



***National Competency Standards Level-5 for “HVACR”***



**National Competency Standards Level-5 for “HVACR Technology”**



**National Vocational and Technical Training Commission (NAVTTTC),  
Government of Pakistan**



## **National Competency Standards Level-5 for “HVACR”**



### **ACKNOWLEDGEMENTS**

National Vocational and Technical Training Commission (NAVTTTC) extends its gratitude and appreciation to many representatives of business, industry, academia, government agencies, Provincial TEVTAs, Sector Skill Councils and trade associations who spared their time and expertise to the development and validation of these National Vocational Qualifications (Competency Standards, Curricula, Assessments Packs and related material). This work would not have been possible without the financial and technical support of the TVET Sector Support Programme co-funded by European Union, Norwegian and German Governments implemented by GIZ Pakistan. NAVTTTC is especially indebted to *Dr. Muqem ul Islam*, who lead the project from the front. The core team was comprised on:

- *Dr. Muqem ul Islam*, Director General (Skills, Standards and Curricula) NAVTTTC
- *Mr. Muhammad Naeem Akhtar*, Senior Technical Advisor TSSP-GIZ,
- *Mr. Muhammad Yasir*, Deputy Director (SS&C Wing) NAVTTTC
- *Mr. Muhammad Ishaq*, Deputy Director (SS&C Wing) NAVTTTC
- *Mr. Fayaz A. Soomro*, Deputy Director (SS&C Wing) NAVTTTC

NAVTTTC team under the leadership of Dr. Muqem ul Islam initiated development of CBT & A based qualifications of diploma level-5 as a reform project of TVET sector in November 2018 and completed 27 NVQF diplomas of Level-5 in September, 2019. It seems worth highlighting that during this endeavor apart from developing competency standards/curricula in conventional trades new dimensions containing high-tech trades in TVET sector in the context of generation IR 4.0 trades have also been developed which inter alia includes Robotics, Mechatronics, artificial intelligence, industrial automation, instrumentation and process control. Moreover, trades like entrepreneurship, green/environmental skills and variety of soft/digital skill have also been developed to equip the Pakistani youth with skills set as per requirement of the global trends. These skills have been made integral part of all the 27 diplomas.

Nobody has been more important in the pursuit of this project than Dr. Nasir Khan, Executive Director, NAVTTTC, whose patronage and support remain there throughout the development process and lastly to thanks specially to Syed Javed Hassan, Chairman NAVTTTC and Raja Saad Khan, Deputy Team Lead TSSP-GIZ who made it happened in this challenging time.



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## National Competency Standards Level-5 for “HVACR”



### Introduction

The HVACR Industry is a worldwide enterprise, having role including operation, maintenance, system design, construction, equipment manufacturing, sales, education and research. The HVACR industry is being regulated by the manufacturers of HVACR equipment, but organizations such as HARDI, ASHRAE, SMACNA, ACCA, etc. have been established to support the industry and to encourage high standards of achievements. HVACR is a necessity of the day for personal comfort, medical health, food preservation, water supply and work productivity. In fact, all human activities rely on HVACR in one way or the other. This industry produces thousands of jobs in the market for its products. The HVACR experts plan, install and maintain the climate control system that makes our environment more comfortable and functional. The areas mentioned above continuously upgrading existing system for economical cost and environment efficiency. The HVACR field also offers variety of jobs and opportunities to grow for obtaining better bread and butter and its professionals can use their skills at any place in the world. Homes, Office Buildings, Industries such as Chemical, Food Preservation, Medical & Textile, Airplanes, Railways, Vehicles, Mobile Refrigerating Units and Electronic Equipment, all rely on HVACR systems for their better working. Hence the HVACR technology/industry provides huge employment opportunities for HVACR professionals in the field of Designing, Manufacturing, Erection, Operation & Maintenance throughout Pakistan and abroad.

### 2. Purpose of the Qualification

The purpose of this qualification is to set high professional standards for HVACR industry. The specific objectives for developing this qualification are as under:

- Improve the professional competence of the trainees
- Provide opportunities for the recognition of skills attained by a person through non-formal or informal pathways
- Improve the quality & effectiveness of training and assessment for HVACR industry
- Enable the existing workforce to capacitate themselves in new techniques and methods

### 3. Levelling of Core Competencies of the Qualification

Code #	Competency Standards	Level	Hrs.	Credit Hrs.	Category
<b>Safety in HVAC&amp;R Systems (HVAC-121)</b>					
<b>CS.1</b>	Apply Occupational Health & Safety (OSH)	1	40	4	Technical
<b>CS.2</b>	Maintain Safe Work Environment	2	40	4	Technical
<b>Applied Electricity (ET-113)</b>					



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<b>CS.3</b>	Make PVC Cable Joints and Construct Electrical Test Box	1	60	6	Technical
<b>CS.4</b>	Connect Loads in Electrical Circuit	1	30	3	Technical
<b>CS.5</b>	Measure Electrical Quantities in Electrical Circuits	2	40	4	Technical
<b>CS.6</b>	Prepare Electrical Circuits for Commercial Refrigeration Systems	2	40	4	Technical
<b>CS.7</b>	Evaluate Transformer & Verify Kirchoff's Law	2	30	3	Technical
<b>Technical Drawing (MT-111)</b>					
<b>CS.8</b>	Apply Basics of Drawing	1	30	3	Technical
<b>CS.9</b>	Draw Pictorial Drawing	1	20	2	Technical
<b>CS.10</b>	Apply Basic Dimensioning System in Working Drawing	1	20	2	Technical
<b>CS.11</b>	Draw Sectioning Drawing	2	30	3	Technical
<b>CS.12</b>	Draw Auxiliary Drawing	2	30	3	Technical
<b>Principles of Refrigeration (HVAC-113)</b>					
<b>CS.13</b>	Identify and Use HVAC Tools	1	70	7	Technical
<b>CS.14</b>	Joint Copper tubes	2	70	7	Technical
<b>CS.15</b>	Use of Pressure gauges & Meters for measuring System Parameters	2	30	3	Technical
<b>CS.16</b>	Check and Test compressors	2	70	7	Technical
<b>CS.17</b>	Check and Test electrical accessories	2	40	4	Technical
<b>CS.18</b>	Check and Test Electric Motors	2	20	2	Technical
<b>Workshop Practice-I (HVAC-132)</b>					
<b>CS.19</b>	Perform Sheet metal Processes	1	60	6	Technical
<b>CS.20</b>	Perform Threading with Tap & Die	2	30	3	Technical
<b>CS.21</b>	Perform Machining Operation	2	40	4	Technical
<b>CS.22</b>	Perform Taper turning, Drilling and Thread Cutting by Lathe Machine	2	40	4	Technical
<b>CS.23</b>	Perform Welding Process	2	80	8	Technical
<b>Applied Thermodynamics in HVAC&amp;R Systems (HVAC-223)</b>					
<b>CS.24</b>	Analyze Thermodynamics performance of HVAC system	3	50	5	Technical
<b>CS.25</b>	Prepare Boiler for Smooth Operation	3	60	6	Technical
<b>CS.26</b>	Perform Water Treatment	3	30	3	Technical
<b>Advance Refrigeration (HVAC-243)</b>					
<b>CS.27</b>	Service and Maintain Transport Refrigeration Units	3	30	3	Technical
<b>CS.28</b>	Apply Principles of Refrigeration in Cold Storage Technology	3	30	3	Technical
<b>CS.29</b>	Maintain and Repair Multistage, Cascade & Ultra low Temperature Refrigeration	4	20	2	Technical





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	System				
<b>CS.30</b>	Monitor Refrigeration in Food Processing	4	40	4	Technical
<b>HVAC&amp;R Workshop Practice-II (HVAC-253)</b>					
<b>CS.31</b>	Perform refrigerant recovery	3	10	1	Technical
<b>CS.32</b>	Install Residential Air conditioner	3	40	4	Technical
<b>CS.33</b>	Repair refrigerator, deep freezer, display unit, bottle cooler and Water cooler	3	110	11	Technical
<b>CS.34</b>	Repair and Service Residential Air conditioner	3	60	6	Technical
<b>CS.35</b>	Overhaul the compressors	3	20	2	Technical
<b>CS.36</b>	Repair and Service Residential Refrigeration Units	3	30	3	Technical
<b>CS.37</b>	Test, Recover, evacuate and charge refrigeration system	3	70	7	Technical
<b>Principle of Air Conditioning (HVAC-214)</b>					
<b>CS.38</b>	Calculate Fundamental Properties of Gases	2	30	3	Technical
<b>CS.39</b>	Calculate Psychrometric Process of Air	3	70	7	Technical
<b>CS.40</b>	Calculate Psychrometric Properties of System Air	4	80	8	Technical
<b>CS.41</b>	Analyze the Psychrometric performance of HVAC system	4	70	7	Technical
<b>Engr. Architectural and Computer Aided Drawing (HVAC-233)</b>					
<b>CS.42</b>	Develop Geometrical Solids	3	60	6	Technical
<b>CS.43</b>	Draw Projection of Pipes	3	30	3	Technical
<b>CS.44</b>	Draw Building Drawings	4	50	5	Technical
<b>CS.45</b>	Prepare Computer Aided Drawings (Auto CAD) File	5	110	11	Technical
<b>Air conditioning System Design (HVAC-315)</b>					
<b>CS.46</b>	Contribute to the design of Commercial Refrigeration System	4	50	5	Technical
<b>CS.47</b>	Design HVAC System and Select Components	5	50	5	Technical
<b>CS.48</b>	Develop Specifications and Prepare Drawings for HVAC Systems	5	30	3	Technical
<b>CS.49</b>	Calculate Cooling Load of Commercial Buildings	5	110	11	Technical
<b>CS.50</b>	Design and Select Fan for HVAC System	5	30	3	Technical
<b>CS.51</b>	Design Duct System for Commercial HVAC System	5	40	4	Technical
<b>CS.52</b>	Design Piping for Commercial HVAC System	5	40	4	Technical
<b>CS.53</b>	Design& Select Pumps for HVAC System	5	40	4	Technical



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<b>Water &amp; Air Distribution (HVAC-322)</b>					
<b>CS.54</b>	Attenuate Noise & Vibration encounter in HVAC Applications	4	30	3	Technical
<b>CS.55</b>	Perform Water Treatment in HVAC System	4	40	4	Technical
<b>CS.56</b>	Analyze the Operation of HVAC Air and Hydronic System	5	40	4	Technical
<b>Heat Transfer and Refrigeration Calculations (HVAC-353)</b>					
<b>CS.57</b>	Calculate Quantity of Heat Transfer for Different Applications	4	20	2	Technical
<b>CS.58</b>	Plot Refrigeration Cycle on PH Chart	4	20	2	Technical
<b>CS.59</b>	Calculate Different Process on PH Chart	4	40	4	Technical
<b>CS.60</b>	Calculate the Quantity of Gases in a Flue Gas Sample	5	20	2	Technical
<b>Basic Electronics Applied to HVACR Systems (ELR-311)</b>					
<b>CS.61</b>	Make Circuit using Electronic Components	3	20	2	Technical
<b>CS.62</b>	Make Temperature Control & Sensing Devices	4	20	2	Technical
<b>CS.63</b>	Connect the Accessories in Control Circuits	4	40	4	Technical
<b>CS.64</b>	Make Opto-Coupler Devices	5	20	2	Technical
<b>Workshop Practice - III (HVAC-363)</b>					
<b>CS.65</b>	Install Commercial Refrigeration System	4	30	3	Technical
<b>CS.66</b>	Install, Maintain & Repair Industrial Refrigeration System	4	30	3	Technical
<b>CS.67</b>	Install, Maintain & Repair Commercial Refrigeration System	5	20	2	Technical
<b>CS.68</b>	Install, Maintain & Repair Package Type Air Conditioning System	4	20	2	Technical
<b>CS.69</b>	Install Central Air Conditioning System	5	30	3	Technical
<b>CS.70</b>	Repair and Service Central Air Conditioning System	5	60	6	Technical
<b>CS.71</b>	Service and Maintain Ceiling Mounted Cassette Type Air Conditioner	4	20	2	Technical
<b>CS.72</b>	Service and Maintain Cooling Tower	5	30	3	Technical
<b>CS.73</b>	Perform Preventive Maintenance	5	30	3	Technical
<b>CS.74</b>	Diagnose Faults in Complex HVAC Control System	5	30	3	Technical
<b>CS.75</b>	Service and Maintain Automobile Air Conditioner	4	30	3	Technical
<b>CS.76</b>	Perform Commissioning of HVAC Systems	5	20	2	Technical
<b>CS.77</b>	Install and Commission Carbon Dioxide	5	20	2	Technical



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	Refrigeration System Components & Accessories				
<b>Industrial Refrigeration &amp; Air-conditioning Machines &amp; Equipment (HVAC-342)</b>					
<b>CS.78</b>	Operate & Maintain Absorption Air Conditioning System	5	30	3	Technical
<b>CS.79</b>	Check & Inspect Air Washer System in respect of Preventive Maintenance	5	20	2	Technical
<b>CS.80</b>	Check & Inspect Central Air Conditioning System	5	20	2	Technical
<b>CS.81</b>	Install & Commission Ammonia Refrigeration System, Components & Accessories	5	30	3	Technical
<b>CS.82</b>	Check and Inspect HVAC Variable Refrigerant Flow (VRF) System	5	30	3	Technical
<b>CS.83</b>	Check and Inspect Centrifugal HVAC System	5	10	1	Technical
<b>CS.84</b>	Check and Inspect Screw Type HVAC System	5	10	1	Technical
<b>CS.85</b>	Install, Maintain and Repair Industrial Refrigeration Systems	5	30	3	Technical
<b>CS.86</b>	Service and Maintain Air Handling Unit (AHU)	5	10	1	Technical
<b>Controls &amp; instrumentation (HVAC-334)</b>					
<b>CS.87</b>	Check and Connect Basic Controls used in HVAC	4	30	3	Technical
<b>CS.88</b>	Prepare Control Circuits	4	30	3	Technical
<b>CS.89</b>	Measure Air Velocity	5	10	1	Technical
<b>CS.90</b>	Produce HVACR Control System Drawings	5	30	3	Technical
<b>CS.91</b>	Adjust and Balance HVACR Controls	5	20	2	Technical
<b>CS.92</b>	Operate HVAC Building Management System (BMS)	5	30	3	Technical
<b>Entrepreneurial Skill</b>					
<b>CS.93</b>	Develop Entrepreneurial Skills	4	5	0.5	Generic
<b>CS.94</b>	Apply project information management and communications techniques	5	5	0.5	Generic
<b>CS.95</b>	Apply project human resources management approaches	5	5	0.5	Generic
<b>CS.96</b>	Direct human resources management of a project program	5	5	0.5	Generic
<b>CS.97</b>	Develop a project management plan	5	5	0.5	Generic
<b>CS.98</b>	Maintain business resources	4	5	0.5	Generic
<b>CS.99</b>	Develop a sales plan	4	5	0.5	Generic
<b>CS.100</b>	Plan and implement business-to-business marketing	5	5	0.5	Generic



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<b>CS.101</b>	Address customer needs	3	5	0.5	Generic
<b>CS.102</b>	Manage personal finances	5	5	0.5	Generic
<b>CS.103</b>	Solve problems which jeopardize safety and security	5	5	0.5	Generic
<b>CS.104</b>	Coordinate a work team	4	5	0.5	Generic
<b>CS.105</b>	Lead small teams	4	5	0.5	Generic
<b>CS.106</b>	Plan and organize work	5	5	0.5	Generic
<b>CS.107</b>	Develop teams and individuals	4	5	0.5	Generic
<b>CS.108</b>	Apply problem solving techniques in the workplace using critical thinking	5	5	0.5	Generic
<b>CS.109</b>	Manage human resource services	5	5	0.5	Generic
<b>Soft Skills</b>					
<b>CS.110</b>	Develop workplace policy and procedures for sustainability	5	5	0.5	Generic
<b>CS.111</b>	Manage meetings	4	5	0.5	Generic
<b>CS.112</b>	Manage recruitment selection and induction processes	5	5	0.5	Generic
<b>CS.113</b>	Manage personal work priorities and professional development	5	5	0.5	Generic
<b>CS.114</b>	Manage workforce planning	5	5	0.5	Generic
<b>CS.115</b>	Undertake project work	5	5	0.5	Generic
<b>CS.116</b>	Identify and communicate trends in career development	5	5	0.5	Generic
<b>CS.117</b>	Apply specialist interpersonal and counseling interview skills	5	5	0.5	Generic
<b>CS.118</b>	Work safely in an office environment	4	5	0.5	Generic
<b>CS.119</b>	Develop workplace documents	5	5	0.5	Generic
<b>CS.120</b>	Prepare and implement negotiation	5	5	0.5	Generic
<b>CS.121</b>	Maintain professionalism in the workplace	5	5	0.5	Generic
<b>CS.122</b>	Maintain professional development and career professionalism	5	5	0.5	Generic
<b>CS.123</b>	Organize schedules	5	5	0.5	Generic
<b>Digital Skills</b>					
<b>CS.124</b>	Use computer operating systems and hardware	5	5	0.5	Generic
<b>CS.125</b>	Operate digital media technology	4	5	0.5	Generic
<b>CS.126</b>	Perform computer operations	4	5	0.5	Generic
<b>CS.127</b>	Use computer applications	2	5	0.5	Generic
<b>CS.128</b>	Create user documentation	2	5	0.5	Generic
<b>CS.129</b>	Create technical documentation	4	5	0.5	Generic
<b>CS.130</b>	Create basic databases	5	5	0.5	Generic
<b>CS.131</b>	Use social media tools for collaboration and engagement	4	5	0.5	Generic
<b>CS.132</b>	E-Commerce- SEO (Search Engine Optimization)	4	5	0.5	Generic
<b>CS.133</b>	E-Commerce- SCM (Supply Chain	5	5	0.5	Generic



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	Management)				
<b>CS.134</b>	E-Commerce- Social Media Marketing	5	5	0.5	Generic
<b>CS.135</b>	Use digital devices	3	5	0.5	Generic
<b>CS.136</b>	Operate word-processing applications	2	5	0.5	Generic
<b>CS.137</b>	Operate spreadsheet applications	2	5	0.5	Generic
<b>CS.138</b>	Operate presentation packages	4	5	0.5	Generic
<b>CS.139</b>	Perform writing and editing tasks	3	5	0.5	Generic
<b>CS.140</b>	Write and Edit Copy	3	5	0.5	Generic

### 4. Date of Validation

The level 5 of National DAE qualification on HVACR has been validated by the Qualifications Validation Committee (QVC) members on May 20-22, 2019 and will remain valid for ten years i.e. **22 May, 2029**

### 5. Date of Review

The level 5 of National DAE qualification on Electrical has been validated by the Qualifications Validation Committee (QVC) members on 20-22, 2019 and shall be reviewed after three years i.e. **23 May, 2022**

### 6. Codes of Qualifications

The International Standard Classification of Education (ISCED) is a framework for assembling, compiling and analyzing cross-nationally comparable statistics on education and training. ISCED codes for these qualifications are assigned as follows:

ISCED Classification for HVACR level 5	
Code	Description
<b>0713E&amp;E(1)</b>	1 <sup>st</sup> Level D.A. E National Certificate of level-5, in “ HVACR”



## ***National Competency Standards Level-5 for “HVACR”***



<b>0713E&amp;E(2)</b>	2 <sup>nd</sup> Level D.A. E National Certificate of level-5, in “HVACR”
<b>0713E&amp;E(3)</b>	3 <sup>rd</sup> Level D.A. E National Certificate of level-5, in “HVACR”
<b>0713E&amp;E(4)</b>	4 <sup>th</sup> Level D.A. E National Certificate of level-5, in “HVACR”
<b>0713E&amp;E(5)</b>	5 <sup>th</sup> Level D.A. E National Certificate of level-5, in “HVACR”



## National Competency Standards Level-5 for “HVACR”



### 7. Members of Qualifications Development Committee

The following members participated in the qualifications’ development workshop 31<sup>st</sup> December 2018 to 4<sup>th</sup> January 2019 at Hospitality Inn, Lahore:

S. No.	Name & Designation	Organization
1.	<b>Mr. Amjad Mehmood Baloch,</b> Deputy Manager (Operations) / DACUM Facilitator	Punjab TEVTA
2.	<b>Engr. Zamir UI Hassan Gardezi,</b> MEP Manager	MIDJAC Construction Pvt. Ltd, Islamabad
3.	<b>Mr. Syed Shabbir Haider,</b> HVAC Expert	Haier, Lahore Pakistan
4.	<b>Mr. Muhammad Haroon,</b> Senior Instructor HVAC	Govt. College of Technology, Railway Road, Lahore
5.	<b>Mr. Muhammad Shahid Saeed,</b> HVAC Expert	Govt. ATC, Township, Lahore
6.	<b>Mr. Azhar Waheed,</b> Instructor HVAC	PVTC, Islamabad
7.	<b>Mr. Muhammad Aslam,</b> HVAC Expert	Textronics, Phase-,1 Pakistan Town Islamabad
8.	<b>Mr. Asad Masood,</b> HVAC Supervisor	Climate Control, Lahore
9.	<b>Mr. Muhammad Atif Latif,</b> Sr. Technician HVAC	Pakistan Railway, Lahore.
10.	<b>Mr. Muhammad Awais Arshad,</b> HVAC Supervisor	Climate Solution, Lahore
11.	<b>Mr. Farooq Saeed,</b> Incharge HVAC	Greaves Air-Conditioning, Lahore
12.	<b>Mr. Muhammad Shahbaz,</b> Senior Instructor HVAC	Govt. College of Technology, Railway Road, Lahore
13.	<b>Mr. Shehzad Yousaf,</b> HVAC Expert	Cool Care, Shalimar Garden, Lahore



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14.	<b>Mr. Yasir Ali,</b> Senior Instructor HVAC	Govt. College of Technology, Railway Road, Lahore
15.	<b>Dr. Zulfiqar Ali Cheema,</b> Deputy Director (VT)	NAVTTC HQ, Islamabad

### 8. Members of Qualification Validation Committee

The following members participated in the qualifications Validation workshop w.e.f. 20<sup>th</sup> May 2019 to 22<sup>nd</sup> May 2019 at Park Lane Hotel, Lahore:

S. No.	Name & Designation	Organization
1.	<b>Mr. Amjad Mehmood Baloch,</b> Deputy Manager (Operations) / DACUM Facilitator	Punjab TEVTA
2.	<b>Mr. Muhammad Haroon,</b> Senior Instructor HVAC	Govt. College of Technology, Railway Road, Lahore
3.	<b>Mr. Muhammad Shahid Saeed,</b> HVAC Expert	Govt. ATC, Township, Lahore
4.	<b>Engr. Asad Mehmood Butt,</b>	Representative from P. TEVTA, Lahore
5.	<b>Mr. Ghulam Rasool Rajput,</b>	Representative from S. TEVTA, Karachi
6.	<b>Mr. Shoukat Ali,</b>	Representative From KPK. TEVTA, Bannu
7.	<b>Mr. Saulat Saeed,</b> CEO (HVACR Expert)	Air Comfort, Lahore.
8.	<b>Engr. Liaqat Ali Jamro,</b> Director Acad & Training	S. TEVTA, Karachi
9.	<b>Mr. Saddam Anwar Rana</b> Research Officer	PBTE, Lahore
10.	<b>Dr. Zulfiqar Ali Cheema,</b> Deputy Director (VT)	NAVTTC HQ, Islamabad

### 9. Entry Requirements

The entry for D.A. E National Certificate level 5, in HVACR are





***National Competency Standards Level-5 for “HVACR”***



1. A person having **National Vocational Certificate level 4**, in HVACR.
2. A person having **Matric certificate with Science**



## National Competency Standards Level-5 for “HVACR”



### 10. Detail of Competency Standards

#### 0713E&E-1. Apply Occupational Health and Safety on HVAC Systems

##### Overview

This Competency Standard identifies the competencies required to apply occupational health and safety at workplace in accordance with the organization’s approved guidelines and procedures. Students will be expected to implement occupational health and safety at workplace. His underpinning knowledge regarding safety rules, Personal Protective Equipment (PPE), and international standards for occupational health and safety at workplace will be enough to provide the basis for your work.

Competency Units	Performance Criteria
<b>1. Recognize occupational health and safety on HVAC systems</b>	<b>P1.</b> Recognize the objectives and contents of general OHS and environmental protection in HVAC Systems <b>P2.</b> Identify Pressure safety devices (including pressure gauge, safety valve, safety diaphragm and fusible plug) <b>P3.</b> Identify the types, utilization, maintenance and limitations of HVAC Tools <b>P4.</b> Use of Personal protective equipment <b>P5.</b> Apply safe operation procedures for HVAC Units <b>P6.</b> Handling and safe practice of refrigerants & chemicals to avoid hazards <b>P7.</b> Use of safe practice of Refrigerants and compressor safeties to minimize the risk <b>P8.</b> Recognize Hazards of Compression and Absorption systems that have the potential to cause harm
<b>2. Apply safety in on-job HVAC systems</b>	<b>P1.</b> Identify the safety standards of electrical and mechanical workplace <b>P2.</b> Asses safety requirements of on-job HVAC systems <b>P3.</b> Work safely while complying installation of HVAC Units including domestic & commercial units <b>P4.</b> Work safely while complying in Servicing of HVAC systems <b>P5.</b> Work safely while complying in trouble shooting of HVAC systems

##### Knowledge and Understanding



## National Competency Standards Level-5 for “HVACR”



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
- Personal Protective Equipment use
- 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:

- Use of Personal Protective Equipment (PPE)
- Identify potential hazards
- Perform work safely

### List of Tools, Equipment and Machinery

<b>Sr. No</b>	<b>Description</b>
1	Self-contained breathing apparatus
2	Fall protection (such as personal fall arrest systems, harnesses and lanyards)
3	Head protection (such as hard hats)
4	Hearing Protection Equipment (earplugs and earmuffs)
5	Foot protection (such as boots with metatarsal guards and puncture-resistant soles)
6	Hand protection (such as gloves and barrier creams)
7	Body Protection (such as high-visibility vests, coveralls, welding leathers, life jackets or buoyant work vests, chemical suits and skin protection)
8	Respiratory protection (such as half-face, full-face and supplied-air respirators and two-strap irritant dust masks)



## National Competency Standards Level-5 for “HVACR”



### Maintain Safe Work Environment

#### Overview

This Competency Standard identifies the competencies required to identify and observe hazards 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 safety rules, Personal Protective Equipment (PPE), and international standards for occupational health and safety will be enough to provide the basis for your work.

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



## National Competency Standards Level-5 for “HVACR”



- Personal Protective Equipment use
- 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
- Arrange workplace to reduce potential hazards
- Use correct Personal Protective Equipment (PPE) for the assigned job

### List of Tools, Equipment and Machinery

Sr. No	Description
1	Self-contained breathing apparatus
2	Fall protection (such as personal fall arrest systems, harnesses and lanyards)
3	Head protection (such as hard hats)
4	Hearing Protection Equipment (earplugs and earmuffs)
5	Foot protection (such as boots with metatarsal guards and puncture-resistant soles)
6	Hand protection (such as gloves and barrier creams)
7	Body Protection (such as high-visibility vests, coveralls, welding leathers, life jackets or buoyant work vests, chemical suits and skin protection)
8	Respiratory protection (such as half-face, full-face and supplied-air respirators and two-strap irritant dust masks)



## National Competency Standards Level-5 for “HVACR”



### 0713E&E-2. Make PVC Cable Joints and Construct Electrical Test Box

#### Overview

This Competency Standard identifies the competencies required to making of different types of cable joints as well as the construction of an electrical test box with the organization’s approved guidelines and procedures. Students underpinning knowledge regarding PVC cable Joints & construction of electrical box will be enough to provide the basis for his work.

Competency Units	Performance Criteria
1. Arrange Tools/Material for Job	<p><b>P1.</b> Identify &amp; Collect tools and material as per job.</p> <p><b>P2.</b> Prepare workplace for the job/task.</p> <p><b>P3.</b> Prepare Layouts/Drawing for job/task</p> <p><b>P4.</b> Arrange backup resources for lighting, power and safety purposes as per job requirement</p>
2. Make different types of joints	<p><b>P1.</b> Remove and Clean the insulation from conductors</p> <p><b>P2.</b> Twist and over lay the conductors</p> <p><b>P3.</b> Make simple twist joint of PVC cable No.1/0.044</p> <p><b>P4.</b> Make married joint of PVC cable No 7/0.036 or 7/0.029</p> <p><b>P5.</b> Make pigtail joint of PVC Cable No 1/0.044.</p> <p><b>P6.</b> Make "tee" joint of PVC Cable No 7/0.036 or 7/0.029</p> <p><b>P7.</b> Splice the conductors smoothly &amp; properly</p> <p><b>P8.</b> Solder the splice in a way so that there is no space remaining between splice conductors.</p> <p><b>P9.</b> Insulate (Taping) the splice.</p>
3. Construct an electrical Test Box.	<p><b>P1.</b> Prepare the lay-out/circuit diagram for making test board</p> <p><b>P2.</b> Install series-parallel circuit on test board by using two pin socket, lamp holder &amp; single way switch.</p> <p><b>P3.</b> Install AVO-Meter on test board to check the voltage, current and resistance of the circuit.</p> <p><b>P4.</b> Make test lamp (Single phase, three phase) for checking the presence of electricity</p> <p><b>P5.</b> Make a continuity tester to check the different kind of series-Parallel circuits.</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:

- Hazards that are most likely to cause harm
- Identification and use of Personal Protective Equipment (PPE)
- American Society of Heating, Refrigeration and Air Conditioning Engineers (ASHRAE)



## National Competency Standards Level-5 for “HVACR”



- PVC cables With Standard cable numbers as well as type of insulation.
- Interpretation of cable Ampacity chart
- Electrical tools specially electrician knife to remove insulation from the conductor.
- Watts, ohms, volts, and amps
- Ammeter, ohmmeter, voltmeter and wattmeter
- Electrical characteristics of both series and parallel circuits
- Calculate resistance in a parallel and series circuit
- Define the equivalent capacitance in a parallel and series circuit
- Drawings related to joints type to make them properly.
- Different types of insulations and sheaths
- Testing devices present in electrician test box.
- Install equipment according to circuit diagrams.
- Interpretation of drawings, symbols, cable number according to load
- 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:

- Cut & remove insulation from PVC cables
- Join different cables in different ways
- Draw circuit diagram of respective circuit
- Make connection safely
- Make connections of electric meters
- Use PPE for electric works

### List of Tools, Equipment and Machinery

<b>Sr. No</b>	<b>Description</b>
1	Personal Protective Equipment (PPE)
6	Electric iron
8	Combination Plier
9	Power Supply
10	Electrician Knife
11	Lamps
12	Lamp Holders
13	Single way switches



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14	AVO Meter (Multi Meter)
15	Tow Pin Socket
16	Wooden Board
17	Electrician Knife





## National Competency Standards Level-5 for “HVACR”



### 0713E&E-3. Connect Loads in Electrical Circuits

#### Overview

This Competency Standard identifies the competencies required to wiring different numbers of electrical loads (light bulbs) in series-Parallel circuits with the organization’s approved guidelines and procedures. Students under pinning knowledge regarding series-Parallel circuits will be enough to provide the basis for his work.

Competency Units	Performance Criteria
1. Arrange Tools/Material for Job	<p>P1. Identify &amp; Collect tools and material as per job.</p> <p>P2. Prepare workplace for the job/task.</p> <p>P3. Prepare Layouts/circuit diagrams for job/task</p> <p>P4. Arrange backup resources for lighting, power and safety purposes as per job requirement</p>
2. Connect loads in series circuit	<p>P1. Connect three loads (light bulbs) in a series circuit.</p> <p>P2. Connect three loads (light bulbs) and a switch in a series circuit.</p> <p>P3. Connect two loads (light bulbs) in series using a switch to turn them off and on,</p> <p>P4. Connect third light in the circuit on continuously.</p>
3. Connect loads in Parallel circuit	<p>P1. Connect three loads (light bulbs) in a parallel circuit.</p> <p>P2. Connect three loads (light bulbs) in a parallel circuit by using a single-throw switch to control the circuit.</p> <p>P3. Connect three loads (light bulbs) in parallel using a single-pole single-throw switch to turn two light bulbs off and leave one light bulb on all the time</p>
4. Connect loads in series and Parallel circuit.	<p>P1. Connect a series-parallel circuit with six light bulbs - three lights wired in parallel, and three light bulbs wired in series.</p> <p>P2. Connect a series-parallel circuit with a single-pole single-throw switch controlling the total circuit.</p> <p>P3. Verify the voltage drop of loads (light bulbs) wired in parallel,</p> <p>P4. Verify the voltage drop of three loads (light bulbs) wired in series.</p> <p>P5. Verify the voltage drop of six loads (light bulbs) wired in series-parallel circuit.</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:

- Hazards that are most likely to cause harm to health and safety with HVAC tools
- Identification and use of Personal Protective Equipment (PPE)



## National Competency Standards Level-5 for “HVACR”



- American Society of Heating, Refrigeration and Air Conditioning Engineers (ASHRAE)
- Interpretation of drawings, symbols, cable number according to load.
- Watts, ohms, volts, and amps
- Ammeter, ohmmeter, voltmeter and wattmeter
- Electrical characteristics of both series and parallel circuits
- Calculate resistance in a parallel and series circuit
- Calculate capacitance in a parallel and series circuit
- Installation procedures
- Tools, equipment and materials required for the job
- Ohm’s Law and laws of resistances
- Install equipment according to circuit diagram.
- Interpretation of drawings and circuit diagrams; Soldering
- Testing procedures and equipment
- 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:

- Draw circuit diagram
- Install electric components
- Make connections
- Adopt PPE for electrical works

### List of Tools, Equipment and Machinery

Sr. No	Description
1	Personal Protective Equipment (PPE)
2	Lamps (light bulbs)
3	Screwdriver Set
4	Combination Plier
5	Screws (Different sizes)
6	Volt Meters
7	Ampere Meters.
8	Lamp Holders.
9	Switches (Single way)
10	Wooden Board
11	Electrician Knife



## National Competency Standards Level-5 for “HVACR”



### 0713E&E-4. Measure Electrical Quantities in Electric Circuits

#### Overview

This Competency Standard identifies the competencies required to measure the electrical quantities by using Ohm's Law & VOM (Volt, Ohm, Mille-ampere) with the organization's approved guidelines and procedures. Students underpinning knowledge regarding measurements of electrical quantities in electric circuits will be enough to provide the basis for his work.

Competency Units	Performance Criteria
<b>1. Arrange Tools / Material for Job</b>	<b>P1.</b> Identify & Collect tools and material as per job. <b>P2.</b> Prepare workplace for the job/task. <b>P3.</b> Prepare Layouts/circuit diagrams for job/task <b>P4.</b> Arrange backup resources for lighting, power and safety purposes as per job requirement
<b>2. Measure Resistance</b>	<b>P1.</b> Measure resistance using Ohm's law. formula $V=I/R$ <b>P2.</b> Measure resistance of a given wire with the help of ampere, volt, ohm (AVO) meter <b>P3.</b> Measure the resistance in a series circuit with an Ohmmeter
<b>3. Measure Voltage &amp; Current in Series and Parallel circuits</b>	<b>P1.</b> Measure voltage drop in a series circuit using Voltmeter. <b>P2.</b> Measure voltage drop in a parallel circuit using Voltmeter. <b>P3.</b> Measure current in a series circuit using clamp-on ammeter. <b>P4.</b> Measure current in a parallel circuit using clamp-on ammeter. <b>P5.</b> Measure an in-line amperage reading with AVO meter.

#### 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:

- Hazards that are most likely to cause harm Identify and use of Personal Protective Equipment (PPE)
- American Society of Heating, Refrigeration and Air Conditioning Engineers (ASHRAE)
- Watts, ohms, volts, and amps
- Ammeter, ohmmeter, voltmeter and wattmeter use
- Electrical characteristics of both series and parallel circuits
- Calculate resistance in a parallel and series circuit
- Calculate capacitance in a parallel and series circuit
- Ohm's Law and related to laws of resistances



## National Competency Standards Level-5 for “HVACR”



- Installation procedure of components/ according to circuit diagram.
- Identification of tools according to their use/range
- Interpretation safety instructions from manuals for inspection purpose
- 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:

- Identify electric meters
- Make connections of electric meters
- Measure electric parameters
- Use AVO meter to measure current, volt and resistance
- Use clamp on meter to measure current, volt and resistance

### List of Tools, Equipment and Machinery

<b>Sr. No</b>	<b>Description</b>
1	Personal Protective Equipment (PPE)
2	Resisters of different ratings
3	VOM Meter (volt, ohm, mille ampere)
4	Combination Plier
5	Ohm Meter
6	Volt Meters
7	Ampere Meters
8	Toggle switches
11	Electrician Knife
12	Electric Line Tester



## National Competency Standards Level-5 for “HVACR”



### 0713E&E-5. Establish Electrical Circuits for Commercial Refrigeration Systems

#### Overview

This Competency Standard identifies the competencies required to establish circuits of commercial Refrigeration system & identifies the accessories used in Refrigeration with the organization’s approved guidelines and procedures. Students underpinning knowledge regarding electrical circuits for commercial refrigeration will be enough to provide the basis for his work.

<b>Competency Units</b>	<b>Performance Criteria</b>
<b>1. Arrange Tools / Material for Job</b>	<b>P1.</b> Identify and Collect tools & material as per job. <b>P2.</b> Prepare workplace for the job/task. <b>P3.</b> Prepare Layouts/circuit diagrams for job/task <b>P4.</b> Arrange backup resources for lighting, power and safety purposes as per job requirement
<b>2. Draw circuit diagram and install accessories</b>	<b>P1.</b> Draw the circuit diagram for a commercial refrigerating system. <b>P2.</b> Install a single pole breaker to control the whole circuit. <b>P3.</b> Install motor and capacitor in circuit. <b>P4.</b> Install relay and overload in circuit.
<b>3. Dismantle and Re-assemble motors.</b>	<b>P1.</b> Dismantle capacitor start induction run motor <b>P2.</b> Identify parts of capacitor start induction run motor <b>P3.</b> Check automatic motor control circuit of single-phase induction motor according to constructional drawing <b>P4.</b> Check the speed-regulator switch in motor control circuit. <b>P5.</b> Re-assemble the capacitor start induction motor. <b>P6.</b> Test the capacitor start induction motor

#### 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:

- Hazards that are most likely to cause harm
- Identification and use of Personal Protective Equipment (PPE)
- American Society of Heating, Refrigeration and Air Conditioning Engineers (ASHRAE)
- Watts, ohms, volts, and amps
- Ammeter, ohmmeter, voltmeter and wattmeter use
- Electrical characteristics of both series and parallel circuits



## National Competency Standards Level-5 for “HVACR”



- Calculate resistance in a parallel and series circuit
- Calculate capacitance in a parallel and series circuit
- Electrical functioning of different machines and equipment
- Basics causes and effects for common electrical faults
- Electrical working job
- Different types of drawings (e.g. power, control, single line etc.)
- How to prepare drawing if not available
- Types of breakers, contactors, relays etc.
- Electrical symbols to be used in drawings
- 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:

- Draw circuit diagram
- Install electric components
- Install electric controls
- Make connections
- Adopt PPE for electrical works

### List of Tools, Equipment and Machinery

<b>Sr. No</b>	<b>Description</b>
1	Personal Protective Equipment (PPE)
2	Single pole Breaker
3	Capacitor start induction run motor
4	Overload relay
5	Speed-regulator Switch
6	Screwdriver set
7	Combination Plier
8	Adjustable Wrench
11	Allen Key Set
13	Pulley Puller
16	Three Pole Breaker
18	Electric Line Tester



## National Competency Standards Level-5 for “HVACR”



### 0713E&E-6. Evaluate Transformer and Verify Kirchhoff's Law

#### Overview

This competency standard identifies the competencies required to evaluate the transformers and verify Kirchhoff's Law with the organization's approved guidelines and procedures. Students underpinning knowledge regarding Transformers and Kirchhoff's Law will be enough to provide the basis for this task.

Competency Units	Performance Criteria
1. Arrange Tools/Material for Job	<p>P1. Identify &amp; Collect tools and material as per job.</p> <p>P2. Prepare workplace for the job/task.</p> <p>P3. Prepare Layouts/circuit diagrams for job/task</p> <p>P4. Arrange backup resources for lighting, power and safety purposes as per job requirement</p>
2. Evaluate the transformer	<p>P1. Check resistance of transformer with an ohm meter.</p> <p>P2. Check transformer primary and secondary voltage using voltmeter.</p> <p>P3. Verify current and voltage transformation ratios of transformer.</p>
3. Control circuit of transformer	<p>P1. Connect a step-down transformer to a relay contactor</p> <p>P2. Check a relay contactor with voltmeter.</p> <p>P3. Check a relay contactor with ohm meter.</p> <p>P4. Control two loads using switching relay into the circuit.</p>
4. Verify Kirchhoff's Law	<p>P1. Draw a series-parallel circuit using resistors</p> <p>P2. Install voltmeters in the circuit.</p> <p>P3. Install ampere meters in the circuits at total input and individually with all the circuit resistors.</p> <p>P4. Connect circuit to the power source</p> <p>P5. Get readings of all meters and verify the Kirchhoff's Law.</p> <p>P6. Verify that sum of all voltage drop in the circuit is equal to the total input voltage.</p> <p>P7. Verify that sum of all currents is equal to zero.</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:

- Hazards that are most likely to cause harm
- Identification and use of Personal Protective Equipment (PPE)
- American Society of Heating, Refrigeration and Air Conditioning Engineers (ASHRAE)



## National Competency Standards Level-5 for “HVACR”



- Watts, ohms, volts, and amps
- Ammeter, ohmmeter, voltmeter and wattmeter use
- Electrical characteristics of both series and parallel circuits
- Calculate resistance in a parallel and series circuit
- Calculate capacitance in a parallel and series circuit
- Electrical functioning of different machines and equipment
- Inspection procedure for electrical equipment (e.g. motors, transformers, switch gears, valves and sensors)
- Overloads relays, Current, Capacitor
- Types of breakers, contactors, relays etc.
- Electrical symbols to be used in drawings
- 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:

- Explain working principle of transformer
- Measure input & output at primary and secondary windings
- Calculate current & volts of primary and secondary windings
- Connect power source with transformer
- Verify the Kirchhoff's Law

### List of Tools, Equipment and Machinery

Sr. No	Description
1	Personal Protective Equipment (PPE)
2	Transformer
3	Relay contactor
4	Voltmeter
5	Switching relay
6	Ohmmeter
7	Ampere meters
8	Resistors (Assorted Range)
11	Screwdriver set
12	Combination Plier
13	Electrician Test Box
14	Electric Line Tester





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### 0713E&E-7. Apply Basics of Drawing

#### Overview

This Competency Standard identifies the competencies required to draw different forms of drawings, lines with measurements and free hand sketching. Students will be expected to draw different forms of drawing and lines according to the nature of work at workplace. His underpinning knowledge regarding basic drawings will be enough to provide the basis for his work.

