requirement.				
		1.1.3	Materials collected and prepared as per task requirement.				
		1.2.1	Materials required for servicing/repair listed.				
1.2	Estimate cost	1.2.2	Servicing/repair cost calculated as per industry norms.				
		1.2.3	Client informed about estimated cost and risk factor.				
		1.3.1	Air conditioning system inspected through <i>general</i>				
1.3	Service air		inspection and testing.				
	conditioning system	1.3.2	Components and accessories of air conditioning unit				
			cleaned, inspected and lubricated as per preventive				





			maintenance schedule.		
		1.3.3	Refrigerant lines and drain lines checked for abnormal		
			condition and fixed.		
		1.3.4	Control box, electrical wiring and connection checked and		
			tightened.		
		1.3.5	Damaged or worn-out components and accessories		
			replaced in specific time interval as per manufacturer's		
			instruction.		
		1.3.6	Refrigerant system leak tested, evacuated and charged		
			with correct amount of refrigerant.		
		1.3.7	Performance of air conditioning system checked and		
			adjusted as per manufacturer's instruction.		
		1.3.8	Servicing details recorded as per industry norms.		
		1.4.1	Faulty history collected from clients and recorded as per		
			industry norms.		
		1.4.2	Electrical parameters measured and verified against		
1.4	Repair air conditioning		manufacturer's specification.		
	system	1.4.3	Fault in air conditioning identified through general		
			inspection and testing.		
		1.4.4	Air conditioning system dissembled sequentially as per		
			manufacturer's specification and components tagged.		





1.	.4.5 Components of air conditioning system inspected, cleaned
	and foreign materials removed.
1.	.4.6 Refrigerant recovered and stored according to standard
	procedure.
1.	.4.7 Damaged components repaired or replaced with new
	components of correct specification.
1.	.4.8 Air conditioning system reassembled as per manufacturer's
	specification.
1.	.4.9 Refrigeration system flushed with Oxygen Free Dry
	Nitrogen (OFDN).
1.	.4.10 Refrigeration system leak tested, evacuated and charged
	with correct amount of refrigerant.
1.	.4.11 Post repair testing carried out as per the checklist.
1.	.5.1 Unused materials collected and stored in designated area.
1.	.5.2 Tools and equipment cleaned, checked for damage and
1.5 Clean workplace	stored in designated area.
1.	.5.3 Workplace cleaned neatly and waste disposed as per 3R's
	<i>principle</i> 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

NOSS ID: #





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
General inspection and testing	May include but not limited to:
	 Pressure Current Air flow Refrigerant flow Refrigerant level Oil level



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	 Vibration RPM Insulation Resistance Continuity Smoke
	• Humidity
Components and accessories	May include but not limited to:
	• Compressor
	• Condenser
	• Evaporator
	Expansion device
	Pulley assembly
	Auto controller
	Receiver cum filter dryer
	Vibration absorber
	• Valves
	Sight glass
	Liquid receiver
	Pressure cut out switch
	Operating switch
	Refrigerant lines and drain lines
	 Electrical components: fuse, relay, control circuit, wire harness, cables





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





	Unit No:2			
5	Unit Title: Install, maintain and repair Variable Re	frigerant	t Flow (VRF)	Unit code:
	air conditioning system	<u> </u>		Performance standards
	Elements of competency	2.1.1	Personal prote	ective equipment (PPE) used in accordance with task requirement.
			•	
	2.1 Prepare tools and equipment	2.1.2	Tools and equi	pment collected as per task requirement.
		2.1.3	Materials colle	cted and prepared as per task requirement.
		2.2.1	Materials requ	ired for installation/repair listed.
	2.2 Estimate cost	2.2.2	Installation/rep	pair cost calculated as per industry norms.
		2.2.3	Client informed	d about estimated cost and risk factor.
		2.3.1	Installation red	uirement for VRF System inspected and prepared as per manufacturer's
			instruction.	
		2.3.2	Location of ind	oor and outdoor units identified and marked as per drawing.
		2.3.3	Plumbing work	ks and electrical works checked, prepared and supervised as per the
			manufacturer's	s requirement.
		2.3.4	Refrigerant pip	peline tested using dry Nitrogen and the entire system evacuated as per
	2.3 Install VRF system		manufacturer's	s instruction.
		2.3.5	Indoor unit and	d outdoor unit installed in marked location.
		2.3.6	Refrigerant sys	tem tested using dry Nitrogen and the entire system evacuated as per
			manufacturer's	s instruction.
		2.3.7	Electrical conn	ection connected to the respective power supply as per wiring diagram.
		2.3.8	Additional refr	igerant required calculated based on pipe length and charged as per





	manufacturer's instruction.
	2.3.9 VRF system operated and tested for proper functioning.
	2.3.10 Service data recorded as per industry norms.
	2.4.1 VRF system inspected through <i>general inspection and testing</i> .
	2.4.2 <i>Components and accessories</i> of VRF system cleaned, inspected and lubricated as per
	preventive maintenance schedule.
	2.4.3 Refrigerant lines and drain lines checked for abnormal condition and fixed.
	2.4.4 Control box, electrical wiring and connection checked and tightened.
	2.4.5 Damaged or worn-out components and accessories replaced in specific time interval as
2.4 Service VRF system	per manufacturer's instruction.
	2.4.6 Temperature and defrost settings checked and adjusted.
	2.4.7 Refrigerant system leak tested, evacuated and charged with correct amount of
	refrigerant.
	2.4.8 Operation of VRF system checked for proper functioning and adjusted as per
	manufacturer's instruction.
	2.4.9 Servicing details recorded as per industry norms.
	2.5.1 Faulty history collected from clients and recorded as per industry norms.
	2.5.2 <i>Electrical parameters</i> measured and verified against wiring diagram.
2.5 Repair VRF system	2.5.3 Fault in VRF system identified through general inspection and testing.
	2.5.4 VRF system dissembled sequentially as per manufacturer's specification and
A	components tagged.



	2.5.5	Electrical problems fixed as per circuit diagram.	
	2.5.6	Controls and settings checked and adjusted.	
	2.5.7	Refrigerant recovered and stored according to standard procedure.	
	2.5.8	Defective components repaired or replaced with new components of correct	
		specification.	
	2.5.9	Refrigeration system flushed with Oxygen Free Dry Nitrogen (OFDN).	
	2.5.10	Refrigeration system leak tested, evacuated and charged with correct amount of	
		refrigerant.	
	2.5.11	Post repair testing carried out as per the checklist.	
	2.6.1	Unused materials collected and stored in designated area.	
2.6 Clean workplace	2.6.2	Tools and equipment cleaned, checked for damage and stored in designated area.	
	2.6.3	Workplace cleaned neatly and waste disposed as per 3R's principle in designated area.	

