

COMPETENCY STANDARDS
for
**HEATING VENTILATION, AIR-CONDITIONING
AND REFRIGERATION (HVACR)**
(Level-2,3&4)

TABLE OF CONTENTS

INTRODUCTION.....	3
PURPOSE OF THE QUALIFICATION	3
DATE OF VALIDATION	4
CODE OF QUALIFICATION	4
ENTRY REQUIREMENTS	4
QUALIFICATIONS DEVELOPMENT COMMITTEE.....	5
QUALIFICATIONS VALIDATION COMMITTEE.....	6
REGULATIONS FOR THE QUALIFICATION AND SCHEDULE OF UNITS.....	6
SUMMARY OF COMPETENCY STANDARDS.....	7
COMPETENCIES.....	8
Demonstrate Communication Skills.....	9
Maintain Safe Work Environment.....	11
Carry out Calculations and Prepare Estimates.....	13
Install Residential Air Conditioner	15
Repair / Service Residential Air Conditioner	20
Repair / Service Residential Refrigeration Units	25
Install Commercial Refrigeration Units	30
Repair / Service Commercial Refrigeration Units	35
Carry out Fabrication for HVAC Work	40
Install Central Air Conditioning Systems	45
Repair / Service Central Air Conditioning System	51
Perform Preventive Maintenance	57

INTRODUCTION

Heating Ventilation, Air-Conditioning and Refrigeration (HVACR) is a sub discipline of Mechanical (Power) Engineering that makes it possible for us to live comfortably in air-conditioned spaces and enjoy a wide variety of foods. HVACR technology is growing and it will continue to make its mark by introducing further developments in the field. The technicians need to be aware of the fact that change is inevitable and it requires an in depth analysis of the trends and developments in the field so that they can claim successful professionals in the industry.

National competency standards have been developed with the aim to provide quality training and to improve the assessment procedures which must inculcate practical aspect of the job. Since these competency standards are minimum acceptable standards for performances or benchmarks, they provide practical applications of the knowledge, skills and attitude required by a skilled HVAC worker to work in HVAC industry.

The competency standards cover generic, functional and technical competency standards for both the domestic and commercial practices. These standards enable the technician to maintain work safety, develop good communication skills, and be cognizant of fundamentals of installing, servicing, troubleshooting, and repairing the various types of equipment used in residential and light-commercial heating, ventilating, air conditioning and refrigeration systems. When the HVACR technicians will apply these standards and the learnt procedures through training, it will ensure reduction in energy consumption and lasting performance by the installed units.

PURPOSE OF THE QUALIFICATION

The competency based National Vocational Qualification (NVQ) has been developed to equip the unskilled individuals with the technical and entrepreneurial skills to be employed / self-employed and inevitably set sustainable impact on their lives through increase in their livelihood/ income. The purpose of this qualification is to:

- Set professional standards for HVACR technician to build a challenging work force to support the needs of the labor market and the economy, including foreign investment, private-sector employment and entrepreneurship
- Provide individuals with the skills they need to contribute to the economy and to support themselves and their families
- Decrease unemployment by supplying quality skilled manpower, who will serve as the key elements in enhancing the quality of Pakistan's Refrigeration and Air conditioning industry
- Reduce cost and improve productivity of services by providing skilled manpower equipped with training of International Standards
- Endeavor towards development of skilled manpower for diversified area through short term, structured job oriented courses
- Bridge skill gap and provide trained HVACR manpower to various emerging service areas in Pakistan industry

The specific objectives of developing HVACR Qualification are as under:

- Enable the trainees to perform their duties in efficient manner
- Establish a standardized and sustainable system of Refrigeration and Air Conditioning training in the institutes / colleges / schools of Pakistan

- Improve the professional competence of Refrigeration and Air Conditioning industry
- Capacitate the workforce and trainers in modern CBT trainings, methodologies and processes as envisaged by NVQF
- Provide flexible pathways and progressions in Refrigeration and Air conditioning industry

DATE OF VALIDATION

These national qualifications have been validated by the Qualifications Validation Committee (QVC) on 13th& 14th February 2018 and they will remain in currency until 13th February 2021.

CODE OF QUALIFICATION

Qualification Title	Code
National Vocational Certificate Level-4 in Mechanical Technology (HVAC Technician)	0714E&A05
National Vocational Certificate Level-3 in Mechanical Technology (Refrigeration Mechanic)	0714E&A06
National Vocational Certificate Level-2 in Mechanical Technology (Domestic AC Mechanic)	0714E&A07

ENTRY REQUIREMENTS

The minimum academic qualification required for a candidate to get enrolled in National Vocational Certificate Level-2 in Mechanical Technology (Domestic AC Mechanic) is Middle or Grade- VIII. For National Vocational Certificate Level-3 in Mechanical Technology (Refrigeration Mechanic), the entry requirement is National Vocational Certificate Level-2 in Mechanical Technology (Domestic AC Mechanic). For National Vocational Certificate Level-4 in Mechanical Technology (HVAC Technician), the entry requirement is National Vocational Certificate Level-3 in Mechanical Technology (Refrigeration Mechanic).

QUALIFICATIONS DEVELOPMENT COMMITTEE

The Qualifications Development Committee consisted of following members:

S.No.	Name	Designation & Organization
1.	Zamir-ul-Hassan Gardezi	MEP Manager MIDJAC Construction Pvt. Limited, Islamabad
2.	Abdul Basit Malik	CEO Business Track Solutions Pvt. Limited, Islamabad
3.	Asad Masood	HVAC Supervisor Climate Control Pvt. Limited, Lahore
4.	Naeem Younas	HVACR Technician Pak Elektron Pvt. Limited, Lahore
5.	Muhammad Aslam	Incharg HVACR Hospitality Inn Hotel, Lahore
6.	Muhammad Naveed	HVACR Expert Punjab Forensic Science Agency, Lahore
7.	Arsalan Iqbal	HVACR Expert Koldkraft Pvt. Limited, Lahore
8.	Atif Latif	HVACR Technician Pakistan Railway, Lahore
9.	Ihsan UI Haq	HVACR Expert Usman Refrigeration Center, Sargodha
10.	Shehbaz Ali	HVACR Expert Shehbaz Brothers, Temple Road, Lahore
11.	Faisal Razzaq	HVACR Expert Shakori International, Islamabad
12.	Waqas Ilyas	HVAC Supervisor Co-Techno Engineers, Lahore
13.	Shehzad Yousaf	HVACR Technician Cool Care, Baghbaan Pura, Lahore

QUALIFICATIONS VALIDATION COMMITTEE

The Qualifications Validation Committee consisted of following members:

S.No.	Name	Designation & Organization
1.	Amjad Mehmood Baloch	Chief Instructor HVACR TEVTA Punjab
2.	Hafiz Muhammad Azeem	Country Manager Kenwood Pakistan, Head Office, Karachi
3.	Aftab Ahmad	Zonal Manager Dawlance Pakistan (Jhelum Zone)
4.	Muhammad Imran	Branch Manager Dawlance Service Center, Rawalpindi
5.	Muhammad Jamil	Regional Trainer Haier Pakistan (Sargodha division)
6.	Qaisar Saleem	Senior Service Engineer Gree DWP Group, Pakistan
7.	Muhammad Nadeem	Project Manager HVAC Pakistan Kidney Liver and Research Institute, Lahore
8.	Rasib Ali	CWS Incharge Dawlance Pakistan, Gujrat
9.	Sajid Pervaiz Butt	HVACR Expert Sajid Refrigeration, Gujrat
10.	Awais Ahmad	HVAC Supervisor Climate Solution, Lahore
11.	Ali Bahadur	Site Supervisor Mecatech PVT Limited, Lahore
12.	Muhammad Ehsan Younas	Electrical Engineer Pakistan Electronics Limited, Lahore
13.	Hassan Saeed	Mechanical Engineer Millat Tractor Pakistan, Lahore

REGULATIONS FOR THE QUALIFICATION AND SCHEDULE OF UNITS

Not Applicable

SUMMARY OF COMPETENCY STANDARDS

Code	Competency Standards	Level	Credits	Category
	Demonstrate Communication Skills	2	4	Generic
	Carry out Calculations and Prepare Estimates	2	5	Functional
	Maintain Safe work Environment	2	4	Generic
	Install Residential Air Conditioner	2	7	Technical
	Repair/Service Residential Air Conditioner	2	8	Technical
	Repair / Service Residential Refrigeration Units	3	8	Technical
	Install Commercial Refrigeration Units	3	7	Technical
	Repair / Service Commercial Refrigeration Units	3	8	Technical
	Carry out Fabrication for HVAC Work	4	6	Technical
	Install Central Air Conditioning System	4	7	Technical
	Repair / Service Central Air Conditioning System	4	8	Technical
	Perform Preventive Maintenance	4	8	Technical

COMPETENCIES

Code	Competency Standards	Domestic AC Mechanic (Level-II)	Refrigeration Mechanic (Level- III)	HVAC Technician (Level- IV)
	Demonstrate Communication Skills	✓	✓	✓
	Carry out Calculations and Prepare Estimates	✓	✓	✓
	Maintain Safe work Environment	✓	✓	✓
	Install Residential Air Conditioner	✓		
	Repair/Service Residential Air Conditioner	✓		
	Repair / Service Residential Refrigeration Units		✓	
	Install Commercial Refrigeration Units		✓	
	Repair / Service Commercial Refrigeration Units		✓	
	Carry out Fabrication for HVAC Work			✓
	Install Central Air Conditioning System			✓
	Repair / Service Central Air Conditioning System			✓
	Perform Preventive Maintenance			✓

Code:

Demonstrate Communication Skills

Overview

This Competency Standard identifies the competencies required to apply communication skills at workplace in accordance with organization guidelines and procedures. You are expected to work in a team to achieve common organizational goals and avoid conflicts. This competency standard would also enable you to use basic computer skills to communicate effectively and prepare work related documents.

