Draft Study Material

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एन सी ई आर टी
NCERT

JUNIOR FIELD TECHNICIAN HOME APPLIANCES

(Job Role)

(Qualification Pack: Ref. Id. ELE/Q3117)
Sector: Electronics

(Grade X)

PSS CENTRAL INSTITUTE OF VOCATIONAL EDUCATION
(a constituent unit of NCERT, under Ministry of Education, Government of India)
Shyamla Hills, Bhopal - 462 002, M.P., India

Preface

Vocational Education is a dynamic and evolving field, and ensuring that every student has access to quality learning materials is of paramount importance. The journey of the PSS Central Institute of Vocational Education (PSSCIVE) toward producing comprehensive and inclusive study material is rigorous and time-consuming, requiring thorough research, expert consultation, and publication by the National Council of Educational Research and Training (NCERT). However, the absence of finalized study material should not impede the educational progress of our students. In response to this necessity, we present the draft study material, a provisional yet comprehensive guide, designed to bridge the gap between teaching and learning, until the official version of the study material is made available by the NCERT. The draft study material provides a structured and accessible set of materials for teachers and students to utilize in the interim period. The content is aligned with the prescribed curriculum to ensure that students remain on track with their learning objectives.

The contents of the modules are curated to provide continuity in education and maintain the momentum of teaching-learning in vocational education. It encompasses essential concepts and skills aligned with the curriculum and educational standards. We extend our gratitude to the academicians, vocational educators, subject matter experts, industry experts, academic consultants, and all other people who contributed their expertise and insights to the creation of the draft study material.

Teachers are encouraged to use the draft modules of the study material as a guide and supplement their teaching with additional resources and activities that cater to their students' unique learning styles and needs. Collaboration and feedback are vital; therefore, we welcome suggestions for improvement, especially by the teachers, in improving upon the content of the study material.

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Date: 06 September, 2024

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Module 1 Installation, Repair and Maintenance of Electric Iron

Module Overview

The operation of an electric iron refers to the process of using and controlling the iron to effectively and safely remove wrinkles from fabrics. It involves understanding and utilizing the features of the iron, such as temperature settings, steam functions, and other controls, to iron different types of fabrics at their recommended temperatures. The installation of an electric iron includes the initial setup and preparation required before using the iron. It involves tasks such as checking the power requirements, inspecting the iron for any damage, filling the water tank (if applicable), and ensuring that the iron is connected to a suitable.

This module covers the operation and working of electric iron, troubleshooting and repairing dysfunctional irons. The module begins with detailed instructions on how to install an electric iron for optimal performance. It covers connecting it to power sources, and ensuring safety measures. It also covers setting temperature controls and other settings according to user preferences.

It further covers the troubleshooting common issues that may arise with electric irons, such as heating problems, steam malfunctions, or electrical faults, detailed step-by-step instructions for diagnosing and repairing these issues. This ensures users can quickly fix their irons without the need for professional help. Special attention is given to the importance of regular maintenance to prevent minor issues from escalating into major repairs.

Emphasizing the economic and environmental benefits of repairing electric irons instead of purchasing new ones. The minor repairs and maintenance can extend the lifespan of electric irons, saving users money in the long run. Repairing the parts rather than replacing reduces waste and contributes to sustainability efforts, making it a more environmentally friendly choice.

The various parts of an electric iron are discussed that can be removed for repair or maintenance purposes. The components such as the soleplate, water reservoir, or temperature control knobs, can be easily detached for cleaning or replacement. This enables to perform thorough maintenance and repairs.

Overall, this module provides the knowledge and skills necessary to install, troubleshoot, and maintain electric irons effectively, promoting cost-effective and sustainable iron usage.

Learning Outcomes

After completing this module, you will be able to:

- Understand the setup, components, and proper operational procedures of an electric iron, ensuring safety and efficiency during use.

- Identify common faults in electric irons and apply troubleshooting and repair techniques to restore their functionality effectively.

Module Structure

Session 1: Installation and Operation of Electric Iron

Session 2: Troubleshooting and Repairing of Dysfunctional Electric Iron

Session 1: Installation and Operation of Electric Iron

Ram was ironing his school uniform (Figure 1.1). But he found that the iron was undoable to heat as required for his cotton uniform. Then he checked and noticed that the knob was set for nylon cloths. He set the know for cotton cloths and start ironing his uniform. Thus, it is necessary to check all the setting of modern electric iron before staring iron your cloths.

Fig. 1.1: Operating Electric iron

So, it is required to check all the necessary settings electric iron before staring iron your cloaths. In this chapter you will understand the basic working principle, types, testing and installation of electric iron.

An electric iron is employed to eliminate wrinkles from clothing through the application of heat and pressure. Upon activation, the flat triangular soleplate is applied to the fabric, smoothing and flattening it. A typical the electric iron is shown in Figure 1.2.

Fig. 1.2: Electric iron

Ironing the clothes is the ideal choice to remove the wrinkles and shrinkage of the cloth material. It also enables the cloths to look fresher. Ironing also handles the fabric in clothes to boost their quality and guarantee a longer lifespan.

The ironing process also enables the germs if remains ever if after washing process to get killed completely with the heat; especially thermophilic bacteria and fungi. In fact, ironing is the most suitable to eradicate microorganisms from the clothes.

1.1 History of iron

Two of the oldest sorts of iron were either containers filled with a burning substance, or solid lumps of metal which could be heated directly. Metal pans filled with hot coals were used for smoothing fabrics. It consists of a thick slabs of cast iron in triangular shape and with a handle as shown in Figure 1.3. With the increasing use of this method a product is introduced, called as flat iron.

Fig. 1.3: Old flat iron

In the industrialized world, these designs have been superseded by the electric iron, which uses resistive heating from an electric current. The hot plate, called the sole plate, is made of aluminium or stainless steel polished to be as smooth as possible. It is sometimes coated with a low-friction heat-resistant plastic to reduce friction below that of the metal plate. The typical old electric iron is shown in Figure 1.4.

Fig. 1.4: Old electric iron

The early electric irons were not facilitated to control their temperature. The first thermostatically controlled electric iron, shown in Figure 1.5, appeared in 1920. The heating element is controlled by a thermostat that switches the current ON and OFF to maintain the selected temperature.

Fig. 1.5: Electric iron with thermostat feature

The invention of the steam iron revolutionized the way people approached household chores, marking a significant milestone in the history of domestic technology. Looking back to the early 19th century, when ironing was labour-intensive and time-consuming, the introduction of the steam iron drastically streamlined the process. Patented by Henry W. Seeley in 1882, the steam iron utilized steam power to effectively remove wrinkles from fabric, offering a quicker and more efficient solution compared to traditional flat irons heated over an open flame. This innovation not only simplified the task of ironing but also improved the quality of garment care, ultimately enhancing the standards of cleanliness and presentation in households worldwide. A typical steam iron is shown in Figure 1.6.

Fig. 1.6: Steam iron

1.2 Types of Electric Iron

The various types of electric irons that are used for fabric today can be categorized based on following features:

Power Source – Corded vs. Cordless Iron

Temperature Control – Automatic vs. Non-Automatic Iron

Type of Heat – Basic Clothes vs. Steam Iron

Sole Plate Material – Ceramic, Stainless, vs. Titanium

Portability – Foldable vs. Mini Iron

1.2.1 Types of irons according to power source

In the past, people used coals, sand, heated metal inserts, and bricks to power up their fabric irons. Similar to any other appliances and tools, electricity made things more convenient, leading to the invention of electric irons

Corded iron – As the name implies, a corded electric iron has a cord attached to it with a plug at the other end that is used to insert into an electric outlet to power ON the iron and use it.

Cordless iron – On the contrary, cordless irons usually get their power from a charging base, which means the cord is attached to it instead of the iron itself. Using a cordless unit will make ironing easier. These irons are also lighter than corded one. The corded and cordless iron are shown in Figure 1.7 (a) and (b) respectively.

Fig 1.7 (a) Corded (b) cordless iron

1.2.2 Types of irons according to temperature control

Temperature control is a critical factor when it comes to iron different fabric, since different fabric types require different temperatures. This is where automatic and non-automatic irons differ.

Non-automatic iron – A non-automatic iron only has one temperature control regulator. Hence it is required to turn ON or OFF the switch to supply the required heat to iron.

Automatic iron – Automatic fabric irons have a thermostat switch for heat regulation as shown in Figure 1.8. It allows to set the temperature at a predetermined value. Once the iron reaches the said temperature, it automatically disconnects the electrical supply and then reconnects when the iron starts to cool down

Fig. 1.8: Temperature control knob

These irons also have an indicating lamp that lights up when the predetermined temperature hasn't been reached yet and turns off when it does.

1.2.3 Types of irons according to type of heat

According to this, types of clothes irons are the basic flat iron and steam iron.

Basic iron – The basic iron is corded and non-automatic as shown in Figure 1.9. It is inexpensive. It uses dry heat to iron the cloths.

Fig.1.9: Basic iron

Steam iron – This type of iron uses moist heat or steam. It has the general parts of a basic clothes iron but is usually automatic and available in corded and cordless models. Other additional parts are those that allow the unit to produce steam, such as a water tank, button to release steam, and additional sole plate holes. Some units also have retractable cords for easy storage.

Steam iron parts and steam generation are shown in Figure 1.10 (a) and (b).

Fig. 1.10: (a) Steam iron parts (b) Steam generation

This iron can be used horizontally as well as vertically. It can be used horizontally like a typical clothes iron without the need to use a spray bottle and vertically similar to a garment steamer so that you can remove creases and wrinkles on curtains without taking them down.

1.2.4 Types of irons according to soleplate material

One of the most important parts of clothes irons is the sole plate since it comes in direct contact with the fabric. The material used in manufacturing their sole plate also usually determines the iron's durability, ease of maintenance, and weight. Commonly used materials for sole plate are ceramic, stainless steel, titanium as shown in Figure 1.11.

Fig. 1.11: Different types of sole plate

Ceramic soleplate – Irons with a ceramic sole plate ensure quick heat-up, even heat distribution, and static prevention. These irons also won't stick to the fabric even when set at a high temperature.

Stainless steel soleplate – Like ceramic, irons with stainless steel soleplates ensure even heat distribution because the material is one of the best heat conductors. Being resistant to rust, these irons have a highly durable and easy-to-maintain sole plate or base. However, these irons are usually on the heavier side.

Titanium soleplate – Titanium is another material that heats up quickly and ensures even heat distribution. It is also easy to clean, durable and lightweight.

1.2.5 Types of iron according to portability

There are some special types of irons that are specifically designed for traveling. Since these are modern irons, they already have a steam function and automatic temperature control and they are lightweight.

Foldable iron – As the name implies, these irons can be fold for easy packing without occupying too much space. Foldable irons are available in several sizes. The way of folding the iron and how they look after folding depends on the model. A typical folding iron is shown in Figure 1.12.

Fig. 1.12: Foldable iron

Mini iron – A mini clothes iron is just a small-sized, available in either foldable or non-foldable types. Mini irons are great for small craft projects as shown in Figure 1.13.

Fig.1.13: Mini iron

1.3 Different Parts of an Electric Iron

An electric iron comprises of many essential parts that can be categorised in external and internal parts.

1.3.1 External parts

There may be little difference in parts according to the type of electric iron. The common external parts of basic flat electric iron are handle, sole plate, cover plate, power indicator, power cord as shown in Figure 1.13 are explained below.

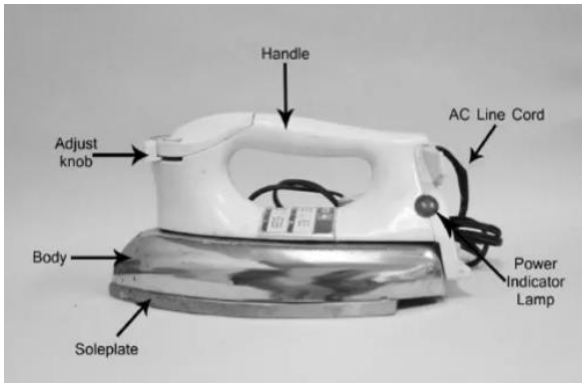


Fig. 1.13: External parts of electric iron

1. Handle – The handle of electric iron is covered with insulating material wooden or plastic as shown in Figure 1.14. This prevents the user from electric shock in the event of a fault when handling or ironing.

Fig. 1.14: Handle of electric iron

2. Soleplate – This is the flat, heated surface that makes direct contact with the fabric being ironed. Soleplates are typically made up of materials like stainless steel, ceramic, or non-stick coating. They are designed to distribute heat evenly across the fabric, ensuring effective ironing.

Soleplate, also called as the hot plate or base plate. It forms the base of the electric iron that is composed of a substantial, triangular-shaped iron slab. To keep it from rusting, the edges and bottom surface have a thick layer of chromium plating. The iron pressure plate and cover plate should be secured in place by the base plate. A typical sole plate of an electric iron is shown in Figure 1.15.

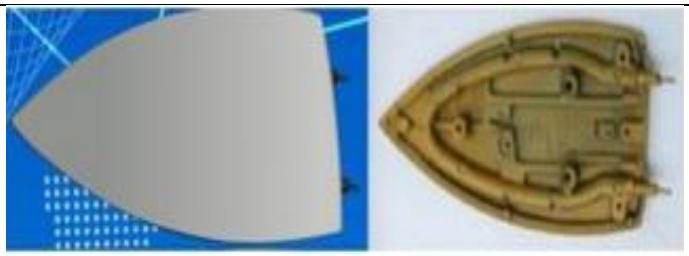


Fig. 1.15: Soleplate

3. Cover Plate – A thin sheet of iron is used to make the cover plate. It covers the entire interior of the iron and is positioned on top of the base plate. Only the cover plate is fixed to the handle and connector as depicted in Figure 1.16.

Fig. 1.16: Cover plate

4. Power Indicator Lamp – A LED lamp serves as the indicating lamp in the iron. It is provided to determine whether the supply is going into the appliance or not. It is fixed on the iron's cover plate. The lamp has two ends – one is connected to the supply and the other to the heating element. The indicator lamp glows while the supply is in place. When the regulating knob reaches its fixed level, the indicating lamp automatically shuts off. This displays the appliance supply availability. Figure 1.17 shows The indicator lamp is shown near the knowb.

Fig. 1.17: Indicator lamp in iron

5. Power Cord – It is the electric conductor that permits electric supply to an electric appliance. The electrical conductors coiled with cotton threads are the most commonly used power cords as shown in Figure 1.18.

Fig. 1.18: Power cord

1.3.2 Internal parts

The common internal parts of basic flat electric iron are pressure plate, heating element, thermostat, capacitor as shown in Figure 1.19 are explained below.

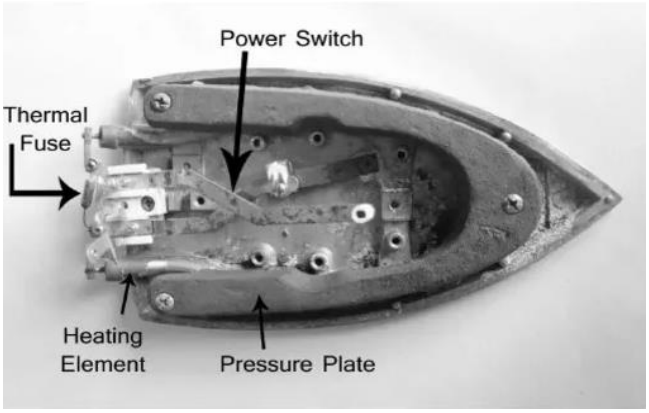


Fig. 1.19: Internal parts of electric iron

1. Pressure Plate – Because it resembles a sole plate, this plate is commonly referred to as the top plate. The studs that make up the base plate pass through a few holes in the pressure plate. The nuts on the studs tighten it so that the sole plate and pressure plate are pressed firmly against one another. In certain instances, the pressure plate is composed of thin steel sheet, but in others it is a heavy cast iron piece as shown in Figure 1.20.

Fig. 1.20: Pressure plate

2. Heating Element – Nickel-chromium wire, which has a high resistance to current flow and tensile strength, is used in the construction of most heating elements. There are variety of shapes and sizes of heating elements. The sole plate and pressure plate are separated by the heating element. It is firmly compressed between the two plates as shown in Figure 1.21.

Fig. 1.21: Heating element in electric iron

A mica sheet is encircled by nichrome wire, which serves as the heating element. The contact strips are connected to the two ends of the nichrome wire. The iron's terminals are linked to the contact strips. Mica is selected for the heating material for two reasons:

Mica is a highly effective insulator.

1. Mica is resistant to extremely high temperatures.

Different shapes and types of heating elements are shown in Figure 1.22.

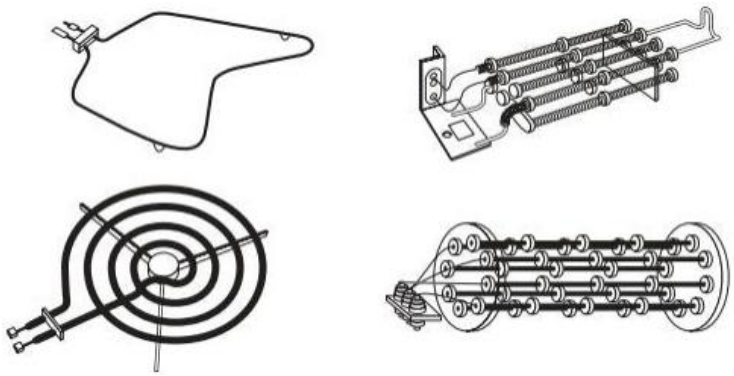


Fig. 1.22: Different types of Heating element

The mica sheet, nichrome wire, and contact strips are all riveted together to form a sturdy and mechanically sound assembly. The top plate and the heating element are separated and thermally insulated by an asbestos sheet.

3. Thermostat – Thermostat is a fundamental component electric iron which is responsible for regulating the temperature of the iron's soleplate. The common type of thermostat used in electric irons employs a bimetallic strip. This strip is made up of two different metals with different rates of expansion when heated. Typically, these metals are bonded together to form a single strip as shown in Figure 1.23.

Fig. 1.23: Thermostat employs a bimetallic strip

When the iron is turned ON, electricity flows through a heating element, heating the soleplate. As the temperature rises, the bimetallic strip also heats up. However, because the two metals have different rates of expansion, the strip begins to bend when heated. This bending action is utilized as a switch to control the flow of electricity to the heating element.

As the strip bends due to the temperature increase, it activates a switch mechanism that either increases or decreases the flow of electricity to the heating element. When the temperature reaches a certain threshold, the switch is triggered, reducing the heat output to prevent overheating. At this point, the circuit opens, the strip no longer has a physical connection to the contact point, and current ceases to flow. The iron's temperature drops as long as the circuit is open, at which point the strip returns to its starting position and current starts to flow once more. This cycle keeps going until the primary electrical source is disconnected from the power supply.

Conversely, when the temperature drops below the desired level, the switch allows more electricity to flow, increasing the heat output.

This mechanism ensures that the iron's soleplate remains at a safe and consistent temperature for ironing various fabrics. The use of a bimetallic strip in the thermostat provides a simple yet effective method of temperature control in electric irons, contributing to their safety and reliability.

The working of bimetallic strip is shown in Figure 1.24.

(a) When the iron is at normal temperature.

(b) When the iron becomes too hot.

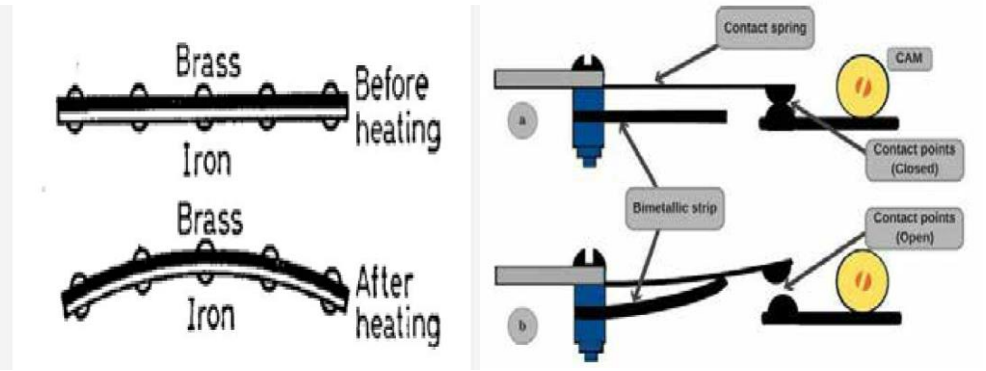
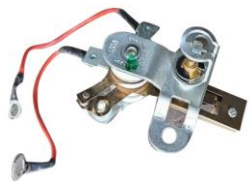


Fig.1.24: Working of bimetallic strip

3. Capacitor – The thermostat helps in maintaining the temperature within limits. But frequent making and breaking of circuit damages the contact points and it may also result in interference with radio reception. To avoid this, a capacitor of certain range is connected across the two contact points.

Activity 1

Practical Activity 1.1. Identify and name the given parts electric flat iron and write it's functions.

Image of part	Name of part	Functions of part
		
		
		

1.3.2 Steam iron

Steam iron consists of all the parts same as that of basic electric iron with some additional parts as shown in the Figure 1.25.

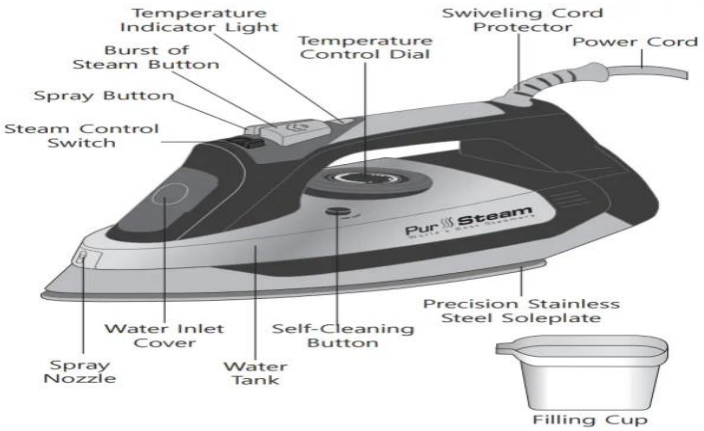


Fig. 1.25: Parts of Steam Iron

The additional parts of steam iron are explained below.

1. Water Tank

Water can be filled in water tank of the iron to produce steam. It is usually located near the top or front of the iron and has a capacity ranging from a few mililitre to several mililitre, depending on the model. Some steam irons feature transparent water tanks, allow users to monitor the water level easily.

2. Spray Nozzle

Some steam irons feature a water spray function that moistens fabrics to help remove stubborn wrinkles. The water spray nozzle is usually located near the front of the iron and releases a fine mist of water onto the fabric when activated.

3. Temperature Control

Most steam irons come equipped with temperature control settings that allow users to adjust the heat level based on the type of fabric being ironed. This ensures that delicate fabrics are not damaged by excessive heat while heavier fabrics receive the necessary heat for effective wrinkle removal.

4. Steam Control Switch

This switch allows to control the release of steam from the iron's steam vents. By pressing the steam control button, users can activate or deactivate the steam function as needed during ironing.

5. Self-Cleaning System

Many steam irons come equipped with a self-cleaning system that helps remove mineral deposits and impurities from the water tank and steam vents. This prolongs the lifespan of the iron and ensures optimal steam performance over time.

6. Indicator Lights

Indicator lights on the iron's handle to provide visual directions to the user, indicating when the iron is heating up, ready to use, or in standby mode. This helps users monitor the iron's status and prevents accidental burns or injuries.

7. Steam shot button

It is a button for switching between steam and dry ironing.

8. Steam Vents

These are small openings or holes on the soleplate through which steam is emitted. Steam vents release bursts of steam when activated, helping to remove wrinkles and creases from fabrics more effectively than dry ironing as shown in Figure 1.26.

Fig.1.26: Steam vents

These additional parts in steam iron enhance the functionality, convenience, and safety of steam irons, making them more versatile and user-friendly for a variety of ironing tasks.

Activity 2

Practical Activity 1.2. Label the parts of electric flat iron shown in Figure 1.27.

Fig.1.27: parts of electric flat iron

1.4 Working principle of electric iron

Electric iron is a domestic appliance used to remove the wrinkles of clothes. The electric iron operates based on the heating effect of current. It draws current from the AC power

supply, heating the internal coil. The heat is subsequently conducted to the soleplate, which, when rubbed against clothing, causes small fabric fibers to stretch and lie flat.

Features of electric iron are as follows:

Steam Generation – These irons have a water tank to produce steam.

1. ***Steam Device*** – Sends a continuous stream of steam to the garments.
2. ***Steam Amount Control*** – Allows cost-effective control of the steam emission.
3. ***Temperature Control Dial*** – It indicates the ideal temperature for different types of clothes.
4. ***Thermostat*** – This keeps the iron's temperature steady.
5. ***Anti-Burn Control*** – If the iron is left on clothes for a long time, it turns off automatically to prevent burns.
6. ***Water Indicator*** – It shows how much water is in the tank.
7. ***Side Platform*** – This keeps the iron elevated and prevents direct contact with clothes, also allowing it to stand upright.
8. ***Energy-Saving Control*** – If the iron is unused for 10 minutes, it automatically turns off to save energy.

1.5 Wiring or Circuit diagram of an Electric Iron

The electrical wiring or circuit diagram of an electric iron provides a visual representation of the electrical components and their connections within the appliance as shown in Figure 1.28.

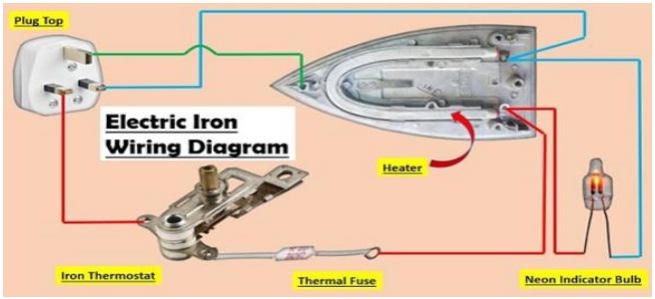


Fig. 1.28: Electric iron wiring/Circuit diagram

The wiring or circuit diagram of an electric iron typically consists of several key components arranged in a specific configuration. The main component of this circuit is the *heating element*, which is connected to a power source through a switch.

When the switch is turned ON, electricity flows through the heating element to heat up. A thermostat is integrated into the circuit to regulate the temperature of the iron. It senses the temperature of the *sole plate* and automatically adjusts the flow of electricity to the heating element to maintain the desired temperature.

Additionally, there may be safety features such as a fuse or thermal cut-off switch to prevent overheating and potential hazards. The circuit also includes indicator lights to signal when the iron is heating up or when it has reached the set temperature. Overall, the wiring or circuit diagram of an electric iron is designed to ensure efficient heating while prioritizing safety and convenience for the user.

Understanding the electrical wiring diagram is crucial for technicians, engineers, or anyone involved in the maintenance or repair of electric irons. It provides a clear

roadmap of the electrical circuitry, aiding in troubleshooting and ensuring safe operation. The real image of wiring is shown in Figure 1.28.

Fig. 1.28: Electric iron wiring real image

1.6 Working Mechanism of an Electric Iron

The electric iron working mechanism can be easily understood as follows:

Heating Element Activation – Electric supply powers the heating element of the iron. The heating element heats up in response to the electrical current.

Heat Transfer Mechanism – The heated heating element transfers heat to the sole plate through the process of conduction. The sole plate absorbs the transferred heat and becomes heated as well.

Wrinkle Removal Mechanism – Wrinkles in clothing are effectively removed by applying a combination of heat and pressure. The heat required for this process is generated by the coil within the iron.

Ironing Action – When the iron is pressed onto clothes, the heat from the sole plate, along with applied pressure, smoothens out wrinkles. The heat effectively relaxes the fabric, making it more pliable during ironing.

Temperature Regulation Mechanism – A thermostat is incorporated to maintain the optimum ironing temperature. Thermostat ensures that the iron neither gets too hot nor too cold for effective wrinkle removal. The thermostat utilizes a *bimetallic strip*, a component made of brass and iron strips in contact, to control the temperature of the base plate.

At normal room temperature, both strips have the same length. Due to differential expansion or contraction, the bimetallic strip bends based on temperature changes. Brass expands (or contracts) more than iron when heated (or cooled), causing the strip to bend, adjusting the temperature control. The schematic diagram and actual picture of temperature regulation mechanism is shown in Figure 1.29 (a) and (b) respectively.

