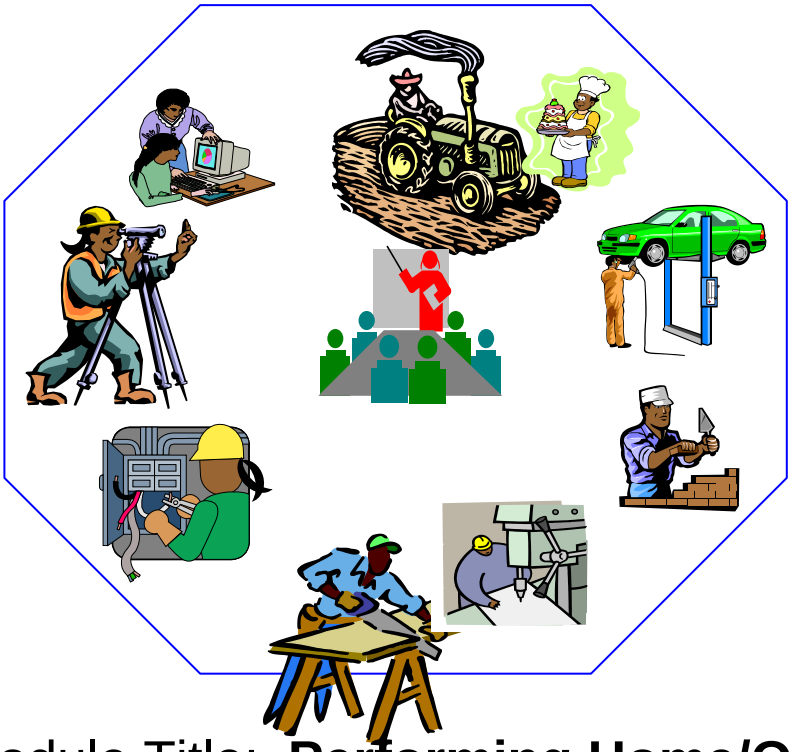
Intermediate Home/Office Electrical/ Electronic Equipment III

Based on Dec, 2020 Version OS and Dec, 2020 Version Curriculum



Module Title: **Performing Home/Office Electrical/Electronic Equipment Maintenance**

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LG #1	LO #1- Prepare to install home/office electrical/electronic equipment

Instruction sheet

This learning guide is developed to provide you the necessary information regarding the following content coverage and topics:

- OH &S and safety procedures
- Preparing work station and equipment
- Maintain/repair product

Test repaired unit/product This guide will also assist you to attain the learning outcomes stated in the cover page. Specifically, upon completion of this learning guide, you will be able to:

- Prepare unit, tools and workstation
- Diagnose faults
- Maintain/repair product

Learning Instructions:

1. Read the specific objectives of this Learning Guide.
2. Follow the instructions described below.
3. Read the information written in the “Information Sheets”. Try to understand what are being discussed. Ask your trainer for assistance if you have hard time understanding them.
4. Accomplish the “Self-checks” which are placed following all information sheets.
5. Ask from your trainer the key to correction (key answers) or you can request your trainer to correct your work. (You are to get the key answer only after you finished answering the Self-checks).
6. If you earned a satisfactory evaluation proceed to “Operation sheets
7. Perform “the Learning activity performance test” which is placed following “Operation sheets” ,
8. If your performance is satisfactory proceed to the next learning guide,
9. If your performance is unsatisfactory, see your trainer for further instructions or go back to “Operation sheets”.

Information Sheet 1:- Requiring pre-test instruments

1.1 **Electrical Personal Protective Equipment (PPE)**

Qualified workers are responsible for avoiding and preventing accidents while performing electrical work, repairs, or troubleshooting electrical equipment. Personnel shall wear or use personal protective equipment (PPE), and protective clothing that is appropriate for safe performance of work.

- Electrical Safety Shoes

For safety, one should always wear and take care of electrical safety shoes whenever one works in the vicinity of energized equipment's. Unlike regular safety shoes, electrical safety shoes do not have any exposed metal parts. These are specially designed using non- conducting materials to provide insulation from electric shock.

Figure 1: safety Shoes

- Rubber Gloves

Based on the wall thickness and maximum safe voltage rating, the rubber insulating gloves are classified in various categories. Some of the generally used gloves are shown below inFig.4.

Figure 2: rubber Gloves

- Safety Shorting Probe

Some electronic equipment use large capacitors to filter the electrical power. These capacitors must be discharged before working on the equipment. A safety authority probe will be required for this. The procedures to be minimally followed are:

- ✓ Ensure that input power has been unplugged.
- ✓ Open the equipment to discharge the capacitors. Don't touch any naked terminals without safety gloves on

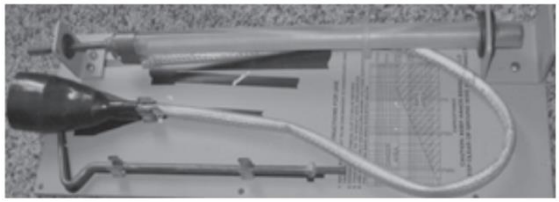


Figure 3: safety Shorting Probe

- Retina Protection

An electronics technician must protect his eyes for this, he needs to know:

- ✓ When to wear eye protection.
- ✓ Which eye protection to wear.
- ✓ Whenever you are doing something that could potentially damage your eyes, you must have eye protection on.

Figure 4**:** google

- Hearing Protection

Working around noisy equipment, may cause damage to eardrums. Generally, this damage manifests itself slowly. Working at places with high vibration field could cause slow and consistent hearing deficit leading to complete or partial deafness. This can be minimized by wearing hearing protection.

The various types of hearing protective aids are shown below.

Figure 5: headphone

- Respiratory Protection

Whenever you work with materials that can possibly lead to respiratory issues, one must take precautions and wearing safety masks is advisable. Some of the masks used in industry are shown in Fig.6.

Figure 6: safety masks

1.2 OH&S Policies and procedures

Occupational health and safety is an aspect of public health program. Creating a healthy workplace and a healthy work force in any occupational environment is the best way to position that occupation to better delivery of service. Concern for your own safety as well as the safety of others should always be on your mind. Most safety procedures are common sense but, because some hazards are not obvious, there are regulations born out of experience which are designed to make the workplace safer. The need to use safe working practices and safety equipment is to avoid the risk of injury to yourself and to others in the course of your work.

1.2.1 Need of occupational health and safety:

- ✓ We have to ensure in all business about the care of technicians and all the persons involved in business for good health all the time.
- ✓ It provides technicians lives and health.
- ✓ Occupational safety and health rules can decrease technician's injury and illness.

In general, Occupational health and safety (OHS) policies and procedures protect the safety, health and welfare of people at the work place.

1.2.2 Safety requirements of equipment/tools

There may be particular requirements on the equipment you use at work; where this is the case the leaflet will point you towards further information you may need.

1.2.3 What equipment is covered by the Regulations?

Generally, any equipment which is used by an employee at work is covered, for example hammers, knives, drilling machines, power presses, and printers, photocopiers, lifting equipment (including lifts), and motor vehicles. Similarly, if you allow technicians to provide their own equipment and you will need to make sure it complies. Examples of uses of equipment which are covered by the Regulations include starting or stopping the equipment, repairing, modifying, maintaining, servicing, cleaning and transporting.

1.2.4 Codes, Standards, and Regulations

Workers who perform electrical or electronic work, where applicable, shall comply with relevant DOE Orders and should comply with the current revision of the following codes and standards.

- Standards published by the National Fire Protection. Association (NFPA)
  - ✓ National Electrical Code (NEC), NFPA 70

- ✓ Electrical Safety Requirements for Employee Workplaces, NFPA 70E.

- National Electrical Safety Code, ANSI C2.
- All relevant state and local requirements.

The standards and performance specifications from the following organizations are recommended and should be observed when applicable:

- Institute of Electrical and Electronics Engineers (IEEE)
- National Electrical Manufacturers Association (NEMA)
- American National Standards Institute (ANSI)
- American Society for Testing and Materials (ASTM)
- National Fire Protection Association (NFPA)
- Underwriters Laboratory, Inc. (UL)
- Factory Mutual Engineering Corporation (FMEC)
- Other Nationally Recognized Testing Laboratories recognized by OSHA on a limited basis.

Where no clear applicable code or standard provides adequate guidance or when questions regarding workmanship, judgment, or conflicting criteria arise, personnel safety protection shall be the primary.

Self-Check 1	Written Test

Directions: Answer all the questions listed below. Use the Answer sheet provided in the next page:

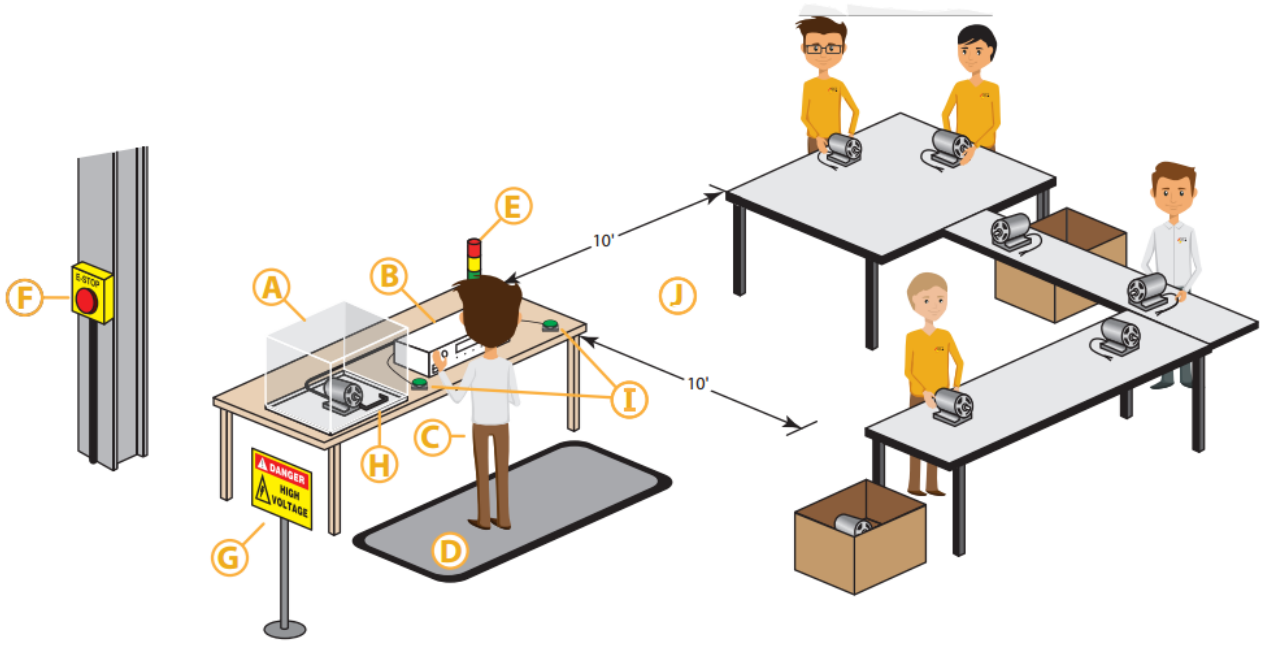
1. **Selection of proper tools, instruments, and other equipment will ensure maximum safety and productivity. (True, False) (1 points)**
2. **Equipping the workshop with the correct tools and equipment plays an essential role in achieving timely and good results. (True, False) (1 points)**
3. **Faulty tools, test instruments and equipment is a common reason for poor maintaining work. (True, False) (1 points)**
4. **Qualified workers are responsible for avoiding and preventing accidents while performing electrical work, repairs, or troubleshooting electrical equipment. (True, False) (1 points)**
5. **Some electronic equipment use large capacitors to filter the electrical power. These capacitors must be discharged before working on the equipment. (True, False) (1 points)**

Information Sheet2 :- Preparing work station and equipment

2.1 Required test instruments

Setting up a Safe Workstation

one of the best ways to prevent injury is to ensure that the test station is set up safely and securely. Test stations can be setup with or without direct protection depending on your requirements. Direct protection means that the operator cannot physically come into contact with an energized DUT/device under test/ while a test is running



2.2.1. Service manuals

Service manuals are available for a great deal of consumer electronics. Once you have exhausted the obvious possibilities or mechanical problems, the cost may be well worth it. Depending on the type of equipment, the price becomes more. Some are more useful than others.

However, not all include the schematics so if you are hoping to repair an electronic problem try to check before buying.

The availability of up-to-date, accurate, and complete diagrams is the foundation of a successful electrical preventive maintenance program. No electrical preventive maintenance program can operate without them, and their importance cannot be overemphasized. The following diagrams are some of those in common use:

2..1.1 operating instructions/User's/Owner's manual

2.1.2 Component data sheet/handbook

2.1.3 Operating instructions/User's/Owner's manual

Operating Instruction manual prepared by the equipment manufacturer which contains detailed instructions and notes on the operation and use of the machine. Before using the machine/equipment the user must read the manual carefully for his/her safety and benefit, The manual must be kept in a handy place for quick reference.

3.1.2 Component data sheet/handbook

Ultimate success for an electronic or electrical product design can only be achieved through judicious selection of component parts for use in that design. The increasingly competitive economic environment no longer allows designer complacency if corporate survival is to be assured.

Handbook of Components for Electronics prepared thorough and comprehensive sourcebook of practical data, guidelines, and information for all ranges of interests. It contains a next ensive array of property and perform anecdata for all the important component groups; these are presented as a function of the most important design and performance variables. Further, it presents comparison data and guidelines for best trade-off design decisions, extensive test and reliability data, detailed listings of important specifications and standards, a wealth of data and information on dimensions, configuration, and mechanical and environmental performance.

3.2 Service Information

3.2.1 Job Orders

Definition: Job order is a documented task specifications that an individual is required to complete the task at a given unit of time.

Job orders are very much and highly recommended for each and every skilled worker in his/her work environment particularly in almost all industries. In which, most of these industries required it for the purpose of written report or a documented report of the task being perform.

There are several kinds of job orders as well as formats and required information that may vary depending upon the nature of the industry or a service center.

JOB ORDER CONTENTS

Job Order Control Number	is basically non-identical number usually located at the upper left or right corner of the sheet usually written in different color
Name of Client	This field contains the clients name usually divided in three (3) parts, the family name, first/given name and the middle initial. But some job orders may only have one (1) single field that requires the complete name of the client.
Contact Number	requires the client contact number either a cellular phone number or a landline telephone

Client's Address	requires the current address of the client
Job Description	represents the overall overview of the task to be perform
Date and Time	The date when the job order is requested of delivered
Date Finished	The date when the task is completed.
Signature	Signatures are areas of the job order form that requires the signature of the technician and the client that serves as the specimen of agreement between the two parties.