Competency Units	Performance Criteria
1. Draw different forms of drawing	<p>P1. Draw convention layout drawing P2. Draw convention electrical circuit drawing P3. Draw lines with different scale of measurement P4. Select the sheet format P5. Select the tool and equipment</p>
2. Draw different lines for free hand sketching	<p>P1. Draw horizontal lines P2. Draw vertical lines P3. Draw arcs P4. Draw circles P5. Draw ellipse P6. Draw all conic section P7. Draw projection of lines P8. Sketch different objects</p>
3. Draw different lines with measurement	<p>P1. Draw single Stroke lettering P2. Draw double stroke gothic letter P3. Draw different types of letter P4. Draw alphabet of lines in original scale P5. Apply alphabet of lines in drafting</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:

- Mechanical drawings, civil drawings and electrical drawings
- Terms used in drawing
- Application of drawing forms
- Scales used in drawing
- Fundamentals units i.e. arcs, circles and ellipse
- Single stroke and double stroke gothic letters
- Tolerance, limits and fits definitions
- Layout and line drawings

#### Critical Evidence(s) Required

The candidate needs to produce following critical evidence(s) in order to be competent in



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this competency standard:

- Draw different lines and figures freehand
- Draw different lines and figures with specified measurements
- Perform lettering exercises to write specified data

### List of Tools, Equipment and Machinery

<b>Sr. no</b>	<b>Description</b>
1.	T-square
2.	Set square
3.	Compass
4.	Eraser
5.	Pencil
6.	Sharpener
7.	Drawing sheet
8.	Drawing board
9.	Drafting machine
10.	French Curves
11.	Rulers
12.	Compass
13.	Templates



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### 0713E&E-8. Draw Pictorial Drawing

#### Overview

This competency standard identifies the competencies required to draw pictorial drawings. Students will be expected to draw different types of pictorial drawings and multi view projection according to the nature of work at workplace. His underpinning knowledge regarding pictorial drawing will be enough to provide the basis for his work.

Competency Units	Performance Criteria
1. Draw different types of pictorial drawing	P1. Draw oblique drawing P2. Draw axonometric drawing P3. Draw perspective drawing P4. Draw Multi-view drawing
2. Draw multi view projection	P1. Draw principle plane of projection P2. Draw projector / projection lines P3. Draw auxiliary view of objects P4. Draw Multi-view drawing of machine components

#### 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:

- Oblique drawing
- Axonometric drawing
- Perspective drawing
- Multi-view drawing
- Plan of projection
- Projection drawing
- Multi-view drawing of machine equipment
- Terms being used in drawing
- Application of drawing forms
- Scales used in drawing
- Draw fundamentals units i.e. arcs, circles and ellipse
- Draw single stroke and double stroke gothic letters
- Tolerance, limits and fits definitions
- Layout and line drawings

#### Critical Evidence(s) Required

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

- Draw measured figures
- Identify three views



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### List of Tools, Equipment and Machinery

<b>Sr. No</b>	<b>Description</b>
1.	T-square
2.	Set square
3.	Compass
4.	Eraser
5.	Pencil
6.	Sharpener
7.	Drawing sheet
8.	Drawing board
9.	Drafting machine
10.	French Curves
11.	Rulers
12.	Compass
13.	Templates





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### 0713E&E-9. Apply Basic Dimensioning System in Working Drawing

#### Overview

This Competency Standard identifies the competencies required to draw dimensional geometrical constructions and working drawings. Students will be expected to apply dimensioning in working drawings according to the nature of work at workplace. His underpinning knowledge regarding dimensioning will be enough to provide the basis for his work.

Competency Units	Performance Criteria
1. Draw dimensional geometrical constructions	<p><b>P1.</b> Draw the types of dimensioning (size dimension and location dimension)</p> <p><b>P2.</b> Draw system of dimensioning</p> <p><b>P3.</b> Draw dimensioning of holes</p> <p><b>P4.</b> Draw dimensioning of arc</p> <p><b>P5.</b> Draw dimensioning circles</p> <p><b>P6.</b> Draw dimensioning of angles</p> <p><b>P7.</b> Draw all conic sections separately</p> <p><b>P8.</b> Draw engineering involute curve of a circle</p>
2. Draw working Drawing	<p><b>P1.</b> Draw preliminary design sketching</p> <p><b>P2.</b> Draw detail Drawing of an object</p> <p><b>P3.</b> Draw Assembly Drawing of an object</p> <p><b>P4.</b> Draw working drawing of machine component</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 dimensioning
- System of dimensioning
- Dimensioning in size of holes
- Dimension in size of arc
- Dimensions in size of circle
- All conic section drawings
- Detail drawing of an object
- Assembly drawing of an object
- Working drawing of machine components
- Terms used in drawing
- Application of drawing forms
- Scales used in drawing
- Fundamentals units i.e. arcs, circles and ellipse
- Single stroke and double stroke gothic letters
- Tolerance, limits and fits definitions
- Layout and line drawings



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### Critical Evidence(s) Required

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

- Apply different dimensioning methods
- Write measured values for drawings
- Lettering Exercise

### List of Tools, Equipment and Machinery

Sr. No	Description
1.	T-square
2.	Set square
3.	Compass
4.	Eraser
5.	Pencil
6.	Sharpener
7.	Drawing sheet
8.	Drawing board
9.	Drafting machine
10.	French Curves
11.	Rulers
12.	Compass
13.	Templates



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### 0713E&E-10. Draw Sectioning Drawing

#### Overview

This Competency Standard identifies the competencies required to draw sectioning and pictorial drawings. Students will be expected to draw sectioning according to the nature of work at workplace. His underpinning knowledge regarding sectioning drawing will be enough to provide the basis for his work.

Competency Units	Performance Criteria
1. Draw sectioning	<p><b>P1.</b> Draw material symbols used in sectioning</p> <p><b>P2.</b> Draw full section of an object</p> <p><b>P3.</b> Draw half section of an object</p> <p><b>P4.</b> Draw broken section of an object</p> <p><b>P5.</b> Draw sectional view of machine components</p>
2. Draw pictorial Drawing	<p><b>P1.</b> Draw isometric view of an object</p> <p><b>P2.</b> Draw isometric view of arc</p> <p><b>P3.</b> Draw isometric view of circle</p> <p><b>P4.</b> Draw oblique view of a rectangular block</p> <p><b>P5.</b> Draw isometric views of an object / components</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:

- Material symbols used in engineering drawing
- Full section of an object
- Half section of an object
- Sectional views of machine components
- Oblique view of a rectangular block
- Isometric views of an object
- Terms used in drawing
- Application of drawing forms
- Scales used in drawing
- Fundamentals units i.e. arcs, circles and ellipse
- Single stroke and double stroke gothic letters
- Tolerance, limits and fits definition
- Layout and line drawings





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### Critical Evidence(s) Required

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

- Draw measured figures
- Understand sections
- Draw a view to show sectioned part

### List of Tools, Equipment and Machinery

<i>Sr. no</i>	<i>Description</i>
1.	T-square
2.	Set square
3.	Compass
4.	Eraser
5.	Pencil
6.	Sharpener
7.	Drawing sheet
8.	Drawing board
9.	Drafting machine
10.	French Curves
11.	Rulers
12.	Compass
13.	Templates



## National Competency Standards Level-5 for “HVACR”



### 0713E&E-11. Draw Auxiliary Drawing

#### Overview

This Competency Standard identifies the competencies required to draw primary auxiliary and true length line drawings. Students will be expected to draw auxiliary drawings according to the nature of work at workplace. His underpinning knowledge regarding auxiliary drawings will be enough to provide the basis for his work.

Competency Units	Performance Criteria
1. Draw primary auxiliary view	<b>P1.</b> Draw Primary auxiliary view of frontal projection <b>P2.</b> Draw primary auxiliary view of horizontal projection <b>P3.</b> Draw primary auxiliary view of profile projection <b>P4.</b> Draw Example of all these
2. Draw true length line	<b>P1.</b> Draw true length line in auxiliary view of different objects <b>P2.</b> Draw auxiliary view in different objects <b>P3.</b> Draw auxiliary view of objects <b>P4.</b> Draw auxiliary view of component part <b>P5.</b> Draw example of above two

#### 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:

- Auxiliary views applications
- Primary auxiliary views of frontal projection
- Primary auxiliary view in horizontal projection
- Primary auxiliary view in profile projection
- True length line in the auxiliary view of different objects
- Secondary auxiliary view in different objects
- Terms used in drawing
- Application of drawing forms
- Scales used in drawing
- Fundamentals units i.e. arcs, circles and ellipse
- Single stroke and double stroke gothic letters
- Tolerance, limits and fits definitions
- Layout and line drawing

#### Critical Evidence(s) Required

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

- Draw measured figures



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- Identify three views

### List of Tools, Equipment and Machinery

Sr. No	Description
1.	T-square
2.	Set square
3.	Compass
4.	Eraser
5.	Pencil
6.	Sharpener
7.	Drawing sheet
8.	Drawing board
9.	Drafting machine
10.	French Curves
11.	Rulers
12.	Compass
13.	Templates



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### 0713E&E-12. Identify and Use HVAC Tools

#### Overview

This Competency Standard identifies the competencies required to identify and use HVAC tools at workplace in accordance with the manufacturers' / organization's approved guidelines and procedures. Student will be expected to identify and use HVAC hand tools and HVAC power tools according to the nature of work at workplace. His underpinning knowledge regarding HVAC tools will be sufficient to provide the basis for your work.

Competency Units	Performance Criteria
1. Identify & use hand tools	<p><b>P1.</b> Select appropriate hand tools according to the task requirements.</p> <p><b>P2.</b> Use hand tools to produce desired outcomes to job specifications which may include finish, tension, size or shape.</p> <p><b>P3.</b> Adhere to all safety requirements before, during and after use.</p> <p><b>P4.</b> Identify unsafe or faulty tools and mark for repair according to designated procedures before, during and after use.</p> <p><b>P5.</b> Carry out routine maintenance of tools including cleaning, packing, hand sharpening etc. according to standard operational procedures, principles and techniques.</p> <p><b>P6.</b> Store hand tools safely in appropriate location according to standard operational procedures and manufacturer's recommendations.</p>
2. Identify & use power tools	<p><b>P1.</b> Select appropriate power tools according to the task requirements.</p> <p><b>P2.</b> Use power tools following a determined sequence of operations to produce desired results.</p> <p><b>P3.</b> Follow all safety requirements before, during and after use.</p> <p><b>P4.</b> Identify and mark unsafe or faulty tools for repair according to designated procedures.</p> <p><b>P5.</b> Undertake maintenance of tools according to standard procedures, principles and techniques.</p> <p><b>P6.</b> Store power tools safely in appropriate location according to standard workshop procedure and manufacturer's recommendations</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:



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- Hazards types that are most likely to cause harm to health and safety with HVAC tools
- Identification and use of Personal Protective Equipment (PPE)
- American Society of Heating, Refrigeration and Air Conditioning Engineers (ASHRAE)
- Ozone Protection and Synthetic Greenhouse Gas Management Act 1989
- Identification of basic tools
- Identification of power tools
- Identification of fasteners
- Identification of pipe and tubing tools
- Basic measuring & cutting tools
- HVACR, Electric and Electronics tools
- Basic measuring & cutting tools applications
- HVACR, Electric and Electronics tools applications
- 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:

- Identify tools
- Select proper tool for specified task
- Use tools properly & safely
- Maintain tools
- Use power tools properly

### List of Tools, Equipment and Machinery

Sr.#	Description
1	Personal Protective Equipment
2	Metal Drill Bit Set
3	Masonry Drill Set
4	File Set
5	Hand Hacksaw Frame
6	Allen Key Set
7	Hammer Set
8	Mallet Set



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<b>9</b>	Laser Temperature Measuring Device
<b>10</b>	Combination Plier
<b>11</b>	Nose Plier
<b>12</b>	Locking Plier
<b>13</b>	Measuring Tape
<b>14</b>	Adjustable Screw & Pipe Wrenches
<b>15</b>	Ratchet Wrench
<b>16</b>	Socket Set
<b>17</b>	Open Ended Spanner Set
<b>18</b>	Box Spanner Screw Drivers
<b>19</b>	Steel Ruler
<b>20</b>	Scissors
<b>21</b>	Scriber
<b>22</b>	Try Square
<b>23</b>	Chisel Set
<b>24</b>	Gas Welding Set with All Accessories
<b>25</b>	Nitrogen Gas Cylinder with Hose Pipe, Regulator and Back Arrestor
<b>26</b>	Tube Cutter
<b>27</b>	Electric Hand Grinder
<b>28</b>	Digital Air Flow / Velocity Meter
<b>29</b>	Screwdriver Set Manual & Electric
<b>30</b>	Electronic Leak Detector
<b>31</b>	Spirit Level
<b>32</b>	Wire Stripper



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<b>33</b>	Digital Multi Meter
<b>34</b>	Digital Clamp-On Ampere Meter
<b>35</b>	Electric Hand Drills
<b>36</b>	Insulation Remover
<b>37</b>	HILTI Drill Machine (Piston Type)
<b>38</b>	Digital Optical Tachometer
<b>39</b>	Megohmmeter (0-1000 Volts)
<b>40</b>	Digital Capacitor Analyzer
<b>41</b>	Digital Pressure Gauges Set (High &Combine)
<b>42</b>	Fins Straightening Comb Set
<b>43</b>	Flaring and Swaging Tool Kit
<b>44</b>	Vacuum Pump 2-Stage, 6cfm
<b>45</b>	Tube Benders (Spring Type and Pulley Bender Type)
<b>46</b>	Laser Distance Measuring Device
<b>47</b>	Feeler Gauge



### 0713E&E-13. Joint Copper Tubes

#### Overview

This Competency Standard classifies the competencies required to join different tubes used in HVAC works according to required specification of organization’s approved guidelines and procedures. Students will be expected to joint copper tubes according to the nature of work at workplace. His underpinning knowledge regarding Jointing of copper tubes will be sufficient to provide the basis of his work.

Competency Units	Performance Criteria
1. Perform Permanent Copper Joints	<p><b>P1.</b> Measure and Cut the tubes according to drawing</p> <p><b>P2.</b> Ream of tubes end inside and outside to clean debars.</p> <p><b>P3.</b> Prepare the neutral flame</p> <p><b>P4.</b> Apply flux at joints.</p> <p><b>P5.</b> Assembly and support to join of copper tubes</p> <p><b>P6.</b> Heat the joints by using neutral flame</p> <p><b>P7.</b> Apply solder rod at joints</p> <p><b>P8.</b> Cool and clean the joints</p> <p><b>P9.</b> Leak testing the joints</p>
2. Perform Temporary Copper Joints	<p><b>P1.</b> Measure and cut the tubes according to drawing</p> <p><b>P2.</b> Cut the tubes squarely by using a tube cutter with sharp wheel.</p> <p><b>P3.</b> Ream of tube ends inside and outside to clean burrs</p> <p><b>P4.</b> Place the flare nut once the tubing is flared, the nut would have to be placed from the far end</p> <p><b>P5.</b> Match the tube diameter to the hole in the block and insert the tubing into the flaring block</p> <p><b>P6.</b> Tight the nearest nut first and then tight the far nut</p> <p><b>P7.</b> Ensure that the block holds the tubing tightly</p> <p><b>P8.</b> Slip the yoke on the flaring block, slots in the yoke engage the flaring block and center the anvil cone over the tubing</p> <p><b>P9.</b> Tighten the mandrel screw, then loosen and retighten once or twice to fully seat and flare the copper</p> <p><b>P10.</b> Hold the flared end on the fitting, and tighten the nut</p> <p><b>P11.</b> Snug it but don't over-tighten</p> <p><b>P12.</b> Snug it up more if an air test reveals a leak</p>

#### Knowledge and Understanding





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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:

- Hazards types that are most likely to cause harm to health and safety with HVAC tools
- Identification and use of Personal Protective Equipment (PPE)
- American Society of Heating, Refrigeration and Air Conditioning Engineers (ASHRAE)
- Ozone Protection and Synthetic Greenhouse Gas Management Act 1989
- Pipe and tubing identification used in HVACR industry
- Fittings or valve types identification for specific applications
- Heat sink methods
- Insulating pipe and tubing methods
- Heat exchange techniques
- Torch types identification used for cutting and welding
- Copper Tube cutting, Reaming, Bending, Swaging, Flaring, Brazing, Jointing and Fixing methods
- Methods of temporary copper joints
- Methods of permanent copper joints
- Angles and measurements of copper tubes to grip in the yoke
- Methods of leak testing
- 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:

- Cut & ream tubes
- Make flares
- Join tubes temporarily
- Perform swaging
- Use oxy acetylene gas welding set
- Perform silver soldering & brazing to join tubes

### List of Tools, Equipment and Machinery

Sr. No	Description
1	Personal Protective Equipment
2	Basic Measuring tools
3	Basic Hand tools
4	Basic Cutting tools
5	Basic Power tools
6	Basic Marking tools
7	Allen Key Set



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<b>8</b>	Copper tube cutter
<b>9</b>	Flaring tool set
<b>10</b>	Swaging tool set
<b>11</b>	Gas welding set
<b>12</b>	Reamer
<b>13</b>	Copper tube bender
<b>14</b>	Tube Cutter
<b>15</b>	Electric Hand Grinder



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### 0713E&E-14. Use of Pressure Gauges and Meters for Measuring Refrigerants Pressure

#### Overview

This Competency Standard identifies the competencies required to measure refrigerant pressures on different type of pressured gauges at workplace in accordance with the organization’s approved guidelines and procedures. Students will be expected to identify and use of low pressure, high pressure and gauge manifold gauges according to the nature of work at workplace. His underpinning knowledge regarding pressure gauges will be sufficient to provide the basis for his work.

Competency Units	Performance Criteria
1. Apply Compound Pressure Gauge	<p><b>P1.</b> Identify the color of compound pressure gauge</p> <p><b>P2.</b> Read gauge Pressure from 1 to 250 PSIG</p> <p><b>P3.</b> Read vacuum reading from 1 inches of Hg to 30 inches of Hg.</p> <p><b>P4.</b> Measure the suction pressure of different refrigerants.</p> <p><b>P5.</b> Identify &amp; use of different port for different purpose.</p>
2. Apply High Pressure Gauge	<p><b>P1.</b> Identify the color of high-pressure gauge.</p> <p><b>P2.</b> Read gauge pressure from 1 to 500 PSIG.</p> <p><b>P3.</b> Measure the discharge pressure of different refrigerants.</p> <p><b>P4.</b> Identify &amp; use of different port for different purpose.</p>
3. Apply Gauge Manifold	<p><b>P1.</b> Differentiate between low pressure and high-pressure gauge.</p> <p><b>P2.</b> Access port that will be used for vacuuming and charging of refrigerant.</p> <p><b>P3.</b> Check a flow and condition of refrigerant during recovering and charging.</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:

- Hazards types that are most likely to cause harm to health and safety with HVAC tools
- Identification and use of Personal Protective Equipment (PPE)
- American Society of Heating, Refrigeration and Air Conditioning Engineers (ASHRAE)
- Ozone Protection and Synthetic Greenhouse Gas Management Act 1989
- Conversion of different pressure scale
- Pressure and Temperature laws
- Micron unit and Micron pressure



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- Inches of mercury absolute
- Bourdon tubes construction and working
- Working principles of pressure gauges and its types
- Refrigerant recovery method
- 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:

- Identify pressure gauge
- Connect a gauge with system
- Measure pressure in a system
- Measure vacuum in a system
- Use AVO meter & Clamp on meter to measure electric quantities

### List of Tools, Equipment and Machinery

<i>Sr. No</i>	<i>Description</i>
1	Personal Protective Equipment
2	Basic Measuring tools
3	Basic Hand tools
4	Basic Cutting tools
5	Basic Power tools
6	Basic Marking tools
7	Allen Key Set
8	Gauge manifold
9	Compound Pressure Gauge
10	High Pressure Gauge
11	Refrigerant Recovery Unit



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### 0713E&E-15. Check and Test Compressors

#### Overview

This Competency Standard identifies the competencies required to check and test a compressor for smooth operation of HVAC system & energy consumption. Students will be expected to check and test compressors electrically & mechanically according to the nature of work at workplace. His underpinning knowledge regarding Compressors will be sufficient to provide the basis for his work.

Competency Units	Performance Criteria
1. Perform Electrical Test	<p><b>P1.</b> Prepare meter adjustment and series board</p> <p><b>P2.</b> Identify electrical terminals of hermetic compressor</p> <p><b>P3.</b> Check continuity and resistance of start &amp; running winding of compressor according to its specifications</p> <p><b>P4.</b> Compare Resistance between start &amp; common, start &amp; running and common &amp; running winding terminals according to compressor specifications</p> <p><b>P5.</b> Test &amp; Diagnose fault in compressor windings according to manufacturer’s specifications.</p> <p><b>P6.</b> Evaluate the problem and report to seniors</p>
2. Perform Mechanical Test	<p><b>P1.</b> Start the compressor</p> <p><b>P2.</b> Check discharge pressure of air / refrigerant according to its specifications</p> <p><b>P3.</b> Check suction / back pressure of compressor according to its specifications</p> <p><b>P4.</b> Evaluate and diagnose fault according to manufacturer’s 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:

- Hazard types that are most likely to cause harm to health and safety with HVAC tools
- Identification and use of Personal Protective Equipment (PPE)
- American Society of Heating, Refrigeration and Air Conditioning Engineers (ASHRAE)
- Ozone Protection and Synthetic Greenhouse Gas Management Act 1989
- Watts, ohms, volts, and amps
- Proper use of ammeter, ohmmeter, voltmeter and wattmeter



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- Different types of compressors
- Working principles of different types of compressors
- Pressure and Temperature laws
- Ohm meter / Series test lamp use
- 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:

- Adjust AVO meter
- Calculate & compare resistances
- Decide condition of compressor
- Measure pressure of compressor

### List of Tools, Equipment and Machinery

Sr. No	Description
1	Personal Protective Equipment
2	Basic Measuring tools
3	Basic Hand tools
4	Basic Cutting tools
5	Basic Power tools
6	Basic Marking tools
7	Basic Electric tools
8	Ampere meter
9	AVO meter
10	Watt meter
11	Copper tube cutter
12	Flaring tool set
13	Swaging tool set
14	Screwdriver Set (Manual & Electric)
15	Test Series lamp



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### 0713E&E-16. Check and Test Electrical Accessories

#### Overview

This Competency Standard identifies the competencies required to prepare test equipment, apply check and test electrical accessories used in electrical circuit of HVAC systems. Students will be expected to check and test electrical accessories according to the nature of work at workplace. His underpinning knowledge regarding electrical accessories will be sufficient to provide the basis for his work.

Competency Units	Performance Criteria
1. Prepare for Test Equipment	<p><b>P1.</b> Calibrate test instruments and prepare test series board</p> <p><b>P2.</b> Identify and clean the electric terminals / points</p> <p><b>P3.</b> Select the meter to check the continuity &amp; resistance between electric terminals</p>
2. Apply check and test methods	<p><b>P1.</b> Apply pressure heat or relevant conditions according to its rating</p> <p><b>P2.</b> Check results of such component according to manufacturer's specifications</p> <p><b>P3.</b> Diagnose fault and report to his supervisor</p>
3. Check the Accessories	<p><b>P1.</b> Perform the method to check overloads</p> <p><b>P2.</b> Perform the method to check different relays</p> <p><b>P3.</b> Perform the method to check thermostats</p> <p><b>P4.</b> Perform the method to check capacitors</p> <p><b>P5.</b> Perform the method to check defrost heaters</p> <p><b>P6.</b> Perform the method to check defrosting timer</p> <p><b>P7.</b> Perform the method to check Thermal Disc with Fuse</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:

- Hazard types that are most likely to cause harm
- Personal Protective Equipment (PPE) use
- American Society of Heating, Refrigeration and Air Conditioning Engineers (ASHRAE)
- Watts, ohms, volts and amps
- Ammeter, ohmmeter, voltmeter and wattmeter use
- Applications of magnetic principles to electrical theory
- Principles of solid-state switching devices





## National Competency Standards Level-5 for “HVACR”



- Ohms Law to solve circuit problems and calculate circuit loads
- Meters to check basic electrical components
- Electrical characteristics of both series and parallel circuits
- Calculate resistance in a parallel and series circuit
- Calculate capacitance in a parallel and series circuit
- Different types of electric accessories
- Working principles of different accessories
- Repair / maintenance of electrical accessories
- Pressure and Temperature laws
- 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:

- Adjust AVO meter
- Apply relevant conditions of pressure & Temperature
- Observe behavior of different accessories

### List of Tools, Equipment and Machinery

Sr. No	Description
1	Personal Protective Equipment
2	Basic Measuring tools
3	Basic Hand tools
4	Basic Cutting tools
5	Basic Power tools
6	Basic Marking tools
7	Basic Electric tools
8	Ampere meter
9	Ohm meter
10	Defrost timer
11	Thermal Disc with Fuse
12	Different type of relays and overloads
13	Defrost heater
14	Copper tube cutter
15	Thermostat
16	Running & Start Capacitors
17	Compressors
18	Thermistor



## National Competency Standards Level-5 for “HVACR”



### 0713E&E-17. Check and Test Electric Motors

#### Overview

This Competency Standard identifies the competencies required to check and test single phase and three phase electrical motors for smooth operation of HVAC system & energy consumption. Students will be expected to check and test electrical motors according to the nature of work at workplace. His underpinning knowledge regarding electrical motors will be sufficient to provide the basis for his work.

Competency Units	Performance Criteria
1. Test Single Phase Motors	<p><b>P1.</b> Identify type of single-phase motors</p> <p><b>P2.</b> Identify and clean single-phase motor electric terminals</p> <p><b>P3.</b> Check continuity and resistance of windings according to its specifications</p> <p><b>P4.</b> Make comparison of resistances with original one mentioned by the manufacturer.</p> <p><b>P5.</b> Diagnose fault in the windings of single-phase motor</p>
2. Test Three Phase Motors	<p><b>P1.</b> Identify types of three phase motor</p> <p><b>P2.</b> Identify and clean three phase motor electric terminals</p> <p><b>P3.</b> Check continuity and resistance of Windings according to its specifications</p> <p><b>P4.</b> Make comparison of resistances with original one mentioned by the manufacturer.</p> <p><b>P5.</b> Check Star delta connections to start three phase motors</p> <p><b>P6.</b> Diagnose fault in the windings of three phase motor</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
- Identification and use of Personal Protective Equipment (PPE)
- American Society of Heating, Refrigeration and Air Conditioning Engineers (ASHRAE)
- Watts, ohms, volts, and amps
- Ammeter, ohmmeter, voltmeter and wattmeter use
- Applications of magnetic principles to electrical theory
- Principles of solid-state switching devices applications



## National Competency Standards Level-5 for “HVACR”



- Ohms Law to solve circuit problems and calculate circuit loads
- Meters to check basic electrical components
- Electrical characteristics of both series and parallel circuits
- Calculate resistance in a parallel and series circuit
- Calculate capacitance in a parallel and series circuit
- Electric motor theory i.e., magnetism, electromotive force, etc.
- Different types of electric motors
- Working principles of different types of electric motors
- Starting components associated with single-phase and three phase motors
- Operation/replacement of electric motor protection devices demonstration
- Significance of power factor
- Electric motors and motor circuits troubleshooting
- Replace motor controls
- Single phase motors testing
- Three phase motors testing
- 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:

- Adjust AVO meter
- Calculate & compare resistances
- Decide condition of motor
- Operate star delta connections

### List of Tools, Equipment and Machinery

Sr. No	Description
1	Personal Protective Equipment
2	Basic Measuring tools
3	Basic Hand tools
4	Basic Cutting tools
5	Basic Power tools
6	Basic Marking tools
7	Basic Electric tools
8	Ampere meter
9	Ohm meter
10	AVO meter



## National Competency Standards Level-5 for “HVACR”



### 0713E&E-18. Perform Sheet Metal Processes

#### Overview

This Competency Standard covers the knowledge, skills and attitudes required to prepare rectangular air duct for HVAC technology in accordance with duct construction standards. Students will be expected to plan preparation for layout duct and fabricate sheet metal process according to the nature of work at workplace. His underpinning knowledge regarding sheet metal fabrication processes will be sufficient to provide the basis for his work.

Competency Units	Performance Criteria
1. Plan and prepare for work	<p><b>P1.</b> Identify work requirements</p> <p><b>P2.</b> Wear safety dress</p> <p><b>P3.</b> Identify tools and material required in accordance with work plan</p> <p><b>P4.</b> Plan appropriate sequence of procedural steps to complete the work</p> <p><b>P5.</b> Prepare work area in accordance with work requirements</p>
2. Lay out rectangular duct on sheet metal	<p><b>P1.</b> Select appropriate material in accordance with work plan</p> <p><b>P2.</b> Establish datum points to ensure efficient use of material in accordance with the work plan</p> <p><b>P3.</b> Lay out and develop the sheet metal in accordance with the work plan</p> <p><b>P4.</b> Check the layout to ensure the work specification</p>
3. Fabricate sheet metal	<p><b>P1.</b> Mark the metal sheet according to required sizes</p> <p><b>P2.</b> Cut the metal sheet according to required sizes</p> <p><b>P3.</b> Bend the metal sheet according to required sizes</p> <p><b>P4.</b> Fold the edges for double hemmed edge seam joint</p> <p><b>P5.</b> Join the edges of sheet in the shape of double hammed edge seam joint</p>
4. Complete the work	<p><b>P1.</b> Complete the work in accordance with work requirements</p> <p><b>P2.</b> Clean and clear the work area</p> <p><b>P3.</b> Return the tools and equipment to the main store</p> <p><b>P4.</b> Get your work checked by your instructor</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:

- Identification and use of Personal Protective Equipment (PPE)
- Hazard types that are most likely to cause harm
- American Society of Heating, Refrigeration and Air Conditioning Engineers (ASHRAE)



## National Competency Standards Level-5 for “HVACR”



- Interpretation of basic drawings
- Types of ductwork and fittings
- Tin snips left, right and straight
- Identify the different types of connections
- Marking and lay out tools
- Measuring and hand tools
- Cutting tools use to cut sheet metal
- Bending on folding machine
- Assembling of metal sheets
- 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:

- Use PPE
- Layout on sheet
- Cut and Fabricate Duct & its accessories
- Bend sheets
- Make joint of sheets

### List of Tools, Equipment and Machinery

Sr. No	Description
1.	Personal Protective Equipment
2.	Work bench
3.	Bench vice
4.	Tin cutter
5.	Hacksaw
6.	Measuring tools
7.	Marking tools
8.	Layout tools
9.	Common kinds and sizes of files (Assorted range)
10.	Twist drill set (Assorted range)
11.	Drill machine
12.	Power saw
13.	Bending machine
14.	Folding machine
15.	Riveting Plier
16.	Mallet



## National Competency Standards Level-5 for “HVACR”



### 0713E&E-19. Perform Threading with Tap & Die

#### Overview

The candidate must be able to demonstrate underpinning knowledge and understanding required to carry out the tasks covered in this competency standard. Students will be expected to plan and preparation for internal / external cutting threads by using Tap & Die according to the nature of work at workplace. His underpinning knowledge regarding threads cutting will be sufficient to provide the basis for his work.

Competency Units	Performance Criteria
1. Plan and prepare for Thread work	<p><b>P1.</b> Identify job material and tools required</p> <p><b>P2.</b> Get the required job material and tools issued from main store</p> <p><b>P3.</b> Wear proper safety dress</p> <p><b>P4.</b> Plan sequence of procedural steps to complete the job</p>
2. Cut internal threads using Tap	<p><b>P1.</b> Clamp the work piece in bench vice jaws</p> <p><b>P2.</b> Prepare the work piece using file up to required sizes</p> <p><b>P3.</b> Mark the location of central point of hole</p> <p><b>P4.</b> Punch the center of hole</p> <p><b>P5.</b> Drill the hole as per required tap drill size</p> <p><b>P6.</b> Hold the tap in tap handle</p> <p><b>P7.</b> Re-clamp the work piece in vice jaws for taping</p> <p><b>P8.</b> Locate the tap in hole and rotate it clockwise direction carefully</p> <p><b>P9.</b> Use tap no 1, 2 and 3 after one and another</p> <p><b>P10.</b> Check the thread with thread plug gauge</p>
3. Cut external threads using Die	<p><b>P1.</b> Cut the job material in to required size</p> <p><b>P2.</b> Chamfer the sharp edge of job by filing</p> <p><b>P3.</b> Select the proper threading die as per requirement of work</p> <p><b>P4.</b> Locate the threading die in the diestock</p> <p><b>P5.</b> Clamp the work piece in V-block</p> <p><b>P6.</b> Hold the V-block in vice</p> <p><b>P7.</b> Cut threads up to required length</p> <p><b>P8.</b> Check the threads with thread ring gauge</p>
4. Complete the work	<p><b>P1.</b> Complete the work in accordance with requirement</p> <p><b>P2.</b> Clean and clear your work area</p> <p><b>P3.</b> Return the tools and equipment to the main store</p> <p><b>P4.</b> Get you work checked by your instructor</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:

- Identification and use of Personal Protective Equipment (PPE)



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- Types of hazards that are most likely to cause harm
- American Society of Heating, Refrigeration and Air Conditioning Engineers (ASHRAE)
- Thread and their uses
- Pitch & lead of thread
- Thread cutting methods
- Cutting tools which are used in metal work
- Cutting of internal threads by using tap
- Cutting external threads by using die & die stock
- Perform drilling operation
- Layout tools & Marking tools
- Perform regarding filing of metal jobs
- Functions of lubricant in threading
- 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:

- Use PPE
- Cut internal threads
- Cut external threads

### List of Tools, Equipment and Machinery

Sr. No	Description
1.	Personal Protective Equipment
2.	Work bench
3.	Bench vice
4	Pipe vice
5	Hand hacksaw
6	Measuring tools
7	Marking tools
8	Layout tools
9	Impact tools (Assorted range)
10	Common kinds and sizes of files (Assorted range)
11	Twist drill set (Assorted range)
12	Tap & Die set (Assorted range)
13	Thread gauge
14	Drill machine
15	Power saw



## National Competency Standards Level-5 for “HVACR”



### 0713E&E-20. Perform Machining Operation

#### Overview

This Competency Standard identifies the competencies required to perform Machining processes of centering, facing, simple turning, step turning and knurling. Students will be expected to perform Machining process according to the job requirement. His underpinning knowledge regarding Machining processes will be sufficient to provide the basis for his work.

Competency Units	Performance Criteria
1. Perform the centering of job	<p>P1. Identify job material and tools required.</p> <p>P2. Wear safety dress.</p> <p>P3. Clamp the job in chuck</p> <p>P4. Locate surface gauge at cross side</p> <p>P5. Check the concentricity of job</p> <p>P6. Adjust the work piece if required.</p>
2. Perform facing operation	<p>P1. Clamp the job in chuck extending 10mm length from chuck jaws</p> <p>P2. Clamp facing tool in tool post</p> <p>P3. Set suitable Revolution Per Minute (RPM)</p> <p>P4. Set the suitable depth 1mm for rough cut</p> <p>P5. Perform facing operation by moving the tool uniformly towards the center of job</p> <p>P6. Take finishing cut having 0.1mm depth</p>
3. Perform simple turning	<p>P1. Clamp the job in chuck extending suitable length</p> <p>P2. Support free end of job</p> <p>P3. Set proper depth of cut from cross slide dial for rough cut</p> <p>P4. Set suitable Revolution Per Minute (RPM)</p> <p>P5. Take rough cut up to specified length</p> <p>P6. Take finishing cut</p> <p>P7. Measure the diameter and length as per drawing</p>
4. Perform step turning	<p>P1. Mark the length of step</p> <p>P2. Set the turning tool in proper position</p> <p>P3. Turn the diameter &amp; length of step as specified</p> <p>P4. Check the sizes of step</p>
5. Perform knurling operation	<p>P1. Mark the length of knurling portion</p> <p>P2. Select proper knurling tool</p> <p>P3. Clamp the knurling tool in proper position</p> <p>P4. Set slow RPM for knurling</p> <p>P5. Finish knurling operation</p>

#### Knowledge and Understanding





## National Competency Standards Level-5 for “HVACR”



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:

- Identification and use of Personal Protective Equipment (PPE)
- Types of hazards that are most likely to cause harm to health and safety with HVAC tools
- American Society of Heating, Refrigeration and Air Conditioning Engineers (ASHRAE)
- Measuring tools
- Work holding devices identification
- Centering and facing process
- Sharpening and clamping of facing tool
- Cutting speed, feed and depth of cut
- Simple turning, rough and finish turning process
- Define step turning
- Grinding of turning tool
- Knurling, types and knurling tools
- Clamping and positioning of knurling tools
- 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:

- Use PPE
- Operate lathe machine properly
- Perform different operations by use of lathe machine

### List of Tools, Equipment and Machinery

Sr. No	Description
1.	Personal Protective Equipment
2.	Lathe machine (with standard accessories)
3.	Power saw machine
4.	Measuring and marking tools (assorted range)
5.	Work holding devices and attachments
6.	Standard lathe machine attachments
7.	Pedestal grinder with tools, cutting angle support
8.	Twist drill bits and boring bars (assorted range)
9.	Threading tools (assorted range)
10.	Knurling tools (assorted range)
11.	Turning, parting, grooving and forming tools etc. (assorted range)
12.	Common kinds and sizes of files (assorted range)
13.	General maintenance & repairing tool kit
14.	Radius gauge - concave & convex (assorted range)



***National Competency Standards Level-5 for “HVACR”***





## National Competency Standards Level-5 for “HVACR”



### 0713E&E-21. Perform Taper Turning, Drilling and Thread Cutting by Lathe Machine

#### Overview

This Competency Standard identifies the competencies required to perform taper turning, drilling & thread cutting by Lath machine. Students will be expected to perform turning, drilling & threading according to the nature of work at workplace. His underpinning knowledge regarding turning, drilling and threading process will be sufficient to provide the basis for his work.

Competency Units	Performance Criteria
1. Perform taper turning operation.	<p>P1. Wear personal protective equipment</p> <p>P2. Clean and oil the machine</p> <p>P3. Calculate the taper angle</p> <p>P4. Set the compound rest at required angle</p> <p>P5. Perform taper turning as per specification taking necessary steps</p>
2. Perform drilling.	<p>P1. Select the suitable drill as per work requirement</p> <p>P2. Mark the center of hole</p> <p>P3. Clamp the drill in drill chuck</p> <p>P4. Locate drill chuck in machine spindle</p> <p>P5. Clamp the work piece in proper position</p> <p>P6. Set the suitable RPM for drilling</p> <p>P7. Perform drilling operation with proper feed</p>
3. Perform Thread cutting on lathe machine.	<p>P1. Turn the job as per specification</p> <p>P2. Select proper threading tool</p> <p>P3. Clamp and position the threading tool</p> <p>P4. Select and set suitable RPM for thread cutting</p> <p>P5. Set the position of tumbler gear lever for required pitch of thread</p> <p>P6. Take trail cut by engaging half nut lever and measure the pitch of thread</p> <p>P7. By repeating necessary steps complete the required depth of thread</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:

- Identification and use of Personal Protective Equipment (PPE)
- Types of hazards that are most likely to cause harm to health and safety with HVAC tools
- American Society of Heating, Refrigeration and Air Conditioning Engineers (ASHRAE)
- Marking tools
- Taper turning operation



## ***National Competency Standards Level-5 for “HVACR”***



- Different methods of taper turning
- Calculation of taper angle
- Setting of compound rest in proper position
- Drilling and threading operation
- Calculation of RPM required for drilling
- Clamping and positioning of job for drilling
- Type of threads and methods of threads cutting
- Pitch, lead and depth of thread and relation amongst them
- Thread cutting mechanism of lath machine
- Record keeping and reporting



## National Competency Standards Level-5 for “HVACR”



### Critical Evidence(s) Required

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

- Use PPE
- Operate lathe machine properly
- Perform different operations by use of lathe machine

### List of Tools, Equipment and Machinery

Sr. No	Description
1.	Personal protective equipment
2.	Lathe machine (with standard accessories)
3.	Power saw machine
4.	Measuring and marking tools (assorted range)
5.	Work holding devices and attachments
6.	Standard lathe machine attachments
7.	Pedestal grinder with tools, cutting angle support
8.	Twist drill bits and boring bars (assorted range)
9.	Threading tools (assorted range)
10.	Knurling tools (assorted range)
11.	Turning, parting, grooving and forming tools etc. (assorted range)
12.	Common kinds and sizes of files (assorted range)
13.	General maintenance & repairing tool kit
14.	Radius gauge - concave & convex (assorted range)



## National Competency Standards Level-5 for “HVACR”



### 0713E&E-22. Perform Welding Process

#### Overview

This Competency Standard identifies the competencies required to make gas welding joints and arc welding joints. Students will be expected to perform welding according to the nature of work at workplace. His underpinning knowledge regarding Oxy-Acetylene flame, Flange joints, MS Butt joint, Lap Joint, soldering and brazing joints will be sufficient to provide the basis for his work.

Competency Units	Performance Criteria
1. Identify and make Oxy-Acetylene Flames	<p>P1. Wear personal protective equipment</p> <p>P2. Fix oxygen acetylene regulator</p> <p>P3. Open oxygen/acetylene cylinder valve</p> <p>P4. Check leakage of regulators</p> <p>P5. Open valve of acetylene from welding torch valve and light the torch and make neutral flame</p> <p>P6. Identify and make the harsh flame</p> <p>P7. Identify and make the carburizing flame</p> <p>P8. Identify and make the neutral flame</p> <p>P9. Identify and make the oxidizing flame</p>
2. Perform Flange joint	<p>P1. Bend of MS sheet at 90° to make flange</p> <p>P2. Put both pieces on welding table without gap</p> <p>P3. Grip the pieces from flange</p> <p>P4. Open the pressure of both cylinders</p> <p>P5. Make flame and melt the edges and continue this process to complete joint</p>
3. Make MS Butt joint by Oxy Acetylene flame	<p>P1. Clean and straight the both edges of base metal</p> <p>P2. Adjust both gases pressures</p> <p>P3. Set base metals with required gap</p> <p>P4. Make neutral flame</p> <p>P5. Melt the edge of base metal and fill the gap by fusing filler rod on both sides</p> <p>P6. Complete the bead after tacking continue the puddle making and filling of gap</p>
4. Perform MS Lap joint by Oxy Acetylene flame	<p>P1. Clean and straight the both edges of base metal</p> <p>P2. Adjust both gases pressure</p> <p>P3. Set base metals in overlap position</p> <p>P4. Make neutral flame</p> <p>P5. Make puddle at edges and fill the gap by molten filler metal</p> <p>P6. Complete the joint by using filler rod</p>
5. Make brazing joints	<p>P1. Clean and straight the both edges of base metal</p> <p>P2. Put the both pieces of base metal on the welding table</p> <p>P3. Heat up the edges of base metal up to red hot</p>



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	condition <b>P4.</b> Use the brazing flux with cleaned nonferrous filler rod <b>P5.</b> Complete the process of joint by using fore hand technique
<b>6.</b> Prepare soldering joint	<b>P1.</b> Make permanent joint of different materials using nonferrous filler metal having melting point less than 800°F with the help of soldering iron. <b>P2.</b> Heat copper made soldering iron in furnace <b>P3.</b> Heat copper made soldering iron by electricity <b>P4.</b> Clean the surfaces to be joint <b>P5.</b> Apply soldering flux on the clean surfaces
<b>7.</b> Make Arc Welding joint	<b>P1.</b> Wear personal protective equipment <b>P2.</b> Clean and straight the edges of base metal <b>P3.</b> Set the both pieces of base metal with sufficient gap <b>P4.</b> Switch on the welding machine and set required current <b>P5.</b> Tack both ends of base metal <b>P6.</b> Clean the slag from both tacks <b>P7.</b> Start bead from one end of base metal with proper length of Arc and proper speed <b>P8.</b> Remove slag from bead

### 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:

- Identification and use of Personal Protective Equipment (PPE)
- Types of hazards that are most likely to cause harm to health and safety with HVAC tools
- American Society of Heating, Refrigeration and Air Conditioning Engineers (ASHRAE)
- Carburizing flame add small quantity of oxygen gas
- Inner core of carburizing flame
- Neutral and Oxidizing flame
- Flange joint use to join the thin sheets without filler rod by neutral flame
- Gap between both pieces of base metal for open square butt joint
- Neutral flame for thin sheets an oxidizing flame for welding of thick sheet
- Angle of welding torch be kept at 45° between fillet
- Brazing differ from fusion welding in which base metal is not melted and have no gape between base metal pieces
- 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:

- Use PPE
- Operate Oxy Acetylene Gas welding set
- Make different types of flame



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- Make different joints of metals use Oxy Acetylene Gas welding set
- Operate Arc welding set
- Make joint by Arc welding

### List of Tools, Equipment and Machinery

Sr. No	Description
1	Personal protective equipment
2	Oxygen gas cylinder
3	Acetylene gas cylinder
4	Spark lighter
5	Pressure regulators
6	Hose pipe
7	Goggles
8	Filler rod with filler rod holder
9	Welding table
10	Tip cleaner
11	Tong
12	Welding torch
13	Welding machine (Welding transformer or welding rectifier or welding generator)
14	welding screen or helmet
15	Chipping hammer
16	Wire brush
18	Soldering iron along with soldering rod

### 0713E&E-23. Analyse Thermodynamic performance of HVACR System

#### Overview

This Competency Standard identifies the competencies required to analyze the thermodynamic performance of HVAC systems. Students will be expected to analyze the thermodynamic performance according to the nature of work at workplace. His underpinning knowledge regarding thermodynamic performance will be sufficient to provide the basis for his work.

