Home/Office Electrical/Electronic Equipment Servicing

Level-II

Learning Guide-24

Unit of Competence: Maintaining and Repairing Electronically-Controlled Office Equipment
Module Title: Maintaining and Repairing Electronically-Controlled Office Equipment
LG Code: EEL HOS2 M07 1019 LO1-LG 24
TTLM Code: EEL HOS2 M07 1019 TTLM 1019v1

LO 1: Prepare unit, tools, equipment and workstation

Instruction Sheet:1	Learning Guide #24

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

- Preparing Workplace/equipment
- Verifying repair/maintenance history in line with the company procedures
- Acquiring Service manuals and service information
- Setting /arranging workplace for repair job in accordance with company standard procedures
- Preparing tools, test instruments and personal protective equipment

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

- Prepare Workplace/equipment
- Verify repair/maintenance history in line with the company procedures
- Acquire Service manuals and service information
- Set /arrange workplace for repair job in accordance with company standard procedures
- Prepare tools, test instruments and personal protective equipment

Learning Instructions:

1. Read the specific objectives of this Learning Guide.
2. Follow the instructions described below to.
3. Read the information written in the information “Sheet 1, Sheet 2, Sheet 3 and Sheet 4”.
4. Accomplish the “Self-check 1, Self-check t 2, Self-check 3 and Self-check 4,” **in page 5, 10, 13, 16, -,** Self-check 5 **, page 25** respectively.
5. If you earned a satisfactory evaluation from the “Self-check” proceed to “Operation Sheet 1, Operation Sheet 2 and Operation Sheet 3 ” **in page 26 -.**
6. Do the “LAP test” **in page 27** (if you are ready).

Information Sheet-1	Preparing Workplace/equipment

1.1 INTRODUCTION

Safety is the number one priority in any job. Every year, electrical accidents cause serious injury or death. Many of these casualties are young people just entering the workplace. They are involved in accidents that result from carelessness, from the pressures and distractions of a new job, or from a lack of understanding about electricity. This chapter is designed to develop an awareness of the dangers associated with electrical power and the potential dangers that can exist on the job or at a training facility.

Safety precautions you must observe in any work area:

- Don't fool around. "Horseplay" is one of the biggest causes of injuries on the job and it may be grounds for dismissal.
- Never work while under the influence of drugs or alcohol, as you are a hazard to yourself and your co-workers.
- Pay particular attention to moving objects, such as equipment, tools, machines, and others.
- Walk, do not run, in the work areas.
- Stay completely alert on the job.

Electrical safety

Even though you may normally deal with low voltages and current, the values are never far away from lethal levels. You can receive a shock or burn from any common electrical circuit. The severity of the electrical shock depends on four factors:

- The amount of current that passes through the body
- The path that the current takes through the body
- The frequency of the current
- The length of time that the current flows within the body.

Electrical Shock

The human body conducts electricity. Even low currents may cause severe health effects.Spasms, burns, muscle paralysis, or death can result, depending on the amount of the current flowing through the body, the route it takes, and the duration of exposure. The main factor for determining the severity of an electric shock is the amount of electric current

that passes through the body. This current is dependent upon the voltage and the resistance of the path it follows through the body. Electrical resistance (*R*) is the opposition to the flowof current in a circuit and is measured in ohms (Ω). The lower the body resistance, the greater the current flow and potential electric shock hazard. Body resistance can be divided into external (skin resistance) and internal (body tissues and blood stream resistance). Dry skin is a good insulator; moisture lowers the resistance of skin, which explains why shock intensity is greater when the hands are wet. Internal resistance is low owing to the salt and moisture content of the blood. There is a wide degree of variation in body resistance. A shock that may be fatal to one person may cause only brief discomfort to another.

Typical body resistance values are:

Dry skin—100,000 to 600,000 Ω

• Wet skin—1,000 Ω

• Internal body (hand to foot)—400 to 600 Ω

• Ear to ear—100 Ω

Thin or wet skin is much less resistant than thickor dry skin. When skin resistance is low, the current may cause little or no skin damage but severely burn internal organs and tissues. Conversely, high skin resistance can produce severe skin burns but prevent the current from entering the body.

Voltage (*E*) is the pressure that causes the flow of electric current in a circuit and is measured in units called volts (V). The amount of voltage that is dangerous to life varies with each individual because of differences in body resistance and heart conditions. Generally, any voltage above 30 V is considered dangerous. Electric current (*I*) is the rate of flow of electrons in a circuit and is measured in amperes (A) or milliamperes (mA). One milliampere is one-thousandth of an ampere. The amount of current flowing through a person's body depends on the voltage and resistance. Body current can be calculated using the following Ohm'slaw formula:

$$\text{Current} = \frac{\text{voltage}}{\text{Resistance}}$$

If you came into direct contact with 120 volts and your body resistance was 100,000 Ω, then the current that flow would be:

$$I = \frac{120v}{100000\Omega} = 0.0012 \text{ A}$$

Self-Check -1	Written Test

Name: _____ Date: _____

Directions: Answer all the questions listed below.

PART I TRUE/FALSE

If the statement is correct write TRUE if the statement is in correct write FALSE

_____1. The human body conducts electricity.(4 pts).

_____2 The amount of current that passes through the body.(5 pts)

Note:Satisfactory rating – 5 and above points Unsatisfactory below 5 points

Answer Sheet

Score = _____

Rating: _____

Name: _____ Date: _____

Information Sheet-2	maintenance procedures

2.1 Introduction

This document is intended to establish standard practice as well as to give general advice and guidance in the maintenance of electrical equipment owned and operated by the Bureau of Reclamation. Specific technical details of maintenance are included in other documents which are referenced in this document.
Maintenance recommendations are based on industry standards and experience in Reclamation facilities. However, equipment and situations vary greatly, and sound engineering and management judgment must be exercised when applying these recommendations. Other sources of information must be consulted (e.g., manufacturer's recommendations, unusual operating conditions, personal experience with the equipment, etc.) in conjunction with these maintenance recommendations.