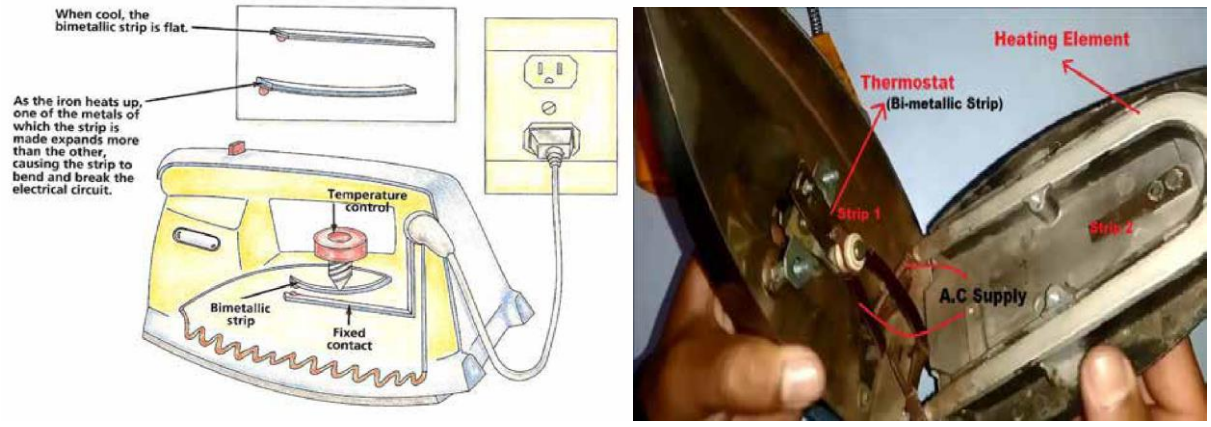


Fig. 1.29: Temperature Regulation Mechanism (a) Schematic Diagram (b) Actul picture

Indicator Lamp Functionality – An indicator lamp accompanies the thermostat. The lamp serves as a visual indicator, helping users to monitor and regulate the temperature settings.

1.7 Specifications of Electric Iron

Power Rating – Typically measured in watts, indicating the electrical power consumption of the iron. Common power ratings range from 1000W to 2000W.

Voltage Requirements – Specifies the electrical voltage (e.g., 110V or 220V) required for proper operation.

Cord Length – The length of the power cord, providing flexibility for user mobility during ironing.

Material and Weight – Information about the material used in the construction of the iron and its overall weight for user convenience.

Temperature Range – Indicates the range of temperatures that the iron can achieve for different fabric types.

Water Tank Capacity (for steam irons) **–** Specifies the volume of water the iron's reservoir can hold for steam generation.

1.8 Features of Modern Electric Iron

Variable Temperature Settings – Enables users to adjust the iron's temperature based on the fabric type, preventing damage.

Steam Functionality – Steam irons come with a steam feature for effective wrinkle removal. The iron may have variable steam control and a spray function.

Non-Stick Soleplate – A non-stick coating on the soleplate ensures smooth gliding over fabrics and prevents sticking.

Auto Shut-Off – A safety feature that automatically turns off the iron when it's left unattended for a specified period, preventing accidents.

Indicator Lights – Lights indicating when the iron is heating up, has reached the desired temperature, or is in the auto shut-off mode.

Vertical Steaming (for some models) **–** Allows users to steam hanging garments directly, eliminating the need for an ironing board.

Anti-Drip System – Prevents water leakage during ironing, ensuring a clean and efficient process.

Self-Cleaning Feature – Some irons have a self-cleaning function to remove mineral deposits and maintain optimal performance.

1.9 Pre-installation checks

Before using or installing an electric iron, it is essential to conduct a few pre-installation checks to ensure safety and optimal performance. Here are some key pre-installation checks for an electric iron –

Voltage Compatibility – Verify that the electric iron is compatible with the voltage of your electrical system. Check the voltage rating on the iron and ensure it matches the voltage available in your location.

Power Cord Inspection – Examine the power cord for any signs of damage, fraying, or exposed wires. Ensure that the plug is intact and undamaged. If there are issues, do not use the iron until the cord is repaired or replaced.

Plug Type and Outlet Compatibility – Confirm that the plug type on the electric iron matches the outlet type in your home. If not, use an appropriate adapter. Avoid using makeshift solutions that can compromise safety.

Water Reservoir Check (for steam irons) **–** If the iron has a steam function, check the water reservoir for cleanliness and make sure it is securely attached. Use only clean and distilled water as recommended by the manufacturer.

Soleplate Inspection – Inspect the soleplate for any foreign objects or residue. Wipe it clean with a damp cloth if necessary. Ensure that the soleplate is firmly attached and in good condition.

Temperature Control Functionality – Test the temperature control settings to ensure they are functioning correctly. Adjust the dial or settings to see if there are any issues with temperature adjustment.

Indicator Lights – Check the indicator lights on the iron. Ensure that they are working properly, indicating when the iron is heating up, has reached the desired temperature, or is in the auto shut-off mode.

Auto Shut-Off Test – If the iron has an auto shut-off feature, test its functionality. Plug in the iron, let it heat up, and then leave it unattended for the specified duration to see if it automatically turns off.

Stability and Upright Position – Check the stability of the iron when placed in an upright position. Ensure that it stands securely on its heel without tipping over.

Read the User Manual – Familiarize yourself with the user manual that comes with the electric iron. Follow any specific pre-installation or safety instructions provided by the manufacturer. Be aware of general safety precautions, such as keeping the iron away from water, not leaving it unattended when plugged in, and using it on a stable and flat surface.

By performing these pre-installation checks, the safe and effective operation of electric iron can be ensured. If any issues are identified during these checks, refer the manufacturer's instructions.

1.10 Earthing in Electric Iron

Earthing in electrical appliances, including electric irons, is a safety measure designed to prevent electric shock and ensure that the appliance is grounded. The primary purpose of earthing (grounding) is to provide a path for fault currents to safely dissipate into the ground, reducing the risk of electrical shock to users. Earth/ground wire is connected to the metal body of an Electric iron as shown in Figure 1.30.

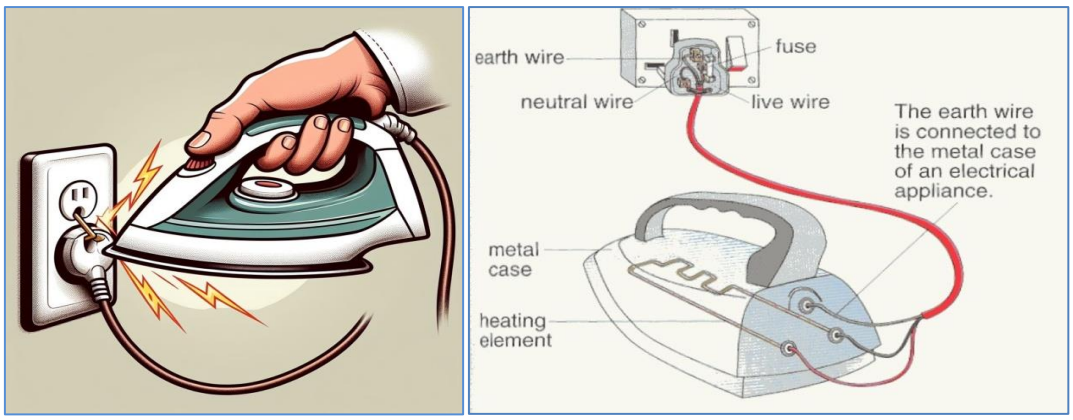


Fig. 1.30: Earth wire in Electric Iron

In the context of electric irons, earthing is typically achieved through the following components –

i) Three-Pin Plug – Most modern electric irons are designed with a three-pin plug. The third pin is the grounding or earthing pin as shown in Figure 1.31.

Fig. 1.31: Three-pin Plug (Wire, Internal and External view)

The three-pin plug is connected to a three-wire power cord, with the third wire being the ground wire.

ii) Ground Wire – The ground wire is usually a green or bare copper wire in the power cord as viewed in Figure 1.31. It is connected to the grounding prong of the plug and runs through the cord to the iron's internal components.

iii) Grounding Connection – Inside the electric iron, the ground wire is connected to the metal components that could potentially become energized in the event of a fault. This connection ensures that any fault currents are directed to the ground, minimizing the risk of electric shock.

iv) Grounded Metal Parts – Various metal parts of the iron, such as the sole plate and casing, are connected to the ground wire to ensure proper grounding. It is important to note that proper earthing is a critical safety feature, especially in appliances with metal components that users might come into contact with. When the electric iron is plugged into an electrical outlet with a proper ground connection, any electrical faults that may occur are directed away from the user through the grounding system. When using an electric iron, ensure that you are using a grounded electrical outlet and that the power cord & plug are in good condition.

1.11 Safety precautions while installing and handling Electric Iron

Safety precautions are crucial when installing and handling an electric iron to ensure the well-being of users and the proper functioning of the appliance. Here are important safety precautions to follow –

1.11.1 During Installation

Voltage Compatibility – Confirm that the electric iron is compatible with the voltage of your electrical system. Using an incompatible voltage may damage the iron and pose safety risks.

Power Cord Inspection – Thoroughly check the power cord for any signs of damage, such as fraying or exposed wires. If any issues are found, refrain from using the iron and have the cord repaired or replaced.

Plug and Outlet Match – Ensure that the plug type on the electric iron matches the outlet type in your home. Avoid using makeshift adapters that may compromise safety.

Proper Outlet Usage – Plug the iron directly into a wall outlet. Avoid using extension cords or multiple plugs, as these may overheat and pose a fire hazard.

1.11.2 During Handling

Water Reservoir Safety (for steam irons) **–** Only use clean and distilled water in the iron's reservoir. Do not overfill the reservoir, and make sure it is securely attached to prevent water leaks.

Soleplate Inspection – Before ironing, inspect the soleplate for any outside objects or residue. Wipe it clean with a damp cloth if necessary. Ensure the soleplate is securely attached.

Temperature Control – Use the appropriate temperature setting for the type of fabric being ironed. Avoid using excessively high temperatures, as this may damage delicate fabrics and pose a burn risk.

Indicator Lights – Pay attention to indicator lights. Monitor the signals for heating, reaching the desired temperature, and any other relevant information according to the manufacturer's guidelines.

Auto Shut-Off Feature (if applicable) **–** If the iron has an auto shut-off feature, take advantage of it to enhance safety. This feature automatically turns off the iron after a specific period of inactivity.

Safe Storage – When not in use, unplug the iron and allow it to cool before storing it. Store the iron in an upright and stable position to prevent accidental falls.

Handling with Dry Hands – Ensure your hands are dry when handling the iron to prevent electrical shock. If your hands are wet, dry them thoroughly before touching the iron.

Iron on Stable Surface – Always use the iron on a stable and flat surface to prevent accidental tipping or falls.

1.11.3 General safety instructions

Read the User Manual

1. Familiarize yourself with the user manual that accompanies the iron. Follow the manufacturer's instructions and safety guidelines.
2. Keep the iron out of reach of children and pets, especially when it is plugged in or still hot. Store it in a secure location.
3. In case of an emergency, unplug the iron immediately. Be aware of the location of the nearest power outlet and keep it easily accessible.

By adhering to these safety precautions, users can reduce the risk of accidents and ensure the safe installation and handling of an electric iron. Always prioritize safety and follow manufacturer guidelines for the specific iron model you are using.

1.12 Testing of Electric Iron

Testing an electric iron is a crucial step to ensure its proper functioning, efficiency, and safety. Here's a guide on how to conduct various tests on an electric iron –

1.12.1 Earth Continuity test – The Earth Continuity Test is an important safety check for electric irons to ensure that the metal parts that should be earthed are effectively connected to the earth. This is crucial in preventing electric shock hazards in case of a fault.

1.12.2 Electric strength test – The electric strength test, also known as a *dielectric strength* or *high-potential (hipot) test*, is a safety test conducted on electrical appliances and equipment, including electric irons. The purpose of this test is to ensure that the insulation in the device can withstand high voltages without breaking down, preventing electrical shock hazards.

1.12.3 Functional test – A functional test for an electric iron involves verifying that the appliance operates correctly and safely, ensuring that all its features and functions perform as intended.

1.12.4 Protection against access to live parts – Protection against access to live parts in electric irons is crucial to ensure the safety of users. Live parts refer to components carrying electrical current that, if touched, could result in an electric shock. Various safety measures are implemented in electric irons to prevent accidental contact with live parts.

1.12.5 Electric strength and Leakage current at operating temperature – Electric strength and leakage current are important parameters to consider in electrical appliances like electric irons, especially when assessing safety. Let's discuss each of these concepts:

A) Electric Strength (Dielectric Strength) – Electric strength, also known as dielectric strength, refers to the ability of an electrical insulation material to withstand a high voltage without breaking down. It is typically measured as the voltage at which a material or device fails when subjected to a high potential difference. For electric irons, electric strength is crucial to ensure that the insulation around live parts, such as wires and heating elements, can withstand the operational voltages without causing electric breakdown or safety hazards. The dielectric strength is usually tested during the manufacturing process to confirm that the insulation materials used in the electric iron can withstand the specified voltages.

B) Leakage Current at Operating Temperature – Leakage current is the unintentional flow of electric current from a conductor to another unintended path. In electrical appliances, including electric irons, leakage current is a concern because it can contribute to energy loss and, in some cases, pose a safety risk. The operating temperature of an electric iron is relevant because it can affect the electrical properties of materials. At higher temperatures, some insulating materials may exhibit increased leakage current due to factors like thermal expansion and changes in conductivity.

Manufacturers typically design electric irons to minimize leakage current and ensure safe operation. Insulation materials are chosen to maintain their properties over a range of temperature, and quality control measures are implemented to verify the safety of the product. Compliance with safety standards and regulations ensures that electric iron undergo rigorous testing, including assessments of leakage current, to meet established safety criteria.

1.12.7 Heating- Up Time – The heating-up time of an electric iron refers to the duration it takes for the iron to reach its operating temperature after being turned on. This time can vary based on several factors related to the design and specifications of the electric iron.

1.13 Temperature settings for various types of cloths

Understanding the appropriate temperature settings for different types of fabrics is essential for effective ironing without causing damage. Here's a guide to temperature settings for various types of clothes –

Cotton – Cotton is a sturdy fabric that can withstand higher temperatures. Set the iron to high temperature, usually around 400°F (204°C). This ensures effective wrinkle removal for cotton garments.

Linen – Linen is another robust fabric that can handle higher temperatures. For effective ironing of linen cloths, set the iron to a high temperature, around 445°F (229°C).

Wool – Wool is a delicate fabric that requires lower heat to prevent damage. Set the iron to a medium or low temperature, approximately 300°F (148°C), and use a pressing cloth to protect the wool during ironing.

Silk – Silk is a delicate and heat-sensitive fabric. Use a low temperature setting, typically around 275°F (135°C). It's advisable to iron silk on the reverse side or with a pressing cloth to avoid direct heat exposure.

Synthetics (Polyester, Nylon, Acrylic) **–** Synthetic fabrics are sensitive to high temperature and can melt or scorch. Use a low to medium setting, around 300°F (148°C), for polyester, nylon, acrylic. Always check the care label for specific recommendations.

Rayon – Rayon is a semi-synthetic fabric that can be delicate. Use a low to medium setting, approximately 275°F (135°C), to prevent damage to the fabric. Iron rayon items inside out when possible.

Denim – Denim is a robust fabric but may benefit from higher temperatures for effective ironing. Set the iron to a medium to high temperature, around 375°F (190°C), for denim garments.

Velvet – Velvet requires special care due to its pile. Place a pressing cloth over the velvet and use a low temperature setting, around 275°F (135°C), to prevent crushing the pile.

1.14 Utility and maintenance procedure of Electric Iron

A) Utility of Electric Iron

Wrinkle Removal – The primary function of an electric iron is to remove wrinkles and creases from clothing, providing a smooth and polished appearance as shown in Figure 1.32.

Fig. 1.32: Utility of Electric Iron

Fabric Care – Electric irons come with adjustable temperature settings, allowing users to select the appropriate heat level for different types of fabrics. This helps to prevent damage to delicate fabrics while effectively ironing sturdier materials. A typical temperature selecting switch is shown in Figure 1.33.

Fig. 1.33: Temperature selecting switch

Versatility – Modern electric irons often have features such as steam function, spray mist, and variable steam control, enhancing their versatility in handling various fabrics and garment types. These features are shown in Figure 1.34.

Fig. 1.34: Features of electric iron

Time Efficiency – Electric irons heat up quickly, reducing the time required for ironing compared to traditional methods like flat irons or irons heated on stoves.

Professional Finish – The even distribution of heat and the smooth soleplate contribute to achieving a professional finish on clothing items.

Convenience – Electric irons are user-friendly with features like temperature indicators, auto shut-off, and cord management, making them convenient for everyday use.

B) Maintenance Procedure of Electric Iron:

Cleaning the Soleplate – Wipe the soleplate regularly to remove any fabric residues, starch, or other substances. For stubborn stains, a mixture of vinegar and baking soda can be used as shown in Figure 1.35.

Fig. 1.35: Cleaning the Soleplate

Descaling – If the iron has a steam function, it may accumulate mineral deposits over time. It means the steam vents are clogged and the iron needs a good cleaning. Descaling solutions are available, or a mixture of water and vinegar can be used to clean the steam vents. Mix 1/2 cup of distilled white vinegar and 1/2 cup of distilled water. Pour the mixture into a cool, unplugged iron as shown in Figure 1.36.

Fig. 1.36: Descaling process of steam iron

Emptying Water Reservoir – If your iron has a water reservoir for steam, empty it after each use to prevent the build-up of stagnant water, which can lead to mold or bacteria growth.

Avoiding Overheating – Follow the manufacturer's instructions for temperature settings. Using excessive heat for a fabric type can lead to scorching or damage.

Proper Storage – Before storing it, allow the iron to cool completely. Store the iron in an upright position to prevent the soleplate from coming into contact with surfaces that may cause damage.

Checking and Replacing Parts – Regularly check the power cord and plug for any signs of wear or damage. If you notice any issues, repair or replace the cord promptly. Ensure that the iron's other components, such as buttons and temperature control, are functioning correctly.

Avoiding Hard Surfaces – Be cautious when ironing on hard surfaces to prevent damage to the soleplate. It's advisable to use an ironing board or a padded surface.

Regular Inspections – Periodically inspect the iron for any loose screws, damaged parts, or signs of wear. To ensure safe and efficient operation, it is necessary to inspect regularly.

1.15 Operational guidelines

Operating an electric iron safely and efficiently requires following specific guidelines to ensure proper use and prevent accidents.

Here's a set of operational guidelines for using an electric iron –

A) Before Use

Read the User Manual **–** Familiarize yourself with the user manual that comes with the electric iron. It contains important safety instructions and usage guidelines specific to the model.

Inspect the Iron **–** Before plugging in the iron, visually inspect it for any damage. Check the power cord, plug, soleplate, and controls. Do not use a damaged iron.

Choose the Right Temperature **–** Select the appropriate temperature setting on the iron based on the fabric you will be ironing. Different fabrics require different heat settings.

Setting Up **–** Place the Iron on a Stable Surface: Set up the iron on a stable and heat-resistant surface. Ensure the surface is clean to prevent stains on fabrics.

Check the Water Reservoir (if applicable) **–** If the iron has a steam function, check the water reservoir. Follow the manufacturer's instructions for adding water. Use only clean, distilled water to avoid mineral build up.

B) Ironing Process

Power On **–** Plug in the iron and turn it on. Wait for the indicator light to show that the iron has reached the set temperature.

Preheat **–** Allow the iron to preheat to the desired temperature before starting to iron. This ensures optimal performance.

Select the Right Setting for Fabrics **–** Adjust the temperature control based on the fabric being ironed. Most irons have settings for delicate fabrics, synthetics, wool, and cotton, as shown in Figure 1.37.

Fig. 1.37: Temperature control of iron

Iron in Batches **–** Iron garments in batches with similar fabric types and temperature requirements to avoid constantly adjusting the temperature setting as shown in Figure 1.38.

Fig. 1.38: Iron in Batches

***Use Steam Wisely (if applicable)* –** If the iron has a steam function, use it for fabrics that benefit from steam, such as cotton. Follow the manufacturer's guidelines for steam usage.

***Iron Inside Out for Delicate Fabrics* –** For delicate fabrics, iron them inside out to prevent shine or damage to the visible side.

C) Safety Measures

***Be Mindful of the Cord* –** Keep the power cord away from the hot soleplate and do not let it come into contact with water. Avoid pulling the cord sharply.

***Auto-Shutoff Feature* –** If the iron has an auto-shutoff feature, take advantage of it. This feature turns off the iron automatically after a certain period of inactivity.

***Unplug After Use* –** Always unplug the iron when you finish ironing or when leaving it unattended.

***Do not leave a hot iron face down* –** This could cause the iron to burn a surface, and even start a fire. Always stand the iron upright when you need to step away from your ironing for a moment as shown in Figure 1.39.

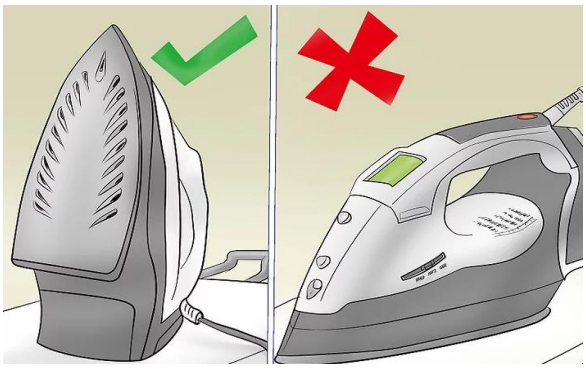


Fig. 1.39: Do not leave a hot iron face down

***Keep iron away from small children* –** An iron is very hot and can cause serious injury for children. Ironing is not an appropriate household chore for small children. Iron should also keep out of reach of small kids at the time of ironing, as shown in Figure 1.40.

Fig. 1.40: Keep iron away from small children

Treat a burn quickly in the event of an accident – A burn will heal faster and hurt less with proper treatment. As soon as you or someone else is burnt, run the burn under cool running water for about 20 minutes as shown in Figure 1.41.

Fig. 1.41: Treat a burn quickly

Never use ice, oil, butter, or soy sauce on a burn. This can cause skin damage.

If a burn is bigger than a small coin, seek medical attention.

D) After Use

Let an iron cool off for at least 10 minutes before putting it away – An iron gets extremely hot, and could potentially start a fire. After you finish ironing, turn OFF the iron. You should wait at least 10 minutes before storing the iron, as shown in Figure 1.42. That will give it adequate time to cool.

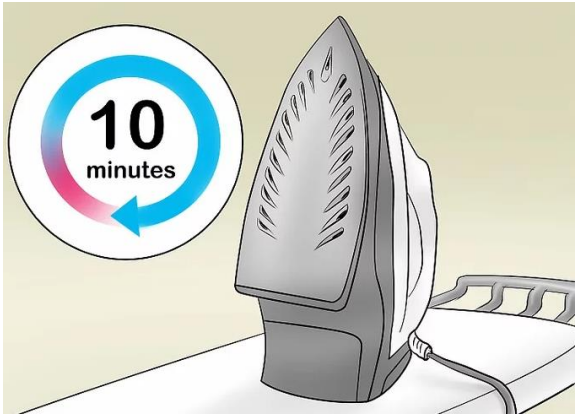


Fig. 1.42: Wait at least 10 minutes before storing the iron

Clean the Soleplate – Allow the iron to cool, and then wipe the soleplate with a damp cloth to remove any residue. It is shown in Figure 1.43. Follow the manual instructions for cleaning.

Fig. 1.43: Clean the Soleplate

Empty the Water Reservoir – If the iron has a water reservoir, empty it after use to prevent mineral build-up.

Store Safely – Store the iron in a safe and dry place. Wrap the cord neatly to avoid damage.

Activity 3

Practical Activity 1.3. Demonstrate to Repair Electric Iron.

Tools Required

Screwdriver Kit, Plier, Electric Iron, Long Nose Plier, Wire Stripper, Multi meter

Safety Precautions

Wear Safety Gloves, make sure Electric Iron is disconcerted from the power source, put all the fasteners in box to avoid misplacing them, make sure that iron is not heated up.

Procedure

Step 1. Remove all screws and nuts on the cover for disassemble the electric iron as shown in Figure 1.44.

Fig. 1.44: Disassemble the Electric Iron

Step 2. Check the wiring connections as shown in Figure 1.45 to inspect the fault.

Fig. 1.45: Wiring connections

Step 3. Use multi meter to check iron is working or not it is shown in Figure 1.46.

Fig. 1.46: Use multi meter to check iron

Step 4. If required, change the power cord of electric iron or repair it.

Step 5. By adopting reverses process of disassemble, reassemble the electric iron it is shown in Figure 1.47.

Fig. 1.47: Reassemble the electric iron

Summary

- The chapter explores electric irons, providing an overview of their operation, types, components, and installation procedures.
- It explains the working mechanism, highlighting the role of components such as the thermostat and bimetallic strip in regulating temperature.
- The chapter concludes with specifications, safety measures, and guidelines for setting appropriate temperatures tailored to specific fabrics.
- The chapter provide an essential insight to users and technicians for achieving effective and safe ironing practices.

Check Your Progress

A. Multiple Choice questions

1. What is the primary purpose of an electric iron? (a) Cooking (b) Cleaning (c) Eliminating wrinkles from clothing (d) Heating rooms
2. How does the electric iron operate based on the heating effect of current? (a) Convection (b) Conduction (c) Radiation (d) Insulation
3. Which feature of modern irons prevents burns by turning off automatically if left on clothes for too long? (a) Steam Generation (b) Thermostat (c) Anti-Burn Control (d) Water Indicator
4. What is the purpose of the side platform in modern irons? (a) Steam generation (b) Temperature control (c) Prevents direct contact with clothes (d) Energy-saving control
5. Which type of iron uses moist heat or steam for ironing? (a) Basic iron (b) Cordless iron (c) Steam iron (d) Mini iron
6. What is the soleplate material that ensures even heat distribution and static prevention? (a) Ceramic (b) Stainless steel (c) Titanium (d) All of the above
7. Which safety feature automatically turns off the iron after a specified period of inactivity? (a) Steam Amount Control (b) Auto Shut-Off (c) Energy-Saving Control (d) Temperature Control Dial
8. What is the purpose of the bimetallic strip in the thermostat of an automatic iron? (a) Steam generation (b) Temperature regulation (c) Energy-saving control (d) Anti-burn control
9. What does the indicator lamp on an electric iron signify? (a) Power supply availability (b) Temperature control (c) Steam generation (d) All of the above
10. Which pre-installation check is important for steam irons regarding water use? (a) Voltage compatibility (b) Power cord inspection (c) Water reservoir check (d) Soleplate inspection

B. Fill in the blanks

1. An electric iron is a household appliance used to eliminate wrinkles from clothing through the application of _____ and pressure.
2. The electric iron operates based on the heating effect of _____.
3. Corded irons have a cord attached for power, while cordless irons get power from a charging base, making them _____.
4. The basic clothes iron uses dry heat and is often corded and _____.
5. The material used in manufacturing their sole plate also usually determines the iron's durability_____.
6. Foldable iron areirons can be fold for easy packing without occupying____.
7. Nickel-chromium wire, which has a high resistance to current flow and tensile strength, is used in the construction of _____.
8. The thermostat helps in maintaining the temperature _____.
9. The switch, which is connected in series with the resistance (or) heating element, is operated by a _____.

10. Testing an electric iron is a crucial step to ensure its _____.

C. State whether the following statements are True or False

1. Modern irons may come with features such as steam generation, thermostat control, and energy-saving mode.
2. Corded irons get their power from a charging base, making them more convenient for users.
3. Automatic fabric irons have a thermostat switch for heat regulation, while non-automatic irons require manual temperature adjustment.
4. The basic clothes iron uses moist heat or steam for wrinkle removal.
5. Steam irons can only be used horizontally, similar to a typical clothes iron.
6. The soleplate material options include ceramic for quick heat-up and rust resistance.
7. The soleplate of an electric iron comes in direct contact with the fabric when pressing clothes.
8. Steam iron parts include features like a vaporizer, water reservoir, and steam shot button.
9. The wiring/circuit diagram of an electric iron provides a visual representation of the plumbing components.
10. The working of an electric iron involves conduction heat transfer and the activation of the cooling element.

D. Answer the following questions in short

1. List three features commonly found in modern irons.
2. What distinguishes automatic fabric irons from non-automatic ones in terms of temperature control?
3. Name three types of soleplate materials used in electric irons and their characteristics.
4. What are the key components of a basic electric iron?
5. Highlight the additional parts present in a steam iron compared to a basic iron.
6. How does a thermostat contribute to the temperature regulation in an electric iron?
7. What are the specific safety precautions mentioned during the installation of an electric iron?
8. Explain the purpose of a capacitor in the thermostat of an electric iron.
9. What factors should be considered for choosing the appropriate temperature setting for ironing different fabrics?
10. What safety feature is auto shut-off, and how does it enhance the safety of electric irons?

Session 2: Troubleshooting and Repairing of Dysfunctional Iron

Troubleshooting is systematic approach to locate the cause of a fault in an electronic circuit or system. A Field Technician should have the knowledge and skill to repair home appliances. Technician should be able to diagnose and troubleshoot the problem. Technician should carry out repairs according to the requirements of that particular appliance. It is very important for a technician to correctly identify the fault in the home appliances. Wrong identification of fault will lead to waste of time and money and it can also cause damage to the equipment. Following steps have to be performed in troubleshooting and repairing of an appliance as shown in Figure 2.1.

