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Participant Handbook

Sector
Electronics

Sub-Sector
Consumer Electronics

Occupation
Manufacturing

Reference ID - **ELE/Q3501, Version 1.0**
NSQF Level 4

RAC Assembly Operator

Published by

First Edition, October 2017

Printed in India at
New Delhi – 110016

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"Skilling is building a better India. If we have to move India towards development then Skill Development should be our mission."

Shri Narendra Modi
Prime Minister of India

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Certificate

COMPLIANCE TO

QUALIFICATION PACK - NATIONAL OCCUPATIONAL STANDARDS

is hereby issued by the

ELECTRONICS SECTOR SKILL COUNCIL OF INDIA

for

SKILLING CONTENT : PARTICIPANT HANDBOOK

Complying to National Occupational Standards of

Job Role/ Qualification Pack: **"RAC Assembly Operator"** QP No. **"ELE/Q3501, NSQF Level 4"**

Date of Issuance : March 10th, 2018
Valid up to* : March 10th, 2020
*Valid up to the next review date of the Qualification Pack or the 'Valid up to' date mentioned above (whichever is earlier)

Authorised Signatory
(Electronics Sector Skill Council)

Acknowledgements

The need for having a standard curriculum for the Job Role based Qualification Packs under the National Skills Qualification Framework was felt necessary for achieving a uniform skill-based training manual in the form of a participant handbook.

I would like to take the opportunity to thank everyone who contributed in developing this handbook for the QP RAC Assembly Operator.

The handbook is the result of tireless pursuit to develop an effective tool for imparting the Skill Based training in the most effective manner.

I would like to thank the team of KontentEdge for their support to develop the content, the SME and the team at the ESSCI along with the industry partners for the tireless effort in bringing the handbook in the current format.

CEO

Electronics Sector Skills Council of India

About this Book

This Participant Handbook is designed to enable training for the specific Qualification Pack (QP). Each National Occupational (NOS) is covered across Unit/s.

Key Learning Objectives for the specific NOS mark the beginning of the Unit/s for that NOS.

- Describe the manufacturing process
- Describe the assembly line process
- Explain the assembly line process in a refrigerator manufacturing unit
- Describe electric circuits
- Describe voltage, current and resistance
- Define Ohm's law
- Define the principle of refrigeration
- Explain the uses and terms in refrigeration
- Explain the methods used in refrigeration
- Identify the types of tools used for assembling
- Describe the assembling flow of a refrigerator
- Explain the assembling steps
- Identify work requirements and targets
- List the ways to ensure quality and timely completion of work
- Identify standard safety procedures
- Explain the importance of participating in fire drills

The symbols used in this book are described below.

Symbols Used


Key Learning Outcomes


Steps


Role Play


Tips


Notes


Unit Objectives


Activity


Practical

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1. Basics of Assembling Process in Refrigeration and Air Conditioning (RAC)

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ELE/N3506
ELE/N3507

Key Learning Outcomes

At the end of this module, you will be able to:

1. Describe the manufacturing process
2. Describe the assembly line process
3. Explain the assembly line process in a refrigerator manufacturing unit
4. Explain the assembly line process in an AC manufacturing unit

UNIT 1.0: Introduction to Assembling Process

Unit Objectives

At the end of this unit, you will be able to:

1. Describe the manufacturing process
2. Describe the assembly line process

1.0.1 The Manufacturing Process

A manufacturing process is a sequence of steps that transforms raw materials into a final product. The process begins with creating the design of the product to be made. The raw materials are then finalized and sourced. They are then shaped into desired parts. The parts are assembled to make the final product. The product is then subjected to quality control checks and inspection. Once it is cleared, the product is packed and shipped for delivery.
The following image shows the various stages of the manufacturing process:

Fig. 1.0.1: The manufacturing process

There are different types of manufacturing processes such as production line, assembly line, custom manufacturing and fixed position manufacturing. The refrigerator and air -conditioner manufacturing process follows the assembly line process by using various equipment and machines.

The following image shows the equipment and machines for the production of refrigerators at a factory:

Fig. 1.0.2: Refrigerator manufacturing factory

1.0.2 What is Assembly Line Process?

An assembly line process is an automated process that involves breaking down the manufacturing of a product into steps or tasks in a pre-defined sequence. Each worker is responsible for executing a specific task on the product. The product then moves on to the next worker or machine which in turn completes another specific task. This process goes on till the manufacturing is complete and the product is made. The following image depicts the concept of a basic assembly line process:

Fig. 1.0.3: Assembly line process

The assembly line process was introduced by Henry Ford in mass production of automobiles in 1908. Its success led to other industries adopting the process and it is now a common method to assemble complex products such as household appliances, electronic goods, automobiles and so on.