Competency Units	Performance Criteria
<b>1.</b> Prepare to analyze the thermodynamic performance of HVACR systems	<b>P1.</b> Calculate thermodynamic properties of air <b>P2.</b> Calculate specific heat of air at constant pressure and at constant volume <b>P3.</b> Calculate enthalpy of air / gasses <b>P4.</b> Calculate internal energy of air / gasses <b>P5.</b> Calculate specific gravity of different liquids <b>P6.</b> Calculate density of air / liquids <b>P7.</b> Calculate rate of discharge of fluids
<b>2.</b> Analyze the	<b>P1.</b> Apply thermodynamic principles to analytical





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thermodynamic performance of HVACR systems	solutions on refrigeration and air conditioning systems. <b>P2.</b> Obtain Parameters, specifications and performance requirements in relation to refrigeration and air conditioning systems in accordance with established procedures. <b>P3.</b> Carry out approaches to analyze thermodynamic parameters to provide the most effective solution.
<b>3.</b> Make report and act on the results of thermodynamic performance analysis	<b>P1.</b> Evaluate to determine the effectiveness of solutions for thermodynamic issues and modify where necessary. <b>P2.</b> Make report of the analysis including details of all findings, calculations and assumptions. <b>P3.</b> Take actions regarding equipment, documents for inclusion in work/project or development records in accordance with professional standards and manufacturer’s specifications.

### 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:

- American Society of Heating, Refrigeration and Air Conditioning Engineers (ASHRAE)
- Thermodynamic performance issues
- Forming effective strategies for analyzing refrigeration and air conditioning systems performance
- Obtaining thermodynamic performance parameters, specifications and performance requirements appropriate to each situation
- Evaluating the results of the analysis
- Documenting analysis details of all findings, calculations and assumptions
- 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:

- Apply thermodynamic principles to analytical solutions on HVACR systems
- Analyze the thermodynamic performance of HVAC/R systems
- Take action on the results of different thermodynamic performance analysis
- Make report thermodynamic performance analysis



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### List of Tools, Equipment and Machinery

Sr. No	Description
1	Personal Protective Equipment
2	Basic Measuring tools
3	Basic Hand tools
4	Basic Cutting tools
5	Basic Power tools
6	Basic Marking tools
7	Basic Electrical and Electronics tools





## National Competency Standards Level-5 for “HVACR”



### 0713E&E-24. Prepare Low Pressure Boiler for Smooth Operation

#### Overview

This competency standard identifies the competencies required to prepare boiler for smooth operation. Students will be expected to prepare boiler for smooth operation according to the nature of work at workplace. His underpinning knowledge regarding boiler operation will be enough to provide the basis for his work.

Competency Units	Performance Criteria
1. Prepare the low-pressure boiler for operation	<p><b>P1.</b> Review operational order and check appropriate / designated / concerned / competent person where required</p> <p><b>P2.</b> Identify and report health and safety hazards / maintenance requirements to appropriate personnel according to workplace reporting procedures</p> <p><b>P3.</b> Identify and set quantity of steam to be generated for allocated Process</p> <p><b>P4.</b> Purge the boiler according to workplace procedure</p> <p><b>P5.</b> Perform pre-operational checks to confirm operational status of boiler and related equipment</p>
2. Operate and monitor boiler	<p><b>P1.</b> Use equipment in line with organizational safety procedures, manufacturer's instructions and environmental protection practices.</p> <p><b>P2.</b> Apply complete pre-operational safety and pre start-up checks to ensure operational effectiveness.</p> <p><b>P3.</b> Start boiler and bring safely online; communicate recent performance to appropriate personnel.</p> <p><b>P4.</b> Monitor boiler operation, diagnose status and adjust to maintain safe and efficient operation.</p>
3. Shut down and store boiler	<p><b>P1.</b> Shut down boiler according to workplace procedures and manufacturer's recommendations</p> <p><b>P2.</b> Clean boiler internally and externally according to workplace procedures and manufacturer's recommendations</p> <p><b>P3.</b> Remove valves and fittings in preparation for maintenance</p> <p><b>P4.</b> Store the boiler in the appropriate storage mode according to workplace procedures and manufacturer's recommendations</p> <p><b>P5.</b> Store and record boiler house chemicals, in line with safety procedures and environmental protection practices.</p> <p><b>P6.</b> Follow emergency shutdown procedures in cases of fire.</p> <p><b>P7.</b> Complete operating log, record fuel efficiency and report to the designated personnel.</p>



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**4.** Analyze and respond to abnormal performance (Trouble Shooting of Boiler)

- P1.** Analyze operating data and plant operating conditions to identify causes of abnormal performance
- P2.** Act correctively in accordance with workplace procedures in response to Hazards, out-of-specification test results and/or plant performance
- P3.** Implement emergency procedures as required according to workplace procedures and manufacturer's recommendations and ASHRAE US Standards.

### 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:

- Hazards that are most likely to cause harm
- Identification and use of Personal Protective Equipment (PPE)
- American Society of Heating, Refrigeration and Air Conditioning Engineers (ASHRAE)
- Different types of electric motors
- Working principles of different types of electric motors
- Pressure and pressure laws
- Temperature and its units
- Ohm meter, Voltmeter and Ampere meter use
- 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:

- Adopt PPE for boiler operation
- Set measured quantities of boiler
- Follow start up precautions
- Start & Operate boiler safely
- Shutdown boiler

### List of Tools, Equipment and Machinery

Sr. No	Description
1	Personal Protective Equipment
2	Basic Measuring tools
3	Basic Hand tools
4	Basic Cutting tools



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<b>5</b>	Basic Power tools
<b>6</b>	Basic Marking tools
<b>7</b>	Basic Electric and Electronics tools



## National Competency Standards Level-5 for “HVACR”



### 0713E&E-25. Perform Water Treatment

#### Overview

This Competency Standard identifies the competencies required to perform chemical test of water, hot water treatment, post-treatment procedures, organic and inorganic materials treatment procedures in HVAC systems. Students will be expected to perform water treatment according to the nature of work at workplace. His underpinning knowledge regarding water treatment will be sufficient to provide the basis for his work.

Competency Units	Performance Criteria
1. Perform chemical test of water	<p>P1. Collect water samples from boiler, close water circuit and cooling tower</p> <p>P2. Examine sample waters with the help of chemical test kit</p> <p>P3. Compare values of required water with PH standards</p> <p>P4. Prepare report</p>
2. Prepare for hot water treatment	<p>P1. Confirm work instructions on hot water treatments</p> <p>P2. Confirm materials as available and ready to meet requirements</p> <p>P3. Set up equipment in according to its specifications</p> <p>P4. Prepare chemicals for hot water treatment and hydration according to specifications</p> <p>P5. Collect Waste and dispose it of according to workplace procedures</p>
3. Carry out post-treatment procedures	<p>P1. Collect water samples from boiler, close water circuit and cooling tower</p> <p>P2. Compare values of required water with PH standards</p> <p>P3. Collect Waste and dispose it of according to workplace procedures</p> <p>P4. Conduct work in accordance with the workplace environmental guidelines</p> <p>P5. Prepare report</p>
4. Perform organic and inorganic material treatment procedure	<p>P1. Perform Chlorination</p> <p>P2. Remove temporary hardness by boiling in boiler</p> <p>P3. Remove salt concentration in cooling tower by neutralization process</p> <p>P4. Insert recommended amount of chemical for eradicate the growth of fungi</p>

#### Knowledge and Understanding



## National Competency Standards Level-5 for “HVACR”



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:

- Hazards that are most likely to cause harm
- Identification and use of Personal Protective Equipment (PPE)
- Knowledge of American Society of Heating, Refrigeration and Air Conditioning Engineers (ASHRAE)
- Chemicals used for the treatment of water
- Properties of the different chemicals
- Ratio between water and chemical
- Advantages of the water treatment
- Examine the water with the help of chemical test
- PH value
- Work instructions on hot water treatments
- Hydration, and chlorination
- Hardness of water and neutralization process
- Eradication process of fungi
- Organic and inorganic material and their properties
- 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:

- Collect samples of water
- Perform different test of water
- Perform water treatment with different methods

### List of Tools, Equipment and Machinery

Sr. No	Description
1	Personal Protective Equipment
2	Basic Measuring tools
3	Basic Hand tools
5	Basic Power tools
6	Basic Electric tools
7	Chemical test kit
8	Water treatment assembly kit
9	Water pots for sampling



## National Competency Standards Level-5 for “HVACR”



### 0713E&E-26. Service and Maintain Transport / Mobile Refrigeration Units

#### Overview

This competency standard identifies the competencies required to service and maintain transport / mobile refrigeration units. Students will be expected to diagnose the defects and service / maintain in transport / mobile refrigeration units according to the nature of work at workplace. His underpinning knowledge regarding servicing and maintenance of transport / mobile refrigeration units will be sufficient to provide the basis for his work.

Competency Units	Performance Criteria
1. Check and diagnose the defect in the freezer unit	<p><b>P1.</b> Inspect unit and ascertain, record to the extent of repair needed.</p> <p><b>P2.</b> Prepare list of material, equipment, manpower and items according to the requirement.</p> <p><b>P3.</b> Check / observe all components of refrigerant circuit according to standard practices and manufactures specifications to ensure correct performance.</p> <p><b>P4.</b> Check / observe all components of the refrigerant system, electrical system and accessories according to standards practices &amp; manufactures specifications to ensure correct operation.</p> <p><b>P5.</b> Test system pressure with dry nitrogen gas and locate leaks using specified equipment and recommended safety procedures.</p>
2. Service / repair refrigerant system of the freezer unit	<p><b>P1.</b> Check internal and external electrical / electronic control systems for operations and repair / replace where necessary according to manufacturer's instructions.</p> <p><b>P2.</b> Check electronic climatic controls for smooth operation and replace where necessary according to manufacturer's instructions.</p> <p><b>P3.</b> Check freezer unit for specified /specific performance against manufacturer's specification</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:

- Hazards that are most likely to cause harm
- Identification and use of Personal Protective Equipment (PPE)
- American Society of Heating, Refrigeration and Air Conditioning Engineers (ASHRAE)





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- Different types of compressors and their functions
- Define pressure and temperature laws
- Define temperature and its units
- Read and interpret manufacturer’s manuals, specifications etc.,
- Basic refrigeration and air conditioning principles Refrigeration Cycle
- Types of Refrigerants, their properties and applications
- Functions of the gauge manifold and color code of hoses
- Function of service valves
- Working principles of the recovery machine
- Refrigerant recovery process
- Refer to manufacturer’s specifications/ instructions on service and maintenance of transport / mobile refrigeration units
- Identify the type of refrigerants
- Detection of gas leaks and repairing leaks Pressure testing in refrigerant lines Adherence to conditions of the “Environment Protection Acts “(EPA)
- Coupling manifold gauge and hoses to the refrigerant lines either by piercing or using service valves
- Safe handling and use of refrigerants, gauges, tools & equipment
- 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 Transport Refrigeration by using specified tools and instruments
- Repair refrigerant leak in Transport Refrigeration system
- Replace the compressor and other accessories of unit
- Recharge refrigerant
- Operate crankcase pressure regulator (KVL)

### List of Tools, Equipment and Machinery

Sr. No	Description
1	Personal Protective Equipment
2	Basic Measuring tools
3	Basic Hand tools
4	Basic Cutting tools
5	Basic Power tools
6	Basic Electric tools
7	Gauge manifold
8	Recovery Machine with accessories



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<b>9</b>	Vacuum pump
<b>10</b>	Refrigerant Charging Station
<b>11</b>	Oxy-acetylene welding set with accessories



## National Competency Standards Level-5 for “HVACR”



### 0713E&E-27. Apply principles of refrigeration in Cold Storage Technology

#### Overview

This Competency Standard identifies the competencies required to apply principles of refrigeration cold storage technology. Students will be expected to recognize causes of food spoilage analyze food spoilage risks in supply chain and select optimum methods storage of perishable food, in cold storage technology according to the nature of work at workplace. His underpinning knowledge regarding cold storage technology will be sufficient to provide the basis for his work.

Competency Units	Performance Criteria
1. Recognize causes of food spoilage	<p><b>P1.</b> Obtain and implement work health and safety (WHS) and environmental requirements for a given work area</p> <p><b>P2.</b> Determine causes of food spoilage from observation, testing, measurements and/or supply chain tracking</p> <p><b>P3.</b> Interpret and apply relevant National / ASHRAE US standards, codes and regulations for food storage and handling</p> <p><b>P4.</b> Obtain equipment and resources needed for the task in accordance with enterprise procedures</p>
2. Analyze food spoilage risks in supply chain	<p><b>P1.</b> Identify critical points in the food supply chain and determine the associated risks</p> <p><b>P2.</b> Identify and document risks and propose appropriate risk minimization strategies</p> <p><b>P3.</b> Check proposed risk minimization strategies against relevant standards, codes and legislative requirements</p> <p><b>P4.</b> Develop and Provide immediate solutions to unexpected situations of faults</p> <p><b>P5.</b> Provide solution which is consistent with enterprise procedures</p>
3. Select optimum storage methods of perishable food	<p><b>P1.</b> Propose options to minimize food spoilage based on analysis of the produce type, facilities available and supply chain requirements</p> <p><b>P2.</b> Select optimum solutions with respect to equipment, facilities, processing techniques and cost-</p> <p><b>P3.</b> Adopt storage and handling method in accordance with enterprise procedures</p> <p><b>P4.</b> Develop proper documentation of the situation and keep record for future reference and use</p>



## National Competency Standards Level-5 for “HVACR”



### 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:

- Hazards that are most likely to cause harm
- Identification and use of Personal Protective Equipment (PPE)
- American Society of Heating, Refrigeration and Air Conditioning Engineers (ASHRAE)
- Cold storage technology
- Principles of refrigeration
- Food storage methods
- Storage temperature of different type of food
- Ability to analyze food properties
- Storage methods of perishable food
- Define food chain
- Define and can analyze food spoilage risks
- 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:

- Recognize cause of food spoilage
- Adopt correct method for storage of different food items
- Select suitable conditions for storage
- Select accurate temperature and humidity for specified items

### List of Tools, Equipment and Machinery

Sr. No	Description
1	Personal Protective Equipment
2	Food analyzer



## National Competency Standards Level-5 for “HVACR”



### 0713E&E-28. Maintain and Repair Multi-Stage, Cascade & Ultra-Low Temperature Refrigeration System

#### Overview

This Competency Standard identifies the competencies required to maintain and repair multi-stage, cascade & ultra-low temperature refrigeration system. Students will be expected to undertake preventive maintenance checks/ adjustment on multi-stage, cascade and/or ultra-cold industrial refrigeration systems and coordinate an air conditioning system in the production of food products according to the nature of work at workplace. His underpinning knowledge regarding ultra-low temperature refrigeration units will be sufficient to provide the basis for his work.

Competency Units	Performance Criteria
1. Undertake preventive maintenance checks / adjustment on multi- stage, cascade and/or ultra-cold industrial refrigeration systems	<p><b>P1.</b> Check the temperature, pressure and properties of the multi-stage, cascade and/or ultra-cold refrigeration system for conformance to specification.</p> <p><b>P2.</b> Check the noise/vibration levels of the multi- stage, cascade and/or ultra-cold refrigeration system for conformance to specification.</p> <p><b>P3.</b> Perform preventative maintenance tasks according to manufacturers' specifications using refrigeration techniques / practices.</p>
2. Coordinate an air conditioning system in the production of food products	<p><b>P1.</b> Identify common forms of air conditioning systems used in the production of food products</p> <p><b>P2.</b> Assess air conditioning requirements for a given situation in the production process</p> <p><b>P3.</b> Identify variables on a psychrometric chart</p> <p><b>P4.</b> Apply psychrometric charts for the analysis of air conditioning systems in the production process</p> <p><b>P5.</b> Monitor the performance of the air conditioning system in the production process</p> <p><b>P6.</b> Rectify issues with performance of air conditioner</p> <p><b>P7.</b> Monitor energy efficiency to reduce costs and environmental impacts</p> <p><b>P8.</b> Report problems to the designated person</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:

- Hazards that are most likely to cause harm
- Identification and use of Personal Protective Equipment (PPE)



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- American Society of Heating, Refrigeration and Air Conditioning Engineers (ASHRAE)
- Using tools, techniques and equipment necessary to check multi-stage, cascade and/or ultra-cold industrial refrigeration systems and components for correct operation
- Comparing system, sub-systems and component performance/operation against specification
- Identifying faulty components and non-compliances making required adjustments to achieve specifications
- Applying safety procedures, standard operating procedures and legislative requirements to all work undertaken documenting results of the adjustments
- Reading, interpreting and following information on written job instructions, specifications, standard operating procedures, charts, lists, drawings and other applicable reference documents
- Procedures for reporting non-conformances procedures and sequence for performing preventative maintenance
- Procedures and sequence for performing safety equipment checks specifications and process for identifying system components
- Operational characteristics of the system components procedures and all legislative and regulatory requirements for safely removing the refrigerant from the system procedures for dismantling and repairing components, selecting replacement parts, reassembling and testing
- 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:

- Maintain log sheet of unit
- Inspect different parts of unit
- Diagnose fault in system
- Repair faults
- Check & Repair leaks in system
- Shut down the system
- Replace different parts of system

### List of Tools, Equipment and Machinery

Sr. No	Description
1	Personal Protective Equipment
2	Basic Measuring tools
3	Basic Hand tools
4	Basic Cutting tools
5	Basic Power tools
6	Basic Electric tools
7	Gauge manifold



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<b>8</b>	Recovery Machine with accessories
<b>9</b>	Vacuum pump
<b>10</b>	Refrigerant Charging Station
<b>11</b>	Oxy-acetylene welding set with accessories



## National Competency Standards Level-5 for “HVACR”



### 0713E&E-29. Monitor Refrigeration in Food Processing

#### Overview

This Competency Standard identifies the competencies required to monitor refrigeration in food processing. Students will be expected to organize refrigeration and air conditioning system in the production of food item in food processing according to the nature of work at workplace. His underpinning knowledge regarding food processing refrigeration will be sufficient to provide the basis for his work.

Competency Units	Performance Criteria
1. Organize a refrigeration system in the production of food items	<p><b>P1.</b> Identify refrigerants and their required properties</p> <p><b>P2.</b> Monitor performance of the refrigeration system in the production process</p> <p><b>P3.</b> Analyze performance of a refrigeration system according to HVAC standards and manufacturers specifications.</p> <p><b>P4.</b> Identify and evaluate ways to improve the performance of the refrigeration system</p>
2. Organize an air conditioning system in the production of food items	<p><b>P1.</b> Identify common forms of air conditioning systems used in the production of food products</p> <p><b>P2.</b> Assess air conditioning requirements for a given situation in the production process</p> <p><b>P3.</b> Identify variables on a psychrometric chart</p> <p><b>P4.</b> Apply psychrometric charts for the analysis of air conditioning systems in the production process</p> <p><b>P5.</b> Monitor the performance of the air conditioning system in the production process</p> <p><b>P6.</b> Rectify issues with performance of air conditioner</p> <p><b>P7.</b> Monitor energy efficiency to reduce costs and environmental impacts</p> <p><b>P8.</b> Report problems to the designated person</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:

- Hazards that are most likely to cause harm
- Identification and use of Personal Protective Equipment (PPE)
- American Society of Heating, Refrigeration and Air Conditioning Engineers (ASHRAE)
- Using tools, techniques and equipment necessary to check refrigeration and air conditioning systems and components for correct operation
- Comparing system, sub-systems and component performance/operation against specification





## National Competency Standards Level-5 for “HVACR”



- Identifying faulty components and non-compliances making required adjustments to achieve specifications
- Applying safety procedures, standard operating procedures and legislative requirements to all work undertaken documenting results of the adjustments
- Reading, interpreting and following information on written job instructions, specifications, standard operating procedures, charts, lists, drawings and other applicable reference documents
- Procedures for reporting non-conformances procedures and sequence for performing preventative maintenance
- Procedures and sequence for performing safety equipment checks specifications and process for identifying system components
- Operational characteristics of the system components procedures and all legislative and regulatory requirements for safely removing the refrigerant from the system procedures for dismantling and repairing components, selecting replacement parts, reassembling and testing
- 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:

- Recognize & select refrigeration system
- Analyze performance of a refrigeration system for food processing
- Identify & Rectify issues regarding food processing

### List of Tools, Equipment and Machinery

Sr. No	Description
1	Personal Protective Equipment
2	Basic Measuring tools
3	Basic Hand tools
4	Basic Cutting tools
5	Basic Power tools
6	Basic Electric tools
7	Gauge manifold
22	Recovery Machine with accessories
23	Vacuum pump
24	Refrigerant Charging Station
25	Oxy-acetylene welding set with accessories



## National Competency Standards Level-5 for “HVACR”



### 0713E&E-30. Perform Refrigerant Recovery

#### Overview

This Competency Standard identifies the competencies required to couple the recovery unit to the equipment and recover the refrigerant. Students will be expected to recover refrigerant from the system according to the nature of work at workplace. His underpinning knowledge regarding refrigerant recovery will be sufficient to provide the basis for his work.

Competency Units	Performance Criteria
1. Couple the recovery unit to the equipment	<p><b>P1.</b> Identify type of refrigerant to be recovered according to available information.</p> <p><b>P2.</b> Select appropriate system for connection of charging hoses, either with piercing valve or charging valve according to requirements.</p> <p><b>P3.</b> Ensure recovery unit to be free of any other type of refrigerant.</p> <p><b>P4.</b> Transfer refrigerant in unit to a separate recovery cylinder; ensure that no refrigerant escapes to atmosphere.</p> <p><b>P5.</b> Connect gauge manifold to system, according to standard color codes of hoses of manifold gauge.</p> <p><b>P6.</b> Couple recovery unit to equipment, following standard procedure for connections.</p> <p><b>P7.</b> Connect overfill protection device and ensure safety of operation.</p>
2. Recover Refrigerant	<p><b>P1.</b> Start recovery unit, monitor process and ensure full recovery of Refrigerant.</p> <p><b>P2.</b> Stop recovery unit</p> <p><b>P3.</b> Disconnect system according to standard procedure</p> <p><b>P4.</b> Ensure no refrigerant escapes to atmosphere</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:

- Hazards that are most likely to cause harm
- Identification and use of Personal Protective Equipment (PPE)
- American Society of Heating, Refrigeration and Air Conditioning Engineers (ASHRAE)
- Basic refrigeration and air conditioning Cycle
- Types of Refrigerants, their properties and applications
- Functions of the gauge manifold and color code of hoses
- Function of service valves
- Working principles of the recovery machine
- Refrigerant recovery process



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- Gas leaks and repairing leaks Pressure testing in refrigerant lines Adherence to conditions of the “Environment Protection Acts “(EPA)
- Coupling manifold gauge and hoses to the refrigerant lines either by piercing or using service valves
- Recovery of refrigerants using recovery machines and allied accessories.
- Safe handling and use of refrigerants, pressure gauges, tools & equipment
- 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:

- Operate refrigerant recovery unit
- Connect unit with HVAC machine
- Transfer refrigerant in a cylinder

### List of Tools, Equipment and Machinery

Sr. No	Description
1	Personal Protective Equipment
2	Basic Measuring tools
3	Basic Hand tools
4	Basic Cutting tools
5	Basic Power tools
6	Basic Electric tools
7	Gauge manifold with hoses
8	Piercing valve
9	Recovery unit



**0713E&E-31. Install Residential Air Conditioner**

**Overview**

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

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



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- pipe and control wires to pass through
- P5.** Mount the Indoor unit wall mounting plate according to manufacturer specifications and install the Indoor unit on it
  - P6.** Prepare base for the fixing of Outdoor unit according to manufacturer specifications and fix the Outdoor unit there
  - P7.** Make electric supply connection at outer unit.
  - P8.** Connect the refrigerant pipes amongst/ to both indoor and outdoor units, supply and control wires according to manufacturer manual
  - P9.** Add additional refrigerant for additional piping according to manufacturer recommendations
  - P10.** Make oil trap in copper pipe as per site requirement  
Perform leak test, evacuation procedure, charge refrigerant and open the service valves
  - P11.** Insulate the joints and refrigerant pipes according to standards and manufacturer installation manual
  - P12.** Remove all packing material - Cardboard, Styrofoam, Tape and Plastic film
  - P13.** Switch on the Air Conditioner and check performance as per capacity and specifications

### Knowledge & 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:

- American Society of Heating, Refrigeration and Air Conditioning Engineers (ASHRAE)
- Ozone Protection and Synthetic Greenhouse Gas Management Act 1989 Basic load calculation for cooling / heating.
- 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.
- Types of electrical wires and cables, including underground cables, their ratings and its 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/ Evacuation / Purging / Refrigerant charging



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- Types of Refrigerant, its properties, Recycling, Recovery and Reclaiming

### 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
- Purge refrigerant and charge the unit

### List of Tools, Equipment and Machinery

Sr. No	Description
1	Personal Protective Equipment
2	Basic Measuring tools
3	Basic Hand tools
4	Basic Cutting tools
5	Basic Power tools
6	Basic Marking tools
7	Basic Electric tools
8	AVO meter
10	Adjustable Screw Wrench
11	Combination Plier
12	Nose Plier Set
13	Locking Plier
14	Copper tube cutter
15	Electric Hand Drill Machine



## National Competency Standards Level-5 for “HVACR”



### 0713E&E-32. Repair Refrigerator, Deep Freezer, Display Unit, Bottle Cooler and Water Cooler

#### Overview

This Competency Standard identifies the competencies required to repair refrigerators, deep freezers, display units, bottle coolers and water coolers. Students will be expected to repair refrigerators, deep freezers, display units, bottle coolers and water coolers according to the nature of work at workplace. His underpinning knowledge regarding repairing of refrigerators, deep freezers, display units, bottle coolers and water coolers will be sufficient to provide the basis for his work.

Competency Units	Performance Criteria
1. Check and identify defects in window type & split type Air Conditioners	<p><b>P1.</b> Check unit for the extent of repair needed ascertain and recorded.</p> <p><b>P2.</b> Enlist equipment / items, material main power and accessories as required for job.</p> <p><b>P3.</b> Check all components of the electrical / electronic circuit according to standard / practices and manufacturers specifications to ensure correct performance.</p> <p><b>P4.</b> Check all components of the refrigerant circuit according to standard / practices and manufactures specifications to ensure correct performance.</p> <p><b>P5.</b> Check all components of the Air-flow system according to standards / practices and manufactures specifications to ensure correct performance.</p> <p><b>P6.</b> Check outer cover / chassis for corrosion etc.</p> <p><b>P7.</b> Test system pressure with dry nitrogen and locate gas leaks by using specified equipment following safety procedures.</p>
2. Repair window type & split type Air Conditioners	<p><b>P1.</b> Identify defects and repair / replace the relevant component(s).</p> <p><b>P2.</b> Perform brazing and test system for leakages</p> <p><b>P3.</b> Evacuate the system using vacuum pump and test according to manufacturer’s specifications</p> <p><b>P4.</b> Recharge refrigerant using specified type of refrigerant and recharging equipment, to required specification following safety practices.</p> <p><b>P5.</b> Check filters clean / replace if necessary.</p> <p><b>P6.</b> Check corrosion in outer cover / base plate and restore required conditions.</p> <p><b>P7.</b> Operate and check unit to ensure satisfactory performance according to manufacturer’s specifications</p>



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### 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:

- Hazards that are most likely to cause harm
- Identification and use of Personal Protective Equipment (PPE)
- American Society of Heating, Refrigeration and Air Conditioning Engineers (ASHRAE)
- 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 Refrigeration unit by using specified tools and instruments
- Check & Replace electrical accessories of unit
- Check & Replace the mechanical parts & accessories of the unit
- Charge the refrigerant in unit

### List of Tools, Equipment and Machinery

Sr. No	Description
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## ***National Competency Standards Level-5 for “HVACR”***



<b>1</b>	Personal Protective Equipment
<b>2</b>	Basic Measuring tools
<b>3</b>	Basic Hand tools
<b>4</b>	Basic Cutting tools
<b>5</b>	Basic Power tools
<b>6</b>	Basic Marking tools
<b>7</b>	Basic Electric tools
<b>8</b>	Portable Refrigerant Charging Station
<b>9</b>	Digital Air Flow / Velocity Meter
<b>10</b>	Water Pressure Gun for Service
<b>11</b>	Electronic Leak Detector
<b>12</b>	Tube Cutter
<b>13</b>	Digital Optical Tachometer
<b>14</b>	Micron Pressure Gauge
<b>15</b>	Digital Pressure Gauges Set (High & Combine)
<b>16</b>	Pinch-Off Plier
<b>17</b>	Flaring and Swaging Tool Kit
<b>18</b>	Vacuum Pump 2-Stage, 6cfm
<b>19</b>	Tube Benders (Spring Type and Pulley Bender Type)
<b>20</b>	Megohmmeter (0 - 1000 Volts)
<b>21</b>	Laser Temperature Measuring Device Nose Plier Set
<b>22</b>	Electric Hand Grinder
<b>23</b>	Soldering Iron
<b>24</b>	Digital Clamp-On Ampere Meter
<b>25</b>	Digital Multi Meter
<b>26</b>	Electric Hand Drills
<b>27</b>	Hot Air Gun
<b>28</b>	Digital Capacitor Analyzer
<b>29</b>	Hand Electric Blower
<b>30</b>	Digital Humidity Meter
<b>31</b>	Digital Psychrometer (Hygrometer)
<b>32</b>	Pulley Wheel Puller
<b>33</b>	Screwdriver Set
<b>34</b>	Nitrogen Gas Cylinder with Hose Pipe, Regulator and Back Arrestor
<b>35</b>	Gas Welding Set with All Accessories
<b>36</b>	Allen Key Set
<b>37</b>	Locking Plier



## National Competency Standards Level-5 for “HVACR”



### 0713E&E-33. Repair and 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’s 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 student work.

Competency Units	Performance Criteria
1. Diagnose Faults in Residential Air Conditioner	<p><b>P1.</b> Adopt Occupational Safety and Health (OSH) procedures to avoid hazards and accidents at workplace.</p> <p><b>P2.</b> Check for obvious problem to determine which component or system is causing the problem</p> <p><b>P3.</b> Select tools, equipment and related accessories according to requirements and standards.</p> <p><b>P4.</b> 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><b>P5.</b> Eliminate the causes of the problem according to the manufacturer’s manual and standards.</p> <p><b>P6.</b> Isolate and recheck the causes of the problem and rectify the fault</p> <p><b>P7.</b> Start the Air conditioner and recheck the unit as specified in the manufacturer’s manual and record the results</p>
2. Repair Window / Split Air Conditioner	<p><b>P1.</b> Adopt Occupational Safety and Health (OSH) procedures to avoid hazards and accidents at workplace.</p> <p><b>P2.</b> Select tools, equipment and related accessories according to job requirements</p> <p><b>P3.</b> Disconnect the Air conditioner from electric supply and follow the manual instructions for rectification</p> <p><b>P4.</b> Rectify the faults as per diagnosed, repair / replace the components, as necessary</p> <p><b>P5.</b> Switch on the Air conditioner to check the performance of electrical/ electronic and mechanical components as specified in the manufacturer’s manual and record the results</p>
3. Service Window Air	<p><b>P1.</b> Adopt Occupational Safety and Health (OSH)</p>



## National Competency Standards Level-5 for “HVACR”



Conditioner	<p>procedures to avoid hazards and accidents at workplace.</p> <p><b>P2.</b> Select tools, equipment and related accessories according to job requirements</p> <p><b>P3.</b> Start the Air conditioner, check and record performance by using specified test instruments</p> <p><b>P4.</b> Disconnect the Air conditioner from electric supply and remove Air conditioner from the cover</p> <p><b>P5.</b> Secure the electric / electronic components with polythene sheet</p> <p><b>P6.</b> Clean / wash the all mechanical parts of Window Air conditioner with specified cleaning agents / detergent by using pressure pump.</p> <p><b>P7.</b> Fix the Air conditioner in the cover, connect with electric supply, check and record performance</p>
<b>4. Service Split Air Conditioner</b>	<p><b>P1.</b> Adopt Occupational Safety and Health (OSH) procedures to avoid hazards and accidents at workplace.</p> <p><b>P2.</b> Select tools, equipment and related accessories according to job requirements</p> <p><b>P3.</b> Start the Air conditioner, check and record performance by using specified test instruments</p> <p><b>P4.</b> Pump down the split type Air conditioner and dismantle the both indoor and condensing unit</p> <p><b>P5.</b> Clean the components of Air conditioner with specified cleaning agents/tools &amp; material.</p> <p><b>P6.</b> Re-Install the indoor &amp; outdoor unit, connect with refrigerant pipes, control wires and open the service valves</p> <p><b>P7.</b> 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 the tasks covered in this competency standard. This includes the 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 repairing of Window / Split air conditioners
- Technical Operations of split air conditioners
- Electrical / Copper piping layout plans/wiring diagrams.
- Types of electrical wires and cables, including underground cables, their ratings and its applications
- Techniques of Diagnose and Troubleshooting of Residential Air conditioners



## National Competency Standards Level-5 for “HVACR”



- Familiar with Residential Air conditioners 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:
  - o Diagnose faults of Air Conditioner by using specified tools and instruments
  - o Perform pump down operation in split type air conditioner
  - o Repair refrigerant leak in Air Conditioner
  - o Replace the compressor of Air conditioner
  - o Replace the printed circuit board (PCB) of split air conditioner

### List of Tools, Equipment and Machinery

Sr. No	Description
1	Personal Protective Equipment
2	Basic Measuring tools
3	Basic Hand tools
4	Basic Cutting tools
5	Basic Power tools
6	Basic Marking tools
7	Basic Electric tools



## ***National Competency Standards Level-5 for “HVACR”***



<b>8</b>	Portable Refrigerant Charging Station
<b>9</b>	Digital Air Flow / Velocity Meter
<b>10</b>	Water Pressure Gun for Service
<b>11</b>	Electronic Leak Detector
<b>12</b>	Tube Cutter
<b>13</b>	Digital Optical Tachometer
<b>14</b>	Micron Pressure Gauge
<b>15</b>	Digital Pressure Gauges Set (High & Combine)
<b>16</b>	Pinch-Off Plier
<b>17</b>	Flaring and Swaging Tool Kit
<b>18</b>	Vacuum Pump 2-Stage, 6cfm
<b>19</b>	Tube Benders (Spring Type and Pulley Bender Type)
<b>20</b>	Megohmmeter (0 - 1000 Volts)
<b>21</b>	Laser Temperature Measuring Device Nose Plier Set
<b>22</b>	Electric Hand Grinder
<b>23</b>	Soldering Iron
<b>24</b>	Digital Clamp-On Ampere Meter
<b>25</b>	Digital Multi Meter
<b>26</b>	Electric Hand Drills
<b>27</b>	Hot Air Gun
<b>28</b>	Digital Capacitor Analyzer
<b>29</b>	Hand Electric Blower
<b>30</b>	Digital Humidity Meter
<b>31</b>	Digital Psychrometer (Hygrometer)
<b>32</b>	Pulley Wheel Puller
<b>33</b>	Screwdriver Set



## National Competency Standards Level-5 for “HVACR”



### 0713E&E-34. Overhaul the compressors

#### Overview

This Competency Standard covers the competencies required to overhaul the compressors in accordance with the manufacturer’s specifications / guidelines. This unit covers the knowledge regarding overhauling of compressors to provide you the basis for student work.

Competency Units	Performance Criteria
1. Prepare to dismantle compressor	<ul style="list-style-type: none"><li>P1. Determine job requirements from workplace instructions</li><li>P2. Control and interpret refrigerant gases during installation, servicing or de-commissioning of air conditioners source</li><li>P3. Source and interpret dismantling information</li><li>P4. Analyze dismantling options and select most appropriate to the circumstances</li><li>P5. Identify hazards associated with the work and manage the risks</li><li>P6. Select dismantling tools and equipment and check for serviceability</li></ul>
2. Dismantle and evaluate compressor and components	<ul style="list-style-type: none"><li>P1. Dismantle compressor in a logical sequence according to manufacturer, workplace procedures, safety &amp; environmental requirements and without affecting unnecessary damage to components or systems</li><li>P2. Clean components for evaluation according to workplace procedures, safety and environmental requirements</li><li>P3. Measure and Compare components with manufacturer specifications and serviceability is determine</li><li>P4. Determine component repair methods</li><li>P5. Identify unserviceable parts and replacement parts sourced</li></ul>
3. Carry out overhaul	<ul style="list-style-type: none"><li>P1. Source and interpret overhaul information</li><li>P2. Analyze overhaul options and select those most appropriate to the circumstances</li><li>P3. Select and check overhaul tools and equipment for serviceability</li><li>P4. Machine the components repair / replace as required</li><li>P5. Carryout adjustments according to manufacturer specifications, workplace procedures, safety and</li></ul>



## National Competency Standards Level-5 for “HVACR”



	environmental requirements
<b>4. Assemble compressor and components</b>	<p><b>P1.</b> Assemble compressor according to manufacturer specifications, workplace procedures, and safety &amp; environmental requirements</p> <p><b>P2.</b> Measure tolerance and clearances against manufacturer specifications and make necessary adjustments</p> <p><b>P3.</b> Complete assembly of compressor within workplace timeframes and without causing damage to other components or systems</p> <p><b>P4.</b> Carryout post-assembly testing according to workplace procedures, safety &amp; environmental requirements</p> <p><b>P5.</b> Detect and rectify problem(s) as have been introduced during the assembly process</p>
<b>5. Complete work processes</b>	<p><b>P1.</b> Ensure final inspection to make work according to workplace expectations and ready compressor for use or storage</p> <p><b>P2.</b> Clean work area, dispose of waste and non-recyclable materials and collect recyclable material Check and store tools and equipment or identify any faulty electrical equipment tagged and isolated according to workplace procedures</p> <p><b>P3.</b> Process workplace documentation according to workplace procedures</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:

- 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 repairing of Window / Split air conditioners
  - Operations of split air conditioners
  - Electrical circuit diagrams.
  - Copper piping layout
  - Techniques of Diagnose and Troubleshooting of Residential Air conditioners
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- Familiar with Residential Air conditioners 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



## National Competency Standards Level-5 for “HVACR”



- 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:

- Dismantle compressor
- Servicing of compressor
- Cleaning of compressor
- Reassembling of compressor

### List of Tools, Equipment and Machinery

Sr. No	Description
1	Personal Protective Equipment
2	Basic Measuring tools
3	Basic Hand tools
4	Basic Cutting tools
5	Basic Power tools
6	Basic Marking tools
7	Basic Electric tools
8	Portable Refrigerant Charging Station
9	Electronic Leak Detector
10	Tube Cutter
11	Micron Pressure Gauge
12	Digital Pressure Gauges Set (High & Combine)
13	Pinch-Off Plier
14	Flaring and Swaging Tool Kit
15	Electric Hand Grinder
16	Vacuum Pump 2-Stage, 6cfm
17	Digital Clamp-On Ampere Meter
18	Digital Multi Meter
19	Electric Hand Drills
20	Screwdriver Set





## National Competency Standards Level-5 for “HVACR”



### 0713E&E-35. Repair and 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 student work.

Competency Units	Performance Criteria
1. Diagnose Faults in Residential Refrigeration Units	<p><b>P1.</b> Check for obvious problem to determine which component or system is causing the problem</p> <p><b>P2.</b> Select tools, equipment and related accessories according to requirements and standards</p> <p><b>P3.</b> 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</p> <p><b>P4.</b> Eliminate the causes of the problem according to the manufacturer manual and standards</p> <p><b>P5.</b> Isolate and recheck the causes of the problem and rectify the fault</p> <p><b>P6.</b> Start the refrigeration unit and recheck as specified in the manufacturer manual and record the results</p>
2. Repair Window / Split Air Conditioner	<p><b>P1.</b> Select tools, equipment and related accessories according to job requirements</p> <p><b>P2.</b> Disconnect the Refrigerator / Freezer from electric supply and follow the instructions in manufacture manual for rectification</p> <p><b>P3.</b> Rectify the diagnosed faults; repair / replace the components, as necessary</p> <p><b>P4.</b> Check, wash and restore to the actual condition Refrigerator / Freezer Body / Cabinets</p> <p><b>P5.</b> Check, service, and replace if necessary, the proper functioning of Thermostat / Door Gasket / Heaters</p> <p><b>P6.</b> 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</p>
3. Repair / Service Residential Electric Water Cooler / Water Dispenser	<p><b>P1.</b> Select tools, equipment and related accessories according to job requirements</p> <p><b>P2.</b> Disconnect the water cooler / dispenser from electric supply and follow the manual instructions for</p>



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	rectification <b>P3.</b> Rectify the diagnosed faults; repair / replace the components, as necessary <b>P4.</b> Check, wash and restore to actual condition Water Cooler / Dispenser Body / Mounts <b>P5.</b> 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
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### 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:

- 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 repairing of Window / Split air conditioners
- Technical Operations of split air conditioners
- Electrical / Copper piping layout plans/wiring diagrams.
- Types of electrical wires and cables, including underground cables, their ratings and its applications
- Techniques of Diagnose and Troubleshooting of Residential Air conditioners
- Familiar with Residential Air conditioners 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:



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- o Diagnose faults of Refrigeration unit by using specified tools and instruments
- o Check & Replace electrical accessories of unit
- o Check & Replace the mechanical parts & accessories of the unit
- o Charge the refrigerant in unit

### List of Tools, Equipment and Machinery

Sr. No	Description
1	Personal Protective Equipment
2	Basic Measuring tools
3	Basic Hand tools
4	Basic Cutting tools
5	Basic Power tools
6	Basic Marking tools
7	Basic Electric tools
8	Portable Refrigerant Charging Station
9	Digital Air Flow / Velocity Meter
10	Water Pressure Gun for Service
11	Electronic Leak Detector
12	Tube Cutter
13	Digital Clamp-On Meter & AVO Meter
14	Micron Pressure Gauge
15	Digital Pressure Gauges Set (High & Combine)
16	Pinch-Off Plier
17	Flaring and Swaging Tool Kit
18	Vacuum Pump 2-Stage, 6cfm
19	Tube Benders (Spring Type and Pulley Bender Type)
21	Electric Hand Drills
22	Digital Capacitor Analyzer
23	Screwdriver Set



***National Competency Standards Level-5 for “HVACR”***





## National Competency Standards Level-5 for “HVACR”



### 0713E&E-36. Test, recover, evacuate and charge refrigeration system

#### Overview

This Competency Standard covers the competencies required to test, recover and charge refrigeration system at workplace in accordance with the manufacturer’s specifications / guidelines. This unit covers the knowledge regarding testing, recovering of refrigerants, evacuation and charging refrigeration system to provide you the basis for student work.