6 Task Performance Requirements (Tools, equipment, and materials):

• VRF system, screwdriver set, spanner set, knife, silicone, silicone gun, socket wrench set, Allen key, fin comb, pliers, circlip 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, charging unit, vacuum cleaner, thermometer, refrigerant recovery unit, tachometer, megger, anemometer, sound meter, ladder, extension cord, dust bin, dust pan, flare nuts, insulating materials, brazing rod,



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brazing flux, emery paper, cleaning cover bag, 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.





			red Knowledge					
8		Technical Knowledge		Applied (Calculation	Gr	aphical Informatio	n
	 Types Uses Prepa Safe h Fundamental Variable Refri Conce Types Key co Worki Install Refrig Contro Preventive m Maint Maint 	ration andling s of HVAC system gerant Flow (VRF) air conditioning system pt of VRF technology and its benefits emponents and their function ing principles ation and design consideration eration cycle and components of system and operations aintenance aining electrical system aining mechanical system ing technique	em	Perform correfrigeration	onversion of on unit ost of installation,	Re cirRe maRe	ead and interpret elecuit and drawing ead and interpret wanual ead and interpret anufacturer's specificanufacturer's	ectric orkshop
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- o Common faults/defects Electrical testing procedure Mechanical testing procedure Diagnostic and troubleshooting technique
- System commissioning and performance testing
- Safety consideration
- Refrigerant
 - Types
 - Evacuation
 - Charging
 - Recovery
 - o Pressure temperature relationship of refrigerants
- Ozone depleting substances, refrigerant and environmental issues
- Fundamentals of plumbing
- Types of pipes
- Fundamentals of electrical and electronics
- Costing and estimation
- Record keeping

- Waste management
- Occupational health and safety rules and regulations





9	Assessment of Competency							
	Unit: 2							
	Unit Title: Service, maintain and repair Variable Refrigerant Flow (VRF) air conditioning system							
			Candidate Details		As	ssessors Detail		
	Candidate's Name:			Assessors'	Name		ID/License No:	
	Registration Number:			1.				
	Symbol No:			2.				
	Test Centre:		Test Date:	3.				
Elei	ment of competency		Performance Standards	Standard Met	Standard Not Met	Evidence Type	Comments	
		2.1.1	Personal protective equipment (PPE) used in accordance					
2.1	Prepare tools and		with task requirement.					
	equipment 2.1.2	2.1.2	Tools and equipment collected as per task requirement.					
		2.1.3	Materials collected and prepared as per task requirement.					
		2.2.1	Materials required for installation/repair listed.					
2.2	Estimate cost	2.2.2	Installation/repair cost calculated as per industry norms.					
		2.2.3	Client informed about estimated cost and risk factor.					
		2.3.1	Installation requirement for VRF System inspected and					
			prepared as per manufacturer's instruction.					
2.3	Install VRF system	2.3.2	Location of indoor and outdoor units identified and					
			marked as per drawing.					





	2.3.3 <i>Plumbing works</i> and <i>electrical works</i> checked, prepared
	and supervised as per the manufacturer's requirement.
	2.3.4 Refrigerant pipeline tested using dry Nitrogen and the
	entire system evacuated as per manufacturer's instruction.
	2.3.5 Indoor unit and outdoor unit installed in marked location.
	2.3.6 Refrigerant system tested using dry Nitrogen and the
	entire system evacuated as per manufacturer's instruction.
	2.3.7 Electrical connection connected to the respective power
	supply as per wiring diagram.
	2.3.8 Additional refrigerant required calculated based on pipe
	length and charged as per manufacturer's instruction.
	2.3.9 VRF system operated and tested for proper functioning.
	2.3.10 Service data recorded as per industry norms.
	2.4.1 VRF system inspected through <i>general inspection and</i>
	testing.
	2.4.2 <i>Components and accessories</i> of VRF system cleaned,
	inspected and lubricated as per preventive maintenance
2.4 Service VRF system	schedule.
	2.4.3 Refrigerant lines and drain lines checked for abnormal
	condition and fixed.
•	2.4.4 Control box, electrical wiring and connection checked and

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		tightened.		
	2.4.5	Damaged or worn-out components and accessories		
		replaced in specific time interval as per manufacturer's		
		instruction.		
	2.4.6	Temperature and defrost settings checked and adjusted.		
	2.4.7	Refrigerant system leak tested, evacuated and charged		
		with correct amount of refrigerant.		
	2.4.8	Operation of VRF system checked for proper functioning		
		and adjusted as per manufacturer's instruction.		
	2.4.9	Servicing details recorded as per industry norms.		
	2.5.1	Faulty history collected from clients and recorded as per		
		industry norms.		
	2.5.2	Electrical parameters measured and verified against wiring		
		diagram.		
	2.5.3	Fault in VRF system identified through general inspection		
2.5 Repair VRF system		and testing.		
	2.5.4	VRF system dissembled sequentially as per manufacturer's		
		specification and components tagged.		
	2.5.5	Electrical problems fixed as per circuit diagram.		
	2.5.6	Controls and settings checked and adjusted.		
	2.5.7	Refrigerant recovered and stored according to standard		



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	procedure.
	2.5.8 Defective components repaired or replaced with new
	components of correct specification.
	2.5.9 Refrigeration system flushed with Oxygen Free Dry
	Nitrogen (OFDN).
	2.5.10 Refrigeration system leak tested, evacuated and charged
	with correct amount of refrigerant.
	2.5.11 Post repair testing carried out as per the checklist.
	2.6.1 Unused materials collected and stored in designated area.
	2.6.2 Tools and equipment cleaned, checked for damage and
2.6 Clean workplace	stored in designated area.
·	2.6.3 Workplace cleaned neatly and waste disposed as per <i>3R's</i>
	<i>principle</i> 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 							
Plumbing works	May include but are not limited to: Pipe cutting Pipe insulation Pipe laying/hanging Pipe connection Piping support Welding/Brazing Flushing							
Electrical works NOSS ID: # Developed Date: 2023-05-	May include but are not limited to: Communication/electrical wire cutting laying Wire connection Revision Number: ## Revised Date: dd/mm/yy Page:26							

	 Installing panel board Installing control and protective device
General inspection and testing	May include but not limited to:
	Abnormal noise
	Physical damage
	• Leakage
	• Clog
	• Temperature
	• Pressure
	• Current
	Air flow
	Refrigerant flow
	Refrigerant level
	• Vibration
	• RPM
	• Insulation
	• Resistance
	• Continuity
	• Smoke
	Humidity
	Error code
Components and accessories	May include but not limited to:
·	• Compressor
	• Condenser



Т	
	• Evaporator
	Expansion device
	Auto controller
	• Receiver
	Filter dryer
	Vibration absorber
	 Valves
	Sight glass
	Liquid receiver
	Pressure cut out switch
	Operating switch
	Refrigerant lines and drain lines
	 Electrical components: fuse, relay, control circuit, wire harness, cables
Electrical parameters	May include but not limited to:
	 Voltage
	• Resistance
	• Continuity
	• Current
	Capacitance
	Voltage drop
	Short circuit
	Open circuit
	May include but are not limited to:
3R's principle	Reduce
	• Reuse
\wedge	Recycle
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CTEV .	