JOB ORDER

Job Order No:			Date:	
Name of Client:	(Family Name):	(Given Name):	MI:	Contact No:
Client's Address:				
Appliance Type:	Brand name:	Model:	Serial:	Color:
Appliance Physical Pre-Conditions: 1. _____ 2. _____ 3. _____			Symptoms: 1. _____ 2. _____ 3. _____	
Date & Time Received: Date_____/Time_____	Expected Date & Time to be released: Date_____/Time_____		Received by:	
Assigned Technician:	Date Received:		Technician's Pre-Condition Findings: 1. _____	

_____		2. _____
Diagnose Results: 1. _____ 2. _____ 3. _____		
Replacements: (If any)		

No. of Items	Description	Price/Unit	Total/Unit	Remarks
TOTAL AMOUNT:				

Report: _____ _____ _____		Signature of Technician:
Total Billing: (Amount in words)		(w/ Service Charge)
Date & Time Released: Date_____/Time_____	Released by:	Received by: (Owner)

Tabel-1: Sample Job Order

Preparing Job Orders

For most service centers, preparation of job before the start of every task is required. Basically, preparing job orders are just filling out the information required. In addition, a short conversation should take place between the owner and the one who prepares the job order.

Most of the questions that should be ask:

1. When was this equipment started to show irregular operation or malfunctioning.

2. Events took place before the fault happened

3. Repair history of the equipment if any.

These questions are most likely to be ask, since this information could lead some conclusions and future awareness.

Interpreting Job Orders

For most of the industry they provide job orders to their skilled workers to have a concrete formal request of the task to be done. Before each task to be done the worker should be able to secure the job order, “no job order means NO task to be done”. Upon receiving the job order make sure that all required fields are correctly and clearly written.

First, check date and Job Order control number for its validity. Next, is to check the client’s name, address and contact number, this information is highly required, which means that if this required information are missing, the worker should refer to the immediate supervisor.

The most important part of the job order is the task description in which each worker should be able to understand and be able to attain the task requirement within the specific period of time which is also can be seen under the date and time of completion.

LG #2	LO #2- Diagnose faults

Instruction sheet

This learning guide is developed to provide you the necessary information regarding the following content coverage and topics:

- **Requiring test instruments**
- **Observing Pre-testing procedure**
- **Identifying defective/faulty symptoms**
- **Checking adjustments/settings**

This guide will also assist you to attain the learning outcomes stated in the cover page. Specifically, upon completion of this learning guide, you will be able to:

- **Requiring test instruments**
- **observing Pre-testing procedure**
- **Identifying defective/faulty symptoms**
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Information Sheet1 :- Required test instruments

2.1 Inspection and Testing of Electrical Equipment

1. Purpose

Electrical equipment is used extensively throughout STFC and includes portable, movable, stationary, hand held and built in appliances, along with extension leads and multiway adaptors. The purpose of this code and electrical legislation is to minimise possible hazards, such as electric shock, fire and electrical burns, arising from electrical equipment.
Electrical equipment should only be used for the purpose for which it was intended and in the environment for which it was designed and constructed. To comply with legislation electrical equipment should be properly maintained, inspected and tested to prevent danger.
Electrical maintenance is the subject of extensive and detailed legislation and guidance:

- Provision and Use of Work Equipment Regulations 1998
- Electricity at Work Regulations 1989
- The Electrical Equipment (Safety) Regulations 1994
- Waste Electronic and Electrical Equipment Regulations 2006 (WEEE directive)
- BS7671: Requirements for Electrical Installations
- Code of Practice for In-service Inspection and Testing of Electrical Equipment (IET)

2.2 Testing instruments

Test equipment is necessary for determining proper set-up, adjustment, operation, and maintenance of electrical systems and control panels.

Figure 5.4 multimeters

VOLTMETERS: For measuring differences of potential (voltage) between two points in an electrical circuit. The instrument is connected in parallel with the circuit being measured. Ranges vary from a few tenths volt to a few thousand volts. Instruments are capable of measuring both A.C. and D.C voltage.

OHMETERS: For measuring the electrical D.C. ohm resistance of a circuit, circuit part, or component. Calibrated from zero ohms to infinite. Measures either series or parallel resistance.

AMMETERS: Measure magnitude of electrical current flow in an electrical circuit. When measuring D.C. currents, some types must be inserted in series with the circuit. A.C. ammeters are of two types. One requires that it be connected in series with the circuit; the other needs only to be clamped around the current carrying conductor.

checks carried out on test instruments

Test instruments that are to be used or connected to electrical equipment should meet the following conditions:

1. be suitable for the work in terms of their function, operating range and accuracy be in good condition and working order, clean and have no cracked or broken insulation. Particular care must be taken regarding the condition of the insulation on leads, probes and clips of test equipment pose no danger of electrocution to workers or damage to the electrical equipment during testing have suitably insulated leads and connection probes that enable connection or contact with energised parts to be made with minimal risk to the electrical worker provide suitable protection against hazards arising from over-voltages that may arise from or during the testing or measurement process.
2. Test probes and other equipment should be designed and selected so that they cannot inadvertently short circuit between live conductors or live conductors and earth. The terminals of test equipment should be shrouded and all other test sockets on measuring instruments should be designed so as to prevent inadvertent contact with any live test socket or conductor when equipment is in use. Where appropriate, test leads and testing devices need to be provided with suitable fuse protection. Testing equipment, where used in hazardous flammable areas, should be designed and clearly marked as being suitable for use in these conditions.
3. Testing equipment used for detecting an energised source should be checked to prove that it is functioning correctly immediately before and after the test has taken place. The standard test regime is to test a known source of energy, test the de-energised circuit for zero volts then test the known source again.

Proximity voltage testers

1. To confirm a positive indication and to establish the circuit voltage, the use of an alternative test instrument that incorporates a visual display should be used before commencing electrical work on the equipment.
2. Testers for detecting an electric field surrounding an energised conductor may not be suitable for testing cables that are surrounded by a metallic screen, enclosed in a metallic pipe or duct, or cables carrying direct current and in some other circumstances.

Proximity voltage testers are not reliable in proving de-energised and should only be treated as an indicator. Proximity voltage testers should be tested for correct operations immediately before use and again immediately after use, particularly if the test result indicates zero voltage, to confirm that the instrument is still working correctly.

Self-Check -1	Written Test

Name: _____ Date: _____

Directions: Answer all the questions listed below.

PART I TRUE/FALSE(3 ponts each)

If the statement is correct write TRUE if the statement is in correct write FALSE
_____1.Solderined gun can be used for connecting..

_____2. Long nose plier can not be used to splice wires.

PART II CHOOSE THE BEST ANSWER(3 points each)

1. _____ is used to measure magnitude of electrical current flow in an electrical circuit

   A. ammeters **C. ohmeters**

   B. voltmeters **D. all**

2. _____used to both patients and HCW from exposure to potentially infectious microorganisms that may be carried on the hands..

   A. Face Protection C. Gloves

   B. Clothing D. Footwear

Note: **Satisfactory rating - 6 points** **Unsatisfactory -6 below points**

You can ask your teacher for the copy of the correct answers.

Score = _____

Rating: _____

Name: _____ Date: _____

Information Sheet 2 :- Pre-testing procedure

2.1 Pre-testing procedure

Pre testing is the process of testing before the post testing is done to identify the defect /faulty parts of the electronically controlled domestic equipment.

2.1 Why Test?

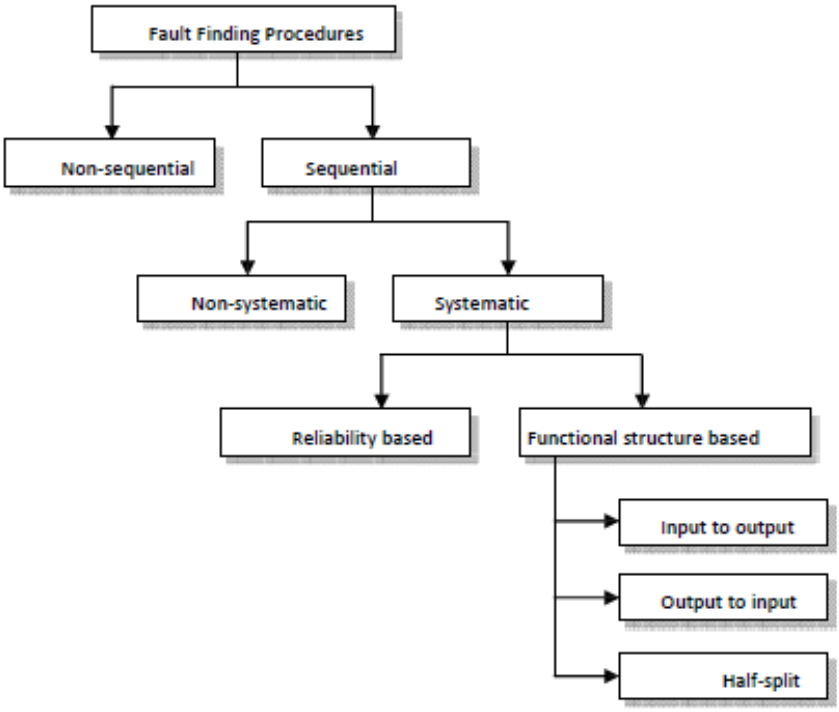
There are four main reason why you should safety test your products prior to shipment

1. Safety	Ensure that the product is not going to pose a hazard to the end user.
2. Quality	Detect workmanship defects and prevent faulty components from being installed.
3. Cost Control	Identify production problems before a product is shipped, preventing costly recalls.
4. Liability	Prevent product liability suits because the responsibility of performing electrical safety tests ultimately rests on the manufacturer

Table 1

- **The following are the general pre testing procedures.**

1. Visual inspection of the unit with power off
2. Interview of customer re history of unit
3. Be sure you understand how the domestic appliance (washing machine, micro-oven, refrigerator etc.) operates. If possible, read the operation's manual first for its function and additional features.
4. Operate the appliance according to manual to confirm defects
5. Determine what the problem really is.
6. Perform preliminary inspection to locate where the problem has originated.
7. Perform closer inspection into the suspected parts or components.
8. Use appropriate instrument in initial testing of the appliance.
9. Plan your approach to repair the problem.


Fault Finding Procedures
Non-sequential
Sequential
Non-systematic
Systematic
Reliability based
Functional structure based
Input to output
Output to input
Half-split

Self-Check -2	Written Test

Directions: ***For the Following Questions You are Given Four Alternatives then Choose the Correct Answer and circle***

1, which one of the is general pre testing procedures.*(3 pt each)*

A, Plan your approach to repair the problem. B, Determine what the problem really is. C, Interview of customer re history of unit D, all of the above

2, which one of the main reason why we should safety test your products prior to shipment. A, quality B, Cost control C, safety. D all *(3 pt each)*

3, Pre testing is the process of testing before the post testing is done to identify the defect /faulty parts of the electronically controlled domestic equipment. A, true B, false *(3 pt each)*

Note: Satisfactory rating 4 and above points Unsatisfactory below 4 points

Answer Sheet

Score = _____

Rating: _____

Name: _____ Date: _____

Information Sheet2 :- Identifying defective/faulty symptoms

3.1 FAULT FINDING

A fault is defined as a disturbance in an electrical system of such magnitude as to cause a malfunction of that system. It must be remembered, of course, that such disturbance may be the secondary effects of mechanical damage or equipment failure. Actual electrical faults, or should one say faults that are caused by 'electricity ', are rare and are confined in the main too bad design and/or installation or deterioration and ageing.

3.2 Troubleshoot and Fault localizing

Trouble shooting means finding the problem that is occur in the equipment.Before you begin to troubleshoot any piece of equipment, you must be familiar with safety rules and procedures for working on electrical equipment. These rules and procedures govern the methods you can use to troubleshoot electrical equipment (testing procedures.) and must be followed while troubleshooting.

Next, you need to gather information regarding the equipment and the problem. Be sure you understand how the equipment is designed to operate. It is much easier to analyze faulty operation when you know how it should operate. Operation or equipment manuals and drawings are great sources of information and are helpful to have available. If there are equipment history records, you should review them to see if there are any recurring problems. During trouble shooting schematic diagram is important to see components of the equipment and to find the fault easily and to reduce the time required to find the fault in different components of the equipment.

Functional block diagram is simple than schematic diagram but for maintenance it is better to use schematic diagram. That is, functional block diagram is simply used to explain how the equipment operates or the operation of the circuit. So to locate different parts of the equipment schematic diagram is preferable.

When trouble shooting is carry out we should have service data that gives the value of each component, the block diagram and the output of each block. Therefore it is important to detect the fault easily.

Service data includes theory of operation, schematic diagram, functional block diagram, spire part lists, trouble shooting procedures and alignment procedures.

Visual inspection: - is important to localize the faulty component during trouble shooting. Fault localizing means determining the functional unit or the electronic equipment responsible for the indicated fault. In the initial inspection of any equipment, first open the equipment to look at it. There are several things that can observe by using our sense of organs. Such as broken parts, burned resistors, open wires and poor connections, there can be smoke or smell, damaged or worn out parts. Many troubles can be located with initial inspection using our senses. The final solution involves application of our knowledge of electronic circuit operation and understanding of proper usage of the test equipment. In this step by using test instruments we can check the continuity (open circuit), short circuit, ground etc and also input output tests on the proper units is performed in order to locate the one that was actually at fault.

Testing is an experiment in which the system is exercised and its resulting response is analyzed to check its behavior. If incorrect behavior is detected, the system is diagnosed and locates the cause of the misbehavior. Diagnosis requires the knowledge of the internal structure of the system under test.

The task of detecting and diagnosing fault on appliances lies on technicians. Successful fault finding calls for an additional skill set, including the ability to:

- devise a plan;
- think logically;
- select and use a range of test equipment;
- make a detailed record of the process.

steps to Fault Finding

Step 1 - Prepare

- Are there any safety issues?
- What test equipment do you intend to use?
- Document your findings!

Step 2 - Observe

- Are there signs of damage - overheated components, melted insulation, frayed wire, bad solder joints?
- Can you smell burning or overheating?
- Take voltage measurements from a working circuit.
- Take voltage measurements from the faulty circuit to compare.
- Document your findings!

Step 3 - Identify the problem subsystem

- Which subsystems are operating correctly?
- Where does the problem seem to lie?
- Document your findings!

