Jabatan Pembangunan Kemahiran
Kementerian Sumber Manusia, Malaysia

NATIONAL OCCUPATIONAL SKILLS STANDARD
(STANDARD KEMAHIRAN PEKERJAAN KEBANGSAAN)

F432-007-3:2020

HEATING, VENTILATION, AIR-CONDITIONING (HVAC) SINGLE PHASE INSTALLATION AND MAINTENANCE

PEMASANGAN DAN PENYELENGGARAAN SATU FASA PENYAMANAN UDARA, PENGUDARAAN, PEMANASAN (HVAC)

LEVEL 3

Department of Skills Development (DSD)
Federal Government Administrative Centre
62530 PUTRAJAYA, MALAYSIA

NATIONAL OCCUPATIONAL SKILLS STANDARD

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Preface

Standard Definition

The National Occupational Skills Standard (NOSS) is a Standard document that outlines the **minimum** competencies required by a skilled worker working in Malaysia for a particular area and level of occupational, also the path to achieve the competencies. The competencies are based on the needs of employment, according to the career structure for the occupational area and developed by industry experts and skilled workers.

The National Competency Standard (NCS) is a Standard document that outlines the competencies required by a skilled worker in Malaysia.

Description of Standard Components

The document is divided into three (3) components which includes: -

Component I **Standard Practice**
This component is about the information related to occupational area including introduction to the industry, Standard requirements, occupational structure, levelling of competency, authority and industry requirements as a whole.

Component II **Standard Content**
This component is a reference to industry employers in assessing and improving the competencies that is required for a skilled worker. The competencies are specific to the occupational area. The component is divided into two (2) section which are the chart (Competency Profile Chart, CPC) and details of the competencies (Competency Profile, CP).

Component III **Curriculum of Competency Unit**
This component is a reference for the training personnel to identify training requirements, design the curriculum, and develop assessment. The training hours that included in this component is based on the recommendations by the Standard Development Committee (SDC). If there are modifications to the training hours, the Department provides the medium for discussion and consideration for the matter.

Abbreviation

1	DOSH	Department of Occupational Safety and Health
2	CSTP	Certified Service Technician Programme
3	DSD	Department of Skill Development
4	GSP	Good Service and Practices
5	HSE	Health, Safety and Environment
6	HVAC	Heating, Ventilation, Air Conditioning
7	IR	Industrial Revolution
8	MACRA	Malaysian Air-Conditioning & Refrigeration Association
9	MSC	Malaysian Skills Certificate
10	NOSS	National Occupational Skills Standard
11	ODS	Ozone Depleting Substances
12	OSHE	Occupational Safety, Health and Environment
13	PVC	Polymerizing Vinyl Chloride
14	RAC	Refrigeration and Air Conditioning
15	SOP	Standard Operating Procedures

Glossary

1	Air changes per hour	The hourly ventilation rate divided by the volume of a space. For perfectly mixed air or laminar flow spaces, this is equal to the number of times per hour that the volume the space is exchanged by mechanical and natural ventilation. Also called air change rate or air exchange rate. Abbreviated ACH or ac/hr.
2	Air conditioner	An appliance, system, or mechanism designed to dehumidify and extract heat from an area. Usually this term is reserved for smaller self-contained units such as a residential system.
3	Centrifugal fan	A centrifugal fan is a mechanical device for moving air or other gases.
4	Chiller	A device that removes heat from a liquid via a vapour-compression or absorption refrigeration cycle. This cooled liquid flows through pipes in a building and passes through coils in air handlers, fan-coil units, or other systems, cooling and usually dehumidifying the air in the building. Chillers are of two types; air-cooled or water-cooled. Air-cooled chillers are usually outside and consist of condenser coils cooled by fan-driven air. Water-cooled chillers are usually inside a building, and heat from these chillers is carried by recirculating water to a heat sink such as an outdoor cooling tower.
5	Coil	Equipment that performs heat transfer to air when mounted inside an air handling unit or ductworks. It is heated or cooled by electrical means or by circulating liquid or steam within it.
6	Condenser	A component in the basic refrigeration cycle that ejects or removes heat from the system. The condenser is the hot side of an air conditioner or heat pump. Condensers are heat exchangers, and can transfer heat to air or to an intermediate fluid (such as water or an aqueous solution of ethylene glycol) to carry heat to a distant sink, such as ground (earth sink), a body of water, or air (as with cooling towers).
7	Constant air volume	A device that controls the operation of part or all of a system. It may simply turn a device on and off, or it may more subtly modulate the set point of components. Most controllers are automatic but have user input such as temperature set points, e.g. a thermostat. Controls may be analogue or digital.
8	Dehumidifier	A dehumidifier is the equipment that extracts and removes humidity from the air. It works by cooling air to the point where water turns to liquid from vapour form and then the liquid is removed.
9	Dry bulb temperature	Dry bulb temperature is the temperature of air measured by a thermometer which is freely exposed to the air while it is shielded from radiation and moisture. It is usually thought of as air temperature, and it is the true thermodynamic temperature. It is a measurement of heat intensity independently of humidity and a dry bulb thermometer is used to measure it.

10	Dry bulb thermometer	A dry bulb thermometer is a device that measures air temperature independently of humidity. It is freely exposed to the air it is measuring and is protected from the radiation and moisture.
11	Duct (HVAC)	Specialized housing for the air flow.
12	Evaporator	A component in the basic refrigeration cycle that absorbs or adds heat to the system. Evaporators can be used to absorb heat from air or from a liquid. The evaporator is the cold side of an air conditioner or heat pump.
13	Fan coil unit	A small terminal unit that is often composed of only a blower and a heating and/or cooling coil, as is often used in hotels, condominiums, or apartments. Abbreviated FCU.
14	Flow	A transfer of fluid volume per unit time.
15	Gas furnace heat exchanger	A gas furnace heat exchanger is responsible for the transfer of heat from inside the furnace into the air outside the furnace. The duct system then transfers this exchanged air to different rooms in the building or space.
16	Heat pump	A heat pump is a compressor that cycles hot or cold air. It is a device that is designed to move thermal energy in the opposite direction of heat flow by absorbing heat from a cold space which is released to a warmer space.
17	Heat transfer	Heat transfer happens when heat moves from one area to another. It is an important and vital step in the process of cooling a space.
18	Heating coil	A heat exchanger is the part of the system that transfers heat from the hot parts of the machine or a system to the cold parts of the machine or system.
19	HVAC	Heating, Ventilation, and Air Conditioning is a major sub discipline of mechanical engineering.
20	Industrial refrigerator	An industrial refrigerator is a refrigeration equipment designed for low-temperature processing of food products by creating and maintaining inside the object a specified operating cooling mode, including temperature, humidity, speed for the cooling environment, and sometimes may include pressure and gas composition.
21	Industrial Revolution (IR) 4.0	The subset of the fourth industrial revolution that concerns industry. The fourth industrial revolution encompasses areas which are not normally classified as industry, such as smart cities for instance.
22	ODS	Ozone depleting substances are chemicals that destroy the earth's protective ozone layer.
23	Sub cooling	The condition where liquid refrigerant is colder than the minimum temperature required to keep it from boiling which would change it from a liquid to a gas phase. Sub cooling is the difference between its saturation temperature and the actual liquid refrigerant temperature.
24	Superheat	The number of degrees a vapour is above its boiling point at a specific pressure.
25	Terminal unit	A small component that contains a heating coil, cooling coil, automatic damper, or some combination of the three. Used to control the temperature of a single room. Abbreviated TU.

26	Two-stage (cooling and heating)	A two-stage air conditioner is designed to operate on high and low settings during different weather conditions and seasons. The high setting is used during extreme weather, and the low setting is used during moderate weather. This type of air conditioner produces a balanced temperature and is in use for a longer period of time.
27	TXV - Thermostatic Expansion Valve	A thermostatic expansion valve is a piece of equipment that meters the flow of liquid refrigerant into the evaporator while measuring the vapour refrigerant leaving the evaporator. It thereby controls the superheating at the outlet of the evaporator.

List of Figure

1. Figure 1 Occupational Structure of HVAC Single Phase
2. Figure 2 Occupational Area Structure of HVAC Single Phase

Acknowledgement

Director General of Department of Skills Development (DSD) would like to extend his gratitude to the National Skills Development Council (MPKK), Standard Technical Committee (JTS), Standard Technical Evaluation Committee (JTPS), Standard Development Committee (JPS), and organisation and individuals who have been involved directly or indirectly for the contribution, persistence and support in the development of this Standard until it is completed.

The Director General of DSD also would like to express his sincere thanks to Department of Environmental (DOE) officer the support and involvement of HVAC Single Phase experts as a major contributor, En. Sukri Bin Awang for supervision of development session.

STANDARD PRACTICE

NATIONAL OCCUPATIONAL SKILLS STANDARD (NOSS) FOR:

HEATING, VENTILATION, AIR-CONDITIONING (HVAC) SINGLE PHASE INSTALLATION AND MAINTENANCE

LEVEL 3

1. Introduction

1.1 Occupation Overview

Heating, Ventilation, Air-Conditioning (HVAC) Single Phase Installation and Maintenance is to ascertain equipment meeting environmental conditions including air temperature, air motion, moisture level, radiant heat energy level, dust, various pollutants, and microorganisms.

The main key function of Heating Ventilation Air Conditioning (HVAC) personnel are to provide comfort air conditioning refers to control of spaces to promote the comfort, health, or productivity of the inhabitants. Spaces in which air is conditioned for comfort include residences, offices, institutions, sports arenas, hotels, factory works areas, and motor vehicles. Process air-conditioning systems are designed to facilitate the functioning of a production, manufacturing, or operational activity.

In order to generate skilful and experience labour or personnel in Heating Ventilation Air Conditioning (HVAC) industry, the NOSS is being developed. This NOSS document is structured to be used for constructing the competencies needed in the HVAC fieldworks as per discussion made by the experts from the HVAC industry. Personnel who used this level 2 of NOSS will have competency in technical skill such as service technician in performing maintenance of small Ventilation fan, Heating and Air-Cooled Split Unit. Later, personnel will use this level of skill in order to gain better income based on experience, ability and organization they have been hired itself. Further, this NOSS has arranged and developed accordingly from the discussion made by the industrial experts and based on what the industry's needs. Thus, we hope this NOSS will be usable to produce the most skilful labour or personnel for the betterment of the HVAC industry and country as well.

In Malaysia, there numerous companies or organization that support and provide training in Heating Ventilation Air Conditioning (HVAC) industry such as Malaysian Air-Conditioning & Refrigeration Association (MACRA). Personnel who are inspired and interested in this industry may enrol within the minimum requirement based on the discussion made by the experts; possesses minimum SPM and medically fit.

1.2 Rationale of NOSS Development

This is a reviewed NOSS ME-020-2:2012 HVAC Single Phase Air Conditioning Equipment (Installation, Servicing, Troubleshooting and Repair) and ME-020-3:2012 HVAC Installation and Maintenance Supervision which addresses level 2 and 3. Department of Skills Development (DSD) suggested that this NOSS be reviewed due to the current regulation and skills requirements. The regulation and skills requirements encompass the element of gas disposal and handling during the installation and maintenance of HVAC equipment. Elements of Industrial Revolution (IR) 4.0 also need to be address in the new NOSS (reviewed).

1.3 Rationale of Occupational Structure and Occupational Area Structure

The panel of experts conclude that this reviewed NOSS be developed at Level 3, to justify that the nature of Level 2 and Level 3 competencies are holistic to produce a works cycle.

1.4 Regulatory/Statutory Body Requirements Related to Occupation

a) Department of Environment;
b) Occupational Safety, Health and Environment (OSHE); and
c) Department of Occupational Safety and Health (DOSH) Ministry of Human Resources.

1.5 Occupational Prerequisite

The minimum requirement set forth by the industry for interested individual to undertake the job or career in this area are as follows;

a) Must not be colour blind.

1.6 General Training Prerequisite for Malaysian Skills Certification System

Certified Service Technician Programme (CSTP) Refrigeration and Air Conditioning (RAC) sector upon completion of single-phase air-conditioning equipment maintenance.

2. Occupational Structure (OS)

Section	(F) Specialized Construction Activities	
Group	(432) Electrical, Plumbing and Other Construction Installation Activities	
Area	HVAC Single Phase	HVAC Three Phase
Level 5	Foreman	Foreman
Level 4	Assistant Foreman	Assistant Foreman
Level 3	Senior Technician	Senior Technician
Level 2	Technician	Technician
Level 1	Junior Technician	Junior Technician

Figure 1: Occupational Structure of HVAC Single Phase

3. Occupational Area Structure (OAS)

Section	(F) Specialized Construction Activities	
Group	(432) Electrical, Plumbing and Other Construction Installation Activities	
Area	HVAC Single Phase	HVAC Three Phase
Level 5	HVAC Installation and Maintenance Engineering	HVAC Installation and Maintenance Engineering
Level 4	HVAC Installation and Maintenance Coordination	HVAC Installation and Maintenance Coordination
Level 3	HVAC Single Phase Installation and Maintenance	HVAC Three Phase Installation and Maintenance
Level 2	Embedded to L3	Embedded to L3
Level 1	Embedded to L3	Embedded to L3

Figure 2: Occupational Area Structure of HVAC Single Phase

4. Definition of Competency Levels

The NOSS is developed for various occupational areas. Below is a guideline of each NOSS Level as defined by the Department of Skills Development, Ministry of Human Resources, Malaysia.

Level 1: Competent in performing a range of varied work activities, most of which are routine and predictable.

Level 2: Competent in performing a significant range of varied work activities, performed in a variety of contexts. Some of the activities are non-routine and required individual responsibility and autonomy.

Level 3: Competent in performing a broad range of varied work activities, performed in a variety of contexts, most of which are complex and non-routine. There is considerable responsibility and autonomy and control or guidance of others is often required.

Level 4: Competent in performing a broad range of complex technical or professional work activities performed in a wide variety of contexts and with a substantial degree of personal responsibility and autonomy. Responsibility for the work of others and allocation of resources is often present.

Level 5: Competent in applying a significant range of fundamental principles and complex techniques across a wide and often unpredictable variety of contexts. Very substantial personal autonomy and often significant responsibility for the work of others and for the allocation of substantial resources features strongly, as do personal accountabilities for analysis, diagnosis, planning, execution and evaluation.

5. Award of Certificate

The Director General may award, to any person upon conforming to the Standards the following skills qualifications as stipulated under the National Skills Development Act 2006 (Act 652):

a) Malaysian Skills Certificate (MSC) Level 3; or
b) Statements of Achievement.

6. Occupational Competencies

The Heating, Ventilation, Air-Conditioning (HVAC) Single Phase Installation and Maintenance Level 3 personnel are competent in performing the following core competencies:

a) Single Phase Heating Equipment Installation;
b) Single Phase Ventilation Equipment Installation;
c) Single Phase Air-Conditioning Equipment Installation;
d) HVAC Equipment Testing and Commissioning;
e) Single Phase Heating Equipment Maintenance;
f) Single Phase Ventilation Equipment Maintenance;
g) Single Phase Air-Conditioning Equipment Maintenance; and
h) HVAC Single Phase Installation and Maintenance Supervision.

7. Work Conditions

Service technician in commercial sector usually works either under supervision of the company or works himself in a small size of business. They must be meticulous in selecting the appropriate tools and be precise in completing their service job. They are also doing service within the time given. Therefore, the time management, self-discipline and prioritizing skill are highly emphasized. Mostly service technician works in hours are around 8 to 12 hour per day. They are also facing various kind of risk. In order to gain a safety vies condition, they must be equipped with precaution knowledge towards uncertainties conditions. In this commercial sector, a service technician should be able have knowledge in sales and promote their service in giving good and better services towards customer. This is due to build and maintain customer satisfaction.

8. Employment Prospects

Heating Ventilation Air Conditioning (HVAC) industry in this country plays major in developing the economy vision and achievement. Malaysia had played the role as among the biggest manufactured in air conditioning equipment.

A career as service technician in Heating Ventilation Air Conditioning (HVAC) industry has wide prospect in enhancing their career. This is due to the needs of industries maintaining and servicing in air conditioning equipment.

There are many factors which make the industries so extremely demand by the private and government sector. Air Conditioning is not a luxury item anymore.

It is a necessary item that everybody is now owned and used the air condition regardless domestic houses or even big organization's buildings. Air conditioning equipment is necessity for the society to live in a comfortable environment due to changeability of the world's climate. At this reason, the demand of skilful, knowledgeable and experience service technician is emphasised.

Every industries sector such as factory plant, hospital, government's building, hotel, university, museums, hypermarket and etc. could not be avoided in using air conditioning & ventilation. In order to maintain industries productivity, humidity and temperature in any spaces of room in a comfortable, cool and healthy air circulation and again, multi skilled service technicians is needed. They must be able to have a capability to identified, installation, servicing, trouble shooting and repair any domestic air conditioning & ventilation. In addition, this industry may help personnel enhance and cultivate service and maintenance skills to be commercialized and profitable for new business persona in HVAC industry.

Besides, personnel in this HVAC industry may be able to use their skills and abilities in many sectors such as in education and training, business, manufacturing and many more towards the Malaysia vision in producing skilful labour for international markets.

9. Up Skilling Opportunities

The works force of HVAC industry can upgrade their skills by means of training and certification by recognised body or authority related to their skill trade. Career progress available for personnel who have related works in experience, who know their job well and also who have supervisory ability. Advancement and opportunity to lead a group of persons as a supervisor and as a manager is possible in many factories. Those who understand and can apply the knowledge or procedures of HVAC and also able to manage people, are the most likely to be promoted. For now, there are no professional certificate available for this industry.

10. Organisation Reference for Sources of Additional Information

The following organisations can be referred as sources of additional information which can assist in defining the document's contents.

a) Department of Environment (DOE)
Ministry of Energy, Science, Technology, Environment,
and Climate Chance (MESTECC),
Level 1-4, Podium 2&3, No. 25, Wisma Sumber Asli
62574 Persiaran Perdana, Percint 4,
Putrajaya.
Tel: 03-8889 1972
Website: http://www.doe.gov.my
Email: aduan_k@doe.gov.my

b) Department of Occupational Safety and Health (DOSH)
Level 1 3 4 & 5 Block D3,
Komplek D, Pusat Pentadbiran Kerajaan Persekutuan,
62000 Wilayah Persekutuan, Putrajaya.
Tel: 03- 8886 5383
Website: http://www.dosh.gov.my
Email: projkkp@mohr.gov.my

c) Malaysian Air-Conditioning & Refrigeration Association (MACRA)
No. 27-3, Jalan 1/16B,
Kuchai Entrepreneur's Park Off,
Jalan Kuchai Lama 58200,
Kuala Lumpur.
Tel: 03-7984 9106
Website: http://www.macra.org.my
Email: ict@macra.org.my

d) Energy Commission (Suruhanjaya Tenaga)
No. 12, Jalan Tun Hussien, Precint 2,
62100 Putrajaya,
Malaysia.
Tel: 03-8870 8500
Website: http://www.st.gov.my
Email: info@st.gov.my

11. Standard Technical Evaluation Committee

NO	NAME	POSITION & ORGANISATION
CHAIRMAN		
1	Mohd Yazid B. Awaluddin	Director Department of Skills Development
EVALUATION PANEL		
1	Amy Charlene Wong	Senior Environmental Officials Department of Environmental (DOE)
2	Muhammad Azli B. Shariff	Director MPTEC Enterprise
3	Mazlan B. Abu Bakar	Director Prihoda Sdn. Bhd.
4	Wong Siew Loon	Engineer Iknowledge Sdn. Bhd.
SECRETARIAT		
1	Sukri B. Awang	Senior Assistant Director Department of Skills Development

12. Standard Development Committee

HEATING, VENTILATION, AIR-CONDITIONING (HVAC) SINGLE PHASE INSTALLATION AND MAINTENANCE

LEVEL 3

NO	NAME	POSITION & ORGANISATION
DEVELOPMENT PANEL		
1	Mohamad Fauzi Bin Abdul Aziz	Assistant Control Officer Environment Department of Environmental (DOE)
2	Amran Bin Ismail	Instructor Industrial Training Institute, Manpower Department
3	Zulkifly Bin Bakron	Senior Supervisor ADEM Engineering
4	Muhamad Shafei Bin Nordin	Senior Technician Miza Shafei Resources
5	Ramesh A/L Kuppan	Senior Technician Yokotech Aircond & Electrical
6	Razman Bin Mohamed	Senior Technician RM Condition
7	Sharriza Bin Omar	Senior Technician Avien Enterprise
8	Zunurain Bin Rahman	Senior Technician Eazy Niaga Sdn Bhd
9	Liew Swee Cheong	Technical Supervisor Naluri Merpati Sdn. Bhd.
FACILITATOR		
1	Razalee Bin Che Ros	CIAST/PPL/FDS-016/2012 Total Oracle Sdn. Bhd.