Competency Units	Performance Criteria
1. Work in Team	<p>P1. Treat team members with respect and maintain positive relationships to achieve common organizational goals</p> <p>P2. Listen to instructions carefully and comply with them</p> <p>P3. Provide work related information to team members and identify interrelated work activities to avoid confusion</p> <p>P4. Adopt communication skills appropriate to work activities and company procedures</p> <p>P5. Identify problems and resolve them through discussion and mutual agreement</p>
2. Deal with Clients	<p>P1. Collect and confirm work requirements from clients using appropriate communication procedures</p> <p>P2. Provide clear information to clients about work requirements including costs and time needed to accomplish tasks</p> <p>P3. Negotiate with clients regarding wages, time, labour requirements etc.</p>
3. Demonstrate Basic IT Skills	<p>P1. Create folders and files and learn major commands of operating system/windows</p> <p>P2. Type text and use major commands such as printing, editing, creating tables, header footer, footnotes, table of contents and page number etc.</p> <p>P3. Make the document as per work specifications and client's requirement</p> <p>P4. Generate reports for clients as required using appropriate computer applications</p> <p>P5. Use internet for sending/receiving emails and connecting through social or other media</p>

Knowledge and Understanding

The candidate must be able to demonstrate underpinning knowledge and understanding required to carry out the tasks covered in this competency standard. This includes the knowledge of:

- Principles of effective and interactive communication
- 7 C's of communication and their importance
- Cultural and organizational practices for effective communication
- Effective negotiation skills
- Role of team members and development of team work
- Team dynamics and stages of team development
- Conflict resolution strategies
- Negotiation techniques
- Basic architecture of computer system
- Input / output devices of computer and their functions
- Basic computer skills using MS Word, MS Excel, use of internet, sending and receiving emails etc.
- Preparing documents and work related reports

Critical Evidence(s) Required

The candidate needs to produce following critical evidence(s) in order to be competent in this competency standard:

- Communicate effectively with colleagues and clients
- Develop a job completion report for the work using computer technology

Code:

Maintain Safe Work Environment

Overview

This Competency Standard identifies the competencies required to apply occupational safety and health at workplace in accordance with the organization's approved guidelines and procedures. You will be expected to identify and use Personnel Protective Equipment (PPE) according to the job requirement and potential hazards at workplace. The underpinning knowledge regarding OSH will be sufficient to provide the basis for your work

Competency Units	Performance Criteria
1. Identify Hazards at Workplace	<p>P1. Read and interpret work processes and procedures correctly to identify risk of hazards at workplace</p> <p>P2. Recognize engineering processes, tools, equipment and consumable materials that have the potential to cause harm</p> <p>P3. Identify any potential hazards and take appropriate action to minimize the risk</p>
2. Observe Occupational Safety and Health (OSH)	<p>P1. Work safely while complying with health and safety precautions, regulations and other relevant guidelines</p> <p>P2. Identify health and safety hazards in the workplace, so that the potential for personal injury, damage to equipment or workplace is prevented, and corrective action is taken</p> <p>P3. Deal with problems which are within your control, and report those that cannot be resolved to safety officer</p> <p>P4. Wear, adjust, and maintain Personal Protective Equipment to ensure correct fit and optimum protection in compliance with company procedures</p> <p>P5. Keep work area clean and clear of obstructions, and storing tools or equipment, so that the potential for accident or injury is prevented</p>

Knowledge and Understanding

The candidate must be able to demonstrate underpinning knowledge and understanding required to carry out tasks covered in this competency standard. This includes the knowledge of:

- Types of hazards that are most likely to cause harm to health and safety
- Health and safety precautions
- Health and safety signs and symbols
- Techniques and methods to identify the risks of hazards at workplace

- Dealing with hazards to avoid any accident or injury
- Safety reporting procedures and documentation
- Use of Personal Protective Equipment
- First aid treatment methods including methods of resuscitation
- Fire-fighting methods
- Safe methods of handling heavy loads

Critical Evidence(s) Required

The candidate needs to produce following critical evidence(s) in order to be competent in this competency standard:

- Identify possible hazards at workplace
- Use correct Personal Protective Equipment (PPE) for the assigned job

Code:

Carry out Calculations and Prepare Estimates

Overview

This competency standard identifies the competencies required to prepare estimates in accordance with client's guidelines. You will be expected to estimate, ensuring cost effectiveness, conforming to standards and regulations. Your underpinning knowledge regarding estimation skills will be sufficient to provide the basis for your work.

Competency Units	Performance Criteria
1. Develop Basic Drawing	<p>P1. Calculate the electric load for circuit distribution</p> <p>P2. Develop drawing according to requirement</p> <p>P3. Negotiate any alteration to the job specifications with clients</p>
2. Perform Estimation of Materials	<p>P1. Take measurements as per drawing</p> <p>P2. Quantify the material as per drawing</p> <p>P3. Calculate cost of material and accessories in accordance with current market prices</p> <p>P4. Make the cost estimate of material</p> <p>P5. Incorporate the agreed alteration in Job specifications for estimation</p>
3. Prepare Costing for the Work	<p>P1. Calculate man-hours for work as per drawing</p> <p>P2. Make the cost estimate of labor as per requirement</p>

Knowledge & Understanding

The candidate must be able to demonstrate underpinning knowledge and understanding required to carry out tasks covered in this competency standard. This includes the knowledge of:

- Basic electrical terminologies
- Electrical Circuit Characteristics
- Basic electric formulas & numeracy
- Norms in interacting & negotiating with customers/clients
- Interpretation of layout plans/wiring diagrams, service manuals and manufacturer specifications, technical sketches, graphic symbols etc.
- Types of electrical control and protective switchgear and accessories used in electrical circuits
- Types of electrical wires and cables and their ratings
- Types of electrical conduits, casing & capping etc.; their applications and their cutting/jointing/fixing methods
- Types of insulation material used in electrical installations
- Types of earth electrodes and their applications

- Local authority/enterprise policies related to electrical installations
- Electrical legislation and regulations related to electrical wiring
- Method of calculating labor cost/overheads/profit margin etc.
- Norms and standard formats of preparing estimates
- Record keeping and reporting

Critical Evidence(s) Required

The candidate needs to produce following critical evidence(s) in order to be competent in this competency standard:

- The candidate will demonstrate the following estimation skills in a simulated environment to provide evidence of competency:
 - Provide cost effective and quality oriented Bill of Quantity (BOQ)
 - Make the rate analysis according to market prices
 - Provide the estimate in accordance with the BOQ

Code:

Install Residential Air Conditioner

Overview

This Competency Standard identifies the competencies required to install different types of Window type / Split type residential Air conditioners skills at workplace in accordance with the organization's / clients guidelines. This unit covers the knowledge regarding safety rules, Personal Protective Equipment (PPE), and international standards for installing Residential Air conditioners to provide you the basis for your work.

Competency Units	Performance Criteria
1. Install Window Air Conditioner	P1. Select tools, equipment and related accessories according to job requirements P2. Mark the location on the wall where Window Air Conditioner to be installed according to Unit specifications and client requirements P3. Make opening at the marked area on the wall P4. Fix Iron / wooden frame in the opening firmly and insert in it the Air Conditioner cover according to the instructional manual and standards P5. Install the Air conditioner in the framed opening with standard slope so that condensate water drops outside P6. Cover / Seal side air gaps of opening with insulation material P7. Fix the fancy wooden border around the Air conditioner grill as per client's requirement P8. Fix the Air Conditioner condensate drain pipe and put it into main sewerage line P9. Arrange power supply with circuit breaker near the Air Conditioner P10. Make sure that all packing materials - Cardboard, Styrofoam, Tape and Plastic Film, have been removed from the site after installation P11. Switch on the Air Conditioner and check Air Conditioner performance as per capacity and specifications
2. Install Split Air Conditioner	P1. Select tools, equipment and related accessories according to job requirements P2. Select and mark the area on the wall where Indoor and Outdoor units are to be installed according to