5	Unit No:3 Unit Title: Install, maintain and repair Air Handling Unit (FCU)	g Unit (AHU)/Fan Coil Unit code:
	Elements of competency	Performance standards
		3.1.1 Personal protective equipment (PPE) used in accordance with task requirement.
	3.1 Prepare tools and equipment	3.1.2 Tools and equipment collected as per task requirement.
		3.1.3 Materials collected and prepared as per task requirement.
		3.2.1 Materials required for installation/repair listed.
	3.2 Estimate cost	3.2.2 Installation/repair cost calculated as per industry norms.
		3.2.3 Client informed about estimated cost and risk factor.
		3.3.1 Installation requirement for DX AHU inspected and prepared as per manufacturer's
		instruction.
		3.3.2 <i>Plumbing works</i> and <i>electrical works</i> checked, prepared and supervised as per the
		manufacturer's requirement.
		3.3.3 DX AHU installed as per manufacturer's instruction.
	3.3 Install direct expansion air handling unit	3.3.4 Refrigerant pipeline tested using dry Nitrogen and the entire system evacuated as per
	(DX AHU)	manufacturer's instruction.
		3.3.5 Electrical connection connected to the respective power supply as per wiring diagram.
		3.3.6 Additional refrigerant required calculated based on pipe length and charged as per
		manufacturer's instruction.
		3.3.7 DX AHU system operated and tested for proper functioning.
		3.3.8 Service data recorded as per industry norms.





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	3.4.1 Installation requirement for chilled/hot water AHU/FCU inspected and prepared as per
	manufacturer's instruction.
	3.4.2 Plumbing works and electrical works checked, prepared and supervised as per the
	manufacturer's requirement.
3.4 Install chilled/hot water AHU/FCU	3.4.3 Chilled/hot water system AHU/FCU installed as per manufacturer's instruction.
	3.4.4 Water pressure of entire system tested as per manufacturer's instruction.
	3.4.5 Electrical connection connected to the respective power supply as per wiring diagram.
	3.4.6 Chilled/hot water AHU/FCU system operated and tested for proper functioning.
	3.4.7 Service data recorded as per industry norms.
	3.5.1 DX AHU/AHU/FCU inspected through <i>general inspection and testing</i> .
	3.5.2 <i>Components and accessories</i> of DX AHU/AHU/FCU cleaned, inspected and lubricated as
	per preventive maintenance schedule.
	3.5.3 Refrigerant lines and drain lines checked for abnormal condition and fixed.
	3.5.4 Control box, electrical wiring and connection checked and tightened.
	3.5.5 Damaged or worn-out components and accessories replaced in specific time interval as
3.5 Service AHU/FCU	per manufacturer's instruction.
	3.5.6 Temperature settings checked and adjusted.
	3.5.7 Refrigerant system leak tested, evacuated and charged with correct amount of
	refrigerant.
	3.5.8 Operation of DX AHU/AHU/FCU checked for proper functioning and adjusted as per
	manufacturer's instruction.
\	





3.5.9 Servicing details recorded as per industry norms.
3.6.1 Faulty history collected from clients and recorded as per industry norms.
3.6.2 <i>Electrical parameters</i> measured and verified against wiring diagram.
3.6.3 Fault in DX AHU/AHU/FCU identified through general inspection and testing.
3.6.4 DX AHU/AHU/FCU dissembled sequentially as per manufacturer's specification and
components tagged.
3.6.5 Electrical problems fixed as per circuit diagram.
3.6.6 Controls and settings checked and adjusted.
3.6.7 Refrigerant recovered and stored according to standard procedure.
3.6.8 Defective components repaired or replaced with new components of correct
specification.
3.6.9 Refrigeration system flushed with Oxygen Free Dry Nitrogen (OFDN).
3.6.10 Refrigeration system leak tested, evacuated and charged with correct amount of
refrigerant.
3.6.11 Post repair testing carried out as per the checklist.
3.7.1 Unused materials are collected and stored in designated area.
3.7.2 Tools and equipment are cleaned, checked for damage and stored in designated area.
3.7.3 Worksite cleaned neatly and waste disposed as per <i>3R's principle</i> in designated area.

Task Performance Requirements (Tools, equipment, and materials):

DX AHU, Chilled/hot water AHU, FCU, screwdriver set, spanner set, knife, silicone, silicone gun, socket wrench set, Allen key, fin comb, pliers,



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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, charging unit, vacuum cleaner, thermometer, dust bin, dust pan, flare nuts, insulating materials, brazing rod, brazing flux, emery paper, tachometer, megger, anemometer, sound meter, ladder, extension cord, 3 way motorized valve, 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.





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Required Knowledge								
8	Technical Knowledge		Applied Calculation			Graphical Information		
	Tools, equipment, and materials Types Uses Preparation Safe handling Fundamentals of HAVC system Air Handling Unit (AHU)/Fan Coil Unit (FCU) Introduction Types Key components and their function Working principles Air distribution and ventilation Installation and design consideration Refrigeration cycle and components Control system and operations Preventive maintenance Maintaining electrical system Maintaining mechanical system Servicing technique		Perform corefrigeration	onversion of on unit ost of installation,	ReacircReamanReamanReaman	d and interpret el uit and drawing d and interpret w nual d and interpret nufacturer's specif	ectric orkshop	
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- Repair and maintenance
 - Common faults/defects
 - Electrical testing procedure
 - Mechanical testing procedure
 - Diagnostic and troubleshooting technique
 - o System commissioning and performance testing
 - Safety consideration
- Refrigerant
 - o Types
 - Evacuation
 - Charging
 - Recovery
 - o Pressure temperature relationship of refrigerants
- Fundamentals of plumbing
- Types of pipes
- Fundamentals of electrical and electronics
- Ozone depleting substances, refrigerant and environmental issues
- Costing and estimation
- Record keeping
- Waste management
- Occupational health and safety rules and regulations





9	Assessment of Competency								
	Unit: 3								
	Unit Title: Install, maintain and repair Air Handling Unit (AHU)/Fan Coil Unit (FCU)								
			Candidate Details	Assessors Detail					
	Candidate's Name:			Assessors'	Name	ID/License No:			
	Registration Number:			1.					
	Symbol No:								
	Test Centre:		Test Date:	3.					
Element of competency			Performance Standards		Standard Not Met	Evidence Type	Comments		
	Prepare tools and equipment	3.1.1	Personal protective equipment (PPE) used in accordance						
3.1			with task requirement.						
		3.1.2	Tools and equipment collected as per task requirement.						
		3.1.3	Materials collected and prepared as per task requirement.						
		3.2.1	Materials required for installation/repair listed.						
3.2	Estimate cost	3.2.2	Installation/repair cost calculated as per industry norms.						
		3.2.3	Client informed about estimated cost and risk factor.						
		3.3.1	Installation requirement for DX AHU inspected and						
3.3	Install direct expansion air handling unit (DX AHU)		prepared as per manufacturer's instruction.						
		3.3.2	Plumbing works and electrical works checked, prepared						
			and supervised as per the manufacturer's requirement.						