Step 4 - Suggest possible causes

- Check likely components:
- Switches, fuses and bulbs tend to wear out or burn out.
- Check possible components:

- Motors, relays, inductors - components with coils - may overheat.
- Check connections:
- Look for faulty connections or loose contacts which may offer high resistance.
- Look for stray connections that can short-circuit.
- Look for breaks that create open-circuit conditions.
- Document your findings!

Step 5 - Test and repair

- Be safe! Remember -
- capacitors can store electrical charge and give electric shocks;
- Inductors can store energy in a magnetic field and give electric shocks.
- Take measurements around the circuit, but mentally predict what they should be.
- In this way, home in on the problem component(s), and replace it(them), observing all safety procedures.
- Next, re-test the system to ensure that no other faults exist.
- Document your findings!

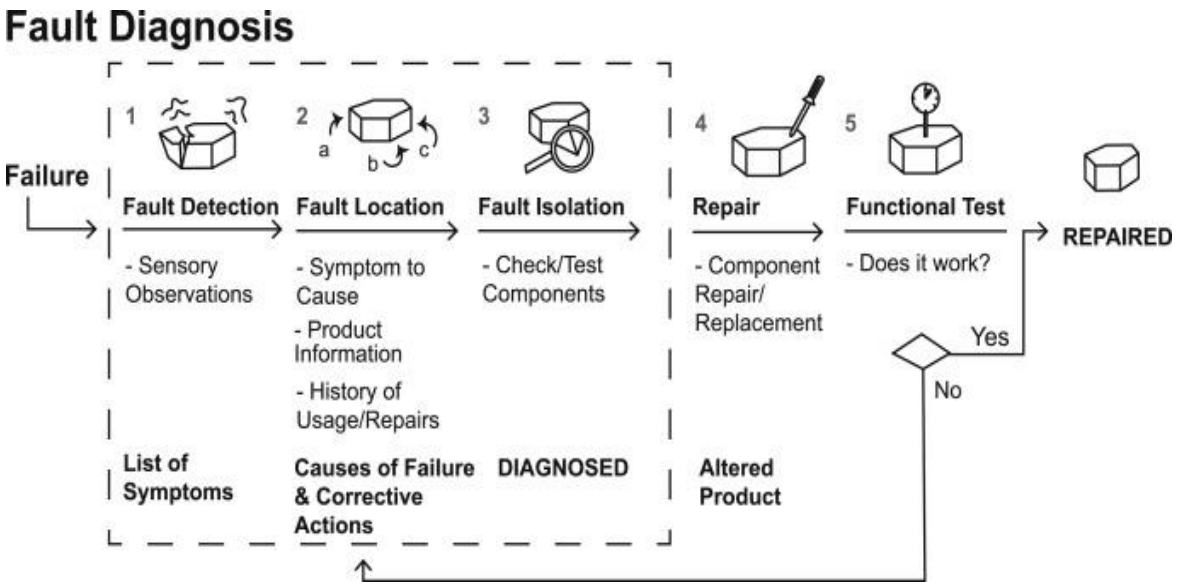
3.3. Common faults and their symptoms:

✓ **Short circuit**:

- zero volts between positive and 0V power rails everywhere;
- power supply output voltage restored when the circuit is removed from the supply;
- excessive current drawn from power supply;
- the fuse protecting the circuit may 'blow';
- zero ohms between power rails, (with circuit removed from power supply.)

✓ **open circuit:**

- zero volts between positive and 0V power rails at one end of the circuit, but not the other;
- part of the circuit may function while another part does not;
- reduced or zero current drawn from power supply.
- reverse connection:
- can occur in 'polarised' components - ones which only work when connected the 'right' way round, e.g. diodes, LEDs, transistors and some capacitors;
- can be the result of the power supply or battery being connected to the circuit the 'wrong' way round;
- produces an unusual voltage drop across the component.
- incorrect value or faulty component:
- an incorrect value can be identified by examining the component against that specified in the circuit diagram;
- a faulty component may show signs of overheating or mechanical damage;
- both produce an unusual voltage drop across the component.
- incorrect component:
- can be identified by examining the component against that specified in the circuit diagram;
- produces an unusual voltage drop across the component.



f ig 3.1 fault diagnisis procedures

3.4 Importance of Testing

In Today's Electronics world, more time is required for testing rather than design and fabrication. When the circuit/device is developed, it is necessary to determine the functional and timing specifications of the circuit/device. When the multiple copies of a circuit are manufactured, it is essential to test each copy to verify whether the manufacturing process has introduced any flaws. In order to meet the requirements of the consumer, it is essential to test the circuit effectively, before it is released into the market.

Good Testing leads to:

- ☞ Better quality products
- ☞ Good brand value for company
- ☞ Total Customer satisfaction improves yield in manufacturing

A. Testing Principle

During testing, a set oftest stimulus are applied to the inputs of the Circuit/Device under test (CUT/DUT) and the output responses are analyzed. Circuits that produce the correct output responses for all input stimuli are considered as fault-free and the circuits that fail to produce a correct response are assumed to be faulty.

- ➢ ***Types of Testing***

Manual testing and Automated Testing:

Devices can be tested in two ways, manually and automatically. Testing Devices with human intervention is referred as Manual test. Testing devices with the help of programs or tools with minimal human intervention is referred as Automation test. Before Automation testing of any device, one must know how to test the particular device manually.

To identify system defects and fault symptoms follow the following basic steps

- Observe systematic pre-testing procedures in accordance with manufacturer's instructions
- Check and isolate circuits using specified testing procedures

- Document results of diagnosis and testing accurately and completely within the specified timeframe Explain identified defects and faults based on the result of diagnosis and testing
- Provide data/information regarding the status and serviceability of the unit as per procedure

Self-Check -2	Written Test

Directions: ***For the Following Questions You are Given Four Alternatives then Choose the Correct Answer and circle***

1, which one of the is not Good Testing. A, Better quality products *B,* Good brand value for company *C,* Total Customer satisfaction improves yield in manufacturing D, none of the above *(3 pt each)*

2, A fault is defined as a disturbance in an electrical system of such magnitude as to cause a malfunction of that system. *(3 pt each)*A, true B, false *(3 pt each)*

*3,*Visual inspections important to localize the faulty component during trouble shooting. A, true B, false *(3 pt each)*

Note: Satisfactory rating 4 and above points Unsatisfactory below 4 points

Answer Sheet

Score = _____

Rating: _____

Name: _____ Date: _____

Information Sheet 3 :- Troubleshooting procedures

4.1 What is troubleshooting?

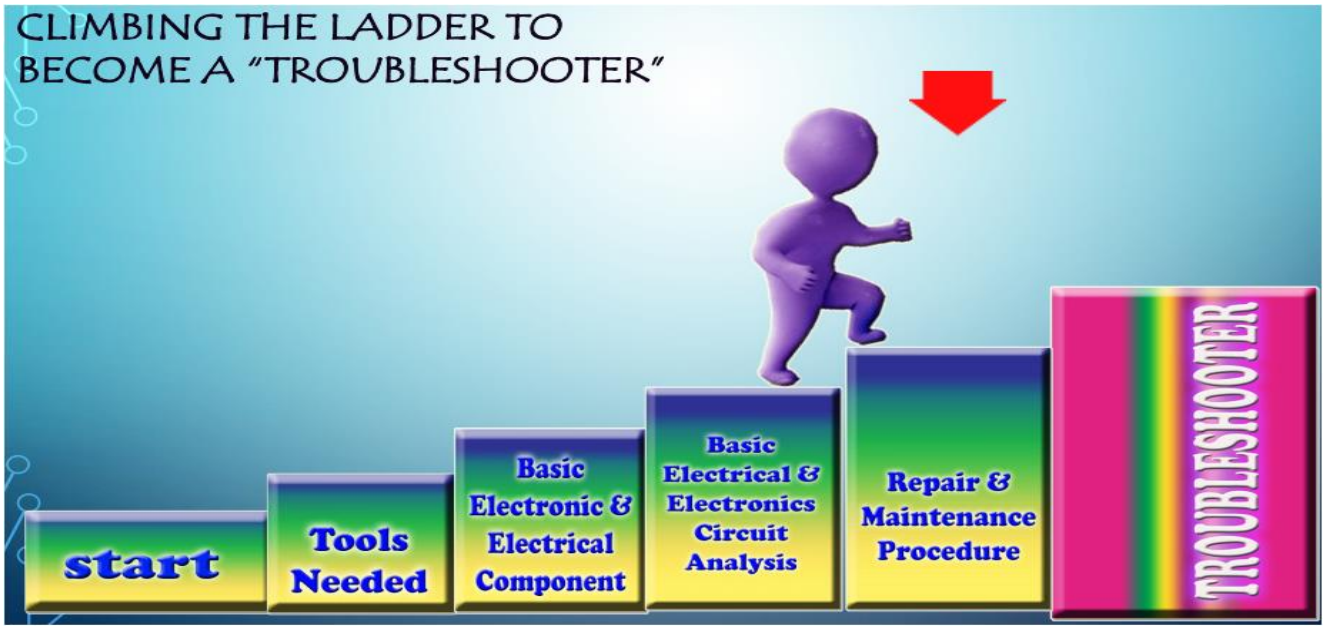
Troubleshooting is a form of problem solving, often applied to repair failed products or processes. It is a logical, systematic search for the source of a problem so that it can be solved, and so the product or process can be made operational again. Troubleshooting is needed to develop and maintain complex systems where the symptoms of a problem can have many possible causes.

- Troubleshooting is used in many fields such as engineering, system administration, electronics, automotive repair, and diagnostic medicine. Troubleshooting requires identification of the malfunction(s) or symptoms within a system. Then, experience is commonly used to generate possible causes of the symptoms. Determining which cause is most likely is often a process of elimination - eliminating potential causes of a problem. Finally, troubleshooting requires confirmation that the solution restores the product or process to its working state

4. 2 Basic steps of Troubleshooting

Step1 analysis
Step2 problem identification/replication
Step3 action plan
Step4 implementation
Step5 testing
Step 6 documentation
Step7 follow up

Figure 1


CLIMBING THE LADDER TO
BECOME A "TROUBLESHOOTER"
start
Tools Needed
Basic Electronic & Electrical Component
Basic Electrical & Electronics Circuit Analysis
Repair & Maintenance Procedure
TROUBLESHOOTER

Self-Check -4	Written Test

Directions: ***For the Following Questions You are Given Four Alternatives then Choose the Correct Answer and circle***

1, To be trouble shooter one must be a knowledge of .A, tools needed *B,* basic electronic/electrical component *C,* basic electronic/electrical ckt analysis D, all of the above *(3 pt each)*

2, Troubleshooting is used in many fields such as engineering, system administration, electronics, automotive repair, and diagnostic medicine. *(3 pt each)*A, true B, false *(3 pt each)*

3, write basic steps of Troubleshooting.

Note: Satisfactory rating 4 and above points Unsatisfactory below 4 points

Answer Sheet

Score = _____

Rating: _____

Name: _____ Date: _____

LG #3	LO # 3. Maintain/repair product

Instruction sheet

This learning guide is developed to provide you the necessary information regarding the following content coverage and topics:

- Replace defective parts/components
- Solder/mount repaired or replaced parts/components
- Handle the unit
- Clean the unit

This guide will also assist you to attain the learning outcomes stated in the cover page. Specifically, upon completion of this learning guide, you will be able to:

- Identifying appropriate shutdown procedure
- Shutting down procedures of the process
- Identifying and reporting maintenance requirements

Learning Instructions:

1. Read the specific objectives of this Learning Guide.
2. Follow the instructions described below.
3. Read the information written in the “Information Sheets”. Try to understand what are being discussed. Ask your trainer for assistance if you have hard time understanding them
4. Accomplish the “Self-checks” which are placed following all information sheets.
5. Ask from your trainer the key to correction (key answers) or you can request your trainer to correct your work. (You are to get the key answer only after you finished answering the Self-checks).
6. If you earned a satisfactory evaluation proceed to “Operation sheets
7. Perform “the Learning activity performance test” which is placed following “Operation sheets” ,
8. If your performance is satisfactory proceed to the next learning guide,
9. If your performance is unsatisfactory, see your trainer for further instructions or go

back to “Operation sheets”.

Information Sheet1. Replacing defective parts/components

3.1 Replacing defective parts/components

Repair or replace

The decision to replace or repair an item must be made with a clear understanding of the relative values of each. The following points should be considered in a repair versus replacement decision:

• Whether replacement parts are available in a reasonable time frame and whether or not the part can be repaired in a reasonable manner and time.

• Whether the law allows or prohibits repair of a scheduled item by any other than the manufacturer or accredited person.

• Whether the repair can be guaranteed for a specific period.

• Repair will take less time than awaiting spares or vice-versa.

• The cost of replacement modules exceeds the gain from production in a fast changeover.

• The efficacy of the repair, that is, how long it may be expected to hold and its effect on efficiency of operation, particularly with makeshift-repairs and substitution of components.

• The loss of warranty.

• The general condition of the component, that is, is the system likely to fail in other places as a result of the repair. This is a part of the old adage “new wine in old wineskins”. If a unit or assembly is in a generally poor condition through age or misuse, the fitting of a new component or sub-assembly can increase strain on other parts.

1. Basic Computer Technical Knowledge

1.1. How a Computer Works

A computer is a fabulous instrument that turns human inputs into electronic

information that it then can store or share/distribute through various output devices. A computer performs (if instructed to do so) the steps shown in the diagram below, using information that a user provides (such as a typed sentence):

Input

Via keyboard, mouse or microphone

- **Processing**

The information is digitized, becoming a simple code that

the computer can store

- **Storage**

The information is stored as a part of the computer's memory

- **Output**

Information is shared via monitor, printer, speakers or projector

- **Further Processing**

If instructed to do so, the information is edited or enhanced with input from the user

All of the equipment (hardware) and the instructions (software) needed to complete the above steps are described in the next section.

Amazingly, the information that the user inputs into a computer is processed so that it becomes a simple code made up of only two digits: zero and one! For all its complexity, a computer is only able to handle these two choices. This is because it is based on electrical signals that have only two options (such as either on or off). But computers compensate for this very simple code by using it in huge quantities. A single unit of this zero/one code is called a bit. Grouping 8 bits together makes a unit of information called a byte. Typing a single page of typed text on a computer requires a minimum of about 20 kilobytes (20 KB or 20,000 bytes) of information to be stored. Good quality digital photographs are usually 1 megabyte (1 MB or 1,000,000 bytes) or larger. So a computer is a very "busy" machine indeed!