	<p>Unit specifications and client requirements</p> <p>P3. Perform physical inspection of indoor and outdoor unit according to unit specifications</p> <p>P4. Make opening for the refrigerant pipes, condensate pipe and control wires to pass through</p> <p>P5. Mount the Indoor unit wall mounting plate according to manufacturer specifications and install the Indoor unit on it</p> <p>P6. Prepare base for the fixing of Outdoor unit according to manufacturer specifications and fix the Outdoor unit there</p> <p>P7. Connect the refrigerant pipes amongst both indoor and outdoor units, supply and control wires according to manufacturer manual</p> <p>P8. Add additional refrigerant for additional piping according to manufacturer recommendations</p> <p>P9. Make oil trap in copper pipe as per site requirement</p> <p>P10. Perform leak test, evacuation procedure, charge refrigerant and open the service valves</p> <p>P11. Insulate the joints and refrigerant pipes according to standards and manufacturer installation manual</p> <p>P12. Make sure that all packing materials - Cardboard, Styrofoam, Tape and Plastic film, have been removed</p> <p>P13. Switch on the Air Conditioner and check performance as per capacity and specifications</p>
--	---

Knowledge and Understanding

The candidate must be able to demonstrate underpinning knowledge and understanding required to carry out tasks covered in this competency standard. This includes the knowledge of:

- Basic load calculation for cooling / heating
- Fundamental knowledge of HVACR, Electric and Electronics
- Techniques for installation of Window / Split (DC Inverter)
- Technical Operations of all types of Split Air Conditioners
- Electrical / HVAC layout plans/wiring diagrams
- Type of Electrical wires and cables including underground cables, their ratings and applications
- Methods of Copper Tube Cutting / Reaming / Bending / Swaging / Flaring / Brazing / Jointing / Fixing

- Basic masonry and carpentry applications
- Gas welding (Soldering and Brazing)
- Types of insulation and their applications
- Compressor types and applications
- Methods of Pressurizing / Evacuations / Purging / Refrigerant Charging
- Types of Refrigerant, its properties, recycling, recovery and reclaiming
- Record Keeping and reporting

Critical Evidence(s) Required

The candidate needs to produce following critical evidence(s) in order to be competent in this competency standard:

- The candidate will demonstrate the following Installation skills in a simulated environment to provide evidence of competency:
 - Mark location according to specifications and standards
 - Perform electric connections to joint indoor unit and outdoor unit
 - Prepare the base for condensing unit
 - Install the indoor / outdoor unit according to HVAC standards

LIST OF TOOLS, EQUIPMENT AND MACHINERY

S.No.	Description
1.	Personal Protective Equipment
2.	Metal Drill Bit Set
3.	Masonry Drill Set
4.	File Set
5.	Hand Hacksaw Frame
6.	Hand Saw
7.	Allen Key Set
8.	Hammer Set
9.	Mallet Set
10.	Diagonal Side Cutter
11.	Combination Plier
12.	Nose Plier Set

13.	Locking Plier
14.	Measuring Tape
15.	Adjustable Screw Wrench
16.	Adjustable Pipe Wrench
17.	Ratchet Wrench
18.	Box Spanner Set
19.	Socket Set
20.	Open Ended Spanner Set
21.	Box Spanner Screw Drivers
22.	Steel Ruler
23.	Scissors
24.	Scriber
25.	Try Square
26.	Chisel Set
27.	Gas Welding Set with All Accessories
28.	Nitrogen Gas Cylinder with Hose Pipe, Regulator and Back Arrestor
29.	Tube Cutter
30.	Electric Hand Grinder
31.	Digital Air Flow / Velocity Meter
32.	Manual Screw Driver Set
33.	Electric Screw Driver Set
34.	Spirit Level
35.	Wire Stripper
36.	Digital Multi Meter
37.	Digital Clamp-On Ampere Meter
38.	Electric Hand Drills
39.	Insulation Remover
40.	HILTI Drill Machine (Piston Type)
41.	Digital Optical TachoMeter

42.	Megohmmeter(0 - 1000 Volts)
43.	Digital Capacitor Analyzer
44.	Digital Pressure Gauges Set (High &Combine)
45.	Fins Straightening Comb Set
46.	Flaring And Swaging Tool Kit
47.	Vacuum Pump 2-Stage, 6cfm
48.	Tube Benders (Spring Type and Pulley Bender Type)
49.	Laser Distance Measuring Device
50.	Laser Temperature Measuring Device
51.	Electronic Leak Detector

Code:

Repair / Service Residential Air Conditioner

Overview

This Competency Standard covers the competencies required to diagnose / repair / service residential Air Conditioners at workplace in accordance with the manufacturer specifications / guidelines. This unit covers the knowledge regarding safety rules, Personal Protective Equipment, and international standards for repairing / servicing of Residential Air Conditioners to provide you the basis for your work.

Competency Units	Performance Criteria
1. Diagnose Faults in Residential Air Conditioner	<p>P1. Check for obvious problem to determine which component or system is causing the problem</p> <p>P2. Select tools, equipment and related accessories according to requirements and standards</p> <p>P3. Check power supply, electric wiring, electric / electronic components and refrigerant pressure to determine the exact problem by using AVO meter / Gauge manifold / flow chart as recommended by manufacturer, and record the results</p> <p>P4. Eliminate the causes of the problem according to the manufacturer manual and standards</p> <p>P5. Isolate and recheck the causes of the problem and rectify the fault</p> <p>P6. Start the Air Conditioner and recheck the unit as specified in the manufacturer manual and record the results</p>
2. Repair Window / Split Air Conditioner	<p>P1. Select tools, equipment and related accessories according to job requirements</p> <p>P2. Disconnect the Air Conditioner from electric supply and follow the manual instructions for rectification</p> <p>P3. Rectify the diagnosed faults; repair / replace the components, as necessary</p> <p>P4. Switch on the Air Conditioner to check the performance of electrical/ electronic and mechanical components as specified in the manufacturer manual and record the results</p>
3. Service Window Air Conditioner	<p>P1. Select tools, equipment and related accessories according to job requirements</p> <p>P2. Start the Air Conditioner, check and record performance by using specified test instruments</p> <p>P3. Disconnect the Air Conditioner from electric supply</p>

	<p>and remove Air Conditioner from the cover</p> <p>P4. Secure the electric / electronic components with polythene sheet</p> <p>P5. Clean / wash all mechanical parts of Window Air conditioner with specified cleaning agents / detergent by using pressure pump</p> <p>P6. Fix the Air conditioner in the cover, connect with electric supply, check and record performance</p>
4. Service Split Air Conditioner	<p>P1. Select tools, equipment and related accessories according to job requirements</p> <p>P2. Start the Air Conditioner, check and record performance by using specified test instruments</p> <p>P3. Pump down the split Air Conditioner and dismantle both indoor unit and condensing unit</p> <p>P4. Clean the components of Air conditioner with specified cleaning agents/tools and material</p> <p>P5. Re-Install the indoor and outdoor unit; connect with refrigerant pipes, control wires and evacuation; open the service valves and leak testing</p> <p>P6. Switch on the Air Conditioner, check and record performance</p>

Knowledge & Understanding

The candidate must be able to demonstrate underpinning knowledge and understanding required to carry out tasks covered in this competency standard. This includes the knowledge of:

- Knowledge of American Society Of Heating, Refrigeration, And Air Conditioning Engineers (ASHRAE)
- Knowledge of Ozone Protection and Synthetic Greenhouse Gas Management Act 1989
- Basic load calculation for cooling / heating
- Fundamental knowledge of HVACR, Electric and Electronics
- Techniques for repairing of Window / Split Air Conditioners
- Technical Operations of Split Air Conditioners
- Electrical / copper piping layout plans/wiring diagrams
- Type of Electrical wires and cables including underground cables, their ratings and applications
- Techniques of diagnosing and troubleshooting of Residential Air Conditioners
- Familiarity with Residential Air Conditioner error codes and solution
- Types of motors used in Residential Air Conditioners
- Types of lubricants and their properties
- Capable to replace PCB Card
- Compressor types / Specifications and applications

- Methods of Copper Tube cutting / Bending /Swaging / Flaring / Brazing / Jointing / fixing
- Gas welding (Soldering and Brazing)
- Types of Insulation and their applications
- Methods of Pressurizing / Evacuation / Purging / Refrigerant Charging
- Types of Refrigerant, its properties, recovery and reclaiming
- Record Keeping and reporting

Critical Evidence(s) Required

The candidate needs to produce following critical evidence(s) in order to be competent in this competency standard:

- The candidate will demonstrate the following repair / service skills in a simulated environment to provide evidence of competency:
 - Diagnose faults of Air Conditioner by using specified tools and instruments
 - Perform pump down operation in split type air conditioner
 - Repair refrigerant leak in Air Conditioner
 - Replace the compressor of Air conditioner
 - Replace the printed circuit board (PCB) of split air conditioner

LIST OF TOOLS, EQUIPMENT AND MACHINERY

S.No.	Description
1.	Personal Protective Equipment (PPE)
2.	Allen Key Set
3.	Diagonal Side Cutter
4.	Combination Plier
5.	Nose Plier Set
6.	Locking Plier
7.	Metal Drill Bit Set
8.	Masonry Drill Set
9.	File Set
10.	Hand Hacksaw Frame
11.	Hammer Set
12.	Mallet Set
13.	Rivet Gun / Plier