Competency Units	Performance Criteria
1. Assess refrigeration system operation	<p><b>P1.</b> Apply refrigeration system operating principles and terminology to assessment activities.</p> <p><b>P2.</b> Obtain all relevant information and interpret correctly prior to the commencement of work on the refrigeration system.</p> <p><b>P3.</b> Undertake refrigeration system checks safely in accordance with standard operating procedures, relevant codes and regulations.</p> <p><b>P4.</b> Apply appropriate operating procedures as required.</p> <p><b>P5.</b> Determine pressures and temperatures correctly and recorded.</p> <p><b>P6.</b> Rectify faults</p>
2. Recover refrigerant and evacuate system	<p><b>P1.</b> Recover the refrigerant from the system in accordance with standard operating procedures, codes and regulations.</p> <p><b>P2.</b> Contain the refrigerant recovered from the refrigeration system in accordance with the relevant codes and regulations of ASHRAE.</p> <p><b>P3.</b> Evacuate the refrigeration system in accordance with standard operating procedures, codes and regulations</p>
3. Charge the refrigeration system	<p><b>P1.</b> Charge the refrigeration system with the correct refrigerant in accordance with standard operating procedures.</p> <p><b>P2.</b> Add the appropriate lubricating oil to the refrigeration system in accordance with standard operating procedures.</p> <p><b>P3.</b> Check the refrigeration system for leaks.</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:



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- 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 repairing of Window / Split air conditioners
- Technical Operations of split air conditioners
- Electric circuit diagrams.
- Copper piping layout
- Types of electrical wires and cables, including underground cables, their ratings and its applications
- Techniques of Diagnose and Troubleshooting of Residential Air conditioners

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- Familiar with Residential Air conditioners 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:

- Recover refrigerant
- Leak testing & Repair leaks
- Evacuate system
- Purge and charge refrigerant



## National Competency Standards Level-5 for “HVACR”



### List of Tools, Equipment and Machinery

Sr. No	Description
1	Personal Protective Equipment
2	Basic Measuring tools
3	Basic Hand tools
4	Basic Cutting tools
5	Basic Power tools
6	Basic Marking tools
7	Basic Electric tools
8	Portable Refrigerant Charging Station
9	Digital Air Flow / Velocity Meter
10	Electronic Leak Detector
11	Tube Cutter
12	Digital Optical Tachometer
13	Micron Pressure Gauge
14	Digital Pressure Gauges Set (High &Combine)



**National Competency Standards Level-5 for “HVACR”**



<b>15</b>	Pinch-Off Plier
<b>16</b>	Flaring and Swaging Tool Kit
<b>17</b>	Vacuum Pump 2-Stage, 6cfm
<b>18</b>	Digital Clamp-On Ampere Meter
<b>19</b>	Digital Multi Meter
<b>20</b>	Electric Hand Drills
<b>21</b>	Hot Air Gun
<b>22</b>	Digital Capacitor Analyzer
<b>23</b>	Screwdriver Set





## National Competency Standards Level-5 for “HVACR”



### 0713E&E-37. Calculate Fundamental Properties of Gasses

#### Overview

This competency standard identifies the competencies required to calculate the basic properties of gasses, quantity of heat in gasses, calculate & convert temperature scale, pressure volume and temperature relationship of gasses. Students will be expected to calculate properties of gasses according to the nature of work at workplace. His underpinning knowledge regarding calculation of properties of gasses will be sufficient to provide the basis for his work.

Competency Units	Performance Criteria
1. Calculate the basic properties of gasses.	<p>P1. Convert other system of units into S.I units.</p> <p>P2. Calculate pressure of gases.</p> <p>P3. Calculate energy, density and specific volume of gases.</p> <p>P4. Calculate volume and velocity of gases.</p> <p>P5. Calculate vapor density of gases</p>
2. Calculate the quantity of heat in gasses.	<p>P1. Calculate sensible heat.</p> <p>P2. Calculate latent heat</p> <p>P3. Calculate total heat</p>
3. Calculate and convert the temperature scale.	<p>P1. Convert the Units of temperature into different systems.</p> <p>P2. Convert the Units of pressure into different systems.</p> <p>P3. Calculate the absolute temperature and pressure.</p>
4. Pressure, volume and temperature relationship of gasses.	<p>P1. Calculate Boyle’s law.</p> <p>P2. Calculate Charles’s law.</p> <p>P3. Calculate properties of Gay-Lussac law</p> <p>P4. Calculate general gas (equation) law.</p>

#### Knowledge and understanding

The trainee 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:

- Identification and use of Personal Protective Equipment (PPE)
- Hazards that are most likely to cause harm to health and safety with HVAC tools
- American Society of Heating, Refrigeration and Air Conditioning Engineers (ASHRAE)
- SI units, pressure, energy, density and specific volume of gases
- Work, area, volume and velocity of gases
- Density of gases, sensible, latent and total heat
- Absolute temperature and pressure of gases
- Boyles’s and Charles’s law
- Gay-Lussac law and General gas law
- Solving problems on sensible and latent heat



## National Competency Standards Level-5 for “HVACR”



- Solving problem Boyles’s, Charles’s and Gay-Lussac and General gas law
- 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:

- Calculate pressure of gases
- Calculate the quantity of heat in gases
- Calculate Boyle’s law
- Calculate Charles’s law
- Calculate properties of Gay-Lussac law
- Calculate general gas (equation) law

### List of Tools, Equipment and Machinery

Sr. No	Description
1.	Sling Psychrometer
2.	Psychrometer Chart
3.	Lead Pencil
4.	Foot rule
5.	Eraser
6.	Sharpener
7.	Compound Gauge
8.	High Pressure Gauge
9.	Thermometer



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### 0713E&E-38. Calculate Psychrometric Processes of Air

#### Overview

This competency standard identifies the competencies required to identify and evaluate cool & heat Psychrometric processes of air. Students will be expected to calculate and evaluate Psychrometric processes according to the nature of work at workplace. His underpinning knowledge regarding calculation and evaluation of Psychrometric process will be sufficient to provide the basis for his work.

Competency Units	Performance Criteria
1. Identify cool Psychrometric processes of air	<p><b>P1.</b> Identify and mark the sensible cooling process on Psychrometric chart as per given reading.</p> <p><b>P2.</b> Identify and mark the cooling and humidification process on Psychrometric chart as per given reading.</p> <p><b>P3.</b> Identify and mark the cooling and dehumidification process on Psychrometric chart as per given reading.</p> <p><b>P4.</b> Identify and mark the evaporative cooling process on Psychrometric chart as per given reading.</p> <p><b>P5.</b> Identify and mark the air mixing process on Psychrometric chart as per given reading.</p>
2. Identify heat Psychrometric properties of air.	<p><b>P1.</b> Identify and mark the Sensible heating process on Psychrometric chart as per given reading.</p> <p><b>P2.</b> Identify and mark the heating and humidification process on Psychrometric chart as per given reading.</p> <p><b>P3.</b> Identify and mark the heating and dehumidification process on Psychrometric chart as per given reading.</p> <p><b>P4.</b> Identify and mark the air mixing process on Psychrometric chart as per given reading.</p>
3. Evaluate Psychrometric properties.	<p><b>P1.</b> Calculate sensible heating and cooling properties.</p> <p><b>P2.</b> Calculate cooling and dehumidification properties.</p> <p><b>P3.</b> Calculate heating humidification properties.</p> <p><b>P4.</b> Calculate evaporative cooling properties.</p> <p><b>P5.</b> Calculate air mixing properties.</p>

#### Knowledge and understanding

The trainee 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:

- Identification and use of Personal Protective Equipment (PPE)



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- American Society of Heating, Refrigeration and Air Conditioning Engineers (ASHRAE)
- Psychrometric chart
- Sensible Cooling, Sensible Heating, humidification and dehumidification
- Air mixing process
- Heating and humidification
- Heating and dehumidification
- Calculation of evaporative cooling process
- Cooling and Humidification (Evaporative Cooling)
- Cooling and Dehumidification (Summer Cooling)

### Critical Evidence(s) Required

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

- Draw different processes on Psychrometric chart
- Calculate Cooling, Heating with Humidification & Dehumidification

### List of Tools, Equipment and Machinery

<i>Sr. No</i>	<i>Description</i>
1.	Sling Psychrometer
2.	Psychrometric Chart
3.	Lead Pencil
4.	Foot rule
5.	Eraser
6.	Sharpener



## National Competency Standards Level-5 for “HVACR”



### 0713E&E-39. Calculate Psychrometric Properties of System Air

#### Overview

This Competency Standard identifies the competencies required to draw and calculate Psychrometric properties of system air. Students will be expected to calculate Psychrometric properties of system air according to the nature of work at workplace. His underpinning knowledge regarding calculation of Psychrometric properties of system air will be sufficient to provide the basis for his work.

Competency Units	Performance Criteria
1. Calculate the Psychrometric properties of air.	<p>P1. Calculate the relative humidity</p> <p>P2. Calculate the specific humidity</p> <p>P3. Calculate the specific enthalpy</p> <p>P4. Calculate the enthalpy</p> <p>P5. Calculate the specific volume</p> <p>P6. Calculate the volume of mixture per kg of dry air</p>
2. Draw Psychrometric properties of air	<p>P1. Draw dry bulb temperature line on Psychrometric chart.</p> <p>P2. Draw wet bulb temperature line on Psychrometric chart.</p> <p>P3. Draw dew point temperature line on Psychrometric chart.</p> <p>P4. Draw relative humidity curve on Psychrometric chart.</p> <p>P5. Draw specific humidity / humidity ration line on Psychrometric chart.</p> <p>P6. Draw saturation curve on Psychrometric chart.</p> <p>P7. Draw enthalpy line on Psychrometric chart.</p> <p>P8. Determine enthalpy deviation on Psychrometric chart.</p> <p>P9. Determine specific volume line on Psychrometric chart.</p>
3. Calculate the properties of system air	<p>P1. Calculate properties of air in heating or cooling process</p> <p>P2. Calculate the latent heat</p> <p>P3. Calculate the sensible heat</p> <p>P4. Calculate sensible heat factor</p> <p>P5. Calculate the properties of bypass return air</p> <p>P6. Calculate the properties of air in a duct</p>

#### Knowledge and understanding

The trainee 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:

- Identification and use of Personal Protective Equipment (PPE)
- Hazards that are most likely to cause harm to health and safety with HVAC tools



## National Competency Standards Level-5 for “HVACR”



- American Society of Heating, Refrigeration and Air Conditioning Engineers (ASHRAE)
- Relative and specific humidity
- Enthalpy, specific volume and specific enthalpy
- Volume of mixture per kg of dry air
- Dry bulb temperature and wet bulb temperature
- Define humidification and de humidification
- Saturation and dew point temperature
- Calculation of enthalpy deviation and specific volume
- Heating and cooling processes of air
- Sensible heat factor / ratio
- Bypass return air
- Bypass factor
- Content factor
- Degree day

### Critical Evidence(s) Required

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

- Draw any two properties of air on Psychrometric chart
- Calculate all properties of air
- Calculate cooling & heating process

### List of Tools, Equipment and Machinery

Sr. No	Description
1.	Sling Psychrometer
2.	Psychrometric Chart
3.	Lead Pencil
4.	Foot rule
5.	Eraser
6.	Sharpener



***National Competency Standards Level-5 for “HVACR”***





## National Competency Standards Level-5 for “HVACR”



### 0713E&E-40. Analyze Psychrometric Performance of HVAC Systems

#### Overview

This Competency Standard identifies the competencies required to analyze Psychrometric performance of HVAC systems. Students will be expected to analyze the Psychrometric performance according to the nature of work at workplace. His underpinning knowledge regarding Psychrometric performance will be enough to provide the basis for his work.

Competency Units	Performance Criteria
1. Prepare to analyze the Psychrometric performance of HVACR System	<b>P1.</b> Measure indoor room temperature <b>P2.</b> Measure atmospheric temperature <b>P3.</b> Measure specific heat of air at constant pressure <b>P4.</b> Measure mass of available room air
2. Analyze the Psychrometric performance of HVACR systems	<b>P1.</b> Calculate mass flow rate of air <b>P2.</b> Calculate volume flow rate of air <b>P3.</b> Calculate temperature of supply air <b>P4.</b> Calculate temperature of return air <b>P5.</b> Calculate cooling load of given room
3. Report and act on the results of Psychrometric performance analysis.	<b>P1.</b> Evaluate to determine their effectiveness of solutions for Psychrometric issues and modify where necessary. <b>P2.</b> Develop report of the analysis including details of all findings, calculations <b>P3.</b> Report analysis to the concerned personnel to establish appropriate action to be taken based on findings.

#### 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:

- American Society of Heating, Refrigeration and Air Conditioning Engineers (ASHRAE)
- Psychrometric principals / parameters in respect of HVACR like Wet Bulb temperature, Dry Bulb temperatures, PH values etc.
- Effective strategies for analyzing refrigeration and air conditioning systems performance
- Psychrometric performance parameters, specifications and performance requirements appropriate to each situation.
- Results of the analysis
- Documenting analysis details of all findings, calculations and assumptions.





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- Documenting justification of actions to be implemented in accordance with professional standards.
- Dealing with unplanned events by drawing on essential knowledge and skills to provide appropriate solutions incorporated in the holistic assessment with the above listed items
- 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:

- Apply knowledge of Psychrometric principles
- Obtain Parameters of HVAC system
- Evaluate Parameters of HVAC system to determine their effectiveness
- Develop report of the analysis

### List of Tools, Equipment and Machinery

Sr. No	Description
1.	Sling Psychrometer
2.	Psychrometric Chart
3.	Lead Pencil
4.	Foot rule
5.	Eraser
6.	Sharpener



***National Competency Standards Level-5 for “HVACR”***





## National Competency Standards Level-5 for “HVACR”



### 0713E&E-41. Develop Geometrical Solids

#### Overview

This Competency Standard identifies the competencies required to draw mechanical lines and surfaces, piping joints, duct / cone & transition and symbolic representations. Students will be expected to develop geometrical solids according to the nature of work at workplace. His underpinning knowledge regarding development of geometrical solids will be sufficient to provide the basis for his work.

Competency Units	Performance Criteria
1. Draw Mechanical lines and surfaces	<b>P1.</b> Draw straight lines and curved lines <b>P2.</b> Draw inclined and curved surfaces by parallel line and radial line method <b>P3.</b> Draw development of a cone by triangular method <b>P4.</b> Draw development of a cylinder by radial line method
2. Draw sketches of piping Joints	<b>P1.</b> Draw different types of joints <b>P2.</b> Draw Development of tea joint of a round pipe <b>P3.</b> Draw line of intersection for intersecting pipe
3. Draw sketches of Ducts, cone and transition pieces	<b>P1.</b> Draw different types of ducts <b>P2.</b> Draw truncated cone and pipe <b>P3.</b> Draw transition pieces used in pipes and ducts <b>P4.</b> Draw the development of rectangular duct <b>P5.</b> Draw the development of square duct <b>P6.</b> Draw development of truncated cone
4. Draw Symbolic Representation	<b>P1.</b> Draw symbols of HAVC components <b>P2.</b> Draw symbols of HAVC equipment <b>P3.</b> Draw sectioning symbols of different materials used in mechanical drawing

#### 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:

- Terms being used in drawing
- Application of drawing forms
- Scales used in drawing
- Fundamentals units i.e. arcs, circles and ellipse
- Single stroke and double stroke gothic letters
- Definitions of tolerance, limits and fits



## National Competency Standards Level-5 for “HVACR”



- Layout and line drawing
- Development by a radial line method
- Pipe and duct joint
- Frustum of a cone
- Component symbols
- Complete detail of intersecting pipes

### Critical Evidence(s) Required

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

- Draw lines & shapes
- Make sketch for complex drawings
- Draw drawings for joints
- Draw specific symbols

### List of Tools and Equipment

<i>Sr. No</i>	<i>Description</i>
1.	T-square
2.	Set square
3.	Compass
4.	Eraser
5.	Pencil
6.	Sharpener
7.	Drawing board



***National Competency Standards Level-5 for “HVACR”***





## National Competency Standards Level-5 for “HVACR”



### 0713E&E-42. Draw Projection of Pipes

#### Overview

This Competency Standard identifies the competencies required to draw electric symbols, single- & double-line piping and orthographic projection of pipes. Students will be expected to draw projection of pipes according to the nature of work at workplace. His underpinning knowledge regarding drawings of projection pipes will be sufficient to provide the basis for his work.

Competency Units	Performance Criteria
1. Draw orthographic projection.	<b>P1.</b> Draw orthographic views of a square pipe <b>P2.</b> Draw orthographic views of a round pipe <b>P3.</b> Draw isometric view of square pipe <b>P4.</b> Draw isometric view of round pipe
2. Draw single- and double-line piping.	<b>P1.</b> Draw orthographic view of single line piping <b>P2.</b> Draw orthographic view of double line piping <b>P3.</b> Draw isometric view of single line piping <b>P4.</b> Draw isometric view of double line piping
3. Draw electrical symbols	<b>P1.</b> Draw complete drawing of electrical accessories <b>P2.</b> Draw working drawing of electrical accessories <b>P3.</b> Draw the symbolic representation of electrical accessories along with drawing

#### 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:

- Terms being used in drawing
- Application of drawing forms
- Scales used in drawing
- Fundamentals units i.e. arcs, circles and ellipse
- Single stroke and double stroke gothic letters
- Definitions of tolerance, limits and fits
- Layout and line drawing
- Orthographic drawing
- Isometric drawing
- Single line piping
- Double line piping
- Electrical symbols



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### Critical Evidence(s) Required

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

- Draw different views of pipe
- Draw single line & double line piping system
- Draw specific symbols

### List of Tools, Equipment and Machinery

Sr. No	Description
1.	T-square
2.	Set square
3.	Compass
4.	Eraser
5.	Pencil
6.	Sharpener
7.	Drawing board



***National Competency Standards Level-5 for “HVACR”***







## National Competency Standards Level-5 for “HVACR”



### 0713E&E-43. Draw Building Drawings

#### Overview

This Competency Standard identifies the competencies required to draw building accessories and building sectioning drawings. Students will be expected to draw building drawings according to the nature of work at workplace. His underpinning knowledge regarding building drawings will be enough to provide the basis for his work.

Competency Units	Performance Criteria
1. Draw building accessories drawings	<p><b>P1.</b> Draw accessories of building</p> <p><b>P2.</b> Draw complete drawing of a building showing doors, windows and arches in it</p> <p><b>P3.</b> Draw symbols of accessories used in building</p> <p><b>P4.</b> Show section of a building viewing walls section and doors windows and arches etc.</p>
2. Draw building sectioning drawings	<p><b>P1.</b> Draw different types of building according to design and use</p> <p><b>P2.</b> Draw different views of a building like perspective view and single point view</p> <p><b>P3.</b> Draw plan, front and side elevation of a building</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:

- Terms being used in drawing
- Application of drawing forms
- Scales used in drawing
- Fundamentals units i.e. arcs, circles and ellipse
- Single stroke and double stroke gothic letters
- Definitions of tolerance, limits and fits
- Layout and line drawing
- Details of door, windows and arches
- Symbols used in architectural drawing
- Different design in building

#### Critical Evidence(s) Required

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

- Draw required lines to complete drawing
- Draw sectioning views of required parts
- Draw relevant symbols

#### List of Tools and Equipment



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<i>Sr. No</i>	<i>Description</i>
1.	T-square
2.	Set square
3.	Compass
4.	Eraser
5.	Pencil
6.	Sharpener
7.	Drawing board



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### 0713E&E-44. Prepare Computer Added Drawings File (Auto CAD)

#### Overview

This Competency Standard identifies the competencies required to prepare computer added drawing files. Student will be expected to prepare computer added drawings according to the nature of work at workplace. His underpinning knowledge regarding Auto CAD will be enough to provide the basis for his work.

Competency Units	Performance Criteria
1. Confirm drawing requirements and access software and setup for drawing work	<p><b>P1.</b> Open software and navigate organizational filing and library system</p> <p><b>P2.</b> Identify organizational symbols, codes and standards to be applied in drafting work and how these are accessed and applied</p> <p><b>P3.</b> Set up working environment</p> <p><b>P4.</b> Review available information relevant to project and work requirements, identify and address further information needs</p> <p><b>P5.</b> Identify workflow and procedures for work supervision</p>
2. Identify key features of CAD software.	<p><b>P1.</b> Select type of CAD software used for detail drafting, their key features and suitability for producing specific drawing outcomes</p> <p><b>P2.</b> Select type of CAD software used for design drafting, their key features and suitability for producing specific drawing outcomes use with suitable commands like that arc, circle Poly line Rectangle Spline and text etc.</p> <p><b>P3.</b> Identify differences in CAD process to generate 2-D drawings and 3-D models, and reasons for each presentation</p> <p><b>P4.</b> Identify differences in CAD process to generate single and multiple view drawings, and reasons for each presentation</p> <p><b>P5.</b> Identify CAD software used in the organization and confirm compatibility with other software programs and peripheral equipment</p> <p><b>P6.</b> Identify software features for linked specifications, catalogues or materials ordering</p>

#### Knowledge and Understanding



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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:

- Terms being used in drawing
- Application of drawing forms
- Scales used in drawing
- Fundamentals units i.e. arcs, circles and ellipse
- Single stroke and double stroke gothic letters
- Definitions of tolerance, limits and fits
- Layout and line drawing
- Apply unit setting
- Apply limit setting
- Apply user coordinate system
- Apply workspace setting
- Apply object snap setting
- Angle and lines in Auto CAD
- Differentiate between absolute, relative and polar system
- DIMSTYLE and MTEXT commands
- HATCHING concepts in AutoCAD
- Differentiate between CHAMFER and FILLET command
- Types of Array
- OFFSET, CIRCLE and ROTATE short commands
- Zooming options
- Tools palettes window
- Design center
- Scale and paper sizes
- Modify dimension style and text size according to paper size
- Backup file

### Critical Evidence(s) Required

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

- Operate computer confidently & Select type of CAD software
- Understand drawing completely
- Use right commands
- Convert said drawing into CAD

### List of Tools and Equipment

Sr. No	Description
1.	PC with accessories



## National Competency Standards Level-5 for “HVACR”



### 0713E&E-45. Contribute to the Design of Commercial Refrigeration system

#### Overview

This Competency Standard covers the competencies required to contribute the design of commercial refrigeration system at workplace in accordance with the manufacturer’s specifications / guidelines. This unit covers the knowledge regarding commercial refrigeration system designing to provide you the basis for students work.

Competency Units	Performance Criteria
1. Determine optimum system design for a given application	<p><b>P1.</b> Consult appropriate personnel to determine system specifications and obtain final confirmation</p> <p><b>P2.</b> Plan design development work to meet scheduled timelines in consultation with others involved on the worksite</p>
2. Design system	<p><b>P1.</b> Design system considering safety, regulatory requirements, relevant standards, system specifications and budgetary constraints</p> <p><b>P2.</b> Determine selected equipment required for the systems and locations in accordance with the design specifications and enterprise procedures</p> <p><b>P3.</b> Check system design draft for compliance with the design brief, regulatory requirements and environmental standards as per ASHRAE standards</p>
3. Validate system performance	<p><b>P1.</b> Establish operating criteria for expected ambient conditions</p> <p><b>P2.</b> Determine and validate likely operating characteristics for a given refrigeration load against the design specifications and standards</p> <p><b>P3.</b> Adjust the functional design and remap operating characteristics to achieve optimal system performance</p> <p><b>P4.</b> Program the control system to meet the operational requirements</p> <p><b>P5.</b> Document the designed system and its validation according to enterprise procedures</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:

- American Society of Heating, Refrigeration and Air Conditioning Engineers (ASHRAE)



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- Selecting appropriate system components
- Applying relevant standards and regulatory requirements to the design task
- Documenting technical information and designs
- Interpreting and applying manufacturers' data, tables and specifications
- Using relevant software tools effectively
- Interpreting drawings and specifications
- Standards and codes relevant to commercial refrigeration systems
- Calculation of capacity in heat exchangers
- Commercial refrigeration systems feature and components; applications system requirements operating conditions and criteria
- Refrigerants, refrigeration cycle, evaporators, condensers, compressors, liquid expansion devices
- 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:

- Plan work according to specification
- Design a system to perform required task
- Make documents to complete work

### List of Tools, Equipment and Machinery

Sr. No	Description
1	Personal Computer
2	HVAC Design Soft wares



## National Competency Standards Level-5 for “HVACR”



### 0713E&E-46. Design HVAC System and Select Components

#### Overview

This Competency Standard covers the competencies required to design HVAC systems and select components at workplace in accordance with the manufacturer’s specifications / guidelines. This unit covers the knowledge regarding designing of HVAC systems and selection of components to provide you the basis for student work.

<i>Competency Units</i>	<i>Performance Criteria</i>
<b>1.</b> Prepare to design commercial refrigeration systems.	<b>P1.</b> Determine the extent and nature of the refrigeration system from design specifications. <b>P2.</b> Consult Work supervisor or customers to determine which functions of the system are to be used and seek the parameter of each and written confirmation. <b>P3.</b> Plan design development work to meet scheduled timelines in consultation with others involved on the work site.
<b>2.</b> Design commercial refrigeration systems.	<b>P1.</b> Apply knowledge of refrigeration and food storage technology, refrigeration system components and piping, performance standards and compliance methods to develop the system design <b>P2.</b> Incorporate functional and budgetary considerations in the installation design. <b>P3.</b> Select equipment required for the system in accordance with the design specifications and established requirements. <b>P4.</b> Document location of components of the system to ensure correct operation of system functions. <b>P5.</b> Check system design draft for compliance with the design brief and regulatory requirements. <b>P6.</b> Document system design for submission to appropriate person(s) for approval. <b>P7.</b> Provide solutions to unplanned situation consistent with organization’s policy.
<b>3.</b> Obtain approval for engineering computer applications design	<b>P1.</b> Present and explain system design to client representative and/or another relevant person(s). <b>P2.</b> Negotiate requests for alterations to the design with relevant person(s) within the constraints of organization's policy. <b>P3.</b> Document final design and approval obtained from appropriate person(s).



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### **P4. Monitor quality of work against personal performance agreement and/or establishment**

#### **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:

- American Society of Heating, Refrigeration, And Air Conditioning Engineers (ASHRAE)
- Design parameters for single-story buildings (e.g. offices, restaurants, hotels, bars)
- Building purpose, location, orientation and shape
- Zoning and building use
- Design features, engineering and selection procedures for direct expansion air conditioning systems:
  - Split systems and package units
  - Free blow and ducted fan coil units
  - Cooling, heat pump and electric heating
- Implement Occupational Health and Safety workplace procedures and practices including the use of risk control measures as specified in the performance criteria and range statement
- Apply sustainable energy principles and practices as specified in the performance criteria and range statement
- Demonstrate an appropriate level of skills enabling employment
- Conduct work observing the relevant Anti-Discrimination legislation, regulations, policies and workplace procedures
- 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:

- Collect data
- Calculate heat load
- Select HVAC system
- Select accessories





## ***National Competency Standards Level-5 for “HVACR”***



### **List of Tools, Equipment and Machinery**

<i>Sr. No</i>	<i>Description</i>
<b>1</b>	Personal Computer
<b>2</b>	HVAC Soft wares



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### 0713E&E-47. Develop specifications and prepare drawings for HVAC Systems

#### Overview

This Competency Standard covers the competencies required to develop specifications and prepare drawings for HVAC systems at workplace in accordance with the manufacturer’s specifications / guidelines. This unit covers the knowledge regarding development of specifications and preparing drawings for HVAC systems to provide you the basis for your work.

Competency Units	Performance Criteria
1. Prepare to develop specifications and prepare drawings	<p><b>P1.</b> Identify, obtain and understand OHS processes and procedures for a given work area</p> <p><b>P2.</b> Establish the extent of the project from design brief and/or other relevant documentation and from discussions with concerned expert person(s).</p> <p><b>P3.</b> Consult appropriate personnel to ensure the work is coordinated effectively with others involved in the work</p> <p><b>P4.</b> Obtain Software tools and equipment as needed for the work in accordance with established procedures</p>
2. Develop specifications and prepare drawings	<p><b>P1.</b> Establish and select sources of components and materials needed for the project for their availability, suitability for purpose and cost in accordance with organization policies and procedures.</p> <p><b>P2.</b> Develop specifications that include the necessary performance requirements for components and system.</p> <p><b>P3.</b> Seek and obtain risk management strategies for the project for incorporating in the specification.</p> <p><b>P4.</b> Use appropriate software tools to develop specifications and produce drawing based on standard protocols.</p> <p><b>P5.</b> Review project specifications and drawings against all inputs and adjust to rectify any anomalies.</p> <p><b>P6.</b> Document Project specifications and drawings in accordance with organization policies and procedures.</p> <p><b>P7.</b> Provide solutions to unplanned situation consistent with organization’s policy.</p> <p><b>P8.</b> Monitor quality of work against personal performance agreement and/or established organizational or professional standards</p>
3. Obtain approval for	<p><b>P1.</b> Present project specifications and drawings and</p>



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specifications and drawings.

discuss with person(s) of higher authority.

**P2.** Negotiate alterations to the project specifications and drawings resulting from the presentation / discussion with person(s) of higher authority within the constraints of organization's policy.

**P3.** Document final project specifications and drawings and obtain approval from appropriate person(s).

### 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:

- Hazards that are most likely to cause harm
- Identification and use of Personal Protective Equipment (PPE)
- Evidence shall show an understanding of air conditioning drawing, applying safe working practices and relevant Standards, Codes and Regulations to an extent indicated by the following aspects:
  - Architectural and mechanical drafting conventions encompassing:
    - Fire, hydraulic, electrical layout diagrams,
    - Sketching of pipework circuits and mechanical services,
    - Drawing standards and symbols,
    - Working, detail and assembly drawings,
    - Ductwork layouts and conventions,
    - Pipework layouts and conventions,

#### • **Extent of the drawing work accurately**

- Determining appropriate types of drawings and their layouts correctly including appropriate technical data parameters in the drawings
- Checking and correcting drawings accurately
- Filing copies of completed drawings securely
- 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:

- Collect data
- Calculate heat load
- Present data on CAD
- Draw drawings by using CAD

### List of Tools, Equipment and Machinery



## National Competency Standards Level-5 for “HVACR”



Sr. No	Description
1	Personal Computer
2	HVAC CAD Soft ware



## National Competency Standards Level-5 for “HVACR”



### 0713E&E-48. Calculate Cooling Load of Commercial Buildings

#### Overview

This Competency Standard covers the competencies required to calculate cooling load for commercial buildings in accordance with the manufacturer’s specifications / guidelines. This unit covers the knowledge regarding cooling load calculations of commercial buildings to provide you the basis for student work.

Competency Units	Performance Criteria
1. Extract Data from Drawings	<p><b>P1.</b> Read and interpret construction plans, schematics, and blueprints for new construction projects. understand the building Geometry</p> <p><b>P2.</b> Finalize and Freeze indoor Design Condition with the consent of Client. Consult relevant International ASHRAE Standards</p> <p><b>P3.</b> Assess and analyze the environmental and structural information of the building</p>
2. Calculate Cooling Load	<p><b>P1.</b> Select and operate HVAC load Calculation Software or Manually</p> <p><b>P2.</b> Create Spaces in Software</p> <p><b>P3.</b> Calculate ventilation requirements based on the types of systems needed.</p> <p><b>P4.</b> Identify or Determine the Function/Activity of space for occupants Heat Dissemination.</p> <p><b>P5.</b> Determine the total cooling load of the building’s air-conditioning system</p> <p><b>P6.</b> Calculate the heat generation due to conduction from peripheral structures of the building (including external and internal walls, roof and windows)</p> <p><b>P7.</b> Calculate the heat generation due to penetration of sunlight through windows</p> <p><b>P8.</b> Calculate the heat generation due to indoor heat sources (including equipment, lighting and human bodies)</p> <p><b>P9.</b> Calculate the cooling load caused by infiltration and ventilation</p> <p><b>P10.</b> Determine the total cooling load of the building’s air-conditioning system</p> <p><b>P11.</b> Estimate and calculate the total cooling load of the building’s air-conditioning system on computer software</p>
3. Develop Computer Aided Design (CAD)	<p><b>P1.</b> Operate AutoCAD or any other CAD software (AutoCAD and Intel CAD).</p>



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- P2.** Make/Draft Drawing in CAD. Understand the techniques and methods of using computer to draw complicated mechanical engineering drawings
- P3.** Set the CAD layers and Annotation.

### 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:

- K1.** American Society of Heating, Refrigeration and Air Conditioning Engineers (ASHRAE)
- K2.** Understand the Significance of Reduction of heat gain from Glass and other Building Materials.
- K3.** HVAC CAD design
- K4.** Make strategies to achieve high performance Buildings such as Low Water Consumption, Low heat gain/Leak, Shading, Building Envelop etc., this includes the measure to insulate Building, Types of insulation and their availability in Pakistan.
- K5.** Impact of different types of refrigeration systems on energy saving.
- K6.** Working principles and selection criteria for different types of air-conditioning and refrigeration energy-saving equipment.
- K7.** Various types of energy-saving methods for air-conditioning systems, including:
- Energy-saving methods for air-handling units
  - Energy-saving methods for air-conditioning water systems
  - Energy-saving methods for variable air-volume (VAV) air-conditioning systems
  - Energy-saving methods for heat recovery of air-conditioning system
- K8.** Impact of Testing, adjusting and Balancing (TAB) for HVAC System.
- K9.** 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:

- Collect data of building
- Calculate cooling load manually
- Calculate cooling load by software
- Calculate safety factor
- Sum up total cooling load



## ***National Competency Standards Level-5 for “HVACR”***



### **List of Tools, Equipment and Machinery**

<i>Sr. No</i>	<i>Description</i>
1	Personal Computer
2	HVAC Design Soft wares



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### 0713E&E-49. Design and Select Fans for HVAC system

#### Overview

This Competency Standard covers the competencies required to design and select fans for HVAC systems in accordance with the manufacturer’s specifications / guidelines. This unit covers the knowledge regarding designing and selection of fans for HVAC systems to provide you the basis for student work.

Competency Units	Performance Criteria
1. Select Fan	<p><b>P1.</b> Identify the Fan Arrangements (SMACNA) Fan Arrangement 1 to 12</p> <p><b>P2.</b> Read and Interpret Fan Performance and Fan Curves</p> <p><b>P3.</b> Find the Fan specifications from Equipment Schedule/Design Document</p>
2. Select Air-handling equipment	<p><b>P1.</b> Determine the type and arrangement of air-handling unit according to uses and building conditions</p> <p><b>P2.</b> Determine the type and arrangement of fan coil unit, and its intake of fresh air according to uses and building conditions</p> <p><b>P3.</b> Perform audit checks for the surface air cooler of the selected air-conditioning plant to ensure that the unit plant the design requirements</p> <p><b>P4.</b> Select suitable air filters according to requirements</p> <p><b>P5.</b> Select suitable air purifiers according to requirements</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:

- American Society of Heating, Refrigeration and Air Conditioning Engineers (ASHRAE)
- Different types of electric motors
- Significance of Fan Laws
- Basic Knowledge of Terminology such as Air flow, pressure head, power, efficiency ESP, TSP, VP etc.
- Working principles and construction of centrifugal fans and recognize different Fan Types.
- Define working principles of different types of electric motors





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- Define pressure and temperature laws
- Define temperature and its units
- Use of Ohm meter, Voltmeter and Ampere meter
- 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:

- Use SMACNA standards
- Obtain specifications of air flow & HVAC system
- Select capacity & type of fan according to specification
- Select accessories for fan arrangement

### List of Tools, Equipment and Machinery

<i>Sr. No</i>	<i>Description</i>
1	Personal Computer
2	HVAC Design Software



## National Competency Standards Level-5 for “HVACR”



Design Duct system for Commercial HVAC system

### Overview

This Competency Standard covers the competencies required to design duct system for commercial HVAC systems in accordance with the manufacturer's specifications / guidelines. This unit covers the knowledge regarding designing of duct system for commercial HVAC systems to provide you the basis for student work.

Competency Units	Performance Criteria
1. Develop Duct Design (Air Distribution Network)	<p><b>P1.</b> Identify different types of Ducts (Round, Rectangular, Spiral, Oval etc.)</p> <p><b>P2.</b> Make Duct route considering building geometry and Coordinating with other disciplines.</p> <p><b>P3.</b> Determine the Size of Air duct as per Space Air Distribution (determined by Cooling/Heating load Calculations).</p> <p><b>P4.</b> Calculate Air Velocity and Cross-sectional Area of the Duct</p> <p><b>P5.</b> Calculate Total "Air flow Rate" and "Pressure drop" for Fan Sizing.</p> <p><b>P6.</b> Study Duct Standards such as SMACNA or Equivalent.</p>
2. Develop Air-Distribution Devices	<p><b>P1.</b> Interpret the selection catalogues of Air Distribution Devices.</p> <p><b>P2.</b> Determine the type of air distribution and the air flow pattern according to the design and requirements of the building</p> <p><b>P3.</b> Select the appropriate "Air-Distribution Devices" such as Diffusers, Grills, Register and VCDs.</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:

- K1.** American Society of Heating, Refrigeration and Air Conditioning Engineers (ASHRAE)
- K2.** Working principles of different types of electric motors
- K3.** Pressure, temperature and its units
- K4.** Significance of Fan Laws
- K5.** Basic Knowledge of Terminology such as Air flow, pressure head, power, efficiency ESP, TSP, VP etc.
- K6.** Working principles and construction of centrifugal fans, and recognize different Fan Types
- K7.** Duct material and its types according to construction



## National Competency Standards Level-5 for “HVACR”



- K8.** Types of duct insulation
- K9.** 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:

- Use SMACNA standards of duct designing
- Obtain specifications of air flow & HVAC system
- Calculate Total Air Flow Rate and Pressure drop
- Select size & type of duct according to specification
- Select air distribution accessories for selected duct system

### List of Tools, Equipment and Machinery

<i>Sr. No</i>	<i>Description</i>
<b>1</b>	Personal Computer
<b>2</b>	HVAC Design Software



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***National Competency Standards Level-5 for “HVACR”***





## National Competency Standards Level-5 for “HVACR”



### 0713E&E-50. Design Piping for Commercial HVAC System

#### Overview

This Competency Standard covers the competencies required to design piping for commercial HVAC systems in accordance with the manufacturer’s specifications / guidelines. This unit covers the knowledge regarding designing of piping for commercial HVAC systems to provide you the basis for student work.

Competency Units	Performance Criteria
1. Design Hydronic System	<p><b>P1.</b> Understand the Basics of Hydronic System</p> <p><b>P2.</b> Differentiate the Types of Hydronic Systems (Open Loop and Close Loop)</p> <p><b>P3.</b> Identify the Components of Hydronic System such as Pumps, Expansion/Compression Tank, Air Separator, De-Coupler, Chemical Feeding Pumps, Cooling Towers, AHU's, FCU's, Chillers, Radiators, Hot Water Generator, Control Valves etc.</p>
2. Design Pipe Network	<p><b>P1.</b> Understand the difference and working principle of open circuit and close circuit for design purpose.</p> <p><b>P2.</b> Calculate the Piping system head.</p> <p><b>P3.</b> Calculate Total flow rate of piping system.</p> <p><b>P4.</b> Determine the pipe size for required Flow rate and Pressure Loss using pipe sizing chart/software.</p> <p><b>P5.</b> Make best route for Hydronic Piping with co-ordination of other discipline.</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:

- K1.** American Society of Heating, Refrigeration and Air Conditioning Engineers (ASHRAE)
- K2.** Basics of Hydronic System
- K3.** All types and arrangements of the "Hydronic Piping Circuits Arrangement /Types"
- K4.** Different types of electric motors
- K5.** Working principles of different types of electric motors
- K6.** Ohm meter, Voltmeter and Ampere meter
- K7.** Record keeping and reporting

Critical Evidence(s) Required



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

- Use ASHRAE standards
- Design Hydronic system
- Calculate water flow rate
- Calculate pressure head of water
- Select pipe sizes manually & by use of software

### List of Tools, Equipment and Machinery

Sr. No	Description
1	Personal Computer
2	HVAC Design Software



## National Competency Standards Level-5 for “HVACR”



### 0713E&E-51. Design & Select Pumps for HVAC system

#### Overview

This Competency Standard covers the competencies required to design and select pumps for HVAC system in accordance with the manufacturer’s specifications / guidelines. This unit covers the knowledge regarding designing and selection pumps for HVAC system to provide you the basis for student work.

Competency Units	Performance Criteria
1. Understand Pumps Basics	<p><b>P1.</b> Identify the Pump Types used for Hydronic System (End-Suction Pumps, Split Case Pumps, and In-line Pumps), identify the parts of Pumps.</p> <p><b>P2.</b> Select suitable centrifugal water pumps with understanding of performance curves of pumps</p> <p><b>P3.</b> Determine the operating point of centrifugal water pumps with reference to the pump performance curves and piping performance curves</p>
2. Select Size and type of Pump	<p><b>P1.</b> Read and Interpret Pump Laws, Pump Performance Curves, System Curve</p> <p><b>P2.</b> Calculate the Head Loss of Hydronic System.</p> <p><b>P3.</b> Construct or Draw System curve before pump selection, furthermore, able to differentiate System Curve and Pump performance Curve.</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:

- K1.** American Society of Heating, Refrigeration and Air Conditioning Engineers (ASHRAE)
- K2.** Working Principle of Centrifugal Pumps.
- K3.** Characteristics of centrifugal water pumps, including: Definition of flow Rate, lift, power, efficiency, rotational speed, Duty Point, BHP, NPSH, Required Horsepower, BEP
- K4.** Working principles and characteristics of primary pump and secondary pump chilled water systems
- K5.** Difference in Static Balancing and Dynamic Balancing of Pumps with Motors on Mount.
- K6.** Ohm meter, Voltmeter and Ampere meter
- K7.** Record keeping and reporting

#### Critical Evidence(s) Required





## National Competency Standards Level-5 for “HVACR”



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

- Use ASHRAE standards
- Design Hydronic system
- Calculate water flow rate
- Calculate pressure head of water
- Select pipe sizes
- Design & Select pump sizes
- Select accessories to connect pumps

### List of Tools, Equipment and Machinery

Sr. No	Description
1	Personal computer
2	HVAC Design Software



## National Competency Standards Level-5 for “HVACR”



### 0713E&E-52. Attenuate Noise and Vibration Encounter in HVAC Applications

#### Overview

This Competency Standard covers the competencies required to measurement of noise and vibration encountered in HVAC system. It encompasses working safely, problem solving procedures, including using measuring instruments, applying appropriate theorems and providing interpretations derived from measurements and calculations and justification for such interpretations.