1.2. Hardware

1.2.1. Basic Hardware Components

Hardware is the physical equipment needed for a computer to function properly. The basic hardware parts are briefly described here. Many computer lab managers will already have been exposed to computer hardware through other courses, but those desiring additional information can find it in a variety of texts and online sources. A desktop computer is used in the photos, but all of this equipment is also found (in a more compact arrangement) in a laptop computer.

Case. The computer case (also called a tower or housing) is the box that

encloses many of the parts shown below. It has attachment points, slots and screws that allow these parts to be fitted onto the case. The case is also sometimes called the CPU, since it houses the CPU (central processing unit or processor), but this designation can lead to confusion. Please see the description of the processor, below.

Power Supply. The power supply is used to connect all of the parts of the

computer described below to electrical power. It is usually is found at the back of the computer case.

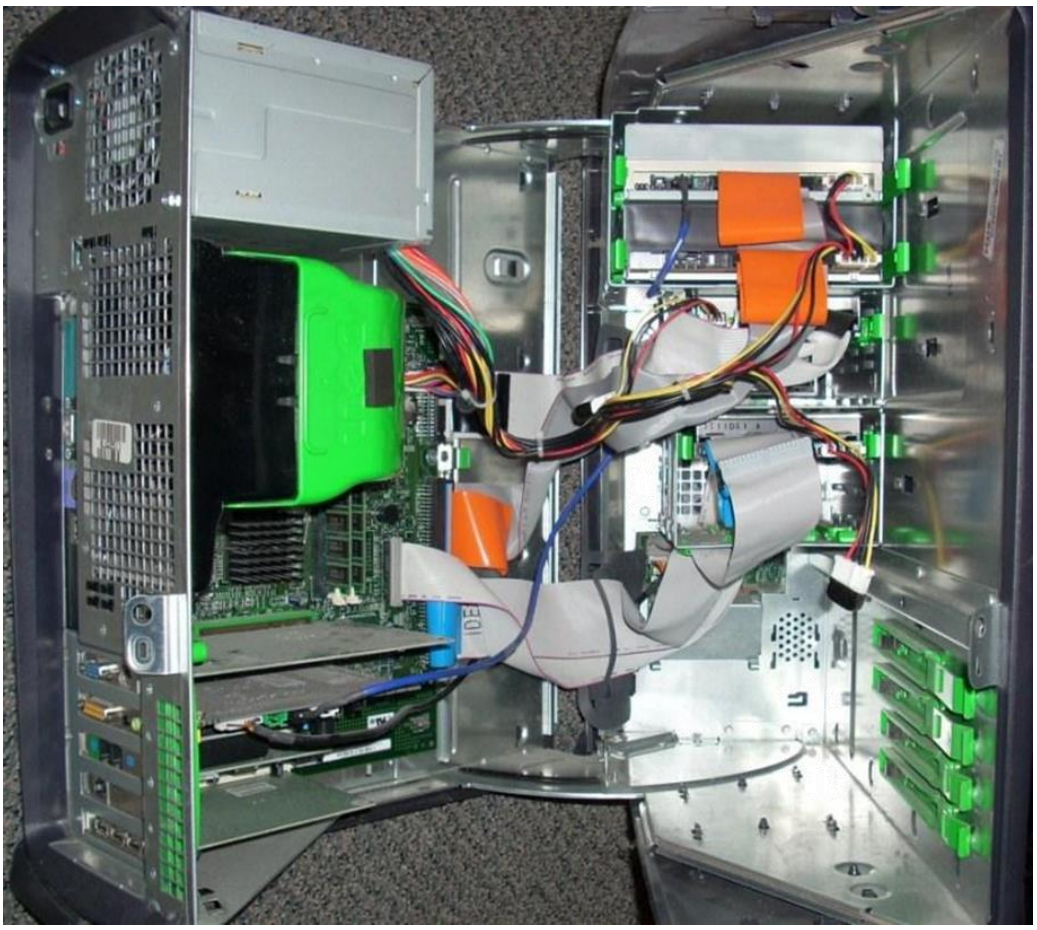
Fan. A fan is needed to disperse the significant amount of heat that is generated

by the electrically powered parts in a computer. It is important for preventing overheating of the various electronic components. Some computers will also have a heat sink (a piece of fluted metal) located near the processor to absorb heat from the processor.

Motherboard. The motherboard is a large electronic board that is used to

connect the power supply to various other electronic parts, and to hold these parts in place on the computer. The computer's memory (RAM, described below) and processor are attached to the motherboard. Also found on the motherboard is the BIOS (Basic Input and Output System) chip that is responsible for some fundamental operations of the computer, such as linking hardware and software. The motherboard also contains a small battery (that looks like a watch battery) and the chips that work with it to store the system time and some other computer settings.

Drives. A computer's drives are the devices used for long term storage of information. The main storage area for a computer is its internal **hard drive** (also called a hard disk). The computer should also have disk drives for some sort of removable storage media. A **floppy disk drive** was very common until recent years, and is still found on many older desk top computers. It was replaced by **CD-ROM** and **DVD drives**, which have higher storage capacities. The current standard is a **DVD-RW** drive, which can both read and write information using both CD and DVD disks. The USB ports (described later) on a computer can also be used to connect other storage devices such as **flash drives**



Cards. This term is used to describe important tools that allow your computer to

connect and communicate with various input and output devices. The term "card" is used because these items are relatively flat in order to fit into the slots provided in the computer case. A computer will probably have a sound card, a video card, a network card and a modem.

RAM. RAM is the abbreviation for random access memory. This is the short

term memory that is used to store documents while they are being processed. The amount of RAM in a computer is one of the factors that affect the speed of a computer. RAM attaches to the motherboard via some specific slots. It is

important to have the right type of RAM for a specific computer, as RAM has changed over the years.

Processor. The processor is the main "brain" of a computer system. It performs

all of the instructions and calculations that are needed and manages the flow of information through a computer. It is also called the CPU (central processing unit), although this term can also be used to describe a computer case along with all of the hardware found inside it. Another name for the processor is a computer "chip" although this term can refer to other lesser processors (such as the BIOS). Processors are continually evolving and becoming faster and more powerful. The speed of a processor is measured in megahertz (MHz) or gigahertz (GHz). An older computer might have a processor with a speed of 1000 MHz (equivalent to 1 GHz) or lower, but processors with speeds of over 2 GHz are now common. One processor company, Intel, made a popular series of processors called Pentium. Many reconditioned computers contain Pentium II, Pentium III and Pentium 4 processors, with Pentium 4 being the fastest of these.

Peripheral hardware. Peripheral hardware is the name for the computer components that are not found within the computer case. This includes input devices such as a **mouse, microphone** and **keyboard**, which carry information from the computer user to the processor, and output devices such as a **monitor, printer** and **speakers**, which display or transmit information from the computer back to the user **.**

1.2.2. Computer Ports

The peripheral hardware mentioned above must attach to the computer so that it can transmit information from the user to the computer (or vice versa). There are a variety of ports present on a computer for these attachments. These ports have gradually changed over time as computers have changed to become faster and easier to work with. Ports also vary with the type of equipment that connects to the ports. A computer lab manager should become familiar with the most common ports (and their uses), as described below.

Serial Port. This port for use with 9 pin connectors is no longer commonly used,

but is found on many older computers. It was used for printers, mice, modems and a variety of other digital devices.

Parallel Port. This long and slender port is also no longer commonly used, but was the most common way of attaching a printer to a computer until the introduction of USB ports (see below). The most common parallel port has holes for 25 pins, but other models were also manufactured.

VGA. The Video Graphics Array port is found on most computers today and is used to connect video display devices such as monitors and projectors. It has three rows of holes, for a 15 pin connector.
PS/2. Until recently, this type of port was commonly used to connect keyboards and mice to computers. Most desktop computers have two of these round ports for six pin connectors, one for the mouse and one for the keyboard.
USB. The Universal Serial Bus is now the most common type of port on a computer. It was developed in the late 1990s as a way to replace the variety of ports described above. It can be used to connect mice, keyboards, printers, and external storage devices such as DVD-RW drives and flash drives. It has gone through three different models (USB 1.0, USB 2.0 and USB 3.0), with USB 3.0 being the fastest at sending and receiving information. Older USB devices can be used in newer model USB ports.
TRS. TRS (tip, ring and sleeve) ports are also known as ports for mini-jacks or audio jacks. They are commonly used to connect audio devices such as headphones and microphones to computers.
Ethernet. This port, which looks like a slightly wider version of a port for a phone jack, is used to network computers via category 5 (CAT5) network cable. Although many computers now connect wirelessly, this port is still the standard for wired networked computers. Some computers also have the narrower port for an actual phone jack. These are used for modem connections over telephone

Figure 2 - Back of Desktop Computer Showing Ports

Software

1.3.1. Software Types and Categories

As mentioned in section 2.1, computer software is the term used for the instructions that have been programmed to allow a computer to process information. Software comes in three main categories, described below:
Operating Systems. These are the basic software programs that are needed to for a computer to work. They give a computer the basic information needed for it to process and

store information. Currently all common operating systems are also graphical user interfaces (GUIs) which means they use graphics to help the user to easily input instructions, and open other programs. The most common operating systems (OS) are the Windows family of operating systems, from Microsoft. A computer lab manager is likely to encounter Windows 2000, Windows XP, Windows Vista and Windows 7 (the most recent Microsoft OS) in a computer lab. Other operating systems are described in the next section.

Utility Software. This is a broad category of programs that allow a computer to perform tasks that aren't a part of the operating system, but are still practical and useful. For example, a utility might instruct a computer on how to copy (burn) information to a CD-ROM disk, or it might be an anti-virus program (see section 3.3).

Productivity Software. This is one term used to describe the type of software used to perform standard office computer tasks. Word processing, presentation, spreadsheet and database software are all common examples of productivity programs. The most common set of productivity programs is Microsoft Office, offered by the Microsoft Corporation.

1.3.2. Proprietary Software vs. Open Source Software

The Microsoft operating system and productivity software packages mentioned above are very common and used around the world in business and education. The Apple Corporation also has very popular and successful operating systems used for their Macintosh computers. Despite the success of these software products, they aren't the best choices for everyone. They are proprietary, which means that their use and modification are restricted. They can be quite costly to buy licenses for, and they are not adaptable to meet local needs. Some users, particularly in developing countries, illegally use unlicensed (also known as pirate) copies of this software. This is legally unwise, and can also keep the user from accessing important software updates.

Users who cannot afford proprietary software or prefer software that can be locally modified, can choose to use open source (often called free and open source or FOSS)

software. For most of the standard computer uses, an open source software option is available. This includes the Linux family of operating systems (which includes Ubuntu, a common operating system in African countries) and the OpenOffice.org productivity programs.

The Source Forge website (www.sourceforge.net) is a good resource for finding and downloading open source programs. While open source software often does not come with professional support available, there are user groups found on the Internet who can offer assistance to puzzled users. This training module does describe how to perform some tasks using the Ubuntu operating system, but does not provide thorough coverage. Further assistance with Ubuntu is available through the website: http://help.ubuntu.com.

When first setting up a computer lab, the steering committee for a computer project should discuss the benefits of both proprietary and open source software and make an informed and intentional choice on which way to go. The computer lab manager should then make sure that he or she is aware of all policies related to software choices.

It is possible that a computer project will choose to use proprietary software for some purposes and open source software for others. For example, a project might be able to obtain used computers that have a Windows operating system legally installed (such as through a Microsoft Authorized Refurbisher) but these computers do not include other Microsoft programs. In this case the organization might choose to continue to run Windows on its computers, but choose open source options for all utility and productivity software.

Computer Maintenance

2.1. Why Maintain?

Think of a computer as being like a human body. We are advised to perform certain tasks to keep our body in good shape. These maintenance tasks such as eating well, avoiding some harmful activities and getting exercise keep our body in good condition. If

we don't maintain our bodies, we might end up in the hospital with problems that result from the abuse such as high blood pressure from eating too much salt, obesity from not exercising or lung problems from smoking. Similarly, if we allow our computers to intake harmful materials (such as dust) and programs (such as viruses) and we don't keep our software in good condition (updated) then the computer may also end up with significant problems that are then harder to deal with. Proper maintenance of a computer, on the other hand, can keep it running smoothly for years and years. Some of the different categories of computer maintenance are described below.

2.2. Updating Software

Software programmers gradually develop updates for their software packages as they discover problems with the software and design tools to address or fix these problems. This can be true for any of the types of software described in section 2.3, but is typically most common and important for operating systems.

It is important for a computer user to find and install software updates in order to have well performing computers. Updating software can be done in a variety of ways, described below.

- **Automatic Updates.** If a computer is on a reasonably fast Internet connection, the easiest way to keep it up to date is to allow the programs to automatically check for updates and download and install them as needed. When setting up a new computer with Microsoft Windows, this is the choice that the software recommends. It does not require any action on the part of the user, and results in a computer system that is current. To turn on automatic updates for a Windows operating system, find the Systems and Maintenance options in the Control Panel.
- **Automatic Alerts for Updates.** If a computer is connected to the Internet, but the connection is slow at some times of the day, another option is to have the computer automatically check for updates but not download or install them until the user elects to do so. For Microsoft Windows computers, if this option is selected, an alert appears in the computer's system tray stating that there are

updates waiting, and then the user can wait until the Internet is faster to install these updates.

- **Manual Updating.** A computer user can also turn off all automatic update checking and choose to manually check for updates. For a computer that is rarely connected to the Internet, this would be a good option as long as the user remembered to check when connecting to the Internet. Also some programs do not have automatic update options, and can only be updated in this manner. A program usually has a menu item titled “check for updates” that a user can click on when connected to the Internet.
- **Offline Updating.** If a computer is in a location that never has access to the Internet, a computer lab manager will need to download updates from a computer that is connected to the Internet and then transfer them (via a disk or flash drive) to the computer in question to be installed. This option is also useful if a computer lab has several computers that all need the same update. Instead of having each computer download the update separately, one computer could download the update and then it could be shared amongst all of the computers. Offline updates for operating systems can easily be found through Internet searches.

Hardware Repair Planning and Strategy

Before beginning a computer hardware repair, it is important to make sure that the repair is necessary and that a repair plan is in place. To determine if a repair is necessary, the lab manager should have worked through the troubleshooting steps described earlier in this module. If a computer is still operational, the lab manager should be using software tools to diagnose (and in some cases repair) problems before physically opening the computer. For example, the Device Manager can be used to check for hardware faults, and a hard drive diagnostic tool can be used to determine if a hard drive needs to be replaced. Also remember that error messages can give important information about what is wrong with a computer.