14.	Adjustable Screw Wrench
15.	Adjustable Pipe Wrench
16.	Ratchet Wrench
17.	Box Spanner Set
18.	Socket Set
19.	Open Ended Spanner Set
20.	Box Spanner Screw Drivers
21.	Steel Ruler
22.	Scissors
23.	Scriber
24.	Pulley Wheel Puller
25.	Gas Welding Set with All Accessories
26.	Nitrogen Gas Cylinder with Hose Pipe, Regulator and Back Arrestor
27.	Digital Pressure Gauges Set (High & Combine)
28.	Tube Cutter
29.	Digital Capacitor Analyzer
30.	Hand Electric Blower
31.	Micron Pressure Gauge
32.	Pinch-Off Plier
33.	Flaring and Swaging Tool Kit
34.	Vacuum Pump 2-Stage, 6cfm
35.	Tube Benders (Spring Type and Pulley Bender Type)
36.	Laser Temperature Measuring Device
37.	Electronic Leak Detector
38.	Digital Air Flow / Velocity Meter
39.	Portable Refrigerant Charging Station
40.	Fins Straightening Comb Set
41.	Water Pressure Gun For Service
42.	Hot Air Gun

43.	Digital Optical TachoMeter
44.	Bearing Puller
45.	Manual Screw Driver Set
46.	Electric Screw Driver Set
47.	Soldering Iron
48.	Electric Hand Grinder
49.	Insulation Remover
50.	De-Soldering Tool
51.	Wire Stripper
52.	Digital Multi Meter
53.	Digital Clamp-On Ampere Meter
54.	Electric Hand Drills

Code:

Repair / Service Residential Refrigeration Units

Overview

This Competency Standard covers the competencies required to diagnose / repair / service residential refrigeration units at workplace in accordance with the manufacturer specifications / guidelines. This unit covers the knowledge regarding safety rules, Personal Protective Equipment, and international standards for repairing / servicing of residential refrigeration units to provide you the basis for your work.

Competency Units	Performance Criteria
1. Diagnose Faults in Residential Refrigeration Units	P1. Check for obvious problem to determine which component or system is causing the problem P2. Select tools, equipment and related accessories according to requirements and standards P3. Check power supply, electric wiring, electric / electronic components and refrigerant pressure to determine the exact problem by using AVO Meter / Gauge manifold as recommended by manufacturer and record the results P4. Eliminate the causes of the problem according to the manufacturer manual and standards P5. Isolate and recheck the causes of the problem and rectify the fault P6. Start the refrigeration unit and recheck as specified in the manufacturer manual and record the results
2. Repair / Service Residential Refrigerator / Freezer	P1. Select tools, equipment and related accessories according to job requirements P2. Disconnect the Refrigerator / Freezer from electric supply and follow the instructions in manufacture manual for rectification P3. Rectify the diagnosed faults; repair / replace the components, as necessary P4. Check, wash and restore to the actual condition Refrigerator / Freezer Body / Cabinets P5. Check, service, and replace if necessary, the proper functioning of Thermostat / Door Gasket / Heaters P6. Switch on the Refrigerator / Freezer to check the performance of electrical/ electronic and mechanical components as specified in the manufacturer manual and record the results

3. Repair / Service Residential Electric Water Cooler / Water Dispenser	<p>P1. Select tools, equipment and related accessories according to job requirements</p> <p>P2. Disconnect the water cooler / dispenser from electric supply and follow the manual instructions for rectification</p> <p>P3. Rectify the diagnosed faults; repair / replace the components, as necessary</p> <p>P4. Check, wash and restore to actual condition Water Cooler / Dispenser Body / Mounts</p> <p>P5. Switch on water cooler / dispenser to check the performance of electrical/ electronic and mechanical components as specified in the manufacturer manual and record the results</p>
--	---

Knowledge and Understanding

The candidate must be able to demonstrate underpinning knowledge and understanding required to carry out tasks covered in this competency standard. This includes the knowledge of:

- Knowledge of American Society of Heating, Refrigeration, and Air Conditioning Engineers (ASHRAE)
- Knowledge of Ozone Protection and Synthetic Greenhouse Gas Management Act 1989
- Fundamental knowledge of HVACR, Electric and Electronics
- Techniques for repairing of Refrigerators / Freezers / Water Coolers and Water Dispensers
- Technical Operations of Non-Frost refrigerators
- Types of electrical wires and cables, their ratings and applications
- Techniques for Diagnosing and Troubleshooting of Residential Refrigerators / Freezers / Water Coolers and Water Dispensers
- Types of Lubricants and their properties
- Capable to replace PCB Card
- Compressor types/ Specifications and applications
- Methods of Copper Tube Cutting / Bending /Swaging / Flaring / Brazing / Jointing / Fixing
- Gas welding (Soldering and Brazing)
- Methods of Pressurizing/ Evacuation / Purging / Refrigerant Charging
- Types of Refrigerant, its properties, recovery and reclaiming
- Record keeping and reporting

Critical Evidence(s) Required

The candidate needs to produce following critical evidence(s) in order to be competent in this competency standard:

- The candidate will demonstrate the following repair / service skills in a simulated environment to provide evidence of competency:
 - Diagnose faults of Non-Frost Refrigerator by using specified tools and instruments
 - Replace condenser fan motor in Electric water cooler
 - Charge the refrigerant in refrigerator / freezer
 - Replace the thermostat in Electric water dispenser

LIST OF TOOLS, EQUIPMENT AND MACHINERY

S.No.	Description
1.	Personal Protective Equipment
2.	Allen Key Set
3.	Bench Vice
4.	Center Punch
5.	File Set
6.	Hand Hacksaw Frame with Blade
7.	Metal Drill Bit Set
8.	Hammer Set
9.	Mallet Set
10.	Diagonal Side Cutter
11.	Combination Plier
12.	Nose Plier Set
13.	Locking Plier
14.	Rivet Gun / Plier
15.	Adjustable Screw Wrench
16.	Adjustable Pipe Wrench
17.	Ratchet Wrench
18.	Box Spanner Set

19.	Socket Set
20.	Open Ended Spanner Set
21.	Box Spanner Screw Drivers
22.	Steel Ruler
23.	Scissors
24.	Scriber
25.	Tap and Die Set
26.	Try Square
27.	Chisel Set
28.	Pulley Wheel Puller
29.	Gas Welding Set with All Accessories
30.	Nitrogen Gas Cylinder with Hose Pipe, Regulator and Back Arrestor
31.	Pipe Cutter
32.	Pipe Vice
33.	Manual Screw Driver Set
34.	Electric Screw Driver Set
35.	Electric Hand Grinder
36.	Scissors
37.	Soldering Iron
38.	Crimping Tool
39.	Insulation Remover
40.	Wire Stripper
41.	Digital Multi Meter
42.	Digital Clamp-On Ampere Meter
43.	Electric Hand Drills
44.	Hot Air Gun
45.	Digital Capacitor Analyzer
46.	Hand Electric Blower
47.	Digital Humidity Meter

48.	Digital Psychrometer(Hygrometer)
49.	Tube Cutter
50.	Digital Optical TachoMeter
51.	Micron Pressure Gauge
52.	Digital Pressure Gauges Set (High &Combine)
53.	Pinch-Off Plier
54.	Flaring And Swaging Tool Kit
55.	Vacuum Pump 2-Stage, 6cfm
56.	Tube Benders (Spring Type and Pulley Bender Type)
57.	Megohmmeter(0 - 1000 Volts)
58.	Laser Temperature Measuring Device
59.	Electronic Leak Detector
60.	Water Pressure Gun For Service
61.	Digital Air Flow / Velocity Meter
62.	Portable Refrigerant Charging Station

Code:

Install Commercial Refrigeration Units

Overview

This Competency Standard covers the competencies required to install different types and sizes of walk in coolers / freezers / ice making machines / chilled water tanks at work place in accordance with the organization guidelines. This unit covers the knowledge regarding safety rules, personal protective equipment, and international standards for installing Commercial refrigeration units to provide you the basis for your work.