Competency Units	Performance Criteria
1. Prepare to determine noise and vibration encountered in HVAC applications	<p><b>P1.</b> Obtain the nature of the problem from documentation or from work supervisor to establish the scope of work to be undertaken.</p> <p><b>P2.</b> Establish procedures, sources of equipment and products that may be required for the work accordingly</p> <p><b>P3.</b> Carry out tools, equipment and testing devices needed to the work are obtained and check for correct operation and safety</p>
2. Determine noise and vibration encountered in HVAC applications	<p><b>P1.</b> Select methods to determine noise and vibration measurements encountered in HVAC/R application</p> <p><b>P2.</b> Deal unexpected situations safely with the approval of an authorized person.</p> <p><b>P3.</b> Take measures without damage to apparatus, circuits, the surrounding environment or services and using sustainable energy practices with the minimum waste and rework.</p>
3. Document noise and vibration measurements in HVAC applications	<p><b>P1.</b> Determine noise and vibration to justify alternative approach</p> <p><b>P2.</b> Document the work completion and an appropriate person or persons notified in accordance with established procedures.</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:

- K1.** American Society of Heating, Refrigeration and Air Conditioning Engineers (ASHRAE)
- K2.** Noise and vibration measurements
- K3.** Record keeping and reporting



## National Competency Standards Level-5 for “HVACR”



### Critical Evidence(s) Required

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

- Deal & understand unexpected situations safely
- Take measures without damage
- Select alternative approach to determine Noise & Vibration

### List of Tools, Equipment and Machinery

Sr. No	Description
1	Personal Computer
2	Charts of Noise Criteria Standards



## National Competency Standards Level-5 for “HVACR”



### 0713E&E-53. Perform Water Treatment in HVAC System

#### Overview

This Competency Standard covers the competencies required to perform water treatment in HVAC system in accordance with the manufacturer’s specifications / guidelines. This unit covers the knowledge regarding water treatment in HVAC system to provide you the basis for student work.

Competency Units	Performance Criteria
1. Prepare the water treatment process for operation	<ul style="list-style-type: none"><li><b>P1.</b> Confirm chemicals and test equipment readiness for use</li><li><b>P2.</b> Confirm services are available and ready for operation</li><li><b>P3.</b> Select, fit and use personal protective equipment according to workplace safety procedures</li><li><b>P4.</b> Conduct pre-operational checks according to operating procedures</li><li><b>P5.</b> Calibrate instrumentation and test equipment according to operating specifications</li><li><b>P6.</b> Identify and report health and safety hazards and maintenance requirements according to workplace safety procedures</li></ul>
2. Operate and monitor the water treatment process	<ul style="list-style-type: none"><li><b>P1.</b> Start the water treatment system according to operating procedures</li><li><b>P2.</b> Confirm operating condition is maintained within operating requirements</li><li><b>P3.</b> Monitor, test and adjust wastewater quality according to operating procedures</li><li><b>P4.</b> Operate first flush systems during rainfall events</li><li><b>P5.</b> Ensure the work area is maintained to workplace cleaning standards</li></ul>
3. Analyze and respond to abnormal performance	<ul style="list-style-type: none"><li><b>P1.</b> Analyze water condition and plant operating conditions according to workplace procedures and manufacturer s guidelines</li><li><b>P2.</b> Take corrective action in response to hazards, out-of-specification test results and / plant performance</li><li><b>P3.</b> Implement emergency procedures according to workplace safety procedures</li></ul>



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<b>4.</b> Hand over water treatment system	<b>P1.</b> Maintain workplace records according to workplace procedures <b>P2.</b> Carry out handover according to workplace procedures <b>P3.</b> Ensure operators are aware of system status and related equipment at completion of handover
<b>5.</b> Shut down the water treatment system	<b>P1.</b> Safely shut down the system according to operating procedures <b>P2.</b> Prepare the system for storage in shutdown mode according to operating procedures <b>P3.</b> Identify and report operational maintenance requirements according to workplace procedures

### 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:

- K1.** Hazards that are most likely to cause harm
- K2.** Identification and use of Personal Protective Equipment (PPE)
- K3.** American Society of Heating, Refrigeration, And Air Conditioning Engineers (ASHRAE)
- K4.** Water treatment functions
- K5.** Monitoring, testing and adjustment of water treatment
- K6.** PH value of the water
- K7.** Cleaning of water systems
- K8.** Corrosion and its eradication process
- K9.** 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:

- Collect samples of water
- Perform different test of water
- Perform water treatment with different methods

### List of Tools, Equipment and Machinery



## ***National Competency Standards Level-5 for “HVACR”***



<b>Sr. No</b>	<b>Description</b>
<b>1</b>	Personal Protective Equipment
<b>2</b>	Basic tool Kit
<b>3</b>	PH meter
<b>4</b>	Water cleaning system



## National Competency Standards Level-5 for “HVACR”



### 0713E&E-54. Analyse the operation of HVAC Air and Hydronic system

#### Overview

This Competency Standard covers the competencies required to analyze the operating parameters of heating, ventilating and air conditioning air and hydronic systems to determine whether performance requirements are being met or otherwise. It encompasses working safely, applying knowledge of operating parameters, gathering and analyzing data, applying problem solving techniques, developing and documenting results and solutions for use in design work.

<i>Competency Units</i>	<i>Performance Criteria</i>
<b>1.</b> Prepare to analyze the operation of HVAC air and hydronic systems	<b>P1.</b> Identify, obtain and understand OHS processes and procedures for a given work area <b>P2.</b> Follow established OHS risk control measures and procedures in preparation for the work. <b>P3.</b> Determine the extent of operating analysis from performance specifications and situation reports and in consultations with relevant persons Plan activities to meet scheduled timelines in consultation with others involved in the work <b>P4.</b> Plan effective strategies to ensure solution development and carry out implementation efficiently.
<b>2.</b> Analyze the operation of HVAC air and hydronic systems	<b>P1.</b> Follow OHS risk control measures and procedures for carrying out the work <b>P2.</b> Apply knowledge of HVAC air and hydronic systems operating parameters to analytical solutions of refrigeration and air conditioning systems <b>P3.</b> Obtain parameters, specifications and performance requirements in relation to HVAC air and hydronic systems in accordance with established procedures <b>P4.</b> Carry out approaches to analyzing operating parameters to provide the most effective solution. Deal with unplanned/ unforeseen events safely and effectively consistent with regulatory requirements and enterprise policy <b>P5.</b> Monitor quality of work against personal performance agreement and/or established organizational or professional standards
<b>3.</b> Document and develop report on the results of the operation of HVAC/R systems analysis and actions taken.	<b>P1.</b> Evaluate results of system operating analysis to determine whether performance requirements are being met or otherwise. Document analysis including details of all findings, calculations and assumptions. Report analysis to concerned expert personnel to



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establish appropriate action to be taken based on findings.

**P2.** Document justification for findings and any actions to be undertaken in relation to the equipment for inclusion in work/project or development records in accordance with professional standards.

### 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:

- Hazards that are most likely to cause harm
- Identification and use of Personal Protective Equipment (PPE)
- American Society of Heating, Refrigeration, And Air Conditioning Engineers (ASHRAE)
- Basics of Hydronic System
- All types and arrangements of the "Hydronic Piping Circuits Arrangement /Types"
- Effective strategies to ensure solution development
- Carry out implementation efficiently regarding hydronic system
- Evaluation parameters of hydronic system
- 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:

- Understand HVAC air and hydronic systems
- Operate HVAC air and hydronic systems
- Obtain different parameter of system
- Analyze obtained data
- Make report

### List of Tools, Equipment and Machinery

Sr. No	Description
1	Personal Protective Equipment
2	Personal Computer





## National Competency Standards Level-5 for “HVACR”



### 0713E&E-55. Calculate Quantity of Heat Transfer for Different Applications

#### Overview

This Competency Standard covers the competencies required to calculate quantity of heat transfer for different applications in accordance with the manufacturer’s specifications / guidelines. This unit covers the knowledge regarding calculation quantities of heat transfer for different applications to provide you the basis for student work.

Competency Units	Performance Criteria
1. Calculate temperature change	<p>P1. Calculate temperature change caused by heating/cooling pipes &amp; ducts</p> <p>P2. Calculate change in heat content caused by different heat transferred factors</p> <p>P3. Calculate temperature change caused by insulation</p>
2. Select appropriate heating and cooling mechanism	<p>P1. Compare rates of heat transfer/overall heat transfer coefficients for major methods of heating and cooling</p> <p>P2. Determine appropriate methods of varying/controlling rates of heat transfer in HVAC systems</p> <p>P3. Calculate heat transfer rates under a range of designed conditions</p>
3. Determine heating required to suit process conditions	<p>P1. Determine heating requirements to obtain correct viscosity for processing</p> <p>P2. Select appropriate heat transfer mechanism(s) to achieve desired conditions</p> <p>P3. Select appropriate mechanism to control the flow of heat transfer</p>
4. Conduct energy balance over process components	<p>P4. Determine overall heating load for process components</p> <p>P5. Determine overall cooling load for process components</p> <p>P6. Determine the adequacy (or otherwise) of the process/plant heating/cooling system to cope with this</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:

- Hazards that are most likely to cause harm
- Identification and use of Personal Protective Equipment (PPE)



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- American Society of Heating, Refrigeration and Air Conditioning Engineers (ASHRAE)
- Pressure, Temperature and its units
- Heat transfer and methods of heat transfer
- Load calculations
- Effects of temperature changes
- Interpret the relation between pressure and temperature
- 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:

- Calculate quantity of transferred heat by all modes
- Calculate heat transfer coefficient

### List of Tools, Equipment and Machinery

Sr. No	Description
1	Personal Protective Equipment
2	Basic tool Kit
3	Digital Air Flow / Velocity Meter
4	Digital Optical Tachometer
5	Electronic Leak Detector
6	Laser Temperature Measuring Device



## National Competency Standards Level-5 for “HVACR”



### 0713E&E-56. Plot Refrigeration Cycle on PH Chart

#### Overview

This Competency Standard covers the competencies required to plot refrigeration cycle on PH chart in accordance with the manufacturer’s specifications / guidelines. This unit covers the knowledge regarding plotting of refrigeration cycle on PH chart to provide you the basis for student work.

Competency Units	Performance Criteria
1. Calculate refrigeration process of actual refrigeration cycle.	<p><b>P1.</b> Draw refrigeration cycle on PH chart.</p> <p><b>P2.</b> Calculate refrigerating effect.</p> <p><b>P3.</b> Calculate coefficient of performance.</p> <p><b>P4.</b> Calculate the mass flow rate.</p> <p><b>P5.</b> Calculate the system capacity.</p> <p><b>P6.</b> Calculate the heat of compression.</p>
2. Calculate effects of change in condensing temperature on cycle efficiency	<p><b>P1.</b> Draw refrigeration cycle on PH chart.</p> <p><b>P2.</b> Calculate refrigerating effect.</p> <p><b>P3.</b> Calculate coefficient of performance.</p> <p><b>P4.</b> Calculate the mass flow rate.</p> <p><b>P5.</b> Calculate the system capacity.</p> <p><b>P6.</b> Calculate the heat of compression.</p> <p><b>P7.</b> Compare such properties with theoretical refrigeration cycle</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:

- Hazards that are most likely to cause harm
- Identification and use of Personal Protective Equipment (PPE)
- American Society of Heating, Refrigeration and Air Conditioning Engineers (ASHRAE)
- PH chart
- Read and interpret PH chart
- Draw refrigeration cycle on PH chart
- Calculate system capacity through PH chart
- Coefficient of performance
- Refrigerating effect and system capacity
- Heat of compression and mass flow rate
- Record keeping and reporting



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### Critical Evidence(s) Required

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

- Draw relevant lines of refrigeration cycle
- Calculate enthalpies
- Calculate Refrigerating effect

### List of Tools, Equipment and Machinery

<i>Sr. No</i>	<i>Description</i>
1	T-square
2	Drafting machine
3	French Curves
4	Rulers
5	Compass



## National Competency Standards Level-5 for “HVACR”



### 0713E&E-57. Calculate Different Process on PH Chart

#### Overview

This Competency Standard covers the competencies required to calculate different processes on PH chart in accordance with the manufacturer’s specifications / guidelines. This unit covers the knowledge regarding calculation of different processes on PH chart to provide you the basis for student work.

Competency Units	Performance Criteria
1. Identify and interpret PH chart	<p>P1. Identify the PH chart.</p> <p>P2. Identify the line &amp; curves of ph. chart with their readings.</p> <p>P3. Differentiate phases of ph. chart.</p> <p>P4. Draw the different refrigeration process on ph. chart.</p>
2. Draw refrigeration cycle of PH chart.	<p>P1. Draw condensing process for specified refrigerant.</p> <p>P2. Draw expansion process for specified refrigerant.</p> <p>P3. Draw vaporization process for specified refrigerant.</p> <p>P4. Draw compression process for specified refrigerant.</p> <p>P5. Complete the diagram according to given pressure &amp; temperature.</p> <p>P6. Calculate the properties of air after observing enthalpies at different point</p>
3. Analyze the cycle performance	<p>P1. Calculate refrigerating effect</p> <p>P2. Calculate coefficient of performance</p> <p>P3. Calculate the mass flow rate of refrigerant in the system.</p> <p>P4. Calculate the compressor capacity.</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:

- Hazards that are most likely to cause harm
- Identification and use of Personal Protective Equipment (PPE)
- American Society of Heating, Refrigeration and Air Conditioning Engineers (ASHRAE)
- PH chart
- Read and interpret PH chart
- Draw refrigeration cycle on PH chart
- Calculate system capacity through PH chart
- Coefficient of performance
- Refrigerating effect and system capacity



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- Heat of compression and mass flow rate
- 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:

- Plot refrigeration cycle of respective refrigerant on PH chart
- Calculate enthalpies
- Evaluate different processes of refrigeration cycle

### List of Tools, Equipment and Machinery

Sr. No	Description
1	T-square
2	Drafting machine
3	French Curves
4	Rulers
5	Compass



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## National Competency Standards Level-5 for "HVACR"



### 0713E&E-58. Calculate the Quantity of Gasses in a flue gas Sample

#### Overview

This Competency Standard covers the competencies required to calculate the quantity of gasses in a flue gas samples in accordance with the manufacturer's specifications / guidelines. This unit covers the knowledge regarding calculation quantity of gasses in flue gasses to provide you the basis for student work.

Competency Units	Performance Criteria
1. Identify and use flue gases	<p><b>P1.</b> Identify the properties of gases.</p> <p><b>P2.</b> Identify the properties of flue gases.</p> <p><b>P3.</b> Use air and gases.</p>
2. Estimate flue gases quantity	<p><b>P1.</b> Identify and operate Ores apparatus.</p> <p><b>P2.</b> Identify the percentage of different gasses in flue gas.</p> <p><b>P3.</b> Convert the content of the different element of mol.</p> <p><b>P4.</b> Calculate the air according to the stoichiometric reaction.</p> <p><b>P5.</b> Calculation of excess air.</p> <p><b>P6.</b> Convert flue gases to mol.</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:

- Hazards that are most likely to cause harm
- Identification and use of Personal Protective Equipment (PPE)
- American Society of Heating, Refrigeration and Air Conditioning Engineers (ASHRAE)
- Flue gasses and flue gasses calculations
- Identification and use of Ores apparatus
- Stoichiometric reaction
- Elements of mol and conversion of flue gases into mol
- 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:

- Identify air composition
- Use oars apparatus
- Calculate composition of gases in ores apparatus





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- Calculate quantity of Excess air

### **List of Tools, Equipment and Machinery**

<i>Sr. No</i>	<i>Description</i>
<b>1</b>	Personal computer



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### 0713E&E-59. Make Circuits Using Electronic Components

#### Overview:

This Competency Standard identifies the competencies required to make different types of Circuits using Electronics Components with the organization's approved guidelines and procedures. Student underpinning knowledge regarding basic electronics will be sufficient to provide the basis for this task.

Competency Units	Performance Criteria
1. Arrange tools/material for job	<p><b>P1.</b> Identify &amp; collect tools and material as per job.</p> <p><b>P2.</b> Prepare workplace for the job/task.</p> <p><b>P3.</b> Prepare layouts/drawing for job/task</p> <p><b>P4.</b> Arrange backup resources for lighting, power and safety purposes as per job requirement</p>
2. Make rectifier circuit.	<p><b>P1.</b> Connect two diodes; make an "L" of their two ends marked with the white bands (cathodes).</p> <p><b>P2.</b> Connect the remaining two diodes, this time with their ends having no bands (anodes)</p> <p><b>P3.</b> Connect both sets of diodes according to the circuit diagram.</p> <p><b>P4.</b> Verify the results that the circuit is converting complete cycle of AC supply into DC supply.</p>
3. Make common emitter (CE) amplifier circuit.	<p><b>P1.</b> Connect the transistors according to circuit diagram.</p> <p><b>P2.</b> Connect amplifier circuit to the power supply</p> <p><b>P3.</b> Measure the input voltage (f=1 kHz).</p> <p><b>P4.</b> Verify the output is 4Vpp at 1 kHz as compare to input.</p>
4. Make DC motor speed control circuit.	<p><b>P1.</b> Connect the silicon-controlled rectifier (SCR) according to circuit diagram</p> <p><b>P2.</b> Connect the dc motor with controlling circuit.</p> <p><b>P3.</b> Connect the circuit to power supply.</p> <p><b>P4.</b> Check and verify the circuit that speed of dc motor controlled properly</p>
5. Make AC power control circuit.	<p><b>P1.</b> Connect the diac &amp; triac according to circuit diagram.</p> <p><b>P2.</b> Connect circuit to power source (AC supply).</p> <p><b>P3.</b> Trigger the circuit at different positions of AC wave form</p> <p><b>P4.</b> Check and verify the results that circuit is controlling AC power supply properly.</p>
6. Make time delay circuit.	<p><b>P1</b> Connect the uni junction transistor (UJT) and SCR according to circuit diagram.</p> <p><b>P2</b> Connect the circuit to power supply and adjust the</p>



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	power supply to 12V dc. <b>P3</b> Trigger the SCR through UJT to operational the circuit. <b>P4</b> Verify that by increase in resistance should change the time delay period longer. <b>P5</b> Verify that by decrease in resistance should change the time delay period shorter.
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### Knowledge & 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:

- Definition and identification of diodes and its working.
- Theory of transformer
- Tools, equipment and materials required for the job
- Install equipment according to circuit diagram.
- Interpretation of drawings and circuit diagrams; soldering
- Testing procedures and equipment
- Describe SCR and its operation as dc motor power control.
- Working of diac and triac, and its application.
- Definition and working of UJT as time delay circuit.
- Working and operation of oscilloscope.
- 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:

- Draw circuit diagrams
- Make circuit on PCB
- Connect components by soldering
- Operate circuit

### LIST OF TOOLS, EQUIPMENT AND MACHINERY

Sr. No	Description
1	Personal protective equipment. (PPE)
2	Diodes
3	Bread board



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4	Jumper wires or leads.
5	Electric iron
6	Rosin paste
7	Soldering wire
8	Transistors
9	Oscilloscope
10	Silicone controlled rectifies. (SCRs)
11	DC motor
12	Power supply
13	Diac
14	Triac
15	Transformer
16	Uni junction transistors. (UJT)
17	Time delay relay
18	Plier
19	Cutter
20	Screwdriver
21	Voltmeter
22	Ampere meter
23	Frequency meter.



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### 0713E&E-60. Make Temperature Control & Sensing Devices

#### Overview:

This Competency Standard identifies the competencies required to make different temperature control and sensing devices with the organization’s approved guidelines and procedures. Student underpinning knowledge regarding these devices will be sufficient to provide the basis for this task.

Competency Units	Performance Criteria
1. Arrange tools/material for Job	<p><b>P1.</b> Identify &amp; collect tools and material as per job.</p> <p><b>P2.</b> Prepare workplace for the job/task.</p> <p><b>P3.</b> Prepare layouts/circuit diagrams for job/task</p> <p><b>P4.</b> Arrange backup resources for lighting, power and safety purposes as per job requirement</p>
2. Make a temperature control device	<p><b>P1.</b> Strip back the outer insulation of wires.</p> <p><b>P2.</b> Bend the wire to make a contact point and weld them</p> <p><b>P3.</b> Measure &amp; verify the output of thermocouple at open circuit that readings must be above 17 to 18 mill volts.</p> <p><b>P4.</b> Measure &amp; verify the output of thermocouple at close circuit that readings must be up to 8 to 9 mill volts.</p>
3. Make a temperature sensing device	<p><b>P1.</b> Connect the thermistor according to circuit diagram.</p> <p><b>P2.</b> Connect the power supply to op- amp and apply <math>\pm 15</math> V and apply +5 V to the sensor.</p> <p><b>P3.</b> Measure the output voltage using a digital voltmeter (DVM)</p> <p><b>P4.</b> Checked and verified resistance verses temperature characteristics.</p> <p><b>P5.</b> Verify the thermistor sense cold weather, tap weather, and hot weather combinations to obtain a range between 15 to 60 centigrade</p>

#### Knowledge & 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

- Interpretation of drawings, symbols, and circuit diagrams.
- Installation procedures
- Tools, equipment and materials required for the job
- Thermocouple and thermistor as temperature sensing device.
- Install equipment according to circuit diagram.
- Interpretation of drawings and circuit diagrams; Soldering



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- Testing procedures and equipment
- To testing and measuring of circuit and components by digital voltmeter (DVM)
- Use of safety equipment and tools
- 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:

Make Circuit using Electronic Components

- Draw circuit diagrams
- Make circuit on PCB
- Connect components by soldering
- Connect sensors
- Operate circuit

### LIST OF TOOLS, EQUIPMENT AND MACHINERY

Sr. No	Description
1	Personal protective equipment (PPE)
2	Opto-coupler
3	Selenium photocell with metal surface
4	Wooden plank with scale
5	Lamp holder
6	Lamp
7	Patch chords
8	Thermocouple
9	Thermistors
10	Time delay relay



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11	Power Supply
12	Connecting Wire or Connecting Leads.
13	Sequence timer
14	Screwdriver
15	Nose plier
16	Plier
17	Electrician Knife
18	Bread board
19	Jumper wires or connecting leads
20	Soldering iron
21	Soldering wire
22	Rosin paste

### **0713E&E-61. Connect the Accessories in Control Circuits**

#### **Overview**

This Competency Standard identifies the competencies required to connect the electronics accessories in control circuits with the organization’s approved guidelines and procedures. Students underpinning knowledge regarding electronics accessories will be sufficient to provide the basis for this task.

*Competency Units*

*Performance Criteria*



## National Competency Standards Level-5 for “HVACR”



<b>1. Arrange tools/material for Job</b>	<b>P1.</b> Identify & collect tools and material as per job. <b>P2.</b> Prepare workplace for the job/task. <b>P3.</b> Prepare layouts/circuit diagrams for job/task <b>P4.</b> Arrange backup resources for lighting, power and safety purposes as per job requirement
<b>2. Connect electronic relays, timers in circuits.</b>	<b>P1.</b> Connect dc time delay relay according to circuit diagram. <b>P2.</b> Check & verify its time delay function. <b>P3.</b> Connect AC resistance sensitive relay according to circuit diagram. <b>P4.</b> Check & verify its resistance sensitivity function. <b>P5.</b> Connect heat sensitive relay according to circuit diagram. <b>P6.</b> Check & verify heat sensitivity function. <b>P7.</b> Connect sequence timer according to circuit diagram. <b>P8.</b> Check & verify its function.
<b>3. Connect electro-pneumatic &amp; mechanical controller</b>	<b>P1.</b> Connect electro-pneumatic controller according to circuit diagram. <b>P2.</b> Check & verify its pneumatic function. <b>P3.</b> Connect electro-mechanical controller according to circuit diagram. <b>P4.</b> Check & verify its function.

### Knowledge & 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

- Interpretation of drawings, symbols, and circuit diagrams.
- Installation procedures
- Tools, equipment and materials required for the job
- Relays and timer's theory
- Install equipment according to circuit diagram.
- Interpretation of drawings and circuit diagrams; Soldering
- Testing procedures and equipment
- To testing and measuring of circuit and components by digital voltmeter (DVM)
- Use of safety equipment and tools
- Definition and theory of logic gates.
- Theory and operation of electro-pneumatic & mechanical controller
- Record keeping and reporting

### Critical Evidence(s) Required





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

- Draw circuit diagram
- Make PCB
- Connect components
- Operate circuit

### LIST OF TOOLS, EQUIPMENT AND MACHINERY

Sr. No	Description
1	Personal protective equipment (PPE)
2	Dc time delay relay
3	Sequence timer
4	AC resistance sensitive relay
5	Heat sensitive relay
6	Elector- pneumatic controller
7	Electro- mechanical controller
8	Nose plier
9	Plier
10	Electrician Knife
11	Bread board
12	Jumper wires or connecting leads
13	Soldering iron
14	Soldering wire
15	Rosin paste
16	Power supply
17	Connecting Wire or Connecting Leads.



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### 0713E&E-62. Make Opto-Cuopler Devices

#### Overview:

This Competency Standard identifies the competencies required to make Opto-cuopler devices with the organization’s approved guidelines and procedures. Student underpinning knowledge regarding make Opto-cuopler will be sufficient to provide the basis for this task.

Competency Units	Performance Criteria
1. Arrange tools/material for Job	<p><b>P1.</b> Identify &amp; collect tools and material as per job.</p> <p><b>P2.</b> Prepare workplace for the job/task.</p> <p><b>P3.</b> Prepare layouts/circuit diagrams for job/task</p> <p><b>P4.</b> Arrange backup resources for lighting, power and safety purposes as per job requirement</p>
2. Make illumination Control	<p><b>P1.</b> Hold the piece of copper foil in Bunsen flame &amp; heat for a few second until half of the copper has been oxidized to black copper oxide.</p> <p><b>P2.</b> Let the piece of copper cool &amp; one drop of concentrated of salt solution on the solar cell.</p> <p><b>P3.</b> Connect the crocodile and lead the shiny wind of copper foil to voltmeter.</p> <p><b>P4.</b> Connect the lead from the voltmeter to crocodile clip which hold the piece of wire.</p> <p><b>P5.</b> Allow the copper wire to dip into the drop of salt solution.</p> <p><b>P6.</b> Verify the photocell as an illumination control device.</p>
3. Make a counter	<p><b>P1.</b> Connect increment and reset to an OR gate.</p> <p><b>P2.</b> Connect the increment button to each AND gate.</p> <p><b>P3.</b> Connect AND gate each output to one S input on each RS flip-flop</p> <p><b>P4.</b> Connect the reset button to every R input on each RS flip-flop.</p> <p><b>P5.</b> Connect the single OR gate output to the clock input on each RS flip-flop</p> <p><b>P6.</b> Connect each or gate’s output to one of the numerical display inputs.</p> <p><b>P7.</b> Connect RS flip-flop’s Q output, to one input of the first XOR gate, and one input of the first AND gate.</p> <p><b>P8.</b> Connect RS flip-flops output to an input of the previous XOR gate, an input of the next XOR gate, and the input of the next AND gate Connect</p> <p><b>P9.</b> Connect RS flip-flop to the last XOR gate, and one to each of the OR gates.</p>



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<b>4. Make a pin-hole detector</b>	<b>P1.</b> Connect the components according to circuit diagram. <b>P2.</b> Connect the circuit low voltage power supply. <b>P3.</b> Check automatic sensitivity calibration and voltage <b>P4.</b> Measure insulated coatings less than 500 $\mu\text{m}$ or 20 milli meter on conductive substrates
<b>5. Make flame failure Control</b>	<b>P1.</b> Connect flame failure detector according to circuit diagram <b>P2.</b> Install the detector to burner. <b>P3.</b> Connect the device to power supply. <b>P4.</b> Verify that detector stopping flow of gas to the burner



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### Knowledge & 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:

- Interpretation of drawings, symbols, and circuit diagrams.
- Installation procedures
- Tools, equipment and materials required for the job
- Theory of opto-cuopler and use of opto-cuopler with different electronic devices.
- Install equipment according to circuit diagram.
- Interpretation of drawings and circuit diagrams; soldering
- Testing procedures and equipment
- To testing and measuring of circuit and components by digital voltmeter (DVM)
- Use of safety equipment and tools
- Definition and theory of logic gates.
- 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:

- Connect the crocodile
- Connect photocell
- Verify photocell
- Make necessary connections
- Operate GATES in circuit

### LIST OF TOOLS, EQUIPMENT AND MACHINERY

Sr. No	Description
1	Personal protective equipment (PPE)
2	Copper foil
3	Voltmeter.
4	Solar cell
5	OR gate
6	XOR gate



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7	AND gate
8	RS flip-flop.
9	Burner
10	Flame failure detector
11	Nose plier
12	Plier
13	Electrician Knife
14	Bread board
15	Jumper wires or connecting leads
16	Soldering iron
17	Soldering wire
18	Rosin paste
19	Power supply
20	Connecting Wire or Connecting Leads.



## National Competency Standards Level-5 for “HVACR”



### 0713E&E-63. Install Commercial Refrigeration System

#### Overview

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

Competency Units	Performance Criteria
1. Install Walk in Cooler / Freezer	<p><b>P1.</b> Adopt Occupational Safety and Health (OSH) procedures to avoid hazards and accidents at workplace.</p> <p><b>P2.</b> Select tools, equipment and related accessories according to job requirements</p> <p><b>P3.</b> Prepare insulated room for preserving the food on lowest temperature as per drawing and requirements</p> <p><b>P4.</b> Prepare steel structure for installation of evaporator assembly and condensing unit following manufacturer's specifications</p> <p><b>P5.</b> Prepare the place and leveled it, to fix the evaporator and condensing unit firmly according to manufacturer's specifications</p> <p><b>P6.</b> Layout piping and control wiring from indoor to outdoor unit according to instructional manual</p> <p><b>P7.</b> Perform leak test, evacuation and charge the refrigerant according to unit specifications and standards, before commissioning</p> <p><b>P8.</b> Connect the electric supply and check the performance</p>
2. Install Ice Making Machine	<p><b>P1.</b> Adopt Occupational Safety and Health (OSH) procedures to avoid hazards and accidents at workplace.</p> <p><b>P2.</b> Select tools, equipment and related accessories according to job requirements</p> <p><b>P3.</b> Fix the machine on potable water supply by following manufacturer's specifications</p> <p><b>P4.</b> Measure the clearance on each side to be sure it meets the standards set by the manufacturer</p> <p><b>P5.</b> Make water drain connections in order to empty purged and melt water as per manual instructions and client requirements</p> <p><b>P6.</b> Install shut of valve on water supply near the machine according to unit specifications</p> <p><b>P7.</b> Make electric supply, switched on and check</p>



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	performance according to machine specification by using specific instruments
<b>3. Install Electric Water Cooler / Chilled Water Tank</b>	<b>P1.</b> Adopt Occupational Safety and Health (OSH) procedures to avoid hazards and accidents at workplace. <b>P2.</b> Select tools, equipment and related accessories according to job requirements <b>P3.</b> Fix the cooler / tank on potable water supply by following manufacturer’s specifications and client requirements <b>P4.</b> Measure the clearance on each side to be sure it meets the standards set by the manufacturer <b>P5.</b> Make water drain connections adjacent to the water supply as per manual instructions / location <b>P6.</b> Fix minimum water level protection & interlocking with refrigeration unit to prevent empty freezing <b>P7.</b> Make power supply as per manual instructions. <b>P8.</b> Operate and check performance

### 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:

- Hazards that are most likely to cause harm
- Identification and use of Personal Protective Equipment (PPE)
- American Society of Heating, Refrigeration and Air Conditioning Engineers (ASHRAE)
- Ohm meter, Voltmeter and Ampere meter use
- Refrigeration and its types
- Commercial refrigeration
- Refrigerants and properties of refrigerants
- Filters, strainers and lubrication oils
- Working principle of cooling tower
- Control devices and safety devices for operational parameters
- Compressors and functions of compressors
- Air purge valves, fans and its types
- Vibration and abnormal noises of electrical devices and machinery
- 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:



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- Read and understand drawings
- Make foundations and hangers
- Install components of refrigeration system
- Install plumbing assembly Chilled Water Tank, condenser and cooling tower
- Make water drain connections
- Install anti freezing/defrosting and water level protection system

### List of Tools, Equipment and Machinery

Sr. No	Description
1	Personal Protective Equipment
2	Basic Measuring tools
3	Basic Hand tools
4	Basic Cutting tools
5	Basic Power tools
6	Basic Marking tools
7	Basic Electric tools
8	Gas Welding Set with All Accessories
9	Nitrogen Gas Cylinder with Hose Pipe, Regulator and Back Arrestor
10	Tube Cutter
11	Electric Hand Grinder
12	Digital Air Flow / Velocity Meter
13	Electronic Leak Detector
14	Spirit Level
15	Digital Multi Meter
16	Digital Clamp-On Ampere Meter
17	HILTI Drill Machine (Piston Type)
18	Digital Optical Tachometer
19	Megohmmeter (0 - 1000 Volts)
20	Digital Capacitor Analyzer





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21	Digital Pressure Gauges Set (High &Combine)
22	Flaring and Swaging Tool Kit
23	Vacuum Pump 2-Stage, 6cfm
24	Tube Benders (Spring Type and Pulley Bender Type
25	Laser Distance Measuring Device
26	Laser Temperature Measuring Device



## National Competency Standards Level-5 for “HVACR”



### 0713E&E-64. Install, Maintain & Repair Industrial Refrigeration System

#### Overview

This competency standard covers the competencies required to install, maintain and repair different types and sizes of cold rooms/ freezer rooms/ ice plants using specified tools & test instruments and material and referring to manufacturer’s specifications while ensuring safe working conditions and the safe use of tools, equipment and material.

Competency Units	Performance Criteria
1. Identify the selected design of industrial refrigeration system.	<p><b>P1.</b> Identify location as per the design.</p> <p><b>P2.</b> Select system specifications, check to ensure matching with selected design of the unit.</p> <p><b>P3.</b> Prepare a list of equipment/items and material required for the job.</p>
2. Install industrial refrigeration system	<p><b>P1.</b> Select components of system according to requirements for the installation.</p> <p><b>P2.</b> Prepare Floor and level to install industrial refrigeration system according to layout plans.</p> <p><b>P3.</b> Install industrial refrigeration system according to specifications following manufacturer’s specification.</p> <p><b>P4.</b> Install refrigeration equipment including piping &amp; electrical wiring following standard practices and safety procedures.</p> <p><b>P5.</b> Check and test system before commissioning, as per specifications and manufacturer’s instructions, and under the supervision of the engineer.</p> <p><b>P6.</b> Record commissioning data indicating system pressures, electrical data, humidity &amp; temperatures outside &amp; inside cold room and filed for future use.</p>
3. Maintain / repair industrial refrigeration system.	<p><b>P1.</b> Check cold room / freezer room / ice plant and repair / maintenance if necessary</p> <p><b>P2.</b> Enlist equipment / items, material and accessories as required for the job.</p> <p><b>P3.</b> Check all components of the electrical / electronic circuits according to standard practice and manufacturers specifications to ensure correct performance and defects rectified.</p> <p><b>P4.</b> Check and ensure performance of all electro - mechanical safety &amp; control devices according to manufacturer’s specifications.</p> <p><b>P5.</b> Check all mechanical devices such as drive belts etc. for correct performance according to manufacturer’s specifications.</p>



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- P6.** Check all components of the refrigeration circuit and rectify defects for correct performance according to manufacturer’s specifications.
- P7.** Check Defrost heaters, drain line, Pan heaters, fan delays, de frost timers, defrost termination devices and temperature controllers, service / replace where necessary to ensure proper functioning.
- P8.** Check Body mounts and restore to the required condition
- P9.** Test system pressure and repair gas leaks by using specified test instruments.
- P10.** Evacuate system by using vacuum pump and charge gas by weight method using specified equipment according to specifications.
- P11.** Operate, check and test plant, to ensure satisfactory performance according to manufacturer’s specifications.
- P12.** Re-commission and hand over the plant, according to manufactures specifications, following safety procedures, under the supervision of the superior and record readings / data obtained during commissioning of the plant and check against manufacturers specifications.

### 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:

- Hazards that are most likely to cause harm
- Identification and use of Personal Protective Equipment (PPE)
- American Society of Heating, Refrigeration, And Air Conditioning Engineers (ASHRAE)
- Different types of electric motors
- Working principles of different types of electric motors
- Refrigeration and its types
- Commercial refrigeration
- Refrigerants and properties of refrigerants
- Filters, strainers and lubrication oils
- Working principle of cooling tower
- Control devices and safety devices for operational parameters
- Compressors and functions of compressors
- Air purge valves, fans and its types
- Vibration and abnormal noises of electrical devices and machinery
- Record keeping and reporting



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### 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:
  - Read and understand drawings
  - Make foundations and hangers
  - Install components of refrigeration system
  - Install plumbing assembly Chilled Water Tank, condenser and cooling tower
  - Make water drain connections
  - Install anti freezing/defrosting and water level protection system
  - Fault finding & Trouble shooting
  - Leak testing & Charge refrigerant in refrigeration system
  - Replace different parts

### List of Tools, Equipment and Machinery

Sr. No	Description
1	Personal Protective Equipment
2	Basic Measuring tools
3	Basic Hand tools
4	Basic Cutting tools
5	Basic Power tools
6	Basic Marking tools
7	Basic Electric tools
8	Gas Welding Set with All Accessories
9	Nitrogen Gas Cylinder with Hose Pipe, Regulator and Back Arrestor
10	Tube Cutter
11	Electric Hand Grinder
12	Digital Air Flow / Velocity Meter
13	Electronic Leak Detector
14	Spirit Level
15	Digital Multi Meter



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<b>16</b>	Digital Clamp-On Ampere Meter
<b>17</b>	HILTI Drill Machine (Piston Type)
<b>18</b>	Digital Optical Tachometer
<b>19</b>	Megohmmeter (0 - 1000 Volts)
<b>20</b>	Digital Capacitor Analyzer
<b>21</b>	Digital Pressure Gauges Set (High &Combine)
<b>22</b>	Flaring and Swaging Tool Kit
<b>23</b>	Vacuum Pump 2-Stage, 6cfm
<b>24</b>	Tube Benders (Spring Type and Pulley Bender Type)
<b>25</b>	Laser Distance Measuring Device
<b>26</b>	Laser Temperature Measuring Device



## National Competency Standards Level-5 for “HVACR”



### 0713E&E-65. Install Maintain and Repair Commercial Refrigeration System

#### Overview

This Competency Standard covers the competencies required to diagnose / repair / service residential refrigeration units at workplace in accordance with the manufacturer’s 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 student work.

Competency Units	Performance Criteria
1. Diagnose Faults in Refrigerant Units	<p><b>P1.</b> Adopt Occupational Safety and Health (OSH) procedures to avoid hazards and accidents at workplace.</p> <p><b>P2.</b> Check for obvious problem to determine which component or system is causing the problem</p> <p><b>P3.</b> Select tools, equipment and related accessories according to requirements and standards.</p> <p><b>P4.</b> 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><b>P5.</b> Eliminate the causes of the problem according to the manufacturer’s manual and standards.</p> <p><b>P6.</b> Isolate and recheck the causes of the problem and correct the fault</p> <p><b>P7.</b> Start the Refrigeration unit and recheck the unit as specified in the manufacturer’s manual and record the results</p>
2. Repair Refrigeration Units	<p><b>P1.</b> Adopt Occupational Safety and Health (OSH) procedures to avoid hazards and accidents at workplace.</p> <p><b>P2.</b> Select tools, equipment and related accessories according to requirements and standards</p> <p><b>P3.</b> Disconnect the Refrigerator from electric supply and follow the manual instructions for rectification</p> <p><b>P4.</b> Rectify the fault as per diagnosed with the help of repair / replace the components</p> <p><b>P5.</b> Switched on Refrigerator to check the performance of electrical/ electronic and mechanical components as specified in the manufacturer’s manual and record the results</p>



## **National Competency Standards Level-5 for “HVACR”**



### **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:

- Hazards that are most likely to cause harm
- Identification and use of Personal Protective Equipment (PPE)
- American Society of Heating, Refrigeration, And Air Conditioning Engineers (ASHRAE)
- Different types of electric motors
- Working principles of different types of electric motors
- Ohm meter, Voltmeter and Ampere meter use
- Refrigeration and its types
- Commercial refrigeration
- Refrigerants and properties of refrigerants
- Filters, strainers and lubrication oils
- Working principle of cooling tower
- Control devices and safety devices for operational parameters
- Compressors and functions of compressors
- Air purge valves, fans and its types
- Vibration and abnormal noises of electrical devices and machinery
- 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:
  - Read and understand drawings
  - Make foundations and hangers
  - Install components of refrigeration system
  - Install plumbing assembly Chilled Water Tank, condenser and cooling tower
  - Make water drain connections
  - Install anti freezing/defrosting and water level protection system
  - Fault finding & Trouble shooting
  - Leak testing & Charge refrigerant in refrigeration system
  - Replace different parts

### **List of Tools, Equipment and Machinery**



## National Competency Standards Level-5 for “HVACR”



Sr. No	Description
1	Personal Protective Equipment
2	Basic Measuring tools
3	Basic Hand tools
4	Basic Cutting tools
5	Basic Power tools
6	Basic Marking tools
7	Basic Electric tools
8	Gas Welding Set with All Accessories
9	Nitrogen Gas Cylinder with Hose Pipe, Regulator and Back Arrestor
10	Tube Cutter
11	Electric Hand Grinder
12	Digital Air Flow / Velocity Meter
13	Electronic Leak Detector
14	Spirit Level
15	Digital Multi Meter
16	Digital Clamp-On Ampere Meter
17	HILTI Drill Machine (Piston Type)
18	Digital Optical Tachometer
19	Megohmmeter (0 - 1000 Volts)
20	Digital Capacitor Analyzer
21	Digital Pressure Gauges Set (High & Combine)
22	Flaring and Swaging Tool Kit
23	Vacuum Pump 2-Stage, 6cfm
24	Tube Benders (Spring Type and Pulley Bender Type)
25	Laser Distance Measuring Device





***National Competency Standards Level-5 for “HVACR”***



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Laser Temperature Measuring Device



## National Competency Standards Level-5 for “HVACR”



### 0713E&E-66. Install Maintain and Repair Package Type Air Conditioning System

#### Overview

This Competency Standard identifies the competencies required to repair package type Air Conditioners. It includes preparing unit, tools and workplace, checking and identifying defects and repairing of package type air conditioners to provide you the basis for your work.