3.	.3 DX AHU installed as per manufacturer's instruction.
3.	.4 Refrigerant pipeline tested using dry Nitrogen and the
	entire system evacuated as per manufacturer's instruction.
3.	.5 Electrical connection connected to the respective power
	supply as per wiring diagram.
3.	.6 Additional refrigerant required calculated based on pipe
	length and charged as per manufacturer's instruction.
3.	.7 DX AHU system operated and tested for proper
	functioning.
3.	.8 Service data recorded as per industry norms.
3.	.1 Installation requirement for chilled/hot water AHU/FCU
	inspected and prepared as per manufacturer's instruction.
3.	.2 Plumbing works and electrical works checked, prepared
	and supervised as per the manufacturer's requirement.
3.	.3 Chilled/hot water system AHU/FCU installed as per
3.4 Install chilled/hot	manufacturer's instruction.
water AHU/FCU 3.	.4 Water pressure of entire system tested as per
	manufacturer's instruction.
3.	.5 Electrical connection connected to the respective power
	supply as per wiring diagram.
3.	.6 Chilled/hot water AHU/FCU system operated and tested

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			for proper functioning.		I
		3.4.7	Service data recorded as per industry norms.		
		3.5.1	DX AHU/AHU/FCU inspected through <i>general inspection</i>		
			and testing.		
		3.5.2	Components and accessories of DX AHU/AHU/FCU		
			cleaned, inspected and lubricated as per preventive		
			maintenance schedule.		
		3.5.3	Refrigerant lines and drain lines checked for abnormal		
			condition and fixed.		
		3.5.4	Control box, electrical wiring and connection checked and		
			tightened.		
3.5	Service AHU/FCU	3.5.5	Damaged or worn-out components and accessories		
			replaced in specific time interval as per manufacturer's		
			instruction.		
		3.5.6	Temperature settings checked and adjusted.		
		3.5.7	Refrigerant system leak tested, evacuated and charged		
			with correct amount of refrigerant.		
		3.5.8	Operation of DX AHU/AHU/FCU checked for proper		
			functioning and adjusted as per manufacturer's		
			instruction.		
٨		3.5.9	Servicing details recorded as per industry norms.		

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	3.6.1 Faulty history collected from clients and recorded as per
	industry norms.
	3.6.2 <i>Electrical parameters</i> measured and verified against wiring
	diagram.
	3.6.3 Fault in DX AHU/AHU/FCU identified through general
	inspection and testing.
	3.6.4 DX AHU/AHU/FCU dissembled sequentially as per
	manufacturer's specification and components tagged.
	3.6.5 Electrical problems fixed as per circuit diagram.
3.6 Repair AHU/FCU	3.6.6 Controls and settings checked and adjusted.
	3.6.7 Refrigerant recovered and stored according to standard
	procedure.
	3.6.8 Defective components repaired or replaced with new
	components of correct specification.
	3.6.9 Refrigeration system flushed with Oxygen Free Dry
	Nitrogen (OFDN).
	3.6.10 Refrigeration system leak tested, evacuated and charged
	with correct amount of refrigerant.
	3.6.11 Post repair testing carried out as per the checklist.
2.7 Danfanna ika alas sasas	3.7.1 Unused materials are collected and stored in designated
3.7 Perform site clearance	area.



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3.7.2	Tools and equipment are cleaned, checked for damage and		
	stored in designated area.		
3.7.3	Worksite cleaned neatly and waste disposed as per 3R's		
	<i>principle</i> 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
Plumbing works	May include but are not limited to: Pipe cutting Pipe insulation Pipe laying/hanging Pipe connection Piping support Welding/brazing Flushing
Electrical works	 May include but are not limited to: Communication/electrical wire cutting laying Wire connection
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	 Installing power socket 	
	 Installing panel board 	
	Installing control and protective device	
General inspection and testing	May include but not limited to:	
	Abnormal noise	
	Physical damage	
	 Leakage 	
	• Clog	
	• Temperature	
	• Pressure	
	• Current	
	Air flow	
	Refrigerant flow	
	Refrigerant level	
	Oil level	
	 Vibration 	
	• RPM	
	 Insulation 	
	Resistance	
	 Continuity 	
	• Smoke	
	• Humidity	
Components and accessories	May include but not limited to:	
	 Compressor 	
	• Condenser	



			 Evaporator 			
			 Expansion device 			
			 Pulley assembly 			
			 Auto controller 			
			 Receiver 			
			 Filter dryer 			
			 Vibration absorber 			
			 Valves 			
			 Sight glass 			
			 Liquid receiver 			
			Pressure cut out swit	tch		
			 Operating switch 			
			Refrigerant lines and	l drain lines		
			Fan blower			
			 Air filter 			
			• Coil			
			 Damper 			
			 Humidifier 			
			Water pump			
				ts: fuse, relay, control circuit, wi	re harness, cables	:
Electrical parameters		Ма	y include but not limited to:			
			 Voltage 			
			 Resistance 			
			 Continuity 			
			 Current 			
\wedge			 Capacitance 			
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	Voltage drop
	Short circuit
	Open circuit
3R's principle	May include but are not limited to:
	• Reduce
	• Reuse
	Recycle





5	Unit No:4 Unit Title: Install, repair and maintain stationary	efrigeration system Unit code:	
	Elements of competency	Performance standards	
		4.1.1 Personal protective equipment (PPE) used in accordance with task requirement.	
	4.1 Prepare tools and equipment	4.1.2 Tools and equipment collected as per task requirement.	
		4.1.3 Materials collected and prepared as per task requirement.	
		4.2.1 Materials required for installation/repair listed.	
	4.2 Estimate cost	4.2.2 Installation/repair cost calculated as per industry norms.	
		4.2.3 Client informed about estimated cost and risk factor.	
		4.3.1 Installation requirement for instant chiller inspected and prepared as per	
		manufacturer's instruction.	
		4.3.2 Location of units identified and marked as per drawing.	
		4.3.3 <i>Plumbing works</i> and <i>electrical works</i> checked and supervised as per the manufactur	rer's
		requirement.	
		4.3.4 Water cooled condenser with cooling tower installed and connected with piping syst	tem
	4.3 Install instant chiller	as per drawing and manufacturer's specification.	
		4.3.5 Chilled water pump installed and connected with piping system.	
		4.3.6 Water pipeline tested for leakage.	
		4.3.7 Electrical connection connected to the respective power supply as per wiring diagram	m.
		4.3.8 Refrigeration system flushed with Oxygen Free Dry Nitrogen (OFDN).	
		4.3.9 Refrigeration system leak tested, evacuated and charged with correct amount of	
\wedge		refrigerant.	CIEV



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		4.3.10	Instant chiller operated and tested for proper functioning.
		4.3.11	Service data recorded as per industry norms.
-		4.4.1	Installation requirement for IBT inspected and prepared as per manufacturer's
			instruction.
		4.4.2	Compressor, condenser and IBT placed separately on a prepared concrete foundations
			as per manufacturer's instruction and drawings.
		4.4.3	Plumbing works and electrical works checked and supervised as per the manufacturer's
			requirement.
	4.4 Install Ice Bank Tank (IBT)	4.4.4	Water cooled condenser with cooling tower installed and connected with piping system
			as per drawing and manufacturer's specification.
		4.4.5	Chilled water pump installed and connected with piping system.
		4.4.6	Water pipeline tested for leakage.
		4.4.7	Refrigeration system pipelines insulated and connected as per manufacturer
			instructions.
		4.4.8	Electrical connection connected to the respective power supply as per wiring diagram.
		4.4.9	Refrigeration system flushed with Oxygen Free Dry Nitrogen (OFDN).
		4.4.10	Refrigeration system leak tested, evacuated and charged with correct amount of
			refrigerant.
		4.4.11	IBT operated and tested for proper functioning.
		4.4.12	Service data recorded as per industry norms.