STANDARD CONTENT

NATIONAL OCCUPATIONAL SKILLS STANDARD (NOSS) FOR:

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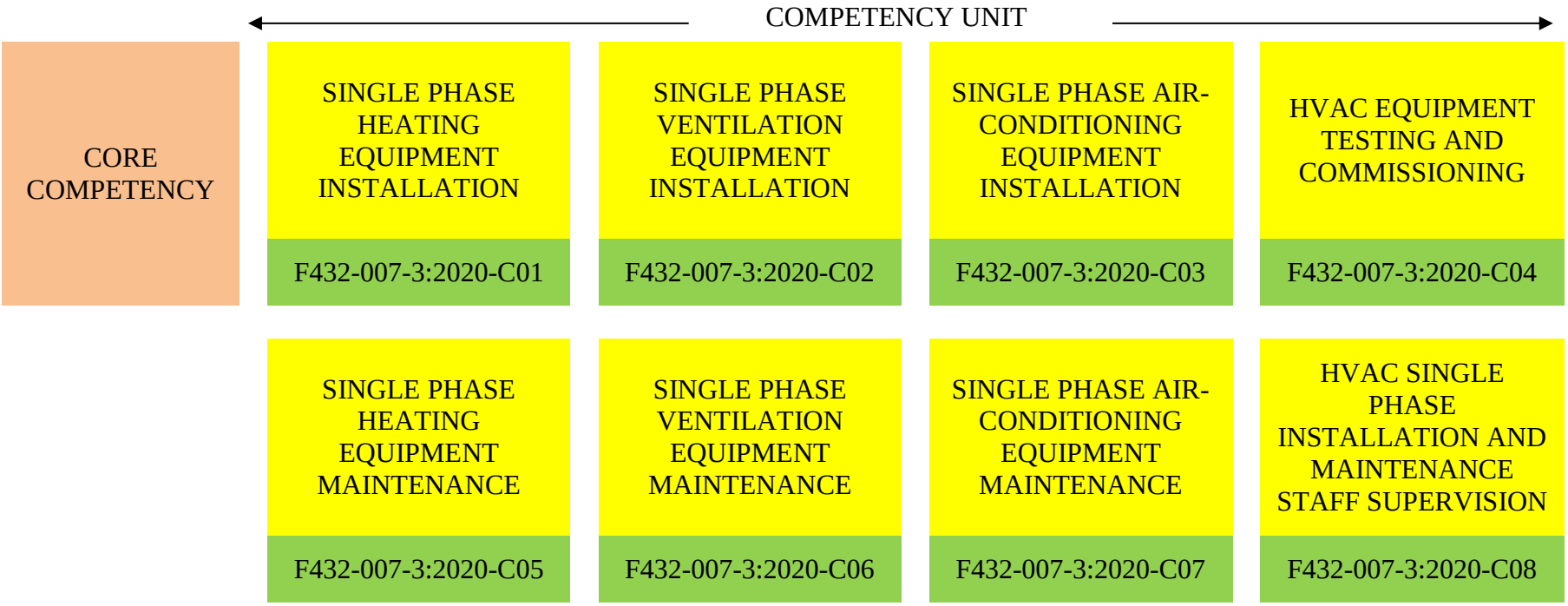
LEVEL 3

13. Competency Profile Chart (CPC)

SECTION	(F) SPECIALIZED CONSTRUCTION ACTIVITIES		
GROUP	(432) ELECTRICAL, PLUMBING AND OTHER CONSTRUCTION INSTALLATION ACTIVITIES		
AREA	HVAC SINGLE PHASE		
NOSS TITLE	HEATING, VENTILATION, AIR-CONDITIONING (HVAC) SINGLE PHASE INSTALLATION AND MAINTENANCE		
NOSS LEVEL	THREE (3)	NOSS CODE	F432-007-3:2020



14. Competency Profile (CP)

SECTION	(F) Specialized Construction Activities		
GROUP	(432) Electrical, Plumbing and Other Construction Installation Activities		
AREA	HVAC Single Phase		
NOSS TITLE	Heating, Ventilation, Air-Conditioning (HVAC) Single Phase Installation and Maintenance		
NOSS LEVEL	Three (3)	NOSS CODE	F432-007-3:2020

CU TITLE & CU CODE	CU DESCRIPTOR	WORKS ACTIVITIES	PERFORMANCE CRITERIA
1 Single Phase Heating Equipment Installation. F432-007-3:2020-C01	Single Phase Heating Equipment Installation describes the installation of heating equipment such as water heater and heater, to provide for consumer's usage at home, industry and offices. The person who is competent in this CU should be able to perform fitting works, install mounting bracket/plate, install piping system, install heating unit, install equipment wiring system and record installation process. The outcomes of this CU are heating equipment safety, performance and energy efficiency complied with manufacturer's specifications Occupational Safety, Health and Environment (OSHE) requirements.	1. Perform fitting works.	1.1 Fitting works selected in accordance with works instruction. 1.2 Fitting materials selected in accordance with works instruction. 1.3 Fitting works produced which include cutting, drilling, bending, joining and assembling in accordance with manufacturer's specifications. 1.4 Tolerance, strength, and levelling confirmed in accordance with manufacturer's specifications.
		2. Install mounting bracket/plate.	2.1 Mounting bracket/plate installation method selected in accordance with works instruction. 2.2 Mounting bracket/plate tools, equipment and materials selected

CU TITLE & CU CODE	CU DESCRIPTOR	WORKS ACTIVITIES	PERFORMANCE CRITERIA
			in accordance with works instruction. 2.3 Levelling of bracket/plate determine in accordance with works instruction. 2.4 Bracket/plate hole visible. 2.5 Wall plug secured at determined position. 2.6 Bracket/plate secured at determined position.
		3. Install piping system.	3.1 Piping system installation method selected in accordance with works instruction. 3.2 Piping system tools, equipment and materials selected in accordance with works instruction. 3.3 Water piping materials which include copper, PVC and ABS secured at specified location. 3.4 No leakage at all fittings confirmed in accordance with manufacturer's and OSHE requirements.

CU TITLE & CU CODE	CU DESCRIPTOR	WORKS ACTIVITIES	PERFORMANCE CRITERIA
		4. Install heating unit.	4.1 Heating unit installation method selected in accordance with works instruction. 4.2 Heating unit tools, equipment and materials selected in accordance with works instruction. 4.3 Heating unit and accessories secured at specified bracket/plate location in accordance with works instruction.
		5. Install equipment wiring system.	5.1 Equipment wiring system installation selected in accordance with works instruction. 5.2 Equipment wiring system tools, equipment and materials selected in accordance with works instruction. 5.3 Power source indicated as per schematic drawing. 5.4 Cable casing secured at determined location. 5.5 Cable connected to the equipment in accordance with manufacturer's specifications. 5.6 Voltage reading obtained in accordance with manufacturer's specifications.

CU TITLE & CU CODE	CU DESCRIPTOR	WORKS ACTIVITIES	PERFORMANCE CRITERIA
		6. Record installation process.	6.1 Installation checklist selected. 6.2 Heating equipment installation process confirmed in accordance with manufacturer's specifications. 6.3 Installation process checklist produced in accordance with organizational requirements.
2 Single Phase Ventilation Equipment Installation. F432-007-3:2020-C02	Single Phase Ventilation Equipment Installation describes the ventilation equipment such as exhaust fan and ducting system, to provide consumer usage at home, industry and offices. The person who is competent in this CU should be able to perform fitting works, install mounting bracket/plate, install ventilation unit, install equipment wiring system, install ventilation ducting system and record installation process. The outcomes of this CU are ventilation equipment safety and performance, complied with manufacturer's specifications and	1. Perform fitting works.	1.1 Fitting works selected in accordance with works instruction. 1.2 Fitting materials selected in accordance with works instruction. 1.3 Fitting works produced which include cutting, drilling, bending, joining and assembling in accordance with manufacturer's specifications. 1.4 Tolerance, strength, and levelling confirmed in accordance with manufacturer's specifications.
		2. Install mounting bracket/plate.	2.1 Mounting bracket/plate installation selected in accordance with works instruction. 2.2 Mounting bracket/plate tools, equipment and materials selected

CU TITLE & CU CODE	CU DESCRIPTOR	WORKS ACTIVITIES	PERFORMANCE CRITERIA
	Occupational Safety, Health and Environment (OSHE) requirements.		in accordance with works instruction. 2.3 Levelling of bracket/plate determined in accordance with works instruction. 2.4 Bracket/plate hole visible. 2.5 Wall plug secured at determined position. 2.6 Bracket/plate secured at determined position.
		3. Install ventilation unit.	3.1 Ventilation unit installation method selected in accordance with works instruction. 3.2 Ventilation unit tools, equipment and materials selected in accordance with works instruction. 3.3 Ventilation unit and accessories secured at specified bracket/plate location in accordance with works instruction.
		4. Install equipment wiring system.	4.1 Equipment wiring system installation method selected in accordance with works instruction. 4.2 Equipment wiring system tools, equipment and materials selected

CU TITLE & CU CODE	CU DESCRIPTOR	WORKS ACTIVITIES	PERFORMANCE CRITERIA
			in accordance with works instruction. 4.3 Power source indicated as per schematic drawing. 4.4 Cable casing secured at determined location. 4.5 Cable connected to the equipment in accordance with manufacturer's specifications. 4.6 Voltage reading obtained in accordance with manufacturer's specifications.
		5. Install ventilation ducting system.	5.1 Ventilation ducting system equipment installation method selected in accordance with works instruction. 5.2 Ventilation ducting system tools, equipment and materials selected in accordance with works instruction. 5.3 Bracket secured at determined position. 5.4 Ducting secured at determine position. 5.5 Torque of bolt tightening confirmed.

CU TITLE & CU CODE	CU DESCRIPTOR	WORKS ACTIVITIES	PERFORMANCE CRITERIA
		6. Record installation process.	6.1 Installation checklist selected. 6.2 Ventilation equipment installation confirmed in accordance with manufacturer's specifications. 6.3 Installation process checklist produced in accordance with organizational requirements.
3 Single Phase Air-Conditioning Equipment Installation. F432-007-3:2020-C03	Single Phase Air-Conditioning Equipment Installation describes air conditioning equipment such as indoor unit and outdoor unit, to provide consumer usage at home, industry and offices. The person who is competent in this CU should be able to perform fitting works, install mounting bracket/plate, drill piping hole, install piping system, install indoor unit, install outdoor unit, install wiring system, vacuum piping system, perform leak test, charge refrigerant and record air conditioning installation process. The outcomes of this CU are air-conditioning equipment safety, performance and energy efficiency	1. Perform fitting works.	1.1 Fitting works selected in accordance with works instruction. 1.2 Fitting materials selected in accordance with works instruction. 1.3 Fitting works produced which include cutting, drilling, bending, joining and assembling in accordance with manufacturer's specifications. 1.4 Tolerance, strength, and levelling confirmed in accordance with manufacturer's specifications.
		2. Install mounting bracket/plate.	2.1 Mounting bracket/plate installation selected in accordance with works instruction. 2.2 Mounting bracket/plate tools, equipment and materials selected

CU TITLE & CU CODE	CU DESCRIPTOR	WORKS ACTIVITIES	PERFORMANCE CRITERIA
	complied with manufacturer's specifications and Occupational Safety, Health and Environment (OSHE) requirements.		in accordance with works instruction. 2.3 Levelling of bracket/plate determined in accordance with works instruction. 2.4 Bracket/plate hole visible. 2.5 Wall plug secured at determined position. 2.6 Bracket/plate secured at determined position.
		3. Drill piping hole.	3.1 Piping hole drilling method selected in accordance with works instruction. 3.2 Piping hole drilling tools, equipment and materials selected in accordance with works instruction. 3.3 Hole indicated and visible in accordance with works instruction.
		4. Install piping system.	4.1 Piping system installation method selected in accordance with works instruction. 4.2 Piping system tools, equipment and materials selected in accordance with works instruction.

CU TITLE & CU CODE	CU DESCRIPTOR	WORKS ACTIVITIES	PERFORMANCE CRITERIA
			4.3 Copper pipe and thermal insulation with specified size secured at determined location. 4.4 Water piping materials which include copper, PVC and ABS secured at specified location. 4.5 No leakage at all fittings confirmed in accordance with OSHE requirements.
		5. Install indoor unit.	5.1 Indoor unit installation method selected in accordance with works instruction. 5.2 Indoor unit installation tools, equipment and materials selected in accordance with works instruction. 5.3 Power source indicated as per schematic drawing. 5.4 Cable casing secured at determined location. 5.5 Cable connected to the equipment in accordance with manufacturer's specifications. 5.6 Voltage reading obtained in accordance with manufacturer's specifications.

CU TITLE & CU CODE	CU DESCRIPTOR	WORKS ACTIVITIES	PERFORMANCE CRITERIA
		6. Install outdoor unit.	6.1 Outdoor unit installation method selected in accordance with works instruction. 6.2 Outdoor unit installation tools, equipment and materials selected in accordance with works instruction. 6.3 Power source indicated as per schematic drawing. 6.4 Cable casing secured at determined location. 6.5 Cable connected to the equipment in accordance with manufacturer's specifications. 6.6 Voltage reading obtained in accordance with manufacturer's specifications.
		7. Install wiring system.	7.1 Wiring system installation method selected in accordance with works instruction. 7.2 Wiring system tools, equipment and materials selected in accordance with works instruction. 7.3 Power source indicated as per schematic drawing. 7.4 Cable casing secured at determined location.

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			7.5 Cable connected to the equipment in accordance with manufacturer's specifications. 7.6 Voltage reading obtained in accordance with manufacturer's specifications.
		8. Vacuum piping system.	8.1 Piping system vacuuming method selected in accordance with works instruction. 8.2 Piping system vacuuming tools, equipment and materials selected in accordance with works instruction. 8.3 Specified manifold gauge secured in accordance manufacturer's specifications. 8.4 Refrigerant piping system at recommended pressure obtained in accordance with manufacturer's specifications. 8.5 No leakage, free from air, moisture and non-condensable gas confirmed in accordance with manufacturer's specifications and OSHE requirements.

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		9. Perform leak test.	9.1 Leak test method selected in accordance with works instruction. 9.2 Leak test tools, equipment and materials selected in accordance with works instruction. 9.3 Specified manifold gauge secured in accordance with manufacturer's specifications. 9.4 Refrigerant piping system at recommended pressure obtained in accordance with manufacturer's specifications. 9.5 Leak test checklist produced in accordance with organizational and OSHE requirements.
		10. Charge refrigerant.	10.1 Refrigerant charging selected in accordance with manufacturer's specifications. 10.2 Refrigerant charging tools, equipment and materials selected in accordance with works instruction. 10.3 Specified manifold gauge secured in accordance with manufacturer's specifications. 10.4 Refrigerant quantity in accordance with manufacturer's and Ozone

CU TITLE & CU CODE	CU DESCRIPTOR	WORKS ACTIVITIES	PERFORMANCE CRITERIA
			Depleting Substances (ODS) specifications. 10.5 Refrigerant test checklist produced in accordance with organizational requirements.
		11. Record air-conditioning installation process.	9.1 Air-conditioning installation checklist selected confirmed in accordance with manufacturer's specifications. 9.2 Installation process checklist produced in accordance with organizational requirements.
4 HVAC Equipment Testing and Commissioning. F432-007-3:2020-C04	HVAC Equipment Testing and Commissioning describes the process of testing HVAC equipment and handing over the equipment with the acceptance of the client during commissioning in compliance with performance of the equipment, safety and consumer's requirements. The person who is competent in this CU should be able to perform heating performance test, perform ventilation performance test,	1. Perform heating performance test.	1.1 Heating performance test method selected in accordance with works instruction. 1.2 Heating performance test materials selected in accordance with works instruction. 1.3 Heating temperature reading confirmed with manufacturer's specifications. 1.4 Electrical safety which include leakage, wear and tear and tolerance confirmed in accordance with manufacturer's specifications.

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	perform air conditioning performance test, commissioning HVAC equipment and record testing and commissioning process. The outcomes of this CU are testing and commissioning equipment safety, performance and energy efficiency complied with manufacturer's specifications and Occupational Safety, Health and Environment (OSHE) requirements		1.5 Heating performance test report produced in accordance with organizational requirements.
		2. Perform ventilation performance test.	2.1 Ventilation performance test method selected in accordance with works instruction. 2.2 Ventilation performance test tools, equipment and materials selected in accordance with works instruction. 2.3 Airflow and fan rotation of ventilation confirmed in accordance with manufacturer's specifications. 2.4 Ventilation performance test report produced in accordance with organizational requirements.
		3. Perform air conditioning performance test.	3.1 Air conditioning performance test method selected in accordance with works instruction. 3.2 Air conditioning performance test tools, equipment and materials selected in accordance with works instruction. 3.3 Airflow, fan rotation, refrigerant pressure, electrical safety, water drainage, temperature and refrigerant and water leakage in

CU TITLE & CU CODE	CU DESCRIPTOR	WORKS ACTIVITIES	PERFORMANCE CRITERIA
			HVAC functioning confirmed in accordance with manufacturer's specifications. 3.4 Air conditioning performance test report produced in accordance with organizational requirements.
		4. Commission HVAC equipment.	4.1 HVAC commissioning works instruction acquired in accordance with client guidelines. 4.2 HVAC commissioning tools, equipment and materials selected in accordance with works instruction. 4.3 HVAC equipment functioned in accordance with manufacturer's specifications and client acceptance acknowledged. 4.4 Commissioning HVAC equipment report produced in accordance with organizational requirements.
		5. Record testing and commissioning process.	5.1 Testing and commissioning checklist selected. 5.2 HVAC equipment testing and commissioning process confirmed in accordance with manufacturer's specifications.

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			5.3 Testing and commissioning process checklist produced in accordance with organizational requirements.
5 Single Phase Heating Equipment Maintenance. F432-007-3:2020-C05	Single Phase Heating Equipment Maintenance describes the maintenance of heating equipment such as water heater and heater, to ensure the equipment performance and safe for consumer usage. The person who is competent in this CU should be able to maintain heating equipment motor pump, maintain heating equipment heater, maintain wiring system, maintain piping system, maintain filter system and record maintenance activities. The outcomes of this CU are heating equipment safety, performance and energy efficiency complied with manufacturer's specifications and Occupational Safety, Health and Environment (OSHE) requirements.	1. Maintain heating equipment motor pump.	1.1 Heating equipment motor pump maintenance selected in accordance with works instruction. 1.2 Heating equipment motor pump maintenance tools, equipment and materials selected in accordance with works instruction. 1.3 Crack, burnt marks, leaking, abnormal noise, overload and control function of motor pump confirmed in accordance with manufacturer's specifications. 1.4 Damage motor pump removed from heating equipment and new motor pump installed in accordance with manufacturer's specifications. 1.5 Motor pump performance as required in accordance with manufacturer's specifications. 1.6 Checklist produce in accordance with organizational requirements.

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		2. Maintain heating equipment heater.	2.1 Heating equipment heater maintenance selected in accordance with works instruction. 2.2 Heating equipment heater maintenance tools, equipment and materials selected in accordance with works instruction. 2.3 Crack, burnt marks, leaking, abnormal noise, overload and control function of heater confirmed in accordance with manufacturer's specifications. 2.4 Damage heater removed from heating equipment and new heater installed in accordance with manufacturer's specifications. 2.5 Heating equipment heater functioned as required in accordance with manufacturer's specifications. 2.6 Checklist produced in accordance with organizational requirements.
		3. Maintain wiring system.	3.1 Wiring system maintenance method selected in accordance with works instruction. 3.2 Wiring system maintenance tools, equipment and materials selected

CU TITLE & CU CODE	CU DESCRIPTOR	WORKS ACTIVITIES	PERFORMANCE CRITERIA
			in accordance with works instruction. 3.3 Burnt marks, leaking, and overload of wiring system confirmed in accordance with manufacturer's specifications. 3.4 Damage wiring system removed from heating equipment and new wiring system installed in accordance with manufacturer's specifications. 3.5 Wiring system functioned as required in accordance with manufacturer's specifications. 3.6 Wiring system maintenance checklist produced in accordance with organizational requirements.
		4. Maintain piping system.	4.1 Piping system maintenance method selected in accordance with works instruction. 4.2 Piping system maintenance tools, equipment and materials selected in accordance with works instruction. 4.3 Crack, bent, corrosion and leaking of piping system confirmed in accordance with manufacturer's specifications.

CU TITLE & CU CODE	CU DESCRIPTOR	WORKS ACTIVITIES	PERFORMANCE CRITERIA
			4.4 Damage piping system removed from heating equipment and new piping system installed in accordance with manufacturer's specifications. 4.5 Piping system functioned as required in accordance with manufacturer's specifications. 4.6 Piping system maintenance checklist produced in accordance with organizational requirements.
		5. Maintain filter system.	5.1 Filter system maintenance method selected in accordance with works instruction. 5.2 Filter system maintenance tools, equipment and materials selected in accordance with works instruction. 5.3 Crack and leaking of filter system confirmed in accordance with manufacturer's specifications. 5.4 Damage filter system removed from heating equipment and new filter system installed in accordance with manufacturer's specifications. 5.5 Filter system functioned as required in accordance with manufacturer's specifications.

CU TITLE & CU CODE	CU DESCRIPTOR	WORKS ACTIVITIES	PERFORMANCE CRITERIA
			5.6 Filter system maintenance checklist produced in accordance with organizational requirements.
		6. Record maintenance activities.	6.1 Heating equipment checklist selected. 6.2 Heating equipment maintenance process confirmed in accordance with manufacturer's specifications. 6.3 Heating equipment maintenance checklist produced in accordance with organizational requirements.
6 Single Phase Ventilation Equipment Maintenance. F432-007-3:2020-C06	Single Phase Ventilation Equipment Maintenance describes the maintenance of ventilation equipment such as exhaust fan and ducting system, to ensure the equipment performance and safe for consumer usage. The person who is competent in this CU should be able to maintain ventilation motor, maintain wiring system, maintain ducting system, maintain fan blade and record ventilation maintenance activities.	1. Maintain ventilation motor.	1.1 Ventilation motor maintenance method selected in accordance with works instruction. 1.2 Ventilation motor maintenance tools, equipment and materials selected in accordance with works instruction. 1.3 Noise, broken fan and fan rotation of ventilation motor confirmed in accordance with manufacturer's specifications. 1.4 Damage ventilation motor removed from heating equipment and new ventilation motor installed in accordance with manufacturer's specifications.

CU TITLE & CU CODE	CU DESCRIPTOR	WORKS ACTIVITIES	PERFORMANCE CRITERIA
	The outcomes of this CU are ventilation equipment safety and performance, complied with manufacturer's specifications and Occupational Safety, Health and Environment (OSHE) requirements.		1.5 Ventilation motor functioned as required in accordance with manufacturer's specifications. 1.6 Ventilation motor maintenance checklist produced in accordance with organizational requirements.
		2. Maintain wiring system.	2.1 Wiring system maintenance method selected in accordance with works instruction. 2.2 Wiring system maintenance tools, equipment and materials selected in accordance with works instruction. 2.3 Burnt marks, leaking and overload of wiring system confirmed in accordance with manufacturer's specifications. 2.4 Damage wiring system removed from heating equipment and new wiring system installed in accordance with manufacturer's specifications. 2.5 Wiring system functioned as required in accordance with manufacturer's specifications. 2.6 Wiring system maintenance checklist produced in accordance with organizational requirements.

CU TITLE & CU CODE	CU DESCRIPTOR	WORKS ACTIVITIES	PERFORMANCE CRITERIA
		3. Maintain ducting system.	3.1 Ducting system maintenance method selected in accordance with works instruction. 3.2 Ducting system maintenance tools, equipment and materials selected in accordance with works instruction. 3.3 Crack, leaking, and abnormal noise of the ducting system confirmed in accordance with manufacturer's specifications. 3.4 Damage ducting system removed from heating equipment and new ducting system installed in accordance with manufacturer's specifications. 3.5 Ducting system functioned as required in accordance with manufacturer's specifications. 3.6 Ducting system maintenance checklist produced in accordance with organizational requirements.
		4. Maintain fan blade.	4.1 Fan blade maintenance method selected in accordance with works instruction. 4.2 Fan blade maintenance tools, equipment and materials selected in accordance with works instruction.

CU TITLE & CU CODE	CU DESCRIPTOR	WORKS ACTIVITIES	PERFORMANCE CRITERIA
			4.3 Crack, broken and abnormal noise of fan blade confirmed in accordance with manufacturer's specifications. 4.4 Damage fan blade removed from heating equipment and new fan blade installed in accordance with manufacturer's specifications. 4.5 Fan blade functioned as required in accordance with manufacturer's specifications. 4.6 Fan blade maintenance checklist produced in accordance with organizational requirements.
		5. Record ventilation maintenance activities.	5.1 Ventilation equipment maintenance checklist selected. 5.2 Ventilation equipment maintenance process confirmed in accordance with manufacturer's specifications. 5.3 Ventilation equipment maintenance checklist produced in accordance with organizational requirements.