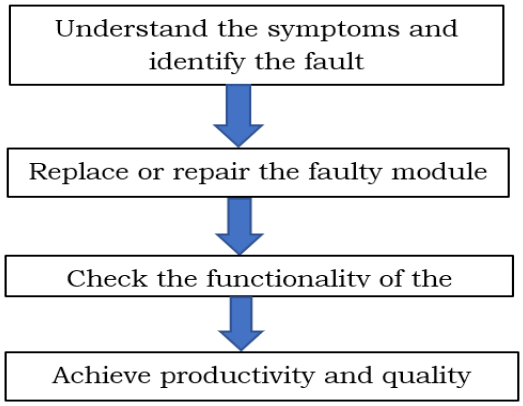


Fig. 2.1: steps in troubleshooting/repairing of appliances

2.1 Faults based on customer interaction, usage pattern and initial inspection

Determining faults in an electric iron based on customer interaction usage patterns and initial inspection involves considering both the information provided by the customer and the observable issues during the initial examination.

Here are some common faults and possible causes –

2.1.1 No Power or Heating Issues –

Customer Interaction **–** The customer reports that the iron doesn't heat up or turn on.

Initial Inspection **–** Check the power cord and plug for damage or loose connections.

1. Verify the power outlet is functional.
2. The heating element should inspect for signs of damage.

2.1.2 Inconsistent Heating

Customer Interaction **–** The iron heats unevenly or struggles to maintain a consistent temperature as shown in Figure 2.2.

Fig. 2.2: Heating Issue

Initial Inspection – Check for mineral deposits or scaling in the steam vents or water reservoir.

- Ensure the temperature control mechanism is functioning properly.
- Inspect the soleplate for damage or uneven heating elements as shown in Figure 2.3.

Fig.2.3: damaged soleplate

2.1.3 Auto-Shutoff Malfunction

Customer Interaction – The iron doesn't shut off automatically as expected.

1. **Initial Inspection:**
   - Check the auto-shutoff mechanism for any obstructions or malfunctions.
   - Inspect the thermostat and associated components for issues.

2.1.4 Steam Function Problems

Customer Interaction – The steam function is not working properly or produces insufficient steam.

Initial Inspection

- Check the water reservoir for proper water level and cleanliness.
- Inspect the steam vents for clogs or mineral deposits.
- Ensure the steam control button or lever is functioning.

2.1.5 Excessive Noise or Vibrations

Customer Interaction – The iron is making unusual sounds or vibrations during use.

1. ***Initial Inspection***
   - Check for loose components, screws, or parts inside the iron.
   - Inspect the soleplate for any foreign objects.

2.1.6 Leaking Water

Customer Interaction – The iron leaks water during use or when idle.

1. ***Initial Inspection:***
   - Check the water reservoir and its seal for leaks.
   - Inspect the steam chamber for cracks or damage.
   - Ensure the water reservoir is securely attached.

2.1.7 Indicator Light Issues

Customer Interaction – The indicator light doesn't turn on or behaves erratically.

1. Initial Inspection

- Check the indicator light for damage or malfunction.

- Inspect the wiring and connections related to the indicator light.

2.1.8 Issues with Cord or Plug

Customer Interaction – Complaints about a frayed cord, exposed wires, or issues with the plug.

1. Initial Inspection

- Inspect the power cord for visible damage.
- Check the plug for secure connections and signs of wear.

2.1.9 Auto-Shutoff Too Soon or Not Working

Customer Interaction – The iron shuts off too quickly or doesn't shut off at all.

1. Initial Inspection

- Inspect the thermostat and associated components for calibration issues.
- Check for obstructions in the auto-shutoff mechanism.

2.1.10 Unusual odor or Smoke

Customer Interaction – Reports of strange smells or visible smoke during operation.

1. Initial Inspection

- Inspect the iron for any burning or melting components.
- Check the electrical connections for signs of overheating.

2.2 Common defects occur in Electric Iron

The Table 2.1 represents the common problems in the working of an electric iron along with their solutions:

Table 2.1 common problems in the working of an electric iron

SN	***Defects***	***Reasons***	***Remedies***
1.	Iron not gets heated	(a) Electric supply issue. No electric supply. defective power cord. loose connections.	Correct the electric supply replace the power cord clean and tight the connections
		b. Heating element is not connected with supply	Connect the supply to the heating element properly
		c. Loose connection in heating element	Heating element should be connected properly
2.	Heat produced in the iron is not adequate	Voltage drop	Correct the voltage
		Thermostat knob not fitted properly	Proper fitting of thermostat knob should be done
		Loose connection in thermostat	Thermostat connection should be done properly
3.	Heat produced is exceeding the setting point kept	Short circuit in thermostat	Short circuit in thermostat should be corrected Emery sheet should be used for cleaning the terminal ends to avoid shot circuit

4.	Clothes are sticking in the sole plate while ironing	Abnormal heat produced. Due to that thermostat terminals contact with one another	Terminals of thermostat should be connected correctly
		Bottom of the sole plate is corroded	The corrosion in the sole plate should be cleaned by applying noncorrosive materials.
5.	Iron is getting electric shock	Supply wire may contact with body of the iron	Connect the supply wire without touching the metal part of the iron
			Earth connections should be properly checked
6.	Iron heats but steams improperly	Burnt or dirty soleplate	Inspect the soleplate and clean the vents and flush sediment out of the steam chamber
7.	Iron does not spray properly	Nozzle is dirty	Inspect and clean the nozzle
8.	Iron leaks or spits	Steam vents, nozzle, and tank are dirty	Clean the steam vents, nozzle, and tank

2.3 Faults in separate parts of Electric Iron

Electric irons can experience faults in various parts, and troubleshooting these issues can help determine if a specific component is malfunctioning. Here are some common faults that may occur in separate parts of an electric iron –

2.3.1 Power Cord and Plug

Faults – Fraying, exposed wires, or damage to the insulation.

Symptoms – Power supply issues, sparks, or electrical shocks.

Solution – Replace the damaged power cord or plug.

2.3.2 Temperature Control

Faults – Inaccurate temperature settings, erratic behaviour, or failure to maintain the selected temperature.

Symptoms – Inconsistent ironing results or overheating.

Solution – Repair or replace the temperature control mechanism.

2.3.3 Heating Element

Faults – Burnout, uneven heating, or complete failure.

Symptoms – Iron not heating up, heating element visibly damaged, or overheating issues.

Solution – Replace the heating element.

2.3.4 Thermostat

Faults – Failure to regulate temperature, leading to overheating or insufficient heating.

Symptoms – Inconsistent temperature control, burnt fabric, or safety concerns.

Solution – Repair or replace the thermostat.

2.3.5 Soleplate

Faults – Warping, damage, or poor heat distribution.

Symptoms – Uneven ironing, sticking to fabric, or visible damage to the soleplate.

Solution – Replace the soleplate.

2.3.6 Steam Function

Faults – No steam, excessive leakage, or steam not being generated.

Symptoms – Ineffective wrinkle removal or water dripping onto clothes.

Solution – Clean or replace clogged steam vents, check the water reservoir, or address any issues with the steam-generating mechanism.

2.3.7 Auto Shut-off System (if applicable)

Faults – Fails to shut off, shuts off prematurely, or doesn't engage.

Symptoms – Safety concerns, potential overheating, or inconvenience.

Solution – Inspect and replace faulty components in the auto shut-off system.

2.3.8 Indicator Lights

Faults – Lights not functioning or providing inaccurate information.

Symptoms – Difficulty in determining the iron's status (heating, ready, or off).

Solution – Replace or repair the indicator lights.

Always refer to the manual instructions and safety guidelines when troubleshooting or repairing electric irons.

2.4 Tools and equipment required during repairing of an Electric iron

Different tools and equipment that are required for repairing of an electric iron are as shown in Table 2.2.

Table 2.2: Tool required for repairing and installation

Name of Tool	***Picture***	***Usage***
Set of screw drivers		A screwdriver is a hand tool used for turning screws. It typically consists of a handle and a shaft with a tip that fits into the screw's head. Screwdrivers are very important and are used to tighten the screws, bolts, and nuts. They come in various shapes and also can be altered as per the size of the bolt.
Wrench/Pliers		Pliers are versatile hand tools that combine features of both cutting pliers and gripping pliers. They often have a cutting edge and serrated jaws for gripping. Pliers are useful for gripping, twisting, bending, and cutting various materials, making them an essential tool for electricians, mechanics,

Soldering iron		A soldering iron is a tool with a heated metal tip used to melt solder and join metal parts together in electronics, plumbing, and other crafts.
Soldering stand		A soldering stand is a tool used to hold a soldering iron when it's not in use, typically featuring a stable base and a holder for the iron. It helps prevent accidental burns and damage to surfaces by keeping the hot iron safely in place when not in hand.
Soldering lead		Soldering lead, also known as solder wire, is a metal alloy used in soldering to create electrical or mechanical connections between components. It typically consists of a mixture of tin and lead, although lead-free alternatives are also available. The solder wire is heated with a soldering iron until it melts and flows onto the joint, forming a bond when it cools.
Wire stripper		A wire stripper is a small hand-held tool that is used to remove the insulation from electric wires.
Multi meter		A multi meter is a device used to measure multiple parameters of an electric circuit like voltage, current, and resistance. The device is made up of a digital or analog meter, batteries, resistors, and other circuitry, which ensure the measurement of several electrical quantities with very high accuracy and speed.
De soldering tools		A desoldering tool, often called a desoldering pump or solder sucker, is a device used to remove solder from electronic components or circuit boards. It typically consists of a spring-loaded plunger and a nozzle. The plunger is manually operated to create a vacuum, and when triggered, it sucks up molten solder from the joint, allowing components to be easily removed or replaced. Desoldering tools are indispensable for repairing or salvaging electronic devices.

Cleaning brush		A cleaning brush for soldering is a tool used to remove excess solder, flux residues, and other debris from soldering equipment, such as soldering iron tips or circuit boards. These brushes often have stiff bristles or abrasive pads to effectively clean surfaces without damaging them. They're essential for maintaining soldering equipment and ensuring proper soldering connections.
Sandpaper (fine grain)		Sandpaper in iron repair cleans, smoothens surfaces, preps for painting, removes coatings, shapes metal, and deburrs edges, crucial for restoring iron components.

2.5 Troubleshooting and Repairing of an Electric iron

An electric iron can be repaired for some defects as follows.

2.5.1 Heating Problem

A) If the iron not heating enough – If it producing either too much of heat or cold then the possible causes for this could be wrong thermostat setting, problem with electric connections or electrical cord.

Solution

To resolve this problem, first check that all the connections are connected properly and in accordance with the user manual. Check the power switch, the plug and the thermostat as well. If thermostat is set at the wrong temperature, in particular a lower one, then the iron may not heat enough. Then turn it to a reasonably higher setting. Moreover, try changing the heating mode to see whether the heat increases.

B) If the iron is heating up properly but not emitting out proper steam – This problem can be raised due to clogged steam vents and soleplate. It occurs because of mineral deposits in the iron.

Solution

Step 1. Unplug the iron and make sure that while cleaning it should not be hot.

Step 2. Check the steam vents and soleplate.

Step 3. Take a little bowl of distilled white vinegar and some cotton swabs. Dip cotton swab into the vinegar and use it to clean out each little hole on the bottom of the iron. The vinegar will dissolve the mineral deposits and remove them. It is depicted in Figure 2.4.

Fig. 2.4: Cleaning of steam vents

Step 4. Cleaning with vinegar will help to soften the minerals, so they should be easy to wipe away, but a toothbrush can be used for a bit more of a deep-clean as shown in Figure 2.5.

Fig. 2.5: Cleaning of steam vents using toothbrush

Step 5. When each hole is de-mineralized, clean the water container and steam holes. For this, fill the reservoir about a quarter full with white vinegar, and then empty it by steaming the iron on to its highest setting. The vinegar fumes will open the holes that were earlier clogged by mineral deposits. Turn the steam on full blast and iron a clean, dry towel. Continue repeating this process until the holes are totally devoid of deposits as shown in Figure 2.6.

Fig. 2.6: Steaming the iron

Step 6. Finish off by wiping with a clean microfiber cloth to remove any excess mineral deposits and avoid any hard water stains on future ironing projects as shown in Figure 2.7.

Fig. 2.7: Steaming the iron

2.5.2 Working problem

Not heating properly and not working altogether are different issues. One common problem that people face is iron not working.

Solution

If dry iron is not working at all then in that case, check the power cord first. If the cord is broken or damaged in any way, then this could be a cause of the appliance not working at all.

Also try changing the plug into another power outlet to check whether the issue is with the outlet or the iron. Some other reasons why iron may not be working could be wrong iron setting for example auto-off setting, lime scale deposits on the soleplate and others.

2.5.3 Dirty Soleplate – Any kind of iron can experience issues with the sole plate. Over a period of time and usage, a sole plate can get dirty and its holes can get clogged. This may affect its heating and overall performance.

Solution

Cleaning of Soleplate – The iron's soleplate should never be scrubbed with anything harsh that can cause scratching. Once the finish is marred, it is nearly impossible to prevent rusting or staining. The soleplate can get gummy and soiled by starch or sizing residue and should be cleaned regularly. The following steps can help.

Step 1. Mix table salt or baking soda with a bit of distilled white vinegar to make a paste.

Step 2. If you choose baking soda, the vinegar will cause it to foam, so mix it in a bowl large enough to contain the foam.

Step 3. Dip a clean white cloth into the mixture and use it to scrub the soleplate as shown in Figure 2.8.

Fig. 2.8: applying the mixture to the soleplate

Step 4. Some areas will need a bit of elbow grease to remove the grime.

Step 5. For really stuck-on build-up, allow the paste to sit for at least 10 minutes before scrubbing.

Step 6. Rinse the soleplate by using a clean white cloth dipped in clear water, then dry as shown in Figure 2.9.

Fig. 2.9: Cleaning of soleplate

Step 7. With the iron in an upright position on a sturdy surface, inspect the steam ducts. If you can see any white residue in the holes, use a wood or plastic toothpick or old toothbrush to clear away the build-up. Never use anything metal that could scratch the soleplate as shown in Figure 2.10.

Fig. 2.10: Cleaning of soleplate with brush

2.5.4 Iron sticking to clothes

Another common problem in iron is sticking of the clothes or fabric. This could be due to a burnt soleplate. Scorch/burnt marks aren't necessarily an issue if they don't come off on the fabrics that you're ironing or cause any staining, but it's a good idea to try to clean as much of them off as possible. It is shown in Figure 2.11.

Fig. 2.11: Scorch/burnt marks on electric iron

Solution – To Remove Scorch/burnt marks on the sole plate following steps can be useful.

Step 1. Allow the iron to cool completely.

Step 2. Take a cotton pad or a cotton ball and dampen it with acetone nail polish remover. Swipe the polish remover over the scorch marks and watch them disappear as shown in Figure 2.12.

Fig. 2.12: Removal of scorch/burnt marks on electric iron

Replacing Faulty Module – In case the technician is unable to repair the components or fix the fault, or if the components cannot be replaced at customer's site, then the faulty module/component is sent to the service centre. The field technician then collects the functional module from the service centre and replaces the defective component at the customer's site.

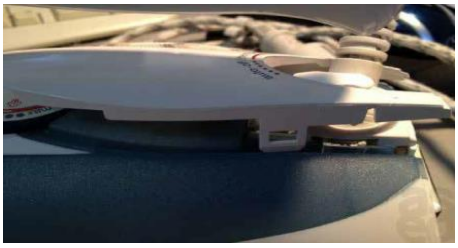
Confirming Functionality of the Repaired Module – After the faulty module has been repaired or replaced, check the new module with testing equipment such as multi meter and ammeter. This is done to ensure that the module is working fine with the other parts of the appliance.

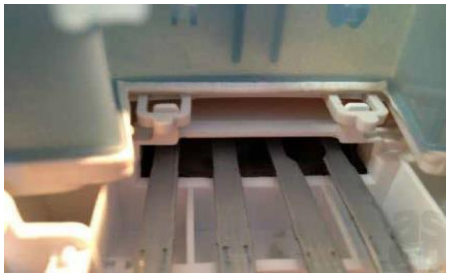
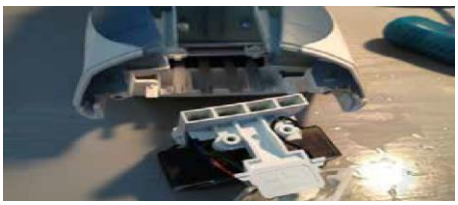
2.6 Disassembly, repair work and assembly of an electric iron

Before starting with the repair work, it is important to note as follows:

1. Professional technicians have the expertise in their crafts.
2. A completely qualified technician has not only good reputation but also is efficient in providing high-quality repair work.
3. A skilful technician has the ability to repair appliances of various brand and models
4. An electric iron repairing work can be performed in the following order given in table 2.2.

Table 2.2: Steps for disassembly of an electric iron

SN	***Action***	***Image***
1	Using a screwdriver, unscrew the two mounting bolts on the back cover of the electric iron. Carefully remove the cover to access the internal components for inspection and repair. Reattach the cover and tighten the bolts securely before plugging the iron back in.	
2	To remove the central pad from the electric iron, use a flat screwdriver to gently unhook it from the back wall to the regulator. Carefully lift it away for inspection or maintenance, ensuring it's free from damage or debris. Replace or repair if necessary before reattaching securely.	
3	To remove the temperature control knob from the electric iron, gently detach it from the handle or main body, being cautious not to dislodge the spring for the ratchet mechanism. Carefully store the knob and ensure the spring remains in place. Inspect the components for damage or debris, and replace or repair as necessary. Reattach the knob securely to complete the process.	

4	Next, remove the control unit with the connector of the heating element.	
5	The indicator is removed along with the power cord. The body of the indicator is mounted on two latches to the body of the iron. To extract, you need a long screwdriver with which the latches are bent in turn, and the indicator is removed.	
6	Next, remove the entire electrical part, just pull it back, putting a little effort.	
7	The cap of the water dispenser is removed, behind which is the fastening screw. Unscrew it with across screwdriver.	
8	On the back of the two latch attachment fasteners are detached, and the sole is removed.	

After performing the troubleshooting, the assembly is carried out in the reverse order.

2.7 Performance check of the repaired module

The Figure 2.13 shows the steps for confirming functionality of the repaired module:

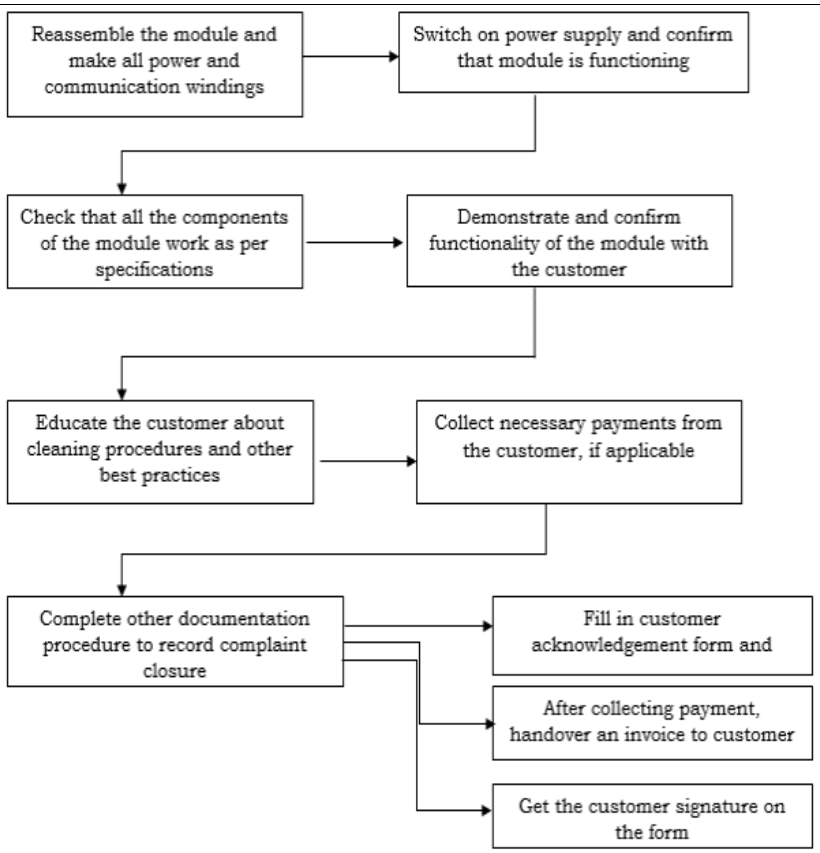


Fig. 2.13: Performance check procedure of the repaired module

Activities

Practical Activity 2.1. Demonstrate to repair electric iron for any fault.

Material needed

Screwdrivers, pliers, sandpaper (fine grain), needle, pipe cleaner, multi meter (tester)

Procedure

Step 1. The first step is to switch off the connection from the plug point.

Step 2. Next, unplug the iron. This step should be performed after became sure that the appliance has cooled down.

Step 3. Check the electric cord, sole plate and thermostat in case it does not heat up to the highest level or the clothes clings to the appliance.(Figure 2.14)

Fig. 2.14: Electric iron

Step 4. One of the reasons for this fault may be due to the accumulation (built-up) of debris (mineral deposits) in steam vents.

Step 5. Take the help of pipe cleaner or toothpick for removing the build-up. It is important to consider that the debris should not clog or block the steam vents.

Step 6. With the assistance of a fine needle (sewing), clean spray nozzle carefully it is shown in Figure 2.15.

Fig. 2.15: Clean spray nozzle carefully

Step 7. For issue in sole plate, open the cover plate with an appropriate screwdriver.

Step 8. Check the calibration of the thermostat and then clean the sole plate.

Step 9. Put the cover panel back and tighten the screw as shown in Figure 2.16.

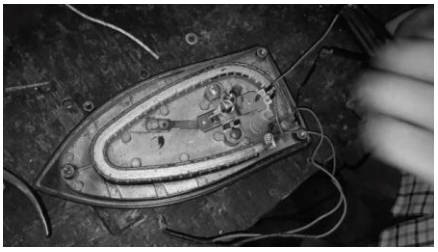


Fig. 2.16: Tighten the screw

Practical Activity 2.2 Demonstrate the replacement of thermostat and element of Electric Iron.

Tools Required

Screwdriver Kit, Plier, Electric Iron, Long Nose Plier, Wire Stripper, spanner set, multi meter, thermostat.

Procedure

Step 1. Plug in the iron box and electric cord and check the bottom surface if the iron heats up or not. (Figure 2.17)

Fig. 2.17: The bottom surface of iron

Step 2. Switch off/disconnect iron box and let it cool before starting the repair. (Figure 2.18)

Fig. 2.18: Switch off iron

Step 3. Use the screwdriver to remove the cover panel of the iron box. (Figure 2.19)

Fig. 2.19: Use the screwdriver to remove the cover panel

Step 4. Check the power cord and the wiring inside the iron box and replace it with a new one if they are damaged. (Figure 2.20)

Fig. 2.20: Check the power cord

Step 5. Remove the nuts that connects the wiring and the power cord inside the iron. (Figure 2.21)

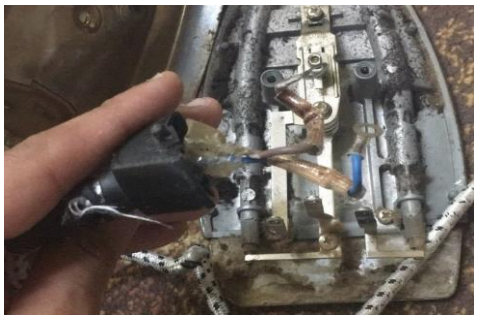


Fig. 2.21: The power cord inside the iron

Step 6. Rub off the stain with a soft cloth or a tooth brush if it got any to allow electric current to pass through. (Figure 2.22)

Fig. 2.22: Rub off the stain with a soft cloth

Step 7. Use the screwdriver to remove the screws holding the iron box thermostat. (Figure 2.23)

Fig. 2.23: Use the screwdriver

Step 8. Replace the old thermostat with a new one. (Figure 2.24)

Fig. 2.24: Replace the thermostat

Safety Precautions

Wear Safety Gloves, make sure Electric Iron is disconcerted from the power source, put all the fasteners in box to avoid misplacing them, make sure that iron is not heated up. Always check earthing fault, Rotate the thermostat slowly and check time to time relay is working or not. In steamed iron do not fill excess water.

2.8 Future scope of electric iron

The future scope of electric irons holds promise for advancements driven by technological innovation, energy efficiency, and user convenience. It is discussed below in detail.

Heating Technology – Future electric irons may feature advanced heating elements, such as induction heating or infrared heating, to provide faster and more efficient ironing. These technologies can reduce heat-up times, improve heat distribution, and minimize energy consumption.

Temperature Control – Precision temperature control mechanisms, possibly incorporating sensors and microprocessors, can enable users to set the iron to specific heat levels tailored to different types of fabrics. This ensures optimal ironing results while preventing damage to delicate materials.

Steam Generation – Enhanced steam generation systems, including larger water tanks, more powerful pumps, and finer misting nozzles, can produce higher volumes of steam for better wrinkle removal and smoother garment finishing. Additionally, innovations in steam distribution mechanisms can ensure uniform steam dispersion across the ironing surface.

Anti-Calcification Systems – Future electric irons may integrate advanced anti-calcification technologies to prevent limescale buildup and prolong the lifespan of the iron. Self-cleaning mechanisms or replaceable cartridges can help maintain optimal steam performance over time.

Smart Connectivity – Integration with smart home ecosystems allows users to control and monitor their irons remotely via smartphone apps or voice commands. Smart features may include setting ironing preferences, receiving maintenance alerts, and accessing energy usage data for efficient operation.

Safety Features – Continued advancements in safety features can enhance user protection and peace of mind. Features such as automatic shut-off sensors, motion detectors, and heat-resistant handles minimize the risk of accidents and injuries during ironing.

Design and Ergonomics – Future electric irons may undergo redesigns focused on ergonomics, aesthetics, and user comfort. Lightweight materials, ergonomic handle shapes, and intuitive control interfaces contribute to a more enjoyable and efficient ironing experience.

Energy Efficiency – Manufacturers may prioritize energy-efficient designs and components to minimize power consumption and environmental impact. This includes optimizing insulation, reducing standby power consumption, and incorporating energy-saving modes without compromising performance.

Durability and Longevity – Improvements in materials engineering and manufacturing processes can enhance the durability and longevity of electric irons. High-quality components, reinforced soleplates, and robust construction contribute to a reliable and long-lasting appliance.

Integration with Fabric Care Technologies – Collaboration with fabric care innovations, such as stain-resistant fabrics or wrinkle-resistant treatments, can complement the performance of electric irons. Coordinated advancements across the textile and appliance industries offer synergistic benefits for consumers.

Customized Ironing Programs – Advanced models may offer customized ironing programs tailored to specific garment types or user preferences. Pre-programmed settings for different fabrics, garment sizes, and ironing techniques simplify the ironing process and ensure consistent results.

Environmental Sustainability – Manufacturers may adopt sustainable practices throughout the product lifecycle, from sourcing eco-friendly materials to implementing responsible disposal and recycling initiatives. This commitment to sustainability aligns with consumer preferences for environmentally conscious products.

Summary

- The chapter give emphasis on the skills necessary for troubleshooting and repairing electric irons.
- It outlines the common issues encountered such as inadequate heating and clothes sticking, offering solutions and necessary tools for repairs.
- The repair process involves disassembly, identification of faulty components, and testing for functionality.
- Significantly, the chapter underscores the importance of accurate diagnosis and careful repair to prevent resource wastage and ensure effective maintenance.

Check Your Progress

A. Multiple Choice Questions

1. What is crucial for a field technician in repairing appliances? (a) Physical strength (b) Knowledge of all appliances (c) Artistic skills (d) Speed of work
2. What can be a consequence of incorrectly identifying a fault in home appliances? (a) Time and money wastage (b) Increased efficiency (c) Improved performance (d) Enhanced durability
3. What tool is NOT mentioned as required for repairing an electric iron? (a) Screwdriver (b) Pliers (c) Hammer (d) Soldering iron
4. What is a possible solution for an electric iron not heating enough? (a) Clean the soleplate (b) Check power cord and switch (c) Increase thermostat setting (d) Use a different power outlet
5. How can a burnt soleplate causing the iron to stick to clothes be addressed? (a) Replace the iron (b) Clean the soleplate with water (c) Apply a paste of water and baking soda (d) Increase thermostat setting
6. When is a faulty module sent to the service centre during the repair process? (a) Always (b) If the technician cannot repair it (c) As a first step (d) At the end of the process
7. What is the purpose of testing the repaired module with a multi meter and ammeter? (a) To confirm functionality (b) To disassemble the module (c) To clean the module (d) To replace faulty components
8. In the troubleshooting process, what should be done if the iron produces excessive heat beyond the set point? (a) Clean the steam vents (b) Check for a short circuit in the thermostat (c) Replace the power cord (d) Apply an emery sheet to the heating element
9. What should be done if the iron heats but steams improperly? (a) a. Replace the heating element (b) Inspect the soleplate (c) Clean the nozzle (d) Adjust the thermostat setting
10. Which tool is recommended for opening latches during the repair of an electric iron? (a) Pliers (b) Wide knife (c) Screwdriver (d) Sandpaper

B. Fill in the blanks

1. During troubleshooting and repairing of an appliance, a technician should carry out repairs according to the _____ of that particular appliance.
2. For an iron not producing adequate heat, a common issue could be voltage ____.
3. In case of an iron leaking or spitting, the problem might be due to dirty steam vents, nozzle, and tank. The solution is to thoroughly clean the steam vents, nozzle, and _.
4. When disassembling an electric iron for repair work, the central pad is removed by hooking it with a _____.
5. The field technician should check the repaired module using testing equipment such as a multi meter and ammeter to ensure its proper functionality with the other _____ of the appliance.
6. In case of an electric iron not spraying properly, the issue might be a dirty _____.
7. To avoid electric shock when ironing, it is crucial to connect the supply wire without touching the _____ of the iron.