Principles of Assembly Line

Assembly line process is a continuous-flow production process in which the worker remains stationary and performs the same small task repetitively. The product, on the other hand, moves down in a sequence from operation to operation until it is completed. The following figure lists the principles of the process:

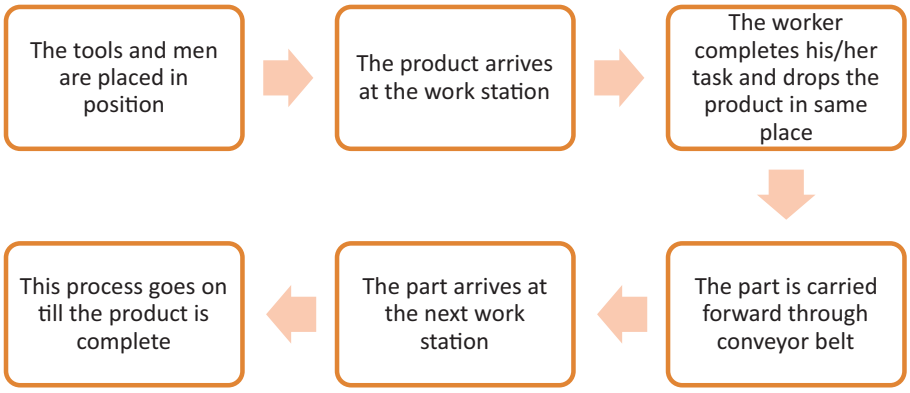


Fig. 1.0.4: Principles of assembly line process

Advantages of Assembly Line Process

Prior to assembly line production, the products were generally made one at a time by hand by a single or a team of workers. They would make the parts, assemble them into a final product and then carry out final tests before declaring a product fit for delivery. This resulted in longer production times and dependency on skilled labour force. The following figure lists the various advantages of the assembly line process:

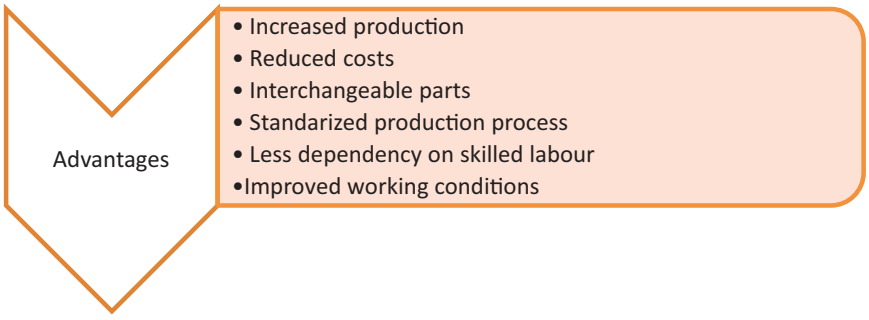
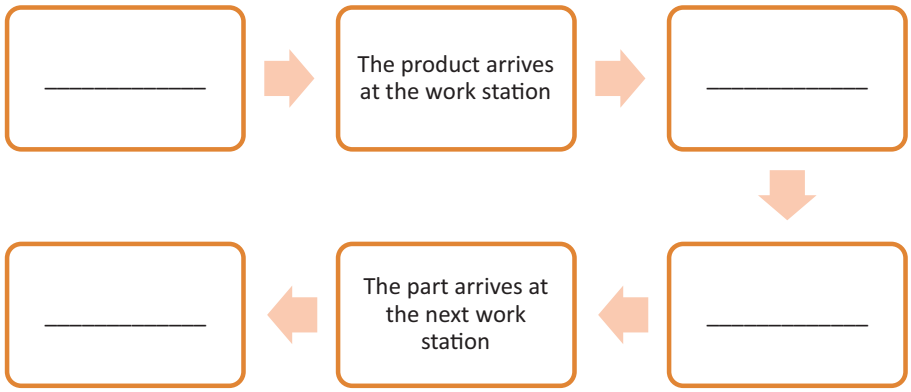


Fig. 1.0.5: Advantages of assembly line process

Activity

Write down the steps of the assembling process in an RAC assembly unit.