CU TITLE & CU CODE	CU DESCRIPTOR	WORKS ACTIVITIES	PERFORMANCE CRITERIA
7 Single Phase Air-Conditioning Equipment Maintenance. F432-007-3:2020-C07	Single Phase Air-Conditioning Equipment Maintenance describes the maintenance of air conditioning equipment such as indoor unit and outdoor unit, to ensure the equipment performance and safe for consumer usage. The person who is competent in this CU should be able to maintain indoor motor, maintain outdoor fan motor, maintain compressor, maintain evaporator/ cooling coil, maintain condenser coil, maintain refrigerant, maintain piping system, maintain wiring control system, maintain metering device, maintain drainage system and record air conditioning maintenance activities. The outcomes of this CU are air-conditioning equipment safety, performance and energy efficiency complied with manufacturer's specifications and Occupational Safety, Health and Environment (OSHE) requirements.	1. Maintain indoor motor.	1.1 Air-conditioning indoor motor maintenance method selected in accordance with works instruction. 1.2 Air-conditioning indoor motor maintenance tools, equipment and materials selected in accordance with works instruction. 1.3 Noise and motor rotation of Air conditioning indoor motor confirmed in accordance with manufacturer's specifications. 1.4 Damage indoor motor removed from air conditioning equipment and new indoor motor installed in accordance with manufacturer's specifications. 1.5 Air-conditioning indoor motor functioned as required in accordance with manufacturer's specifications. 1.6 Air-conditioning indoor motor maintenance checklist produced in accordance with organizational requirements.

CU TITLE & CU CODE	CU DESCRIPTOR	WORKS ACTIVITIES	PERFORMANCE CRITERIA
		2. Maintain outdoor fan motor.	2.1 Air-conditioning outdoor fan motor maintenance method selected in accordance with works instruction. 2.2 Air-conditioning outdoor fan motor maintenance tools, equipment and materials selected in accordance with works instruction. 2.3 Noise, broken fan and fan rotation of air conditioning outdoor fan motor confirmed in accordance with manufacturer's specifications. 2.4 Damage outdoor fan motor removed from air conditioning equipment and new outdoor fan motor system installed in accordance with manufacturer's specifications. 2.5 Air-conditioning outdoor fan motor functioned as required in accordance with manufacturer's specifications. 2.6 Air-conditioning outdoor fan motor maintenance checklist produced in accordance with organizational requirements.

CU TITLE & CU CODE	CU DESCRIPTOR	WORKS ACTIVITIES	PERFORMANCE CRITERIA
		3. Maintain compressor.	3.1 Air-conditioning compressor maintenance method selected in accordance with works instruction. 3.2 Air-conditioning compressor maintenance tools, equipment and materials selected in accordance with works instruction. 3.3 Noise and damage of air conditioning compressor motor confirmed in accordance with manufacturer's specifications. 3.4 Damage compressor removed from air conditioning equipment and new compressor installed in accordance with manufacturer's specifications. 3.5 Air-conditioning compressor motor functioned as required in accordance with manufacturer's specifications. 3.6 Air-conditioning compressor motor maintenance checklist produced in accordance with organizational requirements.

CU TITLE & CU CODE	CU DESCRIPTOR	WORKS ACTIVITIES	PERFORMANCE CRITERIA
		4. Maintain evaporator/ cooling coil.	4.1 Air-conditioning evaporator/ cooling coil maintenance method selected in accordance with works instruction. 4.2 Air-conditioning evaporator/ cooling coil maintenance tools, equipment and materials selected in accordance with works instruction. 4.3 Temperature of air-conditioning evaporator/ cooling coil confirmed in accordance with manufacturer's specifications. 4.4 Damage evaporator/ cooling coil removed from air-conditioning equipment and new evaporator/ cooling coil installed in accordance with manufacturer's specifications. 4.5 Air-conditioning evaporator/ cooling coil functioned as required in accordance with manufacturer's specifications. 4.6 Air-conditioning evaporator/ cooling coil maintenance checklist produced in accordance with organizational requirements.

CU TITLE & CU CODE	CU DESCRIPTOR	WORKS ACTIVITIES	PERFORMANCE CRITERIA
		5. Maintain condenser coil.	5.1 Air-conditioning condenser coil maintenance method selected in accordance with works instruction. 5.2 Air-conditioning condenser coil maintenance tools, equipment and materials selected in accordance with works instruction. 5.3 Temperature of air-conditioning condenser coil confirmed in accordance with manufacturer's specifications. 5.4 Damage condenser coil removed from air-conditioning equipment and new condenser coil installed in accordance with manufacturer's specifications. 5.5 Air-conditioning condenser coil functioned as required in accordance with manufacturer's specifications. 5.6 Air-conditioning condenser coil maintenance checklist produced in accordance with organizational requirements.

CU TITLE & CU CODE	CU DESCRIPTOR	WORKS ACTIVITIES	PERFORMANCE CRITERIA
		6. Maintain refrigerant.	6.1 Air-conditioning refrigerant maintenance method selected in accordance with works instruction. 6.2 Air-conditioning refrigerant maintenance tools, equipment and materials selected in accordance with works instruction. 6.3 Leaking and used refrigerant of air-conditioning equipment confirmed in accordance with manufacturer's specifications. 6.4 Used refrigerant removed from air-conditioning unit and new refrigerant filled up in accordance with manufacturer's and Ozone Depleting Substances (ODS) specifications. 6.5 Air-conditioning refrigerant functioned as required in accordance with manufacturer's and Ozone Depleting Substances (ODS) specifications. 6.6 Air-conditioning refrigerant maintenance checklist produced in accordance with organizational requirements.

CU TITLE & CU CODE	CU DESCRIPTOR	WORKS ACTIVITIES	PERFORMANCE CRITERIA
		7. Maintain piping system.	7.1 Air-conditioning piping system maintenance method selected in accordance with works instruction. 7.2 Air-conditioning piping system maintenance tools, equipment and materials selected in accordance with works instruction. 7.3 Crack, bent, corrosion and leaking of piping system confirmed in accordance with manufacturer's specifications. 7.4 Damage piping system removed from air-conditioning unit and new piping system fixed in accordance with manufacturer's specifications. 7.5 Air-conditioning piping system functioned as required in accordance with manufacturer's specifications. 7.6 Air-conditioning piping system maintenance checklist produced in accordance with organizational requirements.

CU TITLE & CU CODE	CU DESCRIPTOR	WORKS ACTIVITIES	PERFORMANCE CRITERIA
		8. Maintain wiring control system.	8.1 Wiring system maintenance method selected in accordance with works instruction. 8.2 Wiring system maintenance tools, equipment and materials selected in accordance with works instruction. 8.3 Burnt marks, leaking and overload of wiring system confirmed in accordance with manufacturer's specifications. 8.4 Damage wiring control removed from air-conditioning unit and new wiring control installed in accordance with manufacturer's specifications. 8.5 Wiring system functioned as required in accordance with manufacturer's specifications. 8.6 Wiring system maintenance checklist produced in accordance with organizational requirements.
		9. Maintain metering device.	9.1 Metering device maintenance method selected in accordance with works instruction. 9.2 Metering device maintenance tools, equipment and materials selected in accordance with works instruction.

CU TITLE & CU CODE	CU DESCRIPTOR	WORKS ACTIVITIES	PERFORMANCE CRITERIA
			9.3 Burnt marks, leaking and overload of metering device confirmed in accordance with manufacturer's specifications. 9.4 Damage metering device removed from air-conditioning unit and new metering device installed in accordance with manufacturer's specifications. 9.5 Metering device functioned as required in accordance with manufacturer's specifications. 9.6 Metering device maintenance checklist produced in accordance with organizational requirements.
		10. Maintain drainage system.	10.1 Drainage system maintenance method selected in accordance with works instruction. 10.2 Drainage system maintenance tools, equipment and materials selected in accordance with works instruction. 10.3 Leaking of drainage system confirmed in accordance with manufacturer's specifications. 10.4 Damage drainage system removed/ serviced from air-conditioning unit and new/ serviced drainage system fixed in

CU TITLE & CU CODE	CU DESCRIPTOR	WORKS ACTIVITIES	PERFORMANCE CRITERIA
			accordance with manufacturer's specifications. 10.5 Drainage system functioned as required in accordance with manufacturer's specifications. 10.6 Drainage system maintenance checklist produced in accordance with organizational requirements.
		11. Record air-conditioning maintenance activities.	11.1 Air-conditioning maintenance checklist selected. 11.2 Air-conditioning maintenance process confirmed in accordance with manufacturer's specifications. 11.3 Ventilation equipment maintenance checklist produced in accordance with organizational requirements.
8 HVAC Single Phase Installation and Maintenance Staff Supervision.	HVAC Single Phase Installation and Maintenance Staff Supervision describes supervision of HVAC installation, performance of the equipment, safety and comply the consumer's requirements.	1. Monitor Health, Safety And Environmental (HSE) compliance.	1.1 Health, safety and environmental checklist acquired from superior 1.2 Health, safety and environmental requirements determined and recorded. 1.3 Selected personnel assigned to health, safety and environmental responsibilities.

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F432-007-3:2020-C08	The person who is competent in this CU should be able to monitor health, safety and environment compliance, conduct in-house training, prepare installation and maintenance schedule, coordinate staff appraisal, conduct staff briefing, coordinate stock supply and monitor waste disposal. The outcomes of this CU are works efficiency, reliability and productivity complied in accordance with organisation and Occupational Safety, Health and Environment (OSHE) requirements.		1.4 Health, safety and environmental implementation requirements acknowledged to all personnel. 1.5 Health, safety and environmental implementation progress recorded and remedial action taken and reported to superior.
		2. Conduct in-house training.	2.1 Training target group shortlisted. 2.2 Training requirements which included training materials, audio visual aids, venue, budget and training personnel finalized in accordance with organizational requirements. 2.3 Shortlisted target group notified in accordance with organizational requirements. 2.4 Training conducted in accordance with training schedule. 2.5 Training report produced.
		3. Prepare installation and maintenance schedule.	3.1 Inventory report acquired from superior. 3.2 Installation and maintenance requirements confirmed in accordance with manufacturer's specifications. 3.3 Installation schedule which include type of equipment, type of

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			maintenance, reason, cost and date produced in accordance with organizational requirements. 3.4 Maintenance schedule submitted for approval.
		4. Coordinate staff appraisal.	4.1 Staff record acquired from superior. 4.2 Appraisal requirements confirmed in accordance with organizational requirements. 4.3 Staff appraisal checklist comprises of the required criteria drafted and submitted to superior.
		5. Conduct staff briefing.	5.1 Briefing requirements which included briefing materials, venue and target group finalized in accordance with organizational requirements. 5.2 Target group informed of briefing venue and time in accordance with organizational requirements. 5.3 Briefing conducted in accordance with training schedule.

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		6. Coordinate stock supply.	6.1 Stock inventory acquired from superior. 6.2 Stock requirements which included stocks replenishing and replacement confirmed in accordance with organizational requirements. 6.3 Requisition documents drafted and submitted for approval.
		7. Monitor waste disposal.	7.1 Waste disposal instruction acquired from superior. 7.2 Waste disposal requirements confirmed in accordance with organizational requirements. 7.3 Waste disposal itineraries drafted and distributed to all department concerned. 7.4 Waste disposal activities conducted. 7.5 Waste disposal report produced.

CURRICULUM OF COMPETENCY UNIT

NATIONAL OCCUPATIONAL SKILLS STANDARD (NOSS) FOR:

HEATING, VENTILATION, AIR-CONDITIONING (HVAC) SINGLE PHASE INSTALLATION AND MAINTENANCE

LEVEL 3

15. Curriculum of Competency Unit

15.1. Single Phase Heating Equipment Installation

SECTION	(F) Specialized Construction Activities		
GROUP	(432) Electrical, Plumbing and Other Construction Installation Activities		
AREA	HVAC Single Phase		
NOSS TITLE	Heating, Ventilation, Air-Conditioning (HVAC) Single Phase Installation and Maintenance		
COMPETENCY UNIT TITLE	Single Phase Heating Equipment Installation		
LEARNING OUTCOMES	The learning outcomes of this competency unit are trainees enable to install single phase heating equipment ensuring equipment safety, performance and energy efficiency in compliance with manufacturer's specifications and Occupational Safety, Health and Environment (OSHE) requirements. Upon completion of this competency unit, trainees should be able to: 1. Perform fitting works. 2. Install mounting bracket/plate. 3. Install piping system. 4. Install heating unit. 5. Install equipment wiring system. 6. Record installation process.		
TRAINING PREREQUISITE (SPECIFIC)	Not Available		
CU CODE	F432-007-3:2020-C01	NOSS LEVEL	Three (3)

WORKS ACTIVITIES	RELATED KNOWLEDGE	RELATED SKILLS	ATTITUDE/ SAFETY/ ENVIRONMENT	ASSESSMENT CRITERIA
1. Perform fitting works.	1.1 Fitting works: • Fitting drawing.	1.1 Identify fitting works.	<u>ATTITUDE</u> 1.1 Compliance to best	1.1 Fitting works process and performance information

WORKS ACTIVITIES	RELATED KNOWLEDGE	RELATED SKILLS	ATTITUDE/ SAFETY/ ENVIRONMENT	ASSESSMENT CRITERIA
	• Types and usage of materials. • Fitting tools and usage. 1.2 Fitting process: • Technique. • Procedure. 1.3 Fitting checking procedure: • Types of inspection tools and usage. • Technique of checking fitting works.	1.2 Prepare fitting materials. 1.3 Execute fitting works. 1.4 Check fitting works.	practices and procedures. <u>SAFETY</u> 1.1 Compliance to warnings, cautions and notes as stated in manufacturer's manual. <u>ENVIRONMENT</u> 1.1 Minimizing of pollution during handling hazardous chemicals, waste in compliance to current environmental acts.	described in accordance with manufacture's specifications. 1.2 Fitting works selected in accordance with works instruction. 1.3 Fitting materials selected in accordance with works instruction. 1.4 Fitting works produced which include cutting, drilling, bending, joining and assembling in accordance with manufacturer's specifications. 1.5 Tolerance, strength, and levelling confirmed in accordance with manufacturer's specifications. 1.6 Attitude requirements complied in accordance with best practise and procedure. 1.7 Safety and environment requirements complied in according with warnings, cautions and notes as stated in manufacturer's manual.

WORKS ACTIVITIES	RELATED KNOWLEDGE	RELATED SKILLS	ATTITUDE/ SAFETY/ ENVIRONMENT	ASSESSMENT CRITERIA
2. Install mounting bracket/ plate.	2.1 Installation mounting bracket/plate: • Bracket/ plate drawing manual. • Types and usage of mounting bracket/plate. 2.2 Installation bracket/plate process: • Technique. • Procedure. 2.3 Bracket/plate checking procedure: • Types of inspection tools and usage. • Technique of checking mounting bracket/plate.	2.1 Obtain works instruction. 2.2 Prepare tools equipment and material (TEM). 2.3 Mark position. 2.4 Drill marked position. 2.5 Fix wall plug. 2.6 Fix bracket/plate.	ATTITUDE 2.1 Compliance to best practices and procedures. SAFETY 2.2 Compliance to warnings, cautions and notes as stated in manufacturer's manual. ENVIRONMENT Not Available	2.1 Mounting bracket/plate installation and checking process described in accordance with works instruction. 2.2 Mounting bracket/plate installation method selected in accordance with works instruction. 2.3 Mounting bracket/plate tools, equipment and materials. selected in accordance with works instruction. 2.4 Levelling of bracket/plate determine in accordance with works instruction. 2.5 Bracket/plate hole visible. 2.6 Wall plug secured at determined position. 2.7 Bracket/plate secured at determined position. 2.8 Attitude requirements complied in accordance with best practices and procedure. 2.9 Safety requirements complied in accordance with warnings, cautions and notes as stated in manufacturer's manual.

WORKS ACTIVITIES	RELATED KNOWLEDGE	RELATED SKILLS	ATTITUDE/ SAFETY/ ENVIRONMENT	ASSESSMENT CRITERIA
3. Install piping system.	3.1 Water piping works: • Piping drawing. • Types and usage of materials. • Piping tools and usage. 3.2 Water piping works process: • Technique. • Procedure. 3.3 Water piping works checking procedure: • Types of inspection tools and usage. • Technique of checking leakage. • Procedure of remedial action.	3.1 Obtain works instruction. 3.2 Prepare tools, equipment and material. 3.3 Fix water piping. 3.4 Check piping leakage.	<u>ATTITUDE</u> 3.1 Compliance to best practices and procedures. <u>SAFETY</u> 3.1 Compliance to warnings, cautions and notes as stated in manufacturer's manual. <u>ENVIRONMENT</u> 3.1 Minimizing of pollution during handling hazardous chemicals, waste in compliance to current environmental acts.	3.1 Piping system installation and checking process described in accordance with works instruction. 3.2 Piping system installation method selected in accordance with works instruction. 3.3 Piping system tools, equipment and materials selected in accordance with works instruction. 3.4 Water piping materials which include copper, PVC and ABS secured at specified location. 3.5 No leakage at all fittings confirmed in accordance with manufacturer's specifications. 3.6 Attitude requirements complied in accordance with best practices and procedure. 3.7 Safety requirements complied in accordance with warnings, cautions and notes as stated in manufacturer's manual.

WORKS ACTIVITIES	RELATED KNOWLEDGE	RELATED SKILLS	ATTITUDE/ SAFETY/ ENVIRONMENT	ASSESSMENT CRITERIA
4. Install heating unit.	4.1 Water heating installation: • Installation drawing. • Types and usage of materials. • Installation tools and usage. 4.2 Water heating works process: • Technique. • Procedure.	4.1 Obtain works instruction. 4.2 Prepare tools, equipment and material. 4.3 Fix heating unit. 4.4 Fix heating unit accessories.	<u>ATTITUDE</u> 4.1 Compliance to best practices and procedures. <u>SAFETY</u> 4.1 Compliance to warnings, cautions and notes as stated in manufacturer's manual. <u>ENVIRONMENT</u> 4.1 Minimizing of pollution during handling hazardous chemicals, waste in compliance to current environmental acts.	4.1 Heating unit installation process described in accordance with works instruction. 4.2 Heating unit installation method selected in accordance with works instruction. 4.3 Heating unit tools, equipment and materials selected in accordance with works instruction. 4.4 Heating unit and accessories secured at specified bracket/plate location in accordance with works instruction. 4.5 Attitude requirements complied in accordance with best practices and procedure. 4.6 Safety requirements complied in accordance with warnings, cautions and notes as stated in manufacturer's manual.

WORKS ACTIVITIES	RELATED KNOWLEDGE	RELATED SKILLS	ATTITUDE/ SAFETY/ ENVIRONMENT	ASSESSMENT CRITERIA
5. Install equipment wiring system.	5.1 Works instruction: • Wiring information. • Regulation requirements. 5.2 Wiring installation process: • Technique. • Procedure. • Tools, equipment and usage. 5.3 Wiring system testing procedure: • Polarity test. • Continuity test. • Insulation resistance test. • Earthing test.	5.1 Obtain works instruction. 5.2 Prepare tools, equipment and material. 5.3 Locate power source. 5.4 Fix cable casing. 5.5 Lay cable. 5.6 Fix wiring system termination. 5.7 Test power voltage.	<u>ATTITUDE</u> 5.1 Compliance to best practices and procedures. <u>SAFETY</u> 5.2 Compliance to warnings, cautions and notes as stated in manufacturer's manual. <u>ENVIRONMENT</u> Not Available	5.1 Equipment wiring system installation and testing procedure described in accordance with works instruction. 5.2 Equipment wiring system installation selected in accordance with works instruction. 5.3 Equipment wiring system tools, equipment and materials selected in accordance with works instruction. 5.4 Power source indicated as per schematic drawing. 5.5 Cable casing secured at determined location. 5.6 Cable connected to the equipment in accordance with manufacturer's specifications. 5.7 Voltage reading obtained in accordance with manufacturer's specifications. 5.8 Attitude requirements complied in accordance with best practices and procedure. 5.9 Safety requirements complied in accordance with warnings,

WORKS ACTIVITIES	RELATED KNOWLEDGE	RELATED SKILLS	ATTITUDE/ SAFETY/ ENVIRONMENT	ASSESSMENT CRITERIA
				cautions and notes as stated in manufacturer's manual.
6. Record installation process.	6.1 Installation checklist • Installation information. • Heating equipment performance information. 6.2 Heating equipment installation process inspection • Types of inspection tools and usage. • Technique of heating equipment installation inspection.	6.1 Obtain installation checklist. 6.2 Check heating equipment installation. 6.3 Complete checklist.	ATTITUDE 6.1 Compliance to best practices and procedures. SAFETY 6.1 Compliance to warnings, cautions and notes as stated in manufacturer's manual. ENVIRONMENT Not Available	6.1 Installation process recording described in accordance with works instruction. 6.2 Installation checklist selected. 6.3 Heating equipment installation process which include fitting works, bracket/plate mounting, heating unit, equipment wiring system and ventilation ducting system are confirmed in accordance with manufacturer's specifications. 6.4 Installation process checklist produced in accordance with organizational requirements. 6.5 Attitude requirements complied in accordance with best practices and procedure. 6.6 Safety requirements complied in accordance with warnings, cautions and notes as stated in manufacturer's manual.

Employability Skills

Core Abilities

- Please refer NCS- Core Abilities latest edition.

Social Values & Social Skills

- Please refer Handbook on Social Skills and Social Values in Technical Education and Vocational Training.