8. When encountering a burnt or dirty soleplate causing the iron to heat but steam improperly, it is recommended to inspect the soleplate and clean the vents and flush sediment out of the _____.
9. If the technician cannot repair the components on-site or if they cannot be replaced at the customer's location, faulty module/component is sent to the ____.
10. When the heat produced by the iron exceeds the set point, a potential reason is a short circuit in the thermostat. Short circuit in the thermostat should be _____.

C. State whether the following statements are True or False

1. A field technician should repair appliances without considering the specific requirements of each appliance.
2. Incorrect identification of faults in home appliances may result in a waste of time and money, as well as potential damage to the equipment.
3. In troubleshooting an electric iron, if the heat produced exceeds the set point, it may be due to a short circuit in the thermostat, which needs correction.
4. The soleplate of an iron can get dirty over time, affecting its heating and overall performance. Cleaning the soleplate is a recommended solution.
5. If an iron is not spraying properly, the issue could be related to a burnt or dirty soleplate.
6. To avoid electric shock during ironing, it is essential to connect the supply wire without any concern for the metal part of the iron.
7. The tools required for repairing an electric iron include a stylus, fine-grain sandpaper, and pliers.
8. If a technician cannot repair components on-site, the faulty module is sent to the service center, and a functional module is collected for replacement at the customer's site.
9. The performance check of a repaired module involves using testing equipment such as a multi meter and ammeter to ensure proper functionality with other parts of the appliance.
10. The disassembly steps of an electric iron involve removing the temperature control knob before unscrewing the two mounting bolts of the back cover.

D. Answer the following questions in short

1. Explain the importance of a field technician correctly identifying faults in home appliances.
2. What are the common problems associated with the working of an electric iron, and provide solutions for one of them.
3. List three tools required for repairing an electric iron and briefly describe the purpose of each.
4. How can a technician address the issue of an iron not heating enough, and what steps are recommended for resolving it?
5. Describe a solution for the problem of an iron sticking to clothes during ironing.
6. What is the process for replacing a faulty module if it cannot be repaired on-site, according to the provided information?
7. Briefly explain the steps involved in disassembling an electric iron for repair work.
8. Why is it important to perform a performance check of a repaired module, and what testing equipment is used for this purpose?
9. Describe the process of cleaning a dirty soleplate on an electric iron.
10. Explain the role of a multi meter (tester) in troubleshooting and repairing an electric iron.

Module 2 Installation, Repair and Maintenance of Electric Fan

Module Overview

Installation of fans refers to the process of setting up fan in operational condition. Proper installation ensures the fan works efficiently and safely. Repairing of fans covers the fixing of operational problem. This could involve identifying problems, like strange noises or the fan not spinning, and figuring out how to solve these issues. Repairing fans helps make them work like they should.

Maintenance of fans involves taking care of them to keep them in good condition. This includes regular cleaning, checking for any issues, and making sure all the parts are working well. Maintenance helps to prevent problems and makes sure the fan lasts a long time.

This Module covers the installation and operation of fan, common problems that can in fan when it is not working, fault finding and fixing of the faults in fan, repair and replacement of dysfunctional part of the fan.

Learning Outcomes

After completing this module, you will be able to:

- Demonstrate the proper installation process of an electric fan, including wiring, mounting, and safety considerations for efficient operation.
- Diagnose common issues in electric fans and apply effective troubleshooting and repair techniques to ensure optimal performance.

Module Structure

Session 1. Installation of Electric Fan

Session 2. Troubleshooting and Repairing of Dysfunctional Electric Fan

Session 1. Installation of Electric Fan

Every one of us are familiar with the fan that we are using at our home for air circulation. When an electric fan rotates, the surrounding air is blown away and towards the room's corners, hastening the process of evaporation and causing the room and human body to cool. One of the simplest ways to cool down our rooms is using a Ceiling Fan. They are easy to install, use and are also light on the wallet with the benefit of moving a lot of air with very little power consumption.

1.1 Introduction

We observe that electric fan is being used in lot of places including in our home, offices, industries, factories, cars, computers, trains, etc. to circulate air and cool down the

room (or an area/surface). Depending on the type of power supply, there are three types of electric fans:

AC Fans – These fans run on AC mains power supply. The majority of electric fans fall under this category (including the main product of this article, the Ceiling Fan).

DC Fans – These fans run on DC supply, either a regulated DC Power Supply or a battery. We use DC Fans in computers and portable fans. They are rarely used as mainstream fans nowadays as AC power supply is available everywhere and AC fans are easy to make and use.

AC / DC Fans – Finally, we have the AC / DC Fans, which can run on both AC as well as DC power supplies. Hence, these fans are sometimes are known as Universal Fans.

1.2 Air circulation through Fan

The mechanism behind the ceiling fan is quite simple. It is a known fact that air naturally stratifies, with warmer, lighter air rising to the top and heavier, cooler air falling. The ceiling fan is designed with its rotation mechanism to draw warm air upward. The blades of fan cut through the rising hot air, forcing it downward. The air in the room circulates throughout because this is a continuous process. A ceiling fan thus does nothing more than circulating the air as shown in Figure 1.1.

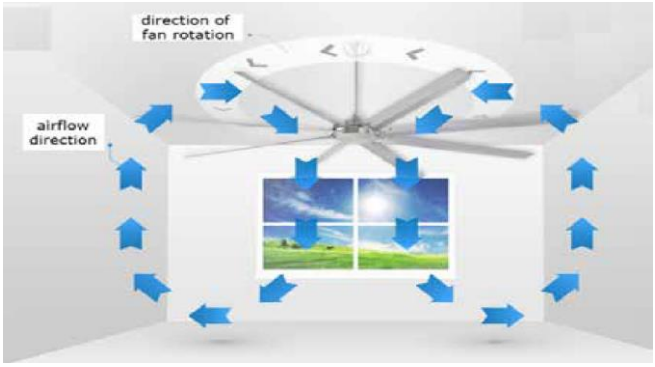


Fig. 1.1: Ceiling fan working mechanism

1.3 Types of fan

Let us now see the different styles of electric fans that are commonly used in our daily lives.

1.1.1 Ceiling Fan

A ceiling fans come in varieties of styles, shapes, and colours to best match the decor of your room. They are great for air circulation around the entire room. The fan size should be appropriate to the room size as shown in Figure 1.2.

Fig. 1.2: Ceiling fan

1.1.2 Table Fans

Another popular type is the table fan. It can be placed on a table or the floor, or just about on anything with a firm base. Table fans are small and compact and are perfect

for cooling small spaces. They are mobile and can be placed on desks, countertops, and other sturdy platforms as shown in Figure 1.3.

Fig. 1.3: Table fan

1.1.3 Tower Fans

Tower fans are slim and vertical. They come in compact and sleek designs that hardly occupying any floor space. Their design makes them a perfect fan for small and cramped spaces. These fans are powerful and quiet. These types of fans mostly include added features like built-in ionisers that purify the air. They have to be placed on the floor and can be moved as needed as shown in Figure 1.4.

Fig. 1.4: Tower fan

1.1.4 Wall Mounted Fans

Wall mount fans are ideal for places with a limited area/floor space. Besides producing a powerful airflow, these fans are space savers. These fans are suitably designed for small offices, huge party halls, warehouses, auditoriums and sometimes even small home kitchens. A typical wall mounted fan is shown in Figure 1.5.

Fig. 1.5: Wall mounted fan

1.1.5 Pedestal Fans

Pedestal fans or *'Stand Fans'*, are tall and their height is adjustable. They come with oscillation feature for maximum air distribution. Pedestal fans are ideal for living rooms

and bedrooms (high performance models that are not noisy). These fans are also great for outdoor events or large non-air-conditioned halls as they offer powerful cooling. Very versatile, they can be easily carried and placed anywhere as shown in Figure 1.6.

Fig. 1.6: Pedestal fan

1.1.6 Exhaust Fans

Exhaust fans suck in the stale air and blow out fresh air. These fans are best for humid rooms, where leaving a window open doesn't suffice as shown in Figure 1.7.

Fig. 1.7: Exhaust fan

1.1.7 Misting Fans

Misting fans, as the name suggests, release a cool misty air which evaporates and creates a chilling breeze. They use evaporative cooling technology. They have high-pressure pumps that push water through tiny nozzle openings releasing micron-sized droplets. The fan blows these droplets into a wide area, producing an entire zone of cooled down air. These are becoming increasingly popular in outdoor areas like pools, backyards, and gardens as shown in Figure 1.8.

Fig. 1.8: Misting fan

1.4 Parts of a Ceiling Fan

Ceiling fans is used in our living rooms, bedrooms, kitchens, by hanging them from the ceiling. They are usually specified by the size of the blade span such as 36" (900mm),

48" (1200mm), and 52" (1300mm) being the popular options. Figure 1.9 shows the different mechanical parts of a typical ceiling fan.

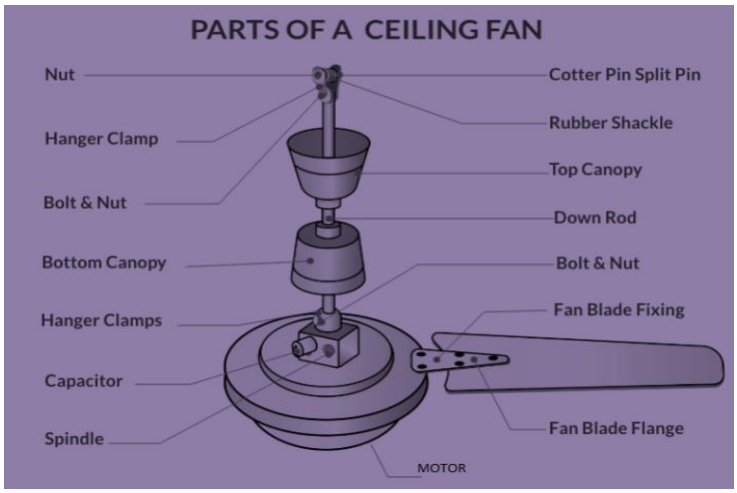


Fig. 1.9: Parts of Ceiling Fan

Working of different parts of a fan is as follows:

1.4.1 Electric Motor and Motor Housing

The electric motor, which powers the fan, transforms electrical energy into mechanical energy. A magnetic field is created inside the electric motor's coil as a result of the electrical current flowing through it. The coil rotates as a result of this. The ceiling fan blades then begin to rotate as a result of this rotational energy.

Parts of motor

a) Rotor – Rotor is the rotating part of motor.

b) Bearing – It is the supporting part of the rotating shaft of the rotor in motor.

c) Stator – It is that part of motor which generates force used to rotate the rotor.

d) Bracket or end plate – It bearing supporting part integral for the stator.

e) Lead wire – It is the wire which is connected to the drive circuit which supplying power to the motor or wire connected to the power supply.

An iron-based motor cover is referred to as a motor housing. By hiding the internal operation motor, it gives the fan a sleek look and shields the motor from dust and dirt as shown in Figure 1.10.

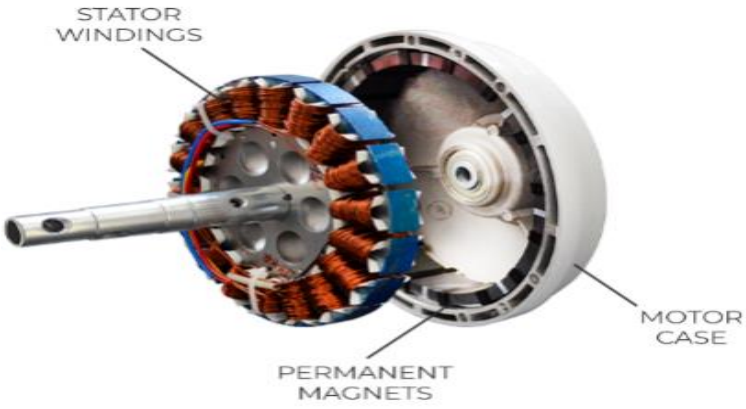


Fig. 1.10: Electric Motor and Motor Housing

1.4.2 Capacitor

Electric fans use start capacitors because, as we all know, they store energy that is used to rotate the fan from a stationary position. This capacitor enables the electric fan motor to spin faster and with greater torque. This capacitor is kept in the circuit until the electric fan only reaches a predetermined speed, which is typically 75% of the fan's maximum speed. Once the fan reaches the predetermined speed, the capacitor is removed from the circuit and is re-incorporated when the fan returns to its resting position as shown in Figure 1.11.

Fig. 1.11: Capacitor

1.4.3 Blade Bracket

A fan blade bracket refers to the blade hinges that attach the fan blades to the centre of the fan. This fan blade bracket is fastened to the fan blades using bolts or rivets as shown in Figure 1.12.

Fig. 1.12: Blade Bracket

1.4.4 Blades

The blades of the fan are one of its most crucial components since they not only look good but also move air around the space. Several materials, including plastic, aluminium, steel, and possibly even wood, are used to make these blades as shown in Figure 1.13.

Fig. 1.13: Blade

A fan with four fan blades will circulate air more effectively than one with three. One thing about ceiling fans in the winter is that the blades need to be turned clockwise in order to pull cool air upward and leave the room warmer. In order to create a cooling

atmosphere in the room during the summer, it is crucial to set the fan to rotate counter clockwise.

1.4.5 Axle/Shaft

Axle or Shaft is the metallic rod mostly made up of mild steel. Axle is connected to fan housing. It stays at rest motion while bearings supporting the housing over it rotates. It also has arrangement for transfer of current to the stator windings.

1.4.6 Bearings

Fans use ball bearings to ensure noiseless, friction-free movements of rotating components. These are made of high-quality steel and are well-greased for improved fan efficiency and quiet operation. Two bearings which are link between housing and axle gives the rotary motion to the housing.

1.4.7 Mounting

In the case of a ceiling fan, mounting simply refers to the fixture that is used to fasten the components of fan to the ceiling. The market offers variety of mounting mechanisms. The J-hook with a shackle clamp and the ball and socket are the most widely used types. While the J-hook and shackle clamp sections fasten straight to the ceiling, the ball and socket are utilized in conjunction with a fan mounting bracket that fits the bottom of the down rod. The fan may fall if the mounting is not installed on the ceiling correctly.

1.4.8 Down Rod

The down rod, sometimes referred to as the suspension rod, is a stiff, galvanized pipe that hangs the fan from the ceiling of the house. The style and kind of ceiling fan determines the down rod's diameter and length. The ceiling height decreases with increasing down rod length for ceiling fans and vice versa. The down rod has two ends: one fastened to the mounting mechanism and the other to the motor housing as shown in Figure 1.14.

Fig. 1.14: Down Rod

1.4.9 Top and Bottom Canopies

There are two canopies located along the suspension rod—top and bottom in case of ceiling fan. The top canopy is mounted in such a way that it covers the bolt, hook, and nut. The bottom canopy, on the other hand, is located under and in the centre of the ceiling fan motor. This canopy is mounted to protect multiple components, such as switches, wires, and capacitors. It is shown in Figure 1.15.

Fig. 1.15: Top and Bottom Canopies

1.5 Parts of a Table Fan

Table fans are compact, portable cooling devices commonly used to provide localized airflow in homes and offices. They typically feature adjustable fan speeds and oscillation functions, making them versatile and adaptable to various cooling needs. With their convenient size and ease of use, table fans offer a practical and efficient solution for maintaining comfort in smaller spaces or specific areas.

Some common parts of a table fan are shown in the Figure 1.16 and described below.

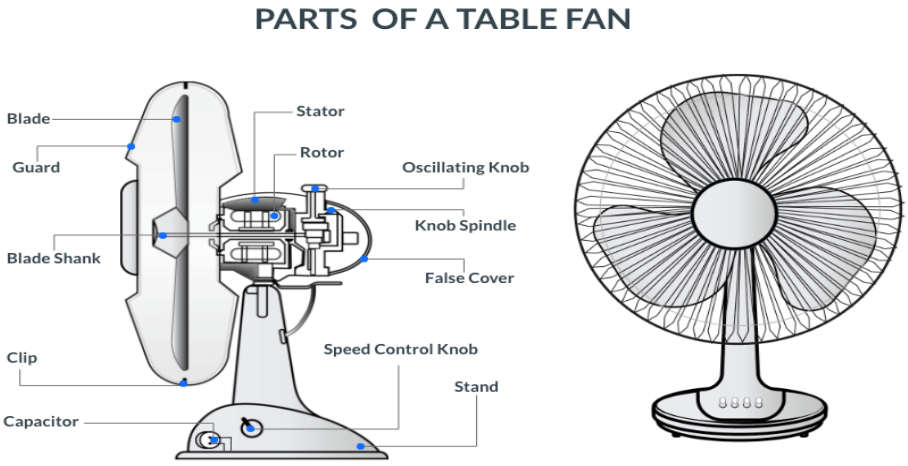


Fig. 1.16: Parts of a Table Fan

The functions of some important parts of a table fan are given as follows:

Capacitor – An electric fan's capacitor is likely divided into several phases to create the magnetic flux. This makes the fan spin towards the produced magnetic field.

Stator – The stator part gives off a magnetic field. This power the electric fan's spinning armature, which is coil-shaped and electrically induced. The armature is responsible for sending electronic conduction throughout the field to power the fan's torque.

Oscillating Knob – One of the most integral features of an electric fan is its movement. The oscillator knob, as its name suggests, aids in the fan's oscillating movements. It's located behind the fan's head. It helps a fan to rotate back and forth to get more coverage.

Fan Blades – Fan blades can come in a variety of numbers such as three, four, or more. Blades can be composed of plastic or aluminium. They are mounted to the electric fan's spindle. Their speed can reach up to 400 revolutions per minute (RPM).

Fan Motor – Consider this part the beating heart of any electric fan. It dispenses the input energy and controls its output. The motor is a larger part of the fan and contains several parts, including the electric wiring, stator, and rotors.

1.5.1 Comparison of Ceiling fan and Table fan

Table 1.1: Comparison of Ceiling fan and Table fan

Parameter	***Ceiling Fan***	***Table Fan***
Usability	Ceiling fan is for bigger heights i.e. greater than 8 feet.	Table fan is for short heights.
Airflow	The ceiling fan circulates air downwards through the space.	Table fan circulates air in an outward direction.
Armature and Motor	In ceiling fan armature is stationery and motor are in motion.	In table fan motor is in stationery and armature is in motion.
Versatility	Ceiling fans once fixed cannot be easily moved from one room to another.	Table fans are compact and portable, making them easy to move from one room to another.
Oscillation Mechanism	Ceiling fan is fixed	Another incredible feature of a table fan is its oscillation mechanism, which is modified to rotate the fan's head 360° and can easily circulate air in all directions.
Energy consumption	Ceiling fans consume more electricity in comparison to Table fans. A ceiling fan can consume 70-90 watts or more, depending on its size and speed settings. This means that a ceiling fan may consume more electricity resulting in higher energy bills	Table fans consume less electricity in comparison to ceiling fans. A table fan may consume anywhere between 30-60 watts of power, while a ceiling fan can consume 70-90 watts or more, depending on its size and speed settings.
Size	Ceiling fans are large appliances.	Table fans are compact appliances
Weight and height	Ceiling fans are heavy weight and don't have the feature of adjustable height	table fans are lightweight and come with an adjustable height.
Different Functions and Features	A ceiling fan, on the other hand, has limited functions since the height or oscillation cannot be adjusted.	Table fans generally come with multifunctional options and offer multiple features such as adjustable height, 360° oscillation, and multiple speeds.
Installation	Ceiling fans require professional help for installation.	Table fan requires no installation. Simply place the table fan in the area where airflow is required and plug it in.
Coverage	Ceiling fans are designed to cover a larger area and provide higher air delivery. It cools the entire room.	Table fans are designed for personalized cooling comfort. Thus, it cools a particular area.

Efficiency	Efficiency of ceiling fan is greater.	Efficiency of table fan is lower.

Activity 1

Practical Activity 1.1 Identify and name the parts ceiling fan and give their functions.

Name the parts and functions of a ceiling fan given below:

Picture of part	*Name of part*	*Functions of part*
		
		
		
		
		

1.6 Switches and controller in Fan

A Fan Regulator, as the name suggests, regulates or controls the speed of the fan motor. Before dealing with the fan regulator, a brief discussion about the fan motor is necessary, as the main purpose of the regulator is to control the speed of the fan motor.

1.6.1 Resistive Regulator – Resistive type of regulator is commonly seen in our homes. In which many contact points to control the speed of fans. Resistive type regulators are large in size shown if Figure 1.17. They consume more power.

Fig. 1.17: Resistive Regulator

1.6.2 Phase Angle-controlled Regulator – These are also known as dimmer switches made up with semiconductor devices as shown in Figure 1.18. These are used to adjust the voltage across the fan.

Fig. 1.18: Phase Angle-controlled Regulator

1.6.3 Inductive Regulator – In this type of regulator there are various points to reach particular speed regulation as shown in Figure 1.19. They are costly and heavy in size.

Fig. 1.19: Inductive Regulator

1.6.4 Capacitive Regulator – In this type of regulator capacitor is used to regulate the voltage of fan as shown in Figure 1.20. These regulators are energy efficient and reliable. These are of two types:

1. Movable type
2. Step type

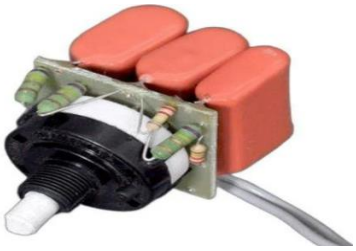
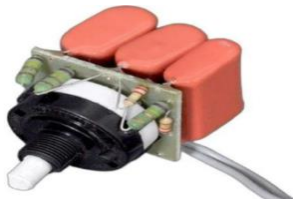


Fig. 1.20: Capacitive Regulator

Activity 2

Practical Activity 1.2 Identify and name of Electric Fan controller shown in the following figures.



1.7 Insulation used in Fan

The insulation is used for fan to prevent the materials and design used in electrical components which are coming in contact with external surfaces of fan, providing safety and proper functioning. Insulation is must in electrical devices to secure electrical shocks and short circuits. There are some points of insulation in a fan given below:

1.7.1 Motor Insulation – The motor is a major component in the fan and windings of fan are insulated to prevent direct contact with the fan's casing and other conductive materials over there. Common materials for insulation in motor windings are varnish, epoxy, copper or aluminum windings.

1.7.2 Wiring Insulation – The wires used to connect the motor with power source are insulated with materials such as Polyvinyl Chloride (PVC) or Teflon to prevent electrical leakage or short circuits as shown in Figure 1.21.

Fig. 1.21: Insulation Used in Fan

Insulation material used in Fan – Insulation provides thermal and sound protection in fan. There are three types of insulation material used in fan:

1. Fiber Glass
2. Rigid foam boards
3. Aluminum Foil

1.8 Working of Fan

Ceiling fan connected to power supply through a switch and regulator. Usually, phase is rotated through switch and regulator and neutral is directly connected at ceiling fan.

Fan regulator is used to control the speed of fan. The connection of ceiling fan with power supply is shown in Figure 1.22.

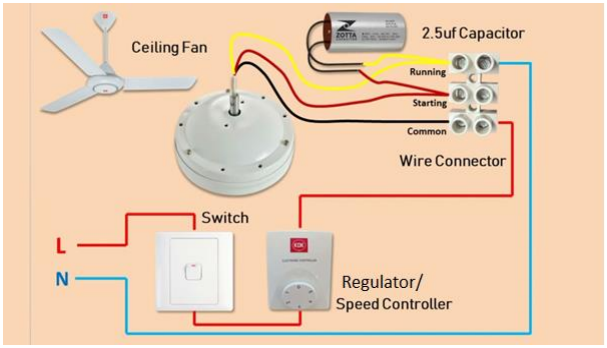


Fig. 1.22: Circuit diagram of fan

The ceiling fan is connected to the power source via a regulator and switch. Phase is typically turned via a switch and regulator, while neutral is connected directly to the ceiling fan. A fan regulator is used to regulate the fan's speed. Electrical energy is transformed into mechanical energy by its motor. The electric motor can start and run because the ceiling fan capacitor increases its torque. After passing through the motor, an electrical current enters wire coils that are encircling a metal base. A magnetic field is created as the current flows through the wire, exerting force in a clockwise direction that essentially transforms the electric energy into mechanical energy. The motor coils spin as a result of this action.

The fan transfers the spinning motion of the coils to the fan blades by capturing the spinning motion. The breeze produced by the ceiling fan is caused by the air being sliced by the fan blades, which forces the air downward. The air in the room is circulated throughout this entire process as new air enters to replace the air that has been forced down from the ceiling. The reason ceiling fans are so successful is that hot air rises. The heat in the room increases as the heated air reaches the ceiling. This hot air is forced from the top of the room by a ceiling fan, which creates space for more hot air to rise.

1.8.1 Working of a Fan Capacitor

Let's examine how a capacitor functions in an electric fan. A ceiling fan rotates when it turned on because electricity flows through the circuit. It is required to control the fan's energy output if it has to run at various speeds. This is the application of a capacitor. The motor's rotational speed can be adjusted by adjusting the amount of energy entering the motor through the use of a capacitor. There are typically two windings in a ceiling fan – a running winding and a starting winding. A capacitor needs to be connected across the power supply and then in series with the starting winding. An alternative is to connect the power supply straight to the running winding. The connection of capacitor is shown in Figure 1.23.

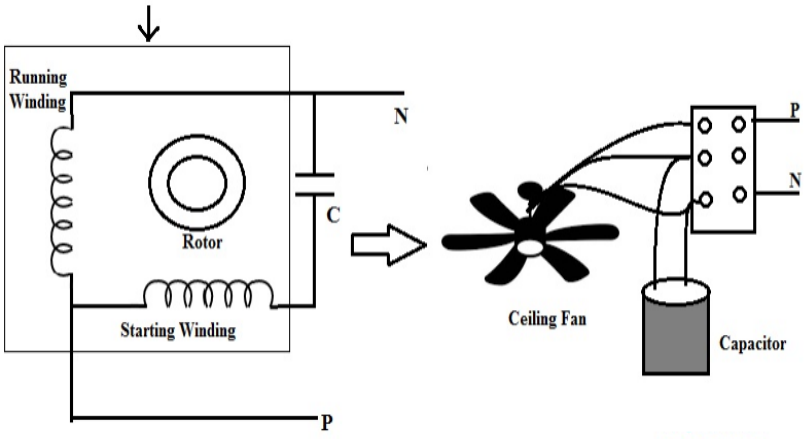


Fig. 1.23: Capacitor connection with fan

When the fan is turned on, the capacitor begins to charge gradually. It then stores energy, which it releases in the form of an electric arc to give the fan a boost at start up by increasing the current flowing through the motor's windings. The motor rotates as a result of the high torque this produces. The motor's speed increases as its rotation increases. These ceiling fan capacitors are non-polarized because they lack a polarity. The external metal layer of the fan is where this capacitor can be connected. While the fan rotation will still be in the same direction, the phase will change from being positive in the first positive half cycle of supply to being positive in the second negative half cycle.

1.9 Energy rating and power consumption of various fans

Energy rating and power consumption are crucial considerations when evaluating the efficiency and cost-effectiveness of various fans. Here's an overview of this:

1.9.1 Energy Rating

Star Ratings – Fans are often assigned star ratings based on their energy efficiency. Higher star ratings indicate greater energy efficiency. In India star rating system is used from 1 Star to 5 Star. Higher rating indicates higher energy efficiency so it is advisable to use fans with a higher number of stars to reduce long-term energy costs. It is shown in table 1.1.

Table 1.2: Power consumption in Watts as per star rating

Watts	***Star rating***
55	1 Star
48	2 Star
44	3 Star
40	4 Star
36	5 Star

BEE Certification – Fans that comply with the Bureau of Energy Efficiency (BEE) standards are more likely to be energy-efficient. BEE-certified fans undergo testing to ensure they meet specified energy consumption criteria.

Speed Settings – Fans with multiple speed settings allow users to adjust the airflow according to their needs. Using a lower speed when high-speed airflow is unnecessary can contribute to energy savings.

BLDC Technology – Fans equipped with Brushless Direct Current (BLDC) motors are known for their energy efficiency. BLDC technology reduces energy loss, making these fans more power-efficient compared to traditional fans.