Competency Units	Performance Criteria
1. Install Walk in Cooler / Freezer	<p>P1. Select tools, equipment and related accessories according to job requirements</p> <p>P2. Prepare insulated room for preserving the food on lowest temperature as per drawing and requirements</p> <p>P3. Prepare steel / concrete foundation / frame for installation of condensing unit following manufacturer specifications</p> <p>P4. Prepare and level the place to fix the evaporator and condensing unit firmly, according to manufacturer specifications</p> <p>P5. Layout piping and control wiring from indoor to outdoor unit according to instructional manual</p> <p>P6. Perform leak test, evacuation and charge the refrigerant according to unit specifications and standards</p> <p>P7. Connect the electric supply and operate the unit to check the performance according to unit specifications</p>
2. Install Ice Making Machine	<p>P1. Select tools, equipment and related accessories according to job requirements</p> <p>P2. Fix the machine on potable water supply by following manufacturer specifications</p> <p>P3. Measure the clearance on each side to be sure it meets the standards set by the manufacturer</p> <p>P4. Make water drain connections in order to empty purged and melt water as per manual instructions and client requirements</p> <p>P5. Install shut of valve on water supply near the machine according to unit specifications</p> <p>P6. Make electric supply switched on and check performance according to machine specification by using specific instruments</p>
3. Install Chilled Water Tank	<p>P1. Select tools, equipment and related accessories according to job requirements</p>

	<p>P2. Fix the cooler / tank on potable water supply by following manufacturer specifications and client requirements</p> <p>P3. Measure the clearance on each side to be sure it meets the standards set by the manufacturer</p> <p>P4. Make water drain connections adjacent to water supply as per instructions manual</p> <p>P5. Install shut off valve and no return valve at water supply line</p> <p>P6. Fix minimum water level protection and interlocking with refrigeration unit to prevent empty freezing</p> <p>P7. Make power supply as per manual instructions</p>
--	---

Knowledge and Understanding

The candidate must be able to demonstrate underpinning knowledge and understanding required to carry out tasks covered in this competency standard. This includes the knowledge of:

- Knowledge of Sheet Metal and Air Conditioning Contractors National Association (SMACNA)
- Regulations of American Society of Heating, Refrigeration, and Air Conditioning Engineers (ASHRAE)
- Ozone Protection and Synthetic Greenhouse Gas Management Act 1989
- Fundamental knowledge of HVACR, Electric and Electronics
- Layout plans, drawing and manufacturer specifications, and HVAC symbols etc.
- Type of Pipes, Pipe fittings and their applications
- Methods of Pipe Cutting / Welding / Jointing / Fixing / Sealing
- Preparation of hanging supportive structures for piping
- Types of insulation and their application
- Techniques for installation of Pipes by using specified test instruments
- Types of electrical wires and cables, including underground cables, their ratings and applications
- Techniques for installation of refrigeration units
- Methods of Copper Tube Cutting / Bending / Swaging / Flaring / Brazing / Jointing / fixing
- Types of Refrigerant, its properties, recovery and reclaiming
- Basic Masonry and Carpentry applications
- Gas welding (Soldering and Brazing)
- Compressor types and applications
- Methods of Pressurizing/ Evacuation / Purging / Refrigerant charging by using specified instruments
- Record keeping and reporting

Critical Evidence(s) Required

The candidate needs to produce following critical evidence(s) in order to be competent in this competency standard:

- The candidate will demonstrate the following Installation skills in a simulated environment to provide evidence of competency:
 - Install plumbing assembly with Electric Water Cooler / Chilled Water Tank
 - Make water drain connections for the installation of Ice Making Machine
 - Install anti freezing and water level protection system

LIST OF TOOLS, EQUIPMENT AND MACHINERY

S.No.	Description
1.	Personal Protective Equipment
2.	Allen Key Set
3.	Bench Vice
4.	Center Punch
5.	Pedestal Drill Machine
6.	Digital Vernier Caliper
7.	Metal Drill Bit Set
8.	Masonry Drill Set
9.	File Set
10.	Hand Hacksaw Frame
11.	Hand Saw
12.	Hammer Set
13.	Mallet Set
14.	Diagonal Side Cutter
15.	Combination Plier
16.	Nose Plier Set
17.	Locking Plier
18.	Measuring Tape
19.	Rivet Gun / Plier
20.	Adjustable Screw Wrench
21.	Adjustable Pipe Wrench
22.	Ratchet Wrench
23.	Box Spanner Set

24.	Socket Set
25.	Open Ended Spanner Set
26.	Box Spanner Screw Drivers
27.	Steel Ruler
28.	Scissors
29.	Scriber
30.	Tap and Die Set
31.	Try Square
32.	Chisel Set
33.	Pulley Wheel Puller
34.	Gas Welding Set with All Accessories
35.	Nitrogen Gas Cylinder with Hose Pipe, Regulator and Back Arrestor
36.	Pipe Cutter
37.	Pipe Vice
38.	Bearing Puller
39.	Manual Screw Driver Set
40.	Electric Screw Driver Set
41.	Spirit Level
42.	Electric Hand Grinder
43.	Wire Stripper
44.	Digital Multi Meter
45.	Digital Clamp-On Ampere Meter
46.	Electric Hand Drills
47.	Hot Air Gun
48.	HILTI Drill Machine (Piston Type)
49.	Digital Optical TachoMeter
50.	Megohmmeter(0 - 1000 Volts)
51.	De-Soldering Tool
52.	Soldering Iron

53.	Crimping Tool
54.	Insulation Remover
55.	Digital Capacitor Analyzer
56.	Tube Cutter
57.	Micron Pressure Gauge
58.	Digital Pressure Gauges Set (High & Combine)
59.	Pinch-Off Plier
60.	Flaring and Swaging Tool Kit
61.	Vacuum Pump 2-Stage, 6cfm
62.	Tube Benders (Spring Type and Pulley Bender Type)
63.	Laser Distance Measuring Device
64.	Laser Temperature Measuring Device
65.	Electronic Leak Detector
66.	Manometer
67.	Digital Air Flow / Velocity Meter
68.	Portable Refrigerant Charging Station
69.	Fins Straightening Comb Set

Code:

Repair / Service Commercial Refrigeration Units

Overview

This Competency Standard covers the competencies required to diagnose / repair / service residential refrigeration units at workplace in accordance with the manufacturer specifications / guidelines. This unit covers the knowledge regarding safety rules, Personal Protective Equipment, and international standards for repairing / servicing of refrigeration units to provide you the basis for your work.

Competency Units	Performance Criteria
1. Diagnose Faults in Commercial Refrigeration Units	<p>P1. Check for obvious problem to determine which component or system is causing problem</p> <p>P2. Select tools, equipment and related accessories according to requirements and standards</p> <p>P3. Check the power supply, electric wiring, electric / electronic components and refrigerant pressure to determine the exact problem by using flow chart as recommended by manufacturer and record the results</p> <p>P4. Eliminate the causes of the problem according to the manufacturer manual and standards</p> <p>P5. Isolate and recheck the causes of the problem and correct the fault</p> <p>P6. Start the refrigeration unit and recheck the unit as specified in the manufacturer manual and record the results</p>
2. Repair Commercial Refrigeration Units	<p>P1. Select tools, equipment and related accessories according to requirements and standards</p> <p>P2. Disconnect the unit from electric supply and follow the manual instructions for rectification</p> <p>P3. Rectify the diagnosed fault by repairing / replacing the components</p> <p>P4. Switch on the unit to check the performance of electrical/ electronic and mechanical components as specified in the manufacturer manual and record the results</p>

Knowledge & Understanding

The candidate must be able to demonstrate underpinning knowledge and understanding required to carry out tasks covered in this competency standard. This includes the knowledge of:

- Knowledge of American Society Of Heating, Refrigeration, And Air Conditioning Engineers (ASHRAE)
- Fundamental knowledge of Electric and Electronics
- Electrical / Copper Piping layout plans/ wiring diagrams
- Types of electrical wires and cables, including underground cables, their ratings and its applications
- Techniques for Diagnosing and Troubleshooting of Residential Refrigeration Units
- Familiarity with Refrigeration Units error codes and solution
- Methods of Copper Tube Cutting / Bending /Swaging / Flaring / Brazing / Jointing / Fixing
- Types of Lubricants and their properties
- Compressor types and applications
- Types of Refrigerant and its properties
- Methods of Pressurizing/ Evacuation / Purging / Refrigerant Charging
- Record keeping and reporting

Critical Evidence(s) Required

The candidate needs to produce following critical evidence(s) in order to be competent in this competency standard:

- The candidate will demonstrate the following repair skills in a simulated environment to provide evidence of competency:
 - Diagnose problems in a refrigeration unit
 - Repair leak in refrigeration unit
 - Replace the compressor
 - Replace the thermostat
 - Repair replace PCB Card

LIST OF TOOLS, EQUIPMENT AND MACHINERY

S.No.	Description
1.	Personal Protective Equipment
2.	Allen Key Set
3.	Bench Vice
4.	Center Punch
5.	Pedestal Drill Machine

6.	Digital Vernier Caliper
7.	Metal Drill Bit Set
8.	Masonry Drill Set
9.	File Set
10.	Hand Hacksaw Frame
11.	Hand Saw
12.	Hammer Set
13.	Mallet Set
14.	Digital Micro Meter
15.	Diagonal Side Cutter
16.	Combination Plier
17.	Nose Plier Set
18.	Locking Plier
19.	Measuring Tape
20.	Rivet Gun / Plier
21.	Adjustable Screw Wrench
22.	Adjustable Pipe Wrench
23.	Ratchet Wrench
24.	Box Spanner Set
25.	Socket Set
26.	Open Ended Spanner Set
27.	Box Spanner Screw Drivers
28.	Steel Ruler
29.	Scissors
30.	Scriber
31.	Tap and Die Set
32.	Try Square
33.	Chisel Set
34.	Pulley Wheel Puller