UNIT 1.1: Refrigerator Manufacturing Process

Unit Objectives

At the end of this unit, you will be able to:

1. Describe the manufacturing process of a refrigerator
2. Describe the assembling process of a refrigerator

1.1.1 Manufacturing Process of a Refrigerator

The manufacturing process of a refrigerator involves various steps from receiving the raw materials to packing of tested, finished product. As an assembly operator the candidate should be aware of each step in the manufacturing process and focus majorly on assembling process.

The following figure shows the various stages of the manufacturing process of a refrigerator:

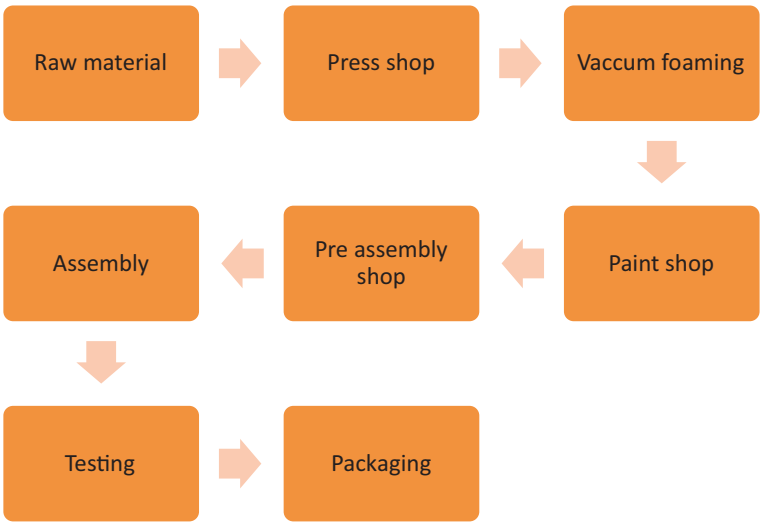


Fig. 1.1.1: Manufacturing process of a refrigerator

Raw Material

In the first step, the raw material is obtained in the manufacturing plant which includes metal sheets, assembling parts like copper tubes, foaming chemical, nuts, bolts and screws, pre-assembled parts like compressors and evaporators and so on. These are then used in different phases of refrigerator manufacturing.

Press Shop

In the press shop, the metal sheets are cut into required shapes for making the refrigerator cabinet and doors. Small slots are made to make the fitting of the sheet panels and for mounting screws. Heavy bench press and sheet metal cutting presses are used in this stage.

Vacuum Foaming

In the vacuum foaming stage, the inner lining of the refrigerator cabinet and the door assembly is filled with foam to provide insulation to the compartments. This process is done by using a foaming machine which fills the foam into the lining and after some time creates an insulation.

Paint Shop

In the paint shop, the metal parts after coming from the press shop are painted with multiple coatings of protective paints to give better surface finish and long life to the metal.

Pre-Assembly Shop

In the pre-assembly shop, the parts like doors and cabinet are assembled before the final assembly. The foamed cabinet is sealed, and the doors are attached with the gaskets and shelves.

Assembly

In the assembling part, the different parts of the refrigerator are assembled on a single moving assembling line. The assembly of refrigerator cabinet, door, evaporator and the condenser, the charging of refrigerant and all other related tasks are done to make the finished final product at the end of the assembly line.

Testing

Testing involves gas leak test and functionality test of individual components that have been assembled. This is done to check their working in a single refrigeration system.

Packaging

In the final step, the tested refrigerator units are packed safely and then transported for selling.

1.1.2 Assembling Process of a Refrigerator

The assembling process of refrigerator majorly depends upon the type of refrigerator unit, which are shown in the following figure:

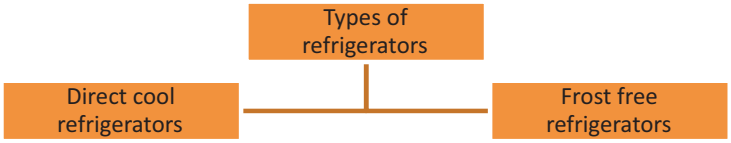


Fig. 1.1.2: Types of refrigerators as per assembling process

The basic difference between the direct cool and the frost-free refrigerator systems is that in frost free, there is no requirement of manual defrosting. A small element is placed instead, which helps in melting the accumulated ice. Thus, the assembling process differs in the two types of refrigerator systems.