1.9.2 Power Consumption – Power consumption is measured in watts. Fans with lower wattage generally consume less electricity. Consider fans that provide adequate airflow while keeping wattage in check to optimize energy efficiency.

Power consumption depends of size, motor and types of fans. It varies according to types of fans. Lowest power consumption rating is 6.9 watts and highest power consumption rating is 65 watts.

When comparing different fans for energy rating and power consumption, it is necessary to consider the specific needs of the intended space, the fan's features, and its compliance with energy efficiency standards. Making an informed choice can lead to significant energy savings over time as shown in table 1.2.

Table 1.3: Power consumption in Watts in different types of fans

Types of Fans	***Average watts (min)***	***Average watts (max)***
Table Fan	17 W	42.5 W
Ceiling Fan	1.6 W	31.1 W
Bladeless Fans	56 W	65 W
Exhaust Fans	40 W	40 W
Tower Fans	44 W	56.5 W
All	6.9 W	39.3 W

1.10 Safety and Precautions for the Installation of a Fan

Safety

Do not stop Fan blades with hands – Stopping blades with hands will harm us and bends the blades which causes wobbly fan.

Make proper distance from the ground – Always maintain a minimum 7-foot height from ground in case of ceiling fan installation. Ceiling fan distance from wall should be 18inch always to avoid heating.

Ensure fan is installed professionally – Installation and maintenance of fan by our own is dangerous for us and our family. Always contact with professional electrician for installation of fan.

Precautions

- Never work on live electrical circuits.
- Always use phase tester to ensure the power is off before installation of fan
- Ensure that Fan is properly balanced to avoid wobbling.
- Use ladder or flat surface to install the fan safely.
- Use proper tools while installing fan.

General Instructions

Read the Manual – Before installation, thoroughly read the manufacturer's manual that accompanies the fan. It provides specific instructions and safety guidelines for your particular fan model.

Turn Off Power – Prior to installation, turn off the power to the electrical circuit where the fan will be installed. This ensures safety during the installation process.

Check for Damages – Inspect the fan and its components for any damages or defects before installation. Do not proceed if you find any issues, and contact the manufacturer for assistance.

Use Suitable Tools – Use appropriate tools for installation, as recommended in the manual. Avoid makeshift tools or tools not designed for the purpose, as they may compromise safety.

Secure Mounting Surface – Ensure that the mounting surface (ceiling or wall) is secure and can support the weight of the fan. Use appropriate mounting hardware, and if in doubt, consult a professional.

Correct Wiring – Follow the wiring instructions in the manual carefully. Ensure that the electrical connections are made securely and in accordance with local electrical codes. If unsure, seek the assistance of a qualified electrician.

Grounding – Properly ground the fan to prevent electrical shocks. Follow the grounding instructions in the manual and make sure the electrical system in your home is properly grounded.

Ceiling Height Consideration – Install the fan at a suitable height from the floor, ensuring that there is enough clearance for the blades. This prevents accidents and ensures optimal performance.

Securely Attach Blades – If the fan requires blade assembly, make sure each blade is securely attached as per the manufacturer's instructions. Loose blades can cause imbalance and pose a safety risk.

Balancing – Check and balance the fan after installation to minimize vibrations and wobbling. Most fans come with a balancing kit for this purpose.

Test Before Use – After installation, test the fan on all speed settings to ensure it operates smoothly. Address any unusual noises or vibrations promptly.

Regular Maintenance – Periodically inspect and clean the fan to prevent dust accumulation, which can affect performance and safety.

By adhering to these safety precautions, a secure and efficient installation of the fan in your living space can be ensured.

1.11 Installation of a Fan

To fix various accessories and parts of ceiling fan to make it in a working condition is called as installation. Before installing new fan check existing fan and remove it from the place carefully. For new installation of a ceiling fan in an existing ceiling box follow the given steps:

Read the Manual – Begin by reading the manufacturer's manual for specific instructions and safety guidelines related to your fan model.

Turn-Off Power – Turn off the power to the electrical circuit where the fan will be installed to ensure safety during the installation process.

Inspect the Fan – Check the fan and its components for any damages or defects before proceeding with the installation. Do not proceed if there are issues; contact the manufacturer for assistance.

Select a Suitable Location – Choose a location on the ceiling or wall that can support the weight of the fan. Ensure there is adequate clearance for the blades.

Secure Mounting Surface – Securely mount the fan bracket or hanger to the ceiling or wall using appropriate hardware. Ensure it is firmly anchored and compatible with the fan model.

Install a ceiling fan mounting bar – If the ceiling box is connected at its centre to a bar hanger attached to two joints, then continue to next step.

Assemble the Fan – Assemble the fan according to the instructions in the manual.

Insert the down rod of fan through the canopy. Thread the motor's wires though the down rod and canopy. Screw the down rod onto the motor as illustrated in Table 1.1.

Table 1.4 Assembling of ceiling fan for installation

Insert the down rod of fan through the canopy. Thread the motor's wires though the down rod and canopy. Screw the down rod onto the motor.	
Screw the ceiling plate to the electrical box, first threading the wires from the box through the plate. Suspend the fan from the ceiling box's support.	
Remove the fan from the hook, put the canopy over the ceiling plate, and screw the canopy into place. Affix the fan blades.	

Wiring – Wire the fan according to the manufacturer's directions. Connect the wires from the fan to the corresponding wires in the electrical box, adhering to local electrical codes. Finish by wiring the light fixture of fan, according to manufacturer directions, and screw the fixture into place.

Grounding – Ensure proper grounding by connecting the green or bare wire from the fan to the grounding conductor in the electrical box. This helps prevent electrical shocks.

Secure the Blades – Attach the blades, ensuring they are securely fixed, balanced and securely attached to the motor. Loose blades can cause imbalance and affect performance.

Test the Fan – Turn ON the power and test the fan on all speed settings. Verify that the fan operates smoothly and without unusual noises or vibrations.

Balancing – If provided, use a balancing kit to minimize vibrations and wobbling. Adjust as needed to achieve optimal balance.

Secure the Fan to the Mounting Bracket – Secure the fan to the mounting bracket using the provided screws. Ensure that the fan is firmly attached to the ceiling or wall.

Final Checks – Conduct a final visual inspection to confirm that all components are secure and that the fan is installed correctly.

1.12 Concept of Earthing in a fan

Earthing is a process of sending leakage current to earth with the help of conducting wire that has low resistance. It includes two types of earthing as : *Neutral Earthing, Equipment Earthing.*

Earthing is important in electric appliances because of metallic body. In fan earthing metal part of the fan is connected to the earth wire to prevent shock while faults occur. Many fans include two connection points i.e. phase and neutral but in damp location earthing connection is required due to fans metallic body. In case of ceiling fan, we will find small screw on the shackle side plate having earth logo near it, with the help of earth wire complete the connection shown in Figure 1.24.

Fig. 1.24: Earthling Plate in fan

Earthing in an electric fan

Fans have metal parts i.e. fan blades, housing, and motor housing. A conductor green or green/yellow wire is connected to the metal parts of the fan. This wire is the grounding or earthing conductor. The electric fan's power plug typically includes three pins – live (L), neutral (N), and earth (E). The earth pin is longer and designed to connect to the grounding system in the electrical outlet.

When the fan is plugged into a properly wired electrical outlet, the earth pin of the plug connects to the grounding system of the building's electrical wiring. when fault occur the metal components of fan become live, the grounding path provided by the earthing conductor directs the electric current safely into the ground. This helps prevent the fan's metal parts from reaching a dangerous voltage level that could pose a risk to users.

1.13 Operational guide lines

For smooth operation of fan following guideline should be followed:

Installation – Ensure stability, performance and installation as per manufacturer guide.

Maintenance– Clean fan blades or dust that provide reduction in efficiency or motor strain.

Safety – Position fan securely away from children's, avoid tipping over.

Power source – Use power source as specified by company or in user manual.

Environment – Avoid moisture or extreme temperature and allow proper vantilaton for fan.

Speed – To optimize the use of energy, select the fan speed according to need.

1.14 Maintenance of Motor

Check motor shaft wear and bearing wear, and replace them if required. Clean motor periodically to remove excess dust from the cover and slits on top of the motor cover. Lubricating the ceiling fan bearings is important for maintenance, and it is best to refer to the owner's manual to determine the type of lubrication required. An adequate cooling system is necessary to keep the machine and related insulating products within certain temperatures, and to prevent overheating and failures.

Frequent checks

Remove dust or oil from motor if any.

- Check oil rings turn with shaft.
- Check oil level in bearings.
- Visually check for oil and grease from bearings.
- Check the starter switch, fuses and tighten loose connections.

Every 6 months

Clean motor, blowing out dirt from windings, and wipe commutator and brushes.

- Visually inspect the commutator clamping ring.
- Replace brushes if damaged.
- Clean the brush holders if dirty.
- Check brush pressure and position.
- Replace oil, clean, Remove sleeve bearings.
- Check grease in ball or roller bearings.
- Check operating speed or speeds.
- Technician to examine and tighten loose connections.
- Check motor foot bolts.

Annually

Remove grease in ball or roller bearing.

- Test insulation.
- Clean magnetic dirt.
- Check shaft and journal boxes of sleeve bearing motors.
- Check slot damage
- Check commutator for smoothness.
- Check connections between commutator and armature coils.
- Inspect armature bands.

1.15 Preventive maintenance

Preventive Maintenance checks

Visual Inspection – Look at the motor and observe its physical condition. If motor is used in rugged environment, then corrosion and dirt can be seen on each component of electric motor. Check motor winding to detect overheating or burnt odor. Also Observe relay and contacts are not having dust and rust on it as shown in Figure 1.25.

Fig. 1.25: Visual Inspection of fan

Brush and commutator Inspection – Check the sign of wear and tear in motor. Wear can cause commutation problem so there is a need to change the brush for batter performance. Also check the motor mount, rotor, stator, belts and replace if necessary.

Motor winding – If there is any burn, marks, smell of burning or cracks then do motor winding test. This test helps to identify failure in winding. For testing disassemble the motor and check the abnormalities of motor.

Check the Bearings – Noise and vibration in fan occur due to poor lubrication, dirt builds up and wear and tear. Bearing house get hot due to overheating due to insufficient grease.

Perform Vibrations Test – Vibration reduces the life span of motor, which leads to motor bearing or failure in winding in many cases vibration is due to improper balance, faulty sleeve or ball bearing.

Activity 3

Practical Activity 1.1. Demonstrate to check the motor of fan.

Tools Required

Plier, Screwdriver kit, Electrician's tape, Wire cutter and stripper, Fan motor, Hammer, Long nose piler, multi meter

Safety Precautions – Wear Safety Gloves, make sure Electric Fan is disconcerted from the power source, put all the fasteners in box to avoid misplacing them.

Procedure

First Method

Step 1. Set the multi meter switch to the ohms setting and touch the both probes of multi meter on the motor.

Step 2. If infinite readings shown on display of multi meter, it indicates an open circuit and it is a defective motor.

Step 1. If zero readings shown on display of multi meter, it indicates a short circuit and a defective motor.

Step 4. If the reading is between these two values, the motor is functioning properly.

Second Method:

Step 1. Turn off the power of the fan motor at the circuit breaker.
Step 2. Dismantle the fan from the ceiling.
Step 1. Remove the blade of fan from the motor shaft.
Step 4. Open the case of fan motor.
Step 5. Use a multi meter to check the continuity of the windings as shown in Figure 1.26.

Fig. 1.26: Multi meter check

Step 6. Check the resistance it should be less than 1 ohm; it indicates that the windings are not open. If resistance is high then it is an open winding and it is a faulty motor as shown in Figure 1.27.

Fig. 1.27: Checking of motor windings

1.16 Product warranty and after sales support

1.16.1 Product warranty support

Fan warranty depends on manufacture and its specification. For example, many companies offer different warranty plans. The warranty period always starts from the date of purchase. The customer has to fill warranty card provided with the appliance shown in Figure 1.26. The following points are given:

Warranty period of fan Motor – Many of the manufacturers provide up to 10 years warranty on the motor of the fan except for other accessories like transmitter and receiver of the remote control. Manufacturing companies are responsible for providing safe installation and operation of Appliance.

Warranty period of Remote control – The Manufacturer provides two years of replacement and repair warranty period on the transmitter and receiver of the remote control of the fan it is shown in Figure 1.28.

Fig. 1.28: Warranty & after Sale Support

Owners are responsible for any labour cost for repairing and replacing of remote control.

Date of purchase of appliance – Make sure original bill and warranty card of appliance includes date of purchase in case of warranty claim.

Transfer of warranty – Providing the original bill to a new owner in case of reselling it. Damage is not covered. It is nil in case of reselling during the warranty period.

Things that the warranty does not cover – Damage from lightning, incorrect installation, power surges, water damage, alternative power system, accidentally damaged and due to any modification do not cover in warranty.

1.16.2 Product after sale support

After purchasing the fan manufacturers have to provide the services to the customer. It includes the following services:

- The Company has a friendly technical team to provide support to the customers having any issues with the fan.
- Some companies provide warranty and repair services to customers for their fans.
- The Company provides a warranty under damage and return policies. The Company will arrange an engineer to the customer's home to repair the damaged or faulty fan.
- The Customer can contact customer service using phone calls, e-mail and live chats in case of having an issue.

Summary

- The chapter covers the basics and installation procedures of electric fans, with a specific focus on ceiling fans.
- It introduces different types of fans and elaborates on their respective operations.
- Safety measures during installation, including the concept of earthing, are thoroughly explained to ensure a secure installation process.
- The concise overview is designed to equip students with a fundamental understanding of fan mechanisms and installation procedures, serving as a foundational resource in their learning journey.

Check Your Progress

A. Multiple Choice questions

1. What is the main advantage of LED technology? (a) Lower cost (b) Higher energy consumption (c) Longer lifespan and energy efficiency (d) Slower switching speed
2. LEDs work based on which principle (a) Thermoluminescence (b) Electromagnetic induction (c) Electroluminescence (d) Photoelectric effect
3. What are the three types of LEDs? (a) Primary, Secondary, Tertiary (b) Indicator, Illuminator, COB (c) Red, Green, Blue (d) Low Power, Medium Power, High Power
4. What factors can affect the lifespan of LEDs? (a) Temperature, Mechanical forces, Current, Radiation (b) Voltage, Humidity, Chemical influences, Light intensity (c) Colour Rendering Index, Colour Temperature, Power Consumption (d) Heat Sink, Housing Design, PCB
5. What does CRI stand for, and what does it measure? (a) Colour Rendering Index, measures power consumption (b) Constant Resistance Indicator, measures resistance in LEDs (c) Coolness Rating Index, measures temperature (d) Continuous Reflectance Indicator, measures reflectance of LEDs
6. How is the Colour Temperature (CCT) of LED lights described in the chapter? (a) In degrees Fahrenheit (b) In Kelvins (°K) (c) In Lumens (d) In Watts
7. What is the primary function of a heat sink in LED thermal management? (a) Increase LED brightness (b) Decrease LED lifespan (c) Efficiently dissipate heat (d) Change LED colour
8. Which LED configuration offers higher fault tolerance, Series or Parallel? (a) Series (b) Parallel (c) Both have equal fault tolerance (d) Matrix Configuration
9. What is the purpose of a bypass circuit in LED matrix configuration? (a) Increase current flow (b) Short out a failed LED (c) Change LED colour (d) Improve energy efficiency
10. What is the significance of the Colour Rendering Index (CRI) in LED lighting? (a) Measures LED lifespan (b) Indicates LED brightness (c) Assesses how well LEDs render colors (d) Determines LED switching speed

B. Fill in the blanks

1. An LED is a _____ electronic light-emitting component.
2. LED's have high economic benefits due to consumption of less energy, long life and _____.
3. In LED chips, on application of certain voltage, ____ in the form of light is given out.
4. An LED comprises _____layers of semi-conducting material.
5. Photons are released as a result of _____.
6. Depending on the kind of semiconductor material used, the LED emits light in a specific colour like _____.
7. The LED's capacity to render colours accurately will ____ with a higher CRI.
8. LED products with CRI _____are considered best for indoor application.
9. In the case of an LED light, there are primarily three types of white colours: ____.

10. Heat sinks are considered for _____ ensuring efficient thermal management of high-power LED applications.

C. State whether True or False

1. LEDs are a type of incandescent light source, known for their high energy consumption and short lifespan.
2. In the matrix configuration of LED circuits, the LEDs are organized in rows and columns, aiming to eliminate issues associated with parallel connections.
3. LED luminaries with passive thermal solutions, such as heat sinks, are effective in dissipating heat and minimizing the impact of high operating temperatures on LED performance.
4. LEDs used for lighting applications require a constant voltage source, unlike other electronics products that need a constant current source.
5. The Color Rendering Index (CRI) is a crucial metric for assessing light quality, and LEDs with a CRI greater than 80 are considered best for outdoor applications.
6. Chemical influences, such as exposure to a corrosive atmosphere or medium chloride content, can negatively impact the operating life of LEDs.
7. In the series connection of LEDs, if one LED fails, it may lead to the failure of the entire string, but the overall brightness of the string will decrease by only one LED.
8. The matrix configuration of LED circuits provides fault tolerance and efficiency advantages, but current imbalances can be addressed by adding resistors for better current sharing.
9. Correlated color temperature (CCT) is used to describe the warmth or coolness of light, and different CCTs are suitable for various applications, such as warm white for relaxation and cool white for concentration.
10. The advantages of LED technology include low power consumption, long life, and immediate light output when switched on.

D. Answer the following questions in short

1. What is the working principle of LEDs, and role of Electroluminescence?
2. Name three advantages of LED technology over traditional lighting sources.
3. Explain the factors influencing the life of an LED module.
4. Describe the importance of Color Rendering Index (CRI) in assessing light quality. What CRI is considered best for indoor applications?
5. How does Correlated Color Temperature (CCT) define the characteristics of LED light, and what are the typical applications for warm white and cool white LEDs?
6. Differentiate between the series and parallel connection of LEDs in terms of advantages and disadvantages.
7. What are the key components of passive thermal design for LEDs, and how do heat sinks contribute to efficient thermal management?
8. Discuss the advantages and disadvantages of the constant current LED driver in controlling LED color and brightness.
9. Explain the matrix configuration of LED connections and its advantages in fault tolerance.
10. List the types of LED lights with examples for each.

Session 2: Troubleshooting and Repairing of Dysfunctional Electric Fan

Troubleshooting in electrical appliances involves identifying and resolving malfunctions to restore functionality. It begins with recognizing symptoms and visually inspecting the appliance for damage or abnormalities. Electrical components are tested using tools like multi meters to pinpoint faults, which are then isolated and repaired or replaced as needed. After fixing the issue, the appliance is tested to ensure proper operation. Preventive measures are also taken to minimize future problems.

2.1 Testing of an electric fan

It involves visually inspecting for damages and cleanliness, checking power connections, testing switch and speed settings, assessing features like oscillation and tilt, confirming stable operation, and verifying safety features. This ensures the fan functions reliably and safely for optimal comfort. This testing features are listed here in detail.

2.1.1 Visual Inspection

Begin by visually inspecting the electric fan.

1. Check for any visible damages, loose screws, or misaligned blades. Ensure that the fan is clean and free of obstructions.

1. Check the type of fan – whether the fan is ceiling fan or table fan
2. Verify the number of blades on the fan
3. Verify the material of which fan's blade and other parts are made
4. Verify the material of which fan's blade and other parts are made
5. Check the length of the fan rod and blades
6. Verify that the weight of the fan is as per the specifications
7. Verify that the colour of the fan is as per the specifications

2.1.2 Power Connection

1. Verify that the fan is properly connected to a power source.

11. Ensure the power cord is securely plugged into an electrical outlet, and inspect the cord for any signs of damage.
12. Check the voltage/power requirement of the fan

2.1.3 Switch Operation

1. Test the fan's switch to ensure it operates smoothly. If the fan has multiple speed settings or modes, test each one to confirm proper functionality.

1. Verify the ON-OFF functionality of fan
2. Check the time taken by fan to attain maximum speed, when switched ON

2.1.4 Rotation and Blade Alignment

1. Turn on the fan and observe the rotation of the blades. Ensure that the blades are aligned correctly and spin smoothly without any wobbling or unusual noises.

1. Check if the blades of the fan can be bend or not, check if its material is brittle
2. Verify if the fan works normally-throws wind on the right direction

2.1.5 Speed Settings

1. Test each speed setting to confirm that the fan operates at different speeds as intended. Ensure that the transition between speed levels is seamless.

1. Verify the maximum speed of fan
2. Check the minimum speed of the fan
3. Verify that the speed of fan can be regulated using regulator

2.1.6 Oscillation (if applicable)

If the fan has an oscillating feature, test it to ensure that the fan head moves horizontally in a smooth and consistent manner.

2.1.7 Tilt Functionality (if applicable)

If the fan has an adjustable head, test the tilt functionality to ensure that the fan can be directed upward or downward as needed.

2.1.8 Noise Level

Listen for any unusual noises during operation. Excessive noise could indicate a problem with the motor, blades, or other internal components.

2.1.9 Stability

1. Check the stability of the fan by gently rocking it back and forth. Ensure that the base is sturdy, and there is no wobbling that could pose a safety risk.

1. Verify that when in motion, the fan should not wobble
2. Check the effect of voltage fluctuation on fan when in motion
3. Check the effect of sudden electricity outage on fan's motor and other electrical parts
4. Verify the fan's condition when continuously switched on for very large duration

2.1.10 Safety Features

If the fan has safety features such as a thermal fuse or overheat protection, test these mechanisms to ensure they function as intended.

2.1.11 Remote Control (if applicable)

If the fan comes with a remote control, test all functions to confirm that the remote operates the fan effectively.

2.1.12 Timer Function (if applicable)

Test the timer function, if available, to ensure that the fan can be programmed to operate for a specific duration and then automatically turn off.

2.1.13 Auto Shut-off (if applicable)

If the fan has an auto shut-off feature, test it to confirm that the fan turns off automatically after a designated period.

2.1.14 Cleaning and Maintenance

1. Remind users about the importance of regular cleaning and maintenance to keep the fan in optimal condition.

1. Check if there is any lifetime of fan's internal parts or the body.

2.2 Testing a fan motor using multi meter

- Before testing the fan motor, first make sure that the power to the unit is turned off.
- To test the fan motor, you will need a multi meter.

- Set the multi meter to the ohms setting and touch the probes to the two terminals on the motor.
- If the reading on the multi meter is infinite, then this means that there is an open circuit and the motor is defective.
- If the reading on the multi meter is zero, then this means that there is a short circuit and the motor is defective.
- If the reading on the multi meter falls between these two values, then this means that the motor is functioning properly.

Alternative Method

1. Turn off the power to the fan motor at the circuit breaker or fuse box.
2. Remove the fan blade from the motor shaft.
3. Use a multi meter to test the continuity of the windings in the fan motor. The resistance should be low, less than 1 ohm, indicating that the windings are not open. A high resistance indicates an open winding and a faulty motor.
4. Reconnect the fan blade to the motor shaft and turn on the power to the motor at the circuit breaker or fuse box.
5. Listen for any strange noises coming from the motor. If there are any unusual sounds, it is likely that the bearings in the motor are worn out and will need to be replaced.
6. Check the operation of the fan by turning it on and feeling for airflow. If the fan is not operating correctly, it will need to be repaired or replaced.

2.3 Testing a fan motor by test bulb arrangement

Open/Short circuit in winding of motors can be detected by using Test bulb arrangement. Arrangement for the same is as shown in Figure 2.1.

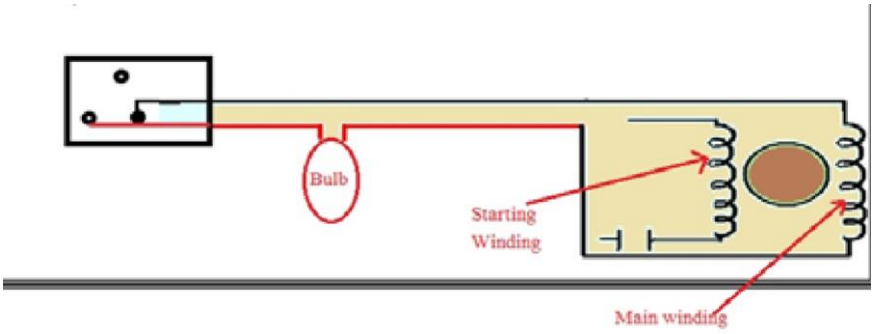


Fig. 2.1: Fan motor testing

1. If bulb doesn't glow then there will disconnection in the winding.

1. If bulb glows full then there will be short circuit in the winding.

2. If bulb glows very dim then there is no fault in the Winding.

2.4 Testing of capacitor by multi meter

1. Disconnect the power supply and remove the capacitor from the circuit board.

1. Fully discharge the capacitor using a resistor.

2. Rotate the knob and set the multi meter in continuity test mode.

3. Make a contact of the positive (RED) probe of the multi meter to the Anode (+) and Common (Black) probe to the Cathode (-) terminal of the capacitor.

4. If the multi meter shows a sign of proper continuity (beep sound or LED light) and suddenly stops and shows an OL (open line). It means the capacitor is in good condition.
5. If the multi meter doesn't show a continuity sign with beep or led, it means the capacitor is open.
6. If the multi meter LED lights ON and makes a continuous beep sound, it means the capacitor is short and it should be replaced with a new one as shown in Figure 2.2.

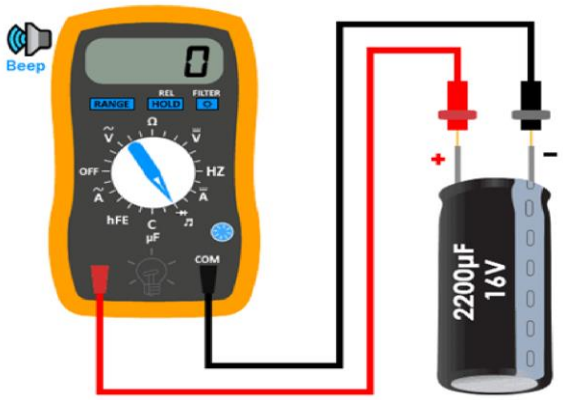


Fig. 2.2: Capacitor testing

2.5 Common Repairing issues in an electric fan

Some common issues that can be resolved by repairing of parts of fan can be as follows:

2.5.1 Fan start issue

If fan is having issues in its starting, following steps can be used to determine cause of the problem:

1. Check the circuit breaker to confirm the power is on. If the circuit breaker tripped, reset the breaker. If there are any blown fuses, replace the damaged fuses.
1. Turn off the circuit breaker. Loosen the canopy, check all the wire connections are correctly assembled and secured with wire nuts.
2. Make sure the fan blades spin freely. Pull the pull chain to make sure it is on.
3. Confirm the reverse switch is not in a neutral position. Flip the switch several times to lock into position.
4. Verify the plug connection in switch housing is securely fastened and all color-coded cables are aligned.

2.5.2 Fan speeds issue

If fan won't turn on or speed settings are not working properly, there may be a sharp change in the airflow. To determine the cause of the fan speed malfunction, follow the steps below:

1. Clean and lubricate the ball bearings.
2. Replace the fan capacitor.
3. If the above does not resolve the issue, continue to the following steps to check for over-heating.

- Run the fan for a few minutes.
- Turn off the fan and allow the blades to come to a full stop.

- Check that motor housing is hot or not. If the motor housing is hot, the bearings are shot and the motor needs to be replaced.
- Then replace the motor.

2.5.3 Fan airflow issues

If fan is not moving air, use the steps below to determine the cause:

1. Confirm the fan is spinning in the right direction.

2. A fan that is too close to the ceiling or wall will provide poor airflow. So verify that the fan is suspended to hang between 7-8 feet from the floor to reach the air to ground.

3. Consider using a longer down rod that allows the ceiling fan to hang at least 8 to 9 feet from the floor.

2. If fan is old, turn it off for a few minutes and then carefully touch the base to see if it is hot. If so, you may need a new fan motor or bearings.

2.5.4 Ceiling fan reversing issue

If attempted to reverse the ceiling fan for the winter, but noticed no change in the direction of the fan blades, there could be several causes. Turn off the ceiling fan and allow the blades to come to a full stop before flipping the switch. Follow the steps below to determine the cause:

1. Confirm the reverse switch is not in a neutral position. Flip the switch several times to make sure it is the right place.

2. If fan is old, the switch may be worn out. In this case, replace the reverse switch.

3. If fan is brand new, contact the manufacturer for a replacement fan.

2.5.5 Ceiling fan wobbling issue

If fan wobbles or shakes, it may be due to several factors such as bent blade brackets, loose screws, or dusty or warped fan blades. Use the steps below to determine the cause of the problem:

1. Remove any dirt or debris from all fan blades.

2. Tighten any loose screws on the light kit, fan blades, motor coupling, down rod, and mounting hardware.

3. Confirm the hanger ball is firmly seated in the mounting bracket.

2. Confirm the outlet box is ceiling fan-rated and designed to support the ceiling fan's weight.

5. Confirm the outlet box is securely attached to a beam or a support brace. If the outlet box is installed directly to the ceiling, this could cause wobbling and eventually damage the ceiling. It is shown in Figure 2.3.