35.	Gas Welding Set with All Accessories
36.	Nitrogen Gas Cylinder with Hose Pipe, Regulator and Back Arrestor
37.	Pipe Cutter
38.	Pipe Vice
39.	Bearing Puller
40.	Manual Screw Driver Set
41.	Electric Screw Driver Set
42.	Spirit Level
43.	Electric Hand Grinder
44.	De-Soldering Tool
45.	Lcr Meter
46.	Soldering Iron
47.	Crimping Tool
48.	Insulation Remover
49.	Wire Stripper
50.	Digital Multi Meter
51.	Digital Clamp-On Ampere Meter
52.	Electric Hand Drills
53.	Hot Air Gun
54.	Digital Optical Tacho Meter
55.	Megohmmeter (0 - 1000 Volts)
56.	Water Pressure Gun for Service
57.	Digital Capacitor Analyzer
58.	Hand Electric Blower
59.	Tube Cutter
60.	Micron Pressure Gauge
61.	Digital Pressure Gauges Set (High & Combine)
62.	Pinch-Off Plier
63.	Flaring and Swaging Tool Kit

64.	Vacuum Pump 2-Stage, 6cfm
65.	Tube Benders (Spring Type and Pulley Bender Type)
66.	Laser Temperature Measuring Device
67.	Electronic Leak Detector
68.	Manometer
69.	Digital Air Flow / Velocity Meter
70.	Portable Refrigerant Charging Station
71.	Fins Straightening Comb Set

Code:

Carry out Fabrication for HVAC Work

Overview

This Competency Standard identifies the competencies required to fabricate different types of Ducts and Pipes at workplace in accordance with the international HVAC standards. Your underpinning knowledge regarding safety rules, Personal Protective Equipment, and international standards for fabricating and installing of Duct and Piping will be sufficient to provide the basis for your work.

Competency Units	Performance Criteria
1. Fabricate Ducts	<p>P1. Select tools, machines, equipment, sheet materials and related accessories according to requirements and standards</p> <p>P2. Take measurements, mark proper location and select Duct fittings as specified in the layout plan/ diagram</p> <p>P3. Prepare different types of Edges / Joints / Seams / Bends and Notches used to join Sheet Metal work</p> <p>P4. Prepare flexible connections between Duct sections and unit fittings (Air Handling Units / Fan Coil Units)</p> <p>P5. Prepare duct in required size, shape and pieces and connect with each other according to Duct route drawing</p> <p>P6. Seal Duct joints with good mastic material, to avoid air leakage, according to SMACNA /ASHRAE standards</p> <p>P7. Fabricate cladding to protect insulation</p>
2. Fabricate Pipes	<p>P1. Select tools, machines, equipment, pipe materials and related accessories according to requirements and standards</p> <p>P2. Prepare joints (Elbow / Reducer / Tees / Offset / Couplings / Flanges etc.) for jointing of Pipes as per layout plan / requirements</p> <p>P3. Prepare and clean Pipe joints for smooth Welding / Threading work according to layout plan / diagram</p> <p>P4. Carry out Jointing using Welding or Threading methods to ensure proper fitting according to international standards</p>
3. Install Ducts and Piping	<p>P1. Follow International standards of ASHRAE or SMACNA while installing ducts and piping</p> <p>P2. Select tools, equipment, Pipe materials and related accessories according to requirements and standards</p> <p>P3. Mark location for Duct and Pipes installations according to drawing specifications</p>

	<p>P4. Mount Hangers, Angle rails, threaded rods / Studs and Straps according to standards</p> <p>P5. Install the Ducts and Pipes on angle rails and ensure the straps are fabricated into one unit according to layout plan/ diagram</p> <p>P6. Seal all the joints with good mastic material to avoid leakage according to standards</p> <p>P7. Install Grills/Diffusers/Dampers and Flexible Duct according to drawing / layout plan</p> <p>P8. Install the valves in pipes as per drawing</p> <p>P9. Perform leak testing of piping and duct system as per standards</p>
<p>4. Insulate Ducts and Piping</p>	<p>P1. Select tools, equipment, pipe materials and related accessories according to requirements and standards</p> <p>P2. Prepare insulation material / Sound liner according to manufacturer specifications</p> <p>P3. Insulate water / steam pipes with specified insulation according to ASHRAE or SMACNA standards</p> <p>P4. Apply vapor barrier paper, cotton cloth wrapping and sheet metal cladding firmly on the ducts / pipes according to manufacturer specifications</p>

Knowledge and Understanding

The candidate must be able to demonstrate underpinning knowledge and understanding required to carry out tasks covered in this competency standard. This includes the knowledge of:

- Knowledge of Sheet Metal & Air Conditioning Contractors' National Association (SMACNA)
- Knowledge of American Society Of Heating, Refrigeration, And Air Conditioning Engineers (ASHRAE)
- Layout plans, drawing and manufacturer specifications, and HVAC symbols etc.
- Working at heights and platforms
- Use and transport of Ladders / Scaffolds safely
- Type of Ducts, Duct fittings and their applications
- Type of Pipes, Pipe fittings and their applications
- Methods of Duct Cutting / Bending / Jointing / Fixing and Sealing
- Methods of Pipe Cutting / Bending / Jointing / Fixing and Sealing
- Preparation of hanging supportive structures for Ducts and Piping
- Types and techniques of welding

- Types of Insulation and their application
- Techniques for installation of Ducts and Pipes by using specified test instruments
- Procedures of pressure testing of Pipes by using specified test instruments
- Procedures of leakage testing in Ducts by using light source
- Record keeping and reporting

Critical Evidence(s) Required

The candidate needs to produce following critical evidence(s) in order to be competent in this competency standard:

- The candidate will demonstrate the following Fabrication skills in a simulated environment to provide evidence of competency:
- Fabricate Duct accessories
- Fabricate Pipe accessories
- Perform welding / Brazing on Pipe joints
- Insulate the Ducts / Pipes
- Perform Leakage test of Ducts and Pipes in accordance with standard HVAC procedures

LIST OF TOOLS, EQUIPMENT AND MACHINERY

S.No.	Description
1.	Personal protective equipment
2.	Working tables
3.	Sheet metal tools
4.	Bench vice
5.	Pedestal drill machine
6.	Digital Vernier caliper
7.	Allen key set
8.	Center punch
9.	Metal Drill bit set
10.	Masonry drill set
11.	File set

12.	Hand Hacksaw frame
13.	Electric hand grinder
14.	Hammer set
15.	Mallet set
16.	Diagonal side cutter
17.	Combination plier
18.	Nose plier set
19.	Locking plier
20.	Measuring tape
21.	Rivet gun / plier
22.	Adjustable screw wrench
23.	Adjustable pipe wrench
24.	Ratchet wrench
25.	Box spanner set
26.	Socket set
27.	Open ended spanner set
28.	Box spanner screw drivers
29.	Steel ruler
30.	Scriber
31.	Tap and Die set
32.	Try square
33.	Chisel set
34.	Tin Cutter
35.	Gas welding set with all accessories
36.	Scissors
37.	Pipe cutter
38.	Pipe vice
39.	Electric hand drills
40.	Manual Screw driver set

41.	Electric Screw driver set
42.	Spirit level
43.	HILTI drill machine (Piston type)
44.	Laser distance measuring device
45.	Tube cutter

Code:

Install Central Air Conditioning Systems

Overview

This Competency Standard identifies the competencies required to install Package type unit / VRF / VRV / Absorption Chiller System at workplace in accordance with the organization / client guidelines under the supervision of HVAC Engineer. This unit covers the knowledge regarding safety rules, Personal Protective Equipment, and international standards for the installation of central air conditioning system to provide you the basis for your work.

Competency Units	Performance Criteria
1. Install Package Unit	<p>P1. Select tools, equipment and related accessories according to job requirements</p> <p>P2. Mark the location and area according to layout plan and manufacturer specifications</p> <p>P3. Prepare foundation as per drawing, place, adjust and level the Package unit by giving attention to safety precautions</p> <p>P4. Connect Package unit with supply, return and fresh air duct through flexible connection as per drawing / unit specification</p> <p>P5. Insulate duct where required</p> <p>P6. Remove all packaging material from work place</p> <p>P7. Connect the power supply and control wire</p> <p>P8. Switch on the supply and check the performance according to manufacturer instructions and standards</p>
2. Install Variable Refrigerant Flow (VRF) / Variable Refrigerant Volume (VRV) System	<p>P1. Select tools, equipment and related accessories according to job requirements</p> <p>P2. Prepare foundation as per drawing, place, adjust and level the outdoor unit by giving attention to safety precautions</p> <p>P3. Prepare piping, weld / braze them according to unit specifications and layout drawings</p> <p>P4. Install indoor units according to layout diagrams, client requirements and manufacturer instruction manual</p> <p>P5. Fix Shut-off valves with service ports on every indoor unit</p> <p>P6. Check leaks by applying pressure method before the joints insulation; repair leaks, if any</p> <p>P7. Insulate the copper pipe joints according to manufacturer instructions and standards</p>