			4.5.1	Bulk milk cooler tank placed on level surface with easy access for loading milk and
			maintaining slope towards outlet for unloading milk.	
			4.5.2	Bulk milk cooler components installed as per manufacturer's instruction.
			4.5.3	Refrigeration lines air tightly insulated without exposing copper lines.
			4.5.4	Electrical connection connected to the respective power supply as per circuit diagram.
		stall DX bulk milk cooler tank/milk chilling	4.5.5	Stainless steel works supervised and connected to bulk milk cooler.
	vat	IT.	4.5.6	Refrigeration system flushed with Oxygen Free Dry Nitrogen (OFDN).
			4.5.7	Refrigeration system leak tested, evacuated and charged with correct amount of
				refrigerant.
			4.5.8	Bulk milk cooler operated and tested for its proper functioning with water/milk.
			4.5.9	Service data recorded as per industry norms.
			4.6.1	Site checked and prepared as per design layout and specification.
			4.6.2	Walk in cold room panels assembled as per manufacturer's instruction and installed on
				the required position with proper alignment.
			4.6.3	Openings sealed tightly using sealing materials without air leak.
			4.6.4	Refrigeration system components and pressure relief damper installed as per
	4.6 Ins	stall walk in cold room refrigeration unit		manufacturer's instruction.
			4.6.5	Refrigeration system flushed with Oxygen Free Dry Nitrogen (OFDN).
			4.6.6	Refrigeration system leak tested, evacuated and charged with correct amount of
				refrigerant.
		4.6.7	Refrigeration system tested for normal functioning and required parameter level	
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	checked to ensure that they are within the required range.
	4.6.8 Service data recorded as per industry norms.
	4.7.1 Installation requirement for ice cream freezer inspected and prepared as per
	manufacturer's instruction.
	4.7.2 Plumbing works and electrical works checked and supervised as per the manufacturer's
	requirement.
	4.7.3 Water cooled condenser with cooling tower installed and connected with piping system
	as per drawing and manufacturer's specification.
	4.7.4 Water pipeline tested for leakage.
4.7 Install ice cream freezer	4.7.5 Air compressor installed and connected with air pipelines.
	4.7.6 Stainless steel pipelines connected with intake of ice cream freezer.
	4.7.7 Electrical connection connected to the respective power supply as per wiring diagram.
	4.7.8 Refrigeration system flushed with Oxygen Free Dry Nitrogen (OFDN).
	4.7.9 Refrigeration system leak tested, evacuated and charged with correct amount of
	refrigerant.
	4.7.10 Ice cream freezer operated and tested for proper functioning.
	4.7.11 Service data recorded as per industry norms.
	4.8.1 Refrigeration system inspected through <i>general inspection and testing</i> .
	4.8.2 <i>Components and accessories</i> of refrigeration system cleaned, inspected and lubricated
4.8 Service refrigeration system	as per preventive maintenance schedule.
	4.8.3 Refrigerant lines and drain lines checked for abnormal condition and fixed.





	4.8.4 Control box, electrical wiring and connection checked and tightened.
	4.8.5 Damaged or worn-out components and accessories replace in specific time interval as
	per manufacturer's instruction.
	4.8.6 Temperature and defrost settings checked and adjusted.
	4.8.7 Refrigeration system flushed with Oxygen Free Dry Nitrogen (OFDN).
	4.8.8 Refrigeration system leak tested, evacuated and charged with correct amount of
	refrigerant.
	4.8.9 Operation of refrigeration system checked for proper functioning and adjusted as per
	manufacturer's instruction.
	4.8.10 Servicing details recorded as per industry norms.
	4.9.1 Faulty history collected from clients and recorded as per industry norms.
	4.9.2 <i>Electrical parameters</i> measured and verified against wiring diagram.
	4.9.3 Fault in refrigeration system identified through general inspection and testing.
	4.9.4 Refrigeration system dissembled sequentially as per manufacturer's specification and
	components tagged.
4.9 Repair refrigeration system	4.9.5 Electrical problems fixed as per circuit diagram.
	4.9.6 Controls and settings checked and adjusted.
	4.9.7 Refrigerant recovered and stored according to standard procedure.
	4.9.8 Defective components repaired or replaced with new components of correct
	specification.
	4.9.9 Refrigeration system flushed with Oxygen Free Dry Nitrogen (OFDN).
^ I	





refrigerant.	
4.9.11 Post repair testing carried out as per the check	list.
4.10.1 Unused materials are collected and stored in decident to the collected and stored in decident	esignated area.
4.10.2 Tools and equipment are cleaned, checked for	damage and stored in designated area.
4.10 Clean workplace 4.10.3 Workplace and window unit cleaned neatly and	d waste disposed as per <i>3R's principle</i> in
designated area.	

6 Task Performance Requirements (Tools, equipment, and materials):

• Instant chiller, ice bank tank, DX bulk milk cooler tank, walk in cold room refrigeration unit, ice cream freezer, screwdriver set, spanner set, knife, silicone, silicone gun, socket wrench set, Allen key, fin comb, pliers, circlip pliers, wire stripper, phase tester, multimeter, megger, 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, charging unit, vacuum cleaner, thermometer, dust bin, dust pan, flare nuts, insulating materials, brazing rod, brazing flux, emery paper, tachometer, anemometer, sound meter, ladder, extension cord, brush, cleaning agent, cotton rag, lubricants, pen, paper, register, broom, first aid kit, and personal protective equipment (PPE).

Safety and Hygiene (Occupational Health and Safety):

- Use personal protective equipment.
- Safe handling of materials, tools and equipment.



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- 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.





		Requi	red Knowledge				
8	Technical Knowledge		Applied Cal	culation	Gra	phical Informatio	n
	 Tools, equipment, and materials: Introduction Types Preparation Safe handling Fundamentals of refrigeration system Types of refrigeration system Principles of operation of cooling tower Instant chiller Introduction to chiller system Types of chillers and their capacity Key components and their function Working principles Installation and design consideration Refrigeration cycle and components Installation technique and process Ice Bank Tank Introduction 		Perform conv refrigeration	version of unit t of installation,	ReactionReactionReactionReactionReaction	ad and interpret elecuit and drawing ad and interpret wonual and interpret musical and interpret mufacturer's specifications.	ectric orkshop
$\supset \bigcirc \langle$	O Types NOSS ID: # Developed Date: 2023-05-25	Revision N	Number: ## Re	evised Date: dd/mm	/уу	Page:51	CTEV





- Key components and their function Working principles Installation and design consideration Installation technique and process Bulk milk cooler tank
 - Introduction
 - Types
 - Key components and their function
 - Working principles
 - Installation and design consideration
 - Installation technique and process
 - Cleaning process
 - Walk in cold room refrigeration unit
 - Introduction
 - Types
 - Key components and their function
 - Working principles
 - Installation and design consideration
 - Installation technique and process
 - Ice cream freezer
 - o Introduction





o Types	
 Key components and their function 	
 Working principles 	
 Installation and design consideration 	
 Installation technique and process 	
Preventive maintenance	
Maintaining electrical system	
 Maintaining mechanical system 	
 Servicing technique 	