Fig. 2.3: Ceiling fan wobbling issue

2.5.6 Noisy Fan issue

To determine the cause of noisy fan, use the steps below:

1. If fan has a light kit, tighten any loose screws securing the glassware. Confirm the light bulbs are firmly threaded into the socket.

2. Locate and tighten any loose screws on lower switch housing, blade holders, motor coupling, and down rod. Confirm all pins are firmly in place.

3. Verify the wire connections are not rattling against each other or the interior wall of the switch housing. Verify wire nuts have not fallen off, as shown in Figure 2.4.

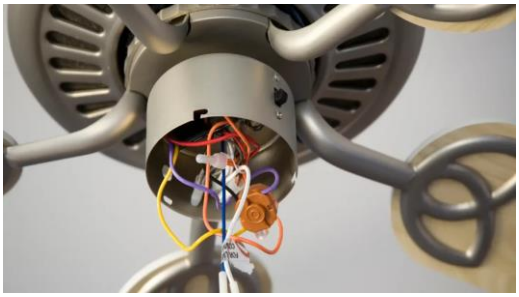


Fig. 2.4: Damaged Wiring

2. Confirm the canopy is not touching the ceiling while the fan is in operation.

5. Verify the fan blades are not cracked. If the fan blades are cracked, replace the damaged blades with a new blade set from the same brand as your ceiling fan to ensure compatibility, as shown in Figure 2.5.

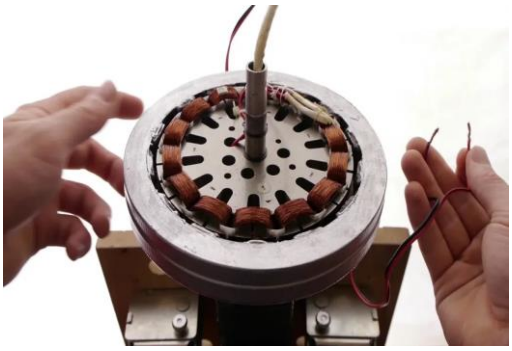


Fig. 2.5: Noisy Fan issue

2.6 Replacing the faulty module in a fan

2.6.1 Replacing a faulty capacitor in a fan

Suppose a simple fan without light kit need to be replaced with a new working capacitor having the same rating, follow the instruction below:

1. Switch off the main power supply.

2. Now, remove the faulty capacitor by cutting exact wires connected to faulty capacitor.

3. Replace a new capacitor by matching the correct wires from the fan to the capacitor

2. Now connect the live and neutral to the power supply. Switch ON the power supply to test the ceiling fan, as shown in Figure 2.6.

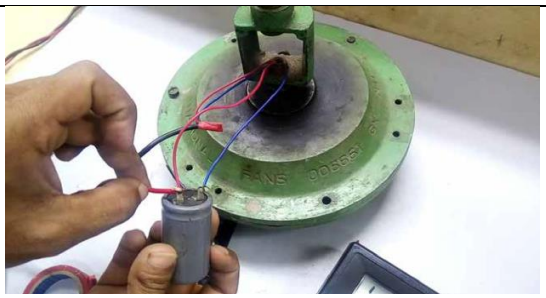


Fig. 2.6: Replacing faulty capacitor

2.6.2 Replacing a faulty motor in a fan

1. Turn off power to the fan – Before starting any work, make sure to turn off the power supply to the fan to prevent any electrical hazards.

2. Remove the fan blades – Remove the fan blades from the fan motor and set them aside. Some fans have screws that hold the blades in place, while others may have a locking mechanism that you will need to release.

3. Disconnect the wiring – Locate the wiring that connects the fan motor to the electrical supply. Disconnect the wiring by removing the wire nuts or by releasing the quick-connect connectors as shown in Figure 2.7.

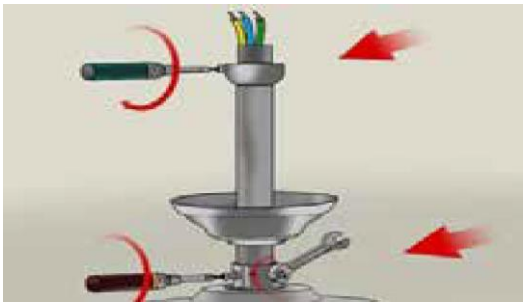


Fig. 2.7: Disconnecting wiring

2. Remove the mounting bracket – The fan motor is typically attached to a mounting bracket that is mounted to the ceiling. Remove the screws that hold the bracket in place to release the motor.

5. Install the new motor – Mount the new motor in the same position as the old motor, making sure to secure it to the bracket with screws. Steps 4 and 5 are depicted in Figure 2.8.

Fig. 2.8: Installing new motor

6. Reconnect the wiring – Connect the wiring to the new motor, following the same pattern as the original wiring. If necessary, replace the wire nuts or use new quick-connect connectors. Install the fan after wiring as shown in Figure 2.9.

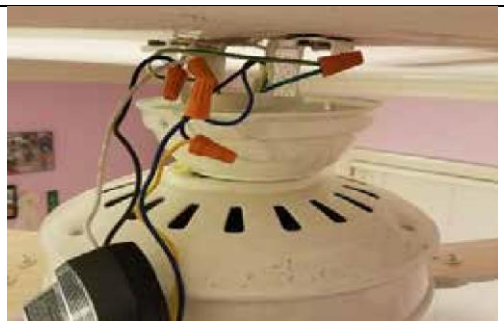


Fig. 2.9: Installing fan

7. Reinstall the fan blades – Reinstall the fan blades onto the new motor, making sure they are properly secured.

8. Test the fan – Turn the power back on and test the fan to make sure it is working properly.

2.7 Maintenance of motor

Maintaining the motor in an electric fan is crucial for ensuring its longevity and optimal performance. Here are key aspects of motor maintenance for electric fans:

Cleaning Blades and Housing – Regularly clean the blades and housing of the fan to prevent dust build up. Dust accumulation can lead to imbalance and strain on the motor it is shown in Figure 2.10. Ensure that vent openings are clear of debris. Blocked vents can cause the motor to overheat.

Fig. 2.10: Cleaning Blades

Lubrication – Lubricate the motor bearings at regular intervals. Over time, bearings may wear out, and proper lubrication helps to reduce friction and noise while extending the motor's life. Some fan motors have oil ports for lubrication it is shown in Figure 2.11. Follow the manufacturer's recommendations for oiling intervals and use the specified lubricant.

Fig. 2.11: Lubrication

Tightening Screws and Bolts – Check and tighten any loose screws or bolts in the motor assembly as shown in Figure 2.12. Vibration during operation can cause components to loosen over time.

Fig. 2.12: Tightening Screws and Bolts

Motor Alignment – Ensure that the motor is properly aligned. Misalignment can lead to increase wear on the motor components and reduce efficiency.

Voltage Checks – Periodically check the voltage supplied to the fan motor. Voltage fluctuations can adversely affect the motor's performance. Use a voltage stabilizer if necessary.

Capacitor Inspection – Fans with capacitor-star motors should have the capacitor inspected. A faulty capacitor can lead to motor starting issues and decreased efficiency.

Motor Windings – Inspect the motor windings for signs of overheating, such as discoloration or a burning smell. Overheating may indicate problems with the motor or inadequate ventilation.

Fan Blade Balance – Ensure that fan blades are balanced. Imbalanced blades can cause undue stress on the motor, leading to increased wear and tear.

Motor Housing Ventilation – Verify that the motor housing is well-ventilated. Proper ventilation prevents the motor from overheating and enhances overall efficiency.

Professional Servicing – Schedule periodic professional servicing for in-depth inspections and maintenance. A trained technician can identify potential issues before they escalate.

Operating Conditions – Avoid operating the fan under extreme conditions, such as high temperatures or excessive humidity. These conditions can negatively impact the motor's performance.

Activity 1

Practical Activity 2.1 Demonstrate to repair a ceiling fan for any fault.

Material needed

Procedure

Step 1. The first step is to turn off the circuit breaker.

Step 2. Unscrew the outside nuts of the fan and remove the connection that holds the fan with the main switch it is shown in Figure 2.13.

Fig. 2.13: Unscrew the outside nuts of the fan

Step 3. Pull out the switch and leave the wires attached.

Step 4. Note down in a separate sheet the wire colours attached to each terminal it is shown in Figure 2.14.

Fig. 2.14: Note down in a separate sheet

Step 5. If the problem is related to the switch, first detach the wires. After that, take the switch as per the fan model.

Step 6. In case of new switch installation, you will find the attachment of wires directly with the terminals. It is shown in Figure 2.15. So, you need to bend the individual wire around the respective terminal. You should tighten the screws in a clockwise direction.

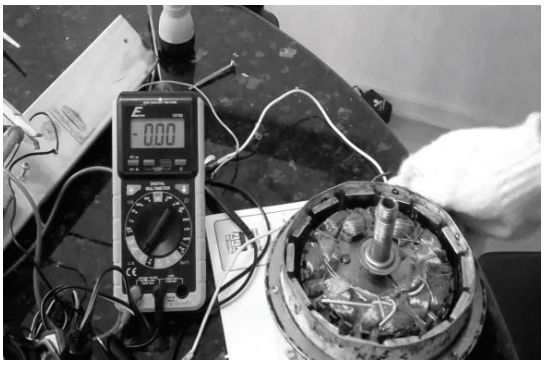


Fig. 2.15: New switch installation

Step 7. Suppose the switch wire is connected with wire-nuts, with a wire insulation strip of 1/2‖ to 3/4‖ width, wrap the two in a clockwise direction.

Step 8. After covering the bare wire, twist the connector in a clockwise direction it is shown in Figure 2.16.

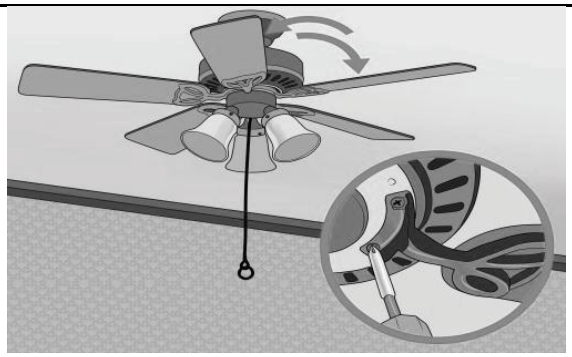


Fig. 2.16: Switch wire is connected with wire-nuts

Step 9. Now you can see a hole in fan housing. So, from inside, insert the switch. And from outside, thread the nut.

Step 10. Attach the cover and turn on the breaker it is shown in Figure 2.17.

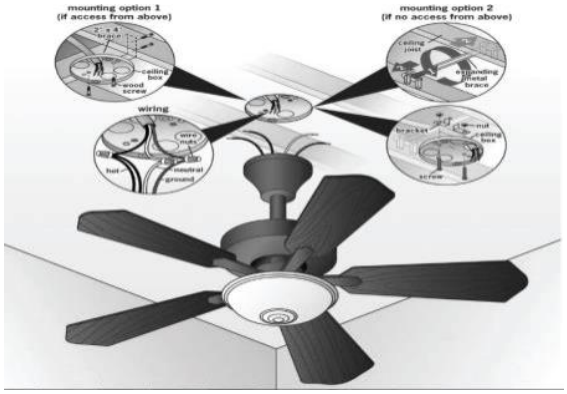


Fig. 2.17: Attach the cover

2.8 Future Scope of Electric Fan

The future of electric fans holds great promise, driven by advancements in technology, energy efficiency, and sustainability. The future developments in different components and aspects of electric fans:

Motor Efficiency – Future electric fans are likely to feature highly efficient motors, possibly utilizing brushless DC (BLDC) motors or other advanced motor technologies. These motors offer improved energy efficiency, reduced noise levels, and longer lifespan compared to traditional brushed motors.

Smart Connectivity – Integration with smart home technology is a promising avenue for electric fans. Fans equipped with Wi-Fi or Bluetooth connectivity can be remotely controlled via smart phone apps or voice commands, allowing users to adjust settings and monitor energy consumption from anywhere.

AI and Automation – Artificial intelligence (AI) algorithms can optimize fan operation based on factors such as room temperature, humidity, occupancy, and user preferences. AI-driven fans can automatically adjust speed, oscillation, and airflow direction to maintain optimal comfort levels while minimizing energy usage.

Sensor Integration – Incorporating sensors such as temperature sensors, motion sensors, and air quality sensors enables electric fans to react dynamically to environmental conditions. For example, fans could adjust their speed and oscillation patterns based on detected temperature changes or air quality deterioration.

Energy Harvesting – Future electric fans may integrate energy harvesting technologies to supplement power from the electrical grid. Solar panels or piezoelectric materials embedded in the fan structure could capture ambient light or mechanical vibrations and convert them into electricity, increasing energy efficiency and reducing dependence on external power sources.

Modular Design – Modular fan designs could allow users to customize and upgrade various components of their fans according to their needs and preferences. This approach promotes longevity and reduces electronic waste by enabling component replacement or upgrades rather than full product replacement.

Materials and Manufacturing – Advancements in materials science and additive manufacturing techniques can lead to lighter, more durable fan components. Sustainable materials such as recycled plastics or bio-based composites could be utilized to reduce the environmental impact of fan production and disposal.

Noise Reduction – Innovative noise reduction technologies, including advanced blade designs, aerodynamic optimizations, and active noise cancellation systems, can make electric fans quieter without compromising performance. Quieter operation enhances user comfort, especially during night time use or in noise-sensitive environments.

Aesthetic Design – Electric fans of the future are likely to prioritize sleek, minimalist designs that seamlessly integrate into modern living spaces. Customizable color options, decorative patterns, and premium finishes may cater to diverse aesthetic preferences and interior design trends.

Health and Wellness Features – Some electric fans may incorporate features aimed at improving indoor air quality and promoting user well-being. This could include built-in air purification systems, aromatherapy diffusers, or UV-C sterilization to reduce allergens, odors, and airborne pathogens.

Energy Efficiency Standards and Regulations – Governments and regulatory bodies may implement stricter energy efficiency standards and labeling requirements for electric fans to promote the adoption of eco-friendly and energy-saving models. Manufacturers will need to innovate to meet these standards while maintaining performance and affordability.

Circular Economy Initiatives – Embracing principles of the circular economy, manufacturers may implement product stewardship programs that facilitate fan refurbishment, recycling, and material recovery at the end of their lifecycle. Designing fans for disassembly and using easily recyclable materials can support these initiatives.

Summary

- This chapter introduces the topic of testing and repairing electric fans.
- It outlines a systematic approach, which includes visual inspection, power connection checks, and testing various functionalities.
- The chapter also addresses motor testing using a multi-meter and testing bulbs for circuit issues.
- Solutions for common problems such as start issues, speed problems, airflow concerns, and noise troubleshooting are provided.
- Practical steps for replacing faulty capacitors and motors are included to ensure a comprehensive guide for troubleshooting and repair.

CHECK YOUR PROGRESS

A. Multiple Choice questions

1. What is the first step in testing an electric fan? (a) Check power connections (b) Inspect for damages (c) Test switch operation (d) Assess oscillation feature
2. What does a reading of "infinite" on a multi meter indicate during fan motor testing? (a) Short circuit (b) Proper functionality (c) Open circuit (d) Overheating
3. How can you detect an open winding in a fan motor using a multi meter? (a) High resistance (b) Low resistance (c) Infinite reading (d) Zero reading
4. What should be done before testing a fan motor using a multi meter? (a) Clean the fan blades (b) Discharge the capacitor (c) Turn on the power (d) Remove the fan blade
5. What does a glowing bulb during the test bulb arrangement indicate? (a) Open winding (b) Short circuit (c) No fault in winding (d) Defective motor
6. In case of a fan wobbling issue, what should be confirmed about the outlet box? (a) It is securely attached to a beam (b) It is directly installed to the ceiling (c) It is made of a ceiling fan-rated material (d) It is touching the ceiling
7. What step is crucial before attempting to reverse a ceiling fan for the winter? (a) Check the reverse switch (b) Replace the fan blades (c) Turn off the power (d) Allow the blades to stop
8. How can you determine if a fan capacitor is faulty using a multi meter? (a) Check for loose screws (b) Use the ohms setting (c) Test the motor's rotation (d) Listen for unusual noises
9. What is the recommended action if the fan is not moving air? (a) Check the fan's stability (b) Verify the fan's color (c) Confirm the fan's direction (d) Lubricate the ball bearings
10. What is the primary purpose of a thermal fuse in a fan? (a) Oscillation control (b) Speed regulation (c) Safety feature (d) Cleaning mechanism

B. Fill in the blanks

1. Before testing the fan motor, make sure that the power to the unit is turned _____.
2. To test the fan motor, you will need a multi meter. Set the multi meter to the _____ setting and touch the probes to the two terminals on the motor.
3. If the reading on the multi meter is infinite, then this means that there is an open circuit and the motor is _____.
4. If the fan motor reading on the multi meter is zero, then this indicates a short circuit, and the motor is _____.
5. If the fan motor reading on the multi meter falls between these two values, then this means that the motor is functioning _____.
6. Disconnect the power supply and remove the capacitor from the circuit board before testing. Fully discharge the capacitor using a _____.
7. If the multi meter shows proper continuity, the capacitor is in good _____.
8. If the multi meter doesn’t show continuity, it means the capacitor is _____.

9. If the multi meter LED lights ON and makes a continuous beep sound, it means the capacitor is _____ and should be replaced with a new one.
10. For a fan experiencing start issues, check the circuit breaker to confirm the power is on. If tripped, reset the breaker. If there are blown fuses, replace the ____ fuses.

C. State whether the following statements are True or False

1. Checking the stability of the fan involves rocking it back and forth to ensure there is no wobbling.
2. The reverse switch on a ceiling fan should be flipped several times to lock it into position.
3. The timer function on a fan is used to adjust the speed settings.
4. The auto shut-off feature on a fan is primarily designed to conserve energy.
5. The testing of a fan motor using a multi meter involves setting the meter to the volts setting.
6. A multi meter showing an OL (open line) during capacitor testing indicates a short circuit.
7. The resistance of the windings in the fan motor should be high, indicating an open winding.
8. The presence of unusual sounds during fan operation indicates proper motor function.
9. Cleaning and maintenance of the fan are unnecessary for optimal performance.
10. The fan capacitor can be tested without disconnecting the power supply.

D. Answer the following questions in short

1. What is the purpose of visually inspecting an electric fan during testing?
2. How can you test the ON-OFF functionality of a fan?
3. What should you check when testing the rotation and blade alignment of a fan?
4. Explain the steps involved in testing a fan motor using a multi meter.
5. What does a reading of infinite on a multi meter during fan motor testing indicate?
6. Describe the alternative method for testing a fan motor, especially focusing on the role of the fan blade.
7. How to detect open or short circuits in a fan motor using a test bulb arrangement?
8. What steps should be followed for testing the capacitor of a fan using a multi meter?
9. What are some common issues in an electric fan that can be resolved by repairing parts?
10. How would you troubleshoot a fan start issue according to the provided content?

Module 3 Installation, Repair and Maintenance of Air Cooler

Module Overview

Air coolers play a vital role in various settings, including residential, commercial, and industrial environments, by providing efficient cooling solutions. Whether it is an air conditioner, evaporative cooler, or refrigeration unit, proper installation, repair, and maintenance are crucial to ensure their longevity and effectiveness.

In this unit, you will understand the installation and operation of air cooler. It will also cover the troubleshooting common issues and ensuring optimal performance through regular maintenance. A deep understanding of cooler mechanisms, mastering correct installation techniques to optimize both efficiency and longevity are covered. Furthermore, it will help to develop the expertise needed to diagnose and resolve common operational issues, effectively reducing downtime and boosting user satisfaction in the process.

Additionally, it focuses on the importance of regular maintenance routines to keep coolers running smoothly and efficiently. By understanding the key maintenance tasks and schedules, you'll be equipped to prevent potential issues, extend the lifespan of coolers, and optimize their performance, ultimately saving time and resources.

This unit will provide the essential know-how to excel in the field of installation, repair, and maintenance of air cooler.

Learning Outcomes

After completing this module, you will be able to:

- Demonstrate the correct installation of an air cooler, including assembly, electrical connections, and operational safety for effective cooling.
- Understand and implement sustainable waste management practices, focusing on reducing environmental impact and promoting eco-friendly practices in the workplace.

Module Structure

Session 1: Installation of Cooler

Session 2: Troubleshooting and Repairing of Dysfunctional Air Cooler

Session 1: Installation of Cooler

A device called an air cooler is used to cool the air in an enclosed area or a room. It works by pulling in hot air and directing it through damp pads, which cools the air while causing the water to evaporate. The room is then filled with the cooled air, which makes it feel cool and cozy. Until the required temperature is reached, the procedure is repeatedly carried out. For those looking to beat the heat without going over budget, air coolers are a popular option because they are a more energy-efficient alternative to air conditioning. One of air cooler model is shown in Figure 1.1.

Fig. 1.1: Air cooler

1.1 Types of Air Cooler

There are four types of air coolers as mentioned below:

1.1.1 Personal Coolers – This type of air cooler is made for smaller spaces and they provide good portability. These are often called *'mini air coolers'* too. These coolers are well known for energy saving and also cleans the air to provide fresh, cool air that gives comfort against sweat and heat. Unlike other types of coolers, personal coolers are light in weight which makes them portable and easy to use anytime, anywhere as shown in Figure 1.2.

Fig. 1.2: Personal cooler

1.1.2 Tower Coolers – Tower Air Coolers are very powerful coolers, capable of cooling a bigger area or space. Tower coolers can provide cooling in bigger spaces, and in lesser time as they distribute air vertically. They may need better maintenance as these are larger units. Tower coolers use a combination of fan and water-cooling means, to take in the hot air and evaporate the heat to give out cool air. It looks like as given in Figure 1.3.

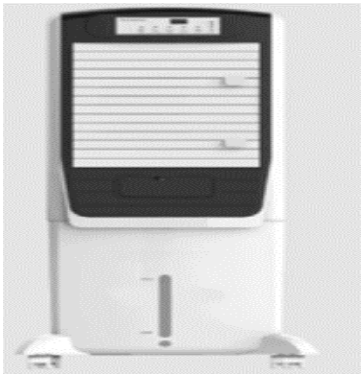


Fig. 1.3: Tower cooler

1.1.3 Window Coolers – Window air coolers are best to be installed on the window frame. It is placed outside the house and takes up no space inside the house. Though it takes up minimal space on the wall, it provides good cooling to the room. Window air coolers are long lasting as they are designed with superior plastic bodies and include honeycomb pads. These coolers cost slightly higher than personal and tower air coolers, and need higher maintenance. Window air coolers consume less energy and provide efficient cooling. It is given in Figure 1.4.

Fig. 1.4: Window cooler

1.1.4 Desert Coolers – Desert air coolers are suitable for places where humidity is low and the temperature is high. These coolers also work on the principle of evaporating heat from water and pushing cool air. As such conditions are mainly found in desert areas, thus it gets the name *'desert cooler'*. Desert air coolers help in reducing ambient temperature in enclosed spaces as shown in Figure 1.5.

Fig. 1.5: Desert cooler

1.2 Parts of Air Cooler

The basic components of an air cooler are shown in Figure 1.6.

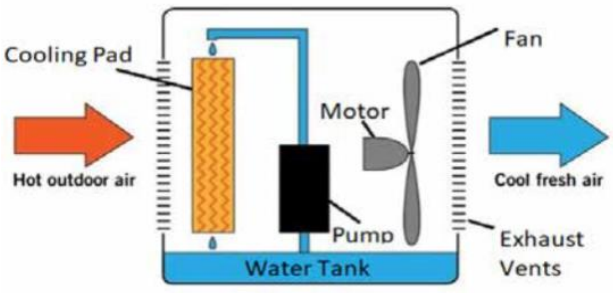


Fig. 1.6: Parts of air cooler

Functions of these parts are as follows:

1.2.1 Water tank – This is where the water is stored for evaporation. The size of the tank varies depending on the capacity of the air cooler as shown in Figure 1.7.

Fig. 1.7: Water tank

1.2.2 Water pump – It circulates the water from tank to cooling pads as shown in Figure 1.8.

Fig. 1.8: Water pump

1.2.3 Cooling pads – These are the medium through which air passes and is cooled by the water evaporating from them. They are typically made of cellulose or synthetic fibres. It is shown in Figure 1.9.

Fig. 1.9: Cooling pads

1.2.4 Fan – The fan pulls the warm air into the air cooler and blows it over the cooling pads, which cools the air. The cool air is then blown out into the room or space. It is shown in Figure 1.10.

Fig. 1.10: Fan

1.2.5 Motor – The motor is responsible for powering the fan and the water pump. It looks like as shown in Figure 1.11.

Fig. 1.11: Motor

1.2.6 Control panel – The control panel allows the user to set the speed of the fan, adjust the water level, and turn the unit on and off as shown in Figure 1.12.

Fig. 1.12: Control panel

1.2.7 Exhaust vents – These are the openings through which the cool air is blown out into the room or space as shown in Figure 1.13.

Fig. 1.13: Exhaust vents

Activity 1

Practical Activity 1.1 Identify parts and functions of an air cooler.

Name the parts and functions of an air cooler given below:

Picture	*Parts*	*Function*
		

1.3 Working of Air Cooler

Air coolers work on the principle of evaporative cooling. The fundamental concept involves using a fan to move air over a damp surface, allowing the water to evaporate and cooling the air.

The air cooler blows hot air over a wet evaporative pad using a fan. The water on the pad evaporates as the air moves over it, removing heat and causing the air to cool. The room's overall temperature is then lowered by blowing in the cooled air.

The air cooler also contributes to the air's increased moisture content, which makes it healthier to breathe as shown in Figure 1.14.

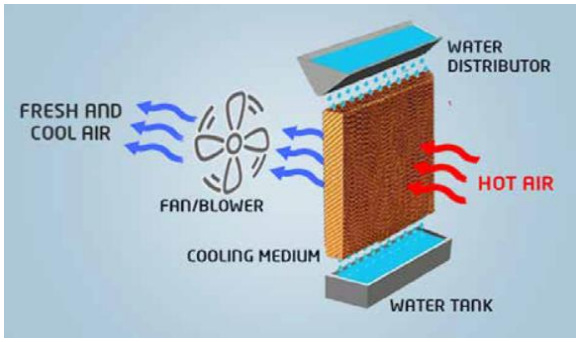


Fig. 1.14: Working of Air cooler

The working of an air cooler is most effective when the relative humidity is low, as the air can absorb more moisture and hence more heat can be removed. When the relative

humidity is high, the air is already saturated with moisture and the cooler will not be as effective.

1.4 Energy Rating and Power Consumption of Coolers

Energy Efficiency Rating – Coolers are often assigned energy efficiency ratings that indicate their energy consumption and performance. Higher ratings signify better energy efficiency.

Power Consumption – The power consumption of a cooler is typically measured in watts (W). It indicates the amount of electrical power the cooler consumes while operating. Most air coolers run on a power consumption of 150-300 watts. This means that when an air cooler is operating, it consumes electrical power at a rate of 150 to 300 watts per hour.

Energy Star Certification – Some coolers may carry the Energy Star certification, indicating compliance with energy efficiency standards set by regulatory bodies. Energy Star-rated coolers tend to consume less power.

Variable Speed Settings – Coolers with variable speed settings allow users to adjust the fan speed based on cooling needs. Lower fan speeds generally result in reduced power consumption.

Inverter Technology – Inverter technology in coolers helps optimize power consumption by adjusting the motor speed according to the cooling requirements. This can lead to significant energy savings.

Type of Cooler – Different types of coolers, such as air coolers and evaporative coolers, may have varying energy consumption profiles. Evaporative coolers, for example, can be more energy-efficient than traditional air conditioners.

Timer and Thermostat Features – Coolers equipped with timers and thermostats allow users to schedule operation periods and set desired temperatures. These features contribute to energy efficiency by preventing unnecessary cooling.

Cooling Capacity – The cooling capacity of a cooler, measured in BTUs (British Thermal Units) or cubic feet per minute (CFM), provides insights into its efficiency in cooling a specific area. Efficient cooling can lead to lower power consumption.

Energy Saving Modes – Some coolers come with energy-saving modes that automatically adjust settings for optimal performance with reduced power consumption.

Size and Design – The size and design of the cooler can influence its power consumption. Compact and well-designed coolers may be more efficient in delivering cooling performance with lower energy usage.

Maintenance Practices – Regular maintenance, such as cleaning filters and ensuring proper ventilation, can contribute to maintaining the cooler's efficiency and preventing increased power consumption over time.

User Guidelines – Adhering to manufacturer-recommended usage guidelines and maintenance practices helps ensure the cooler operates efficiently and consumes power within specified limits.

1.5 Assembly and Disassembly of Cooler

1.1.5 Assembly of Cooler – To assemble an air cooler follow the given steps

Gather Components – Lay out all the components of the cooler, including the main unit, fan blades, water tank, cooling pads, and any additional accessories.

Prepare the Base – Place the base or chassis of the cooler in a flat and stable location. Ensure that it provides proper support for the entire structure.