Competency Units	Performance Criteria
<b>1. Prepare package type Air Conditioner for service and maintenance</b>	<p><b>P1.</b> Observe safe work practices and personal protective equipment (PPE) worn as required for the work to perform.</p> <p><b>P2.</b> Identify necessary tools and equipment in line with job requirements</p> <p><b>P3.</b> Select necessary materials as per job requirement</p> <p><b>P4.</b> Clean and assemble materials for package type Air conditioner as per work standard.</p>
<b>2. Check and Identify faults</b>	<p><b>P1.</b> Observe systematic pre-testing procedure in accordance with manufacturer’s instruction</p> <p><b>P2.</b> Identify system defects / faults symptoms are using appropriate tools and equipment</p> <p><b>P3.</b> Check different feature by using recommended testing procedure</p> <p><b>P4.</b> Check components of Electrical Circuit of Package type air conditioner by using recommended testing procedure</p>
<b>3. Service / Maintain of package type air conditioner</b>	<p><b>P1.</b> Replace defective components of refrigeration system with identical or recommended appropriate equivalent ratings</p> <p><b>P2.</b> Perform control settings/adjustments in conformity with service-manual specifications</p> <p><b>P3.</b> Clean air filter and evaporator fins with cleaning agent</p> <p><b>P4.</b> Evacuate the system by using high vacuum pump.</p>
<b>4. Clean and store of tools and equipment</b>	<p><b>P1.</b> Maintain and clean tools and equipment as per instruction</p> <p><b>P2.</b> Clean workplace in accordance with environmental requirements</p> <p><b>P3.</b> Store tools and equipment safely inappropriate location according to standard workshop procedure</p>



## National Competency Standards Level-5 for “HVACR”



### 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:

- K1. Hazards that are most likely to cause harm
- K2. Identification and use of Personal Protective Equipment (PPE)
- K3. American Society of Heating, Refrigeration, And Air Conditioning Engineers (ASHRAE)
- K4. Different types of electric motors
- K5. Working principles of different types of electric motors
- K6. Types of split air conditioners and package type air conditioners
- K7. Refrigeration and its types
- K8. Commercial refrigeration
- K9. Refrigerants and properties of refrigerants
- K10. Filters, strainers and lubrication oils
- K11. Working principle of cooling tower
- K12. Control devices and safety devices for operational parameters
- K13. Compressors and functions of compressors
- K14. Vibration and abnormal noises of electrical devices and machinery
- K15. 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:

- Mark location for unit
- Install air conditioner and make electrical connections
- Install plumbing assembly for condenser water and drain
- Fault finding & Trouble shooting in unit
- Leak testing & Charge refrigerant in air conditioner
- Replace different parts of air conditioner

### List of Tools, Equipment and Machinery

Sr. No	Description
1	Personal Protective Equipment



## ***National Competency Standards Level-5 for “HVACR”***



2	Basic Measuring tools
3	Basic Hand tools
4	Basic Cutting tools
5	Basic Power tools
6	Basic Marking tools
7	Basic Electric tools
8	Gas Welding Set with All Accessories
9	Nitrogen Gas Cylinder with Hose Pipe, Regulator and Back Arrestor
10	Tube Cutter
11	Electric Hand Grinder
12	Digital Air Flow / Velocity Meter
13	Electronic Leak Detector
14	Spirit Level
15	Digital Multi Meter
16	Digital Clamp-On Ampere Meter
17	HILTI Drill Machine (Piston Type)
18	Digital Optical Tachometer
19	Megohmmeter (0 - 1000 Volts)
20	Digital Capacitor Analyzer
21	Digital Pressure Gauges Set (High & Combine)
22	Flaring and Swaging Tool Kit
23	Vacuum Pump 2-Stage, 6cfm
24	Tube Benders (Spring Type and Pulley Bender Type)
25	Laser Distance Measuring Device
26	Laser Temperature Measuring Device



## National Competency Standards Level-5 for “HVACR”



### 0713E&E-67. Install Central Air Conditioning System

#### 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’s / client’s 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 student work.

Competency Units	Performance Criteria
1. Install Package Unit	<p><b>P1.</b> Adopt Occupational Safety and Health (OSH) procedures to avoid hazards and accidents at workplace.</p> <p><b>P2.</b> Select tools, equipment and related accessories according to job requirements</p> <p><b>P3.</b> Mark the location and area according to layout plan and manufacturer’s specifications</p> <p><b>P4.</b> Prepare foundation as per drawing, place, adjust and level the Package unit by giving attention to safety precautions</p> <p><b>P5.</b> Connect Package unit with duct through flexible connection</p> <p><b>P6.</b> Connect the power supply and control wires attached with Building Management (BMS) system</p> <p><b>P7.</b> Switch on the supply and check the performance according to manufacturer’s instructions and standards</p>
2. Install Variable Refrigerant Flow (VRF) / Variable Refrigerant Volume (VRV) System	<p><b>P1.</b> Adopt Occupational Safety and Health (OSH) procedures to avoid hazards and accidents at workplace.</p> <p><b>P2.</b> Select tools, equipment and related accessories according to job requirements</p> <p><b>P3.</b> Prepare foundation as per drawing, place, adjust and level the system by giving attention to safety precautions</p> <p><b>P4.</b> Prepare piping, weld braze them according to unit specifications and layout drawings</p> <p><b>P5.</b> Install indoor units according to layout diagrams, client requirements and manufacturer’s instruction manual.</p> <p><b>P6.</b> Fix Shut-off valves with service ports on every indoor unit</p> <p><b>P7.</b> Check leaks by applying pressure method before the joint’s insulation, repair leaks, if any</p> <p><b>P8.</b> Insulate the copper pipe joints according to manufacturer’s instructions and standards</p>



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	<p><b>P9.</b> Evacuate the system and charge the refrigerant</p> <p><b>P10.</b> Connect the power supply and control wires attached with Building Management (BMS) system</p> <p><b>P11.</b> Switch on the system and check performance</p>
<b>3. Install Water Chiller System</b>	<p><b>P1.</b> Adopt Occupational Safety and Health (OSH) procedures to avoid hazards and accidents at workplace.</p> <p><b>P2.</b> Select tools, equipment and related accessories according to job requirements</p> <p><b>P3.</b> Mark the location and area according to layout plan</p> <p><b>P4.</b> Prepare foundation as per drawing, place, adjust and level the chiller by giving attention to safety precautions</p> <p><b>P5.</b> Install Air Handling Units (AHU) at different locations inside the building according to drawing</p> <p><b>P6.</b> Install seamless high-pressure MS Pipe from chiller to Air Handling Units inside the building.</p> <p><b>P7.</b> Fabricate and install G.I sheet ducting inside the building as per drawing.</p> <p><b>P8.</b> Install Water Cooling Tower outside the building / roof (Only for water cooled condenser).</p> <p><b>P9.</b> Install building management system (BMS) as per design</p> <p><b>P10.</b> Establish the electric power supply system for the chiller &amp; air handling units and cooling tower as per Requirements &amp; Standards.</p> <p><b>P11.</b> Perform Air Balancing test, Pressure test, Smoke test, etc.</p> <p><b>P12.</b> Switch on the system and check performance.</p>
<b>4. Carry out Commissioning</b>	<p><b>P1.</b> Adopt Occupational Safety and Health (OSH) procedures to avoid hazards and accidents at workplace.</p> <p><b>P2.</b> Select tools, equipment and related accessories according to job requirements</p> <p><b>P3.</b> Start the condenser and chilled water pump for water circulation in the system</p> <p><b>P4.</b> Start the chiller and take reading of all parameters regarding pressure and electric power, check unusual vibrations / noises etc., if any.</p> <p><b>P5.</b> Perform Air Balancing test to check the air distribution according to design requirements</p> <p><b>P6.</b> Start AHU's, FCU's and Humidifiers/ Dehumidifiers for air circulation at the required areas.</p> <p><b>P7.</b> Check the system performance.</p>
<b>5. Install the Water Chiller Plant</b>	<p><b>P1.</b> Check and ensure availability of required electrical power supply</p> <p><b>P2.</b> Check Air Conditioner and ensure its suitability according to requirement</p> <p><b>P3.</b> Layout plan and manufacturer's</p>



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	<p>specifications/instructions referred to, and location of installation identified</p> <p><b>P4.</b> Prepare a list of items and material and number of labor hours required for the estimated job.</p> <p><b>P5.</b> Check &amp; test required Floor / foundation level and firmness</p> <p><b>P6.</b> Transfer Unit to required location giving attention to safety precautions</p> <p><b>P7.</b> Mount, adjust and level unit at pre-identified location</p> <p><b>P8.</b> Install piping &amp; connections for chilled water &amp; condenser water</p> <p><b>P9.</b> Install Stop valve &amp; commissioning valve (DRV) in condenser, evaporator, thermometer wells and pressure tap according to specification</p> <p><b>P10.</b> Install Condenser and chilled water pumps with double regulator valve (DRV) Variable Frequency Drive (VFD) according to specification</p> <p><b>P11.</b> Install Electrical wiring and control panels/switchgear according to specifications</p>
<b>6. Install Cooling Tower</b>	<p><b>P1.</b> Inspect Cooling Tower verify, confirm its suitability layout plan and manufacturer’s specifications/instructions refer to, and location for installation</p> <p><b>P2.</b> Check &amp; test Floor / foundation required level and confirm firmness</p> <p><b>P3.</b> Transfer Unit to required location ensuring safety precautions</p> <p><b>P4.</b> Mount Unit at pre-identified location, adjust and level</p> <p><b>P5.</b> Install Cooling tower basin and level Fill packs, Cooling tower motor &amp; fan</p> <p><b>P6.</b> Connect Water pipes to cooling tower as necessary</p> <p><b>P7.</b> Connect Electrical wiring to cooling tower</p> <p><b>P8.</b> Test Cooling tower for satisfactory performance and make adjustments, where necessary</p>
<b>7. Install Air handling Equipment</b>	<p><b>P1.</b> Install Air handling equipment according to specification at the specified location (Fan) reheat coil to maintain R.H. controller (relative Humidity) as required.</p> <p><b>P2.</b> Connect Electrical supply, piping and duct lines using specifies accessories and tools. (DRV/ motorized valve with temperature control)</p>
<b>8. Install Ducts</b>	<p><b>P1.</b> Read &amp; interpret Drawings and specifications for installing ducts</p> <p><b>P2.</b> Locate and mark places where ducts are to be laid, according to specifications</p> <p><b>P3.</b> Install Brackets / supports for mounting of ducts as necessary</p> <p><b>P4.</b> Mount Ducts, level and adjust, as necessary</p> <p><b>P5.</b> Install Fire dampers and air volume dampers in</p>



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	<p>ducts as per drawings</p> <p><b>P6.</b> Insulate heat ducts according to manufacturer’s specifications</p> <p><b>P7.</b> Do final connections of ducts to air handling plant as per manufacturer’s instructions</p> <p><b>P8.</b> Check and ensure availability of required electrical power supply</p> <p><b>P9.</b> Energize air side equipment of system and check defects in air side, plan, as necessary</p>
<p><b>9.</b> Assist testing &amp; commissioning the Air Conditioning system</p>	<p><b>P1.</b> Check condensing medium equipment such as air-cooled condensers /cooling towers and pumps</p> <p><b>P2.</b> Energize crank case heaters of main plant for specified number of hours according to manufacturer’s specifications, and switch on main air-conditioning equipment.</p> <p><b>P3.</b> Take readings of electrical power taken and check electrical safety gear, unusual noises &amp; vibrations</p> <p><b>P4.</b> Check and repair leak (if any) of refrigerant circuit in air conditioning system</p> <p><b>P5.</b> Operate and check system for satisfactory performance</p> <p><b>P6.</b> Record performance of the equipment</p>





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### Knowledge & 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:

- K1.** American Society of Heating, Refrigeration and Air Conditioning Engineers (ASHRAE)
- K2.** Ozone Protection and Synthetic Greenhouse Gas Management Act 1989
- K3.** HVACR, Electric and Electronics fundamentals
- K4.** Techniques for installation of central Air conditioners
- K5.** Fundamental and Technical Operations of VRF / VRV system
- K6.** Electrical / HVAC layout plans/wiring diagrams.
- K7.** Electrical control wires, cables, including underground cables, their ratings and its applications
- K8.** Methods of Copper Tube cutting / Bending /Swaging / Flaring / Brazing / Y-Jointing / fixing
- K9.** Basic Masonry and Carpentry applications
- K10.** Welding types and techniques
- K11.** Types of Insulation and their applications
- K12.** Types of AHU, FCU, Chillers, Cooling towers, Compressor, Condenser and pump types and their applications
- K13.** Types of Refrigerant, its properties, recovery and reclaiming
- K14.** Procedure regarding commissioning the central HVAC systems
- K15.** 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:

- Read and understand drawings
- Mark locations according to specification
- Make foundations and hangers
- Install components of refrigeration system
- Install plumbing assembly Chilled Water Tank, condenser and cooling tower
- Make water drain connections
- Install AHU and FCU
- Balancing the system (Air / Water)

### List of Tools, Equipment and Machinery

Sr. No	Description
1	Personal Protective Equipment
2	Basic Measuring tools



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<b>3</b>	Basic Hand tools
<b>4</b>	Basic Cutting tools
<b>5</b>	Basic Power tools
<b>6</b>	Basic Marking tools
<b>7</b>	Basic Electric tools
<b>8</b>	Gas Welding Set with All Accessories
<b>9</b>	Nitrogen Gas Cylinder with Hose Pipe, Regulator and Back Arrestor
<b>10</b>	Tube Cutter
<b>11</b>	Electric Hand Grinder
<b>12</b>	Digital Air Flow / Velocity Meter
<b>13</b>	Electronic Leak Detector
<b>14</b>	Spirit Level
<b>15</b>	Digital Multi Meter
<b>16</b>	Digital Clamp-On Ampere Meter
<b>17</b>	HILTI Drill Machine (Piston Type)
<b>18</b>	Digital Optical Tachometer
<b>19</b>	Megohmmeter (0 - 1000 Volts)
<b>20</b>	Digital Capacitor Analyzer
<b>21</b>	Digital Pressure Gauges Set (High & Combine)
<b>22</b>	Flaring and Swaging Tool Kit
<b>23</b>	Vacuum Pump 2-Stage, 6cfm
<b>24</b>	Tube Benders (Spring Type and Pulley Bender Type)
<b>25</b>	Laser Distance Measuring Device
<b>26</b>	Laser Temperature Measuring Device



## National Competency Standards Level-5 for “HVACR”



### 0713E&E-68. Repair and 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’s 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 student work.

Competency Units	Performance Criteria
1. Diagnose Fault in Central Air Conditioning System	<p><b>P1.</b> Adopt Occupational Safety and Health (OSH) procedures to avoid hazards and accidents at workplace.</p> <p><b>P2.</b> Check for obvious problem to determine which component or system is causing the problem</p> <p><b>P3.</b> Select tools, equipment and related accessories according to requirements and standards.</p> <p><b>P4.</b> Arrange drawings and manuals of the equipment to be attended for fault diagnose</p> <p><b>P5.</b> Check the power supply, electric wiring, electric / electronic components and refrigerant pressure to determine the exact problem and record the results</p> <p><b>P6.</b> Eliminate the causes of the problem according to the manufacturer’s manual and standards.</p> <p><b>P7.</b> Start the air conditioning unit and recheck as specified in the manufacturer’s manual and record the results</p>
2. Repairing of Air Handling Unit (AHU) / Fan Coil Unit (FCU)	<p><b>P1.</b> Adopt Occupational Safety and Health (OSH) procedures to avoid hazards and accidents at workplace.</p> <p><b>P2.</b> Select tools, equipment and related accessories according to job requirements</p> <p><b>P3.</b> System shut down and follow the manual instructions for rectification</p> <p><b>P4.</b> Rectify the faults as per diagnosed, repair / replace the components, as necessary</p> <p><b>P5.</b> Switch on the system to check the performance of electrical / mechanical components as specified in the manufacturer’s manual and record the results</p>
3. Maintain Cooling Tower	<p><b>P1.</b> Adopt Occupational Safety and Health (OSH) procedures to avoid hazards and accidents at workplace.</p> <p><b>P2.</b> Select tools, equipment and related accessories</p>



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	<p>according to job requirements</p> <p><b>P3.</b> System shut down and follow the manual instructions for rectification</p> <p><b>P4.</b> Check Air purge valve and water level of cooling tower</p> <p><b>P5.</b> Check the fan assembly, to check the bearings and motor abnormalities according to manufacturer’s specifications and HVAC standards.</p> <p><b>P6.</b> Check the float valves and strainers to maintain water level</p> <p><b>P7.</b> Perform chemical treatment to prevent the sludge / scaling problems according to manufacturer’s specifications and HVAC standards.</p> <p><b>P8.</b> Condenser / chilled water pumps start and check their performance according to their specifications, service / repair, if necessary</p> <p><b>P9.</b> Clean the sprinkler assembly, water pan from leaves, mud, and scale, if any.</p> <p><b>P10.</b> Rectify the fault and restart the cooling tower unit.</p>
<b>4. Repair Control System</b>	<p><b>P1.</b> Adopt Occupational Safety and Health (OSH) procedures to avoid hazards and accidents at workplace.</p> <p><b>P2.</b> Select tools, equipment and related accessories according to job requirements</p> <p><b>P3.</b> System shut down and follow the manual instructions for rectification</p> <p><b>P4.</b> Arrange drawings and manuals of the equipment to be attended for fault diagnose</p> <p><b>P5.</b> Check the details of fault / errors on computer screen to rectify the same</p> <p><b>P6.</b> Eliminate the causes of the problem according to the manufacturer’s manual and standards.</p> <p><b>P7.</b> Isolate and recheck the causes of the problem and correct the fault</p> <p><b>P8.</b> Start the air conditioning unit and recheck as specified in the manufacturer’s manual and record the results</p>

### Knowledge & 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:

- Regulations of American Society of Heating, Refrigeration and Air Conditioning Engineers (ASHRAE)
- HVACR and Electrical / Electronic components
- Technical Operations of Chillers, Cooling Tower, Pumps, AHUs & FCUs



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- Types of electrical controls, wires and cables, including underground cables, their ratings and its applications
- Techniques of Diagnose and Troubleshooting of central Air conditioning systems
- Capable to replace PCB Cards and controls
- PLC and Microprocessor
- Methods of Copper Tube cutting, Bending, Swaging, Flaring, Brazing, Jointing and fixing
- 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
- Uses & 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 motors and other parts & Accessories
  - Replace the controls
  - Replace water pump
  - Replace motorized actuators

### List of Tools, Equipment and Machinery

Sr. No	Description
1	Personal Protective Equipment
2	Basic Measuring tools
3	Basic Hand tools
4	Basic Cutting tools
5	Basic Power tools
6	Basic Marking tools



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7	Basic Electric tools
8	Gas Welding Set with All Accessories
9	Nitrogen Gas Cylinder with Hose Pipe, Regulator and Back Arrestor
10	Tube Cutter
11	Electric Hand Grinder
12	Digital Air Flow / Velocity Meter
13	Electronic Leak Detector
14	Spirit Level
15	Digital Multi Meter
16	Digital Clamp-On Ampere Meter
17	HILTI Drill Machine (Piston Type)
18	Digital Optical Tachometer
19	Megohmmeter (0 - 1000 Volts)
20	Digital Capacitor Analyzer
21	Digital Pressure Gauges Set (High & Combine)
22	Flaring and Swaging Tool Kit
23	Vacuum Pump 2-Stage, 6cfm
24	Tube Benders (Spring Type and Pulley Bender Type)
25	Laser Distance Measuring Device
26	Laser Temperature Measuring Device





## National Competency Standards Level-5 for “HVACR”



### 0713E&E-69. Service and maintain Ceiling Mounted Cassette Type Air Conditioner

#### Overview

This Competency Standard identifies the competencies required to repair Cassette type Air Conditioners using specified tools, test & measuring instruments. It includes preparing unit, tools and workplace, checking and identifying defects and repairing of cassette type air conditioning units to provide you the basis for student work.

Competency Units	Performance Criteria
<b>1. Prepare for service and maintenance Cassette type Air Conditioner</b>	<p><b>P1.</b> Observe safe work practices and personal protective equipment (PPE) worn as required for the work to be performed.</p> <p><b>P2.</b> Identify necessary tools and equipment in line with job requirements</p> <p><b>P3.</b> Select necessary materials as per job requirement</p> <p><b>P4.</b> Clean and assemble materials for package type Air conditioner as per work standards.</p>
<b>2. Check and Identify fault</b>	<p><b>P1.</b> Observe systematic Test and Checking in accordance with manufacturer’s instruction.</p> <p><b>P2.</b> Check components of the Air-flow system according to manufactures specifications to ensure correct performance</p> <p><b>P3.</b> Test system pressure with dry nitrogen using specified equipment following safety procedures.</p> <p><b>P4.</b> Check motor terminals using specified testing procedures</p> <p><b>P5.</b> Check motor settings/adjustments in conformity with service-manual specifications.</p> <p><b>P6.</b> Check components of refrigeration and electrical / electronic circuit according to standard procedures.</p> <p><b>P7.</b> Identify system defects/fault symptoms and document using appropriate tools and equipment.</p>
<b>3. Servicing / Maintenance of package type air conditioner</b>	<p><b>P1.</b> Replace defective components with identical or recommended appropriate equivalent ratings</p> <p><b>P2.</b> Perform control settings/adjustments in conformity with service-manual specifications</p> <p><b>P3.</b> Clean air filter and evaporator fins with approved cleaning agent</p> <p><b>P4.</b> Evacuate system by using high vacuum pump and charge required refrigerant (if needed) according to manufacturer instructions.</p> <p><b>P5.</b> Charge refrigerant using specified type of refrigerant by charging equipment to required specification</p>



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	following safety practices. <b>P6.</b> Perform cleaning of unit in accordance with standard procedures <b>P7.</b> Operate and check unit to ensure satisfactory performance according to manufactures specifications
<b>4. Clean and store of tools and equipment</b>	<b>P1.</b> Clean and maintain tools and equipment as per instruction manual <b>P2.</b> Clean workplace in accordance with environmental requirement <b>P3.</b> Store tools and equipment safely in appropriate location according to standard workshop procedure.

### 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:

- Hazards that are most likely to cause harm
- Identification and use of Personal Protective Equipment (PPE)
- American Society of Heating, Refrigeration and Air Conditioning Engineers (ASHRAE)
- Different types of electric motors
- Working principles of different types of electric motors
- Ohm meter, Voltmeter and Ampere meter use
- 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:

- Diagnose faults of Ceiling Mounted Cassette Type Air Conditioner by using specified tools and instruments
- Repair refrigerant leaks
- Replace the motors and other electric parts & Accessories
- Clean drains





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### List of Tools, Equipment and Machinery

<i>Sr. No</i>	<i>Description</i>
1	Personal Protective Equipment
2	Basic Measuring tools
3	Basic Hand tools
4	Basic Cutting tools
5	Basic Power tools
6	Basic Marking tools
7	Basic Electric tools
8	Gas Welding Set with All Accessories
9	Nitrogen Gas Cylinder with Hose Pipe, Regulator and Back Arrestor
10	Tube Cutter
11	Electric Hand Grinder
12	Digital Air Flow / Velocity Meter
13	Electronic Leak Detector
14	Spirit Level
15	Digital Multi Meter
16	Digital Clamp-On Ampere Meter
17	HILTI Drill Machine (Piston Type)
18	Digital Optical Tachometer
19	Megohmmeter (0 - 1000 Volts)
20	Digital Capacitor Analyzer
21	Digital Pressure Gauges Set (High & Combine)
22	Flaring and Swaging Tool Kit
23	Vacuum Pump 2-Stage, 6cfm
24	Tube Benders (Spring Type and Pulley Bender Type)



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<b>25</b>	Laser Distance Measuring Device
<b>26</b>	Laser Temperature Measuring Device



## National Competency Standards Level-5 for “HVACR”



### 0713E&E-70. Service and Maintain Cooling Tower

#### Overview

This Competency Standard identifies the competencies required to understand, operate & maintain cooling towers/evaporative condenser used in hydronic systems of HVAC units. His underpinning knowledge regarding servicing and maintenance of cooling tower will be sufficient to provide the basis for his work.

Competency Units	Performance Criteria
<b>1. Undertake preventive maintenance checks</b>	<p><b>P1.</b> Understand the legislative requirements.</p> <p><b>P2.</b> Identify the system components.</p> <p><b>P3.</b> Inspect and test the operational function of each component.</p> <p><b>P4.</b> Assess the correct operation of each component against specification.</p> <p><b>P5.</b> Test and visual inspection with appropriate test equipment are carried out according to refrigeration principles, procedures and safety requirements.</p> <p><b>P6.</b> Preventative maintenance tasks are performed to manufacturers' specifications using refrigeration techniques and practices.</p> <p><b>P7.</b> Remove the fills.</p>
<b>2. Undertake fault finding on cooling tower/evaporative condenser water systems components</b>	<p><b>P1.</b> Identify the system components correctly.</p> <p><b>P2.</b> Assess the correct operation of each component against specification.</p> <p><b>P3.</b> Understand the characteristics and operation of each component.</p> <p><b>P4.</b> Calculate the tower approach</p> <p><b>P5.</b> Calculate the tower range.</p> <p><b>P6.</b> Calculate the Ph value of tower water.</p>
<b>3. Repair/replace cooling tower/evaporative condenser components</b>	<p><b>P1.</b> Inspect and test of faulty components are localised, and malfunction is confirmed by using refrigeration principles, procedures and safety requirements.</p> <p><b>P2.</b> Dismantle and repair the faulty components to manufactures' specifications as required.</p> <p><b>P3.</b> Replace parts selected from manufacturers' or other catalogues according to required specifications.</p> <p><b>P4.</b> Recover refrigerant by following refrigeration principles and procedures to all relevant standards, codes and safety standards.</p>



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### 4. Recheck the system after repair/ servicing.

- P1.** Test for correct operation against specification.
- P2.** Charge refrigerant to system, following refrigeration principles and procedures to all relevant standards, codes and safety standards.
- P3.** Use refrigeration principles and system application, correct operation of the equipment is verified.
- P4.** Maintenance records/service reports are completed by appropriate designated means.

### 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:

- Ozone Protection and Synthetic Greenhouse Gas Management Act 1989
- American Society of Heating, Refrigeration and Air Conditioning Engineers (ASHRAE)
- HVACR, Electrical and Electronics control
- Technical Operations and operation of Control
- Terminology of cooling towers
- Sling Psychrometer and measure the properties of air through Psychrometric chart
- Measuring instruments/equipment, specifications and procedures for checking temperature(s)/humidity/air flow
- Terminology operation and field testing of centrifugal water pumps
- Operation of water valves including bypass valve either mechanical or electrical operation
- Procedures for testing of fan motors V-belts
- Measuring instruments/equipment, specifications and procedures for checking component noise and vibration levels
- Procedures for reporting non-conformances
- Procedures and sequence for performing preventative maintenance on refrigeration and air conditioning systems
- Specifications, operational characteristics and process for identifying system components
- Process for localizing and confirming faulty components
- Procedures and all legislative and regulatory requirements for safely removing the refrigerant and charging the system
- Procedures for dismantling, repairing, reassembling and testing components
- Procedure for removal/recharging refrigerant
- Procedures for selecting replacement parts
- Procedures for completing maintenance records/service reports



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- 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:

- Check & Visually inspect the tower
- Replace fills (Filling Material)
- Replace fan motor and float valve
- Calculate tower range & approach
- Calculate PH value of tower water
- Perform make up water and bleed off process

### List of Tools, Equipment and Machinery

Sr. No	Description
1	Personal Protective Equipment
2	Basic Measuring tools
3	Basic Hand tools
4	Basic Cutting tools
5	Basic Power tools
6	Basic Marking tools
7	Basic Electric tools
8	Gas Welding Set with All Accessories
9	Nitrogen Gas Cylinder with Hose Pipe, Regulator and Back Arrestor
10	Tube Cutter
11	Electric Hand Grinder
12	Digital Air Flow / Velocity Meter
13	Electronic Leak Detector
14	Spirit Level
15	Digital Multi Meter
16	Digital Clamp-On Ampere Meter



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17	HILTI Drill Machine (Piston Type)
18	Digital Optical Tachometer
19	Megohmmeter (0 - 1000 Volts)
20	Digital Capacitor Analyzer
21	Digital Pressure Gauges Set (High &Combine)
22	Flaring and Swaging Tool Kit
23	Vacuum Pump 2-Stage, 6cfm
24	Tube Benders (Spring Type and Pulley Bender Type)
25	Laser Distance Measuring Device
26	Laser Temperature Measuring Device



## National Competency Standards Level-5 for “HVACR”



### 0713E&E-71. 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’s 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 student work.

Competency Units	Performance Criteria
<b>1. Calibrate and use the Measuring Instruments</b>	<b>P1.</b> Adopt Occupational Safety and Health (OSH) procedures to avoid hazards and accidents at workplace. <b>P2.</b> Shut down the system if necessary and dismantle measuring instruments <b>P3.</b> Select and arrange tools, equipment and related accessories according to job requirements / sequence of operation <b>P4.</b> Calibrate the instruments following the manufacturer’s instructions <b>P5.</b> Reinstall measuring instruments and start the system to check the performance of calibrated instrument as specified by the manufacturer’s <b>P6.</b> Record the output result of measuring instrument for future reference <b>P7.</b> Follow HVACR standards to complete the job
<b>P2. Carry out Maintenance</b>	<b>P1.</b> Adopt Occupational Safety and Health (OSH) procedures to avoid hazards and accidents at workplace. <b>P2.</b> Pump down / Shut down the system if necessary <b>P3.</b> Select and arrange tools, equipment and material according to job requirements / sequence of operation <b>P4.</b> Check different machines with measuring instruments for temperature, vibration and noise, etc. to operate the plant at design efficiency <b>P5.</b> Carry out weekly / monthly / annual maintenance according to schedule <b>P6.</b> Check and record the performance of system after maintenance <b>P7.</b> Follow HVACR standards to complete the job

#### Knowledge and Understanding



## National Competency Standards Level-5 for “HVACR”



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:

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

- Prepare maintenance schedule and log sheets
- Replace specific parts
- Prepare reports (Report writing)

### List of Tools, Equipment and Machinery

Sr. No	Description
1	Personal Protective Equipment
2	Basic Measuring tools
3	Basic Hand tools
4	Basic Cutting tools
5	Basic Power tools
6	Basic Marking tools
7	Basic Electric tools
8	Gas Welding Set with All Accessories
9	Nitrogen Gas Cylinder with Hose Pipe, Regulator and Back Arrestor





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<b>10</b>	Tube Cutter
<b>11</b>	Electric Hand Grinder
<b>12</b>	Digital Air Flow / Velocity Meter
<b>13</b>	Electronic Leak Detector
<b>14</b>	Spirit Level
<b>15</b>	Digital Multi Meter
<b>16</b>	Digital Clamp-On Ampere Meter
<b>17</b>	HILTI Drill Machine (Piston Type)
<b>18</b>	Digital Optical Tachometer
<b>19</b>	Megohmmeter (0 - 1000 Volts)
<b>20</b>	Digital Capacitor Analyzer
<b>21</b>	Digital Pressure Gauges Set (High & Combine)
<b>22</b>	Flaring and Swaging Tool Kit
<b>23</b>	Vacuum Pump 2-Stage, 6cfm
<b>24</b>	Tube Benders (Spring Type and Pulley Bender Type)
<b>25</b>	Laser Distance Measuring Device
<b>26</b>	Laser Temperature Measuring Device



## National Competency Standards Level-5 for “HVACR”



### 0713E&E-72. Diagnose faults in complex HVAC control system

#### Overview

This Competency Standard covers the competencies required to diagnosing and rectifying faults in complex HVAC / refrigeration control systems. Your underpinning knowledge regarding interpreting technical data, applying knowledge of complex HVACR control systems operating parameters to logical fault-finding processes, implementing fault rectification, safety and functional testing and reporting work activities and outcomes will be enough to provide the basis for student work.

<i>Competency Units</i>	<i>Performance Criteria</i>
<b>1. Prepare to diagnose and rectify faults.</b>	<b>P1.</b> Follow OHS procedures for a given work area <b>P2.</b> Establish OHS risk control measures and procedures and follow in preparation for the work. <b>P3.</b> Determine the extent of faults from reports and other documentation and from discussion with appropriate personnel. <b>P4.</b> Consult appropriate personnel to ensure the work is coordinated effectively with others involved on the work site. <b>P5.</b> Obtain Tools, equipment and testing devices needed to diagnose faults in accordance with established procedures and check for correct operation and safety.
<b>2. Diagnose and rectify faults.</b>	<b>P1.</b> Follow OHS risk control measures and procedures for carrying out the work <b>P2.</b> Check circuits/machines/plant as being isolated where necessary in strict accordance OHS requirements and procedures. <b>P3.</b> Apply logical diagnostic methods to diagnose control system faults employing measurements and estimations of system operating parameters referenced to system operational requirements. <b>P4.</b> Test suspected fault scenarios as being the source of system problems. <b>P5.</b> Identify causes of the faults and engage appropriately competent persons to rectify the fault <b>P6.</b> Rectify faults in components of the system to raise the refrigeration or heating, ventilation air conditioning systems to its operation standard. <b>P7.</b> Test system to verify that the system operates as intended and to specified requirements. <b>P8.</b> Make decisions for dealing with unexpected situations from discussions with appropriate persons and job specifications and requirements.



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	<p><b>P9.</b> Select methods for dealing with unexpected situations based on safety and specified work outcomes.</p> <p><b>P10.</b> Carry out diagnose and rectify activities efficiently without waste of materials or damage to apparatus, surrounding environment / services and using sustainable energy practices.</p>
<b>3.</b> Complete and report fault diagnosis and rectification activities	<p><b>P1.</b> Follow OHS work completion risk control measures and procedures</p> <p><b>P2.</b> Make work site safe in accordance with established safety procedures.</p> <p><b>P3.</b> Document rectification of faults in accordance with established procedures.</p> <p><b>P4.</b> Notify appropriate person / persons, in accordance with established procedures, that the system faults to rectification.</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
- American Society of Heating, Refrigeration and Air Conditioning Engineers (ASHRAE)
- Fundamental 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 of Diagnose 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:

- Check & Visually inspect the tower
- Measure pressure & temperature at different points of HVAC system
- Observe behavior of control and decide its condition



## National Competency Standards Level-5 for “HVACR”



### List of Tools, Equipment and Machinery

Sr. No	Description
1	Personal Protective Equipment
2	Basic Measuring tools
3	Basic Hand tools
4	Basic Cutting tools
5	Basic Power tools
6	Basic Marking tools
7	Basic Electric tools
8	Gas Welding Set with All Accessories
9	Nitrogen Gas Cylinder with Hose Pipe, Regulator and Back Arrestor
10	Tube Cutter
11	Electric Hand Grinder
12	Digital Air Flow / Velocity Meter
13	Electronic Leak Detector
14	Spirit Level
15	Digital Multi Meter
16	Digital Clamp-On Ampere Meter
17	HILTI Drill Machine (Piston Type)
18	Digital Optical Tachometer
19	Megohmmeter (0 - 1000 Volts)
20	Digital Capacitor Analyzer



## ***National Competency Standards Level-5 for “HVACR”***



<b>21</b>	Digital Pressure Gauges Set (High & Combine)
<b>22</b>	Flaring and Swaging Tool Kit
<b>23</b>	Vacuum Pump 2-Stage, 6cfm
<b>24</b>	Tube Benders (Spring Type and Pulley Bender Type)
<b>25</b>	Laser Distance Measuring Device
<b>26</b>	Laser Temperature Measuring Device



## National Competency Standards Level-5 for “HVACR”



### 0713E&E-73. Service and Maintain Automobile Air Conditioner

#### Overview

This Competency Standard covers the competencies required to maintain and service automotive air conditioning Systems. Your underpinning knowledge regarding identification / confirmation of work requirement, Preparation for work, servicing of air conditioning systems, completion of work finalization processes, including clean-up and documentation will be enough to provide the basis for student work.

<i>Competency Units</i>	<i>Performance Criteria</i>
<b>1.</b> Prepare for maintenance of air conditioning system	<b>P1.</b> Observe safe work practices and personal protective equipment (PPE) worn as required for the work performed. <b>P2.</b> Identify and collect necessary tools and equipment in accordance with work requirement. <b>P3.</b> Collect necessary materials in accordance with work requirement. <b>P4.</b> Identify and prepare Technical and/or calibration requirements for servicing sourced and support equipment <b>P5.</b> Handle the refrigerants when observed dangers
<b>2.</b> Conduct test to identify fault	<b>P1.</b> Check air conditioning system components using appropriate tools and techniques. <b>P2.</b> Check amount of refrigerant as per instruction manual <b>P3.</b> Detect damaged components and related electric wiring /ECU operating system according to the standard procedures. <b>P4.</b> Complete the test without causing damage to any work-place property and vehicle. <b>P5.</b> Identify faults/defects for repairing/servicing action based on checking.
<b>3.</b> Repair/service air conditioning system components	<b>P1.</b> Perform system testing and air conditioning service procedures determined. <b>P2.</b> Service the system and components carried out in accordance with manufacturer’s instruction without causing damage to any component or system <b>P3.</b> Replace components of AC system are performing based on faults with identical components. <b>P4.</b> Recover refrigerant according to safe manner. <b>P5.</b> Evacuate the system using high vacuum pump <b>P6.</b> Charging the Refrigerant is performed in accordance with standard procedure. <b>P7.</b> Final testing of auto air conditioning system is carried out to ensure the performance up to the unit



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	standard mentioned in the manual.
<b>4. Clean and store equipment</b>	<b>P1.</b> Perform cleaning of equipment in accordance with workplace expectation <b>P2.</b> Dispose-off waste materials in accordance with workplace requirements. <b>P3.</b> Store tools and equipment safely in appropriate location.

### 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
- American Society of Heating, Refrigeration and Air Conditioning Engineers (ASHRAE)
- Fundamental 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 of Diagnose 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:

- Diagnose faults of Automobile Air Conditioner by using specified tools and instruments
- Repair refrigerant leak in Automobile Air Conditioner
- Replace the compressor and other accessories of unit
- Recharge refrigerant
- Replace belts

### List of Tools, Equipment and Machinery

Sr. No	Description
1	Personal Protective Equipment



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2	Basic Measuring tools
3	Basic Hand tools
4	Basic Cutting tools
5	Basic Power tools
6	Basic Marking tools
7	Basic Electric tools
8	Gas Welding Set with All Accessories
9	Nitrogen Gas Cylinder with Hose Pipe, Regulator and Back Arrestor
10	Tube Cutter
11	Electric Hand Grinder
12	Digital Air Flow / Velocity Meter
13	Electronic Leak Detector
14	Spirit Level
15	Digital Multi Meter
16	Digital Clamp-On Ampere Meter
17	HILTI Drill Machine (Piston Type)
18	Digital Optical Tachometer
19	Megohmmeter (0 - 1000 Volts)
20	Digital Capacitor Analyzer
21	Digital Pressure Gauges Set (High & Combine)
22	Flaring and Swaging Tool Kit
23	Vacuum Pump 2-Stage, 6cfm
24	Tube Benders (Spring Type and Pulley Bender Type)
25	Laser Distance Measuring Device
26	Laser Temperature Measuring Device





## National Competency Standards Level-5 for “HVACR”



### 0713E&E-74. Perform Commissioning of HVAC Systems

#### Overview

This Competency Standard identifies the competencies required to setting-up and adjusting complex (HVAC) heating, ventilation and air conditioning systems for optimum performance. Student underpinning knowledge regarding safe working practices, system parameter testing / analysis, adjusting equipment / controls, following procedures / documenting final operating parameters and settings will be enough to provide the basis for student work.

Competency Units	Performance Criteria
<b>1. Prepare to commission complex heating, ventilation and air conditioning systems</b>	<p><b>P1.</b> Identify and obtain OHS procedures for a given work area</p> <p><b>P2.</b> Establish OHS risk control measures and procedures are follow in preparation for the work.</p> <p><b>P3.</b> Implement safety hazards that have not previously been identified are noted and established risk control</p> <p><b>P4.</b> Consult appropriate personnel to ensure the work is coordinated effectively with others involved on the work site.</p> <p><b>P5.</b> Identify system operating parameters by reviewing system specifications and component technical data.</p> <p><b>P6.</b> Obtain tools, equipment and testing devices needed for the work in accordance with established</p> <p><b>P7.</b> Check procedures for correct operation and safety.</p> <p><b>P8.</b> Check preparatory work to ensure no damage has occurred and complies with requirements.</p> <p><b>P9.</b> Check circuits as being isolated where necessary in strict accordance OHS requirements and procedures</p>
<b>2. Commission complex heating, ventilation and air conditioning systems.</b>	<p><b>P1.</b> Control OHS risk measures and procedures for carrying out the work</p> <p><b>P2.</b> Connect Test / Measure devices and set in accordance with requirements for a system.</p> <p><b>P3.</b> Make measurements and adjustments to equipment components and controls to provide optimum system performance in accordance with system specifications and regulatory requirements.</p> <p><b>P4.</b> Make decisions for dealing with unexpected situations from discussions with appropriate persons and job specifications and requirements.</p> <p><b>P5.</b> Select methods for dealing with unexpected situations based on safety and specified work outcomes.</p> <p><b>P6.</b> Carry out commissioning efficiently without waste of materials or damage to apparatus, the surrounding environment or services and using sustainable energy principles.</p>



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### 3. Completion and report commissioning

- P1.** Follow OHS risk control work completion measures and procedures
- P2.** Clean work site is and make safe in accordance with established procedures.
- P3.** Document adjustment settings and notify an appropriate person or persons in accordance with established procedures.

#### 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
- American Society of Heating, Refrigeration and Air Conditioning Engineers (ASHRAE)
- Fundamental 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 of Diagnose 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:

- Understand system drawing
- Operate HVAC system in order
- Measure pressure and temperature of system

#### List of Tools, Equipment and Machinery

Sr. No	Description
1	Personal Protective Equipment
2	Basic Measuring tools
3	Basic Hand tools



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4	Basic Cutting tools
5	Basic Power tools
6	Basic Marking tools
7	Basic Electric tools
8	Gas Welding Set with All Accessories
9	Nitrogen Gas Cylinder with Hose Pipe, Regulator and Back Arrestor
10	Tube Cutter
11	Electric Hand Grinder
12	Digital Air Flow / Velocity Meter
13	Electronic Leak Detector
14	Spirit Level
15	Digital Multi Meter
16	Digital Clamp-On Ampere Meter
17	HILTI Drill Machine (Piston Type)
18	Digital Optical Tachometer
19	Megohmmeter (0 - 1000 Volts)
20	Digital Capacitor Analyzer
21	Digital Pressure Gauges Set (High & Combine)
22	Flaring and Swaging Tool Kit
23	Vacuum Pump 2-Stage, 6cfm
24	Tube Benders (Spring Type and Pulley Bender Type)
25	Laser Distance Measuring Device
26	Laser Temperature Measuring Device



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## National Competency Standards Level-5 for “HVACR”



### 0713E&E-75. Install and Commission Carbon Dioxide Refrigeration Systems, Components and Accessories

#### Overview

This unit covers specialized procedures for the installation and commissioning to achieve effective and efficient operation of refrigeration equipment using carbon dioxide (CO<sub>2</sub>) as a refrigerant excluding self-contained systems. Student underpinning knowledge regarding safe working practice and encompasses applying specialized knowledge of refrigeration principles that apply to carbon dioxide, following design specifications, testing, locating and rectifying faults and defective components and completing the necessary installation and commissioning documentation will be sufficient to provide the basis for your work.