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1 A.B. Constantinos, B. Francesco, H. Sten Olaf & etl, (2000). Report No 22: Risk Assessment in Relation To Indoor Air Quality. Luxembourg; European Communities. ISBN: 92-828-9284-0.
2 Committee on Risk Appraisal in the Development of Facilities Design Criteria, National Research Council, & et.al., 1991. Uses of Risk Analysis to Achieve Balanced Safety in Building Design and Operations (Studies in Management of Building Technology: A Series) [Paperback]. National Academies Press. ISBN:0309046807.
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5 Richard Jazwin (August 1, 2001), Troubleshooting and Servicing HVAC&R Electrical Systems.
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13 Department of Skills Standard (DSD). (2015). Z-009-3:2015 NCS-Core Abilities
14 Department of Skills Standard (DSD). (2018). Module on Social Skills and Social Values

15.2. Single Phase Ventilation Equipment Installation

SECTION	(F) Specialized Construction Activities		
GROUP	(432) Electrical, Plumbing and Other Construction Installation Activities		
AREA	HVAC Single Phase		
NOSS TITLE	Heating, Ventilation, Air-Conditioning (HVAC) Single Phase Installation and Maintenance		
COMPETENCY UNIT TITLE	Single Phase Ventilation Equipment Installation		
LEARNING OUTCOMES	The learning outcomes of this competency unit are trainees enable to install single phase ventilation equipment ensuring equipment safety and performance, in compliance with manufacturer's and Occupational Safety, Health and Environment (OSHE) requirements. Upon completion of this competency unit, trainees should be able to: 1. Perform fitting works. 2. Install mounting bracket/plate. 3. Install ventilation unit. 4. Install equipment wiring system. 5. Install ventilation ducting system. 6. Record installation process.		
TRAINING PREREQUISITE (SPECIFIC)	Not Available		
CU CODE	F432-007-3:2020-C02	NOSS LEVEL	Three (3)

WORKS ACTIVITIES	RELATED KNOWLEDGE	RELATED SKILLS	ATTITUDE/ SAFETY/ ENVIRONMENT	ASSESSMENT CRITERIA
1. Perform fitting works.	1.1 Fitting works: • Fitting drawing.	1.1 Identify fitting works. 1.2 Prepare fitting materials.	<u>ATTITUDE</u> 1.1 Compliance to best practices and procedures.	1.1 Fitting works performance and checking procedure described in accordance with works instruction.

WORKS ACTIVITIES	RELATED KNOWLEDGE	RELATED SKILLS	ATTITUDE/ SAFETY/ ENVIRONMENT	ASSESSMENT CRITERIA
	• Types and usage of materials. • Fitting tools and usage. 1.2 Fitting process: • Technique. • Procedure. 1.3 Fitting checking procedure: • Types of inspection tools and usage. • Technique of checking fitting works. 1.4 OSHE requirements.	1.3 Execute fitting works. 1.4 Check fitting works.	<u>SAFETY</u> 1.1 Compliance to warnings, cautions and notes as stated in manufacturer's manual. <u>ENVIRONMENT</u> 1.1 Minimizing of pollution during handling hazardous chemicals, waste in compliance to current environmental acts.	1.2 Fitting works selected in accordance with works instruction. 1.3 Fitting materials selected in accordance with works instruction. 1.4 Fitting works produced which include cutting, drilling, bending, joining and assembling in accordance with manufacturer's specifications. 1.5 Tolerance, strength, and levelling confirmed in accordance with manufacturer's specifications. 1.6 Attitude requirements complied in accordance with best practise and procedure. 1.7 Safety and environmental requirements complied in accordance with OSHE requirements.

WORKS ACTIVITIES	RELATED KNOWLEDGE	RELATED SKILLS	ATTITUDE/ SAFETY/ ENVIRONMENT	ASSESSMENT CRITERIA
2. Install mounting bracket/ plate.	2.1 Installation mounting bracket/plate: • Bracket/plate drawing manual • Types and usage of mounting bracket/ plate 2.2 Installation bracket/plate process • Technique • Procedure 2.3 Bracket/plate checking procedure: • Types of inspection tools and usage 2.4 Technique of checking mounting bracket/ plate.	2.1 Obtain works instruction. 2.2 Prepare tools equipment and material. 2.3 Mark position. 2.4 Drill marked position. 2.5 Fix wall plug. 2.6 Fit bracket.	<u>ATTITUDE</u> 2.1 Compliance to best practices and procedures. <u>SAFETY</u> 2.1 Compliance to warnings, cautions and notes as stated in manufacturer's manual. <u>ENVIRONMENT</u> Not Available	2.1 Mounting/bracket plate installation process and checking procedure described in accordance works instruction. 2.2 Mounting bracket/plate installation selected in accordance with works instruction. 2.3 Mounting bracket/plate tools, equipment and materials selected in accordance with works instruction. 2.4 Levelling of bracket/plate determined in accordance with works instruction 2.5 Bracket/plate hole visible. 2.6 Wall plug secured at determined position. 2.7 Bracket/plate secured at determined position. 2.8 Attitude requirements complied in accordance with best practices and procedure. 2.9 Safety requirements complied in accordance with warnings, cautions and notes as stated in manufacturer's manual.

WORKS ACTIVITIES	RELATED KNOWLEDGE	RELATED SKILLS	ATTITUDE/ SAFETY/ ENVIRONMENT	ASSESSMENT CRITERIA
3. Install ventilation unit.	3.1 Works instruction: • Ventilation ducting system requirements. • Regulation requirements. 3.2 Ventilation ducting system installation process: • Technique • Procedure • Tools, equipment and usage. 3.3 Importance of bolt tightening. 3.4 OSHE requirements.	3.1 Obtain works instruction. 3.2 Prepare tools, equipment and materials. 3.3 Fix ventilation unit. 3.4 Fix ventilation unit accessories.	<u>ATTITUDE</u> 3.1 Compliance to best practices and procedures. <u>SAFETY</u> 3.1 Compliance to warnings, cautions and notes as stated in manufacturer's manual. <u>ENVIRONMENT</u> 3.1 Minimizing of pollution during handling hazardous chemicals, waste in compliance to current environmental acts.	3.1 Ventilation unit installation process described in accordance works instruction. 3.2 Ventilation unit installation method selected in accordance with works instruction. 3.3 Ventilation unit tools, equipment and materials selected in accordance with works instruction. 3.4 Ventilation unit and accessories secured at specified bracket/plate location in accordance with works instruction. 3.5 Attitude requirements complied in accordance with best practices and procedure. 3.6 Safety requirements complied in accordance with warnings, cautions and notes as stated in manufacturer's manual.

WORKS ACTIVITIES	RELATED KNOWLEDGE	RELATED SKILLS	ATTITUDE/ SAFETY/ ENVIRONMENT	ASSESSMENT CRITERIA
4. Install equipment wiring system.	4.1 Works instruction: • Wiring information. • Regulation requirements. 4.2 Wiring installation process: • Technique. • Procedure. • Tools, equipment and usage. 4.3 Wiring system testing procedure: • Polarity test. • Continuity test. • Insulation resistance test. • Earthing test	4.1 Obtain works instruction. 4.2 Prepare tools, equipment and materials. 4.3 Locate power source. 4.4 Fix cable casing. 4.5 Lay cable. 4.6 Fix wiring system termination. 4.7 Test power voltage.	ATTITUDE 4.1 Compliance to best practices and procedures. SAFETY 4.2 Compliance to warnings, cautions and notes as stated in manufacturer's manual. ENVIRONMENT Not Available	4.1 Equipment wiring system installation process described in accordance with works instruction. 4.2 Equipment wiring system installation method selected in accordance with works instruction. 4.3 Equipment wiring system tools, equipment and materials selected in accordance with works instruction. 4.4 Power source indicated as per schematic drawing. 4.5 Cable casing secured at determined location. 4.6 Cable connected to the equipment in accordance with manufacturer's specifications. 4.7 Voltage reading obtained in accordance with manufacturer's specifications. 4.8 Attitude requirements complied in accordance with best practices and procedure. 4.9 Safety requirements complied in accordance with warnings, cautions and notes as stated in manufacturer's manual.

WORKS ACTIVITIES	RELATED KNOWLEDGE	RELATED SKILLS	ATTITUDE/ SAFETY/ ENVIRONMENT	ASSESSMENT CRITERIA
5. Install ventilation ducting system.	5.1 Works instruction: • Ventilation ducting system requirements. • Regulation requirements. 5.2 Ventilation ducting system installation process: • Technique. • Procedure. • Tools, equipment and usage. 5.3 Importance of bolt tightening.	5.1 Obtain works instruction. 5.2 Prepare tools, equipment and materials. 5.3 Fix bracket. 5.4 Fix ducting. 5.5 Check bolt tightening.	ATTITUDE 5.1 Compliance to best practices and procedures. SAFETY 5.1 Compliance to warnings, cautions and notes as stated in manufacturer's manual. ENVIRONMENT 5.1 Minimizing of pollution during handling hazardous chemicals, waste in compliance to current environmental acts.	5.1 Ventilation ducting system installation process described in accordance with works instruction. 5.2 Ventilation ducting system equipment installation method selected in accordance with works instruction. 5.3 Ventilation ducting system tools, equipment and materials selected in accordance with works instruction. 5.4 Bracket secured at determined position. 5.5 Ducting secured at determine position. 5.6 Torque of bolt tightening confirmed. 5.7 Attitude requirements complied in accordance with best practices and procedure. 5.8 Safety requirements complied in accordance with warnings, cautions and notes as stated in manufacturer's manual.

WORKS ACTIVITIES	RELATED KNOWLEDGE	RELATED SKILLS	ATTITUDE/ SAFETY/ ENVIRONMENT	ASSESSMENT CRITERIA
6. Record installation process.	6.1 Installation checklist: • Installation information. • Ventilation equipment performance information. 6.2 Ventilation equipment installation process inspection: • Types of inspection tools and usage. • Technique of inspection.	6.1 Obtain installation checklist. 6.2 Check ventilation equipment installation. 6.3 Complete checklist.	ATTITUDE 6.1 Compliance to best practices and procedures. SAFETY 6.1 Compliance to warnings, cautions and notes as stated in manufacturer's manual. ENVIRONMENT Not Available	6.1 Installation process recording described in accordance with recording format. 6.2 Installation checklist selected. 6.3 Ventilation equipment installation confirmed in accordance with manufacturer's specifications. 6.4 Installation process checklist produced in accordance with organizational requirements. 6.5 Attitude requirements complied in accordance with best practices and procedure. 6.6 Safety requirements complied in accordance with warnings, cautions and notes as stated in manufacturer's manual.

Employability Skills

Core Abilities

- Please refer NCS- Core Abilities latest edition.

Social Values & Social Skills

- Please refer Handbook on Social Skills and Social Values in Technical Education and Vocational Training.

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13	Department of Skills Standard (DSD). (2015). Z-009-3:2015 NCS-Core Abilities
14	Department of Skills Standard (DSD). (2018). Module on Social Skills and Social Values

15.3. Single Phase Air-Conditioning Equipment Installation

SECTION	(F) Specialized Construction Activities		
GROUP	(432) Electrical, Plumbing and Other Construction Installation Activities		
AREA	HVAC Single Phase		
NOSS TITLE	Heating, Ventilation, Air-Conditioning (HVAC) Installation and Maintenance		
COMPETENCY UNIT TITLE	Single Phase Air-Conditioning Equipment Installation		
LEARNING OUTCOMES	The learning outcomes of this competency unit are trainees enable to install single phase air-conditioning equipment ensuring equipment safety and performance, in compliance with manufacturer's and Occupational Safety, Health and Environment (OSHE) requirements. Upon completion of this competency unit, trainees should be able to: 1. Perform fitting works. 2. Install mounting bracket/plate. 3. Drill piping hole. 4. Install piping system 5. Install indoor unit 6. Install outdoor unit. 7. Install wiring system. 8. Vacuum piping system. 9. Perform leak test. 10. Charge refrigerant. 11. Record air conditioning maintenance activities.		
TRAINING PREREQUISITE (SPECIFIC)	Not Available		
CU CODE	F432-007-3:2020-C03	NOSS LEVEL	Three (3)

WORKS ACTIVITIES	RELATED KNOWLEDGE	RELATED SKILLS	ATTITUDE/ SAFETY/ ENVIRONMENT	ASSESSMENT CRITERIA
1. Perform fitting works.	1.1 Fitting works: • Fitting drawing. • Types and usage of materials. • Fitting tools and usage. 1.2 Fitting process: • Technique. • Procedure. 1.3 Fitting checking procedure: • Types of inspection tools and usage. • Technique of checking fitting works.	1.1 Identify fitting works. 1.2 Prepare fitting materials. 1.3 Execute fitting works. 1.4 Check fitting works.	ATTITUDE 1.1 Compliance to best practices and procedures. SAFETY 1.1 Compliance to warnings, cautions and notes as stated in manufacturer's manual. ENVIRONMENT 1.1 Minimizing of pollution during handling hazardous chemicals, waste in compliance to current environmental acts.	1.1 Fitting works process and checking procedure described in accordance with works instruction. 1.2 Fitting works selected in accordance with works instruction. 1.3 Fitting materials selected in accordance with works instruction. 1.4 Fitting works produced which include cutting, drilling, bending, joining and assembling in accordance with manufacturer's specifications. 1.5 Tolerance, strength, and levelling confirmed in accordance with manufacturer's specifications. 1.6 Attitude requirements complied in accordance with best practices and procedure. 1.7 Safety requirements complied in accordance with warnings, cautions and notes as stated in manufacturer's manual.

WORKS ACTIVITIES	RELATED KNOWLEDGE	RELATED SKILLS	ATTITUDE/ SAFETY/ ENVIRONMENT	ASSESSMENT CRITERIA
2. Install mounting bracket/ plate.	2.1 Installation mounting bracket/plate: • Bracket/plate drawing manual. • Types and usage of mounting bracket/plate. 2.2 Installation bracket/plate process: • Technique. • Procedure. 2.3 Bracket/plate checking procedure: • Types of inspection tools and usage. 2.1 Technique of checking mounting bracket/ plate.	2.1 Obtain works instruction 2.2 Prepare tools equipment and material. 2.3 Mark position. 2.4 Drill marked position. 2.5 Fix wall plug. 2.6 Fix bracket.	<u>ATTITUDE</u> 2.1 Compliance to best practices and procedures. <u>SAFETY</u> 2.1 Compliance to warnings, cautions and notes as stated in manufacturer's manual. <u>ENVIRONMENT</u> 2.2 Minimizing of pollution during handling hazardous chemicals, waste in compliance to current environmental acts.	2.1 Mounting bracket/plate installation process and checking procedure described in accordance with works instruction. 2.2 Mounting bracket/plate installation selected in accordance with works instruction. 2.3 Mounting bracket/plate tools, equipment and materials selected in accordance with works instruction. 2.4 Levelling of bracket/plate determined in accordance with works instruction 2.5 Bracket/plate hole visible. 2.6 Wall plug secured at determined position. 2.7 Bracket/plate secured at determined position. 2.8 Attitude, safety and environmental requirements complied in accordance with local authority requirements.

WORKS ACTIVITIES	RELATED KNOWLEDGE	RELATED SKILLS	ATTITUDE/ SAFETY/ ENVIRONMENT	ASSESSMENT CRITERIA
3. Drill piping hole.	3.1 Drilling works: • Drawing and marking. • Types and usage of materials. • Drilling tools and usage. 3.2 Drilling works process: • Technique. • Procedure. 3.3 Drilling works checking procedure: • Types of inspection tools and usage. • Technique of checking piping hole drilling.	3.1 Obtain works instruction 3.2 Prepare tools, equipment and material. 3.3 Mark position. 3.4 Drill marked position.	<u>ATTITUDE</u> 3.1 Compliance to best practices and procedures. <u>SAFETY</u> 3.1 Compliance to warnings, cautions and notes as stated in manufacturer's manual. <u>ENVIRONMENT</u> 3.1 Minimizing of pollution during handling hazardous chemicals, waste in compliance to current environmental acts.	3.1 Piping hole drilling process and checking procedure described in accordance with works instruction. 3.2 Piping hole drilling method selected in accordance with works instruction. 3.3 Piping hole drilling tools, equipment and materials selected in accordance with works instruction. 3.4 Hole indicated and visible in accordance with works instruction. 3.5 Attitude requirements complied in accordance with best practices and procedure. 3.6 Safety requirements complied in accordance with warnings, cautions and notes as stated in manufacturer's manual.

WORKS ACTIVITIES	RELATED KNOWLEDGE	RELATED SKILLS	ATTITUDE/ SAFETY/ ENVIRONMENT	ASSESSMENT CRITERIA
4. Install piping system.	4.1 Piping works instruction: • Piping drawing. • Types and usage of materials. • Piping tools and usage. 4.2 Piping works process: • Technique. • Procedure. 4.3 Piping works checking procedure: • Types of inspection tools and usage. • Technique of checking leakage. • Procedure of remedial action.	4.1 Obtain works instruction 4.2 Prepare tools, equipment and materials. 4.3 Fix refrigerant piping 4.4 Fix piping thermal insulation 4.5 Fix drainage piping 4.6 Check piping system leakage	ATTITUDE 4.1 Compliance to best practices and procedures. SAFETY 4.1 Compliance to warnings, cautions and notes as stated in manufacturer's manual. ENVIRONMENT 4.1 Minimizing of pollution during handling hazardous chemicals, waste in compliance to current environmental acts	4.1 Piping system installation and checking procedure described in accordance with works instruction. 4.2 Piping system installation method selected in accordance with works instruction. 4.3 Piping system tools, equipment and materials selected in accordance with works instruction. 4.4 Copper pipe and thermal insulation with specified size are secured at determined location. 4.5 Water piping materials which include copper, PVC and ABS are secured at specified location. 4.6 No leakage at all fittings are confirmed. 4.7 Attitude requirements complied in accordance with best practices and procedure. 4.8 Safety requirements complied in accordance with warnings, cautions and notes as stated in manufacturer's manual.

WORKS ACTIVITIES	RELATED KNOWLEDGE	RELATED SKILLS	ATTITUDE/ SAFETY/ ENVIRONMENT	ASSESSMENT CRITERIA
5. Install Indoor Unit.	5.1 Works instruction: • Indoor unit and wiring information. • Regulation requirements. 5.2 Indoor unit installation process: • Technique. • Procedure. • Tools, equipment and usage. 5.3 Indoor unit installation testing procedure: • Continuity test. • Earthing test.	5.1 Obtain works instruction. 5.2 Prepare tools, equipment and materials. 5.3 Locate power source. 5.4 Fix cable casing. 5.5 Lay cable. 5.6 Fix wiring system termination. 5.7 Test power voltage.	ATTITUDE 5.1 Compliance to best practices and procedures. SAFETY 5.1 Compliance to warnings, cautions and notes as stated in manufacturer's manual. ENVIRONMENT 5.1 Minimizing of pollution during handling hazardous chemicals, waste in compliance to current environmental acts.	5.1 Indoor unit installation process and checking procedure described in accordance with works instruction. 5.2 Indoor unit installation method selected in accordance with works instruction. 5.3 Indoor unit installation tools, equipment and materials selected in accordance with works instruction. 5.4 Power source indicated as per schematic drawing. 5.5 Cable casing secured at determined location. 5.6 Cable connected to the equipment in accordance with manufacturer's specifications. 5.7 Voltage reading obtained in accordance with manufacturer's specifications. 5.8 Attitude requirements complied in accordance with best practices and procedure. 5.9 Safety requirements complied in accordance with warnings, cautions and notes as stated in manufacturer's manual.

WORKS ACTIVITIES	RELATED KNOWLEDGE	RELATED SKILLS	ATTITUDE/ SAFETY/ ENVIRONMENT	ASSESSMENT CRITERIA
6. Install outdoor unit.	6.1 Works instruction: • Outdoor unit and wiring information. • Regulation requirements. 6.2 Outdoor unit installation process: • Technique. • Procedure. • Tools, equipment and usage. 6.3 Outdoor unit installation testing procedure: • Continuity test. • Earthing test.	6.1 Obtain works instruction. 6.2 Prepare tools, equipment and materials. 6.3 Locate power source. 6.4 Fix cable casing. 6.5 Lay cable. 6.6 Fix wiring system termination. 6.7 Test power voltage.	ATTITUDE 6.1 Compliance to best practices and procedures. SAFETY 6.1 Compliance to warnings, cautions and notes as stated in manufacturer's manual. ENVIRONMENT 6.1 Minimizing of pollution during handling hazardous chemicals, waste in compliance to current environmental acts.	6.1 Outdoor unit installation process and checking procedure described in accordance with works instruction. 6.2 Outdoor unit installation method selected in accordance with works instruction. 6.3 Outdoor unit installation tools, equipment and materials selected in accordance with works instruction. 6.4 Power source indicated as per schematic drawing. 6.5 Cable casing secured at determined location. 6.6 Cable connected to the equipment in accordance with manufacturer's specifications. 6.7 Voltage reading obtained in accordance with manufacturer's specifications. 6.8 Attitude requirements complied in accordance with best practices and procedure. 6.9 Safety requirements complied in accordance with warnings, cautions and notes as stated in manufacturer's manual.

WORKS ACTIVITIES	RELATED KNOWLEDGE	RELATED SKILLS	ATTITUDE/ SAFETY/ ENVIRONMENT	ASSESSMENT CRITERIA
7. Install wiring system.	7.1 Works instruction: • Wiring information. • Regulation requirements. 7.2 Wiring installation process: • Technique. • Procedure. • Tools, equipment and usage. 7.3 Wiring system testing procedure: • Polarity test. • Continuity test. • Insulation resistance test. • Earthing test.	7.1 Obtain works instruction. 7.2 Prepare tools, equipment and materials. 7.3 Locate power source. 7.4 Fix wiring cable. 7.5 Fix wiring termination. 7.6 Test power voltage.	<u>ATTITUDE</u> 7.1 Compliance to best practices and procedures. <u>SAFETY</u> 7.1 Compliance to warnings, cautions and notes as stated in manufacturer's manual. <u>ENVIRONMENT</u> 7.1 Minimizing of pollution during handling hazardous chemicals, waste in compliance to current environmental acts.	7.1 Wiring system installation process and checking procedure described in accordance with works instruction. 7.2 Wiring system installation method selected in accordance with works instruction. 7.3 Wiring system tools, equipment and materials selected in accordance with works instruction. 7.4 Power source indicated as per schematic drawing. 7.5 Cable casing secured at determined location. 7.6 Cable connected to the equipment in accordance with manufacturer's specifications. 7.7 Voltage reading obtained in accordance with manufacturer's specifications. 7.8 Attitude requirements complied in accordance with best practices and procedure. 7.9 Safety requirements complied in accordance with warnings, cautions and notes as stated in manufacturer's manual.