- Repair and maintenance
 - Common faults/defects
 - o Electrical testing procedure
 - Mechanical testing procedure
 - Diagnostic and troubleshooting technique
 - o System commissioning and performance testing
 - Safety consideration
- Refrigerant

- o Types
- Evacuation
- o Charging
- Recovery





 Pressure temperature relationship of refrigerants 	
Types of compressor oil	
Fundamentals of plumbing	
Types of pipes	
Fundamentals of electrical and electronics	
Costing and estimation	
Ozone depleting substances, refrigerant and environmental	
issues	
Record keeping	
Waste management	
 Occupational health and safety rules and regulations 	





9		Assessment of Competency						
	Unit: 4							
	Unit Title: Service, mai	intain a	nd repair stationary refrigeration system					
			Candidate Details		As	sessors De	tail	
	Candidate's Name:			Assessors'	Name		ID/License No:	
	Registration Number:			1.				
	Symbol No:			2.				
	Test Centre:		Test Date:	3.				
Eler	ment of competency		Performance Standards	Standard Met	Standard Not Met	Evidence Type	Comments	
		4.1.1	Personal protective equipment (PPE) used in accordance					
4.1	Prepare tools and		with task requirement.					
	equipment .	4.1.2	Tools and equipment collected as per task requirement.					
		4.1.3	Materials collected and prepared as per task requirement.					
		4.2.1	Materials required for installation/repair listed.					
4.2	Estimate cost	4.2.2	Installation/repair cost calculated as per industry norms.					
		4.2.3	Client informed about estimated cost and risk factor.					
		4.3.1	Installation requirement for instant chiller inspected and					
			prepared as per manufacturer's instruction.					
4.3	Install instant chiller	4.3.2	Location of units identified and marked as per drawing.					
		4.3.3	Plumbing works and electrical works checked and					





	supervised as per the manufacturer's requirement.	
	4.3.4 Water cooled condenser with cooling tower installed and	
	connected with piping system as per drawing and	
	manufacturer's specification.	
	4.3.5 Chilled water pump installed and connected with piping	
	system.	
	4.3.6 Water pipeline tested for leakage.	
	4.3.7 Electrical connection connected to the respective power	
	supply as per wiring diagram.	
	4.3.8 Refrigeration system flushed with Oxygen Free Dry	
	Nitrogen (OFDN).	
	4.3.9 Refrigeration system leak tested, evacuated and charged	
	with correct amount of refrigerant.	
	4.3.10 Instant chiller operated and tested for proper functioning.	
	4.3.11 Service data recorded as per industry norms.	
	4.4.1 Installation requirement for IBT inspected and prepared as	
	per manufacturer's instruction.	
4.4 Install Ice Bank Tank	4.4.2 Compressor, condenser and IBT placed separately on a	
(IBT)	prepared concrete foundations as per manufacturer's	
	instruction and drawings.	
	4.4.3 Plumbing works and electrical works checked and	

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			supervised as per the manufacturer's requirement.		
		4.4.4	Water cooled condenser with cooling tower installed and		
			connected with piping system as per drawing and		
			manufacturer's specification.		
		4.4.5	Chilled water pump installed and connected with piping		
			system.		
		4.4.6	Water pipeline tested for leakage.		
		4.4.7	Refrigeration system pipelines insulated and connected as		
			per manufacturer instructions.		
		4.4.8	Electrical connection connected to the respective power		
			supply as per wiring diagram.		
		4.4.9	Refrigeration system flushed with Oxygen Free Dry		
			Nitrogen (OFDN).		
		4.4.10	Refrigeration system leak tested, evacuated and charged		
			with correct amount of refrigerant.		
		4.4.11	IBT operated and tested for proper functioning.		
		4.4.12	Service data recorded as per industry norms.		
		4.5.1	Bulk milk cooler tank placed on level surface with easy		
4.5	Install DX bulk milk		access for loading milk and maintaining slope towards		
	cooler tank/milk chilling vat		outlet for unloading milk.		
-	omming vac	4.5.2	Bulk milk cooler components installed as per		

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			manufacturer's instruction.			
		4.5.3	Refrigeration lines air tightly insulated without exposing			
			copper lines.			
		4.5.4	Electrical connection connected to the respective power			
			supply as per circuit diagram.			
		4.5.5	Stainless steel works supervised and connected to bulk			
			milk cooler.			
		4.5.6	Refrigeration system flushed with Oxygen Free Dry			
			Nitrogen (OFDN).			
		4.5.7	Refrigeration system leak tested, evacuated and charged			
			with correct amount of refrigerant.			
		4.5.8	Bulk milk cooler operated and tested for its proper			
			functioning with water/milk.			
		4.5.9	Service data recorded as per industry norms.			
		4.6.1	Site checked and prepared as per design layout and			
			specification.			
4.6	Install walk in cold	4.6.2	Walk in cold room panels assembled as per manufacturer's			
4.0	room refrigeration		instruction and installed on the required position with			
	unit		proper alignment.			
		4.6.3	Openings sealed tightly using sealing materials without air			
A			leak.			

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	4.6.4	Refrigeration system components and pressure relief			
		damper installed as per manufacturer's instruction.			
	4.6.5	Refrigeration system flushed with Oxygen Free Dry			
		Nitrogen (OFDN).			
	4.6.6	Refrigeration system leak tested, evacuated and charged			
		with correct amount of refrigerant.			
	4.6.7	Refrigeration system tested for normal functioning and			
		required parameter level checked to ensure that they are			
		within the required range.			
	4.6.8	Service data recorded as per industry norms.			
	4.7.1	Installation requirement for ice cream freezer inspected			
		and prepared as per manufacturer's instruction.			
	4.7.2	Plumbing works and electrical works checked and			
		supervised as per the manufacturer's requirement.			
	4.7.3	Water cooled condenser with cooling tower installed and			
4.7 Install ice cream freezer		connected with piping system as per drawing and			
1166261		manufacturer's specification.			
	4.7.4	Water pipeline tested for leakage.			
	4.7.5	Air compressor installed and connected with air pipelines.			
	4.7.6	Stainless steel pipelines connected with intake of ice cream			
		freezer.			



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		4.7.7	Electrical connection connected to the respective power		
			supply as per wiring diagram.		
		4.7.8	Refrigeration system flushed with Oxygen Free Dry		
			Nitrogen (OFDN).		
		4.7.9	Refrigeration system leak tested, evacuated and charged		
			with correct amount of refrigerant.		
		4.7.10	Ice cream freezer operated and tested for proper		
			functioning.		
		4.7.11	Service data recorded as per industry norms.		
		4.8.1	Refrigeration system inspected through <i>general inspection</i>		
			and testing.		
		4.8.2	Components and accessories of refrigeration system		
			cleaned, inspected and lubricated as per preventive		
			maintenance schedule.		
4.8	Service refrigeration	4.8.3	Refrigerant lines and drain lines checked for abnormal		
	system		condition and fixed.		
		4.8.4	Control box, electrical wiring and connection checked and		
			tightened.		
		4.8.5	Damaged or worn-out components and accessories		
			replace in specific time interval as per manufacturer's		
٨			instruction.		