<i>Competency Units</i>	<i>Performance Criteria</i>
<b>1.</b> Prepare to install major components and associated equipment.	<b>P1.</b> Follow OHS procedures for a given work area and establish OHS risk control measures and procedures in preparation for the work. <b>P2.</b> Obtain the nature of work from documentation or from work supervisor to establish the scope of work to be undertaken. <b>P3.</b> Install component and equipment appropriately sequence in accordance with job schedule. <b>P4.</b> Access sources of materials that may be required for the work in accordance with established routines and procedures <b>P5.</b> Carry out tools, equipment and testing devices needed to the work check for correct operation and safety
<b>2.</b> Install major components and associated equipment.	<b>P1.</b> Follow OHS procedures for a given work area and establish OHS risk control measures and procedures in preparation for the work. <b>P2.</b> Install components and equipment to comply with technical standards, job specifications / requirements with enough access to affect electrical and pipe work connections and maintenance. <b>P3.</b> Install components and equipment straight and square in the required locations and within acceptable tolerances <b>P4.</b> Conduct pressure test at a pressure compatible with carbon dioxide and in accordance with standards <b>P5.</b> Locate leaks and rectify using testing methods appropriate to the system and in accordance with industry practices <b>P6.</b> Evacuate system to the required level and clean all



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	<p>moisture and other contaminants in accordance with industry practices</p> <p><b>P7.</b> Charge system safely with refrigerant grade carbon dioxide and compatible lubricants in accordance with industry practices</p> <p><b>P8.</b> Use establish procedures to determine actual and specified range of operating conditions from measured and calculated values as they apply to carbon dioxide vapor compression and volatile secondary (liquid recirculation/cascade) systems</p> <p><b>P9.</b> Discuss establish methods for dealing with unexpected situations with appropriate person(s) and document.</p> <p><b>P10.</b> Deal unexpected situations with safely and with the approval of an authorized person.</p> <p><b>P11.</b> Determine operating conditions without damage to apparatus, circuits, the surrounding environment / services and using sustainable energy practices.</p>
<p><b>3.</b> Complete Installation and commissioning work and document performance data</p>	<p><b>P1.</b> Follow OHS work completion risk control measures and procedures</p> <p><b>P2.</b> Check installed components and to verify that installed components / equipment is documented and an appropriate person(s) notify in accordance with established procedures.</p> <p><b>P3.</b> Sequence commissioning work appropriately in accordance with job specification</p> <p><b>P4.</b> Consult appropriate personnel to ensure the work is coordinated effectively with others involved on the work site.</p> <p><b>P5.</b> Determine the extent of the system and location of system components from site inspection / job specifications and diagrams</p> <p><b>P6.</b> Determine system control settings and operating parameters from job specifications and requirements</p> <p><b>P7.</b> Check pre commissioning parameters to ensure all components are in place and secure</p> <p><b>P8.</b> Test / measure a live operating CO<sub>2</sub> system in strict accordance with OHS requirements and when necessary conducted within established safety procedures.</p> <p><b>P9.</b> Adjust Carbon Dioxide refrigeration system pressure controls, valves, pumps and regulators to their required settings.</p> <p><b>P10.</b> Use Testing /measuring devices to observe the operation of refrigeration system and fine adjustments of controls are made as necessary.</p> <p><b>P11.</b> Establish methods for dealing with unexpected situations discuss with appropriate person(s) and document.</p>



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- P12.** Deal unexpected situations with safely and with the approval of an authorized person.
- P13.** Perform commissioning efficiently without waste of materials or damage to apparatus and the surrounding environment or services and using sustainable energy practices
- P14.** Clean work site and make safe in accordance with established procedures
- P15.** Document results of commissioning including final operating parameters of the system.

### 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
- American Society of Heating, Refrigeration and Air Conditioning Engineers (ASHRAE)
- Fundamental of HVACR, Electrical and Electronics control
- Technical Operations of Control
- Refrigerants and its properties
- Carbon dioxide gas working pressure and temperatures in different conditions
- Types of electrical wires and cables, their ratings and its applications
- Purpose / Advantages of preventive maintenance
- Techniques of Diagnose 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:

- Understand system drawing
- Install components according to specification
- Operate HVAC system in order
- Measure pressure and temperature of system
- Observe system behavior

### List of Tools, Equipment and Machinery



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Sr. No	Description
1	Personal Protective Equipment
2	Basic Measuring tools
3	Basic Hand tools
4	Basic Cutting tools
5	Basic Power tools
6	Basic Marking tools
7	Basic Electric tools
8	Gas Welding Set with All Accessories
9	Nitrogen Gas Cylinder with Hose Pipe, Regulator and Back Arrestor
10	Tube Cutter
11	Electric Hand Grinder
12	Digital Air Flow / Velocity Meter
13	Electronic Leak Detector
14	Spirit Level
15	Digital Multi Meter
16	Digital Clamp-On Ampere Meter
17	HILTI Drill Machine (Piston Type)
18	Digital Optical Tachometer
19	Megohmmeter (0 - 1000 Volts)
20	Digital Capacitor Analyzer
21	Digital Pressure Gauges Set (High & Combine)
22	Flaring and Swaging Tool Kit
23	Vacuum Pump 2-Stage, 6cfm
24	Tube Benders (Spring Type and Pulley Bender Type)
25	Laser Distance Measuring Device





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**26** Laser Temperature Measuring Device



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### 0713E&E-76. Operate & Maintain Absorption Air Conditioning System

#### Overview

This Competency Standard covers the competencies required to operate and maintain Direct Fired absorption air conditioning system in accordance with the manufacturer’s specifications / guidelines. This unit covers the knowledge regarding operation and maintenance of absorption air conditioning system to provide you the basis for student work.

Competency Units	Performance Criteria
1. Preventive Maintenance Requirements Refrigerant Side	<p><b>P1.</b> Check solution chemical analysis (add inhibitors as needed)</p> <p><b>P2.</b> Check refrigerant specific gravity</p> <p><b>P3.</b> Check proper solution levels "adjust quantity &amp; add if required'</p> <p><b>P4.</b> Check proper concentration level octyl &amp; alcohol</p>
2. Perform Preventive Maintenance Safety Controls	<p><b>P1.</b> Check low refrigerant cut-out switch</p> <p><b>P2.</b> Check chilled &amp; condenser water flow switches.</p> <p><b>P3.</b> Check hot water flow switches</p> <p><b>P4.</b> Check HP1 + HP2 (20G direct fired units) high press. &amp; temp. cut-out switches</p> <p><b>P5.</b> Check correct HT1 - High temperature cut-out switch</p> <p><b>P6.</b> Perform to check &amp; rectify low solution level cut-out switch abnormality.</p> <p><b>P7.</b> Perform adoption for accuracy check of thermistors T and transducers</p> <p><b>P8.</b> Perform adoption of right procedure for accuracy check of Condenser T Pressure Gauge</p>
3. Perform Preventive Maintenance Mechanical Parts & System	<p><b>P1.</b> Inspect pump bearing and seal wear, repair / replace if necessary</p> <p><b>P2.</b> Inspection pump Contactors repair / replace if necessary</p> <p><b>P3.</b> Check average skin temperatures T of pumps for adoption of correct</p> <p><b>P4.</b> Check amperage of purge pump for correct operating</p> <p><b>P5.</b> Determine to proceed ultimate vacuum of Purge Pump</p> <p><b>P6.</b> Check accuracy of manometer or Vacuum Gauge for Implementation</p> <p><b>P7.</b> Check Procedure for proper operation of purge educator</p> <p><b>P8.</b> Estimate submitted to superior / client and approval</p>



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	obtained
<b>4.</b> Prepare Sequence for Chillers Piping Preventive Maintenance for Right Operation.	<b>P1.</b> Inspect and brush to clean evaporator, absorber & Maintenance condenser tubes <b>P2.</b> Inspect and brush to clean evaporator, water Heat Exchanger Chamber & tubes. <b>P3.</b> Inspect absorber and condenser tubes (after brush cleaning) for Eddy current and boro scope <b>P4.</b> Inspect hot water heat exchanger tubes and gather requirements of Eddy current and boro scope <b>P5.</b> Check proper steam valve modulation and design steam entering / blocking situation.
<b>5.</b> Select Right Sequence for DFA Chillers Burners &Trains Operation.	<b>P1.</b> Perform safety test - Spark Pick-Up <b>P2.</b> Test Power & Performance of burner fan air proving switch.  <b>P3.</b> Check all Requirements of Combustion air Check to make sure that all sources remain clear and open to ensure safe operation. <b>P4.</b> Inspect for leakage through pilot and main solenoid or motorized valve(s) <b>P5.</b> Inspect for wear of main and pilot gas pressure regulators Combustion analysis ratios, combustion efficiency. <b>P6.</b> Perform test of high pressure and low-pressure gas switches <b>P7.</b> Inspection oil nozzle wear - Replace Fired Units / nozzle if necessary <b>P8.</b> Inspect for wear of oil solenoid and main oil modulating valve(s) to conduct performance test <b>P9.</b> Inspect oil pump unit with Checking for clogging of oil strainer and Leak test of piping (visual observation) <b>P10.</b> Determine and record oil consumption (Charts or Flow Meter) with performance test of oil pressure cutout switch (Refer to burner documentation)

### 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:

- Hazards that are most likely to cause harm
- Identification and use of Personal Protective Equipment (PPE)
- American Society of Heating, Refrigeration and Air Conditioning Engineers (ASHRAE)



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- Define air conditioning systems
- Define absorption air conditioning system
- Identification refrigerant contamination
- Functions of pressure control switches
- Functions of pressure Gas switches
- Combustion analysis
- Types of maintenance
- Preventive maintenance
- Direct Fire Absorption (DFA) chillers
- 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:

- Observe system behavior
- Follow start up and shut down order of system
- Firing order
- Check & replace controls

### List of Tools, Equipment and Machinery

Sr. No	Description
1	Personal Protective Equipment
2	Basic tool Kit



## National Competency Standards Level-5 for “HVACR”



### 0713E&E-77. Check and Inspect Air Washer System in Respect of Preventive Maintenance

#### Overview

This Competency Standard covers the competencies required to check and inspect air washer system in respect of preventive maintenance in accordance with the manufacturer’s specifications / guidelines. This unit covers the knowledge regarding preventive maintenance of air washer system to provide you the basis for student work.

Competency Units	Performance Criteria
<b>1. Perform Preventive Maintenance of Chiller Operation</b>	<p><b>P1.</b> Check Visual Traces of Leakages on Water &amp; Refrigerant Circuits with Sight Glass Level verifications.</p> <p><b>P2.</b> Visual Traces of Oil Leakages, Sight Glass Level for Right Oil presence</p> <p><b>P3.</b> Check Proper operation of oil return valve &amp; its operation during cycle &amp; at Part Load.</p> <p><b>P4.</b> Check Sump Heater &amp; its thermostat. Perform Water Analysis for Chilled &amp; Condenser Side and to choose right water cleaning and softening skills.</p>
<b>2. Perform Preventive Maintenance on Safety Control Performance</b>	<p><b>P1.</b> Check voltage across each electrical phase &amp; check of any abnormality on Connection Tightness or Carbon Presence.</p> <p><b>P2.</b> Check Chilled / Condenser Water Sensors &amp; flow switches and its right values presentation on Interface Panel</p> <p><b>P3.</b> Check Condenser Water Temperature &amp; Flow Sensor / Switches and presentation on interface Panel.</p> <p><b>P4.</b> Check High and Low Press. &amp; Temp. Cutout Switches.</p> <p><b>P5.</b> Adopt procedure for accuracy check of thermistors and transducers values with interface.</p> <p><b>P6.</b> Adopt right Procedure for accuracy check of Condenser Pressure and Temperature Gauges</p> <p><b>P7.</b> Perform Eddy current test and inspection of tubes with proper cleaning procedure implementation.</p>
<b>3. Perform Preventive Maintenance of Mechanical Parts &amp; System</b>	<p><b>P1.</b> Inspect Main Bearing, Bolts and Seal wear</p> <p><b>P2.</b> Inspect motor Margining &amp; Tolerance Levels.</p> <p><b>P3.</b> Adopt Correct Check for average skin temperatures of Compressor Motor &amp; VFD Temperatures.</p> <p><b>P4.</b> Check for operating amperage of Chiller on Full &amp;</p>



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	<p>Part Load Scenario.</p> <p><b>P5.</b> Determine Oil Supply &amp; Return Filter Clogging state &amp; Replacement Procedure.</p> <p><b>P6.</b> Inspect &amp; Replace starter Coolant &amp; Air Filters.</p> <p><b>P7.</b> Check draining / Purge out Refrigerant and Oil for analysis &amp; Lube Oil.</p> <p><b>P8.</b> Perform different vibration Test for Motor, Bearing and Foundation to avoid abnormal sound &amp; parts breaking.</p>
<b>4. Perform preventive Maintenance for Right Operation of HVACR system.</b>	<p><b>P1.</b> Inspect and brush clean evaporator, Condenser &amp; Maintenance Heat Exchanger Baffles.</p> <p><b>P2.</b> Inspect and brush clean evaporator, water Heat Exchanger Chamber &amp; tubes.</p> <p><b>P3.</b> Perform Eddy current and borescope tests on condenser tubes (after brush cleaning)</p> <p><b>P4.</b> Check for different valve modulation and design flow entering / blocking situation</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:

- Hazards that are most likely to cause harm to health and safety with HVAC tools
- Identification and use of Personal Protective Equipment (PPE)
- American Society of Heating, Refrigeration and Air Conditioning Engineers (ASHRAE)
- Air conditioning systems
- Absorption air conditioning system
- Identify refrigerant contamination
- Functions of pressure control switches
- Functions of pressure Gas switches
- Combustion analysis
- Types of maintenance
- Preventive maintenance
- Direct Fire Absorption (DFA) chillers
- Record keeping and reporting

### Critical Evidence(s) Required

The candidate needs to produce following critical evidence(s) in order to be competent in



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this competency standard:

- Prepare schedule and log sheet
- Observe system behavior
- Check & Inspect piping arrangement
- Check flow of secondary refrigerant
- Replace filters and belts

### List of Tools, Equipment and Machinery

Sr. No	Description
1	Personal Protective Equipment
2	Basic tool Kit
3	Bearing Puller
4	Digital Air Flow / Velocity Meter
5	Digital Optical Tachometer
6	Electronic Leak Detector
7	Laser Distance Measuring Device
8	Laser Temperature Measuring Device
9	Megohmmeter (0 - 1000 Volts)
10	Digital Capacitor Analyzer



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### 0713E&E-78. Check and Inspect Central Air Conditioning system

#### Overview

This Competency Standard covers the competencies required to check and inspect central air conditioning system in accordance with the manufacturer’s specifications / guidelines. This unit covers the knowledge regarding checking and inspecting of central air conditioning system to provide you the basis for student work.

Competency Units	Performance Criteria
<b>1. Identify the central Air conditioning system for operation / maintenance</b>	<p><b>P1.</b> Check electrical source of supply and supply being within the requirements.</p> <p><b>P2.</b> Check and ensure availability of continuous supply of good quality of water to the cooling tower &amp; expansion tank.</p> <p><b>P3.</b> Check Cooling tower and water treatment systems and ensure their satisfactory performance</p> <p><b>P4.</b> Check Water pumps, cooling towers and condensing units for their satisfactory performance and necessary adjustments done.</p> <p><b>P5.</b> Check Compressor and change oil as specified by manufacturer</p> <p><b>P6.</b> Clean, service and replace Electrical controls and panels, as necessary, according to instructions of manufacturer.</p> <p><b>P7.</b> Check and ensure Control devices and safety devices for operational parameters</p> <p><b>P8.</b> Record and interpret Chiller different readings</p>
<b>2. Start &amp; operate the central chilled water air conditioning system</b>	<p><b>P1.</b> Follow operational manual and other operational guidelines provided by manufacturer for operating plant.</p> <p><b>P2.</b> Check air purge valve and water level of cooling tower.</p> <p><b>P3.</b> Start, check and ensure Cooling tower fans operation</p> <p><b>P4.</b> Check attend unusual noises and ensure correct performance of cooling tower fans.</p> <p><b>P5.</b> Start Condenser cooling water pumps, check their performance and carry out servicing / repairs as necessary</p> <p><b>P6.</b> Start Chilled water pumps, check their performance and carry out servicing/or repairs as necessary.</p> <p><b>P7.</b> Carry out necessary servicing of air side equipment</p> <p><b>P8.</b> Check start up procedure and start chiller</p> <p><b>P9.</b> Take and record temperature readings at all places</p>





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	<p>of air-conditioned space.</p> <p><b>P10.</b> Check main plant, take readings at regular intervals and record in operational log sheets</p> <p><b>P11.</b> Shut down System as recommended by the manufacturer</p>
<b>3. Start &amp; operate the chilled water central air conditioning system (with air cooled condenser)</b>	<p><b>P1.</b> Provide and interpret instructions on starting operations and other operational guidelines provided by manufacturer.</p> <p><b>P2.</b> Follow steps outlined in manufacturer’s guidelines for starting and operating unit as specified.</p> <p><b>P3.</b> Start condenser fans, and check their performance to ensure proper performance</p> <p><b>P4.</b> Check and inform abnormal noises and vibrations in condenser fans</p> <p><b>P5.</b> Start chilled water pumps, check their performance and carry out servicing / or repairs as necessary.</p> <p><b>P6.</b> Carry out necessary servicing of air side equipment for correct operational parameters</p> <p><b>P7.</b> Take and record temperature readings at all places of air-conditioned space.</p> <p><b>P8.</b> Check main plant, take readings at regular intervals and record in operational log sheets</p> <p><b>P9.</b> Pump down / stop system as recommended by the manufacture.</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:

- Hazards that are most likely to cause harm
- Identification and use of Personal Protective Equipment (PPE)
- American Society of Heating, Refrigeration and Air Conditioning Engineers (ASHRAE)
- Different types of electric motors
- Working principles of different types of electric motors
- Electric controls and panels
- Pressure and pressure laws
- Temperature and its units
- Ohm meter, Voltmeter and Ampere meter use



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- Cooling tower and its types
- Working principle of cooling tower
- Control devices and safety devices for operational parameters
- Pumps and its types
- Compressors and function of compressors
- Air purge valves
- Fans and its types
- Vibration and abnormal noises of electrical devices and machinery
- 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:

- Read and understand drawings
- Balancing the system (Air / Water)
- Observe system behavior
- Check compressor and pumps
- Check & Inspect piping arrangement
- Check flow of secondary refrigerant
- Replace filters and belts

### List of Tools, Equipment and Machinery

Sr. No	Description
1	Personal Protective Equipment
2	Basic tool Kit
3	db. meter
4	Digital Air Flow / Velocity Meter
5	Digital Optical Tachometer
6	Electronic Leak Detector
7	Laser Distance Measuring Device



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<b>8</b>	Laser Temperature Measuring Device
<b>9</b>	Megohmmeter (0 - 1000 Volts)
<b>10</b>	Digital Capacitor Analyzer



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### 0713E&E-79. Install and Commission Ammonia Refrigeration System, Components & Accessories

#### Overview

This Competency Standard covers the competencies required to install and commission ammonia refrigeration system components & accessories in accordance with the manufacturer’s specifications / guidelines. This unit covers the knowledge regarding installation and commissioning of ammonia refrigeration system to provide you the basis for student work.

<i>Competency Units</i>	<i>Performance Criteria</i>
<b>1.</b> Prepare to install and commission Ammonia refrigeration systems	<b>P1.</b> Identify and obtain OHS procedures for a given work area through established routines and procedures <b>P2.</b> Follow established OHS risk control measures and procedures in preparation for the work. <b>P3.</b> Seek advice on risk control measures from the project engineer for safety hazards which have not previously been identified <b>P4.</b> Obtain the nature of work from documentation or from project engineer to establish the scope of work to be undertaken. <b>P5.</b> Seek advice from the project engineer to ensure the work is coordinated effectively with others. <b>P6.</b> Access sources of material that may be required for the work in accordance with established routines and procedures.
<b>2.</b> Install and Commission Ammonia refrigeration systems.	<b>P1.</b> Follow established OHS risk control measures and procedures for carrying out the work. <b>P2.</b> Conduct measuring system operating parameters in strict accordance with OHS requirements and established safety procedures <b>P3.</b> Install major components and pipe work in compliance with all applicable Standards, Codes and Regulations <b>P4.</b> Conduct pressure testing at a pressure compatible with Ammonia and in accordance with applicable standards <b>P5.</b> Take precautions to prevent damage to components while pressure testing the system <b>P6.</b> Locate and rectify Leaks using testing methods appropriate to the system and in accordance with industry practice <b>P7.</b> Evacuate system in accordance with industry practices.



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	<p><b>P8.</b> Charge system safely with Ammonia and lubricants in accordance with industry practices</p> <p><b>P9.</b> Carry out preoperational on all operating and safety controls.</p> <p><b>P10.</b> Commission system and make all adjustments to operating and safety controls.</p> <p><b>P11.</b> Adjust and setting to all refrigerant flow metering devices and level control devices.</p> <p><b>P12.</b> Take caution with temperature reduction of cool rooms and freezers.</p> <p><b>P13.</b> Reduce temperatures in accordance with industry practices</p> <p><b>P14.</b> Carry out maintenance procedures which include inspection and cleaning of all strainers, filters and collection of oil sample for analysis</p> <p><b>P15.</b> Give training to personnel responsible for the operation and maintenance of the refrigeration system.</p>
<p><b>3.</b> Develop report on installation and commissioning of Ammonia refrigeration systems</p>	<p><b>P1.</b> Clean and make safe work site in accordance with established procedures.</p> <p><b>P2.</b> Deal with contaminated refrigerant and lubricant in accordance with legislative/regulatory requirements</p> <p><b>P3.</b> Document operational conditions and commissioning figures, including identification of any parameter that is not within the specified range for the system.</p> <p><b>P4.</b> Mark all mechanical and electrical documentation to be "As Installed"</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:

- Hazards that are most likely to cause harm
- Identification and use of Personal Protective Equipment (PPE)
- American Society of Heating, Refrigeration, And Air Conditioning Engineers (ASHRAE)
- Different types of electric motors
- Working principles of different types of electric motors
- Pressure, Temperature and its units
- Ohm meter, Voltmeter and Ampere meter use



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- Refrigerants and properties of refrigerants
- Filters, strainers and lubrication oils
- Cooling tower and its types
- Working principle of cooling tower
- Control devices and safety devices for operational parameters
- Pumps and its types
- Compressors and function of compressors
- Air purge valves
- Fans and its types
- Vibration and abnormal noises of electrical devices and machinery
- 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:

- Understand system drawing
- Install components according to specification
- Operate HVAC system in order
- Measure pressure and temperature of system
- Observe system behavior

### List of Tools, Equipment and Machinery

Sr. No	Description
1	Personal Protective Equipment
2	Basic tool Kit
3	db. meter
4	Digital Air Flow / Velocity Meter
6	Electronic Leak Detector
7	Laser Distance Measuring Device
8	Laser Temperature Measuring Device
9	Megohmmeter (0 - 1000 Volts)
10	Digital Capacitor Analyzer



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### 0713E&E-80. Check and Inspect HVAC Variable Refrigerant Flow (VRF) System

#### Overview

This Competency Standard covers the competencies required to check and inspect HVAC variable refrigerant flow system in accordance with the manufacturer’s specifications / guidelines. This unit covers the knowledge regarding checking and inspection of HVAC VRF to provide you the basis for student work.

Competency Units	Performance Criteria
<b>1. Install Variable Refrigerant System &amp; Allied Schemes.</b>	<p><b>P1.</b> Select tools, equipment and related accessories according to job requirements</p> <p><b>P2.</b> Mark the location on the site where system to be installed according to Unit Size &amp; Design Drawings meeting all design specifications and client on site requirements.</p> <p><b>P3.</b> Make wall / slab opening at the marked area on the wall or floors for this installation fixtures.</p> <p><b>P4.</b> Fix pipe runners &amp; conduits in the opening and at entire area meeting drawing route</p> <p><b>P5.</b> Install Copper, PVC &amp; Electrical accessories with Proper Insulation according to the instructional manual and standards</p> <p><b>P6.</b> Install the Indoor / Outdoor in the framed opening with standard slope so that condensate water drops outside.</p> <p><b>P7.</b> Cover / Seal wall, Slab, ceiling to cover air gaps of opening with insulation material.</p> <p><b>P8.</b> Fix the fancy decorative grills around the indoor grill as per manufacturer direction</p> <p><b>P9.</b> Check leaks by applying pressure method before the joint’s insulation; repair leaks, if any</p>
<b>2. Perform Mandatory Action for Installation of Variable Refrigerant System.</b>	<p><b>P1.</b> Plan drain routes &amp; Fix the indoor unit’s condensate drainpipe maintaining levels and put into main drain line firmly with provision of Air Vents.</p> <p><b>P2.</b> Arrange power supply with circuit breaker near the Indoor Unit</p> <p><b>P3.</b> _____ make sure that all packing materials - Sheets, Styrofoam, Tape and Plastic Film, have been removed from the site after installation</p> <p><b>P4.</b> _____ Place Outdoor Unit on Civil Foundations and Bolt it properly</p> <p><b>P5.</b> _____ Interconnect Pre-Nitrogen Purged Copper Pipes &amp; Communication between indoor &amp; outdoor Units</p>





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	<p><b>P6.</b> Connect Main Power with outdoor units with matching circuit breakers and other safeties to energize outdoor units.</p> <p><b>P7.</b> Purge the overall System, Make deep Vacuum for 24-hrs and check for any leakages or vacuum break. Make Controls energize and do jumper setting as per manufacturer instruction.</p> <p><b>P8.</b> Switch on the system Heater and after 24 hrs. Turn on Compressor &amp; Indoor Units and check system performance as per capacity and specifications.</p>
<p><b>3. Perform Corrective &amp; Preventive Maintenance for Equipment, Safety Control with Right Performance outputs.</b></p>	<p><b>P1.</b> Check component or system condition, causing the problem</p> <p><b>P2.</b> Ensure the procedure of right voltage supply across each electrical phase &amp; check any abnormality on Connection Tightness or Carbon Presence on contacts.</p> <p><b>P3.</b> Check capability of evaporator / condenser ambient sensors &amp; switches and its right values through diagnostic tool at Interface Panel</p> <p><b>P4.</b> Check condenser fan flow sensor / switches and to rectify and false error code. Check high and low pressure &amp; temperature cutout switches.</p> <p><b>P5.</b> Adopt procedure for accuracy check of thermistors and transducers values with ambient Temperature&amp; communication with Main Panel.</p> <p><b>P6.</b> Adopt right procedure for accuracy check of condenser &amp; evaporators side pressure and temperature sensors.</p> <p><b>P7.</b> Perform indoor / outdoor tubes &amp; fins combing and periodic cleaning with proper procedure implementation</p> <p><b>P8.</b> Conduct checking of programmable operating set points and safety cutouts and assure and assure their correction through outdoor main board for the application</p> <p><b>P9.</b> Arrange OEM drawings and manuals for the subject equipment to be attended for diagnosing the fault</p> <p><b>P10.</b> Isolate and detail check of the causes of the problem and correct the fault &amp; Start the system to recheck as specified in the manufacturer manual and record the results.</p> <p><b>P11.</b> Record &amp; collect daily System operational logs to report any abnormal temperature and system behaviors to implement preventive inspection.</p>

### Knowledge and Understanding



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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:

- Hazards that are most likely to cause harm
- Identification and use of Personal Protective Equipment (PPE)
- American Society of Heating, Refrigeration and Air Conditioning Engineers (ASHRAE)
- Read & understand appropriate Copper Pipe sizes & distributors placement to meet system selection through record of shop drawings.
- Select tools, equipment and related accessories according to job requirements
- Pressure, Temperature and its units
- Ohm meter, Voltmeter and Ampere meter use
- Refrigerants and properties of refrigerants
- Filters, strainers and lubrication oils
- VRF and explain its advantages and disadvantages
- Working principle of cooling tower
- Control devices and safety devices for operational parameters
- Pumps and its types
- Compressors and function of compressors
- Air purge valves
- Fans and its types
- Vibration and abnormal noises of electrical devices and machinery
- 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:

- Find leaks & repair it
- Check & replace controls
- Check & replace mechanical parts
- Operate electronic circuit

### List of Tools, Equipment and Machinery

Sr. No	Description
1	Personal Protective Equipment
2	Basic tool Kit
3	db. meter
4	Digital Air Flow / Velocity Meter



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<b>5</b>	Digital Optical Tachometer
<b>6</b>	Electronic Leak Detector
<b>7</b>	Laser Distance Measuring Device
<b>8</b>	Laser Temperature Measuring Device
<b>9</b>	Megohmmeter (0 - 1000 Volts)
<b>10</b>	Digital Capacitor Analyzer



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### 0713E&E-81. Check and Inspect Centrifugal HVAC system

#### Overview

This Competency Standard covers the competencies required to check and inspect centrifugal HVAC system in accordance with the manufacturer’s specifications / guidelines. This unit covers the knowledge regarding checking and inspection of centrifugal HVAC system to provide you the basis for student work.

Competency Units	Performance Criteria
<b>1. Check and Inspect Chiller Operation</b>	<p><b>P1.</b> Check Visual Traces of Leakages on Water &amp; Refrigerant Circuits with Sight Glass Level verifications.</p> <p><b>P2.</b> Check Visual Traces of Oil Leakages, Sight Glass Level for Right Oil presence</p> <p><b>P3.</b> Check Proper operation oil return valve &amp; its operation during cycle &amp; at Part Load</p> <p><b>P4.</b> Check Sump Heater &amp; its thermostat</p> <p><b>P5.</b> Perform Water Analysis for Chilled &amp; Condenser Side and to choose right water cleaning and softening skills.</p>
<b>2. Check and Inspect Safety Control</b>	<p><b>P1.</b> Perform procedure for assessment of right voltage across each electrical phase &amp; check of any abnormality on Connection Tightness or Carbon Presence.</p> <p><b>P2.</b> Perform procedure to check Chilled / Condenser Water Sensors &amp; flow Switches and its right values presentation on Interface Panel</p> <p><b>P3.</b> Perform procedure to check Condenser Water Temperature &amp; Flow Sensor / Switches and presentation on interface Panel</p> <p><b>P4.</b> Perform procedure to check High and Low Press. &amp; Temp. Cutout Switches.</p> <p><b>P5.</b> Perform procedure adoption for accuracy check of thermistors and transducers values with interface.</p> <p><b>P6.</b> Adopt Right Procedure for accuracy check of Condenser Pressure and Temperature Gauges</p> <p><b>P7.</b> Perform eddy current test and inspection of tubes with proper cleaning procedure implementation.</p>
<b>3. Check and Inspect Mechanical Parts &amp; System</b>	<p><b>P1.</b> Inspect Main Bearing, Bolts and Seal wear.</p> <p><b>P2.</b> Inspect motor Margin &amp; Tolerance Levels.</p> <p><b>P3.</b> Adopt Correct Check for average skin temperatures of Compressor Motor &amp; VFD Temperatures.</p> <p><b>P4.</b> Check for operating amperage of Chiller on Full &amp; Part Load Scenario.</p>



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	<p><b>P5.</b> Perform procedure to Determine Oil Supply &amp; Return Filter Clogging state &amp; Replacement Procedure.</p> <p><b>P6.</b> Implement accuracy to inspect &amp; Replace starter Coolant &amp; Air Filters.</p> <p><b>P7.</b> Analyze o draining / Purge our Refrigerant and Lube Oil Checkups.</p> <p><b>P8.</b> Perform different vibration Test for Motor, Bearing and Foundation to avoid abnormal sound &amp; parts breaking.</p>
<b>4. Check and Inspect Chillers Piping</b>	<p><b>P1.</b> Inspect and brush clean evaporator, Condenser &amp; Maintenance Heat Exchanger Baffles.</p> <p><b>P2.</b> Inspect and brush clean evaporator, water Heat Exchanger Chamber &amp; tubes.</p> <p><b>P3.</b> Inspect condenser tubes (after brush cleaning)</p> <p><b>P4.</b> Check for proper different valve modulation. and design flow entering / blocking situation</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:

- Hazards that are most likely to cause harm
- Identification and use of Personal Protective Equipment (PPE)
- American Society of Heating, Refrigeration and Air Conditioning Engineers (ASHRAE)
- Checking and repairing of main bearings, bolts and seal wear
- Different types of electric motors
- Working principles of different types of electric motors
- Pressure, Temperature and its units
- Ohm meter, Voltmeter and Ampere meter use
- Refrigerants and properties of refrigerants
- Filters, strainers and lubrication oils
- Principle of cooling tower
- Control devices and safety devices for operational parameters
- Pumps and its types
- Compressors and function of Centrifugal compressor
- Air purge valves
- Fans and its types
- Vibration and abnormal noises of electrical devices and machinery
- Record keeping and reporting



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### Critical Evidence(s) Required

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

- Find leaks & repair it
- Check & replace controls
- Check & replace mechanical parts
- Check & adjust centrifugal pumps

### List of Tools, Equipment and Machinery

Sr. No	Description
1	Personal Protective Equipment
2	Basic tool Kit
3	db. meter
4	Digital Air Flow / Velocity Meter
5	Digital Optical Tachometer
6	Electronic Leak Detector
7	Laser Distance Measuring Device
8	Laser Temperature Measuring Device
9	Megohmmeter (0 - 1000 Volts)
10	Digital Capacitor Analyzer



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### 0713E&E-82. Check and Inspect Screw Type HVAC system

#### Overview

This Competency Standard covers the competencies required to check and inspect screw type HVAC system in accordance with the manufacturer's specifications / guidelines. This unit covers the knowledge regarding checking and inspection of screw type HVAC system to provide you the basis for student work.

Competency Units	Performance Criteria
<b>1. Check and Inspect Chiller Operation</b>	<p><b>P1.</b> Check Leakages on water &amp; refrigerant circuits with sight glass level verifications.</p> <p><b>P2.</b> Check oil leakages, sight glass level for right oil presence</p> <p><b>P3.</b> Check Up for Proper operation oil returns valve &amp; its operation</p> <p><b>P4.</b> Check Sump Heater &amp; its thermostat.</p> <p><b>P5.</b> Perform water analysis for chilled &amp; condenser side.</p>
<b>2. Check and Inspect Chiller Equipment and Safety Controls</b>	<p><b>P1.</b> Procedure for assessment of right voltage across each electrical phase &amp; check of any abnormality on Connection Tightness or Carbon Presence.</p> <p><b>P2.</b> Procedure to check Chilled / Condenser Water Sensors &amp; flow switches and its right values presentation on Interface Panel.</p> <p><b>P3.</b> Procedure to check Condenser Water Temperature &amp; Flow Sensor / Switches and presentation on interface Panel.</p> <p><b>P4.</b> Procedure to check High and Low Press. &amp; Temp. Cutout Switches.</p> <p><b>P5.</b> Procedure adoption for accuracy check of thermistors and transducers values with interface.</p> <p><b>P6.</b> Adoption of Right Procedure for accuracy check of Condenser Pressure and Temperature Gauges.</p> <p><b>P7.</b> Ability to perform eddy current test and inspection of tubes with proper cleaning procedure implementation.</p> <p><b>P8.</b> Ability to do Checking Programmable Operating Set points and Safety Cutouts. Assure they are correct and viewable through interface for the application.</p>
<b>3. Check and Inspect Chiller Mechanical Parts &amp; System</b>	<p><b>P1.</b> Inspect Main Bearing, Bolts and Seal wear, repair / replace if necessary</p> <p><b>P2.</b> Inspect and Check Superheat on the Evaporator and the Economizer feed to the Compressor and sub cooling on condenser part.</p> <p><b>P3.</b> Correct Check for average skin temperatures of</p>



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	<p>Compressor Motor &amp; VFD Temperatures.</p> <p><b>P4.</b> Check operating amperage of Chiller on Full &amp; Part Load Scenario.</p> <p><b>P5.</b> Determine Oil Supply &amp; Return Filter Clogging state &amp; Replacement Procedure.</p> <p><b>P6.</b> Inspect starter, coolant &amp; air filters replace if necessary.</p> <p><b>P7.</b> Analyze draining / Purging, Refrigerant and lubrication oil checkups.</p> <p><b>P8.</b> Perform different vibration Test for Motor, Bearing and Foundation to avoid abnormal sound &amp; parts breaking.</p>
<b>4. Check and Inspect Screw Chillers Operation</b>	<p><b>P1.</b> Inspect and clean evaporator, Condenser &amp; Maintenance Heat Exchanger Baffles.</p> <p><b>P2.</b> Inspect and clean evaporator, water Heat Exchanger Chamber &amp; tubes.</p> <p><b>P3.</b> Inspect condenser tubes after brushing / cleaning</p> <p><b>P4.</b> Check different valve modulation and design flow entering / blocking situation.</p> <p><b>P5.</b> Check Glycol concentration on Low Temp or other applications where freezing may be a problem &amp; Change of VSD Glycols.</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:

- Hazards that are most likely to cause harm
- Identification and use of Personal Protective Equipment (PPE)
- American Society of Heating, Refrigeration and Air Conditioning Engineers (ASHRAE)
- Checking and repairing of main bearings, bolts and seal wear
- Different types of electric motors
- Working principles of different types of electric motors
- Pressure, Temperature and its units
- Ohm meter, Voltmeter and Ampere meter use
- Refrigerants and properties of refrigerants
- Filters, strainers and lubrication oils
- Working principle of cooling tower
- Control devices and safety devices for operational parameters
- Pumps and its types
- Compressors and function of Screw compressor
- Air purge valves
- Fans and its types
- Vibration and abnormal noises of electrical devices and machinery





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- 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:

- Find leaks & repair it
- Check & replace controls
- Check & replace mechanical parts
- Check & adjust centrifugal pumps

### List of Tools, Equipment and Machinery

Sr. No	Description
1	Personal Protective Equipment
2	Basic tool Kit
3	db. meter
4	Digital Air Flow / Velocity Meter
5	Digital Optical Tachometer
6	Electronic Leak Detector
7	Laser Distance Measuring Device
8	Laser Temperature Measuring Device
9	Megohmmeter (0 - 1000 Volts)
10	Digital Capacitor Analyzer



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### 0713E&E-83. Install, Maintain and Repair Industrial Refrigeration System

#### Overview

This Competency Standard covers the competencies required to install, maintain and repair industrial refrigeration system in accordance with the manufacturer’s specifications / guidelines. This unit covers the knowledge regarding installation, maintenance and repair industrial refrigeration system to provide you the basis for student work.

<i>Competency Units</i>	<i>Performance Criteria</i>
<b>1. Identify the selected design of industrial refrigeration system.</b>	<b>P1.</b> Identify location as per the design. <b>P2.</b> Select specifications system, check to ensure matching with selected design of the unit. <b>P3.</b> Prepare a list of equipment / items and material required for the job.
<b>2. Install industrial refrigeration system</b>	<b>P1.</b> Select components of system according to requirements for the installation. <b>P2.</b> Prepare and level floor to install industrial refrigeration system according to layout plans. <b>P3.</b> Install industrial refrigeration system according to specifications, following manufacturer’s specification. <b>P4.</b> Install refrigeration equipment including piping & electrical wiring following standard practices and safety procedures. <b>P5.</b> Check and test system before commissioning, as per specifications and manufacturer’s instructions, and under the supervision of the engineer. <b>P6.</b> Record commissioning data indicating system pressures, electrical data, humidity & temperatures outside and inside cold room, and filed for future use.
<b>3. Maintain / repair industrial refrigeration system.</b>	<b>P1.</b> Check cold room / freezer room / ice plant and extent of repair / or maintenance ascertained and recorded. <b>P2.</b> Enlist equipment / items, material and accessories as required for the job. <b>P3.</b> Check all components of the electrical / electronic circuits according to standard practice and manufacturers specifications to ensure correct performance and rectify defects. <b>P4.</b> Check and ensure performance of electro - mechanical safety and control devices according to manufacturer’s specifications. <b>P5.</b> Check for correct performance of all mechanical devices such as drive belts etc. according to manufacturer’s specifications



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- P6.** Check and rectify defects for correct performance of all components of the refrigeration circuit according to manufacturer’s specifications.
- P7.** Check defrost heaters, drain line, Pan heaters, fan delays, defrost timers, defrost termination devices and temperature controllers, replace where necessary to ensure proper functioning.
- P8.** Check body mounts and restore to the required condition
- P9.** Test system pressure, specified test instruments and repair gas leaks
- P10.** Evacuate system by using vacuum pump and gas re-charge by weight using specified equipment according to specifications.
- P11.** Check door heaters and door gaskets & door closers; repair where necessary to ensure proper functioning.
- P12.** Check interior cooler space, cleaned and ensured dust / debris free.
- P13.** Operate, check and test plant to ensure satisfactory performance according to manufacturer’s specifications.
- P14.** Perform plant re-commissioning and handed over according to manufactures specifications observing following safety procedures, under the supervision of the superior and recorded readings / data obtained during commissioning of the plant and check against manufacturers specifications.

### 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:

- Hazards that are most likely to cause harm
- Identification and use of Personal Protective Equipment (PPE)
- American Society of Heating, Refrigeration and Air Conditioning Engineers (ASHRAE)
- Checking and repairing of main bearings, bolts and seal wear
- Different types of electric motors
- Working principles of different types of electric motors
- Pressure, Temperature and its units
- Ohm meter, Voltmeter and Ampere meter use
- Commissioning process
- Refrigeration and its types
- Industrial refrigeration
- Refrigerants and properties of refrigerants



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- Filters, strainers and lubrication oils
- Working principle of cooling tower
- Control devices and safety devices for operational parameters
- Pumps and its types
- Compressors and functions of compressors
- Air purge valves
- Fans and its types
- Vibration and abnormal noises of electrical devices and machinery
- 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:

- Read and understand drawings
- Make foundations and hangers
- Install components of refrigeration system
- Install plumbing assembly Chilled Water Tank, condenser and cooling tower
- Make water drain connections
- Install anti freezing/defrosting and water level protection system
- Fault finding & Trouble shooting
- Leak testing & Charge refrigerant in refrigeration system
- Replace different parts

### List of Tools, Equipment and Machinery

Sr. No	Description
1	Personal Protective Equipment
2	Basic tool Kit
3	db. meter
4	Digital Air Flow / Velocity Meter
5	Digital Optical Tachometer
6	Electronic Leak Detector
7	Laser Temperature Measuring Device
8	Megohmmeter (0 - 1000 Volts)



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**9**

Digital Capacitor Analyzer



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### 0713E&E-84. Service and Maintain Air Handling Unit (AHU)

#### Overview

This Competency Standard covers the competencies required to service and maintain air handling units in accordance with the manufacturer’s specifications / guidelines. This unit covers the knowledge regarding servicing and maintenance of air handling units to provide you the basis for student work.

Competency Units	Performance Criteria
<b>CU-1. Prepare for work.</b>	<p><b>P1.</b> Observe safe work practices and personal protective equipment (PPE) worn as required for the work to be performed.</p> <p><b>P2.</b> Interpret work instructions to determine job requirements</p> <p><b>P3.</b> Identify necessary tools and equipment in line with job requirements</p> <p><b>P4.</b> Select necessary materials as per job requirement</p>
<b>CU-2. Check and Identify faults</b>	<p><b>P1.</b> Observed systematic test and check in accordance with manufacturer’s instruction.</p> <p><b>P2.</b> Check components of the Air-flow system according to manufactures specifications to ensure correct performance</p> <p><b>P3.</b> Check booster fan and rotary fan performance according to the instruction</p> <p><b>P4.</b> Check control settings/adjustments in conformity with service-manual specifications.</p> <p><b>P5.</b> Check components of refrigeration and electrical / electronic circuit according to standard procedures</p> <p><b>P6.</b> Identify system defects/fault symptoms and document using appropriate tools and equipment</p>
<b>CU-3. Service / Maintain of Cassette type air conditioner</b>	<p><b>P1.</b> Replace defective parts/components with identical or recommended appropriate equivalent ratings</p> <p><b>P2.</b> Control settings/adjustments are performing conformity with service-manual specifications</p> <p><b>P3.</b> Clean air filter and evaporator/cooling coil fins with specified cleaning agent</p> <p><b>P4.</b> Perform ducting and fabrication conformity with the drawing</p> <p><b>P5.</b> Check pressure control switch, pressure gauge and temperature</p> <p><b>P6.</b> Operate and check unit to ensure satisfactory performance according to manufactures specifications</p>
<b>CU-4. Clean and store of tools</b>	<p><b>P1.</b> Maintain a Clean tools and equipment as per</p>



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and equipment

instruction manual

- P2.** Clean workplace in accordance with environmental requirement
- P3.** Store tools and equipment safely in appropriate location according to standard workshop procedures.