Some components such as cooling fan, fan motor, freezer, bimetal thermostat, sensors and duct are installed in the front portion of a frost-free refrigerator. Some of these components are not installed in the direct cool refrigerator or they are placed in the back assembly of the refrigerator units. Later in the modules, after discussing the basics of refrigeration, the assembling process of refrigerator has been explained.

UNIT 1.2: Air Conditioning (AC) Manufacturing Process

Unit Objectives

At the end of this unit, you will be able to:

1. Describe the steps in the manufacturing process of an AC
2. Describe the assembling process of an AC

1.2.1 Manufacturing Process of an Air Conditioner (AC)

The manufacturing process of an AC involves steps in which the raw material such as metal sheet is taken and then machined to create the assembling components. Other components are then assembled, and then final product is tested and packed.

The following figure shows the steps involved in manufacturing of the AC:

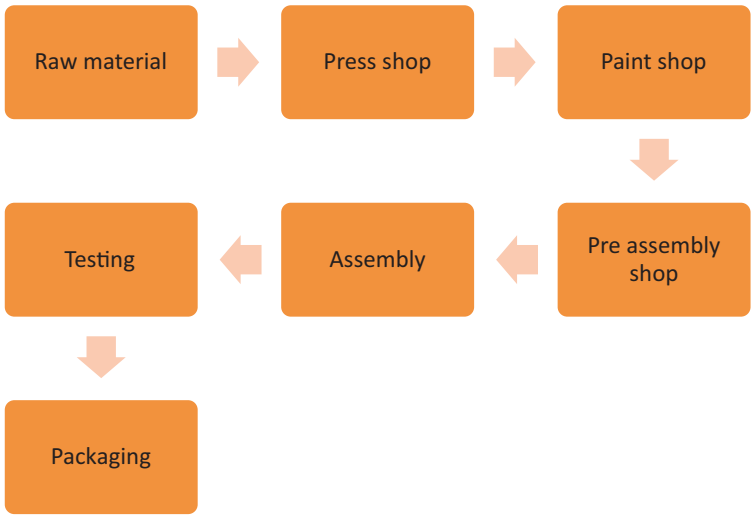


Fig. 1.2.1: Manufacturing process of AC

The basic manufacturing process flow is the same as that of refrigerators. In AC manufacturing, the foaming process which is done for insulation in a refrigerator's assembly is replaced, as insulation in the AC unit is done with a different method. For insulation in AC units, the foam-based structure is installed in the lining.

1.2.2 Assembling Process of an Air Conditioner (AC)

The assembling process of an AC depends upon its type. The following are the types of ACs:

- Window AC
- Split AC

Assembling of a Window AC

A window AC works in a single unit; thus, the assembling is done on a single base and all the components, such as PCB controls, compressor, copper tubing, condenser and so on are installed over it. The assembly of a window AC starts with a foam base in assembly line, then the assembling is done from the front and the back side simultaneously.

Assembling of a Split AC

A split AC contains two functioning parts which are indoor unit (IDU) and outdoor unit (ODU). Thus, the assembling of each unit takes place on the assembly line. This assembly has the same approach of simultaneous assembly of the front and back side. In indoor units, the basic assembly of components such as control panel and air filters are installed. In outdoor units, the heavy working parts like condenser, compressor and service valves ae installed. These two units are installed separately and then connected with a pre-charged line set.

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2. Basics of Electricity and Electronics

Unit 2.1 – Basics of Electric Circuits

Unit 2.2 – Components of an Electric Circuit

ELE/N3506
ELE/N3507

Key Learning Outcomes

At the end of this module, you will be able to:

1. Describe electric circuits
2. Describe voltage, current and resistance
3. Define Ohm's law
4. Explain the difference between alternating current (AC) and direct current (DC)
5. Measure power and energy
6. Describe active components
7. Describe passive components
8. List electromagnetic components
9. Identify colour coding in different electrical components

UNIT 2.1: Basics of Electric Circuits

Unit Objectives

At the end of this unit, you will be able to:

1. Describe electric circuits
2. Define voltage, current and resistance
3. Define Ohm's law
4. Explain the difference between AC and DC
5. Measure power and energy

2.1.1 Electric Circuits

An electric circuit is a path made by the interconnection of electrical components. Electrons from a voltage or current source flow along this path. The following figure lists the elements present in a basic electric circuit:

A source that provides electrical pressure known as voltage or Electromagnetic force (EMF) to electrical equipment to enable them to work.

Example: Battery

A device in a circuit which consumes electric power is called load.

Example: Bulb

A conductor that connects the supply source and the load.