Part re-seating and part swapping are both good strategies to keep in mind when repairing computers. Re-seating means removing or disconnecting a part, cleaning it if appropriate, and correctly replacing the part. Sometimes a computer part can function poorly just because a connection is loose or dirty, and re-seating will improve its performance. If this does not solve a problem, a good next step is to try to swap the same part with one from a functioning computer. This can be a useful part of troubleshooting, since it helps the lab manager identify whether or not that part truly is the source of a computer problem, before a purchase is made. People who are just learning about computer repair can easily practice this with peripheral devices. If a desktop computer keyboard appears not to be working, for example, try replacing it with a keyboard that is known to work properly.

. Basic Hardware Repairs

Below are descriptions of some of the most common hardware repairs, including key steps in the process. In all cases, however, the lab manager who is just beginning to work on computer repair would be encouraged to complete these repairs alongside a more experienced technician as they gain skill and confidence. If the lab manager has an opportunity (through this course or any other) to attend a hardware repair training session, he or she should insist on being involved in as much hands-on training as is possible.

Replacing a Power Supply. For desktop computers in developing countries, power supply failure is a common problem. This is due to an uneven or “dirty” voltage and power surges. Before replacing a power supply, a lab manager should make sure that it truly is dead by following the tip box in section 5.2.2. Then follow the steps below:

1. Unplug the power cord from the back of the computer case.
2. Open up the computer case. The method varies with the brand and model of computer, but often involves laying the case on its side and opening up the side panel. Some computer cases use screws and others have buttons to press that release one side panel.

3. Find and unscrew all of the screws attaching the power supply to the back of the case. Usually there will be four screws, located just outside the cut out in the case (or along the mesh grid) where the power supply is found. Do not disconnect the various cables yet. Move the dead power supply as far out of the way as the cables will allow.

Figure 3 - Replacing a Power Supply
For the complete procedure see http://www.fonerbooks.com/r_power.htm

You may be able to set the power supply on top of the case (see photo).

4. Install the new power supply and screw in all screws.
5. One by one, detach the cables from the old power supply to the various computer components, and replace them with the cables from the new power supply. Doing this one by one will help make sure that no components are missed. There will be power supply connectors for the motherboard and all drives. When removing the cables, keep an eye out for latches that need to be depressed to release the connector. All of the connectors should only fit in one direction, and with little force. If a connector does not attach easily, make sure that it is properly aligned before pushing harder.

Replacing a Hard Drive. Replacing a faulty hard drive is not a difficult task, but a lab manager should have done some investigative work first to determine if the hard drive is faulty. This could include running the Chkdsk utility, as described in section 5.1.4, listening for unusual noises coming from the hard drive and also checking to make sure the cables to the hard drive are still fully connected. The computer may also present error codes during start up that indicate a problem with the hard drive. Before replacing a hard drive, it is worth

trying to reset the BIOS to the default settings to see if this fixes the problem. To do this, enter the BIOS during computer start up (as described in section 4.3) and choose the default settings. Then save the new settings and exit. The onscreen instructions in the BIOS program will guide the computer lab manager through these steps.
Once it has been determined that a hard drive problem is likely, the computer lab manager should follow the steps below to replace the hard drive with a known working hard drive.
1. Disconnect the computer case from electricity and then open the computer case (as described above).

2. Locate the hard drive. It will likely be found in a metal case or cage near the front of the computer case, below the other drives. It could be mounted directly on the cage or it could be mounted on rails that will slide out of the case (see photo).
3. Unscrew the hard drive from the cage or slide the rails out and unscrew the hard drive from the rails.
4. Remove the long ribbon cable from hard drive. There may have been a small amount of glue used to hold the ribbon in place that will also need to be removed.

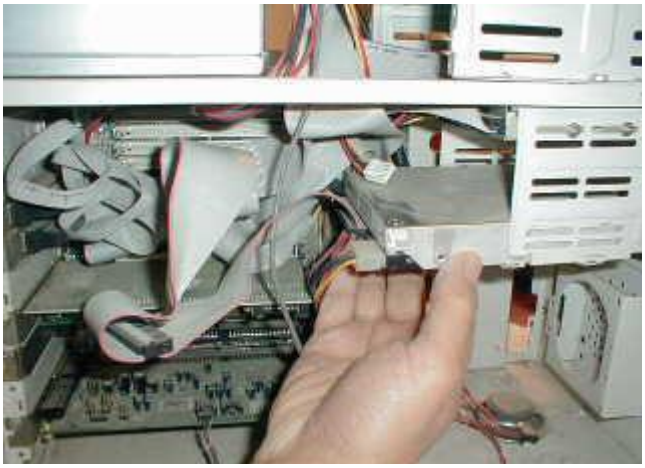


Figure 4 - Removing a Hard Drive
For the complete procedure see http://www.fonerbooks.com/r_hard.htm

Then remove the smaller power cable. If it is difficult to remove, gently wiggle the connector back and forth along its long axis as you pull. Note the orientation of the connector (which end is the red wire on?) to make sure that the new hard drive is connected in the same manner.
5. If there are two hard drives in a computer, one is called the master and the other the slave. On older hard drives, an electrical connection needs to be changed to indicate whether the hard drive is a master or a slave. If the hard drive being installed has not

been used before, it will be correctly set as a master (or also on the acceptable “Cable Select” setting, used when the ribbon cable has two connectors – one for a master and one for a slave). If the hard drive has been previously used as a slave, however, it will need to be changed to a master. To do this, look for a diagram on the hard drive that shows the pattern for connecting (jumping) two of the eight pins located between the two cable connectors on the front end of the hard drive. Then using needle nose pliers, pull off the jumper that is connecting two of the pins and replace it to connect the proper pair.

6. Connect the cables to the new hard drive. Then screw the hard drive back on to the rails and slide the rails into position (or screw the hard drive directly to the cage if there are no rails).

Make sure that all of the other ribbons and cables are as they were found. Close the case and the repair is complete. Note that if any new noises or problems appear after the installation, it is possible that another device or cable was disrupted during the repair and needs to be reattached or reseated.

Replacing a Hard Drive for a Laptop Computer.

Hard drives for many laptop computers can be replaced quite easily because the manufacturers have made the hard drives accessible from hatches on the underside of the computer. To replace the hard drive on a laptop with an accessible hard drive follow the steps below:

1. Remove the laptop battery before making this (or any other) laptop repair. This is important in order to avoid electricity from the battery flowing through the computer during repair, which could be damaging to computer components. The technique for removing the battery depends on the make and model of the laptop, but often involves unlocking the battery at one or two points (on the underside of the computer) and then sliding it out.

2. With the laptop resting upside down on a table, find the hard drive compartment and unscrew the screw or screws holding the lid in place. Remove the lid and examine how the hard drive is attached to the computer.

Figure 5 - A Laptop Hard Drive in its "Cage"
For the complete procedure see http://www.fonerbooks.com/laptop_1.htm

3. Slide out the assembly containing the hard drive in its cage or brackets. You may have to push the assembly in or lift it up first in order to clear anything else used to hold the assembly in place.
4. Remove any screws attaching the laptop to its cage/brackets, remove the damaged hard drive, replace it with a functioning laptop hard drive and then retighten all screws.
5. Slide the assembly back into the laptop and secure it as it was previously. Make sure that you push hard enough to reattach the hard drive to the power and data connectors. Push horizontally (or as close as possible to horizontally) when reconnecting.
6. Close the hard drive compartment and replace all screws. Then replace the laptop battery, turn the computer over and restart it.

Replacing RAM. As discussed in section 5.1.7, a lab manager may want to add RAM to speed up a slow computer. RAM also can fail or come loose from its housing and need to be reseated. If a lab manager has decided that a computer needs new or additional RAM, it is important to make sure that the RAM used is compatible with the computer system. There are several online RAM sales companies that will identify the appropriate RAM if a user inputs the computer make and model. Two example companies are Corsair (www.corsairmemory.com) and Crucial (www.crucial.com). Once the RAM has been obtained, the lab manager should follow the steps below to replace the RAM.
Please Note: RAM is very easily damaged by electrostatic charges, so it is very important for the user to be grounded before picking up RAM. Also RAM should only be handled by the edges.
1. Open the computer case as previously described. Find the RAM slots (long parallel connectors). Note which slots are occupied and if the slots are numbered (at the ends). If the slots are not numbered, the slots closest to the processor are probably the lower numbered slots and should be filled first.
2. Simultaneously push down and out on both retaining clips (on each end) of a RAM slot to remove the old RAM. Note the orientation of the RAM so that the replacement RAM can be put in facing the same direction. There should be some notches on the bottom edge of the RAM that can be used as a guide.
3. Gently place the new RAM in the socket and press down firmly on the top of the RAM at both ends (see photo). When the RAM module is correctly seated, the retaining clips will automatically close.

Figure 6 - Installing RAM
For the complete procedure see http://www.fonerbooks.com/r_ram.htm

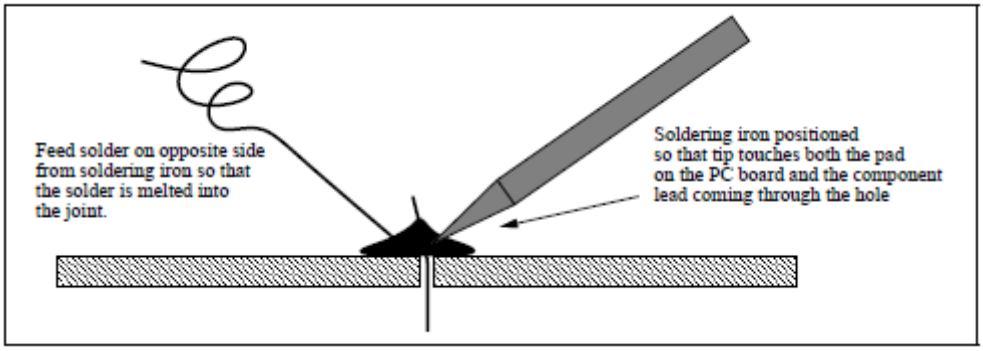
4. Close the computer case as previously described.

Information Sheet-2. Soldering/mounting repaired or replaced parts/components

2.1 Soldering techniques

Soldering is a skill that is handy to know for many types of construction and repair. For modern small appliances, it is less important than it once was as solderless connectors have virtually replaced solder for internal wiring.

However, there are times where soldering is more convenient. Use of the proper technique is critical to reliability and safety. A good solder connection is not just a bunch of wires and terminals with solder dribbled over them. When done correctly, the solder actually bonds to the surface of the metal (usually copper) parts.



Effective soldering is by no means difficult but some practice may be needed to perfect your technique.

- **The following guidelines will assure reliable solder joints:**

✓ **Use rosin core solder (e.g., 60/40 tin/lead) for electronics work.**

✓ **Suggested diameter is .030 to .060 inches for appliances. The smaller size is preferred as it will be useful for other types of precision electronics repairs or construction as well.**

✓ **The rosin is used as a flux to clean the metal surface to assure a secure bond.**

NEVER use acid core solder or the stuff used to sweat copper pipes! The flux is corrosive and it is not possible to adequately clean up the connections afterward to remove all residue.

- ✓ **Keep the tip of the soldering iron or gun clean and tinned.**
- ✓ **Buy tips that are permanently tinned - they are coated and will outlast countless normal copper tips.**
- ✓ **A quick wipe on a wet sponge when hot and a bit of solder and they will be as good as new for a long time. (These should never be filed or sanded).**
- ✓ **Make sure every part to be soldered - terminal, wire, component leads is free of any surface film, insulation, or oxidation.**
- ✓ **Fine sandpaper may be used, for example, to clean the surfaces. The secret to a good solder joint is to make sure everything is perfectly clean and shiny and not depend on the flux alone to accomplish this. Just make sure the scrapings are cleared away so they don't cause short circuits.**
- ✓ **Start with a strong mechanical joint. Don't depend on the solder to hold the connection together. If possible, loop each wire or component lead through the hole in the terminal. If there is no hole, wrap them once around the terminal. Gently anchor them with a pair of needle nose pliers.**
- ✓ **Use a properly sized soldering iron or gun: 20-25 W iron for fine circuit board work; 25-50 W iron for general soldering of terminals and wires and power circuit boards; 100-200 W soldering gun for chassis and large area circuit planes. With a properly sized iron or gun, the task will be fast - 1 to 2 seconds for a typical connection - and will result in little or no damage to the circuit board, plastic switch housings, insulation, etc.**
- ✓ **Heat the parts to be soldered, not the solder. Touch the end of the solder to the parts, not the soldering iron or gun. Once the terminal, wires, or component leads are hot, the solder will flow via capillary action, fill all voids, and make a secure mechanical and electrical bond. Sometimes, applying a little from each side will more effectively reach all nooks and crannies.**
- ✓ **Don't overdo it. Only enough solder is needed to fill all voids. The resulting surface should be concave between the wires and terminal, not bulging with excess solder.**

- ✓ **Keep everything absolutely still for the few seconds it takes the solder to solidify. Otherwise, you will end up with a bad connection - what is called a 'cold solder joint'.**
- ✓ **A good solder connection will be quite shiny - not dull gray or granular. If your result is less than perfect reheat it and add a bit of new solder with flux to help it reflow.**

2.2 De-soldering techniques

Occasionally, it will be necessary to remove solder - either excess or to replace wires or components. A variety of tools are available for this purpose. The one I recommend is a vacuum solder pump called 'SoldaPullet' .