### 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:

- Hazards that are most likely to cause harm
- Identification and use of Personal Protective Equipment (PPE)
- American Society of Heating, Refrigeration and Air Conditioning Engineers (ASHRAE)
- Checking and repairing of main bearings, bolts and seal wear
- Different types of electric motors
- Working principles of different types of electric motors
- Pressure, Temperature and its units
- Ohm meter, Voltmeter and Ampere meter use
- Air Handling Units
- Filters, its types and their properties
- Working principle of cooling tower
- Fans and their working principles
- Ducting systems
- Insulations and their properties
- Control devices and safety devices for operational parameters
- Pumps and its types
- Compressors and function of Screw compressor
- Air purge valves
- Fans and its types
- Vibration and abnormal noises of electrical devices and machinery
- 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:



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- Check & Visually inspect AHU
- Replace filters
- Replace fan motor and belts
- Calculate air flow rate
- Calculate the temperature and flow of refrigerant

### List of Tools, Equipment and Machinery

Sr. No	Description
1	Personal Protective Equipment
2	Basic tool Kit
3	db. meter
4	Digital Air Flow / Velocity Meter
5	Digital Optical Tachometer
6	Electronic Leak Detector
7	Laser Distance Measuring Device
8	Laser Temperature Measuring Device
9	Megohmmeter (0 - 1000 Volts)
10	Digital Capacitor Analyzer





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### 0713E&E-85. Check and Connect Basic Controls used in HVAC

#### Overview

This Competency Standard covers the competencies required to check and connect basic controls used in HVAC system in accordance with the manufacturer’s specifications / guidelines. This unit covers the knowledge regarding checking and connecting basic HVAC controls for HVAC system to provide you the basis for student work.

Competency Units	Performance Criteria
<b>1. Identify purpose of controls</b>	<b>P1.</b> Identify types of controls <b>P2.</b> Categorize interlocking system of control <b>P3.</b> Identify Sign and symbols <b>P4.</b> Identify term and abbreviations <b>P5.</b> Interpret specifications
<b>2. Perform checking methods</b>	<b>P1.</b> Check calibration of calibration instruments <b>P2.</b> Apply relevant suitable conditions <b>P3.</b> Check results of controls <b>P4.</b> Compare results with normal conditions <b>P5.</b> Elaborate faulty controls
<b>3. Perform connections of control</b>	<b>P1.</b> Collect and interpret drawings <b>P2.</b> Make necessary connections <b>P3.</b> Align sensor of controls <b>P4.</b> Check the function of devices and control <b>P5.</b> Check & Justify all the connections <b>P6.</b> Test the function of circuit

#### 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:

- Hazards that are most likely to cause harm
- Identification and use of Personal Protective Equipment (PPE)
- American Society of Heating, Refrigeration, And Air Conditioning Engineers (ASHRAE)
- Identification of HVAC Controls
- Working principles of HVAC Control
- Repair and maintenance of HVAC controls
- Interpret the control circuits diagrams
- Record keeping and reporting



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### Critical Evidence(s) Required

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

- Adjust AVO meter
- Apply relevant conditions of pressure & Temperature
- Observe behavior of different controls
- Make necessary connections
- Obtain end results

### List of Tools, Equipment and Machinery

Sr. No	Description
1	Personal Protective Equipment
2	Basic tool Kit
3	Different type of HVAC Controls



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### 0713E&E-86. Prepare Control Circuits

#### Overview

This Competency Standard covers the competencies required to prepare control circuits for HVAC system in accordance with the manufacturer’s specifications / guidelines. This unit covers the knowledge regarding control circuits preparation to provide you the basis for student work.

<i>Competency Units</i>	<i>Performance Criteria</i>
<b>1. Interpret drawings and Specifications</b>	<b>P1.</b> Collect drawings <b>P2.</b> Interpreted drawings <b>P3.</b> Identify Sign and symbols <b>P4.</b> Identify term and abbreviations <b>P5.</b> Interpret specifications
<b>2. Connect Direct online starter, controls and accessories</b>	<b>P1.</b> Identify and collect Tools, Equipment and Materials <b>P2.</b> Check Tools, Equipment and Materials <b>P3.</b> Connect Direct online starter, controls and accessories
<b>3. Connect Star-delta starter</b>	<b>P1.</b> Collect and interpret Star-delta starter <b>P2.</b> Make Star connections <b>P3.</b> Make delta connection <b>P4.</b> Connect Star-delta starter <b>P5.</b> Connect Auto-transformer starter
<b>4. Check and test circuit</b>	<b>P1.</b> Check & Justify all the connections of each starter, control and accessory <b>P2.</b> Test & check connection between motor and starters
<b>5. Clean the workplace</b>	<b>P1.</b> Clean tools and equipment <b>P2.</b> Dispose waste materials <b>P3.</b> Complete cleaning

#### 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:

- Hazards that are most likely to cause harm
- Identification and use of Personal Protective Equipment (PPE)
- American Society of Heating, Refrigeration, And Air Conditioning Engineers (ASHRAE)
- Different types of electric motors
- Working principles of different types of control circuits
- Different types of controls



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- Interpret circuit diagrams
- Pressure and pressure laws
- Temperature and its units
- Ohm meter, Voltmeter and Ampere meter
- 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:

- Use PPE for electric works
- Identify & Draw circuit drawings
- Install & Connect components
- Make wiring circuit
- Check & Test circuit

### List of Tools, Equipment and Machinery

<i>Sr. No</i>	<i>Description</i>
1	Personal Protective Equipment
2	Basic tools Kit
3	Different type of HVAC Controls



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## National Competency Standards Level-5 for “HVACR”



### 0713E&E-87. Measure Air Velocity

#### Overview

This Competency Standard covers the competencies required to measure air velocity in accordance with the manufacturer’s specifications / guidelines. This unit covers the knowledge regarding measuring of air velocity to provide you the basis for student work.

Competency Units	Performance Criteria
<b>CU-1. Identify air flow equipment’s</b>	<b>P1.</b> Identify ducts <b>P2.</b> Identify fans and blowers <b>P3.</b> Identify dampers, grills and registers
<b>CU-2. Measure air velocity and pressure</b>	<b>P1.</b> Use of velocity & pressure measuring instruments <b>P2.</b> Use of capacitive based pressure sensors <b>P3.</b> Measure static and total pressure <b>P4.</b> Measure Pressure losses
<b>CU-3. Calculation of air velocity and pressure</b>	<b>P1.</b> Calculate cross sectional area of duct <b>P2.</b> Calculate pressure losses <b>P3.</b> Calculate flow rate of air (CFM) <b>P4.</b> Use of tables and charts <b>P5.</b> Calculation of air velocity <b>P6.</b> Accuracy of measured air velocity

#### 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:

- Hazards that are most likely to cause harm
- Identification and use of Personal Protective Equipment (PPE)
- American Society of Heating, Refrigeration, And Air Conditioning Engineers (ASHRAE)
- Describe air velocity
- Functions of air velocity meters
- Measurement of air velocity by velocity meters
- Different types of electric motors
- Significance of Fan Laws
- Basic Knowledge of Terminology such as Air flow, pressure head, power, efficiency ESP, TSP, VP etc.
- Working principles and construction of centrifugal fans and recognize different Fan Types.
- Record keeping and reporting



## National Competency Standards Level-5 for “HVACR”



### Critical Evidence(s) Required

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

- Use of measuring instrument (Velocity Meter)
- Calculate air velocity and pressure

### List of Tools, Equipment and Machinery

Sr. No	Description
1	Personal Protective Equipment
2	Basic tools kit
3	Velocity meter



## National Competency Standards Level-5 for “HVACR”



### 0713E&E-88. Produce HVAC Control System Drawings

#### Overview

This Competency Standard covers the competencies required to produce HVAC control system drawings in accordance with the manufacturer’s specifications / guidelines. This unit covers the knowledge regarding HVAC control system drawings to provide you the basis for student work.

Competency Units	Performance Criteria
<b>1. Initiate control system drawings</b>	<b>P1.</b> Enlist equipment’s used in circuit <b>P2.</b> Draw universal symbols <b>P3.</b> Identify color coding of wirings <b>P4.</b> Identify term and abbreviations
<b>2. Draw control system drawings</b>	<b>P1.</b> Draw Relevant symbols of equipment’s <b>P2.</b> Make necessary connections <b>P3.</b> Use color coding of wires <b>P4.</b> Complete wiring diagram

#### 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:

Hazards that are most likely to cause harm

- Identification and use of Personal Protective Equipment (PPE)
- American Society of Heating, Refrigeration, And Air Conditioning Engineers (ASHRAE)
- Interpretation of drawings, symbols, cable number according to load
- Describe different types of drawings (e.g. power, control, single line etc.)
- Terms being used in drawing
- Draw application of drawing forms
- Draw scales used in drawing
- Draw fundamentals units i.e. arcs, circles and ellipse Draw single stroke and double stroke gothic letters
- Definitions of tolerance, limits and fits
- Layout and line drawing
- Draw drawings by AutoCAD
- Record keeping and reporting

#### Critical Evidence(s) Required





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

- Draw relevant symbols
- Make necessary connections
- Use & understand color coding

### List of Tools, Equipment and Machinery

<i>Sr. No</i>	<i>Description</i>
1	Personal computer with Accessories



## National Competency Standards Level-5 for “HVACR”



### 0713E&E-89. Adjust and Balance HVAC Controls

#### Overview

This Competency Standard covers the competencies required to adjust and balance HVAC controls in accordance with the manufacturer’s specifications / guidelines. This unit covers the knowledge regarding adjustment and balancing of HVAC controls to provide you the basis for student work.

Competency Units	Performance Criteria
<b>1. Testing of HVAC controls</b>	<b>P1.</b> Collect relevant data <b>P2.</b> Examine collected data <b>P3.</b> Measure and compare actual values <b>P4.</b> Identify controlled conditions
<b>2. Adjusting of HVAC controls</b>	<b>P1.</b> Ensure recorded data represents actual measured <b>P2.</b> Mark settings of control permanently <b>P3.</b> Make adjustment of relevant parameters and measure readings to verify <b>P4.</b> Leave the system in proper order <b>P5.</b> Inspect finally
<b>3. Balance of HVAC controls</b>	<b>P1.</b> Examine final test result with design values <b>P2.</b> Make necessary adjustments <b>P3.</b> Check set results <b>P4.</b> Finish adjusting if required desired conditions <b>P5.</b> Make necessary adjustment if required

#### 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
- Identification and use of Personal Protective Equipment (PPE)
- American Society of Heating, Refrigeration and Air Conditioning Engineers (ASHRAE)
- Identification of HVAC Controls
- Working principles of HVAC Control
- Repair and maintenance of HVAC controls
- Interpret the control circuits diagrams
- Record keeping and reporting

#### Critical Evidence(s) Required



## National Competency Standards Level-5 for “HVACR”



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

- Collect & compare relevant data of unit
- Make comparison of data
- Make necessary adjustments according data
- Balance the control according feed back

### List of Tools, Equipment and Machinery

<i>Sr. No</i>	<i>Description</i>
1	Personal Protective Equipment
2	Basic tools Kit
3	Air velocity meters
4	Air Balancing kit



## National Competency Standards Level-5 for “HVACR”



### 0713E&E-90. Operate HVAC Building Management System (BMS)

#### Overview

This Competency Standard covers the competencies required to operate HVAC building management system in accordance with the manufacturer’s specifications / guidelines. This unit covers the knowledge regarding HVAC BMS to provide you the basis for student work.

Competency Units	Performance Criteria
<b>CU-1. Identify Direct Digital Control (DDC)</b>	<b>P1.</b> Identify the Basic Control System <b>P2.</b> Identify the Temperature, Rh, Pressure sensors and Input to Processor <b>P3.</b> Classify the DDC Control Applications <b>P4.</b> Identify the functions and application range of automatic control in air-conditioning and refrigeration systems. <b>P5.</b> Identify the Communication Standards / Protocols for DDC
<b>CU-2. : Read and interpret Sequence of Operation</b>	<b>P1.</b> Read and Interpret the layout plan of automatic air-conditioning and refrigeration control system equipment. <b>P2.</b> Read and interpret the Sequence of Operation for Complete HVAC System <b>P3.</b> Read and interpret the Control Drawings in combination to sequence of operation.
<b>CU-3. Use BMS to Save Energy</b>	<b>P1.</b> Identify the BMS use to conserve energy. Understand the trends of Plants operation. <b>P2.</b> Read and interpret the alarms from BMS System <b>P3.</b> Read the performance logs of HVAC System from BMS
<b>CU-4. Maintain and Operate BMS</b>	<b>P1.</b> Clean the Electrical Contacts and check any loose connections. <b>P2.</b> Remove the dust from control components. (Controllers, Cards, VFDs etc.) <b>P3.</b> Check control cable connectivity <b>P4.</b> Lubricate the actuator moving parts

#### 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:

- Hazards that are most likely to cause harm
- Identification and use of Personal Protective Equipment (PPE)



## National Competency Standards Level-5 for “HVACR”



- American Society of Heating, Refrigeration and Air Conditioning Engineers (ASHRAE)
- Digital direct control system
- Building management system
- Read and interpret the control drawings
- Conservation of energy
- Function of the actuator
- 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:

- Understand basic control and communication system
- Understand HVAC system working
- Service & Maintain BMS parts and accessories
- Read and interpret different obtained parameters
- Obtained desired comfort conditions in controlled environment

### List of Tools, Equipment and Machinery

Sr. No	Description
1	Personal Protective Equipment
2	Basic tool Kit



## National Competency Standards Level-5 for “HVACR”



### 0713E&E-91. Manage the Operations of Workshop Security Units

#### Overview

This Competency Standard identifies the competencies required to prepare for managing the operations, manage resources of a security unit, organize guarding operations, control entry to and exit from premises, control screening and search operations and organize traffic control and parking. Student underpinning knowledge regarding workshop security units will be enough to provide the basis for this task.

Competency Units	Performance Criteria
<b>1. Prepare to manage the operations</b>	<ul style="list-style-type: none"> <li><b>P1.</b> Observe organizational procedures related to security operations</li> <li><b>P2.</b> Plan operations as per site instructions and availability of resources</li> <li><b>P3.</b> Develop personnel and resources in an efficient and economical manner</li> <li><b>P4.</b> Review functioning of teams and shifts and carry out improvements</li> <li><b>P5.</b> Assess training and performance standards of security unit Training Requirements</li> <li><b>P6.</b> Check and report functioning of provided security equipment to facilitate access control, search and screening, parking, surveillance and smoke &amp; fire detection</li> <li><b>P7.</b> Check and report functioning of personal protection equipment</li> <li><b>P8.</b> Initiate actions to rectify faulty equipment</li> <li><b>P9.</b> Organize security operations manually in the event of equipment malfunction</li> <li><b>P10.</b> Check and carry out periodic / surprise inspections</li> <li><b>P11.</b> Communicate effectively with team members and stakeholders</li> <li><b>P12.</b> Take report and feedback from team members</li> <li><b>P13.</b> Coordinate, organize, train and rehearse emergency response teams (ERT)</li> <li><b>P14.</b> Respond to emergencies and irregular situations Emergencies by security unit members</li> <li><b>P15.</b> Take preventive actions and call for assistance to control irregular situations</li> </ul>
<b>2. Manage resources of a security unit</b>	<ul style="list-style-type: none"> <li><b>P1.</b> Plan and organize required personnel and equipment as per site instructions</li> <li><b>P2.</b> Assess and report suitability of provided personnel and equipment</li> <li><b>P3.</b> Carry out adjustments in deployment to cover deficiency of personnel and equipment</li> </ul>



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	<p><b>P4.</b> Record and report status and issues related to personnel and equipment</p> <p><b>P5.</b></p>
<p><b>3. Organize guarding Operations</b></p>	<p><b>P1.</b> Organize security and guarding operations against likely threats and risks</p> <p><b>P2.</b> Organize briefing of guards and supervisors between the shifts</p> <p><b>P3.</b> Carry out periodic review of the deployment and operations</p> <p><b>P4.</b> Control functioning and operations of CCTV control room, if provided</p> <p><b>P5.</b> Follow the laid down procedure of key control</p> <p><b>P6.</b> Prepare, issue and monitor patrolling plan</p> <p><b>P7.</b> Debrief guards/ patrols/ supervisors after the tasks</p> <p><b>P8.</b> Take feedback</p> <p><b>P9.</b> Deal with lost and found property</p>
<p><b>4. Control entry to and exit from premises</b></p>	<p><b>P1.</b> Identify likely threats and risks to premises from outside</p> <p><b>P2.</b> Summarize access control procedure and functioning of the equipment in use</p> <p><b>P3.</b> Train team members in operation of the equipment</p> <p><b>P4.</b> Brief team members regarding people/ vehicles/ material authorized to enter/ leave premises</p> <p><b>P5.</b> Identify papers, passes, permission and documentation to facilitate entry and exit of people/ vehicles/ material to and from the premises</p> <p><b>P6.</b> Organize receipt of postal mail and couriers, if assigned</p>
<p><b>5. Control screening and search operations</b></p>	<p><b>P1.</b> Identify procedure of screening and search operations and the functioning of equipment in use</p> <p><b>P2.</b> Train team members in operation of the equipment</p> <p><b>P3.</b> Sensitize subordinates to respect persons' right to dignity, privacy and gender/ religious/ cultural sensitivity</p> <p><b>P4.</b> Deal with persons and vehicles violating laid down procedures</p> <p><b>P5.</b> Identify presence of prohibited/ unauthorized items</p> <p><b>P6.</b> Segregate material containing prohibited/ unauthorized items</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:



## ***National Competency Standards Level-5 for “HVACR”***



- Category of authorized people/ people debarred entry
- Types of identity/ authorization documents in use
- Areas within the premises having restricted/ controlled entry
- Details of unauthorized/ prohibited items
- Action to be taken in case of recovery of unauthorized/ prohibited items
- Procedure for receipt of postal mail and couriers
- Action to be taken in case of delivery of a suspicious package
- Method of securing and storing letters and packages
- Methods and techniques adopted by miscreants to defeat security measures and equipment
- Security equipment installed in the premises
- Capability and limitations of the security equipment in use
- Signals emanating from equipment
- Common faults occurring in the equipment
- Procedure re for carrying out operations manually, in case of equipment failure
- Indications regarding suspicious packages
- Items that cannot be put through screening and search equipment
- Procedure for vehicle search
- Personal protective gear required for security operations
- Layout of the parking areas and traffic plan in the premises
- Suitability of prevailing conditions for parking
- Traffic signals, signage and markings
- Category of vehicles
- Untoward situations faced during security operations
- Procedure for dealing with untoward situations
- Record keeping and reporting





## National Competency Standards Level-5 for “HVACR”



### 0713E&E-92. Organize Training on Multiple Workshop Units

#### Overview

This Competency Standard identifies the competencies required to organize training on multiple workshop units. Student underpinning knowledge regarding organize training will be enough to provide the basis for this task.

Competency Units	Performance Criteria
<b>1. Assess the training requirements</b>	<p><b>P1.</b> Identify relevant legislation/ regulations, organizational requirements relating to standards of training in the automobile sector.</p> <p><b>P2.</b> Assess site-specific training requirements for technician and experts.</p> <p><b>P3.</b> Report to superiors on existing training standards and additional training required</p> <p><b>P4.</b> assess time required for conduct of training</p> <p><b>P5.</b> Decide on learning objectives of the training</p> <p><b>P6.</b> Maintain environmental and situational awareness to upgrade training Standards</p>
<b>2. Plan and Schedule training for technicians</b>	<p><b>P1.</b> Keep in view availability of time on the type and method of training and resources</p> <p><b>P2.</b> Chalk out training program(s)</p> <p><b>P3.</b> Arrange for required trainers and training infrastructure</p> <p><b>P4.</b> Brief security unit on training schedule</p> <p><b>P5.</b> Carry out/ facilitate pre-induction training</p> <p><b>P6.</b> Train team members in the operation of security and communication equipment</p> <p><b>P7.</b> Carry out routine checks to assess training efficacy</p> <p><b>P8.</b> Assess and report on standards of training and performance</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:

- Category of authorized people/ people debarred entry



## ***National Competency Standards Level-5 for “HVACR”***



- Types of identity/ authorization documents in use
- Areas within the premises having restricted/ controlled entry
- Details of unauthorized/ prohibited items
- Action to be taken in case of recovery of unauthorized/ prohibited items
- Procedure for receipt of postal mail and couriers
- Action to be taken in case of delivery of a suspicious package
- Method of securing and storing letters and packages
- Methods and techniques adopted by miscreants to defeat security measures and equipment
- Security equipment installed in the premises
- Capability and limitations of the security equipment in use
- Signals emanating from equipment
- Common faults occurring in the equipment
- Procedure re for carrying out operations manually, in case of equipment failure
- Indications regarding suspicious packages
- Items that cannot be put through screening and search equipment
- Procedure for vehicle search
- Personal protective gear required for security operations
- Layout of the parking areas and traffic plan in the premises
- Suitability of prevailing conditions for parking
- Traffic signals, signage and markings
- Category of vehicles
- Untoward situations faced during security operations
- Procedure for dealing with untoward situations
- Record keeping and reporting



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### 0713E&E-93. Administer Multiple Commercial Units

#### Overview

This Competency Standard identifies the competencies required to administer multiple commercial units. Student underpinning knowledge regarding Implementation of SOP Process and administer multiple bay units will be enough to provide the basis for this task.

#### Competency Units

#### Knowledge Criteria

1. Control the operations of workshop	<p><b>P2.</b> Commence operations at a new or existing site, as per site instructions</p> <p><b>P3.</b> Assess site-specific administrative requirements i.e. accommodation, transportation, food, medical, hygiene &amp; sanitation, support staff, shift timings, working hours, rest, leave, entitlement of salary/ allowances, payment to staff, documentation, addressing grievances, welfare, security of female guards and handling of petty cash</p> <p><b>P4.</b> Inform superiors about the requirements</p> <p><b>P5.</b> Issue identity cards to team members</p> <p><b>P6.</b> Inform superior about complaints/ suggestion received from principal employer</p> <p><b>P7.</b> Interact with team members frequently</p> <p><b>P8.</b> Resolve grievances of staff</p> <p><b>P9.</b> Maintain confidentiality of information</p> <p><b>P10.</b> Receive/ issue/ account for stores meant for security unit</p> <p><b>P11.</b> Prepare attendance sheet, overtime details and MIS reports</p> <p><b>P12.</b> Document new entrants/ those leaving the site Documents i.e. Master roll, attendance sheet, pay roll, site assignment document, individual's verification &amp; identification documents, personnel movement control documents, duty roster, leave &amp; absence register, medical register</p> <p><b>P13.</b> Handle and account for petty cash</p> <p><b>P14.</b> Pursue pending issues of security unit and agency with principal employer</p>
3. Administer a workshop/bay Unit	<p><b>P1.</b> Identify and address important administrative concerns</p> <p><b>P2.</b> Arrange for accommodation, transportation and food for the unit</p> <p><b>P3.</b> Enforce dress code</p> <p><b>P4.</b> Maintain discipline</p> <p><b>P5.</b> coordinate with own agency/ principal employer to resolve issues</p> <p><b>P6.</b> Ensure privacy and personal safety of the unit, especially of female staff</p> <p><b>P7.</b> Motivate team through personal example and</p>



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concern

**P8.** Assess performance and standards of team members

**P9.** Counsel team members on their performance and conduct

**P10.** Recommend deserving personnel for promotion and rewards

### 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:

- The site instruction
- Details of personnel and equipment required
- Channel of reporting and communication with stakeholders Stake holders: Principal employer, superior, own management, subordinates, visitors and residents/tenants
- Contact details of stakeholders, superiors and team members
- Documentation formats
- Record keeping and reporting
- Organizational standards on grooming, conduct, behavior and performance
- Leadership and management fundamentals Leadership: Administration, discipline, motivation, impartiality, punctuality, concern for subordinates, welfare and leading by example
- Organizational protocol for resolution of concerns/ grievances
- Management information system
- Performance management system
- Compensation management
- Accounting and issue procedure for stores, material and equipment



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### 0713E&E-94. Supervise and Evaluate performance of Technician

#### Overview

This Competency Standard identifies the competencies required to supervise and evaluate performance of technician. Student underpinning knowledge regarding supervision and evaluation the performance of subordinates ensure higher levels of motivation will be enough to provide the basis for this task.

Competency Units	Knowledge Criteria
1. Supervise the staff	<p><b>P1.</b> Ensure and implement strict adherence of all activities performed by subordinates to organizational guidelines</p> <p><b>P2.</b> Monitor and supervise all the activities performed by subordinates and ensure optimization to achieve the set goals</p> <p><b>P3.</b> Document all performance indicators and metrics of subordinates in the prescribed format of organization</p> <p><b>P4.</b> Ensure and implement proper process flow for feedbacks and queries received from subordinates</p>
2. Evaluate performance of all subordinates and reporting executives	<p><b>P1.</b> Set goals and targets as per organizational directives for all reporting executives</p> <p><b>P2.</b> Create quantified measures and metrics to analyze the performance delivered by subordinates</p> <p><b>P3.</b> Set tangible and achievable incentives for subordinates as per the goals and targets assigned</p> <p><b>P4.</b> Assist and support reporting executives whenever necessary or applicable</p> <p><b>P5.</b> Evaluate performance of subordinates and reporting executives on the designed measures and metrics as per the guidelines of the organization</p> <p><b>P6.</b> Perform all appraisal related process flow for subordinates, as per respective performance documents</p> <p><b>P7.</b> Handover all the documents and appropriate support measures to human resources department for official records</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:



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- Standard operating procedures of the organization for appraisals, incentives, promotions and performance evaluation.
- Standard operating procedures for query and problem reporting and their redressal in the organization
- Framework and guidelines prescribed by the organization for query and problem redressal
- Framework and guidelines prescribed by the organization for performance evaluations and based appraisals out of it
- Documentation requirements for each procedure carried out as part of roles and responsibilities
- Institutional and professional code of ethics and standards of practice
- Safety and health policies and regulations for the workplace.



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### 0713E&E-95. Plan and Organize Work to Meet Expected Outcomes

#### Overview

This Competency Standard identifies the competencies required to plan and organize work to meet expected outcomes. Student underpinning knowledge regarding planning and organizing individual's work in order to complete it to the required standards, on time and within budget in terms of cost and material will be sufficient to provide the basis for this task.

Competency Units	Knowledge Criteria
1. Set quality standards for Work requirements including various activities within the given time	<p><b>P1.</b> Keep immediate work area clean and tidy</p> <p><b>P2.</b> Treat confidential information as per the organization's guidelines</p> <p><b>P3.</b> Work in line with organization's policies and procedures</p> <p><b>P4.</b> Work within the limits of job role</p> <p><b>P5.</b> Obtain guidance from appropriate people, where necessary</p> <p><b>P6.</b> Ensure work meets the agreed requirements</p>
2. Use Appropriate resources	<p><b>P1.</b> Establish and agree on work requirements with appropriate people</p> <p><b>P2.</b> Manage time, materials and cost effectively</p> <p><b>P3.</b> Use resources in a responsible manner</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:

- The organization's policies, procedures and priorities for area of work, role and responsibilities in carrying out that work
- The limits of responsibilities and when to involve others
- Specific work requirements and who these must be agreed with
- The importance of having a tidy work area and how to do this
- How to prioritize workload according to urgency and importance and the benefits
- The organization's policies and procedures for dealing with confidential information and the importance of complying
- The purpose of keeping others updated with the progress of work
- Who to obtain guidance from and the typical circumstances when this may be required?
- The purpose and value of being flexible and adapting work plans



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### 0713E&E-96. Work Effectively in a Team

#### Overview

This Competency Standard identifies the competencies required to work effectively in a team. Student underpinning knowledge regarding working effectively with colleagues, either in own work group or in other work groups within organization will be sufficient to provide the basis for this task.

Competency Units	Knowledge Criteria
<b>1. Interact and communicate effectively with colleagues</b>	<p><b>P1.</b> Maintain clear communication with colleagues (including face-to-face, telephonic as well as written)</p> <p><b>P2.</b> Support colleagues to integrate work</p> <p><b>P3.</b> Pass on information to colleagues in line with organizational requirements both through verbal as well as non-verbal means</p> <p><b>P4.</b> Accomplish work in ways that show respect for colleagues</p> <p><b>P5.</b> Carry out commitments made to colleagues</p> <p><b>P6.</b> Identify problems in working with colleagues and take the initiative to solve these problems</p>
<b>2. Interact &amp; communicate With other stack holders.</b>	<p><b>P1.</b> Maintain clear communication with stockholder (including face-to-face, telephonic as well as written)</p> <p><b>P2.</b> Follow the automobile sector policies and procedures for working with stockholders.</p> <p><b>P3.</b> Present all types of information to stack holders when it is required.</p> <p><b>P4.</b> Obey the rules and regulations as per Govt. policy.</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:

1. The organization’s policies and procedures for working with colleagues, role and responsibilities in relation to this
2. The importance of effective communication and establishing good working relationships with colleagues
3. Different methods of communication and the circumstances in which it is appropriate to use these





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4. The importance of creating an environment of trust and mutual respect
5. The implications of own work on the work and schedule of others.
6. Record keeping and reporting



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### 0713E&E-97. Maintain Healthy, Safe and Secure Working Environment

#### Overview

This Competency Standard identifies the competencies required to maintain healthy, safe and secure working environment. Student underpinning knowledge regarding monitoring workplace practices and making sure they meet requirements for health, safety, security and environmental concerns will be sufficient to provide the basis for this task.

#### Competency Units

#### Knowledge Criteria

#### 1. Need Resources to maintain a safe, secure working environment

- P1. Comply with organization’s current health, safety and security policies and procedures
- P2. Report any identified breaches in health, safety, and security policies and procedures to the designated person
- P3. Coordinate with other resources at the workplace to achieve the healthy, safe and secure environment for all incorporating all government norms esp. for emergency situations like fires, earthquakes etc.
- P4. Identify and correct any hazards like illness, accidents, fires or any other natural calamity safely and within the limits of individual’ authority
- P5. Report any hazards outside the individual’s authority to the relevant person in line with organizational procedures and warn other people who may be affected
- P6. Follow organization’s emergency procedures for accidents, fires or any other natural calamity
- P7. Identify and recommend opportunities for improving health, safety, and security to the designated person
- P8. Complete all health and safety records are updates and procedures well defined

#### 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:

- The organization’s policies and procedures for working with colleagues, role and responsibilities in relation to this
- The importance of effective communication and establishing good working relationships with colleagues
- Different methods of communication and the circumstances in which it is appropriate to use these
- The importance of creating an environment of trust and mutual respect
- The implications of own work on the work and schedule of others.



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- Record keeping and reporting



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### 0713E&E-98. Deal with Emergencies and Incidents at Workshop

#### Overview

This Competency Standard identifies the competencies required to deal with emergencies and incidents at workshop. Student underpinning knowledge regarding to deal with emergencies and incidents at workshop will be sufficient to provide the basis for this task.

#### Competency Units

#### Knowledge Criteria

#### 1. Deal with emergencies and incidents at workshop

- P1.** Follow organizational procedures while responding to emergencies and incidents at workshop. (SOP)
- P2.** Review organizational procedure periodically  
Procedures: Laid down SOPs for dealing with accidents, emergency or untoward security situation
- P3.** Train and prepare Staff to respond to emergencies and incidents at workshop.
- P4.** Take appropriate action  
Appropriate Actions: Respond with equipment/ aid at hand, Request for qualified assistance, evacuate people; isolate area; inform and brief relevant authorities and maintain order, Maintain safety of self and others
- P5.** Identify and investigate causes of alarms  
Alarm and Sensors: Against intrusion & forced entry, for heat, smoke & fire, SOS from residents, medical emergencies, elevator/ escalator crisis, gas leak, electrical short circuit, other alarms from building management system, environmental hazards, and CCTV
- P6.** Communicate information and seek assistance
- P7.** Ensure health and safety while responding to risks and threats

#### 2. Reduce risks to health and safety at the workplace

- P1.** Carry out security operations in line with workplace health and safety norms
- P2.** Identify the main safety and health related threat/ risks within the premises i.e. Fires, Electric short circuit; electric shock and electrocution, Medical emergency, Inflammable & toxic chemicals gases, Falls; trips and slips, Natural calamities, Equipment malfunction, Poor ventilation and suffocation, Improper use of personal safety gear and no adherence to safety norms, Ergonomic risks pertaining to long and static postures; prolonged use of computer and viewing of monitor, Poor hygiene and sanitation conditions, Extreme temperature conditions
- P3.** Participate in discussions/ training on safety and health issues



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- P4.** Implement health and safety related procedures
- P5.** Enforce the use of personal protective equipment (PPE) by stakeholders
- P6.** Ensure safety of self and others while carrying out duties
- P7.** Identify key people for anchoring safety and health related roles
- P8.** Organize required equipment/ resources
- P9.** Organize awareness training for stakeholders
- P10.** Organize and train emergency response teams (ERT)
- P11.** Maintain the desired state of readiness for dealing with emergencies
- P12.** Ensure placement of equipment and signage as per plan
- P13.** Organize periodic mock drills/ rehearsals
- P14.** Deal with hazards and report based on operational procedures
- P15.** Report and record safety and health incidents.

### 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:

- Policy/ procedures/ guidelines related to workplace health and safety
- Responsibilities of the security function related to health and safety
- Limits and responsibilities of the security unit
- Organizational procedure for handling different levels of risks
- Reporting protocol for health and safety matters
- Communication protocol
  - Documentation formats and reports to be maintained the seer/individual on the job needs to know and understand:
- Organizational procedures relating to communication
- Details of stakeholders/ concerned agencies
- Means of available communication
- Details of security functions that need employers' approval
- Format and process for obtaining feedback Format: Written and electronic
- Organization's standards of communication, behavior and courtesy
- Resolution process for queries/ complaints of stakeholders
- Communication etiquette to be followed by the security unit
- Gender, cultural, religious and other sensitivities
- Organizational procedure for recording and sharing of information
- Timelines and periodicity for submission of reports/ documentation. Documentation:
  - Relating to operations, training and administration
- Frequency for reviewing records maintained by security unit



## ***National Competency Standards Level-5 for “HVACR”***



- Storage and archival policy/ processes followed by the organization
- Details of stakeholders/ agencies authorized to receive information
- Record keeping and reporting



## National Competency Standards Level-5 for “HVACR”



### 0713E&E-99. Maintain Effective Communication with HVAC Companies

#### Overview

This Competency Standard identifies the competencies required to maintain effective communication with HVAC companies. Your underpinning knowledge regarding effective communication with HVAC companies / dealers and carry out the review role-related documentation will be sufficient to provide the basis for this task.

<b>1. Communicate effectively with Stakeholders</b>	<p><b>P1.</b> Communicate effectively with stakeholders on security functions i.e. residents, resident’s welfare association members, visitors, workers, staff, vendors, facility management, service providers and maintenance staff</p> <p><b>P2.</b> Establish a system of receiving feedback from stakeholders</p> <p><b>P3.</b> Enforce organization’s standards of communication, behavior and courtesy within the security unit Operate communication equipment effectively Communication Equipment: Walkie-talkie, telephone, intercom, mobile phone, signage, whistle, light signals, hand signals, field signals</p> <p><b>P4.</b> Communicate security-related protocol to stakeholders</p> <p><b>P5.</b> Interact with stakeholders to understand their requirements</p> <p><b>P6.</b> Interact with media on instructions</p> <p><b>P7.</b> Resolve queries/ complaints of stakeholders as per procedure</p> <p><b>P8.</b> Train the security personnel in required communication etiquettes</p> <p><b>P9.</b> Educate security staff on gender, cultural and religious sensitivities</p> <p><b>P1.</b> Intervene and resolve instances of aggressive and unruly behavior</p>
<b>2. Carry out and review role-related documentation</b>	<p><b>P2.</b> Identify essential documents to be completed and maintained by the security unit</p> <p><b>P3.</b> Finalize the format for recording information/ incidents as per organizational procedure</p> <p><b>P4.</b> Decide on timelines and frequency for submission of reports</p> <p><b>P5.</b> Use computers and other equipment to facilitate documentation</p> <p><b>P6.</b> Record and store documents as per organizational procedure</p> <p><b>P7.</b> Forward report/ feedback to designated superior</p> <p><b>P8.</b> Store and handle information/ media generated by the security equipment(s)</p> <p><b>P9.</b> Handle electronic media and archive to store</p>



## National Competency Standards Level-5 for “HVACR”



	<p>information/ documents safely Information: Written, verbal, electronic, and public-address system</p> <p><b>P10.</b> Share information with authorized stakeholders on a ‘need-to-know’ basis</p> <p><b>P11.</b> Maintain security and confidentiality of information</p>
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### 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:

- Organizational procedures relating to communication
  - Details of stakeholders/ concerned agencies
  - Means of available communication
  - Details of security functions that need employers’ approval
  - Format and process for obtaining feedback Format: Written and electronic
  - Organization’s standards of communication, behavior and courtesy
  - Resolution process for queries/ complaints of stakeholders
  - Communication etiquette to be followed by the security unit
  - Gender, cultural, religious and other sensitivities
  - Organizational procedure for recording and sharing of information
  - Timelines and periodicity for submission of reports/ documentation. Documentation: Relating to operations, training and administration
  - Frequency for reviewing records maintained by security unit
  - Storage and archival policy/ processes followed by the organization
  - Details of stakeholders/ agencies authorized to receive information.
  - Record keeping and reporting
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## National Competency Standards Level-5 for "HVACR"



Islamabad 31<sup>st</sup> May, 2019

### NOTIFICATION

**No. F. 5(13)/2018-DD (TE):** In pursuance of sub-section (d) of section-6" Functions of the Commission" National Vocational & Technical Training Commission (NAVTTTC) Act-2011, NAVTTTC is pleased to approve and notify following qualifications in twenty (20) trades for Level 1-5 under National Vocational Qualification Framework (NVQF), which have been developed in compatibility with latest global trends in the fields and fulfilling requirements of competency based training and assessment (CBT&A) system. The qualifications have been developed and validated in collaboration with TEVTAs, QABs, industry and other relevant stakeholders: -

S#	National Vocational Qualifications
1.	National Qualification Level-5 diploma in Automobile Technology
2.	National Qualification Level-5 diploma in Civil Technology
3.	National Qualification Level-5 diploma in Construction Technology
4.	National Qualification Level-5 diploma in Information & Commutation Technology (ICT)
5.	National Qualification Level-5 diploma in Garment Manufacturing Technology
6.	National Qualification Level-5 diploma in HVACR
7.	National Qualification Level-5 diploma in Electronics Technology
8.	National Qualification Level-5 diploma in Instrumentation Technology
9.	National Qualification Level-5 diploma in Computer Aided Design & Manufacturing (CAD /CAM)
10.	National Qualification Level-5 diploma in Mechanical Technology
11.	National Qualification Level-5 diploma in Graphics Designing
12.	National Qualification Level-5 diploma in Heating, Ventilation, Air-conditioning & Refrigeration (HVACR) Technology
13.	National Qualification Level-5 diploma in Media Production
14.	National Qualification Level-5 diploma in Hotel Management
15.	National Qualification Level-5 diploma in Professional Chef
16.	National Qualification Level-5 diploma in Tourism Management



## National Competency Standards Level-5 for "HVACR"



17.	National Qualification Level-5 diploma in Hair & Beauty Services
18.	National Qualification Level-5 diploma in Fashion Designing
19.	National Qualification Level-5 diploma in Ceramics Technology
20.	National Qualification Level-5 diploma in Telecom Technology

2. All the TVET related institutions / organizations are required to implement aforementioned qualifications so that a uniform and standardized TVET qualification system is established in Pakistan and efforts are made for international equivalence / recognition of these qualifications.

3. Competency Standards of the above enlisted qualifications can be accessed at NAVTTC's website ([www.navttc.org](http://www.navttc.org)).

**(Muqem Islam)**

Director General (Skill Standards & Curricula)

Phone: 051-9215385

### **Distribution:**

1. Federal Secretary, Ministry of Federal Education & Professional Training, Govt of Pakistan
2. Federal Secretary, Ministry of Overseas Pakistanis and Human Resource Development, Govt of Pakistan, Islamabad
3. Federal Secretary, Ministry of Industry and Production, Govt of Pakistan, Islamabad
4. Federal Secretary, Ministry of Textile Industry, Govt of Pakistan, Islamabad
5. Federal Secretary, Ministry of Commerce, Govt of Pakistan, Islamabad
6. Federal Secretary, Ministry of Railway, Govt of Pakistan, Islamabad
7. Federal Secretary, Ministry of Climate Change, Govt of Pakistan, Islamabad
8. Federal Secretary, Ministry of Religious Affairs, Govt of Pakistan, Islamabad
9. Federal Secretary, Ministry of Communication, Govt of Pakistan, Islamabad
10. Federal Secretary, Ministry of Aviation Division, Govt of Pakistan, Islamabad



## ***National Competency Standards Level-5 for “HVACR”***



11. Federal Secretary, Ministry of Science & Technology, Govt of Pakistan, Islamabad
12. Chairperson, Punjab Technical Education and Vocational Training Authority (P-TEVTA), Lahore
13. Managing Director, Khyber Pakhtunkhwa Technical Education and Vocational Training Authority (KP-TEVTA),
14. Managing Director, Sindh Technical Education and Vocational Training Authority (S-TEVTA), Karachi
15. Chairman, Azad Jammu & Kashmir, Technical Education and Vocational Training Authority (AJ&K TEVTA), Muzafarabad
16. Director TVET Cell, Gilgit Baltistan, Gilgit
17. Director General, Punjab Vocational Training Council (PVTC), Punjab
18. Managing Director, Technology Upgradation and Skill Development Company (TUSDEC) Lahore
19. Project Director, Punjab Skill Development Program (PSDP) Lahore
20. CEO, Punjab Skill Development Fund, Lahore
21. Rector, UNTECH University Islamabad
22. National Deputy Leader, GIZ Islamabad
23. PS to Minister of Federal Education & Professional Training, Govt of Pakistan
24. PS to Special Adviser to the Prime Minister on Youth Affairs, Prime Minister's Office, Islamabad
25. Chairperson, Federal of Pakistan Chamber of Commerce and Industry (FPCCI), Karachi
26. Conveyor, Sector Skills Council (Textile/ Construction/ Renewable Energy/ Hospitality and Tourism)
27. Director Technical Education and Vocational Training Authorities (TEVTA), Balochistan
28. Chairman, Pakistan Tourism Development Corporation, Lahore
29. Chairman, PCSIR Headquarters, Islamabad
30. Director General, Pakistan Forest Institute, Peshawar
31. Chairman, Wafaq ul Madaris, Multan
32. Director General, Staff Welfare, Islamabad
33. Director General, NISTE Capital Administration and Development Division, Islamabad
34. Director General, National Training Bureau, Islamabad
35. Chairmen, Provincial Technical Education Boards
36. Chairmen, Provincial Trade Testing Boards



## ***National Competency Standards Level-5 for “HVACR”***



37. Secretary, IBCC, Islamabad: *with the request that National qualifications of Level 5 diploma in the aforementioned trades may be considered equivalent to Diploma of Associate Engineer/HSSC after inclusion of compulsory courses in the light of IBCC general requirement.*

### **Copy for information to: -**

1. DG (P&D)/(A&F)/ (A&C) (S&C) NAVTTC
2. Director General(s), NAVTTC Regional Office(s).
3. Sr. Technical Advisor, TSSP-GIZ
4. Staff Officer to Chairman, NAVTTC
5. PS to Executive Director, NAVTTC Islamabad
6. Concerned File/ Office Copy



***National Competency Standards Level-5 for “HVACR”***