WORKS ACTIVITIES	RELATED KNOWLEDGE	RELATED SKILLS	ATTITUDE/ SAFETY/ ENVIRONMENT	ASSESSMENT CRITERIA
8. Vacuum piping system.	8.1 Works instruction: • Vacuuming information. • Reading standard requirements. 8.2 Vacuuming tools: • Types. • Usage. • Maintenance. 8.3 Vacuuming process: • Technique. • Procedure. 8.4 Vacuum pressure checking.	8.1 Obtain works instruction. 8.2 Prepare tools, equipment and materials. 8.3 Fix manifold gauge. 8.4 Vacuum refrigerant piping system. 8.5 Check vacuum pressure.	ATTITUDE 8.1 Compliance to best practices and procedures. SAFETY 8.1 Compliance to warnings, cautions and notes as stated in manufacturer's manual. ENVIRONMENT 8.1 Minimizing of pollution during handling hazardous chemicals, waste in compliance to current environmental acts.	8.1 Piping system vacuuming process and checking procedure described in accordance with works instruction. 8.2 Piping system vacuuming method selected in accordance with works instruction. 8.3 Piping system vacuuming tools, equipment and materials selected in accordance with works instruction. 8.4 Specified manifold gauge secured in accordance manufacturer's specifications. 8.5 Refrigerant piping system at recommended pressure obtained in accordance with manufacturer's specifications. 8.6 No leakage, free from air, moisture and non-condensable gas confirmed in accordance with manufacturer's specifications. 8.7 Attitude requirements complied in accordance with best practices and procedure. 8.8 Safety requirements complied in accordance with warnings,

WORKS ACTIVITIES	RELATED KNOWLEDGE	RELATED SKILLS	ATTITUDE/ SAFETY/ ENVIRONMENT	ASSESSMENT CRITERIA
				cautions and notes as stated in manufacturer's manual.
9. Perform leak test.	9.1 Works instruction: • Leak test information. • Standard guidelines. 9.2 Leak test tools, equipment and materials: • Types. • Usage. • Maintenance. 9.3 Leak test: • Technique. • Procedure. • Recording checklist.	9.1 Obtain works instruction. 9.2 Prepare tools, equipment and materials. 9.3 Fix manifold gauge. 9.4 Check pressure. 9.5 Record leak test checklist.	<u>ATTITUDE</u> 9.1 Compliance to best practices and procedures. <u>SAFETY</u> 9.1 Compliance to warnings, cautions and notes as stated in manufacturer's manual. <u>ENVIRONMENT</u> 9.1 Minimizing of pollution during handling hazardous chemicals, waste in compliance to current environmental acts.	9.1 Leak test process and technique described in accordance with works instruction. 9.2 Leak test method selected in accordance with works instruction. 9.3 Leak test tools, equipment and materials selected in accordance with works instruction. 9.4 Specified manifold gauge secured in accordance with manufacturer's specifications. 9.5 Refrigerant piping system at recommended pressure obtained in accordance with manufacturer's specifications. 9.6 Leak test checklist produced in accordance with organizational requirements. 9.7 Attitude requirements complied in accordance with best practices and procedure. 9.8 Safety requirements complied in accordance with warnings, cautions and notes as stated in manufacturer's manual.

WORKS ACTIVITIES	RELATED KNOWLEDGE	RELATED SKILLS	ATTITUDE/ SAFETY/ ENVIRONMENT	ASSESSMENT CRITERIA
10. Charge refrigerant.	10.1 Works instruction: • Types of refrigerant. • Standard pressure. • Refrigerant handling. • Good Service and Practices (GSP). • Regulation requirements. 10.2 Refrigerant charging tools equipment and material: • Types. • Usage. • Maintenance. 10.3 Refrigerant charging process: • Technique. • Procedure. • Safety requirements.	10.1 Obtain works instruction. 10.2 Prepare tools, equipment and materials. 10.3 Fix manifold gauge 10.4 Perform refrigerant charging. 10.5 Record charging value.	<u>ATTITUDE</u> 10.1 Compliance to best practices and procedures. <u>SAFETY</u> 10.1 Compliance to warnings, cautions and notes as stated in manufacturer's manual. <u>ENVIRONMENT</u> 10.1 Minimizing of pollution during handling hazardous chemicals, waste in compliance to current environmental acts.	10.1 Refrigerant charging process and technique described in accordance with manufacturer's specifications. 10.2 Refrigerant charging selected in accordance with manufacturer's specifications. 10.3 Refrigerant charging tools, equipment and materials selected in accordance with works instruction. 10.4 Specified manifold gauge secured in accordance with manufacturer's specifications. 10.5 Refrigerant quantity in accordance with manufacturer's specifications. 10.6 Refrigerant test checklist produced in accordance with organizational requirements. 10.7 Attitude requirements complied in accordance with best practices and procedure. 10.8 Safety and environmental requirements complied in accordance with warnings, cautions and notes as stated in manufacturer's manual and

WORKS ACTIVITIES	RELATED KNOWLEDGE	RELATED SKILLS	ATTITUDE/ SAFETY/ ENVIRONMENT	ASSESSMENT CRITERIA
	• ODS specifications requirements. • Recording charge refrigerant process.			ODS specifications requirements.
11. Record air-conditioning installation process.	11.1Installation checklist: • Safety requirements. • Installation tools, equipment and materials requirements. • Installation works process requirements. • Performance requirements. 11.2 Recording air-conditioning installation process.	11.1 Obtain installation checklist. 11.2 Check air-conditioning equipment installation. 11.3 Complete checklist.	<u>ATTITUDE</u> 11.1 Compliance to best practices and procedures. <u>SAFETY</u> 11.1Compliance to warnings, cautions and notes as stated in manufacturer's manual. <u>ENVIRONMENT</u> 11.1Minimizing of pollution during handling hazardous chemicals, waste in compliance to current environmental acts.	11.1 Air-conditioning installation process recording described in accordance with recording format. 11.2 Air-conditioning installation checklist confirmed in accordance with manufacturer's specifications. 11.3 Installation process checklist produced in accordance with organizational requirements. 11.4 Attitude requirements complied in accordance with best practices and procedure. 11.5 Safety requirements complied in accordance with warnings, cautions and notes as stated in manufacturer's manual.

Employability Skills

Core Abilities

- Please refer NCS- Core Abilities latest edition.

Social Values & Social Skills

- Please refer Handbook on Social Skills and Social Values in Technical Education and Vocational Training.

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15.4. Section HVAC Equipment Testing and Commissioning

SECTION	(F) Specialized Construction Activities		
GROUP	(432) Electrical, Plumbing and Other Construction Installation Activities		
AREA	HVAC Single Phase		
NOSS TITLE	Heating, Ventilation, Air-Conditioning (HVAC) Installation and Maintenance		
COMPETENCY UNIT TITLE	HVAC Equipment Testing and Commissioning		
LEARNING OUTCOMES	The learning outcomes of this competency unit are trainees enable to test and commission HVAC equipment ensuring equipment safety and performance, in compliance with manufacturer's and Occupational Safety, Health and Environment (OSHE) requirements. Upon completion of this competency unit, trainees should be able to: 1. Perform heating performance test. 2. Perform ventilation performance test. 3. Perform air conditioning performance test. 4. Commission HVAC equipment. 5. Record testing and commissioning process.		
TRAINING PREREQUISITE (SPECIFIC)	Competent in any of the installation competency F432-007-1:2020-C01, Single Phase Heating Equipment Installation, F432-007-1:2020-C02, Single Phase Ventilation Equipment Installation and F432-007-1:2020-C03, Single Phase Air-Conditioning Equipment Installation.		
CU CODE	F432-007-3:2020-C04	NOSS LEVEL	Three (3)

WORKS ACTIVITIES	RELATED KNOWLEDGE	RELATED SKILLS	ATTITUDE/ SAFETY/ ENVIRONMENT	ASSESSMENT CRITERIA
1. Perform heating performance test.	1.1 Works instruction: • Types of equipment. • Testing tools.	1.1 Obtain works instruction. 1.2 Prepare tools, equipment and materials.	<u>ATTITUDE</u> 1.1 Compliance to best practices and procedures.	1.1 Heating performance test process and procedure described in accordance with works instruction.

WORKS ACTIVITIES	RELATED KNOWLEDGE	RELATED SKILLS	ATTITUDE/ SAFETY/ ENVIRONMENT	ASSESSMENT CRITERIA
	• Manufacturer's specifications. 1.2 Heating performance testing tools, equipment and materials: • Types. • Usage. • Maintenance. 1.3 Condition and performance of heating equipment. 1.4 Heating equipment testing procedure.	1.3 Check heating equipment condition and performance. 1.4 Record performance checklist.	<u>SAFETY</u> 1.1 Compliance to warnings, cautions and notes as stated in manufacturer's manual. <u>ENVIRONMENT</u> 1.1 Minimizing of pollution during handling hazardous chemicals, waste in compliance to current environmental acts.	1.2 Heating performance test method selected in accordance with works instruction. 1.3 Heating performance test materials selected in accordance with works instruction. 1.4 Heating temperature reading confirmed with manufacturer's specifications. 1.5 Electrical safety which include leakage, wear and tear and tolerance confirmed in accordance with manufacturer's specifications. 1.6 Heating performance test report produced in accordance with organizational requirements. 1.7 Attitude requirements complied in accordance with best practices and procedure. 1.8 Safety requirements complied in accordance with warnings, cautions and notes as stated in manufacturer's manual.

WORKS ACTIVITIES	RELATED KNOWLEDGE	RELATED SKILLS	ATTITUDE/ SAFETY/ ENVIRONMENT	ASSESSMENT CRITERIA
2. Perform ventilation performance test.	2.1 Works instruction: • Types of equipment. • Testing tools. • Manufacturer's specifications. 2.2 Ventilation performance testing tools, equipment and materials: • Types. • Usage. • Maintenance. 2.3 Condition and performance of ventilation equipment: • Airflow. • Fan rotation. • Current. 2.4 Ventilation testing procedure.	2.1 Obtain works instruction. 2.2 Prepare tools, equipment and materials. 2.3 Check airflow. 2.4 Check fan rotation. 2.5 Record ventilation performance.	<u>ATTITUDE</u> 2.1 Compliance to best practices and procedures. <u>SAFETY</u> 2.1 Compliance to warnings, cautions and notes as stated in manufacturer's manual. <u>ENVIRONMENT</u> 2.2 Minimizing of pollution during handling hazardous chemicals, waste in compliance to current environmental acts.	2.1 Ventilation performance test process and procedure described in accordance with works instruction. 2.2 Ventilation performance test method selected in accordance with works instruction. 2.3 Ventilation performance test tools, equipment and materials selected in accordance with works instruction. 2.4 Airflow and fan rotation of ventilation confirmed in accordance with manufacturer's specifications. 2.5 Ventilation performance test report produced in accordance with organizational requirements. 2.6 Attitude requirements complied in accordance with best practices and procedure. 2.7 Safety requirements complied in accordance with warnings, cautions and notes as stated in manufacturer's manual.

WORKS ACTIVITIES	RELATED KNOWLEDGE	RELATED SKILLS	ATTITUDE/ SAFETY/ ENVIRONMENT	ASSESSMENT CRITERIA
3. Perform air conditioning performance test.	3.1 Works instruction: • Types of equipment. • Testing tools. • Manufacturer's specifications. 3.2 Air conditioning performance testing tools, equipment and materials: • Types. • Usage. • Maintenance. 3.3 Condition and performance of air conditioning equipment: • Airflow. • Fan rotation. • Refrigerant pressure. • Electrical safety. • Water drainage. • Temperature.	3.1 Obtain works instruction. 3.2 Prepare tools, equipment and materials. 3.3 Check airflow. 3.4 Check fan rotation. 3.5 Check refrigerant pressure. 3.6 Check electrical safety. 3.7 Check water drainage. 3.8 Check temperature. 3.9 Check refrigerant and water leakage. 3.10 Record air conditioning performance.	<u>ATTITUDE</u> 3.1 Compliance to best practices and procedures. <u>SAFETY</u> 3.1 Compliance to warnings, cautions and notes as stated in manufacturer's manual. <u>ENVIRONMENT</u> 3.1 Minimizing of pollution during handling hazardous chemicals, waste in compliance to current environmental acts.	3.1 Air conditioning performance test process and procedure described in accordance with works instruction. 3.2 Air conditioning performance test method selected in accordance with works instruction. 3.3 Air conditioning performance test tools, equipment and materials selected in accordance with works instruction. 3.4 Airflow, fan rotation, refrigerant pressure, electrical safety, water drainage, temperature and refrigerant and water leakage in HVAC functioning are confirmed in accordance with manufacturer's specifications. 3.5 Air conditioning performance test report produced in accordance with organizational requirements. 3.6 Attitude requirements complied in accordance with best practices and procedure.

WORKS ACTIVITIES	RELATED KNOWLEDGE	RELATED SKILLS	ATTITUDE/ SAFETY/ ENVIRONMENT	ASSESSMENT CRITERIA
	• Refrigerant and water leakage. 3.4 Air conditioning testing procedure.			3.7 Safety requirements complied in accordance with warnings, cautions and notes as stated in manufacturer's manual.
4. Commission HVAC equipment.	4.1 Works instruction: • Types of HVAC equipment. • HVAC Testing tools. • Manufacturer's specifications. 4.2 HVAC performance testing tools, equipment and materials: • Types. • Usage. • Maintenance. 4.3 Testing and commissioning procedure: • Client compliance requirements.	4.1 Obtain works instruction. 4.2 Prepare tools, equipment and materials. 4.3 Test equipment function. 4.4 Handover heating, ventilation and air conditioning (HVAC) equipment. 4.5 Record commissioning equipment.	<u>ATTITUDE</u> 4.1 Compliance to best practices and procedures. <u>SAFETY</u> 4.1 Compliance to warnings, cautions and notes as stated in manufacturer's manual. <u>ENVIRONMENT</u> 4.1 Minimizing of pollution during handling hazardous chemicals, waste in compliance to current environmental acts.	4.1 HVAC equipment commissioning process and procedure described in accordance with client guidelines. 4.2 HVAC commissioning works instruction acquired in accordance with client guidelines. 4.3 HVAC commissioning tools, equipment and materials selected in accordance with works instruction. 4.4 HVAC equipment functioned in accordance with manufacturer's specifications and client acceptance acknowledged. 4.5 Commissioning HVAC equipment report produced in accordance with organizational requirements.

WORKS ACTIVITIES	RELATED KNOWLEDGE	RELATED SKILLS	ATTITUDE/ SAFETY/ ENVIRONMENT	ASSESSMENT CRITERIA
	• HVAC equipment handover.			4.6 Attitude requirements complied in accordance with best practices and procedure. 4.7 Safety requirements complied in accordance with warnings, cautions and notes as stated in manufacturer's manual.
5. Record testing and commissioning process.	5.1 HVAC Testing and commissioning checklist: • Types of HVAC equipment. • Safety requirements. • Testing tools, equipment and materials requirements. • Performance requirements. • Testing and commissioning process requirements.	5.1 Obtain testing and commissioning checklist. 5.2 Check heating, ventilation and air conditioning (HVAC) equipment testing and commissioning process. 5.3 Complete checklist.	<u>ATTITUDE</u> 5.1 Compliance to best practices and procedures. <u>SAFETY</u> 5.1 Compliance to warnings, cautions and notes as stated in manufacturer's manual. <u>ENVIRONMENT</u> Not Available	5.1 HVAC testing and commissioning process recording described in accordance with recording format. 5.2 Testing and commissioning checklist selected. 5.3 HVAC equipment testing and commissioning process confirmed in accordance with manufacturer's specifications. 5.4 Testing and commissioning process checklist produced in accordance with organizational requirements. 5.5 Attitude requirements complied in accordance with best practices and procedure. 5.6 Safety requirements complied in accordance with warnings,

WORKS ACTIVITIES	RELATED KNOWLEDGE	RELATED SKILLS	ATTITUDE/ SAFETY/ ENVIRONMENT	ASSESSMENT CRITERIA
	5.2 Checking testing and commissioning process.			cautions and notes as stated in manufacturer's manual.

Employability Skills

Core Abilities

- Please refer NCS- Core Abilities latest edition.

Social Values & Social Skills

- Please refer Handbook on Social Skills and Social Values in Technical Education and Vocational Training.

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15.5. Single Phase Heating Equipment Maintenance

SECTION	(F) Specialized Construction Activities		
GROUP	(432) Electrical, Plumbing and Other Construction Installation Activities		
AREA	HVAC Single Phase		
NOSS TITLE	Heating, Ventilation, Air-Conditioning (HVAC) Installation and Maintenance		
COMPETENCY UNIT TITLE	Single Phase Heating Equipment Maintenance		
LEARNING OUTCOMES	The learning outcomes of this competency unit are trainees enable to maintain single phase heating equipment ensuring equipment safety and performance, in compliance with manufacturer's and Occupational Safety, Health and Environment (OSHE) requirements. Upon completion of this competency unit, trainees should be able to: 1. Maintain heating equipment motor pump. 2. Maintain heating equipment heater. 3. Maintain wiring system. 4. Maintain piping system. 5. Maintain filter system. 6. Record maintenance activities.		
TRAINING PREREQUISITE (SPECIFIC)	Not Available		
CU CODE	F432-007-3:2020-C05	NOSS LEVEL	Three (3)

WORKS ACTIVITIES	RELATED KNOWLEDGE	RELATED SKILLS	ATTITUDE/ SAFETY/ ENVIRONMENT	ASSESSMENT CRITERIA
1. Maintain heating equipment motor pump.	1.1 Works instruction: • Maintenance of heating equipment	1.1 Obtain works instruction. 1.2 Prepare tools, equipment and materials.	ATTITUDE 1.1 Compliance to best practices and procedures.	1.1 Heating equipment maintenance process described in accordance with works instruction.

WORKS ACTIVITIES	RELATED KNOWLEDGE	RELATED SKILLS	ATTITUDE/ SAFETY/ ENVIRONMENT	ASSESSMENT CRITERIA
	motor pump requirements. • Manufacturer's specifications. 1.2 Types of maintenance: • Preventive maintenance. • Corrective maintenance. 1.3 Motor pump maintenance and testing tools, equipment and materials: • Types. • Usage. • Maintenance. 1.4 Condition and performance of motor pump: • Water pressure. • Electrical safety. 1.5 Motor pump maintenance and testing procedure.	1.3 Check condition and performance. 1.4 Service motor pump. 1.5 Test motor pump function. 1.6 Record motor pump maintenance checklist.	<u>SAFETY</u> 1.1 Compliance to warnings, cautions and notes as stated in manufacturer's manual. <u>ENVIRONMENT</u> 1.1 Minimizing of pollution during handling hazardous chemicals, waste in compliance to current environmental acts.	1.2 Heating equipment motor pump maintenance selected in accordance with works instruction. 1.3 Heating equipment motor pump maintenance tools, equipment and materials selected in accordance with works instruction. 1.4 Crack, burnt marks, leaking, abnormal noise, overload and control function of motor pump are confirmed in accordance with manufacturer's specifications. 1.5 Damage motor pump removed from heating equipment and new motor pump installed in accordance with manufacturer's specifications. 1.6 Motor pump performance as required in accordance with manufacturer's specifications. 1.7 Checklist produce in accordance with organizational requirements. 1.8 Attitude requirements complied in accordance with best practices and procedure.

WORKS ACTIVITIES	RELATED KNOWLEDGE	RELATED SKILLS	ATTITUDE/ SAFETY/ ENVIRONMENT	ASSESSMENT CRITERIA
				1.9 Safety requirements complied in accordance with warnings, cautions and notes as stated in manufacturer's manual.
2. Maintain heating equipment heater.	2.1 Works instruction: • Maintenance of heating equipment heater requirements. • Manufacturer's specifications. 2.2 Types of maintenance: • Preventive maintenance. • Corrective maintenance. 2.3 Heater maintenance and testing tools, equipment and materials: • Types. • Usage. • Maintenance.	2.1 Obtain works instruction. 2.2 Prepare tools, equipment and materials. 2.3 Check condition and Performance. 2.4 Service heating Equipment. 2.5 Test heating function. 2.6 Record heating maintenance checklist.	ATTITUDE 2.1 Compliance to best practices and procedures. SAFETY 2.1 Compliance to warnings, cautions and notes as stated in manufacturer's manual. ENVIRONMENT 2.1 Minimizing of pollution during handling hazardous chemicals, waste in compliance to current environmental acts.	2.1 Heating equipment heater maintenance process and testing procedure described in accordance with works instruction. 2.2 Heating equipment heater maintenance selected in accordance with works instruction. 2.3 Heating equipment heater maintenance tools, equipment and materials selected in accordance with works instruction. 2.4 Crack, burnt marks, leaking, abnormal noise, overload and control function of heater confirmed in accordance with manufacturer's specifications. 2.5 Damage heater removed from heating equipment and new heater installed in accordance with manufacturer's specifications.

WORKS ACTIVITIES	RELATED KNOWLEDGE	RELATED SKILLS	ATTITUDE/ SAFETY/ ENVIRONMENT	ASSESSMENT CRITERIA
	2.4 Condition and performance of heater: • Temperature. • Short circuit. 2.5 Heater maintenance and testing procedure.			2.6 Heating equipment heater functioned as required in accordance with manufacturer's specifications. 2.7 Checklist produced in accordance with organizational requirements. 2.8 Attitude requirements complied in accordance with best practices and procedure. 2.9 Safety requirements complied in accordance with warnings, cautions and notes as stated in manufacturer's manual.
3. Maintain wiring system.	3.1 Works instruction • Wiring system Maintenance requirements. • Manufacturer's specifications. 3.2 Types of maintenance: • Preventive maintenance. • Corrective maintenance.	3.1 Obtain works instruction. 3.2 Prepare tools, equipment and materials. 3.3 Check condition and performance. 3.4 Repair wiring system. 3.5 Test wiring system function. 3.6 Record wiring system	<u>ATTITUDE</u> 3.1 Compliance to best practices and procedures. <u>SAFETY</u> 3.1 Compliance to warnings, cautions and notes as stated in manufacturer's manual.	3.1 Wiring system maintenance process and testing procedure described in accordance with works instruction. 3.2 Wiring system maintenance method selected in accordance with works instruction. 3.3 Wiring system maintenance tools, equipment and materials selected in accordance with works instruction. 3.4 Burnt marks, leaking, and overload of wiring system

WORKS ACTIVITIES	RELATED KNOWLEDGE	RELATED SKILLS	ATTITUDE/ SAFETY/ ENVIRONMENT	ASSESSMENT CRITERIA
	3.3 Wiring system maintenance and testing tools, equipment and materials: • Types. • Usage. • Maintenance. 3.4 Condition and performance of wiring system: • Burn mark. • Short circuit. • Control circuit. 3.5 Wiring system maintenance and testing procedure.	maintenance checklist.	<u>ENVIRONMENT</u> 3.1 Minimizing of pollution during handling hazardous chemicals, waste in compliance to current environmental acts.	confirmed in accordance with manufacturer's specifications. 3.5 Damage wiring system removed from heating equipment and new wiring system installed in accordance with manufacturer's specifications. 3.6 Wiring system functioned as required in accordance with manufacturer's specifications. 3.7 Wiring system maintenance checklist produced in accordance with organizational requirements. 3.8 Attitude requirements complied in accordance with best practices and procedure. 3.9 Safety requirements complied in accordance with warnings, cautions and notes as stated in manufacturer's manual.