- **The following guidelines will assure reliable De-solder the joints:**

- ✓ **Keep the tip of the soldering iron or gun clean and tinned.**
- ✓ **Buy tips that are permanently tinned - they are coated and will outlast countless normal copper tips.**
- ✓ **A quick wipe on a wet sponge when hot and a bit of solder and they will be as good as new for a long time. (These should never be filed or sanded).**
- ✓ **Cock the pump, heat the joint to be cleared, and press the trigger.**
- ✓ **Molten solder is sucked up into the barrel of the device leaving the terminal nearly free of solder.**
- ✓ **Then use a pair of needle nose pliers and a dental pick to gently free the wires or component. For stubborn joints or those connecting to the power planes (surface or multilayer boards), you may need to add some fresh solder and/or flux and then try again. Generally, if you only get part of the solder off the first time, repeated attempts will fail unless you add some fresh solder.**

Directions: Answer all the questions listed below. Use the Answer sheet provided in the next page:

1. The ease and quality of your work will depend both on proper soldering as well as de-soldering (often called rework) equipment. (True, False) (1 points)
2. Soldering is a skill that is handy to know for many types of construction and repair. (True, False) (1 points)
3. In order to get quality soldering keep the tip of the soldering iron or gun clean and tinned. (True, False) (1 points)
4. Buy tips that are permanently tinned - they are coated and will outlast countless normal copper tips. (True, False) (1 points)
5. A quick wipe on a wet sponge when hot and a bit of solder and they will be as good as new for a long time. (These should never be filed or sanded). (True, False) (1 points)

Answer Sheet

Score = _____

Rating: _____

Name: _____ Date:

_____

Information Sheet-3. . Handling the unit

3.1 Handling of Photosensitive Drums

Where the drum is located inside a replaceable toner cartridge, there is no need for special handling. However, where

the drum is a separate unit, the following applies. Or, if for some reason, you need to disassemble (gasp!) a cartridge:

Whatever you do, do NOT use alcohol on an organically based drum, it will ruin it. The alcohol causes the material to crystalize. I use to do copier service and this was stressed a lot by the manufacture as they switched from the old selenium drums to the new opc drums. Direct sunlight will immediately destroy the drum. A couple of minutes under normal lighting is no problem, just place it in a dark area and put a black cloth over the top of the drum while it is out.

If you are replacing the drum cleaning blade or cleaning the crud off the blade, make sure you powder up the drum completely and the blade before reapplying power. The toner actually is a slight lubricant and the rubber cleaning blade directly on the drum will also ruin it. Just print a few low text copies after reassembling to allow the blade to reseat properly.

- Short periods (less than 5 min) under fluorescent lighting is safe.
- Direct sunlight kills them immediately.

Just have a clean brown paper bag to shove it into while it sits on the table outside the machine.

Often more damage is done to them physically during insertion/removal. just be careful.

Information Sheet-4 . Cleaning the unit

4.1 computer cleaning

Computers are expensive, and with all major purchases you probably want to protect your investment**. Luckily, it is not difficult to** keep your computer clean, healthy **and in good working order.**

How do I keep my computer clean?

When dealing with computers, dust isn't just unattractive—it can potentially destroy parts of your computer. By cleaning your computer regularly, you can help to keep it working properly and avoid expensive repairs.

Cleaning the keyboard

A dirty keyboard doesn't look nice and can cause your keyboard to not work properly. Dust, food, liquid, and other particles can get stuck underneath the keys, which can prevent them from working properly. Check your owner's manual to see if the manufacturer has provided you with instructions for your specific keyboard. If so, follow them. If not, the following steps are basic cleaning tips that can help keep your keyboard clean.

1. Unplug the keyboard from the USB or PS/2 port. If the keyboard is plugged into the PS/2 port, you will need to shut down the computer before unplugging it.

2. Turn the keyboard upside down, and gently shake it to remove dirt and dust.

3. Use a can of compressed air to clean between the keys.

4. Moisten a cotton cloth or paper towel with rubbing alcohol, and use it to clean the tops of the keys. Do not pour alcohol or any other liquid directly onto the keys.

5. Reconnect the keyboard to the computer once it is dry. If you are connecting it to a PS/2 port, you will need to connect it before turning on the computer.

Dealing with liquids

If you spill liquid on the keyboard, quickly shut down the computer and disconnect the keyboard and turn it upside down to allow the liquid to drain. If the liquid is sticky, you will need to hold the keyboard on its side under running water to rinse the sticky liquid away. Then turn the keyboard upside down to drain for two days before reconnecting it. The keyboard may not be repairable at this point, but rinsing the sticky liquid off of it is the only chance for it to be usable again. The best way to avoid this situation is to keep drinks away from the computer area.

Cleaning the mouse

There are two main types of mice: optical and mechanical. Each is cleaned in basically the same way, although the mechanical mouse requires a bit more work.

- **Optical mice require no internal cleaning because there aren't any rotating parts; however, they can get sticky over time as dust collects near the light emitter. This can cause erratic cursor movement or prevent the mouse from working properly.**

Mechanical mice are especially susceptible to dust and particles that can accumulate inside the mouse, which can make it difficult to track—or move—properly. If the mouse pointer does not move smoothly, the mouse may need to be cleaned. 5 IT Computer Technical Support Newsletter |

Before you clean your mouse, check the owner's manual to see if the manufacturer has provided you with instructions for your specific mouse. If so, follow those instructions. If not, the following steps are basic cleaning tips that will help keep your mouse clean.

1. Unplug the mouse from the USB or PS/2 port. If the mouse is plugged into the PS/2 port, you will need to shut down the computer before unplugging it.

2. Moisten a cotton cloth with rubbing alcohol, and use it to clean the top and bottom of the mouse.

3. If you have a mechanical mouse, remove the tracking ball by turning the ball-cover ring counterclockwise. Then clean the tracking ball and the inside of the mouse with a cotton cloth moistened with rubbing alcohol.

4. Let all of the parts dry before reassembling and reconnecting the mouse. If you are connecting it to a PS/2 port, you will need to connect it before turning on the computer.

If you want to give the mouse a quick cleaning, place it on a clean white sheet of paper and move the mouse back and forth. Some of the dust and particles should rub off onto the paper.

Cleaning the monitor

Dirt, fingerprints, and dust can make your computer screen difficult to read; however, it's easy to clean your screen when needed. Although there are monitor-cleaning kits you can buy, they may damage your monitor if they are designed for a different type of monitor. For example, a monitor cleaner that is designed for glass screens may not work with some no glass LCD screens. The safest method is simply to use a soft clean cloth moistened with water.

Do not use glass cleaner to clean a monitor. Many screens have anti-glare coatings that can be damaged by glass cleaner.

1. Turn off the computer.

2. Unplug the monitor from the power. If you are using a laptop, unplug the laptop.

3. Use a soft clean cloth moistened with water to wipe the screen clean

Do not spray any liquids directly onto the screen. The liquid could leak into the monitor and damage the internal components.

Tips for cleaning other computer surfaces

From time to time, you should clean your computer case and the sides and back of the monitor to avoid buildup of dust and dirt. Here are a few tips you can use when cleaning these surfaces.

- **Dust is your computer's main enemy. Use an antistatic wipe to lightly dust your computer casing. Don't use furniture cleaners or strong solvents.**
- **Use a can of compressed air with a narrow nozzle to blow out debris from the air intake slots.**

- **Spray cleaning solution—like diluted ammonia cleaner or glass cleaner—on a paper towel or antistatic wipe. Clean the monitor housing and case—not the monitor screen—by wiping in a downward motion.**
- **A safe cleaning solution for computer surfaces—not computer screens—is ammonia diluted with water or glass cleaner comprised mostly of ammonia and water (check the label). The milder the solution, the better.**

Keep it cool

Don't restrict airflow around your computer. A computer can generate a lot of heat, so the casing has fans that keep it from overheating. Avoid stacking papers, books, and other items around your computer.

Many computer desks have an enclosed compartment for the computer case. If you have this type of desk, you may want to position the case so it is not against the back side of the desk. If the compartment has a door, you may want to leave it open to improve airflow.

Cleaning Epson inkjet print heads

The symptom is missing horizontal lines through text or graphics −− or no print at all. This occurs when the water based inks dry at the print heads in amounts that the head cleaning routine cannot dislodge.

The newer Epson Stylus Color series print heads are particularly affected.

It can happen whether you refill your inkjet cartridges or not.

One contributing factor is turning off the printer from a power bar. This prevents a complete shutdown and docking of the heads at their docking stations. You will notice some activity even after turning the printer off by its switch, as it continues to take a trickle charge.

To unclog the heads:

1. Run 3 cleaning cycles from the Epson Utility.

2. Turn off printer, and restart in Test Print mode.

3. When cartridges/ print heads are at extreme left of carriage, quickly spray 3 shots of Windex or Ammonia onto docking station(s) affected, and turn off printer for 5 minutes.

4. Repeat process as needed until perfect test prints are restored − usually 2 procedures.

We've saved 14 printers this way.

LG #4	LO 4- TEST REPAIRD UNIT/PRODUCT

Instruction sheet

This learning guide is developed to provide you the necessary information regarding the following content coverage and topics:

- Reassembling
- Final testing and cleaning
- Documentations
- Environmental requirements

Test repaired unit/product This guide will also assist you to attain the learning outcomes stated in the cover page. Specifically, upon completion of this learning guide, you will be able to:

- Reassemble
- Final test and clean
- Documentations
- Environmental requirements

Learning Instructions:

10. Read the specific objectives of this Learning Guide.
11. Follow the instructions described below.
12. Read the information written in the “Information Sheets”. Try to understand what are being discussed. Ask your trainer for assistance if you have hard time understanding them.
13. Accomplish the “Self-checks” which are placed following all information sheets.
14. Ask from your trainer the key to correction (key answers) or you can request your trainer to correct your work. (You are to get the key answer only after you finished answering the Self-checks).
15. If you earned a satisfactory evaluation proceed to “Operation sheets
16. Perform “the Learning activity performance test” which is placed following “Operation sheets” ,
17. If your performance is satisfactory proceed to the next learning guide,
18. If your performance is unsatisfactory, see your trainer for further instructions or go back to “Operation sheets”.

Information Sheet-1 . Reassembling

1.1 Printers operations

Laser printer operation summary

In general the principle of electrostatic laser printing is as follows:

1. **Charging a photoconductive selenium (or other) coated drum. Discharging the drum with the laser steering engine in accordance with the input image rasterized pattern. (the**
2. **laser is modulated to generate a predefined pixel pattern on the face of the drum − the focal plane).**
3. **3. The rotating drum attracts toner to the charged pattern (latent image) generated by the laser.**
4. **4. The toner is transfered from the drum to the moving papaer to generate a full image.**
5. **The paper carrying the toner moves through the heater to fuse the toner to a fine non−erasable image.**

The laser steering engine is combined of the following components: · Infra−red diode laser, 3 to 4 mW in basic units, up to 30 mW or more for high performance printers.

Beam expander to form the required size of the collimated input beam which generates the beam spot size in the focal plan.

- **·Cylindrical lens to reshape the laser elliptical beam to a round one.**
- **Spinning polygonal mirror to deflect the laser over the focal plan.**

F−Theta lens to flatten the inherent circular plan of a rotating mirror. This lens is a very special lens which only few in the optical community know how to design and fabricate. The one that you own is particularly special because it is a Sectioned F−Theta lens which are typicaly more expensive (most of them are spherical).

If you need to scan or to print in high resolution 500 dpi or higher, you end up using a glass F−Theta lens.

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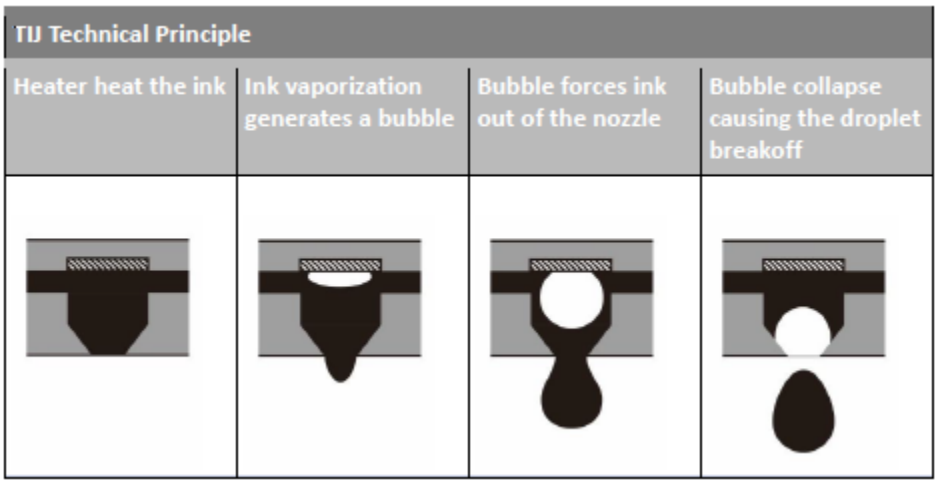
1.1.1 Thermal Ink Jet (TIJ) Technology

TIJ technology uses a drop ejection process, storing ink in a cartridge that regulates the pressure of the fluid. Inks are then delivered to the firing chamber to be heated at more than 1,000,000 C/second by an electric resister. A 0.1 micrometer thick film of ink is heated to around 340C, from which a bubble is formed to expel the ink. A droplet breaks away from this bubble causing it to collapse, the firing chamber then refills as the whole process repeats.



1.1.2 ANSER TIJ inkjet printer portfolio

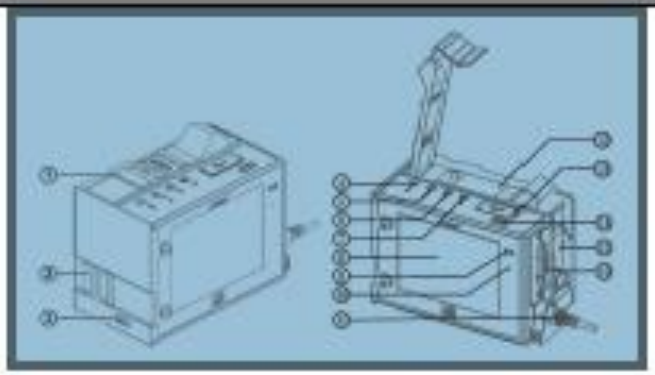
ANSER provide wide range of TIJ printing solution suitable for your ever-increasing coding demand….

	Substrate Type *		
	Porous	Semi Porous	Non-Porous
U2 Smart	c	c	
U2 SmartONE"	c	c	
U2 Diesel	c		
U2 Pro			c
U2 ProS	c	c	c
U2 MobileONE"	c	c	

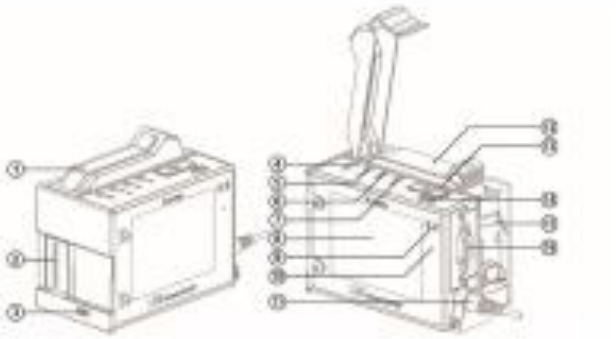
* Substrate classification
Porous: Paper, cardboard, sponge, untreated woods, etc.
Semi Porous: Waxed surfaces, coated paper, plaster, concrete, etc.
Non Porous: plastics, metals, varnished woods, glass, etc.