	<p>P8. Evacuate the system and charge the refrigerant as per requirement</p> <p>P9. Connect the power supply and control wires attached with central control / Building Management (BMS) system</p> <p>P10. Switch on the system and check performance</p>
<p>3. Install Water Chiller System</p>	<p>P1. Select tools, equipment and related accessories according to job requirements</p> <p>P2. Mark the location and area according to layout plan</p> <p>P3. Prepare foundation as per drawing, place, adjust and level the chiller by giving attention to safety precautions</p> <p>P4. Install Air Handling Units (AHU) / Fan Coil Unit (FCU) at different locations inside the building according to drawing</p> <p>P5. Install high pressure MS Pipe from chiller to Air Handling Units/ Fan Coil Unit inside the building</p> <p>P6. Fabricate and install G.I sheet ducting inside the building as per drawing</p> <p>P7. Install Cooling Tower and water pumps (Only for water cooling condenser)</p> <p>Establish the electric power supply system for the chiller and air handling units and cooling tower as per Requirements and Standards</p>
<p>4. Carry out Commissioning</p>	<p>P1. Select tools, equipment and related accessories according to job requirements</p> <p>P2. Start the condenser and chilled water pump for water circulation in the system</p> <p>P3. Start the chiller and take reading of all parameters regarding temperature / pressure and electric power, check unusual vibrations / noises etc., if any</p> <p>P4. Perform Air Balancing and water balancing to check the air / water distribution according to design requirements</p> <p>P5. Check the system performance as per design criteria</p>

Knowledge & Understanding

The candidate must be able to demonstrate underpinning knowledge and understanding required to carry out tasks covered in this competency standard. This includes the knowledge of:

- Knowledge of American Society Of Heating, Refrigeration, And Air Conditioning Engineers (ASHRAE)
- Ozone Protection and Synthetic Greenhouse Gas Management Act 1989

- Fundamental knowledge of HVACR, Electric and Electronics
- Techniques for installation of central Air conditioners
- Fundamental and Technical Operations of VRF / VRV system
- Electrical / HVAC layout plans/wiring diagrams
- Types of electrical control wires, cables, including underground cables, their ratings and its applications
- Methods of Copper Tube Cutting / Bending /Swaging / Flaring / Brazing / Y-Jointing / Fixing
- Basic Masonry and Carpentry applications
- Welding types and techniques
- Types of Insulation and their applications
- Types of AHU, FCU, Chillers and Cooling Towers, Compressor, Condenser and pump types and their applications
- Types of Refrigerant, its properties, recovery and reclaiming
- Procedure regarding commissioning the central HVAC systems
- Record keeping and reporting

Critical Evidence(s) Required

The candidate needs to produce following critical evidence(s) in order to be competent in this competency standard:

- The candidate will demonstrate the following Installation skills in a simulated environment to provide evidence of competency:
 - Mark location according to specifications and standards
 - Perform electric connections to joint indoor unit and outdoor unit
 - Install the indoor / outdoor unit according to HVAC standards
 - Balancing the system (Air / Water)

LIST OF TOOLS, EQUIPMENT AND MACHINERY

S.No.	Description
1.	Personal Protective Equipment
2.	Allen Key Set
3.	Bench Vice
4.	Center Punch
5.	Pedestal Drill Machine

6.	Digital Vernier Caliper
7.	Metal Drill Bit Set
8.	Masonry Drill Set
9.	File Set
10.	Hand Hacksaw Frame
11.	Hammer Set
12.	Mallet Set
13.	Digital Micro Meter
14.	Diagonal Side Cutter
15.	Combination Plier
16.	Nose Plier Set
17.	Locking Plier
18.	Measuring Tape
19.	Rivet Gun / Plier
20.	Adjustable Screw Wrench
21.	Adjustable Pipe Wrench
22.	Ratchet Wrench
23.	Box Spanner Set
24.	Socket Set
25.	Open Ended Spanner Set
26.	Box Spanner Screw Drivers
27.	Steel Ruler
28.	Scissors
29.	Scriber
30.	Tap and Die Set
31.	Try Square
32.	Chisel Set
33.	Pulley Wheel Puller
34.	Gas Welding Set with All Accessories

35.	Nitrogen Gas Cylinder with Hose Pipe, Regulator and Back Arrestor
36.	Pipe Cutter
37.	Pipe Vice
38.	Manual Screw Driver Set
39.	Electric Screw Driver Set
40.	Spirit Level
41.	Electric Hand Grinder
42.	Soldering Iron
43.	Crimping Tool
44.	Insulation Remover
45.	De-Soldering Tool
46.	LCR Meter
47.	Wire Stripper
48.	Digital Multi Meter
49.	Digital Clamp-On Ampere Meter
50.	Electric Hand Drills
51.	Hot Air Gun
52.	HILTI Drill Machine (Piston Type)
53.	Digital Optical TachoMeter
54.	Megohmmeter (0 - 1000 Volts)
55.	Digital Capacitor Analyzer
56.	Hand Electric Blower
57.	Tube Cutter
58.	Micron Pressure Gauge
59.	Digital Pressure Gauges Set (High & Combine)
60.	Pinch-Off Plier
61.	Flaring and Swaging Tool Kit
62.	Vacuum Pump 2-Stage, 6cfm
63.	Tube Benders (Spring Type and Pulley Bender Type)

64.	Laser Distance Measuring Device
65.	Laser Temperature Measuring Device
66.	Electronic Leak Detector
67.	Manometer
68.	Digital Air Flow / Velocity Meter
69.	Portable Refrigerant Charging Station
70.	Fins Straightening Comb Set
71.	Digital Humidity Meter
72.	Digital Psychrometer (Hygrometer)

Code:

Repair / Service Central Air Conditioning System

Overview

This Competency Standard covers the competencies required to diagnose / repair / service central air conditioning system at workplace in accordance with the manufacturer specifications / guidelines. This unit covers the knowledge regarding safety rules, Personal Protective Equipment, and international standards for repairing / servicing of central air conditioning units to provide you the basis for your work.

Competency Units	Performance Criteria
1. Diagnose Fault in Central Air Conditioning System	<p>P1. Check for obvious problem to determine which component or system is causing the problem</p> <p>P2. Select tools, equipment and related accessories according to requirements and standards</p> <p>P3. Arrange drawings and manuals of the equipment to be attended for diagnosing the fault</p> <p>P4. Check the power supply, electric wiring, electric / electronic components and refrigerant pressure to determine the exact problem and record the results</p> <p>P5. Start the air conditioning unit and recheck as specified in the manufacturer manual and record the results</p>
2. Repairing of Chillers / Air Handling Unit (AHU) / Fan Coil Unit (FCU)	<p>P1. Select tools, equipment and related accessories according to job requirements</p> <p>P2. System shut down and follow the instructions manual for rectification</p> <p>P3. Rectify the diagnosed faults; repair / replace the components, as necessary</p> <p>P4. Switch on the system to check the performance of electrical / mechanical components as specified in the manufacturer manual and record the results</p>
3. Repair Pumps and Cooling Tower	<p>P1. Select tools, equipment and related accessories according to job requirements</p> <p>P2. System shut down and follow the instructions manual for rectification</p> <p>P3. Check water level of cooling tower</p> <p>P4. Check the fan assembly, to check the bearings and motor abnormalities according to manufacturer specifications and HVAC standards</p> <p>P5. Check the float valves and strainers to maintain</p>

	<p>water level</p> <p>P6. Perform chemical treatment to prevent the sludge / scaling problems according to manufacturer specifications and HVAC standards</p> <p>P7. Condenser / chilled water pumps start and check their performance according to their specifications; service / repair, if necessary</p> <p>P8. Clean the sprinkler assembly water pan from leaves, mud, and scale, if any</p> <p>P9. Rectify the fault and restart the cooling tower and pumps</p>
4. Repair Control System	<p>P1. Select tools, equipment and related accessories according to job requirements</p> <p>P2. System shut down and follow the instructions manual for rectification</p> <p>P3. Arrange drawings and manuals of the equipment to be attended for diagnosing the fault</p> <p>P4. Check the details of fault / errors on computer screen to rectify the same</p> <p>P5. Eliminate the causes of the problem according to the manufacturer manual and standards</p> <p>P6. Isolate and recheck the causes of the problem and correct the fault</p> <p>P7. Start the air conditioning unit and recheck as specified in the manufacturer manual and record the results</p>

Knowledge & Understanding

The candidate must be able to demonstrate underpinning knowledge and understanding required to carry out tasks covered in this competency standard. This includes the knowledge of:

- Regulations of American Society Of Heating, Refrigeration, And Air Conditioning Engineers (ASHRAE)
- Ozone Protection and Synthetic Greenhouse Gas Management Act 1989
- Fundamental knowledge of HVACR and Electrical / Electronic components
- Technical Operations of Chillers, Cooling Tower, Pumps, AHUs & FCUs
- Types of electrical controls, wires and cables, including underground cables, their ratings and its applications
- Techniques for Diagnosing and Troubleshooting of central Air conditioning systems
- Capability to replace the PCB Cards and controls