Install Wheels or Feet – If the cooler has wheels or adjustable feet, attach them to the base. This step facilitates easy mobility and stability.

Mount the Fan – Attach the fan blades to the motor assembly according to the manufacturer's instructions. Secure the fan in place, ensuring it is cantered and balanced.

Connect Water Pump – If the cooler has a water pump, connect it to the water reservoir following the provided guidelines. Ensure a secure and watertight connection.

Attach Cooling Pads – Install the cooling pads on the designated sides of the cooler. These pads enhance the cooling efficiency by promoting water evaporation.

Secure Water Tank – Place and secure the water tank in its designated position. Ensure that it is properly seated and connected to the pump system.

Connect Control Panel – If the cooler has a control panel for settings like fan speed and timer, connect it to the main unit. Secure any wiring in a way that prevents tangling or damage.

Check Electrical Connections – Verify that all electrical connections are secure and follow safety guidelines. Connect the power cord to a suitable power source.

Test the Cooler – Conduct a brief test to ensure that the fan, pump, and other components are functioning correctly. Make any necessary adjustments.

1.1.2 Disassembly of Cooler

Power Off and Unplug – Ensure the cooler is powered off and unplugged from the electrical outlet to prevent accidents during disassembly.

Remove Water – Empty the water tank to reduce weight and prevent spills. Some models may have a drainage system for this purpose.

Disconnect Control Panel – If applicable, disconnect the control panel from the main unit. Take note of the connections to facilitate reassembly.

Detach Cooling Pads – Remove the cooling pads carefully. Cleaning or replacing them may be necessary, depending on the maintenance schedule.

Separate Water Pump – Disconnect the water pump from the water reservoir. Ensure any hoses or connections are detached without causing damage.

Unscrew Fan Blades – If required, unscrew the fan blades from the motor assembly. Handle with care to avoid damage.

Detach Wheels or Feet – If the cooler has wheels or adjustable feet, detach them from the base.

Disassemble Main Unit – Depending on the design, disassemble the main unit by following the reverse order of assembly or as per the manufacturer's instructions.

Clean Components – Clean each component thoroughly, removing any dust, debris, or mineral deposits that may have accumulated during use.

Storage or Transportation – If disassembling for storage or transportation, ensure that components are securely packed and protected to prevent damage.

Proper assembly and disassembly procedures contribute to the efficient operation and longevity of the cooler. Following manufacturer guidelines and safety precautions is crucial throughout these processes.

1.6 Installation of a Cooler

The steps for installation of Air Cooler are shown in Figure 1.15.

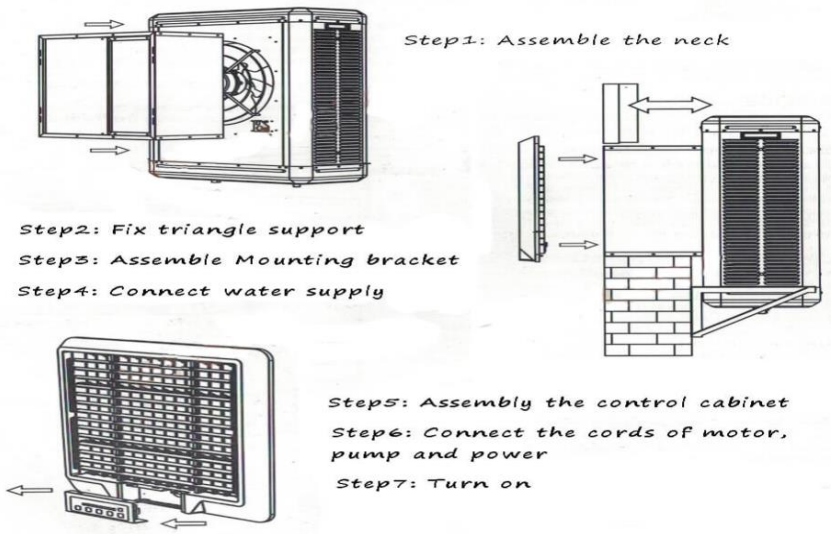


Fig. 1.15: Installation Steps of a Cooler

Installation steps can be described as follows:

Step 1. Choose an Optimal Location – Select a location with good ventilation and airflow. Placing the cooler near a window or door allows for effective air exchange.

Step 2. Ensure a Stable Surface – Position the cooler on a flat and stable surface to prevent vibration during operation.

Step 3. Proximity to Electrical Outlet – Place the cooler near an electrical outlet for easy and safe power connection. Consider using an extension cord if needed.

Step 4. Accessible Water Source – Ensure that the cooler is close to a water source for convenient refilling. Check if it supports continuous water supply and set up accordingly. It can be through a tap connected with water supply inlet as shown in Figure 1.16 (a) or it can be a manual filling method as shown in Figure 1.16(b) depending upon the model of cooler.

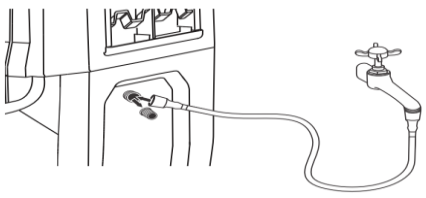


Fig. 1.16 (a) Water supply through tap connected

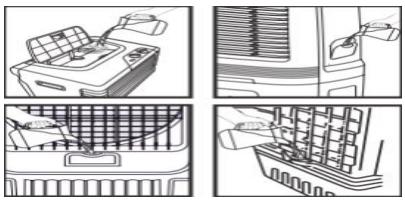


Fig. 1.16 (b) Manual water filling

Step 5. Clear Airflow Paths – Remove obstructions around the air intake and exhaust sides of the cooler to facilitate unrestricted airflow.

Step 6. Secure Wheels or Feet – Lock the wheels securely or set the adjustable feet to the desired height for stability.

Step 7. Fill the Water Tank – Fill the water tank with clean and cool water, following the manufacturer's guidelines on the maximum water level.

Step 8. Install Cooling Pads – Properly install the cooling pads in their designated positions, ensuring they are clean and aligned for effective cooling.

Step 9. Connect Control Panel (if applicable) – Connect the control panel to the main unit as per the provided instructions. Familiarize yourself with fan speed, cooling modes, and additional features.

Step 10. Power on and Test – Plug the cooler into the electrical outlet and turn it on. Test different settings to ensure the fan, pump, and other features are functioning correctly.

Step 11. Adjust Airflow Direction – Set the louvers or vents to control the direction of cooled air, optimizing airflow as needed.

Step 12. Monitor Water Level – Regularly check the water level in the tank, especially during extended use. Refill as necessary to maintain efficient cooling. It is shown in Figure 1.17.

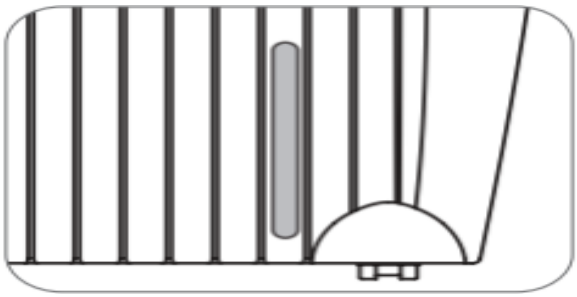


Fig. 1.17: water level indicator

1.7 Maintenance Requirements

Periodic maintenance helps to keep air cooler in condition. Maintenance includes cleaning of cooling pads, checking for mineral deposits, and replacing water as follows:

- Use only clean water to fill the water tank. Do not use any other liquid. The water tank should be cleaned regularly to reduce bacteria build-up.
- It is required to drain the water and clean the honeycomb pads every month as shown in Figure 1.18.

Fig. 1.18: cleaning of honeycomb pads

- If the cooler is not used for a long period of time, clean the tank drain out all the water by twisting open the water drain lid. Securely close the lid back after to prevent dust and insects from entering the water tank as shown in Figure 1.19.

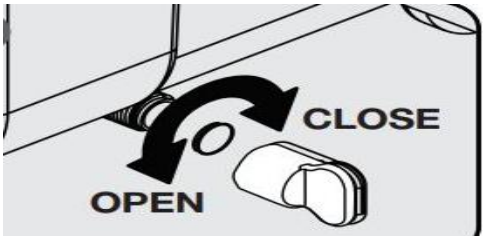


Fig. 1.19: open and close water drain lid

- Follow safety guidelines to ensure proper operation, such as keeping air vents unobstructed, preventing electrical components from getting wet, and unplugging the cooler before maintenance.

1.8 Safety Precautions

Following precautions must be taken while using the air coolers:

- The cooler should not be placed or installed in areas that are of extreme temperatures or near stoves, or in areas that are wet with high humidity, or has hydrocarbon vapors such as petroleum.
- Do not spray all types of spray into the fan; for example, hairspray or cleaning spray.
- Do not insert fingers, pencils or other objects into the grille while the blades are spinning as it may result in possible injury or physical damage.
- If an electrical component such as supply cord, motor, or switch is damaged, it must be replaced by the manufacturer, its service agent or similarly qualified persons in order to avoid a hazard. It is not advisable to fix the fan at home.
- The fan must always be placed vertically; it must never be lying horizontally or placed upside down. If the fan falls down, unplug it immediately and lift the fan up to a vertical standing position. Use a cloth to wipe the fan and leave it to dry in order to prevent electrocution

1.9 Care and Cleaning Instructions

- Use a damp cloth to wipe stains, and then dry the area by wiping.
- When cleaning, be careful not to let the supply cord, switch, motor, and other electrical components get wet.
- Do not use chemical products, thinner solvents, alcohol, kerosene or petrol to clean the fan.
- The water tank, pre-filter, grilles, and water tank can be cleaned with water or soapy water. It should be cleaned at least every 1-2 months.

Activity 2

Practical Activity 1.2 Demonstrate to check the motor of fan in air cooler.

Tools Required

Air cooler, Piler, Screwdriver kit, Electrician's tape, Wire cutter and stripper, Fan motor, Hammer, Long nose piler.

Safety Precautions

Wear Safety Gloves, make sure Air cooler is disconcerted from the power source, put all the fasteners in box to avoid misplacing them.

Procedure

First Method

Step 1. Set the multimeter switch to the ohms setting and touch the both probes of multi meter on the motor.

Step 2. If infinite readings shown on display of multi meter, it indicates an open circuit and it is a defective motor.

Step 3. If zero readings shown on display of multi meter, it indicates a short circuit and a defective motor.

Step 4. If the reading is between these two values, the motor is functioning properly.

Second Method:

Step 1. Turn off the power of the air cooler at the circuit breaker.

Step 2. Dismantle the air cooler.

Step 3. Remove the blade of fan in air cooler from the motor shaft.

Step 4. Open the case of fan motor.

Step 1. Use a multi meter to check the continuity of the windings.

Step 6. Check the resistance it should be less than 1 ohm; it indicates that the windings are not open. If resistance is high then it is an open winding and it is a faulty motor.

Summary

1. The chapter provides an explanation of the working principle behind air coolers, which utilize evaporative cooling to lower the temperature of hot air.
1. It introduces the key components of air coolers, including the water tank, pump, cooling pads, fan, motor, and control panel.
2. Four types of air coolers are discussed in this chapter as Personal, Tower, Window, and Desert Coolers, each with distinct features and applications.
3. Additionally, the chapter covers topics such as energy efficiency, assembly, disassembly, and practical steps for installing a cooler.
4. It emphasizes on safety measures, regular maintenance routines, and troubleshooting techniques to ensure efficient and long-lasting cooling solutions.

CHECK YOUR PROGRESS

A. Multiple Choice questions

1. How do air coolers achieve cooling? (a) Refrigeration (b) Evaporative cooling (c) Conduction (d) Radiation
2. What is the primary purpose of cooling pads in an air cooler? (a) Generate heat (b) Enhance evaporative cooling (c) Regulate fan speed (d) Facilitate air circulation
3. Which component is responsible for circulating water from the tank to the cooling pads in an air cooler? (a) Motor (b) Control panel (c) Water pump (d) Exhaust vents
4. What type of air cooler is suitable for small spaces and is known for its portability? (a) Tower Cooler (b) Window Cooler (c) Desert Cooler (d) Personal Cooler
5. In which scenario is a desert cooler most effective? (a) High humidity, high temperature (b) Low humidity, high temperature (c) High humidity, low temperature (d) Low humidity, low temperature
6. What does the Energy Star certification indicate for air coolers? (a) Higher power consumption (b) Compliance with energy efficiency standards (c) Lower cooling capacity (d) Minimal maintenance requirements

7. What is a crucial step in the assembly of an air cooler? (a) Disconnecting the water pump (b) Emptying the water tank (c) Cleaning the cooling pads (d) Testing the cooler
8. Where should you place an air cooler for effective air exchange? (a) In a closed room with no windows (b) In a corner with no airflow (c) Near a window or door (d) In a space with high humidity
9. What is the purpose of adjusting louvers or vents in an air cooler? (a) Increase power consumption (b) Control the direction of cooled air (c) Decrease cooling efficiency (d) Facilitate water evaporation
10. What is a key consideration for choosing an optimal location for an air cooler? (a) Proximity to a water source (b) Far from electrical outlets (c) Lack of ventilation (d) Dim lighting conditions

B. Fill in the blanks

1. The fan in an air cooler blows hot air over a wet evaporative pad, causing water to evaporate, removing heat, and ultimately _____ the air.
2. Tower coolers are known for their ability to cool larger areas by distributing air _____, utilizing a combination of fan and water-cooling means.
3. Window air coolers are designed to be installed on the _____, providing efficient cooling with minimal space occupied inside the house.
4. Energy consumption of a cooler is typically measured in _____, indicating the electrical power the cooler consumes during operation.
5. Evaporative coolers, such as air coolers, may be more _____-efficient than traditional air conditioners due to their cooling mechanism.
6. The cooling capacity of a cooler, measured in _____ or _____, provides insights into its efficiency in cooling a specific area.
7. Inverter technology in coolers helps optimize power consumption by adjusting the _____ speed according to cooling requirements.
8. Regular maintenance, such as cleaning filters and ensuring proper _____, contributes to maintaining the cooler's efficiency and preventing increased power consumption.
9. Adhering to manufacturer-recommended usage guidelines and _____ practices helps ensure the cooler operates efficiently and consumes power within specified limits.
10. The size and design of the cooler can influence its _____ consumption, with compact and well-designed coolers often being more efficient in delivering cooling performance.

C. State whether the following statements are True or False

1. Evaporative cooling is the principle behind how air coolers work, involving passing hot air through damp pads to cool it by evaporating water.
2. The primary purpose of cooling pads in an air cooler is to regulate fan speed.
3. The water pump in an air cooler is responsible for circulating water from the cooling pads to the water tank.
4. Personal coolers are suitable for larger spaces and provide powerful cooling.
5. Desert coolers are most effective in areas with high humidity and low temperatures.
6. The Energy Star certification for air coolers indicates compliance with energy efficiency standards.

7. A crucial step in the assembly of an air cooler is testing its components, including the main unit, fan blades, water tank, and cooling pads.
8. Placing the air cooler near a window or door facilitates effective air exchange, improving its cooling efficiency.
9. Adjusting louvers or vents in an air cooler helps control the direction of cooled air, optimizing airflow based on needs.
10. Choosing an optimal location for an air cooler includes considering its proximity to a water source, stable surface, and a well-ventilated electrical outlet.

D. Answer the following questions in short

1. Explain the working principle of air coolers in a few sentences.
2. Name three essential components of air cooler and briefly describe the function of each.
3. What are the four types of air coolers mentioned in the chapter, and how do they differ in terms of their applications?
4. What conditions make desert coolers most effective, and why are they given this specific name?
5. Briefly explain the significance of the Energy Star certification for air coolers and what it indicates about their performance.
6. Provide three key steps in the assembly process of an air cooler, emphasizing the importance of each.
7. Why is it important to place an air cooler near a window or door for effective air exchange?
8. How do adjusting louvers or vents contribute to optimizing the efficiency of an air cooler?
9. What factors contribute to the energy consumption of an air cooler, and how can users ensure energy efficiency in their operation?
10. In the context of air coolers, what role does inverter technology play, and how does it contribute to energy savings?

Session 2: Troubleshooting and Repairing of Dysfunctional Air Cooler

Troubleshooting is a systematic process of fault finding from a non-functional product or machine or a system. It is needed to identify the symptoms. In general air cooler is taking a break after the summer season and the winter months arrive. Neglecting its upkeep and maintenance in the off-season might lead to a lot of issues. One of the primary electrical problems you may encounter when running an air cooler is power supply-related. These can include fluctuations in voltage, power surges, or inadequate power supplies. Such problems can cause the air cooler to malfunction, reduce cooling efficiency, or even stop working altogether. In order to guarantee that your cooling device is in top condition even during the winter, it is essential to know about the most typical problems that affect air coolers during unseasonal seasons.

2.1 Troubleshooting and Repairing of Problems in Air Cooler

The troubleshooting of air cooler addresses the most common symptoms. If symptoms persist, a qualified service provider or certified electrician should be called to check the fault. Always turn off all power to the cooler before attempting to troubleshoot.

Table 2.1 provides the symptoms with possible causes and remedy to overcome the problem.

Table 2.1 Common problems and solution of working of an air cooler.

http://www.symphony-usa.com/customer-care/troubleshooting.html

Symptom	***Possible Causes***	***Remedies***
Inadequate cooling	Wrong adjustment of the float value and low water.	Adjust the water level
	The water distributor medium is dirty or filled with mud.	Cleaning required
	The cooling pad is too dirty.	Cleaning required
	Cooling pads are not soaking the water	Change the cooling pads
	The water supply pipe is dirty or filled with mud.	Cleaning required
	Check the pump is working properly or not.	Change a new one
Water leakage	The water tank is slant.	Adjust it to the level
	Cooler body is damaged	Body repairing required
Too much noise	The motor fastener is loose.	Tighten it
	Fan blades are loose.	Tighten them
	The motor bearing gets stuck.	Change the bearing or motor
Cooler won't start	Check power supply for loose, burnt or wrong connections	Tighten of repair the wire connection as required
Low or no air flow	Check power supply for loose, burnt or wrong connections	Tighten or repair the wire connections as required
	Electrical connections in the motor terminal box or starter are not tight	Check and tighten as necessary
	Check fan blades	Tighten the fan blades if loose. Change the fan blades if damaged. Clean the fan blades, if dirty
Cooler Motor Hums but Won't Start	Motor is most likely defective, or its windings are open	Repair or change the motor
	Check wiring for any fault, loose connections etc	Tighten or repair the wire connections as required

2.2 Repairing Defects in Air Cooler

These are the problems associated with the air cooler. They can be resolved by following these steps.

Damage or not working of the motor – It is due to damage to the windings or failure of the capacitor that the motor is not working. Once the exact problem is found, it should be corrected by replacing the part that is failing.

Coolness is not proper – If the cooler is not cooling properly, then the main problem is in the water pumping motor. Changing the pumping motor will solve the problem immediately. If the cooling pad is not wetted properly, then the cooler will not cool completely.

Not working condition of the auto-swing – The auto swing motor can be changed if there is a problem with the air travelling in one direction.

2.3 Steps to repair air cooler

The process of repairing an air cooler can vary depending on the specific issue you're experiencing. However, here are some general steps you can follow:

Step 1. Unplug the air cooler – Before attempting any repairs, make sure the air cooler is unplugged to avoid any potential electrical hazards.

Step 2. Identify the issue – Determine what the problem is with the air cooler. Like ***Is*** *it not turning on at all? Or Is it not cooling the air properly? or Is there a leak?* Identifying the problem will help to determine the best course of action.

Step 3. Clean the air cooler – If air cooler is not cooling the air properly, it may just be clogged with dust and debris. Clean the air cooler thoroughly, including the pre- filter and the honeycomb cooling pads.

The steps to remove the pre-filters for cleaning are as follows:

Pre-filter (BACK)

Step 1. Use a screwdriver to loosen the screws holding the pre-filter in place. Use your hands to press the locks located at the top to remove the pre-filter for cleaning.

Step 2. To insert the pre-filter, use your hands to press the locks located at the top of the pre-filter and carefully push to lock it in place. Use a screwdriver to tighten the screws holding the pre-filter in place. It is shown in Figure 2.1.

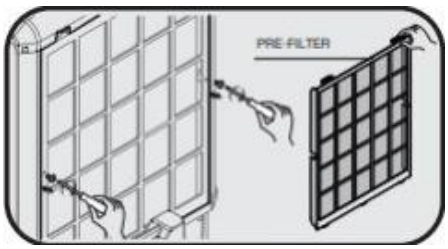


Fig. 2.1: Removing the pre-filter (back)

Pre-filter (SIDES)

Step 1. Use a screwdriver to loosen the screws holding the grille in place. Use your hands to press the locks located at the top of the grille to unlock it. Lift the grille upwards to free it from the latches in the middle and remove the pre-filter for cleaning.

Step 2. To replace the pre-filter within the side grilles, flip the side grille upward and place the pre-filter in place within the frame boundary (A) ensuring that the side with the arrow is at the top.

Step 3. Insert the grille from the top, ensuring that the latches in the middle fit with those of the grille on both sides. Use your hands to press the locks located at the top of the grille and carefully push to lock it. Use a screwdriver to tighten the screws holding the grille in place. This procedure is shown in Figure 2.2.

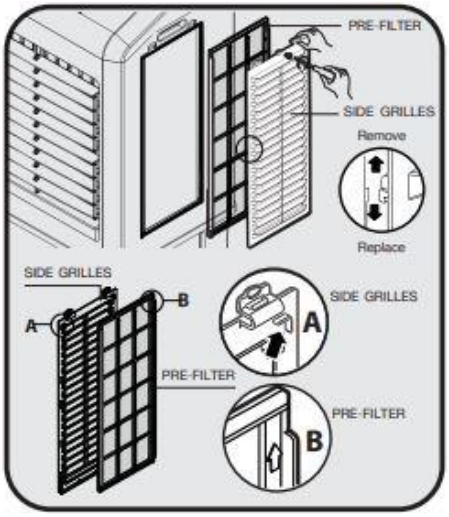


Fig. 2.2: Removing the pre-filter (back)

Step 4. Cleaning of Honeycomb Cooling Media Pads

Generally, the air cooler is supplied with three Honeycomb Cooling Media pads. The Honeycomb Cooling Media are located inside the Rear and Side Grills. Do not run the unit in COOL mode with stale water in the tank. The water tank must be completely empty before and then refill with fresh water, especially if the tank has not been cleaned in a long time. The cleaning frequency for the Honeycomb media depends on local air and water conditions. In areas where the mineral content of water is high, mineral deposits may build up on the Honeycomb Cooling Media and restrict air flow. Draining the water tank and refilling with fresh water at least once a week will help reduce mineral deposits. If mineral deposits remain on the Honeycomb Cooling Media, the media should be removed and washed under fresh water. The media should be cleaned every two months or sooner, depending on your needs. For best results allow the Honeycomb Cooling Media to dry after each use by turning off the cool function 15 minutes before turning the unit off.

Removing the Honeycomb Cooling Media – Following Steps are helpful in removing the honeycomb cooling media from the unit for cleaning and maintenance.

Step 1. Remove the screws from the Rear Grill of the Air Cooler as shown in Figure 2.3.

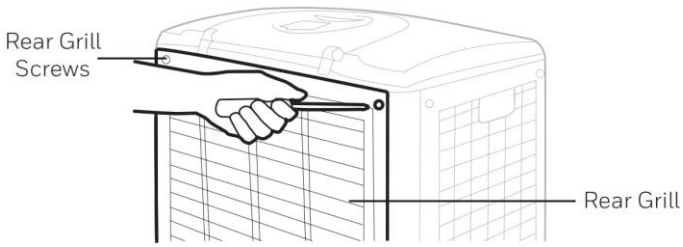


Fig. 2.3: Remove the rear grill screws

Step 2. Carefully pull out the Rear Grill from the Air Cooler as shown in Figure 2.4.

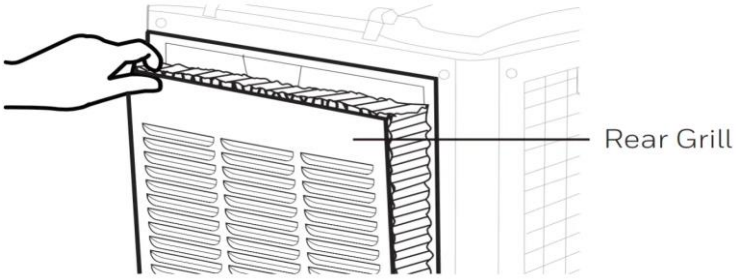


Fig. 2.4: Pull out the rear grill

Step 3. The Honeycomb Cooling Pad is secured on the Rear Grill by two Horizontal Bars that are fixed in place by two screws on the Left and Right Sides of these Horizontal Bars. Remove these screws to release the Horizontal Bars as shown in Figure 2.5.

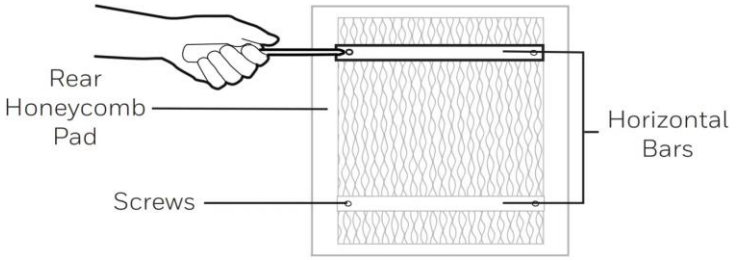


Fig. 2.5: Remove the screws from honeycomb cooling pad

Step 4. Pull out the Honeycomb Cooling Pad by sliding it out from the Rear Grill. Replace with the new Honeycomb Cooling Pad by sliding into the grooves of the Rear Grill until it fits comfortably and securely in place on the grill. Replace the Horizontal Bars back onto the Rear Grill by replacing the Left and Right-Side screws and tightening them in place. This secures the Honeycomb Cooling Pad in place on the Rear Grill. It is depicted in Figure 2.6.

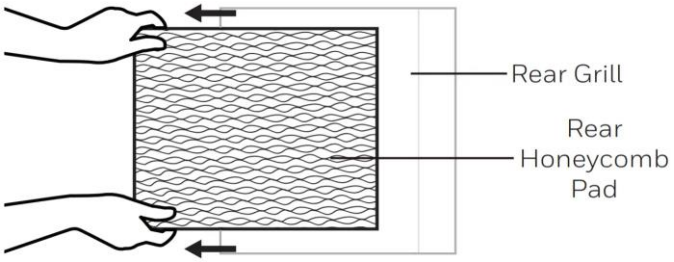


Fig. 2.6: Pull out the honeycomb cooling pad

Step 5. Repeat steps 1 to 4 to remove the Honeycomb Cooling Pad on the Left and Right-Side Grills.

Cleaning of the Honeycomb Cooling Pads – Clean the cooling pad with tap water, but not large pressure as shown in Figure 2.7.

Fig. 2.7: Cleaning of cooler pads

Step 6. Check the water level – Make sure the water level is adequate. If the water level is too low, the air cooler may not be able to function properly.

Step 7. Check the pump – If air cooler uses a pump to circulate water, check to make sure it's working properly. If it's not working, it may need to be replaced.

Step 8. Check the fan – If air cooler's fan isn't working, it may need to be cleaned or replaced. Make sure the blades are clean and free from debris.

Step 9. Check for leaks – If air cooler is leaking, check to see where the leak is coming from. It could be a problem with the water tank, the pump, or the tubing.

Step 10. Make necessary repairs – Once you've identified the issue, make the necessary repairs. This may involve replacing a part, cleaning the air cooler, or tightening connections.

Step 11. Test the air cooler – Once you've made the repairs, test the air cooler to make sure it's functioning properly.

2.4 Maintenance of Motor in Cooler

The motor is a critical component of an air cooler, and regular maintenance is essential to ensure efficient performance and prolong its lifespan. Here are key steps for maintaining the motor in an air cooler:

Cleaning – Regularly clean the motor housing and surrounding areas to prevent dust build up. Accumulated dust can impede the motor's cooling and ventilation capabilities.

Lubrication – Check the motor's bearings and other moving parts for proper lubrication. Lubricate the bearings as per the manufacturer's recommendations to reduce friction and ensure smooth operation.

Belt Inspection – If the air cooler uses a belt-driven motor, inspect the belt for signs of wear or damage. Replace the belt if it appears frayed, cracked, or loose to maintain optimal power transmission.

Fan Blades – Clean the fan blades regularly to prevent imbalances that could strain the motor. Imbalanced blades can lead to vibrations and premature motor wear.

Electrical Connections – Inspect all electrical connections, including wires and terminals, for signs of wear, damage, or loose connections. Tighten any loose connections and replace damaged wiring.

Motor Temperature – Monitor the motor's temperature during operation. Overheating can lead to motor damage. If the motor feels excessively hot or emits a burning smell, turn off the cooler immediately and investigate the cause.

Water Level Check – Constantly check the water level in the tank. Make it sure that it is not above the MAX level or not below the MIN level as shown in Figure 2.8.