1.2 Printer Main Unit

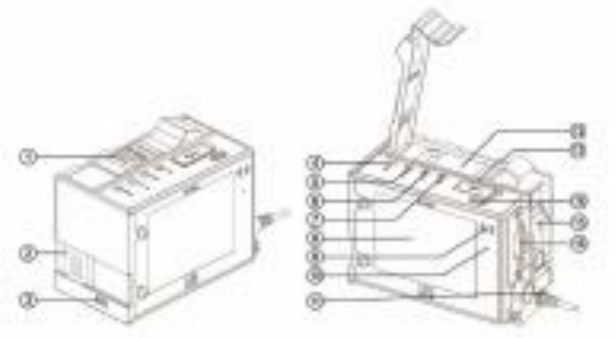
U2 Smart



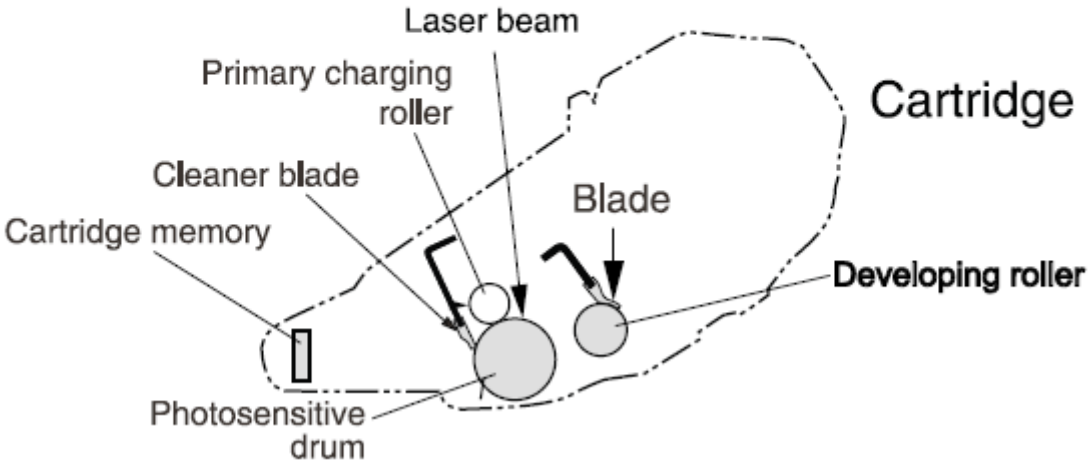
U2 SmartONE"



U2 ProS



Toner cartridge



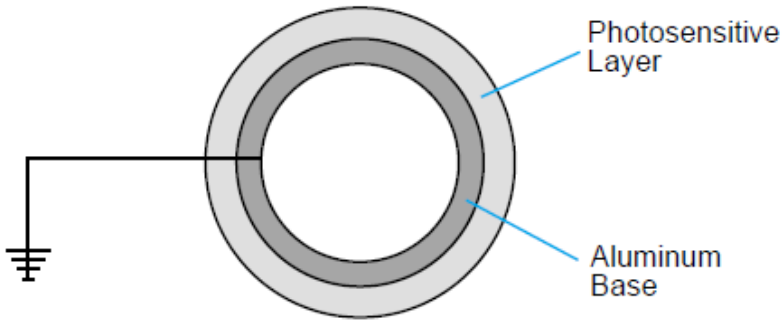
Toner cartridge

A major portion of the image formation system is contained in the cartridge as shown in figure

The toner cartridge is the "heart" of the image formation system. It houses the cleaning, conditioning, and developing steps of the process. The toner cartridge contains the photosensitive drum, primary charging roller, developing roller, toner cavity, and cleaner blade. Including these components that wear, degrade, or are consumed in the replaceable toner cartridge eliminates the need for a service call when replacement is required.

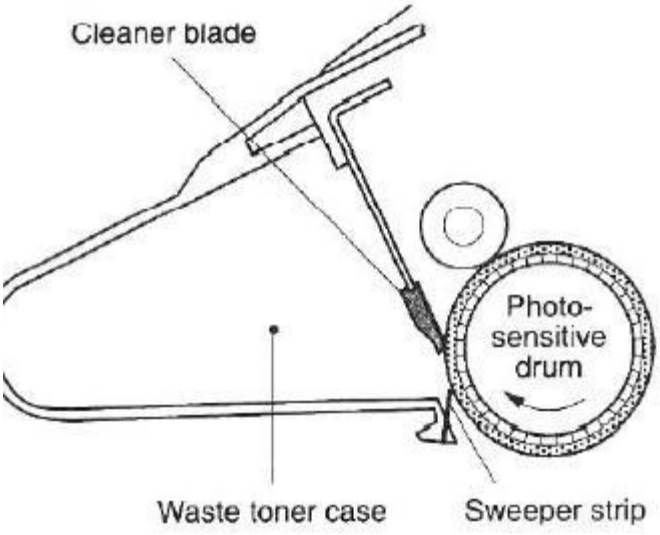
Photosensitive drum

The special properties of the photosensitive drum allow an image to be formed on the drum surface and then transferred to paper. The drum is an aluminum cylinder coated with a layer of organic-photoconductive material (OPC) which is non-toxic. The OPC material has properties similar to a photoresistor. It becomes electrically conductive when exposed to light. (The negative charges deposited on the drum are conducted to the ground potential of the drum base.) Areas not exposed to light remain nonconductive and maintain their negative charge. The aluminum base of the photosensitive drum is electrically connected to ground potential.



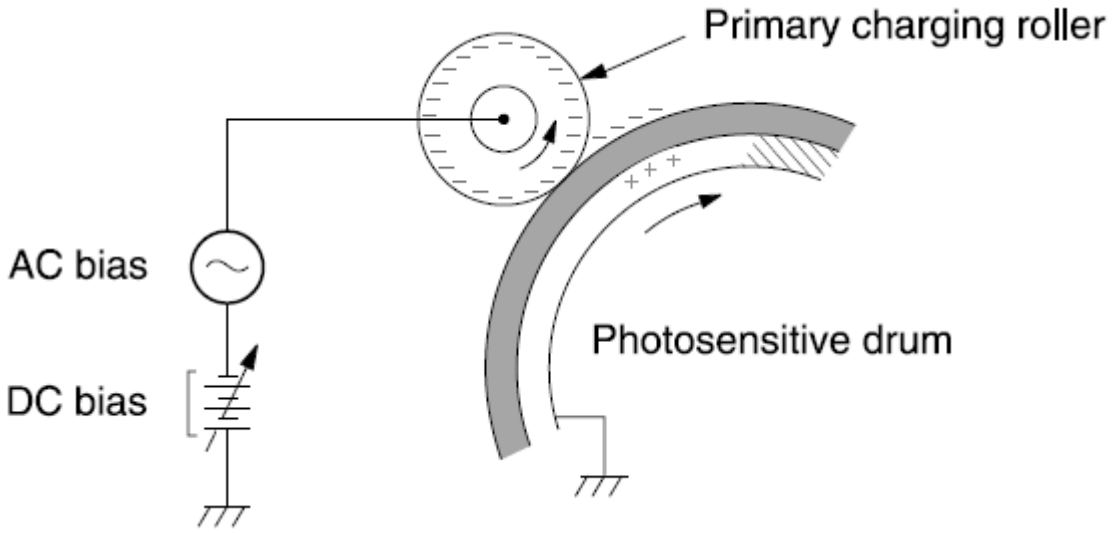
Cleaning the drum

The cleaning blade is in contact with the surface of the drum at all times. As the drum rotates during printing, excess toner is scraped off and stored in the waste toner receptacle.



Conditioning the drum

The conditioning process consists of applying a uniform negative charge on the surface of the drum with the primary charging roller. The primary charging roller is coated with conductive rubber with an AC bias applied to erase any residual charges and maintain a constant drum surface charge. The amount of DC voltage is modified by the print density setting.



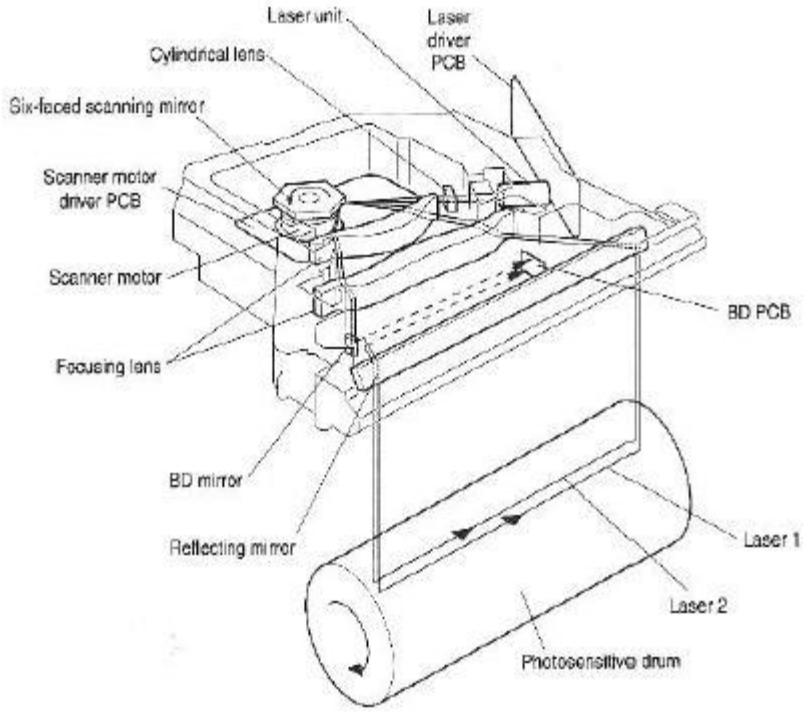
Writing the image

The laser/scanner of this printer has two diodes in the laser unit. During the writing process, the modulated laser diodes project two beams onto the rotating six-sided scanning mirror. As the mirror rotates, the beams reflect off the mirror, through a set of focusing lenses, through a slot in the top of the toner cartridge, and onto the photosensitive drum. The beams sweep the drum from left to right, discharging the negative potential wherever the beams strike the surface. This creates a latent electrostatic image, which later is developed into a visible image.

Developing the image

The developing process develops the latent electrostatic image into a visible image on the drum. The developing unit consists of a metallic cylinder that rotates around a fixed magnetic core inside the toner cavity. Toner is a powdery substance made of black plastic resin bound to iron particles, which is uniformly attracted to the magnetic core of the cylinder.

The toner particles obtain a negative surface charge by rubbing against the developing cylinder which is connected to a negative DC supply. The negatively charged toner is attracted to the discharged (exposed, grounded) areas on the drum. An AC potential is applied to the developing cylinder to decrease the attraction between the toner and the magnetic core of the cylinder, and to increase the repelling action of the toner against the areas of the drum not exposed to laser light. This AC potential improves density and contrast.



Self-Check 1	Written Test

Directions: Answer all the questions listed below. Use the Answer sheet provided in the next page:

I .write the correct answers

1. Wite the procedures o reassembling scanner machines?
2. List the materials or reassembling o scanner machines?

Information Sheet-2 . testing and cleaning

2.1 Cleaning and Handling of Photosensitive Drums

Where the drum is located inside a replaceable toner cartridge, there is no need for special handling. However, where the drum is a separate unit, the following applies. Or, if for some reason, you need to disassemble (gasp!) a cartridge:

Whatever you do, do NOT use alcohol on an organically based drum, it will ruin it. The alcohol causes the material to crystalize. I use to do copier service and this was stressed a lot by the manufacture as they switched from the old selenium drums to the new opc drums. Direct sunlight will immediately destroy the drum. A couple of minutes under normal lighting is no problem, just place it in a dark area and put a black cloth over the top of the drum while it is out. If you are replacing the drum cleaning blade or cleaning the crud off the blade, make sure you powder up the drum completely and the blade before reapplying power. The toner actually is a slight lubricant and the rubber cleaning blade directly on the drum will also ruin it. Just print a few low text copies after reassembling to allow the blade to reseat properly.

Information Sheet-4 . Environmental requirements

4.1 Electronics waste

4.1.1. Electronics waste definition and composition Over the last two decades, the amount of consumer and business electronic equipment has increased continuously. At the same time, rapid changes in information and communication technologies, the concomitant increasing versatility of most electronic devices together with the downward trend in prices have led to a drastically reduced lifespan for most electronic equipment. This holds true even though some electronic devices, e.g. mobile phones, may have several owners during their lifespan prior to being discarded. In 2008, the number of personal computers had already surpassed 1 billion, the overwhelming majority of which have already reached the end of their life, or will reach it soon. In consequence, there is an extremely rapidly growing amount of electronic products which have reached the end of their life, resulting in huge quantities of electronic waste (e-waste, or waste electrical and electronic equipment (WEEE)). Currently there is no clear definition for the term e-waste or when a product becomes waste. A Directive of the EU defines e-waste as obsolete equipment that is dependent on electric currents or electromagnetic fields to work properly and equipment for the generation, transfer and measurement of such current. According to Pongra´cz et al. any definition of ewaste needs to consider the aspects of both the product becoming obsolete and the decision of its owner to turn it into waste: electronic products become waste at the time and place when their structure and state are no longer capable of providing the expected performance with respect to the purpose assigned by their owners. The reasons why an electronic product is no longer able to perform with respect to the intended purpose can be manifold: it may simply be no longer functional because of being damaged; or its technology and design may no longer be state of the art or trendy . Fortunately, what is considered waste by the user is often regarded as profitable by the
recycling industry, which can recover the valuable materials contained therein and sell them for reuse as secondary raw materials in new products.The amount of e-waste that

is being generated in theUSA and in the EU, as well as in developing countries,has increased significantly over the last 10 years. Accordingto the US Environmental Protection Agency [1], on average,each household in the USA uses 34 electronic devicesand electrical appliances, resulting in more than 5 _ 106 t of e-waste annually. For the EU, it was estimated that,on average, each citizen contributes bout15 kg of e-waste annually, to give an estimated total of 7 _ 106 t .Thus, WEEE constitutes one of the fastest growing waste streams, already accounting for about 8% of municipal waste [6]. In developing markets, like China and India, ewaste production per capita is still only about 1 kg year_, but this is increasing rapidly. In view of the huge population, the total e-waste generated in these two countries will surmount that produced in the western countries quite soon. In addition, the amount of e-waste in the newly industrialized and developing countries is also growing because of the import of e-waste from developed countries.Some studies show that up to 50–80% of the e-waste that has been generated in developed markets is being shipped to developing countries for reuse and recycling [6], often in violation of international laws.