- Fundamental knowledge of PLC and Microprocessor Methods of Copper Tube Cutting / Bending /Swaging / Flaring / Brazing / Jointing / Fixing
- Familiarity with central Air conditioners error codes and solution
- Types of Motors used in central Air conditioners
- Types of controls and their functions used in central air conditioning systems
- Capability to use and handle the micron gauge for deep vacuum measuring
- Gas welding (Soldering and Brazing)
- Types of Insulation and their applications
- Compressor, Condenser, Evaporator types and applications
- Types of Refrigerant, its properties, recovery and reclaiming
- Record keeping and reporting

Critical Evidence(s) Required

The candidate needs to produce following critical evidence(s) in order to be competent in this competency standard:

- The candidate will demonstrate the following repair / service skills in a simulated environment to provide evidence of competency:
 - Diagnose faults of central Air Conditioning Systems by using specified tools and instruments
 - Repair refrigerant leaks
 - Replace the Condenser motor
 - Replace the control
 - Replace water pump
 - Replace motorized actuators

LIST OF TOOLS, EQUIPMENT AND MACHINERY

S.No.	Description
1.	Personal Protective Equipment
2.	Allen Key Set
3.	Bench Vice
4.	Center Punch
5.	Pedestal Drill Machine
6.	Digital Vernier Caliper
7.	Metal Drill Bit Set

8.	Masonry Drill Set
9.	File Set
10.	Hand Hacksaw Frame
11.	Hand Saw
12.	Hammer Set
13.	Mallet Set
14.	Digital Micro Meter
15.	Diagonal Side Cutter
16.	Combination Plier
17.	Nose Plier Set
18.	Locking Plier
19.	Measuring Tape
20.	Rivet Gun / Plier
21.	Adjustable Screw Wrench
22.	Adjustable Pipe Wrench
23.	Ratchet Wrench
24.	Box Spanner Set
25.	Socket Set
26.	Open Ended Spanner Set
27.	Box Spanner Screw Drivers
28.	Steel Ruler
29.	Scissors
30.	Scriber
31.	Tap and Die Set
32.	Try Square
33.	Chisel Set
34.	Pulley Wheel Puller
35.	Gas Welding Set with Table and All Accessories
36.	Nitrogen Gas Cylinder with Hose Pipe, Regulator and Back Arrestor

37.	Pipe Cutter
38.	Pipe Vice
39.	Bearing Puller
40.	Manual Screw Driver Set
41.	Electric Screw Driver Set
42.	Spirit Level
43.	Electric Hand Grinder
44.	Soldering Iron
45.	Crimping Tool
46.	Insulation Remover
47.	De-Soldering Tool
48.	LCR Meter
49.	Wire Stripper
50.	Digital Multi Meter
51.	Digital Clamp-On Ampere Meter
52.	Electric Hand Drills
53.	Hot Air Gun
54.	HILTI Drill Machine (Piston Type)
55.	Digital Optical TachoMeter
56.	Megohmmeter (0 - 1000 Volts)
57.	Digital Capacitor Analyzer
58.	Hand Electric Blower
59.	Tube Cutter
60.	Micron Pressure Gauge
61.	Digital Pressure Gauges Set (High & Combine)
62.	Pinch-Off Plier
63.	Flaring and Swaging Tool Kit
64.	Vacuum Pump 2-Stage, 6cfm
65.	Tube Benders (Spring Type and Pulley Bender Type)

66.	Laser Distance Measuring Device
67.	Laser Temperature Measuring Device
68.	Electronic Leak Detector
69.	Manometer
70.	Digital Air Flow / Velocity Meter
71.	Portable Refrigerant Charging Station
72.	Fins Straightening Comb Set
73.	Digital Humidity Meter
74.	Digital Psychrometer (Hygrometer)
75.	Water Pressure Gun For Service

Code:

Perform Preventive Maintenance

Overview

This Competency Standard covers the competencies required to calibrate and carry out maintenance of refrigeration / air conditioning system skills at workplace in accordance with the manufacturer specifications / guidelines. This unit covers the knowledge regarding safety rules, Personal Protective Equipment, and international standards for calibrating / maintenance of refrigeration / air conditioning units to provide you the basis for your work.

Competency Units	Performance Criteria
1. Calibrate / Replace the Measuring Instruments	<p>P1. Shut down the system if necessary and dismantle measuring instruments</p> <p>P2. Select and arrange tools, equipment and related accessories according to job requirements / sequence of operation</p> <p>P3. Calibrate / replace the instruments following the manufacturer instructions</p> <p>P4. Reinstall measuring instruments and start the system to check the performance of calibrated instrument as specified by the manufacturer manual</p> <p>P5. Record the output result of measuring instrument for future reference</p> <p>P6. Follow HVACR standards to complete the job</p>
2. Carry out Maintenance	<p>P1. Pump down / Shut down the system if necessary</p> <p>P2. Select and arrange tools, equipment and material according to job requirements / sequence of operation</p> <p>P3. Check different machines with measuring instruments for temperature, vibration and noise, etc. so as to operate the plant at desired efficiency</p> <p>P4. Carry out weekly / monthly / annual maintenance according to schedule</p> <p>P5. Check and record the performance of system after maintenance</p> <p>P6. Follow HVACR standards to complete the job</p>

Knowledge and Understanding

The candidate must be able to demonstrate underpinning knowledge and understanding required to carry out tasks covered in this competency standard. This includes the knowledge of:

- Ozone Protection and Synthetic Greenhouse Gas Management Act 1989
- Knowledge of American Society Of Heating, Refrigeration, And Air Conditioning Engineers (ASHRAE)
- Fundamental knowledge of HVACR, Electrical and Electronics control
- Technical Operations of Control
- Types of electrical wires and cables, their ratings and its applications
- Purpose / Advantages of preventive maintenance
- Techniques for Diagnosing and Troubleshooting of controls
- Controls error codes and solution
- Types of controls and their functions used in Central Air Conditioning Systems
- Procedure to replace PCB cards and controls
- Methods of calibration of different measurement instruments
- Record keeping and reporting

Critical Evidence(s) Required

The candidate needs to produce following critical evidence(s) in order to be competent in this competency standard:

- The candidate will demonstrate the following preventive maintenance skills in a simulated environment to provide evidence of competency:
 - Calibrate air temperature pressure gauge control device
 - Measure airflow / water flow difference
 - Provide system log sheet and recommend repairs or replacement as necessary

LIST OF TOOLS, EQUIPMENT AND MACHINERY

S.No.	Description
1.	Personal Protective Equipment
2.	Calibrating Tool Set
3.	Allen Key Set
4.	Bench Vice
5.	Center Punch
6.	Pedestal Drill Machine
7.	Digital Vernier Caliper
8.	Metal Drill Bit Set

9.	Masonry Drill Set
10.	File Set
11.	Hand Hacksaw Frame
12.	Hammer Set
13.	Mallet Set
14.	Digital Micro Meter
15.	Diagonal Side Cutter
16.	Combination Plier
17.	Nose Plier Set
18.	Locking Plier
19.	Measuring Tape
20.	Rivet Gun / Plier
21.	Adjustable Screw Wrench
22.	Adjustable Pipe Wrench
23.	Ratchet Wrench
24.	Box Spanner Set
25.	Socket Set
26.	Open Ended Spanner Set
27.	Box Spanner Screw Drivers
28.	Steel Ruler
29.	Scissors
30.	Scriber
31.	Tap and Die Set
32.	Try Square
33.	Chisel Set
34.	Pulley Wheel Puller
35.	Gas Welding Set with All Accessories
36.	Nitrogen Gas Cylinder with Hose Pipe, Regulator and Back Arrestor
37.	Pipe Cutter

38.	Tube Cutter
39.	Pipe Vice
40.	Bearing Puller
41.	Manual Screw Driver Set
42.	Electric Screw Driver Set
43.	Spirit Level
44.	Electric Hand Grinder
45.	Soldering Iron
46.	De-Soldering Tool
47.	LCR Meter
48.	Crimping Tool
49.	Insulation Remover
50.	Wire Stripper
51.	Digital Multi Meter
52.	Digital Clamp-On Ampere Meter
53.	Electric Hand Drills
54.	Hot Air Gun
55.	HILTI Drill Machine (Piston Type)
56.	Digital Optical TachoMeter
57.	Megohmmeter (0 - 1000 Volts)
58.	Digital Capacitor Analyzer
59.	Hand Electric Blower
60.	Micron Pressure Gauge
61.	Digital Pressure Gauges Set (High &Combine)
62.	Pinch-Off Plier
63.	Flaring and Swaging Tool Kit
64.	Vacuum Pump 2-Stage, 6cfm
65.	Tube Benders (Spring Type and Pulley Bender Type)
66.	Laser Distance Measuring Device

67.	Laser Temperature Measuring Device
68.	Electronic Leak Detector
69.	Manometer
70.	Digital Air Flow / Velocity Meter
71.	Water Pressure Gun for Service
72.	Digital Humidity Meter
73.	Digital Psychrometer (Hygrometer)
74.	Portable Refrigerant Charging Station
75.	Fins Straightening Comb Set