WORKS ACTIVITIES	RELATED KNOWLEDGE	RELATED SKILLS	ATTITUDE/ SAFETY/ ENVIRONMENT	ASSESSMENT CRITERIA
4. Maintain piping system.	4.1 Works instruction: • Piping system maintenance requirements. • Manufacturer's specifications. 4.2 Types of piping system maintenance. • Preventive maintenance. • Corrective maintenance. 4.3 Piping system maintenance and testing tools, equipment and materials • Types. • Usage. • Maintenance. 4.4 Condition and performance of piping system • Leakage. • Vibration. • Damage pipe.	4.1 Obtain works instruction. 4.2 Prepare maintenance tools, equipment and materials. 4.3 Check condition. 4.4 Perform piping system maintenance. 4.5 Test piping function. 4.6 Record piping maintenance checklist.	<u>ATTITUDE</u> 4.1 Compliance to best practices and procedures. <u>SAFETY</u> 4.1 Compliance to warnings, cautions and notes as stated in manufacturer's manual. <u>ENVIRONMENT</u> 4.1 Minimizing of pollution during handling hazardous chemicals, waste in compliance to current environmental acts.	4.1 Piping system maintenance process and testing procedure described in accordance with works instruction. 4.2 Piping system maintenance method selected in accordance with works instruction. 4.3 Piping system maintenance tools, equipment and materials selected in accordance with works instruction. 4.4 Crack, bent, corrosion and leaking of piping system confirmed in accordance with manufacturer's specifications. 4.5 Damage piping system removed from heating equipment and new piping system installed in accordance with manufacturer's specifications. 4.6 Piping system functioned as required in accordance with manufacturer's specifications. 4.7 Piping system maintenance checklist produced in accordance with organizational requirements.

WORKS ACTIVITIES	RELATED KNOWLEDGE	RELATED SKILLS	ATTITUDE/ SAFETY/ ENVIRONMENT	ASSESSMENT CRITERIA
	4.5 Piping system maintenance and testing procedure.			4.8 Attitude requirements complied in accordance with best practices and procedure. 4.9 Safety requirements complied in accordance with warnings, cautions and notes as stated in manufacturer's manual.
5. Maintain filter system.	5.1 Works instruction: • Filter system maintenance requirements. • Manufacturer's specifications. 5.2 Types of filter system maintenance: • Preventive maintenance. • Corrective maintenance. 5.3 Filter system maintenance and testing tools, equipment and materials: • Types. • Usage.	5.1 Obtain works instruction. 5.2 Prepare tools, equipment and materials. 5.3 Check condition and performance. 5.4 Service filter 5.5 Equipment Test 5.6 filter system function. 5.7 Record filter maintenance checklist	<u>ATTITUDE</u> 5.1 Compliance to best practices and procedures. <u>SAFETY</u> 5.1 Compliance to warnings, cautions and notes as stated in manufacturer's manual. <u>ENVIRONMENT</u> 5.1 Minimizing of pollution during handling hazardous chemicals, waste in compliance to current environmental acts.	5.1 Filter system maintenance process and testing procedure described in accordance with works instruction. 5.2 Filter system maintenance method selected in accordance with works instruction. 5.3 Filter system maintenance tools, equipment and materials selected in accordance with works instruction. 5.4 Crack and leaking of filter system confirmed in accordance with manufacturer's specifications. 5.5 Damage filter system removed from heating equipment and new filter system installed in accordance with manufacturer's specifications.

WORKS ACTIVITIES	RELATED KNOWLEDGE	RELATED SKILLS	ATTITUDE/ SAFETY/ ENVIRONMENT	ASSESSMENT CRITERIA
	• Maintenance. 5.4 Condition and performance of filter system: • Clog. • Damage. 5.5 Filter system maintenance and testing procedure.			5.6 Filter system functioned as required in accordance with manufacturer's specifications. 5.7 Filter system maintenance checklist produced in accordance with organizational requirements. 5.8 Attitude requirements complied in accordance with best practices and procedure. 5.9 Safety requirements complied in accordance with warnings, cautions and notes as stated in manufacturer's manual.
6. Record maintenance activities.	6.1 Installation Testing and commissioning checklist: • Types of HVAC equipment. • Safety requirements. • Testing tools, equipment and materials requirements.	6.1 Obtain heating equipment. maintenance 6.2 Check heating equipment maintenance process. 6.3 Complete heating equipment maintenance checklist.	<u>ATTITUDE</u> 6.1 Compliance to best practices and procedures. <u>SAFETY</u> 6.1 Compliance to warnings, cautions and notes as stated in manufacturer's manual. <u>ENVIRONMENT</u> Not Available	6.1 Heating equipment maintenance activities recording described in accordance with recording format. 6.2 Heating equipment checklist selected. 6.3 Heating equipment maintenance process confirmed in accordance with manufacturer's specifications. 6.4 Heating equipment maintenance checklist

WORKS ACTIVITIES	RELATED KNOWLEDGE	RELATED SKILLS	ATTITUDE/ SAFETY/ ENVIRONMENT	ASSESSMENT CRITERIA
	• Performance requirements. • Testing and commissioning process requirements. 6.2 Checking maintenance activities process.			produced in accordance with organizational requirements. 6.5 Attitude requirements complied in accordance with best practices and procedure. 6.6 Safety requirements complied in accordance with warnings, cautions and notes as stated in manufacturer's manual.

Employability Skills

Core Abilities

- Please refer NCS- Core Abilities latest edition.

Social Values & Social Skills

- Please refer Handbook on Social Skills and Social Values in Technical Education and Vocational Training.

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15.6. Single Phase Ventilation Equipment Maintenance

SECTION	(F) Specialized Construction Activities		
GROUP	(432) Electrical, Plumbing and Other Construction Installation Activities		
AREA	HVAC Single Phase		
NOSS TITLE	Heating, Ventilation, Air-Conditioning (HVAC) Single Phase Installation and Maintenance		
COMPETENCY UNIT TITLE	Single Phase Ventilation Equipment Maintenance		
LEARNING OUTCOMES	The learning outcomes of this competency unit are trainees enable to maintain single phase ventilation equipment ensuring equipment safety and performance, in compliance with manufacturer's and Occupational Safety, Health and Environment (OSHE) requirements. Upon completion of this competency unit, trainees should be able to: 1. Maintain ventilation motor. 2. Maintain wiring system. 3. Maintain ducting system. 4. Maintain fan blade. 5. Record ventilation maintenance activities.		
TRAINING PREREQUISITE (SPECIFIC)	Not Available		
CU CODE	F432-007-3:2020-C06	NOSS LEVEL	Three (3)

WORKS ACTIVITIES	RELATED KNOWLEDGE	RELATED SKILLS	ATTITUDE/ SAFETY/ ENVIRONMENT	ASSESSMENT CRITERIA
1. Maintain ventilation motor.	1.1 Works instruction: • Maintenance of ventilation motor requirements.	1.1 Obtain works instruction. 1.2 Prepare tools, equipment and materials.	<u>ATTITUDE</u> 1.1 Compliance to best practices and procedures.	1.1 Ventilation motor maintenance process and testing procedure described in accordance with works instruction.

WORKS ACTIVITIES	RELATED KNOWLEDGE	RELATED SKILLS	ATTITUDE/ SAFETY/ ENVIRONMENT	ASSESSMENT CRITERIA
	• Manufacturer's specifications. 1.2 Types of maintenance: • Preventive maintenance. • Corrective maintenance. 1.3 Ventilation motor maintenance and testing tools, equipment and materials: • Types. • Usage. • Maintenance. 1.4 Condition and performance of ventilation motor: • Motor rotation. • Electrical safety. • Damage blade. 1.5 Ventilation fan maintenance and testing procedure.	1.3 Check condition and performance. 1.4 Service ventilation motor. 1.5 Test ventilation motor maintenance. 1.6 Record ventilation motor maintenance checklist.	<u>SAFETY</u> 1.1 Compliance to warnings, cautions and notes as stated in manufacturer's manual. <u>ENVIRONMENT</u> 1.1 Minimizing of pollution during handling hazardous chemicals, waste in compliance to current environmental acts.	1.2 Ventilation motor maintenance method selected in accordance with works instruction. 1.3 Ventilation motor maintenance tools, equipment and materials selected in accordance with works instruction. 1.4 Noise, broken fan and fan rotation of ventilation motor confirmed in accordance with manufacturer's specifications. 1.5 Damage ventilation motor removed from heating equipment and new ventilation motor installed in accordance with manufacturer's specifications. 1.6 Ventilation motor functioned as required in accordance with manufacturer's specifications. 1.7 Ventilation motor maintenance checklist produced in accordance with organizational requirements. 1.8 Attitude requirements complied in accordance with best practices and procedure. 1.9 Safety requirements complied in accordance with warnings,

WORKS ACTIVITIES	RELATED KNOWLEDGE	RELATED SKILLS	ATTITUDE/ SAFETY/ ENVIRONMENT	ASSESSMENT CRITERIA
				cautions and notes as stated in manufacturer's manual.
2. Maintain wiring system.	2.1 Works instruction: • Maintenance of wiring system requirements • Manufacturer's specifications 2.2 Types of maintenance: • Preventive maintenance. • Corrective maintenance. 2.3 Wiring system maintenance and testing tools, equipment and materials: • Types. • Usage. • Maintenance. 2.4 Condition and performance of wiring system: • Short circuit. • Burnt mark.	2.1 Obtain works instruction. 2.2 Prepare tools, equipment and materials. 2.3 Check condition and performance. 2.4 Replace wiring system. 2.5 Test wiring system function. 2.6 Record wiring system maintenance checklist.	<u>ATTITUDE</u> 2.1 Compliance to best practices and procedures. <u>SAFETY</u> 2.1 Compliance to warnings, cautions and notes as stated in manufacturer's manual. <u>ENVIRONMENT</u> 2.1 Minimizing of pollution during handling hazardous chemicals, waste in compliance to current environmental acts	2.1 Wiring system maintenance process and testing procedure described in accordance with works instruction. 2.2 Wiring system maintenance method selected in accordance with works instruction. 2.3 Wiring system maintenance tools, equipment and materials selected in accordance with works instruction. 2.4 Burnt marks, leaking and overload of wiring system confirmed in accordance with manufacturer's specifications. 2.5 Damage wiring system removed from heating equipment and new wiring system installed in accordance with manufacturer's specifications. 2.6 Wiring system functioned as required in accordance with manufacturer's specifications. 2.7 Wiring system maintenance checklist produced in

WORKS ACTIVITIES	RELATED KNOWLEDGE	RELATED SKILLS	ATTITUDE/ SAFETY/ ENVIRONMENT	ASSESSMENT CRITERIA
	• Control circuit. 2.5 Wiring system maintenance and testing procedure.			accordance with organizational requirements. 2.8 Attitude requirements complied in accordance with best practices and procedure. 2.9 Safety requirements complied in accordance with warnings, cautions and notes as stated in manufacturer's manual.
3. Maintain ducting system.	3.1 Works instruction: • Maintenance of ducting system requirements. • Manufacturer's specifications. 3.2 Types of maintenance: • Preventive maintenance. • Corrective maintenance. 3.3 Ducting system maintenance and testing tools, equipment and materials; • Types.	3.1 Obtain works instruction. 3.2 Prepare tools, equipment and materials. 3.3 Check condition and performance. 3.4 Service ducting system. 3.5 Test ducting system function. 3.6 Record ducting system maintenance checklist.	<u>ATTITUDE</u> 3.1 Compliance to best practices and procedures. <u>SAFETY</u> 3.1 Compliance to warnings, cautions and notes as stated in manufacturer's manual. <u>ENVIRONMENT</u> 3.1 Minimizing of pollution during handling hazardous chemicals, waste in compliance to current environmental acts	3.1 Ducting system maintenance process and testing procedure described in accordance with works instruction. 3.2 Ducting system maintenance method selected in accordance with works instruction. 3.3 Ducting system maintenance tools, equipment and materials selected in accordance with works instruction. 3.4 Crack, leaking, and abnormal noise of the ducting system confirmed in accordance with manufacturer's specifications. 3.5 Damage ducting system removed from heating equipment and new ducting system installed in accordance

WORKS ACTIVITIES	RELATED KNOWLEDGE	RELATED SKILLS	ATTITUDE/ SAFETY/ ENVIRONMENT	ASSESSMENT CRITERIA
	• Usage. • Maintenance. 3.4 Condition and performance of ducting system: • Damage. • Leakage. • Vibration. • Contamination. 3.5 Ducting system maintenance and testing procedure.			with manufacturer's specifications. 3.6 Ducting system functioned as required in accordance with manufacturer's specifications. 3.7 Ducting system maintenance checklist produced in accordance with organizational requirements. 3.8 Attitude requirements complied in accordance with best practices and procedure. 3.9 Safety requirements complied in accordance with warnings, cautions and notes as stated in manufacturer's manual.
4. Maintain fan blade.	4.1 Works instruction: • Maintenance of fan blade requirements. • Manufacturer's specifications. 4.2 Types of maintenance • Preventive maintenance.	4.1 Obtain works instruction. 4.2 Prepare tools, equipment and materials. 4.3 Check condition and performance. 4.4 Service fan blade. 4.5 Test fan blade maintenance.	<u>ATTITUDE</u> 4.1 Compliance to best practices and procedures. <u>SAFETY</u> 4.1 Compliance to warnings, cautions and notes as stated in manufacturer's manual.	4.1 Fan blade maintenance process and testing procedure described in accordance with works instruction. 4.2 Fan blade maintenance method selected in accordance with works instruction. 4.3 Fan blade maintenance tools, equipment and materials selected in accordance with works instruction.

WORKS ACTIVITIES	RELATED KNOWLEDGE	RELATED SKILLS	ATTITUDE/ SAFETY/ ENVIRONMENT	ASSESSMENT CRITERIA
	• Corrective maintenance. 4.3 Fan blade maintenance and testing tools, equipment and materials • Types. • Usage. • Maintenance. 4.4 Condition and performance of fan blade • Damage. • Alignment. • Contamination. 4.5 Fan blade maintenance and testing procedure.	4.6 Record fan blade maintenance checklist.	<u>ENVIRONMENT</u> 4.1 Minimizing of pollution during handling hazardous chemicals, waste in compliance to current environmental acts.	4.4 Crack, broken and abnormal noise of fan blade confirmed in accordance with manufacturer's specifications. 4.5 Damage fan blade removed from heating equipment and new fan blade installed in accordance with manufacturer's specifications. 4.6 Fan blade functioned as required in accordance with manufacturer's specifications. 4.7 Fan blade maintenance checklist produced in accordance with organizational requirements. 4.8 Attitude requirements complied in accordance with best practices and procedure. 4.9 Safety requirements complied in accordance with warnings, cautions and notes as stated in manufacturer's manual.

WORKS ACTIVITIES	RELATED KNOWLEDGE	RELATED SKILLS	ATTITUDE/ SAFETY/ ENVIRONMENT	ASSESSMENT CRITERIA
5. Record ventilation maintenance activities.	5.1 Maintenance ventilation equipment checklist. • Types of ventilation equipment. • Safety requirements. • Testing tools, equipment and materials requirements. • Performance requirements. • Testing and commissioning process requirements. 5.2 Checking process in ventilation maintenance activities.	5.1 Obtain ventilation equipment maintenance checklist. 5.2 Check ventilation equipment maintenance process. 5.3 Complete ventilation equipment maintenance checklist.	ATTITUDE 5.1 Compliance to best practices and procedures. SAFETY 5.1 Compliance to warnings, cautions and notes as stated in manufacturer's manual. ENVIRONMENT Not Available	5.1 Ventilation maintenance activities process recording described in accordance with recording format. 5.2 Ventilation equipment maintenance checklist selected. 5.3 Ventilation equipment maintenance process confirmed in accordance with manufacturer's specifications. 5.4 Ventilation equipment maintenance checklist produced in accordance with organizational requirements. 5.5 Attitude requirements complied in accordance with best practices and procedure. 5.6 Safety requirements complied in accordance with warnings, cautions and notes as stated in manufacturer's manual.

Employability Skills

Core Abilities

- Please refer NCS- Core Abilities latest edition.

Social Values & Social Skills

- Please refer Handbook on Social Skills and Social Values in Technical Education and Vocational Training.

References for Learning Material Development

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2 A. Eitan & K. Abraham, (1988). *Engineering Risk and Hazard Assessment, Vol. 1*. 1 ed., CRC Press. ISBN:0849346568.
3 John S. Page (1978), Estimator's Man-Hour Manual on Heating, Air Conditioning, Ventilating, and Plumbing, Second Edition (Man-Hour Manuals)
4 Richard Jazwin (August 1, 2001), Troubleshooting and Servicing HVAC&R Electrical Systems
5 Laurie Young (Hardcover - Dec 1996)Gower Handbook of Customer Service
6 Paul Roe Jordan(1955), Ventilation manual for sheet metal contractors;: A treatise on the type of ventilation which sheet metal contractors are called upon to plan and install,
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9 James E. Brumbaugh(Aug 6, 2004), Audel HVAC Fundamentals, Air Conditioning, Heat Pumps and Distribution Systems
10 Charles L. Hubbard(Apr 27, 2009), The Ventilation Hand Book: The Principles and Practice of Ventilation as Applied to Furnace Heating Ducts, Flues and Dampers For Gravity Heating Fans and ... With the Method of Ventilating Ships
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12 Department of Skills Standard (DSD). (2015). Z-009-1:2015 NCS-Core Abilities
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14 Department of Skills Standard (DSD). (2015). Z-009-3:2015 NCS-Core Abilities
15 Department of Skills Standard (DSD). (2015). Module on Social Skills and Social Values

15.7. Single Phase Air-Conditioning Equipment Maintenance

SECTION	(F) Specialized Construction Activities		
GROUP	(432) Electrical, Plumbing and Other Construction Installation Activities		
AREA	HVAC Single Phase		
NOSS TITLE	Heating, Ventilation, Air-Conditioning (HVAC) Installation and Maintenance		
COMPETENCY UNIT TITLE	Single Phase Air-Conditioning Equipment Maintenance		
LEARNING OUTCOMES	The learning outcomes of this competency unit are trainees enable to maintain single phase air-conditioning equipment ensuring equipment safety and performance, in compliance with manufacturer's and Occupational Safety, Health and Environment (OSHE) requirements. Upon completion of this competency unit, trainees should be able to: 1. Maintain indoor motor. 2. Maintain outdoor fan motor. 3. Maintain compressor. 4. Maintain evaporator/ cooling coil. 5. Maintain condenser coil. 6. Maintain refrigerant. 7. Maintain piping system. 8. Maintain wiring control system. 9. Maintain metering device. 10. Maintain drainage system. 11. Record air conditioning maintenance activities		
TRAINING PREREQUISITE (SPECIFIC)	Not Available		
CU CODE	F432-007-3:2020-C07	NOSS LEVEL	Three (3)

WORKS ACTIVITIES	RELATED KNOWLEDGE	RELATED SKILLS	ATTITUDE/ SAFETY/ ENVIRONMENT	ASSESSMENT CRITERIA
1. Maintain indoor motor.	1.1 Works instruction: • Maintenance of indoor motor requirements. • Manufacturer's specifications. 1.2 Types of maintenance: • Preventive maintenance. • Corrective maintenance. 1.3 Indoor motor maintenance and testing tools, equipment and materials: • Types. • Usage. • Maintenance. 1.4 Condition and performance of indoor motor: • Damage. • Contamination. • Short circuit. • Noise.	1.1 Obtain works instruction. 1.2 Prepare tools, equipment and materials. 1.3 Check condition and performance. 1.4 Replace indoor motor. 1.5 Test indoor motor function. 1.6 Record indoor motor maintenance checklist.	ATTITUDE 1.1 Compliance to best practices and procedures. SAFETY 1.1 Compliance to warnings, cautions and notes as stated in manufacturer's manual. ENVIRONMENT 1.1 Minimizing of pollution during handling hazardous chemicals, waste in compliance to current environmental acts.	1.1 Indoor motor maintenance process and testing procedure described in accordance with works instruction. 1.2 Air-conditioning indoor motor maintenance method selected in accordance with works instruction. 1.3 Air-conditioning indoor motor maintenance tools, equipment and materials selected in accordance with works instruction. 1.4 Noise and motor rotation of Air-conditioning indoor motor confirmed in accordance with manufacturer's specifications. 1.5 Damage indoor motor removed from air-conditioning equipment and new indoor motor installed in accordance with manufacturer's specifications. 1.6 Air-conditioning indoor motor functioned as required in accordance with manufacturer's specifications. 1.7 Air-conditioning indoor motor maintenance checklist

WORKS ACTIVITIES	RELATED KNOWLEDGE	RELATED SKILLS	ATTITUDE/ SAFETY/ ENVIRONMENT	ASSESSMENT CRITERIA
	1.5 Indoor motor maintenance and testing procedure.			produced in accordance with organizational requirements. 1.8 Attitude requirements complied in accordance with best practices and procedure. 1.9 Safety requirements complied in accordance with warnings, cautions and notes as stated in manufacturer's manual.
2. Maintain outdoor fan motor.	2.1 Works instruction: • Maintenance of outdoor fan motor requirements. • Manufacturer's specifications. 2.2 Types of maintenance: • Preventive maintenance. • Corrective maintenance. 2.3 Outdoor fan motor maintenance and testing tools, equipment and materials:	2.1 Obtain works instruction. 2.2 Prepare tools, equipment and materials. 2.3 Check condition and performance. 2.4 Replace outdoor motor. 2.5 Test outdoor motor function. 2.6 Record outdoor motor maintenance checklist.	<u>ATTITUDE</u> 2.1 Compliance to best practices and procedures. <u>SAFETY</u> 2.1 Compliance to warnings, cautions and notes as stated in manufacturer's manual. <u>ENVIRONMENT</u> 2.1 Minimizing of pollution during handling hazardous chemicals, waste in compliance to current environmental acts.	2.1 Outdoor fan motor maintenance process and testing procedure described in accordance with works instruction. 2.2 Air-conditioning outdoor fan motor maintenance method selected in accordance with works instruction. 2.3 Air-conditioning outdoor fan motor maintenance tools, equipment and materials selected in accordance with works instruction. 2.4 Noise, broken fan and fan rotation of air-conditioning outdoor fan motor confirmed in accordance with manufacturer's specifications.

WORKS ACTIVITIES	RELATED KNOWLEDGE	RELATED SKILLS	ATTITUDE/ SAFETY/ ENVIRONMENT	ASSESSMENT CRITERIA
	• Types. • Usage. • Maintenance. 2.4 Condition and performance of outdoor fan motor: • Damage. • Alignment. • Contamination. • Short circuit. • Noise. 2.5 Outdoor fan motor maintenance and testing procedure.			2.5 Damage outdoor fan motor removed from air-conditioning equipment and new outdoor fan motor system installed in accordance with manufacturer's specifications. 2.6 Air-conditioning outdoor fan motor functioned as required in accordance with manufacturer's specifications. 2.7 Air-conditioning outdoor fan motor maintenance checklist produced in accordance with organizational requirements. 2.8 Attitude requirements complied in accordance with best practices and procedure. 2.9 Safety requirements complied in accordance with warnings, cautions and notes as stated in manufacturer's manual.