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	4.8.6	Temperature and defrost settings checked and adjusted.			
	4.8.7	Refrigeration system flushed with Oxygen Free Dry			
		Nitrogen (OFDN).			
	4.8.8	Refrigeration system leak tested, evacuated and charged			
		with correct amount of refrigerant.			
	4.8.9	Operation of refrigeration system checked for proper			
		functioning and adjusted as per manufacturer's			
		instruction.			
	4.8.10	Servicing details recorded as per industry norms.			
	4.9.1	Faulty history collected from clients and recorded as per			
		industry norms.			
	4.9.2	Electrical parameters measured and verified against wiring			
		diagram.			
	4.9.3	Fault in refrigeration system identified through general			
4.9 Repair refrigeration		inspection and testing.			
system	4.9.4	Refrigeration system dissembled sequentially as per			
		manufacturer's specification and components tagged.			
	4.9.5	Electrical problems fixed as per circuit diagram.			
	4.9.6	Controls and settings checked and adjusted.			
	4.9.7	Refrigerant recovered and stored according to standard			
•		procedure.			



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	4.9.8 Defective components repaired or replaced with new
	components of correct specification.
	4.9.9 Refrigeration system flushed with Oxygen Free Dry
	Nitrogen (OFDN).
	4.9.10 Refrigeration system leak tested, evacuated and charged
	with correct amount of refrigerant.
	4.9.11 Post repair testing carried out as per the checklist.
	4.10.1 Unused materials are collected and stored in designated
	area.
	4.10.2 Tools and equipment are cleaned, checked for damage and
4.10 Clean workplace	stored in designated area.
	4.10.3 Workplace and window unit cleaned neatly and waste
	disposed as per <i>3R's principle</i> 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)

Revised Date: dd/mm/yy

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 						
Plumbing works	May include but are not limited to: Pipe cutting Pipe insulation Pipe laying/hanging Pipe connection Pipe support Welding/brazing Flushing						
Electrical works	May include but are not limited to: Communication/electrical wire cutting laying Wire connection						
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	 Installing power socket
	Installing panel board
	Installing control and protective device
General inspection and testing	May include but not limited to:
	Abnormal noise
	Physical damage
	• Leakage
	• Clog
	Temperature
	• Pressure
	• Current
	Air flow
	Refrigerant flow
	Refrigerant level
	Oil level
	• Vibration
	• RPM
	• Insulation
	Resistance
	• Continuity
	• Smoke
	Humidity
	• Error code
Components and accessories	May include but not limited to:
,	• Compressor



Electrical parameters		• • • • • • • • • • • • • • • • • • •	Thermostat Oil separator Refrigeration lines at Fan blade and motor Filter drier Insulation Door accessories Receiver Pressure cut out swith Sight glass Solenoid valve Suction filter Accumulator Electrical componen	r	e harness, cables	
^		•	Voltage Resistance Continuity Current Capacitance Voltage drop			- Tan
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	Short circuit
	Open circuit
3R's principle	May include but are not limited to:
	• Reduce
	• Reuse
	Recycle





5	Unit No: 5 Unit Title: Repair and maintain transport refrigera	ation syst	Unit code:				
	Elements of competency		Performance standards				
		5.1.1	Personal protective equipment (PPE) used in accordance with task requirement.				
	5.1 Prepare tools, equipment and materials	5.1.2	Tools and equipment prepared as per task requirement.				
		5.1.3	Materials collected and prepared as per task requirement.				
		5.2.1	Materials required for installation/repair listed.				
	5.2 Estimate cost	5.2.2	Installation/repair cost calculated as per industry norms.				
		5.2.3	Client informed about estimated cost and risk factor.				
		5.3.1	Refrigeration system inspected through <i>general inspection and testing</i> .				
		5.3.2	Components and accessories of refrigeration unit cleaned, inspected and lubricated as				
			per preventive maintenance schedule.				
		5.3.3	Refrigerant lines and drain lines checked for abnormal condition and fixed.				
		5.3.4	Control box, electrical wiring and connection checked and tightened.				
		5.3.5	Damaged or worn-out components and accessories replaced in specific time interval as				
	5.3 Service refrigeration system		per manufacturer's instruction.				
		5.3.6	Refrigeration system flushed with Oxygen Free Dry Nitrogen (OFDN).				
		5.3.7	Refrigerant system leak tested, evacuated and charged with correct amount of				
			refrigerant.				
		5.3.8	Performance of refrigeration unit checked and adjusted as per manufacturer's				
			instruction.				
\wedge		5.3.9	Servicing details recorded as per industry norms.				



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	5.4.1 Fault history collected from clients and recorded as per industry norms.
	5.4.2 <i>Electrical parameters</i> measured and verified against manufacturer's specification.
	5.4.3 Fault in refrigeration system identified through general inspection and testing.
	5.4.4 Refrigeration system dissembled sequentially as per manufacturer's specification and
	components tagged.
	5.4.5 Components of refrigeration system inspected, cleaned and foreign materials remov
	5.4.6 Refrigerant recovered and stored according to standard procedure.
5.4 Repair refrigeration system	5.4.7 Damaged components repaired or replaced with new components of correct
	specification.
	5.4.8 Refrigeration system reassembled as per manufacturer's specification.
	5.4.9 Refrigeration system flushed with Oxygen Free Dry Nitrogen (OFDN).
	5.4.10 Refrigeration system leak tested, evacuated and charged with correct amount of
	refrigerant.
	5.4.11 Post repair testing carried out as per the checklist.
	5.5.1 Unused materials collected and stored in designated area.
5.5 Clean workplace	5.5.2 Tools and equipment cleaned, checked for damage and stored in designated area.
	5.5.3 Workplace cleaned neatly and waste disposed as per 3R's principle in designated are

Task Performance Requirements (Tools, equipment, and materials):

• Transport refrigeration system, screwdriver set, spanner set, knife, silicone, silicone gun, socket wrench set, Allen key, fin comb, pliers, circlip pliers, wire stripper, phase tester, multimeter, megger, measuring tape, steel ruler, file set, hacksaw, hammer, adjustable wrench, scissor,



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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, charging unit, vacuum cleaner, thermometer, dust bin, dust pan, flare nuts, insulating materials, brazing rod, brazing flux, emery paper, tachometer, anemometer, sound meter, ladder, extension cord, 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.