As part of the WEEE, certain components of some electronic products contain hazardous substances, e.g. mercury and cadmium, which are harmful to the environment if inadequately treated and disposed of; others contain valuable materials which can be profitable if recovered. Thus, in order to cope with the huge and steadily increasing amounts of e-waste, sustainable recycling and reclamation of material and components for reuse have become major issues globally from both the ecological and economical points of view. Nevertheless, hitherto, even in the industrialized countries, depending on the product category, only a small fraction of e-waste is recycled, the overwhelming part being disposed of in landfills and through incineration. As precise statistics are scarce, data from a report by the Industry Council for Electronic Equipment Recycling (ICER) may serve as an illustration

1.2. Product lifetime and end of life

Recycling of WEEE can be profitable when the contained materials are recovered in the recycling process. However, there are huge differences between different types of products and, accordingly, the economic value of the waste depends heavily on the type of the equipment to be recycled. For instance, recycling of a mobile phone is much more profitable than that of a hairdryer, which contains less valuable materials to be recovered.

2. Electronics waste policies

The amount of household waste and e-waste is increasing globally, creating the need to find models for national waste management. Appropriate management of e-waste is being debated by many different stakeholder groups around the world, including international organizations,

governments, academia, industry and non-governmental organizations (NGOs). The main reason for this is the concern that e-waste is causing health and environmental problems in developing countries. The problems are mainly caused by unsafe and environmentally risky processes and bad or unprofessional practices applied by the informal sector when trying to extract the valuable metal content from the different end-of-life products.

The overall target when planning a national e-waste management policy must be the creation of a sustainable recycling society. This involves setting up robust models and infrastructures for collection and recycling, as well as efforts to raise awareness and facilitate changes in the behavior of the consumer. All the new practices will need time to develop, and the solutions will become more visible as recycling becomes everyday practice and products come back for recycling in much larger quantities.

2.1**. Legislation**

EU legislation restricting the use of hazardous substances in electrical and electronic equipment (Directive 2002/95/EC, the RoHS Directive) and WEEE, and promoting the

collection and recycling of such equipment (Directive 2002/96/EC), has been in force since February2003 Similar legislation is in force or under development in many countries around the world. Collection schemes where consumers may return their used e-waste free of charge were therefore created in European countries.

The objective of these schemes is to increase the recycling and/or reuse of such products. The RoHS Directive requires heavy metals, such as lead, mercury, cadmium

and hexavalent chromium, and flame retardants, such as polybrominated biphenyls or polybrominated diphenyl ethers, to be substituted by less hazardous alternatives in

electronics products.

Despite such regulations on collection and recycling, only one-third of electrical and electronic waste in the EU is reported as being collected separately and treated appropriately. A part of the other two-thirds is potentially still going to landfills and to sub-standard treatment sites in or outside the EU, often via illegal exports . In European countries, as for other waste streams, such as packaging materials, batteries and wrecked cars, producer responsibility legislation is in place for electronic scrap (the WEEE Directive).With the objective of achieving higher efficiencies and related cost-savings, certain producer responsibility organizations (PROs) have been set up to specifically manage and comply with the imposed responsibilities on

behalf of several manufacturers of electronic equipment. Apart from the EU and some states in the US, similar legislation for e-waste or substance restrictions is either in force or at different stages of implementation in, for example, Canada, China, South Africa, Mexico, Argentina,

Chile, Colombia, Ecuador, Morocco, Algeria, Tunis, Turkey, Saudi Arabia, Australia, New Zealand, Vietnam, Thailand and Indonesia.

2.2. Policy mechanisms

In order to solve “the e-waste problem”, over the past decade many countries have adopted extended producer responsibility (EPR) regulations. EPR requires “producers”

of electrical and electronic equipment to take back and recycle their products once these have reached the end of their life.

EPR builds on the assumption that, when a producer is made responsible for the costs of dealing with the product as waste, the producer will have incentives to design the product in such a way that these costs are minimized. When put into practice, this should mean that the producer pays only for costs related to his own product, i.e. individual producer responsibility (producer responsibility is called “individual” when each producer pays only for the recycling of its own products and is called “collective”

when producers share all end-of-life costs). Currently, many different models are applied for financing the particular costs in the recycling chain, with regard to what is to be financed, how to assess the costs for the different product categories and the resulting share for the different manufacturers which are participating in the same collection scheme but are manufacturing different kind of electronics products. Usually the setting up of collection systems is most effective if it is organized in a collective

manner, meaning that many producers together share the same collection system and the associated costs. This is typically achieved in Europe by setting up PROs.

3. **manaagement, treatment and final disposal of e-waste**

This section describes the general concepts of e-waste, its fundamental technical definitions and the main sources of its generation. Additionally, this section provides an overview of technological and environmentally sustainable alternatives that are available for proper e-waste management at the global level. It also describes some examples of policies and strategies that many countries have adopted in order to promote sustainability in the management of e-waste. The introduction includes

examples of regulatory frameworks in other regions, such as Europe's WEEE Directive.

3.1 Environmental sustainability in e-waste management

According to the Step Initiative, e-waste constitutes one of the largest waste streams on Earth with significant social and environmental implications. (UNU, 2013) Therefore, it is important to understand that e-waste is a unique waste stream of concern whose management, treatment and disposal must be done in a sound manner.

It is important to define the concept and its associated terms clearly in order to understand the best ways to manage it.

In 2009, Luciano Morselli defined EEE as "Any device that for functional reasons is dependent on electric currents or electro-magnetic fields in order to work properly. It becomes WEEE when its owner disposes of it, tries or needs to discard it". (Morselli et al, 2009) In 2014, the Step Initiative defined electrical and electronic equipment (EEE) as "any item from homes or businesses that contains circuits or electronic components and a power source or batter". Step also established that the term e-waste covers "all types of electrical and electronic equipment and parts 'discarded' by its owner

as waste without the intention of re-use". Step emphasizes the term “discarded” to distinguish between an item or product that can be reused from waste.

According to the European Directive 2012/19/EU, EEE products "are those that run on electric currents or electromagnetic fields and are intended for the use with a voltage rating not exceeding 1000 V alternating current (AC) and 1500 V direct current (DC); are also those apparatuses necessary to generate, transmit and measure such currents and fields".

Categories of e-waste

EEE products have been categorized into various groupings by pieces of national legislation taking into account their original purpose, size, composition and/or weight. Internationally, the suggested classification has been used as a reference by the 2002 **Sustainable management of waste electrical and electronic equipment in Latin America Classification of EEE – European WEEE Directive**

1. Large household appliances, such as large cooling equipment like refrigerators, freezers, or equipment for cookers, microwave ovens, etc.
2. Small household appliances, such as cleaning equipment like vacuum cleaners and irons.
3. Information technology (IT) and telecommunication equipment, personal computers, laptops, printers,
photocopiers, telephones, cell phones, modems, routers, tablets, data processing management equipment,etc.
4. Consumer electronics, such as radios, televisions, video cameras, musical instruments, etc.
5. Lighting equipment, fluorescent lamps, compact fluorescent, excluding incandescent lamps for homes.
6. Electrical and electronic tools (except fixed industrial tools of great significance) like crushing equipment for coatings.
7. Toys or sporting and leisure equipment, video consoles, trains, electric cars, etc.

8. Medical devices (with the exception of all implanted and infected products), such as cardiology equipment, radiotherapy, dialysis, etc.

9. Monitoring and control instruments, such as smoke detectors, thermostats, control panels, etc.

10. Vending machines for drinks, automated teller machines (ATMs), etc.

The European Directive states that from 2018 onward, all EEE should be grouped into six general categories, as described in Table 3. The United Nations University recognizes these e-waste categories as valid for international use.

Classification of EEE

1. Heat exchange equipment: Refers to refrigeration and freezing, such as refrigerators, freezers, air conditioners or heat pumps.

2. Screens, monitors: Typical devices include televisions, monitors, laptops, notebooks and tablets. Any device area larger than 100 cm2.

3. Large equipment: Typical equipment includes washing machines, clothes dryers, dishwashers, electric heaters, large printers, photocopiers and photovoltaic panels. (External dimension more than 50 cm).

4. Lamps: Typical equipment includes vertical fluorescent lamps, compact fluorescent lamps, high-pressure discharge lamps and light emitting diodes (LEDs).

5. Small equipment: Typical equipment includes vacuum cleaners, microwave ovens, ventilation apparatuses, toasters, electric kettles, electric shavers, scales, radios, video cameras, electrical and electronic toys, small electric and electronic tools, small medical devices, small tools for monitoring and control. (Including categories 1 to 3 and 6. External dimension up to 50 cm).

6. Small ICT: Typical devices include cell phones, global positioning systems (GPS), pocket calculators, routers, personal computers, printers and telephones.

Terminology and management processes of e-waste

Reuse: Extension of the end of life of equipment or component parts to be used for the same purpose for which they were originally conceptualized; this may or may not

include a change in ownership of the equipment. This process aims to promote optimal use of available resources, but social or environmental risks associated with poor management should be taken into account.

Dismantling and segregation: This involves careful manual separation of the parts and components of a piece of equipment in disuse. It is suggested that this activity be carried out by authorized recycling companies that specialize in reconditioning.

Recycling and recovery: This process involves the recovery of devices, components and material. The dismantling can be manual or semi-manual. The recovery of materials is part of the WEEE recycling process, especially for metal recovery, which requires specialized facilities and investment.

Refurbishment: This is any process that allows re-utilization of EEE that was previously WEEE. It includes changes in hardware and software.

Final disposition: In the process of final disposal of waste or materials, non-recoverable materials can be disposed of in controlled landfills (dumps) or by incinerating.

The principles of reduce, reuse and recycle (3Rs) should also be taken into account for the proper management of e-waste in order to minimize the generation of waste throughout its life cycle by employing innovative and efficient processes and technologies. Reuse is an alternative that should include the implementation of a proper collection and refurbishment process. Reusing products has its limitations; it can only temporarily extend the life of the equipment.Thus, for any decision regarding extension of the lifespan of ICT equipment and other obsolete or inoperative e-waste for material recovery, recycling should be considered. These recycling processes should be carried out using environmentally sustainable management methods and technologies. Some ICT equipment, for example,require specific methodologies and specialized recovery processes that often can only be performed by skilled operators and recycling companies using specialized equipment.

Self-Check 3	Written Test

Directions: Answer all the questions listed below. Use the Answer sheet provided in the next page:

I. fill the blank spaces

1. _____ is the process involves the recovery of devices, components and material.

Information Sheet-4 . documentation

4.1 Documentation

Complete, accurate, and current documentation is essential to an effective maintenance program. Whether performing preventive, predictive, or reliability centered maintenance, keeping track of equipment condition and maintenance—performed and planned—is critical.

The maintenance recordkeeping system must be kept current so that a complete maintenance history of each piece of equipment is available at all times. This is important for planning and conducting an ongoing maintenance program and provides documentation needed for the technician.

Regular maintenance and emergency maintenance must be well documented as should special work done during overhauls and replacement.

The availability of up-to-date drawings to management and maintenance staff is extremely important. Accurate drawings are very important to ongoing maintenance, testing, and new construction; but they are essential during emergencies for troubleshooting. In addition, accurate drawings are important to the continued safety of the staff working on the equipment.

Before performing any maintenance activity in all electrical/electronic equipment prior to watch documents of equipment's preventive maintenance record that is appropriate for electrical preventive maintenance should be inspected, tested, and serviced in accordance with an electrical preventive maintenance program defined by the equipment manufacturer manual.

Inspections, tests, and servicing shall be performed by personnel who are qualified for the work to be performed. These qualifications can be shown by appropriate documentation of work experience, on-the-job, and offsite formal training to verify understanding and retention of minimum knowledge, skills, and abilities.

Self-Check 4	Written Test

Directions: Answer all the questions listed below. Use the Answer sheet provided in the next page:

1. Discuss why documentation is important in repair o equipments?

Operation Sheet – 1	**Disassembling Procedure**

Purpose: This operation enumerates the proper procedure of Home appliance disassembling procedure.

Equipment, Tools and Materials:

- Equipment
- Appropriate Tools and devices
- Office equipments
  - ✓ Photo copy machines
  - ✓ computers
  - ✓ UPS
  - ✓ printers

Conditions or Situations for the Operation:

- Consider that the event took place in an appliance service center/workshop.
- The Trainee is the service technician

Procedure:

Disassembling

Disassembling procedure must take place upon confirmation of equipment states through inspection procedure.

- Steps are the following:
  - ✓ Considering that all the materials and tools are already prepared and arrange according to 5S standards and PPE, start with inspecting screw positions.
  - ✓ Make sure that screws must be place in a secure place, a permanent magnet is recommended.
  - ✓ Inspect the size of the screw; remember that screw sizes may vary depending on its location and function. Use appropriate screw driver.
  - ✓ Loosing screw must be observed and done carefully so that threads will not be damage most especially when the chassis is made of plastic.
  - ✓ When loosing screws:
  - ✓ Once all the screws are removed from the main chassis make sure to place them in one place.

- ✓ Remove the unscrewed cover and place it on the safe place.
- ✓ Make sure that all the body parts that are removed are placed in sequence so as not to miss any parts during the assembling procedure.
- ✓ Remove connections if necessary.

- **Note:** Make sure that during the disassembling procedure always refer to the service manual. If service manual is un-available make sure that everything should be properly and orderly done.
  For this module, Home/Office electrical/electronic controlled equipment will be the subject of preventive maintenance. The Trainer will provide the equipment for the training. A separate operation manual or supplementary notes will be provided for the particular equipment.

Precautions:

- Apply Kaizen/5's
- Be care full Safety rules

Quality Criteria:

- The trainee should be able to perform the following procedures accordingly

LAP Test	Practical Demonstration

Name: _____ Date: _____

Time started: _____ Time finished: _____

Instructions: Your will be given a faulty equipment, a workbench with tools and equipment as well as PPEs'.

1. You are required to perform the following:
   Task-1, Disassembling Procedure
2. Request your teacher for evaluation and feedback

List of Reference Materials

2. Printer and Photocopier Troubleshooting and Repair Collection
3. ttps://www.researchgate.net/publication/257541214
4. Sustainable management of waste electrical and electronic equipment in Latin America
5. ELECTRICAL INSTALLATION MAINTENANCE 130 K to 12 – Technology and Livelihood Education
6. Managing electrical risks in the workplace

The trainers who developed the TTLM

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