WORKS ACTIVITIES	RELATED KNOWLEDGE	RELATED SKILLS	ATTITUDE/ SAFETY/ ENVIRONMENT	ASSESSMENT CRITERIA
3. Maintain compressor.	3.1 Works instruction: • Maintenance of compressor requirements. • Manufacturer's specifications. 3.2 Types of maintenance: • Preventive maintenance. • Corrective maintenance. 3.3 Compressor maintenance and testing tools, equipment and materials: • Types. • Usage. • Maintenance. 3.4 Condition and performance of compressor: • Noise. • Damage. • Contamination. • Short circuit.	3.1 Obtain works instruction. 3.2 Prepare tools, equipment and materials. 3.3 Check condition and performance. 3.4 Replace compressor. 3.5 Test compressor function. 3.6 Record compressor maintenance checklist.	<u>ATTITUDE</u> 3.1 Compliance to best practices and procedures. <u>SAFETY</u> 3.1 Compliance to warnings, cautions and notes as stated in manufacturer's manual. <u>ENVIRONMENT</u> 3.1 Minimizing of pollution during handling hazardous chemicals, waste in compliance to current environmental acts	3.1 Compressor maintenance process and testing procedure described in accordance with works instruction. 3.2 Air-conditioning compressor maintenance method selected in accordance with works instruction. 3.3 Air-conditioning compressor maintenance tools, equipment and materials selected in accordance with works instruction. 3.4 Noise and damage of air-conditioning compressor motor confirmed in accordance with manufacturer's specifications. 3.5 Damage compressor removed from air-conditioning equipment and new compressor installed in accordance with manufacturer's specifications. 3.6 Air-conditioning compressor motor functioned as required in accordance with manufacturer's specifications. 3.7 Air-conditioning compressor motor maintenance checklist

WORKS ACTIVITIES	RELATED KNOWLEDGE	RELATED SKILLS	ATTITUDE/ SAFETY/ ENVIRONMENT	ASSESSMENT CRITERIA
	3.5 Compressor maintenance and testing procedure.			produced in accordance with organizational requirements. 3.8 Attitude requirements complied in accordance with best practices and procedure. 3.9 Safety requirements complied in accordance with warnings, cautions and notes as stated in manufacturer's manual.
4. Maintain evaporator/ cooling coil.	4.1 Works instruction: • Maintenance of evaporator/ cooling coil requirements. • Manufacturer's specifications. 4.2 Types of maintenance: • Preventive maintenance. • Corrective maintenance. 4.3 Evaporator/ cooling coil maintenance and testing tools,	4.1 Obtain works instruction. 4.2 Prepare tools, equipment and materials. 4.3 Check condition and performance. 4.4 Replace evaporator/ cooling coil. 4.5 Test evaporator/ cooling coil function. 4.6 Record evaporator/ cooling coil maintenance checklist.	<u>ATTITUDE</u> 4.1 Compliance to best practices and procedures. <u>SAFETY</u> 4.1 Compliance to warnings, cautions and notes as stated in manufacturer's manual. <u>ENVIRONMENT</u> 4.1 Minimizing of pollution during handling hazardous chemicals, waste in compliance to current environmental acts.	4.1 Evaporator/cooling coil maintenance process and testing procedure described in accordance with works instruction. 4.2 Air-conditioning evaporator/ cooling coil maintenance method selected in accordance with works instruction. 4.3 Air-conditioning evaporator/ cooling coil maintenance tools, equipment and materials selected in accordance with works instruction. 4.4 Temperature of air-conditioning evaporator/ cooling coil confirmed in accordance with manufacturer's specifications.

WORKS ACTIVITIES	RELATED KNOWLEDGE	RELATED SKILLS	ATTITUDE/ SAFETY/ ENVIRONMENT	ASSESSMENT CRITERIA
	equipment and materials: • Types. • Usage. • Maintenance. 4.4 Condition and performance of evaporator/ cooling coil: • Damage. • Contamination. • Clog. 4.5 Evaporator/ cooling coil maintenance and testing procedure.			4.5 Damage evaporator/ cooling coil removed from air-conditioning equipment and new evaporator/ cooling coil installed in accordance with manufacturer's specifications. 4.6 Air-conditioning evaporator/ cooling coil functioned as required in accordance with manufacturer's specifications. 4.7 Air-conditioning evaporator/ cooling coil maintenance checklist produced in accordance with organizational requirements. 4.8 Attitude requirements complied in accordance with best practices and procedure. 4.9 Safety requirements complied in accordance with warnings, cautions and notes as stated in manufacturer's manual.

WORKS ACTIVITIES	RELATED KNOWLEDGE	RELATED SKILLS	ATTITUDE/ SAFETY/ ENVIRONMENT	ASSESSMENT CRITERIA
5. Maintain condenser coil.	5.1 Works instruction: • Maintenance of condenser coil requirements. • Manufacturer's specifications. 5.2 Types of maintenance: • Preventive maintenance. • Corrective maintenance. 5.3 Condenser coil maintenance and testing tools, equipment and materials: • Types. • Usage. • Maintenance. 5.4 Condition and performance of condenser coil: • Damage. • Contamination. • Clog.	5.1 Obtain works instruction. 5.2 Prepare tools, equipment and materials. 5.3 Check condition and performance. 5.4 Replace condenser coil. 5.5 Test condenser coil function. 5.6 Record condenser coil maintenance checklist.	<u>ATTITUDE</u> 5.1 Compliance to best practices and procedures. <u>SAFETY</u> 5.1 Compliance to warnings, cautions and notes as stated in manufacturer's manual. <u>ENVIRONMENT</u> 5.1 Minimizing of pollution during handling hazardous chemicals, waste in compliance to current environmental acts.	5.1 Condenser coil maintenance process and testing procedure described in accordance with works instruction. 5.2 Air-conditioning condenser coil maintenance method selected in accordance with works instruction. 5.3 Air-conditioning condenser coil maintenance tools, equipment and materials selected in accordance with works instruction. 5.4 Temperature of air-conditioning condenser coil confirmed in accordance with manufacturer's specifications. 5.5 Damage condenser coil removed from air-conditioning equipment and new condenser coil installed in accordance with manufacturer's specifications. 5.6 Air-conditioning condenser coil functioned as required in accordance with manufacturer's specifications. 5.7 Air-conditioning condenser coil maintenance checklist

WORKS ACTIVITIES	RELATED KNOWLEDGE	RELATED SKILLS	ATTITUDE/ SAFETY/ ENVIRONMENT	ASSESSMENT CRITERIA
	5.5 Condenser coil maintenance and testing procedure.			produced in accordance with organizational requirements. 5.8 Attitude requirements complied in accordance with best practices and procedure. 5.9 Safety requirements complied in accordance with warnings, cautions and notes as stated in manufacturer's manual.
6. Maintain refrigerant.	6.1 Works instruction: • Maintenance of refrigerant requirements. • Manufacturer's specifications. 6.2 Types of maintenance: • Preventive maintenance. • Corrective maintenance. 6.3 Refrigerant maintenance and testing tools, equipment and materials: • Types.	6.1 Obtain works instruction. 6.2 Prepare tools, equipment and materials. 6.3 Check condition and performance. 6.4 Replace refrigerant. 6.5 Test refrigerant function. 6.6 Record refrigerant maintenance checklist.	<u>ATTITUDE</u> 6.1 Compliance to best practices and procedures. <u>SAFETY</u> 6.1 Compliance to warnings, cautions and notes as stated in manufacturer's manual. <u>ENVIRONMENT</u> 6.1 Minimizing of pollution during handling hazardous chemicals, waste in compliance to current environmental acts.	6.1 Refrigerant maintenance process and testing procedure described in accordance with works instruction. 6.2 Air-conditioning refrigerant maintenance method selected in accordance with works instruction. 6.3 Air-conditioning refrigerant maintenance tools, equipment and materials selected in accordance with works instruction. 6.4 Leaking and used refrigerant of air-conditioning equipment confirmed in accordance with manufacturer's specifications and DOE regulation.

WORKS ACTIVITIES	RELATED KNOWLEDGE	RELATED SKILLS	ATTITUDE/ SAFETY/ ENVIRONMENT	ASSESSMENT CRITERIA
	• Usage. • Maintenance. 6.4 Condition and performance of refrigerant: • Contamination. • Leakage. 6.5 Refrigerant maintenance and testing procedure: • Recovering refrigerant. • Pump down. • Regulation requirements. • ODS specification requirements. • Good Service and Practice (GSP).			6.5 Used refrigerant removed from air-conditioning unit and new refrigerant filled up in accordance with manufacturer's and ODS specifications requirements. 6.6 Air-conditioning refrigerant functioned as required in accordance with manufacturer's and ODS specifications requirements. 6.7 Air-conditioning refrigerant maintenance checklist produced in accordance with organizational requirements. 6.8 Attitude requirements complied in accordance with best practices and procedure. 6.9 Safety requirements complied in accordance with warnings, cautions and notes as stated in manufacturer's manual.

WORKS ACTIVITIES	RELATED KNOWLEDGE	RELATED SKILLS	ATTITUDE/ SAFETY/ ENVIRONMENT	ASSESSMENT CRITERIA
7. Maintain piping system.	7.1 Works instruction: • Maintenance of piping system requirements. • Manufacturer's specifications. 7.2 Types of maintenance: • Preventive maintenance. • Corrective maintenance. 7.3 Piping system maintenance and testing tools, equipment and materials: • Types. • Usage. • Maintenance. 7.4 Condition and performance of piping system: • Damage. • Clog. • Leakage.	7.1 Obtain works instruction. 7.2 Prepare tools, equipment and materials. 7.3 Check condition and performance. 7.4 Replace piping system. 7.5 Test piping system function. 7.6 Record piping system maintenance checklist.	ATTITUDE 7.1 Compliance to best practices and procedures. SAFETY 7.1 Compliance to warnings, cautions and notes as stated in manufacturer's manual. ENVIRONMENT 7.1 Minimizing of pollution during handling hazardous chemicals, waste in compliance to current environmental acts.	7.1 Air-conditioning piping system maintenance process and testing procedure described in accordance with works instruction. 7.2 Air-conditioning piping system maintenance method selected in accordance with works instruction. 7.3 Air-conditioning piping system maintenance tools, equipment and materials selected in accordance with works instruction. 7.4 Crack, bent, corrosion and leaking of piping system confirmed in accordance with manufacturer's specifications. 7.5 Damage piping system removed from air-conditioning unit and new piping system fixed in accordance with manufacturer's specifications. 7.6 Air-conditioning piping system functioned as required in accordance with manufacturer's specifications. 7.7 Air-conditioning piping system maintenance checklist

WORKS ACTIVITIES	RELATED KNOWLEDGE	RELATED SKILLS	ATTITUDE/ SAFETY/ ENVIRONMENT	ASSESSMENT CRITERIA
	7.5 Piping system maintenance and testing procedure.			produced in accordance with organizational requirements. 7.8 Attitude requirements complied in accordance with best practices and procedure. 7.9 Safety requirements complied in accordance with warnings, cautions and notes as stated in manufacturer's manual.
8. Maintain wiring control system.	8.1 Works instruction: • Maintenance of wiring control system requirements. • Manufacturer's specifications. 8.2 Types of maintenance: • Preventive maintenance. • Corrective maintenance. 8.3 Wiring control system maintenance and testing tools,	8.1 Obtain works instruction. 8.2 Prepare tools, equipment and materials. 8.3 Check condition and performance. 8.4 Replace wiring control. 8.5 Test wiring control function. 8.6 Record wiring control maintenance checklist.	<u>ATTITUDE</u> 8.1 Compliance to best practices and procedures. <u>SAFETY</u> 8.1 Compliance to warnings, cautions and notes as stated in manufacturer's manual. <u>ENVIRONMENT</u> 8.1 Minimizing of pollution during handling hazardous chemicals, waste in compliance to current environmental acts.	8.1 Wiring control system maintenance process and testing procedure described in accordance with works instruction. 8.2 Wiring system maintenance method selected in accordance with works instruction. 8.3 Wiring system maintenance tools, equipment and materials selected in accordance with works instruction. 8.4 Burnt marks, leaking and overload of wiring system confirmed in accordance with manufacturer's specifications. 8.5 Damage wiring control removed from air conditioning unit and new wiring control

WORKS ACTIVITIES	RELATED KNOWLEDGE	RELATED SKILLS	ATTITUDE/ SAFETY/ ENVIRONMENT	ASSESSMENT CRITERIA
	equipment and materials: • Types. • Usage. • Maintenance. 8.4 Condition and performance of wiring control system: • Burnt mark. • Short circuit. • Loose connection. • Control circuit. 8.5 Wiring control system maintenance and testing procedure.			installed in accordance with manufacturer's specifications. 8.6 Wiring system functioned as required in accordance with manufacturer's specifications. 8.7 Wiring system maintenance checklist produced in accordance with organizational requirements. 8.8 Attitude requirements complied in accordance with best practices and procedure. 8.9 Safety requirements complied in accordance with warnings, cautions and notes as stated in manufacturer's manual.
9. Maintain metering device.	9.1 Works instruction: • Maintenance of metering device. requirements • Manufacturer's specifications. 9.2 Types of maintenance:	9.1 Obtain works instruction. 9.2 Prepare tools, equipment and materials. 9.3 Check condition and performance. 9.4 Replace metering device.	<u>ATTITUDE</u> 9.1 Compliance to best practices and procedures. <u>SAFETY</u> 9.1 Compliance to warnings, cautions and notes as stated in	9.1 Metering device maintenance process and testing procedure described in accordance with works instruction. 9.2 Metering device maintenance method selected in accordance with works instruction. 9.3 Metering device maintenance tools, equipment and materials

WORKS ACTIVITIES	RELATED KNOWLEDGE	RELATED SKILLS	ATTITUDE/ SAFETY/ ENVIRONMENT	ASSESSMENT CRITERIA
	• Preventive maintenance. • Corrective maintenance. 9.3 Metering device maintenance and testing tools, equipment and materials: • Types. • Usage. • Maintenance. 9.4 Condition and performance of metering device: • Clog • Damage. 9.5 Metering device maintenance and testing procedure.	9.5 Test metering device function. 9.6 Record metering device maintenance checklist.	manufacturer's manual. <u>ENVIRONMENT</u> 9.1 Minimizing of pollution during handling hazardous chemicals, waste in compliance to current environmental acts.	selected in accordance with works instruction. 9.4 Burnt marks, leaking and overload of metering device confirmed in accordance with manufacturer's specifications. 9.5 Damage metering device removed from air-conditioning unit and new metering device installed in accordance with manufacturer's specifications. 9.6 Metering device functioned as required in accordance with manufacturer's specifications. 9.7 Metering device maintenance checklist produced in accordance with organizational requirements. 9.8 Attitude requirements complied in accordance with best practices and procedure. 9.9 Safety requirements complied in accordance with warnings, cautions and notes as stated in manufacturer's manual.

WORKS ACTIVITIES	RELATED KNOWLEDGE	RELATED SKILLS	ATTITUDE/ SAFETY/ ENVIRONMENT	ASSESSMENT CRITERIA
10. Maintain drainage system.	10.1 Works instruction: • Maintenance of drainage system requirements. • Manufacturer's specifications. 10.2 Types of maintenance: • Preventive maintenance. • Corrective maintenance. 10.3 Drainage system maintenance and testing. tools, equipment and materials: • Types. • Usage. • Maintenance. 10.4 Condition and performance of drainage system: • Clog. • Leakage. • Damage.	10.1 Obtain works instruction. 10.2 Prepare tools, equipment and materials. 10.3 Check condition and Performance. 10.4 Service drainage system. 10.5 Test drainage system function. 10.6 Record drainage system maintenance checklist.	<u>ATTITUDE</u> 10.1 Compliance to best practices and procedures. <u>SAFETY</u> 10.1 Compliance to warnings, cautions and notes as stated in manufacturer's manual. <u>ENVIRONMENT</u> 10.1 Minimizing of pollution during handling hazardous chemicals, waste in compliance to current environmental acts.	10.1 Drainage system maintenance process and testing procedure described in accordance with works instruction. 10.2 Drainage system maintenance method selected in accordance with works instruction. 10.3 Drainage system maintenance tools, equipment and materials selected in accordance with works instruction. 10.4 Leaking of drainage system confirmed in accordance with manufacturer's specifications. 10.5 Damage drainage system removed/ serviced from air-conditioning unit and new/ serviced drainage system fixed in accordance with manufacturer's specifications. 10.6 Drainage system functioned as required in accordance with manufacturer's specifications. 10.7 Drainage system maintenance checklist produced in accordance with organizational requirements.

WORKS ACTIVITIES	RELATED KNOWLEDGE	RELATED SKILLS	ATTITUDE/ SAFETY/ ENVIRONMENT	ASSESSMENT CRITERIA
	• Alignment. 10.5 Drainage system maintenance and testing procedure.			10.8 Attitude requirements complied in accordance with best practices and procedure. 10.9 Safety requirements complied in accordance with warnings, cautions and notes as stated in manufacturer's manual.
11. Record air-conditioning maintenance activities.	11.1 Maintenance checklist: • Safety requirements. • Maintenance tools, equipment and materials requirements. • Maintenance works process requirements. • Performance requirements. 11.2 Recording process air conditioning maintenance activities.	11.1 Obtain air-conditioning maintenance checklist. 11.2 Check air-conditioning maintenance process. 11.3 Complete air-conditioning maintenance checklist.	<u>ATTITUDE</u> 11.1 Compliance to best practices and procedures. <u>SAFETY</u> 11.1 Compliance to warnings, cautions and notes as stated in manufacturer's manual. <u>ENVIRONMENT</u> Not Available	11.1 Air-conditioning maintenance activities recording described in accordance with recording format. 11.2 Air conditioning maintenance checklist selected. 11.3 Air-conditioning maintenance process confirmed in accordance with manufacturer's specifications. 11.4 Ventilation equipment maintenance checklist produced in accordance with organizational requirements. 11.5 Attitude requirements complied in accordance with best practices and procedure. 11.6 Safety requirements complied in accordance with warnings, cautions and notes as stated in manufacturer's manual.

Employability Skills

Core Abilities

- Please refer NCS- Core Abilities latest edition.

Social Values & Social Skills

- Please refer Handbook on Social Skills and Social Values in Technical Education and Vocational Training.

References for Learning Material Development

1. A.B. Constantinos, B. Francesco, H. Sten Olaf & etl.,(2000). *Report No 22: Risk Assessment In Relation To Indoor Air Quality*. Luxembourg; European Communities. ISBN: 92-828-9284-0.
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3. John S. Page (1978), Estimator's Man-Hour Manual on Heating, Air Conditioning, Ventilating, and Plumbing, Second Edition (Man-Hour Manuals)
4. Richard Jazwin (August 1, 2001), Troubleshooting and Servicing HVAC&R Electrical Systems
5. Paul Roe Jordan(1955), Ventilation manual for sheet metal contractors;: A treatise on the type of ventilation which sheet metal contractors are called upon to plan and install,
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7. David P Shelton(1982), Ventilation fans: Types and sizes (NebGuide)
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9. Charles L. Hubbard(Apr 27, 2009), The Ventilation Hand Book: The Principles and Practice of Ventilation as Applied to Furnace Heating Ducts, Flues and Dampers For Gravity Heating Fans and ... With the Method of Ventilating Ships
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11. Department of Skills Standard (DSD). (2015). Z-009-1:2015 NCS-Core Abilities
12. Department of Skills Standard (DSD). (2015). Z-009-2:2015 NCS-Core Abilities
13. Department of Skills Standard (DSD). (2015). Z-009-3:2015 NCS-Core Abilities
14. Department of Skills Standard (DSD). (2015). Module on Social Skills and Social Values

15.8. HVAC Single Phase Installation and Maintenance Supervision

SECTION	(F) Specialized Construction Activities		
GROUP	(432) Electrical, Plumbing and Other Construction Installation Activities		
AREA	HVAC Single Phase		
NOSS TITLE	Heating, Ventilation, Air-Conditioning (HVAC) Installation and Maintenance		
COMPETENCY UNIT TITLE	HVAC Single Phase Installation and Maintenance Staff Supervision		
LEARNING OUTCOMES	The learning outcomes of this competency unit are trainees enable to perform supervisory functions in HVAC single phase installation and maintenance ensuring works efficiency, reliability and productivity complied in accordance with organisation and Occupational Safety, Health and Environment (OSHE) requirements. Upon completion of this competency unit, trainees should be able to: 1. Monitor health, safety and environmental compliance. 2. Conduct in-house training. 3. Prepare installation and maintenance schedule. 4. Coordinate staff appraisal. 5. Conduct staff briefing. 6. Coordinate stock supply. 7. Monitor waste disposal.		
TRAINING PREREQUISITE (SPECIFIC)	Not Available		
CU CODE	F432-007-3:2020-C08	NOSS LEVEL	Three (3)

WORKS ACTIVITIES	RELATED KNOWLEDGE	RELATED SKILLS	ATTITUDE/ SAFETY/ ENVIRONMENT	ASSESSMENT CRITERIA
1. Monitor Health, Safety and	1.1 Occupational, Safety, Health	1.1 Obtain HSE checklist. 1.2 Interpret HSE.	<u>ATTITUDE</u> 1.1 Compliance to best	1.1 HSE compliance monitoring process and requirements

WORKS ACTIVITIES	RELATED KNOWLEDGE	RELATED SKILLS	ATTITUDE/ SAFETY/ ENVIRONMENT	ASSESSMENT CRITERIA
Environmental (HSE) compliance.	and Environment (OSHE) SOP: • Regulation Acts. • Implementation procedure. • OSHE requirements. • Reporting process.	1.3 Appoint working group. 1.4 Brief subordinate. 1.5 Check HSE implementation.	practices and procedures. SAFETY 1.1 Compliance to warnings, cautions and notes as stated in manufacturer's manual. ENVIRONMENT 1.1 Minimizing of pollution during handling hazardous chemicals, waste in compliance to current environmental acts.	described in accordance with local authority requirements. 1.2 HSE checklist acquired from instructor. 1.3 HSE requirements determined and recorded. 1.4 Selected personnel assigned to HSE responsibilities. 1.5 HSE implementation requirements acknowledged to all personnel. 1.6 OSHE requirements described. 1.7 HSE implementation progress recorded and remedial action taken and reported to instructor. 1.8 Attitude requirements complied in accordance with best practices and procedure. 1.9 Safety requirements complied in accordance with warnings, cautions and notes as stated in manufacturer's manual.