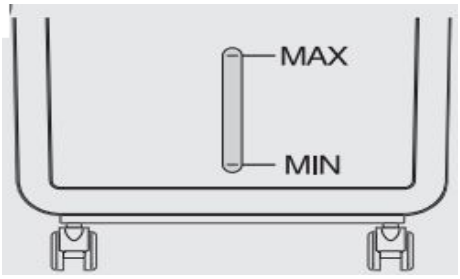


Fig. 2.8: Water level indicator

Vibration Analysis – Periodically check for unusual vibrations during operation. Excessive vibrations may indicate misalignment or other issues that can strain the motor. Correct any misalignments promptly.

Motor Mounting – Inspect the motor mounting brackets for stability. Loose or misaligned mounts can contribute to vibrations and compromise the performance.

Cooling Pads – If the air cooler uses a motor-driven pump for water circulation, ensure that the cooling pads are clean. Clogged pads can increase the load on the motor.

Professional Inspection – Schedule periodic professional inspections to assess the motor's overall condition. Professionals can identify potential issues early on and perform more in-depth maintenance tasks.

Operating Conditions – Avoid overloading the motor by operating air cooler within the specified capacity. Ensure the cooler is not subjected to power fluctuations or voltage spikes.

Activities

Practical Activity 2.1 Replacement of Shaft, Gasket, and Blades in Air Cooler.

Materials and Tools Required

New shaft, New gasket, New blades, Screwdrivers, Adjustable wrench, Lubricating oil, Replacement bolts and nuts, Work gloves, Safety glasses

Procedure

Step 1. Turn Off Power – Ensure the air cooler is completely powered off and disconnected from the electrical supply. Safety should be the top priority during maintenance.

Step 2. Drain Water – If the air cooler has a water reservoir, drain it to prevent water spillage during the replacement process.

Step 3. Access the Motor – Remove any protective covers or panels to access the motor and related components. This may involve unscrewing panels or removing clips, depending on the cooler's design.

Step 4. Disconnect Motor – Disconnect the motor from the power source. This may involve removing wires, connectors, or bolts securing the motor in place.

Step 5. Remove Blades – Unscrew the bolts securing the blades to the motor shaft. Carefully remove the blades, taking note of their orientation for correct reassembly.

Step 6. Detach Gasket – If applicable, detach the gasket from its position. Gently pry it away, being cautious not to damage the surrounding components.

Step 7. Loosen Shaft Fasteners – Use an adjustable wrench or appropriate tool to loosen the fasteners securing the shaft to the motor. Carefully remove the shaft while avoiding any damage to the motor housing.

Step 8. Replace Shaft – Install the new shaft in the same position and secure it with the appropriate fasteners. Ensure the shaft is aligned correctly with the motor.

Step 9. Install New Gasket – Place the new gasket in its designated position. Ensure it fits securely to prevent air or water leakage.

Step 10. Attach New Blades – Mount the new blades onto the shaft, aligning them according to the original configuration. Secure the blades in place with the provided bolts.

Step 11. Tighten Fasteners – Carefully tighten all fasteners, ensuring they are secure but not overly tightened. Over-tightening can cause damage to components.

Step 12. Check Alignment – Verify that the blades and shaft are correctly aligned. Misalignment can lead to operational issues and increased wear on components.

Step 13. Reconnect Motor – Reconnect the motor to the power source, ensuring all wires are properly attached. Double-check the connections to prevent electrical issues.

Step 14. Power on and Test – Power on the air cooler and test its operation. Listen for unusual noises, vibrations, or any signs of malfunction. If everything is functioning correctly, proceed to the next step.

Step 15. Replace Covers – Reattach any panels or covers that were removed to access the motor. Ensure they are securely fastened.

Step 12. Fill Water Reservoir – If applicable, fill the water reservoir to the recommended level to enable the cooler's cooling function.

Step 17. Final Inspection – Conduct a final inspection to confirm that the replaced components are functioning properly. Monitor the air cooler during initial operation to catch any issues early.

Practical Activity 2.2 Demonstreate the Replacement of Pump and Blown-Out Motor in Air Cooler.

Materials and Tools Required

New pump, New motor, Screwdrivers, Adjustable wrench, Lubricating oil, Replacement bolts and nuts, Work gloves, Safety glasses

Procedure

Step 1. Turn Off Power – Ensure the air cooler is completely powered off and disconnected from the electrical supply. Prioritize safety during the replacement process.

Step 2. Drain Water – If the air cooler has a water reservoir, drain it to prevent water spillage during the replacement process.

Step 3. Access the Motor and Pump – Remove any protective covers or panels to access the motor, pump, and related components. This may involve unscrewing panels or removing clips, depending on the cooler's design.

Step 4. Disconnect Motor – Disconnect the motor from the power source. This may involve removing wires, connectors, or bolts securing the motor in place.

Step 5. Remove Pump – Disconnect the pump from its power source and detach any hoses connected to it. Remove the pump from its mounting location, taking note of its position for correct reassembly.

Step 6. Loosen Motor Fasteners – Use an adjustable wrench or appropriate tool to loosen the fasteners securing the motor to the cooler. Carefully remove the motor while avoiding any damage to the housing.

Step 7. Replace Blown-Out Motor – Install the new motor in the same position and secure it with the appropriate fasteners. Ensure the motor is aligned correctly with the cooler.

Step 8. Install New Pump – Mount the new pump in its designated position. Connect any hoses and secure the pump in place with the provided bolts.

Step 9. Tighten Fasteners – Carefully tighten all fasteners, ensuring they are secure but not overly tightened. Over-tightening can cause damage to components.

Step 10. Check Alignment – Verify that the motor and pump are correctly aligned. Misalignment can lead to operational issues and increased wear on components.

Step 11. Reconnect Motor – Reconnect the new motor to the power source, ensuring all wires are properly attached. Check the connections to prevent electrical issues.

Step 12. Connect New Pump – Connect the new pump to its power source and reattach any hoses. Ensure all connections are secure to prevent water leakage.

Step 13. Power on and Test – Power on the air cooler and test its operation. Listen for unusual noises, vibrations, or any signs of malfunction. If everything is functioning correctly, proceed to the next step.

Step 14. Replace Covers – Reattach any panels or covers that were removed to access the motor and pump. Ensure they are securely fastened.

Step 15. Fill Water Reservoir – If applicable, fill the water reservoir to the recommended level to enable the cooler's cooling function.

Step 16. Final Inspection – Conduct a final inspection to confirm that the replaced components are functioning properly. Monitor the air cooler during initial operation to catch any issues early.

Practical Activity 2.3 Demonstrate the Cleaning and Maintenance of Cooler

Materials and Tools Required

Soft brush or vacuum cleaner, Mild detergent or cleaner, Clean cloth or sponge, Water hose or bucket, Lubricating oil, Replacement pads (if needed)

Procedure

Step 1. Power Off and Unplug – Ensure the cooler is powered off and unplugged from the electrical supply to prioritize safety during the cleaning process.

Step 2. Drain Water – If the cooler has a water reservoir, drain the water to prevent spillage during cleaning.

Step 3. Remove Panels and Covers – Remove any protective panels or covers to access internal components. This may involve unscrewing panels or removing clips, depending on the cooler's design.

Step 4. Clean Exterior – Use a soft brush or vacuum cleaner to remove dust and debris from the exterior surfaces of the cooler. Pay attention to vents, grills, and fan blades.

Step 5. Clean Interior – Carefully clean the interior components, including fan blades, motor, and water pump. Use a soft brush or vacuum to remove accumulated dirt and dust.

Step 6. Clean Water Distribution System – Inspect and clean the water distribution system, including pipes, tubes, and the water pump. Use a mild detergent or cleaner to remove any deposits.

Step 7. Inspect Cooling Pads – Check the condition of the cooling pads. If they are damaged or excessively dirty, consider replacing them. Clean reusable pads with water or follow the manufacturer's recommendations.

Step 8. Clean Water Reservoir – Scrub the water reservoir with a clean cloth or sponge using mild detergent if necessary. Rinse it thoroughly to remove any soap

residue.

Step 9. Inspect and Tighten Fasteners – Check all bolts and nuts for tightness. Tighten any loose fasteners to ensure the structural integrity of the cooler.

Step 10. Inspect Belt (if applicable) – If your cooler has a belt-driven system, inspect the belt for wear and tear. Replace the belt if it shows signs of damage.

Step 11. Lubricate Moving Parts – Apply lubricating oil to any moving parts, such as fan bearings, to ensure smooth operation. Follow the manufacturer's recommendations for the type of lubricant to use.

Step 12. Check Electrical Components – Inspect electrical components for signs of wear, damage, or corrosion. Replace any faulty components to avoid electrical issues.

Step 13. Inspect Water Inlet Valve – If your cooler has a water inlet valve, inspect it for proper functioning. Clean or replace the valve if needed.

Step 14. Reassemble Components – Reattach any panels or covers that were removed. Ensure they are securely fastened to prevent rattling during operation.

Step 15. Fill Water Reservoir – If applicable, fill the water reservoir to the recommended level to enable the cooler's cooling function.

Step 16. Power on and Test – Power on the cooler and test its operation. Listen for unusual noises, vibrations, or any signs of malfunction. If everything is functioning correctly, proceed to the next step.

Step 17. Final Inspection – Conduct a final inspection to confirm that all components are functioning properly. Monitor the cooler during initial operation to catch any issues early.

2.5 Future Scope of Air Coolers

The future scope of air coolers lies in several key areas of innovation and advancement as follows:

Energy Efficiency – Future air coolers are likely to focus on enhanced energy efficiency, utilizing advanced technologies such as improved cooling pads, energy-efficient motors, and intelligent control systems to optimize energy usage while maintaining effective cooling.

Smart Features – Integration of smart features such as Wi-Fi connectivity, app control, and voice commands will likely become more prevalent, allowing users to monitor and control their air coolers remotely and adjust settings based on their preferences and environmental conditions.

Environmental Sustainability – There is a growing emphasis on developing eco-friendly air coolers that use natural refrigerants, recyclable materials, and sustainable manufacturing processes to reduce their environmental impact.

Air Quality Improvement – Future air coolers may incorporate air purification and filtration technologies to not only cool the air but also remove pollutants, allergens, and particulate matter, thus improving indoor air quality.

Compact and Portable Designs – Advances in design and engineering may lead to the development of more compact, lightweight, and portable air coolers that are suitable for use in various indoor and outdoor settings.

Integration with Renewable Energy Sources – Integration of air coolers with renewable energy sources such as solar power could offer a sustainable and cost-

effective cooling solution, especially in regions with abundant sunlight and high cooling demands.

Customization and Personalization – Future air coolers may offer customizable cooling profiles and personalized settings to cater to individual preferences and specific cooling requirements, providing a more tailored and comfortable cooling experience.

Summary

- The chapter addresses common issues encountered in air coolers and provides practical solutions, including inadequate cooling, water leakage, noise, and start-up failure.
- It emphasizes on the importance of regular maintenance to prevent these issues, along with offering a step-by-step guide for defect resolution.
- The process outlined in the chapter covers various potential problems such as motor damage, cooling issues, and auto-swing malfunction.
- Additionally, it details the procedure for cleaning, maintenance, and the replacement of key components, providing users with a concise guide for effective care of their air coolers.

CHECK YOUR PROGRESS

A. Multiple Choice questions

1. What is the suggested remedy for inadequate cooling in an air cooler? (a) Adjust fan speed (b) Clean cooling pads (c) Increase water supply (d) Replace the motor
2. What can be the reason for water leakage in the air cooler? (a) water level (b) damaged body (c) dirty cooling pads (d) all of the above
3. What is a possible cause of too much noise in the air cooler? (a) Dirty cooling pads (b) Loose motor fastener (c) Damaged water tank (d) Faulty water pump
4. What is the recommended action if the air cooler won't start? (a) Adjust louvers (b) Check power supply (c) Tighten fan blades (d) Change cooling pads
5. What is a potential solution for low or no airflow in the air cooler? (a) Check fan blades (b) Adjust water level (c) Inspect electrical connections (d) Change the motor
6. If the motor hums but won't start, what is the likely issue? (a) Loose fan blades (b) Defective motor (c) Faulty water pump (d) Damaged cooling pads
7. What should be done before attempting any repairs on the air cooler? (a) Clean the cooling pads (b) Unplug the air cooler (c) Drain the water reservoir (d) Check electrical connections
8. What is the primary step in the procedure for replacing the shaft, gasket, and blades in an air cooler? (a) Drain the water reservoir (b) Disconnect the motor (c) Turn off power (d) Remove protective covers
9. What is a crucial step during the cleaning of an air cooler's cooling pads? (a) Use high-pressure water (b) Scrub vigorously with a brush (c) Clean with a mild detergent (d) Dry the pads with a fan

10. Why is lubrication important in maintaining the motor of an air cooler? (a) Enhances cooling efficiency (b) Prevents rusting (c) Increases water circulation (d) Reduces friction for smooth operation

B. Fill in the blanks

1. It is due to _____ or failure of the capacitor that the motor is not working.
2. If the cooler is not cooling properly, then the main problem is in the _____.
3. The auto swing motor can be changed if there is a problem with the _____ in one direction.
4. Clean the cooling pad with tap water, but not _____.
5. Regularly clean the motor housing and surrounding areas to prevent _____.
6. Check the motor's bearings and other moving parts for _____.
7. Excessive vibrations may indicate _____or other issues that can strain the motor.
8. Clean the fan blades regularly to prevent _____ that could strain the motor.
9. If the air cooler uses a belt-driven motor, inspect the belt for signs of _____.
10. Regular _____ of a cooler are essential to ensure optimal performance and longevity.

C. State whether the following statements are True or False

1. Adjusting the water level is a recommended remedy for inadequate cooling in an air cooler.
2. Water leakage in an air cooler can be addressed by checking the pump's working condition.
3. Excessive noise in an air cooler may result from a tight motor fastener.
4. Checking the power supply for loose or wrong connections is advised when the air cooler won't start.
5. Loose electrical connections can contribute to low or no airflow in an air cooler.
6. If the motor hums but won't start, the motor is likely not defective, and a simple restart may solve the issue.
7. Before attempting repairs on an air cooler, it is not necessary to unplug it if it's turned off.
8. The first step in replacing the shaft, gasket, and blades in an air cooler is to drain the water reservoir.
9. Cleaning the cooling pads with high-pressure water is recommended for effective cleaning.
10. Lubrication of the motor's bearings is essential to increase friction and ensure optimal performance.

D. Answer the following questions in short

1. What is the recommended solution for inadequate cooling in an air cooler?
2. How can water leakage in an air cooler be addressed?
3. What may cause excessive noise in an air cooler, and how can it be rectified?
4. When an air cooler won't start, what should be checked regarding the power supply?
5. How can low or no airflow in an air cooler be improved?

6. What could be the reason if the motor hums but won't start in an air cooler?
7. Why is it essential to unplug the air cooler before attempting any repairs?
8. What is the initial step in the procedure for replacing the shaft, gasket, and blades in an air cooler?
9. How should the cooling pads of an air cooler be cleaned for optimal performance?
10. Why is lubrication important in maintaining the motor of an air cooler?

PROJECT ON AIR COOLER MANUFACTURING

PROJECT ON AIR COOLER MANUFACTURING

1. INTRODUCTION

An air cooler is a cooling device used to maintain the temperature of given space by performing cooling with humidification process. Air Coolers basically consist of body, fan, water pump and control switch.

An exhaust fan is mounted inside a cooler housing and vertical sides of the cooler housing are fitted with cooling pad. These pads are kept wet with the help of water pump. Rotation of fan mounted inside the body draws air from all the three sides through wet pads. Thus, air gets cooled by evaporation of water and which is blown into the room. Air coolers have advantages such as, they are easy to maintain, budget friendly, and portable, compared to air conditioners. Types of air coolers are:

Personal coolers – This type of air cooler is made for smaller spaces and they provide good portability. These are often called *'mini air coolers'* too.

These coolers are well known for energy saving and also cleans the air in your surroundings to provide fresh, cool air that gives you comfort against sweat and heat.

Tower air coolers – Tower coolers can give cooling in greater spaces, and in lesser time as they circulate air vertically. The air coolers are intended to be just about as calm as could be expected and make less noise.

Window air coolers – As the name proposes, window air coolers are ideal to be introduced on the window outline. The unit contains a tank that is outside the house

when introduced and it occupies no room inside the house. In spite of the fact that it occupies negligible room on the divider it gives great cooling to the room. Window air coolers are dependable as they are planned with superior plastic bodies and incorporate honeycomb pads.

Desert air coolers **–** Desert air coolers are suitable for places where humidity is low and the temperature is high. These coolers also work on the principle of evaporating heat from water and pushing cool air. As such conditions are mainly found in desert areas.

2. PRODUCT DESCRIPTION

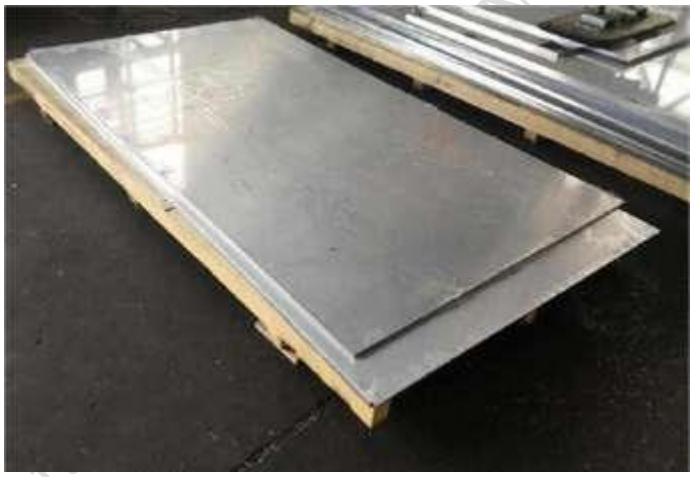
2.1 PRODUCT USES

These air coolers are suitable for places where humidity is low and the temperature is high. These air coolers are easy to maintain, budget friendly, provide good air flow and portable hence it is used for domestic use, animal shelter, for agricultural controlled atmosphere facilities.

2.2 RAW MATERIAL REQUIREMENT

The main raw materials required for manufacturing Air Cooler are as follows:

Galva1nized steel sheet – This sheet come with zinc coating and zinc coat helps to prevent corrosion.



Cooler Parts – Exhaust fan, cooler motor, cooler switches etc. Provided in cooler kit. The switches are used to on off operation or to control the air flow.

Cooler pump – The pump brings water to the evaporative cooling pads.

Cooling Pad – When the hot air passes through these pads, the heat is absorbed by the water spread on pads.


Cable/wires – Power cable, connecting wires etc.

Other – PVC or rubber Pipes, Screws, nuts etc.

4.3 MANUFACTURING PROCESS

This process can be broken down into following steps:

1. Raw material procurement
2. Metal part fabrication
3. Assembly – a) Internal parts assembly b) Final assembly
4. Testing

1. Raw material procurement

The GI steel sheet around 2-5 mm thickness, cold rolled, rectangular shape will be purchased along with other required raw material. The quantity of raw materials will be handled. Quality checking will be done. Sorting of raw material as per their types will be performed. And later material will be stored in raw material inventory.

2. Metal part fabrication

Here cooler body is made from steel metal. Grills, front panel, top cover, back side, base part, corner pillars with slots will be formed by machines and workers.

As per the design specifications, GI sheet is sheared by using guillotine shearing machine, then Punch machine is used to make slots in metal as per requirement like to maintain proper ventilation for grills, then sheet will be bent by using bending machine. Cutting machine is used to cut corners of sheet. And for assembling these parts can be riveted together or can be joined by welding, for which welding apparatus will be used.

3. Assembly

a) Internal parts assembly

After preparing the cooler body parts; base and front parts will be dispatched to next assembly line along with internal parts of cooler. First fan will be mounted at internal side of front panel of cooler. After that water pump, power switch, control switch will be fitted. Wiring connections for fan, switches, motor, and controller will be done and tested. After finishing internal parts assembly, it will be ready for final assembly.

b) Final assembly

Grills will be placed in front of fan to guide the wind to where air will move, then cooling pads will be attached with vertical sides, water pipes will be attached to distribute equal water for cooling pad, then vertical sides, back side and top cover will be assembled together. At last cooler will be painted to give it desired colour. And then it will dispatch for testing.

4. Testing

Assembled cooler is tested as per the requirement of ISO: 2000.

The basic requirements of the tests are as below:

Insulation Resistance Test – The insulation resistance between all electrical circuits when measures at normal room temperature with measure of 500 V DC should be not less than 1 Mega Ohm.

Operational Efficiency Test – Air delivery and air-cooling efficiency for various capacities of air coolers shall be within the limits.

High Voltage Test – The electrical insulation all electric circuits shall be able to withstand high voltage tests of 1000V rms for single phase motors applied for not less than 2 seconds.

3. PROJECT COMPONENTS

3.1 Land /Civil Work

The land require for this manufacturing unit will be approx. Around 2500-3000 square feet. We have not considered the cost of Land purchase & Building Civil work in the project. It is assumed that land & building will be on rent & approx. rental of the same will be Rs.30000.00 to 40000 per month.

3.2 Plant & Machinery

This manufacturing unit will be semi-automatic type and the capacity of this plant will be dependent on the number of factors like total numbers of machines we are using in unit, how much pieces of remote the plant produces daily etc.

Guillotine shearing machine

A guillotine is a machine tool that used to cut steal sheet metal. The machine may be foot powered, less commonly hand powered, or mechanically or hydraulically powered. It works by first clamping the material with a ram. A moving blade then comes down across a fixed blade to shear the sheet. Mechanical shears are faster in full cycle mode. Mechanical shears have simpler mechanisms to maintain and repair making up time longer and downtime shorter.

Power Press machine

Power Press is a functional sheet metal machine that is utilized for bending, cutting, pressing and forming work piece into different sizes and shapes. This press machine will be used to cut steel into the desired shape required to make cooler body parts.

Metal cutting machine

Metal cutting machines are machine tools used for cutting out parts of metal.

Bending machine

Bending machine used for bending and straightening metal sheets and strips.

Drill machine (Portable)

It used for drilling holes whilst assembly of cooler takes place.

Gas welding apparatus

The gas welding is used for joining metal sheets and plates having thickness of 2 to 50 mm.

Air compressor with spray gun

This can be used for paint the cooler body. Paint sprayers can override bumps, cracks, gaps. Tools like measuring tape, wire, cable strippers, screwdrivers, electronic pliers, crimping tools, thermal wire strippers, cable cutters etc. will be required.

Tools requires for testing:

Air flow & temperature measuring apparatus.

1) Anemometer

An anemometer is a device used for measuring wind speed and direction

2) Insulation tester

It is an electrical meter used to determine the condition of the insulation on wire and motor windings.

7. LICENSE & APPROVALS

It is required to obtain the following lincense and approvals to start the Air Cooler manufacturing unit.

1. Obtain Trade License from the local authority.

- MSME Udyam online registration.
- GST Registration
- Company registration (optional)
- Factory license

Glossary

Heating Element: A component that converts electrical energy into heat, commonly used in electric irons and air coolers to generate warmth.
Thermostat: A device used in electric irons and air coolers to control the temperature, ensuring safety by preventing overheating.
Ball Bearing: A mechanical component used in electric fans to reduce friction and ensure smooth rotation of the fan blades.
Motor: The component that converts electrical energy into mechanical energy, driving the operation of electric fans and air coolers.
Capacitor: A device used in electric fans and air coolers to store and release electrical energy, providing the initial surge needed to start the motor.
Fuse: A safety device designed to protect electrical appliances like electric irons, fans, and air coolers from excessive current by breaking the circuit.
Winding: The coiled wire inside electric motors, essential for creating a magnetic field when current flows through, used in fans and air coolers.
Multimeter: A tool used by technicians to measure voltage, current, and resistance in electrical appliances like irons, fans, and coolers for troubleshooting and repair.
PCB (Printed Circuit Board): A board with electrical circuits etched onto it, used in modern appliances to control functions like fan speed or temperature regulation.
Evaporative Cooling: The process used by air coolers where water absorbs heat from the air, turning into vapor and lowering the air temperature.
Blower: A device in air coolers that circulates cooled air by blowing it over the cooling pads, spreading cool air throughout a room.
Thermal Fuse: A protective device that prevents overheating in electric irons by cutting off power when a certain temperature is exceeded.

Oscillation Mechanism: The part of an electric fan that allows the fan head to move side to side, distributing airflow across a wider area.
Resistor: An electronic component used to control the flow of current in appliances like electric irons, helping to regulate heat output.
Grounding: A safety feature in electrical appliances that prevents electric shock by directing excess electricity into the ground.
Water Pump: A component in air coolers responsible for circulating water from the reservoir to the cooling pads for efficient evaporation and cooling.
Element Insulation: A material used in electric irons to insulate the heating element, preventing heat loss and ensuring user safety.
Blade Pitch: The angle at which the blades of an electric fan are set, affecting the airflow and cooling efficiency.
Condenser: A component that stores electrical energy and helps in starting the motor, often found in fans and coolers.
Descaling: The process of removing mineral deposits from water tanks and cooling pads in air coolers to ensure efficient operation and longevity.

Answer

Module 1. Installation, Repair and Maintenance of Electric Iron

Session1. Installation and Operation of Electric Iron

A. Multiple Choice Questions

1. (c) 2. (b) 3. (b) 4. (c) 5. (c) 6. (d) 7. (b) 8. (b) 9. (a) 10. (c)

B. Fill in the blanks

1. Heat and pressure 2. Current 3. More portable 4. Uncomplicated 5. Durability and heat distribution 6. Much space 7. Heating Elements 8. At the desired level 9. User-controlled dial or button 10. functionality and safety

C. State true or False for the following

1. (T) 2. (F) 3. (T) 4. (F) 5. (F) 6. (T) 7. (T) 8. (T) 9. (F) 10. (F)

Session 2. Troubleshooting and Repairing of Dysfunctional Electric Iron

A. Multiple Choice Questions

1. (b) 2. (a) 3. 3. (c) 4. (c) 5. (c) 6. (b) 7. (a) 8. (b) 9. (c) 10. (c)

B. Fill in the blanks

1. Specifications 2. Fluctuation 3. Tank 4. Screwdriver 5. Components 6. Nozzle 7. Metal parts 8. Reservoir 9. Service center 10. Repaired or replaced

C. State true or False for the following

1. (F) 2. (T) 3. (T) 4. (T) 5. (F) 6. (F) 7. (F) 8. (T) 9. (T) 10. (F)

Module 2. Installation, Repair and Maintenance of Fan

Session 1. Installation of Electric Fan

A. Multiple Choice Questions

1. (b) 2. (c) 3. (a) 4. (c) 5. (b) 6. (c) 7. (c) 8. (a) 9. (b) 10. (b)

B. Fill in the blanks

1. Circulate air efficiently 2. Slim and compact design 3. To regulate fan speed 4. Fan's height and clearance 5. Prevent accidents 6. Electric shocks 7. The motor housing and blades 8. Mechanical energy 9. Adjustable in height 10. Personal use

C. State True False for the following

1. (F) 2. (T) 3. (F) 4. (T) 5. (T) 6. (T) 7. (T) 8. (T) 9. (T) 10. (T)

Session 2. Troubleshooting and Repairing of Dysfunctional Electric Fan

A. Multiple Choice questions

1. (a) 2. (c) 3. (c) 4. (b) 5. (a) 6. (a) 7. (c) 8. (b) 9. (c) 10. (c)

B. Fill in the blanks

1. Off 2. Ohms 3. Faulty 4. Faulty 5. Properly 6. Discharge tool 7. Condition 8. Faulty 9. Shorted 10. Blown

C. State True False for the following

1. (T) 2. (F) 3. (F) 4. (T) 5. (F) 6. (T) 7. (F) 8. (F) 9. (F) 10. (F)

Module 3. Installation, Repair and Maintenance of Air Cooler

Session 1. Installation of Cooler

A. Multiple Choice questions

1. (b) 2. (b) 3. (c) 4. (d) 5. (b) 6. (b) 7. (c) 8. (c) 9. (b) 10. (a)

B. Fill in the blanks

1. Cools 2. Vertically 3. Window sill or window frame 4. Watts 5. Energy 6. CFM (Cubic Feet per Minute) or BTUs (British Thermal Units) 7. Fan 8. Ventilation 9. Operational 10. Power

C. State True False for the following

1. (T) 2. (F) 3. (T) 4. (F) 5. (F) 6. (T) 7. (T) 8. (T) 9. (T) 10. (T)

Session 2. Troubleshooting and Repairing of Dysfunctional Air Cooler

A. Multiple Choice questions

1. (b) 2. (d) 3. (b) 4. (b) 5. (a) 6. (b) 7. (b) 8. (c) 9. (c) 10. (d)

B. Fill in the blanks

1. To the windings 2. Water pumping motor 3. Air travelling 4. Large pressure 5. Dust build-up 6. Proper lubrication 7. Misalignment 8. Imbalances 9. Damage or wear 10. Maintenance.

C. State True False for the following

1. (T) 2. (T) 3. (T) 4. (T) 5. (T) 6. (F) 7. (F) 8. (T) 9. (F) 10. (F)