	Required Knowledge								
8			Technical Knowledge	Gı	n				
	• Transpo	Types Uses Prepare Safe has ort refrict Mecha Electric functio Dismar Insulat Servicin Commo Electric Mecha Trouble tive ma Mainta	ent, and materials ation indling igeration system nical components and their function cal and electronic components and the	ir	Perform correfrigeration	ost of installation,	Recorded to the second	ead and interpret el rcuit and drawing ead and interpret w anual ead and interpret anufacturer's specif	ectric orkshop
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Refrigerant
o Types
o Evacuation
o Charging
o Recovery
 Pressure temperature relationship of refrigerants
Ozone depleting substances, refrigerant and environmental
issues
Basic automotive related to refrigeration system
Costing and estimation
Record keeping
Waste management
Occupational health and safety rules and regulations





Assessment of Competency							
Unit: 5							
Unit Title: Repair and I	maintai	n transport refrigeration system					
		Candidate Details		As	sessors De	tail	
Candidate's Name:			Assessors'	Name		ID/License No:	
Registration Number:			1.				
Symbol No:			2.				
Test Centre:		Test Date:	3.				
ment of competency		Performance Standards	Standard Met	Standard Not Met	Evidence Type	Comments	
	5.1.1	Personal protective equipment (PPE) used in accordance					
Prepare tools,		with task requirement.					
• •	5.1.2	Tools and equipment prepared as per task requirement.					
	5.1.3	Materials collected and prepared as per task requirement.					
	5.2.1	Materials required for installation/repair listed.					
Estimate cost	5.2.2	Installation/repair cost calculated as per industry norms.					
	5.2.3	Client informed about estimated cost and risk factor.					
	5.3.1	Refrigeration system inspected through <i>general inspection</i>					
Service refrigeration		and testing.					
system	5.3.2	Components and accessories of refrigeration unit cleaned,					
		inspected and lubricated as per preventive maintenance					
	Candidate's Name: Registration Number: Symbol No: Test Centre: ment of competency Prepare tools, equipment and materials Estimate cost Service refrigeration	Candidate's Name: Registration Number: Symbol No: Test Centre: ment of competency 5.1.1 Prepare tools, equipment and materials 5.1.2 5.1.3 5.2.1 Estimate cost 5.3.1 Service refrigeration	Unit: 5 Unit Title: Repair and maintain transport refrigeration system Candidate Details Candidate's Name: Registration Number: Symbol No: Test Centre: Test Date: Prepare tools, equipment and materials Figure 1.2 Tools and equipment prepared as per task requirement. 5.1.2 Tools and equipment prepared as per task requirement. 5.1.3 Materials collected and prepared as per task requirement. 5.2.1 Materials required for installation/repair listed. 5.2.2 Installation/repair cost calculated as per industry norms. 5.2.3 Client informed about estimated cost and risk factor. Service refrigeration system 5.3.1 Refrigeration system inspected through general inspection and testing. 5.3.2 Components and accessories of refrigeration unit cleaned,	Unit: 5 Unit Title: Repair and maintain transport refrigeration system Candidate Details Candidate's Name: Registration Number: Symbol No: Test Centre: Test Date: 3. Ment of competency Performance Standards Standards Met 5.1.1 Personal protective equipment (PPE) used in accordance with task requirement. 5.1.2 Tools and equipment prepared as per task requirement. 5.1.3 Materials collected and prepared as per task requirement. 5.2.1 Materials required for installation/repair listed. 5.2.2 Installation/repair cost calculated as per industry norms. 5.2.3 Client informed about estimated cost and risk factor. Service refrigeration system 5.3.1 Refrigeration system inspected through general inspection and testing. 5.3.2 Components and accessories of refrigeration unit cleaned,	Unit: 5 Unit Title: Repair and maintain transport refrigeration system Candidate Details Assessors' Name Registration Number: Symbol No: Test Centre: Test Date: Test Date: Standard Met Standard Met Standard Met Standard Not Met Prepare tools, equipment and materials 5.1.1 Personal protective equipment (PPE) used in accordance with task requirement. 5.1.2 Tools and equipment prepared as per task requirement. 5.1.3 Materials collected and prepared as per task requirement. 5.2.1 Materials required for installation/repair listed. Estimate cost Service refrigeration system 5.3.1 Refrigeration system inspected through general inspection and testing. 5.3.2 Components and accessories of refrigeration unit cleaned,	Unit: 5 Unit Title: Repair and maintain transport refrigeration system Candidate Details Candidate Details Assessors Details Candidate's Name: Registration Number: Symbol No: Test Centre: Test Date: 3. Performance Standards Standard Met Not Met Standard Not Met Type 5.1.1 Personal protective equipment (PPE) used in accordance with task requirement. 5.1.2 Tools and equipment prepared as per task requirement. 5.1.3 Materials collected and prepared as per task requirement. 5.2.1 Materials required for installation/repair listed. 5.2.2 Installation/repair cost calculated as per industry norms. 5.2.3 Client informed about estimated cost and risk factor. Service refrigeration system 5.3.1 Refrigeration system inspected through general inspection and testing. 5.3.2 Components and accessories of refrigeration unit cleaned,	





			schedule.		
		5.3.3	Refrigerant lines and drain lines checked for abnormal		
			condition and fixed.		
		5.3.4	Control box, electrical wiring and connection checked and		
			tightened.		
		5.3.5	Damaged or worn-out components and accessories		
			replaced in specific time interval as per manufacturer's		
			instruction.		
		5.3.6	Refrigeration system flushed with Oxygen Free Dry		
			Nitrogen (OFDN).		
		5.3.7	Refrigerant system leak tested, evacuated and charged		
			with correct amount of refrigerant.		
		5.3.8	Performance of refrigeration unit checked and adjusted as		
			per manufacturer's instruction.		
		5.3.9	Servicing details recorded as per industry norms.		
		5.4.1	Fault history collected from clients and recorded as per		_
			industry norms.		
5.4	Repair refrigeration	5.4.2	Electrical parameters measured and verified against		
	system		manufacturer's specification.		
		5.4.3	Fault in refrigeration system identified through general		
			inspection and testing.		





	5.4.4 Refrigeration system dissembled sequentially as per
	manufacturer's specification and components tagged.
	5.4.5 Components of refrigeration system inspected, cleaned
	and foreign materials removed.
	5.4.6 Refrigerant recovered and stored according to standard
	procedure.
	5.4.7 Damaged components repaired or replaced with new
	components of correct specification.
	5.4.8 Refrigeration system reassembled as per manufacturer's
	specification.
	5.4.9 Refrigeration system flushed with Oxygen Free Dry
	Nitrogen (OFDN).
	5.4.10 Refrigeration system leak tested, evacuated and charged
	with correct amount of refrigerant.
	5.4.11 Post repair testing carried out as per the checklist.
	5.5.1 Unused materials collected and stored in designated area.
	5.5.2 Tools and equipment cleaned, checked for damage and
5.5 Clean workplace	stored in designated area.
	5.5.3 Workplace cleaned neatly and waste disposed as per <i>3R's</i>
	<i>principle</i> in designated area.
WT Writton Tost OO Oral (Ougstion DT Practical Test DO Direct Observation SP Supervisor's report SN Simulation

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



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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 			
General inspection and testing	May include but not limited to: Abnormal noise Physical damage Leakage Clog Temperature Pressure Current Air flow Refrigerant flow Refrigerant level			





	 Vibration RPM Insulation Resistance Continuity Smoke Humidity
Components and accessories	 Compressor Condenser Evaporator Expansion device Refrigeration accessories: defrost solenoid, filter dryer, vibration absorber, valves, sight glass, oil separator, liquid receiver, suction accumulator, pressure cut out switch, operation switch, gasket, fans, AC/DC motors Refrigerant lines and drain lines Pulley assembly Electrical components: fuse, relay, control circuit, wire harness, cables Curtain Door accessories
Electrical parameters	May include but not limited to: Voltage Resistance Continuity Current

Revision Number: ##



	Capacitance
	Voltage drop
	Short circuit
	Open circuit
3R's principle	May include but are not limited to:
	Reduce
	• Reuse
	Recycle