WORKS ACTIVITIES	RELATED KNOWLEDGE	RELATED SKILLS	ATTITUDE/ SAFETY/ ENVIRONMENT	ASSESSMENT CRITERIA
2. Conduct in-house training.	2.1 Staff training assessment: • Types of training. • Method of training. 2.2 Training arrangements. 2.3 Technique of delivery. 2.4 Training evaluation.	2.1 Identify target group. 2.2 Prepare training requirements. 2.3 Acknowledge target group. 2.4 Deliver training 2.5 Prepare training report.	ATTITUDE 2.1 Compliance to best practices and procedures. SAFETY 2.1 Compliance to warnings, cautions and notes as stated in manufacturer's manual. ENVIRONMENT Not available	2.1 In-house training process described in accordance with organizational requirements. 2.2 Training target group shortlisted. 2.3 Training requirements which included training materials, audio visual aids, venue, budget and training personnel finalized in accordance with organizational requirements. 2.4 Shortlisted target group are notified in accordance with organizational requirements. 2.5 Training conducted in accordance with training schedule. 2.6 Training report produced. 2.7 Attitude requirements complied in accordance with best practices and procedure. 2.8 Safety requirements complied in accordance with warnings, cautions and notes as stated in manufacturer's manual.

WORKS ACTIVITIES	RELATED KNOWLEDGE	RELATED SKILLS	ATTITUDE/ SAFETY/ ENVIRONMENT	ASSESSMENT CRITERIA
3. Prepare installation and maintenance schedule.	3.1 Inventory report: • Installation requirements. • Maintenance requirements. 3.2 Customer liaison. 3.3 Installation and maintenance scheduling process.	3.1 Obtain inventory report. 3.2 Check installation requirements. 3.3 Check maintenance requirements. 3.4 Liaise with stakeholders. 3.5 Draft installation and maintenance schedule. 3.6 Obtain management approval.	<u>ATTITUDE</u> 3.1 Compliance to best practices and procedures. <u>SAFETY</u> 3.1 Compliance to warnings, cautions and notes as stated in manufacturer's manual. <u>ENVIRONMENT</u> 3.1 Minimizing of pollution during handling hazardous chemicals, waste in compliance to current environmental acts.	3.1 Installation and maintenance schedule preparation process described in accordance with manufacturer's specifications. 3.2 Inventory report acquired from instructor. 3.3 Installation and maintenance requirements which include servicing, cleaning, adjusting and replacement of HVAC equipment confirmed in accordance with manufacturer's specifications. 3.4 Installation schedule which include type of equipment, type of maintenance, reason, cost and date produced in accordance with organizational requirements. 3.5 Maintenance schedule submitted for approval. 3.6 Attitude requirements complied in accordance with best practices and procedure. 3.7 Safety requirements complied in accordance with warnings, cautions and notes as stated in manufacturer's manual.

WORKS ACTIVITIES	RELATED KNOWLEDGE	RELATED SKILLS	ATTITUDE/ SAFETY/ ENVIRONMENT	ASSESSMENT CRITERIA
4. Coordinate staff appraisal.	4.1 Staff appraisal information 4.2 Documentation compilation procedure. 4.3 Method of staff appraisal. 4.4 Reporting staff appraisal procedure.	4.1 Obtain staff record. 4.2 Check appraisal requirement. 4.3 Prepare staff appraisal checklist. 4.4 Submit checklist to instructor.	ATTITUDE 4.1 Compliance to best practices and procedures. SAFETY 4.1 Compliance to warnings, cautions and notes as stated in manufacturer's manual. ENVIRONMENT Not Available	4.1 Staff appraisal coordination process described in accordance with organizational requirements. 4.2 Staff record acquired from instructor. 4.3 Appraisal requirements which include attendance, productivity, sincerity, relationship and innovativeness confirmed in accordance with organizational requirements. 4.4 Staff appraisal checklist comprises of the required criteria drafted and submitted to instructor. 4.5 Attitude requirements complied in accordance with best practices and procedure. 4.6 Safety requirements complied in accordance with warnings, cautions and notes as stated in manufacturer's manual.

WORKS ACTIVITIES	RELATED KNOWLEDGE	RELATED SKILLS	ATTITUDE/ SAFETY/ ENVIRONMENT	ASSESSMENT CRITERIA
5. Conduct staff briefing.	5.1 Staff briefing: • Types • Process 5.2 Briefing arrangements. 5.3 Technique of delivery.	5.1 Identify briefing requirements. 5.2 Notify target group. 5.3 Deliver briefing.	<u>ATTITUDE</u> 5.1 Compliance to best practices and procedures. <u>SAFETY</u> 5.1 Compliance to warnings, cautions and notes as stated in manufacturer's manual. <u>ENVIRONMENT</u> 5.1 Minimizing of pollution during handling hazardous chemicals, waste in compliance to current environmental acts.	5.1 Staff briefing process and technique described in accordance with organizational requirements. 5.2 Briefing requirements which included briefing materials, venue and target group finalized in accordance with organizational requirements. 5.3 Target group are informed of briefing venue and time in accordance with organizational requirements. 5.4 Briefing conducted in accordance with training schedule. 5.5 Attitude requirements complied in accordance with best practices and procedure. 5.6 Safety requirements complied in accordance with warnings, cautions and notes as stated in manufacturer's manual.

WORKS ACTIVITIES	RELATED KNOWLEDGE	RELATED SKILLS	ATTITUDE/ SAFETY/ ENVIRONMENT	ASSESSMENT CRITERIA
6. Coordinate stock supply.	6.1 Stock inventory. • Types of stock. • Method of storage. 6.2 Stock ordering and requisition process.	6.1 Obtain stock inventory. 6.2 Check stock requirements. 6.3 Prepare requisition documents. 6.4 Submit document to instructor.	ATTITUDE 6.1 Compliance to best practices and procedures. . SAFETY 6.1 Compliance to warnings, cautions and notes as stated in manufacturer's manual. ENVIRONMENT 6.1 Minimizing of pollution during handling hazardous chemicals, waste in compliance to current environmental acts.	6.1 Stock supply coordination process described in accordance with organizational requirements. 6.2 Stock inventory acquired from instructor. 6.3 Stock requirements which included stocks replenishing and replacement confirmed in accordance with organizational requirements. 6.4 Requisition documents drafted and submitted for approval. 6.5 Attitude requirements complied in accordance with best practices and procedure. 6.6 Safety requirements complied in accordance with warnings, cautions and notes as stated in manufacturer's manual.

WORKS ACTIVITIES	RELATED KNOWLEDGE	RELATED SKILLS	ATTITUDE/ SAFETY/ ENVIRONMENT	ASSESSMENT CRITERIA
7. Monitor waste disposal.	7.1 Types of waste. 7.2 Method and procedure of waste disposal. 7.3 OSHE requirements. 7.4 Reporting process of waste disposal.	7.1 Obtain waste disposal. 7.2 Check waste disposal requirements. 7.3 Draft waste disposal schedule. 7.4 Obtain management approval.	ATTITUDE 7.1 Compliance to best practices and procedures. SAFETY 7.1 Compliance to warnings, cautions and notes as stated in manufacturer's manual. ENVIRONMENT 7.1 Minimizing of pollution during handling hazardous chemicals, waste in compliance to current environmental acts.	7.1 Waste disposal process and method described in accordance with organizational requirements. 7.2 Waste disposal instruction acquired from instructor. 7.3 Waste disposal requirements which included type of tools, equipment and materials, type of disposal, venue, date, time and person in charge confirmed in accordance with organizational requirements. 7.4 Waste disposal itineraries drafted and distributed to all department concerned. 7.5 Waste disposal activities conducted in accordance with OSHE requirements. 7.6 OSHE requirements complied in accordance with organizational requirements. 7.7 Waste disposal report produced. 7.8 Attitude requirements complied in accordance with best practices and procedure. 7.9 Safety requirements complied in accordance with warnings,

WORKS ACTIVITIES	RELATED KNOWLEDGE	RELATED SKILLS	ATTITUDE/ SAFETY/ ENVIRONMENT	ASSESSMENT CRITERIA
				cautions and notes as stated in manufacturer's manual.

Employability Skills

Core Abilities

- Please refer NCS- Core Abilities latest edition.

Social Values & Social Skills

- Please refer Handbook on Social Skills and Social Values in Technical Education and Vocational Training.

References for Learning Material Development

1 A.B. Constantinos, B. Francesco, H. Sten Olaf & etl.,(2000). *Report No 22: Risk Assessment In Relation To Indoor Air Quality*. Luxembourg; European Communities. ISBN: 92-828-9284-0.

2 Committee on Risk Appraisal in the Development of Facilities Design Criteria , National Research Council , & et.al. , 1991. *Uses of Risk Analysis to Achieve Balanced Safety in Building Design and Operations (Studies in Management of Building Technology: A Series) [Paperback]*. National Academies Press. ISBN:0309046807

3 Richard Jazwin (August 1, 2001), Troubleshooting and Servicing HVAC&R Electrical Systems

4 Laurie Young (Hardcover - Dec 1996)Gower Handbook of Customer Service

5 Paul Roe Jordan(1955), Ventilation manual for sheet metal contractors;: A treatise on the type of ventilation which sheet metal contractors are called upon to plan and install,

6 David P Shelton(1982), Ventilation fans: Types and sizes (NebGuide)

7 James E. Brumbaugh(Aug 6, 2004), Audel HVAC Fundamentals, Air Conditioning, Heat Pumps and Distribution Systems

8 Charles L. Hubbard(Apr 27, 2009), The Ventilation Hand Book: The Principles and Practice of Ventilation as Applied to Furnace Heating Ducts, Flues and Dampers For Gravity Heating Fans and ... With the Method of Ventilating Ships

9 Home Heating & Air Conditioning Systemsby James L. Kittle(Apr 1, 1990).

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12 Department of Skills Standard (DSD). (2015). Z-009-3:2015 NCS-Core Abilities

13 Department of Skills Standard (DSD). (2015). Module on Social Skills and Social Values

16. Delivery Mode

The following are the **recommended** training delivery modes: -

KNOWLEDGE	SKILL
• Lecture • Group discussion • E-learning, self-paced • E-learning, facilitate • Case study or Problem based learning (PBL) • Self-paced learning, non-electronic • One-on-one tutorial • Shop talk • Seminar	• Demonstration • Simulation • Project • Scenario based training (SBT) • Role play • Coaching • Observation • Mentoring

Skills training and skills assessment of trainees should be implemented in accordance with TEM requirements and actual situation.

17. Tools, Equipment and Materials (TEM)

HEATING, VENTILATION, AIR-CONDITIONING (HVAC) SINGLE PHASE INSTALLATION AND MAINTENANCE

LEVEL 3

CU	CU CODE	COMPETENCY UNIT TITLE
C01	F432-007-3:2020-C01	Single Phase Heating Equipment Installation
C02	F432-007-3:2020-C02	Single Phase Ventilation Equipment Installation
C03	F432-007-3:2020-C03	Single-Phase Air-Conditioning Equipment Installation
C04	F432-007-3:2020-C04	HVAC Equipment Testing and Commissioning
C05	F432-007-3:2020-C05	Single Phase Heating Equipment Maintenance
C06	F432-007-3:2020-C06	Single Phase Ventilation Equipment Maintenance
C07	F432-007-3:2020-C07	Single Phase Air-Conditioning Equipment Maintenance
C08	F432-007-3:2020-C08	HVAC Single Phase Installation and Maintenance Staff Supervision

* Items listed refer to TEM's **minimum requirement** for skills delivery only.

NO.	ITEM*	RATIO (TEM: Trainees or AR = As Required)							
		C01	C02	C03	C04	C05	C06	C07	C08
A. Tools									
1	Hammer Drill	1:5	1:5	1:5				1:5	
2	Cordless Drill	1:5	1:5	1:5				1:5	
3	Water Level	1:5	1:5	1:5	1:5		1:5	1:5	
4	Screwdriver	1:1	1:5	1:5	1:1	1:1	1:5	1:1	
5	Test Pen	1:1	1:5	1:5	1:1	1:1	1:1	1:1	
6	Multi meter	1:5	1:5	1:5	1:5	1:5	1:1	1:5	
7	Wire Crimping Tools	1:5	1:5	1:5		1:5	1:5	1:5	
8	Wire Cuter	1:1	1:1	1:1		1:1	1:1	1:1	
9	Combination Spanner	1:5	1:5	1:5					
10	Adjustable Spanner	1:5	1:5	1:5		1:5		1:5	
11	Measuring Tape	1:1	1:1	1:1	1:1		1:1	1:1	

12	Vacuum Pump			1:5				1:5	
13	Micron Gauge			1:5				1:5	
14	Manifold Gauge (2 way/ 4way)			1:5	1:5			1:5	
15	Tube Bender			1:5				1:5	
16	Safety Valve Adapter			1:5	1:5			1:5	
17	Clamp on Meter with Hertz		1:5	1:5	1:5			1:5	
18	Thermometer			1:5	1:5			1:5	
19	Flaring Tools			1:5				1:5	
20	Tube Cutter			1:5				1:5	
21	Deburring Tools			1:5				1:5	
22	Torque Wrench			1:5				1:5	
23	Allen Keys Set		1:5	1:5				1:5	
24	Mega Tester		1:5	1:5	1:5				
25	Spanner					1:5			
26	Soldering Iron					1:5			
27	Adjustable Spanner							1:5	
28	Recovery Machine							1:5	
29	Recovery Tank							1:5	
30	Weighing Scale							1:5	
31	Electronic Leak Detector							1:5	
32	Chemical Pump							1:5	
33	Fin Comb							1:5	
34	Fin Brush							1:5	
35	Investor Checker							1:5	
36	Refrigerant Identifier							1:25	
B. Equipment									
1	Water heater C/W accessories	1:5				1:5			
2	Exhaust Fan		1:5		1:5		1:5		
3	Air Curtain		1:5		1:5		1:5		
4	Split Unit Air Cond			1:5	1:5			1:5	
5	Drainage Pump			1:5	1:5			1:5	

6	Computer and Peripherals				1:5				1:5
7	LCD Projector								1:5
8	Air Cond Unit Investor			1:5	1:5			1:5	
C. Materials									
1	Wall Plug	AR	AR	AR		AR	AR	AR	
2	Wire 2.5mm	AR	AR	AR		AR	AR	AR	
3	Pipe	AR							
4	Pipe Fitting Accessories	AR				AR			
5	Mild Steel Plate	AR	AR	AR		AR	AR	AR	
6	PVC Gum	AR				AR			
7	PTFE Tape	AR	AR			AR			
8	Cable Lug	AR	AR	AR		AR	AR	AR	
9	Drainage Pipe			AR				AR	
10	Nitrogen			AR				AR	
11	Copper Tube			AR				AR	
12	Refrigerant Pipe Insulation			AR				AR	
13	Refrigerant (R410, R32)			AR	AR			AR	
14	PVC Tape			AR				AR	
15	Leak Spray Detector				AR				
16	Soldering Lead/ Wire					AR			
17	Water Filter					AR			
18	Rubber Gasket					AR			
19	Cleaning Chemical							AR	
20	Capacitor							AR	
21	Filter Drier							AR	
22	Service Valve							AR	
23	Metering Device							AR	
24	Compressor							AR	
25	Condenser Fan / Blade							AR	
26	Condenser Coil							AR	
27	Blower Fan							AR	

28	Blower Motor							AR	
29	Compressor Vibration Rubber							AR	
30	Condenser Motor							AR	
31	Stationary								AR
32	Checklist								AR
33	Installation Manual								AR
34	Regulation (exp: EQA 1974)								AR
35	Operation Manual								AR

18. Competency Weightage

The following table shows the percentage of training priorities based on consensus made by the Standard Development Committee (SDC).

HEATING, VENTILATION, AIR-CONDITIONING (HVAC) SINGLE PHASE INSTALLATION AND MAINTENANCE

LEVEL 3

CU CODE	COMPETENCY UNIT TITLE	COMPETENCY UNIT WEIGHTAGE	WORKS ACTIVITIES	WORKS ACTIVITIES WEIGHTAGE
F432-007-3: 2020-C01	Single Phase Heating Equipment Installation	5%	1. Perform fitting works.	25%
			2. Install mounting bracket/plate.	10%
			3. Install piping system.	20%
			4. Install heating unit.	10%
			5. Install equipment wiring system.	25%
			6. Record installation process.	10%
F432-007-3: 2020-C02	Single Phase Ventilation Equipment Installation	10%	1. Perform fitting works.	25%
			2. Install mounting bracket/plate.	10%
			3. Install ventilation unit.	10%
			4. Install equipment wiring system.	25%
			5. Install ventilation ducting system.	20%
			6. Record installation process.	10%
F432-007-3: 2020-C03	Single Phase Air-Conditioning Equipment Installation	20%	1. Perform fitting works.	20%
			2. Install mounting bracket/plate.	5%
			3. Drill piping hole.	5%
			4. Install piping system.	10%
			5. Install indoor unit.	5%
			6. Install outdoor unit.	5%
			7. Install wiring system.	20%

			8. Vacuum piping system.	10%
			9. Perform leak test.	5%
			10. Charge refrigerant.	10%
			11. Record air conditioning installation process.	5%
F432-007-3: 2020-C04	HVAC Equipment Testing and Commissioning	10%	1. Perform heating performance test.	20%
			2. Perform ventilation performance test.	20%
			3. Perform air conditioning performance test.	20%
			4. Commissioning HVAC equipment.	30%
			5. Record testing and commissioning process.	10%
F432-007-3: 2020-C05	Single Phase Heating Equipment Maintenance	10%	1. Maintain heating equipment motor pump.	20%
			2. Maintain heating equipment heater.	25%
			3. Maintain wiring system.	25%
			4. Maintain piping system.	20%
			5. Maintain filter system.	10%
			6. Record maintenance activities.	20%
F432-007-3: 2020-C06	Single Phase Ventilation Equipment Maintenance	15%	1. Maintain ventilation motor.	25%
			2. Maintain wiring system.	25%
			3. Maintain ducting system.	20%
			4. Maintain fan blade.	10%
			5. Record ventilation maintenance activities.	20%
F432-007-3: 2020-C07	Single Phase Air-Conditioning Equipment Maintenance;	20%	1. Maintain indoor motor.	10%
			2. Maintain outdoor fan motor.	10%
			3. Maintain compressor.	10%
			4. Maintain evaporator/ cooling coil.	10%

			5. Maintain condenser coil.	10%
			6. Maintain refrigerant.	10%
			7. Maintain piping system.	10%
			8. Maintain wiring control system.	10%
			9. Maintain metering device.	5%
			10. Maintain drainage system.	10%
			11. Record air conditioning maintenance activities.	5%
F432-007-3: 2020-C08	HVAC Single Phase Installation and Maintenance Staff Supervision	10%	1. Monitor HSE compliance.	20%
			2. Conduct in-house training.	15%
			3. Prepare installation and maintenance schedule.	20%
			4. Coordinate staff appraisal.	10%
			5. Conduct staff briefing.	10%
			6. Coordinate stock supply.	15%
			7. Monitor waste disposal.	10%
TOTAL PERCENTAGE (CORE COMPETENCY)		100%		

Sample Calculation for Summary of Training Hours

The following table shows the nominal training hours based on recommendations made by the Standard Development Committee (SDC). For purpose of Malaysian Skills Certification through accredited centre training, the program duration is subject to Malaysian Skills Certification System.

HEATING, VENTILATION, AIR-CONDITIONING (HVAC) SINGLE PHASE INSTALLATION AND MAINTENANCE

LEVEL 3

CU CODE	COMPETENCY UNIT TITLE	WORKS ACTIVITY	WORKS ACTIVITY TRAINING DURATION(HOURS)		TRAINING DURATION (HOURS)	SKILLS CREDIT
			KNOWLEDGE	SKILLS		
F432-007-3:2020-C01	Single Phase Heating Equipment Installation	1. Perform fitting works.	8	20	110	11
		2. Install mounting bracket/plate.	2	8		
		3. Install piping system.	7	16		
		4. Install heating unit.	2	8		
		5. Install equipment wiring system.	8	20		
		6. Record installation process.	3	8		
F432-007-3:2020-C02	Single Phase Ventilation Equipment Installation	1. Perform fitting works.	16	38	220	22
		2. Install mounting bracket/plate.	7	16		
		3. Install ventilation unit.	7	16		

		4. Install equipment wiring system.	16	38		
		5. Install ventilation ducting system.	13	30		
		6. Record installation process.	7	16		
F432-007-3:2020-C03	Single Phase Air-Conditioning Equipment Installation	1. Perform fitting works.	28	64	450	45
		2. Install mounting bracket/plate.	7	16		
		3. Drill piping hole.	7	16		
		4. Install piping system.	13	30		
		5. Install piping system	7	16		
		6. Install outdoor unit.	7	16		
		7. Install wiring system.	28	64		
		8. Vacuum piping system.	13	30		
		9. Perform leak test.	7	16		
		10. Charge refrigerant.	13	30		
		11. Record air-conditioning equipment process.	7	16		

F432-007-3:2020-C04	HVAC Equipment Testing and Commissioning	1. Perform heating performance test.	13	30	220	22
		2. Perform ventilation performance test.	13	30		
		3. Perform air conditioning performance test.	13	30		
		4. Commissioning HVAC equipment.	20	47		
		5. Record testing and commissioning process.	7	16		
F432-007-3:2020-C05	Single Phase Heating Equipment Maintenance	1. Maintain heating equipment motor pump.	7	16	220	22
		2. Maintain heating equipment heater.	13	30		
		3. Maintain wiring system.	13	30		
		4. Maintain piping system.	13	30		
		5. Maintain filter system.	7	16		
		6. Record maintenance activities.	14	32		

F432-007-3:2020-C06	Single Phase Ventilation Equipment Maintenance	1. Maintain ventilation motor.	26	56	340	34
		2. Maintain wiring system.	26	56		
		3. Maintain ducting system.	20	47		
		4. Maintain fan blade.	13	30		
		5. Record ventilation maintenance activities.	20	47		
F432-007-3:2020-C07	Single Phase Air-Conditioning Equipment Maintenance;	1. Maintain indoor motor.	13	30	450	45
		2. Maintain outdoor fan motor.	13	30		
		3. Maintain compressor.	14	32		
		4. Maintain evaporator/ cooling coil.	13	30		
		5. Maintain condenser coil.	14	32		
		6. Maintain refrigerant.	14	32		
		7. Maintain piping system.	14	32		
		8. Maintain wiring control system.	14	32		
		9. Maintain metering device.	7	16		
		10. Maintain drainage system.	13	30		

		11. Record air conditioning maintenance activities.	7	16		
F432-007-3:2020-C08	HVAC Single Phase Installation and Maintenance Staff Supervision	1. Monitor HSE compliance.	7	16	220	22
		2. Conduct in-house training.	13	30		
		3. Prepare installation and maintenance schedule.	7	16		
		4. Coordinate staff appraisal.	13	30		
		5. Conduct staff briefing.	7	16		
		6. Coordinate stock supply.	13	30		
		7. Monitor waste disposal.	7	16		
TOTAL HOURS (CORE COMPETENCY)			650	1590	2240	224
TOTAL HOURS OF COMPETENCY UNIT					2240	
TOTAL HOURS OF CORE ABILITIES					160	
TOTAL HOURS TRAINING DURATION					2400	

The sample calculations performed are based on table in section 18 for delivery of level 3 training program at 2240 hours excluding delivery of core abilities.

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