Example: Wires

Fig. 2.1.1: Electric circuit constituents

An electric circuit consists of two paths/loops, as shown in the following image:

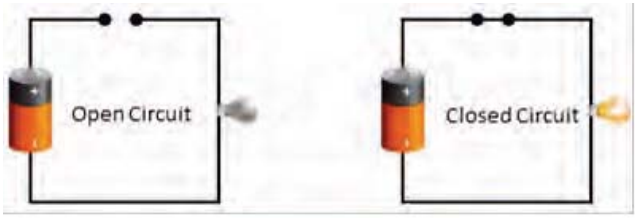


Fig. 2.1.2: Open and closed path

In a typical circuit, a battery provides voltage for the load through wires. For example, the required voltage for a bulb to glow is provided by a battery. The following image shows such an electric circuit:

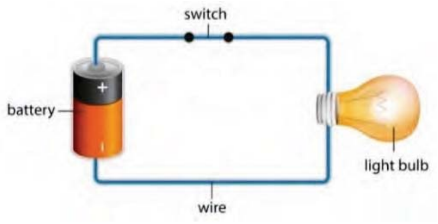


Fig. 2.1.3: An electric circuit

2.1.2 Types of Electric Circuits

An electric circuit is classified into two types:

- Series circuit
- Parallel circuit

Series Circuit

In this type of a circuit, all components are connected as a chain and the current flowing through each one of them is the same all over the circuit. There is a single route through which the current flows. So, the current passes through each and every component. Opening or breaking any point in a series circuit causes the whole circuit to stop functioning, which then needs to be replaced. The following image shows a series circuit:

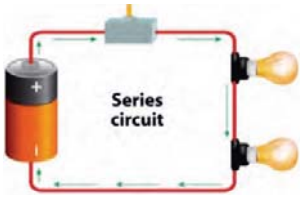


Fig. 2.1.4: A series circuit

Parallel Circuit

In this type of a circuit, two or more than two components are connected in parallel. In a parallel circuit, the components are of the same voltage. The current flow varies across the components. If any point of the circuit gets damaged, only that part needs to be replaced.
The following image shows a parallel circuit:

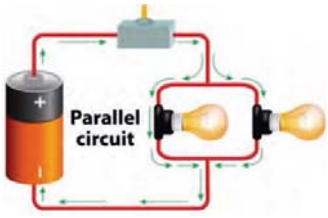


Fig. 2.1.5: A parallel circuit

2.1.3 Parameters of Electric Circuit

Electricity comes into existence whenever there is a flow of electric charge between any t wo components. The main parameters associated with electricity are as follows:

1. Voltage
2. Current
3. Resistance

Voltage

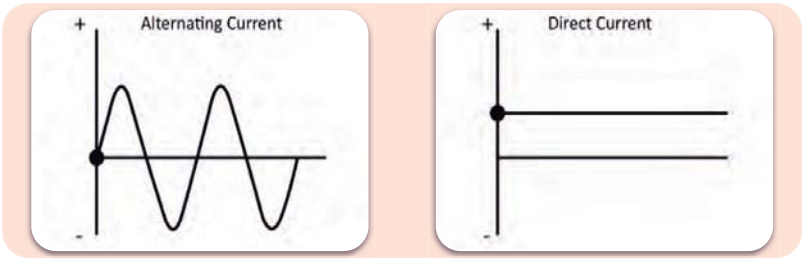
A force that causes electricity to move across a wire/cable is known as voltage. Volt is the unit of voltage and is denoted with letter V.

Current

Electric current, or simply current, is the flow of electric charge carried through electrons moving across wires. Ampere is the unit of current and is denoted with letter I.

AC and DC Current

The following figure lists the two types of current sources that are dependent on the direction in which the electrons flow:



AC can be defined as the flow of current in which electrons keep switching directions, going either forward or backward.

In this, the magnitude of induced current varies with time.

Types of AC are Sinusoidal, Trapezoidal, Triangular, Square.

DC can be defined as the flow of current in which the drift of electrons remains steady in a single direction.

In this the magnitude of induced current remains constant.

Types of DC are Pure and Pulsating.

Fig. 2.1.6: Difference between AC and DC current

Resistance

Resistance is an obstruction caused by a substance to the current flow. The unit of resistance is ohm and it is denoted with the symbol, Ω. According to Ohm's law, 1Ω resistance allows 1A of current to flow from one point to the other with a 1V voltage difference.