2.2 Types of maintenance

2.2.1 Preventive Maintenance

Preventive maintenance (PM) is the practice of maintaining equipment on a regular schedule, based on elapsed time, run-time meter readings, or number of operations. The intent of PM is to "prevent" maintenance problems or failures before they take place by following routine and comprehensive maintenance procedures. The goal is to achieve fewer, shorter, and more predictable outages.
Some advantages of preventive maintenance are:

- It is predictable, making budgeting, planning, and resource leveling possible.
- When properly practiced, it generally prevents most major problems, thus reducing forced outages, "reactive maintenance," and maintenance costs ingeneral.
- It gives managers a level of assurance that equipment is being maintained.
- It is easily understood and justified.

Traditionally, preventive maintenance has been the standard maintenance practice in Reclamation. The maintenance recommendations in this document are based on a PM philosophy and should be considered as "baseline" practices to be used when managing a maintenance program.
However, care should be taken in applying PM recommendations. Wholesale implementation of PM recommendations without considering equipment criticality or equipment condition may result in a workload that is too large to achieve. This could result in important equipment not receiving needed
maintenance, which defeats the purpose of PM.
To mitigate this problem, maintenance managers may choose to apply a ***consciously chosen, effectively implemented, and properly documented*** reliability-centered maintenance (RCM) program or augment PM with conditionbased maintenance (CBM)

practices. Whether utilizing a PM, RCM, or CBM, or a combination of these, the primary focus of the in-house maintenance staff should be scheduled maintenance.
This will reduce reactive (emergency and corrective) maintenance. Scheduled maintenance should have a higher priority than special projects. Scheduled maintenance should be the number one priority.

2.2.2 Reliability Centered Maintenance

Reliability-centered maintenance programs are gaining in popularity and have been piloted in a few Reclamation power facilities with good results. The goal of these programs is to provide the appropriate amount of maintenance at the right time to prevent forced outages while at the same time eliminating unnecessary maintenance.
Implemented properly, RCM can eliminate some of the drawbacks of preventive maintenance and may result in a more streamlined, efficient maintenance program. RCM seems very attractive in times of diminishing funding, scarcity of skilled maintenance staff, and the pressure to “stay online” due to electric utility industry deregulation.
RCM is not an excuse to move to a “breakdown maintenance” philosophy or to eliminate critical preventive maintenance in the name of reducing maintenance staff/funding. However, to mitigate problems associated with a PM program, maintenance managers may choose to apply a ***consciously chosen, effectively implemented, and properly documented*** RCM program.
For RCM to be a viable program at Reclamation facilities, it must:

- Be chosen as the local maintenance philosophy by management.
- Be implemented according to generally accepted RCM practices.
- Be documented so that maintenance decisions are defensible.

2.2.3 Condition-Based Maintenance

This program relies on knowing the condition of individual pieces of equipment.
Some features of CBM include:

- Monitoring equipment parameters such as temperatures, pressures, vibrations, leakage current, dissolved gas analysis, etc.
- Testing on a periodic basis and/or when problems are suspected such as Doble testing, vibration testing, and infrared scanning.
- Careful monitoring of operator-gathered data.
- Results in knowledgeable maintenance decisions which would reduce overall costs by focusing only on equipment that really needs attention.

2.2.4 Combination of Condition-Based and Preventive Maintenance

A combination of condition-based maintenance and preventive maintenance is perhaps the most practical approach. Monitoring, testing, using historical data, and preventive maintenance schedules may provide the best information on when equipment should be maintained. By keeping accurate records of the “as found” condition of equipment when it is torn down for maintenance, one can determine what maintenance was really necessary. In

this manner, maintenance schedules can be lengthened or perhaps shortened, based on experience and monitoring.

2.3. Maintenance and test procedures

Maintenance activities fall into three general categories:

• ***Routine Maintenance*** **:-** Activities that are conducted while equipment and systems are in service. These activities are predictable and can be scheduled and budgeted. Generally, these are the activities scheduled on a time-based or meter-based schedule derived from preventive or predictive maintenance strategies. Some examples are visual inspections, cleaning, functional tests, measurement of operating quantities, lubrication, oil tests, and governor maintenance.

• ***Maintenance Testing*** **:-** Activities that involve using test equipment to assess condition in an offline state. These activities are predictable and can be scheduled and budgeted. They may be scheduled on a time or meter basis but may be planned to coincide with scheduled equipment outages. Since these activities are predictable, some offices consider them "routine maintenance" or "preventive maintenance." Some examples are governor alignments and balanced and unbalanced gate testing.

• ***Diagnostic Testing: –*** Activities that involve using test equipment to assess the condition of equipment after unusual events, such as equipment failure/ repair/replacement or when equipment deterioration is suspected. These activities are not predictable and cannot be scheduled because they
are required after a forced outage. Each office must budget for these events. Some examples are governor troubleshooting, unit balancing, and vibration testing.

Maintenance procedures

- Prepare necessary tools, test instruments and personal protective equipment in line with job requirements
- Acquire service manuals and service information required for repair /maintenance as manufacturer's specifications
- Conduct complete check-up of electronically-controlled domestic appliances
- Document the identified defects based on check-up conducted

When we want to maintan any equipment necessary to maintenance procedures. These are:

- PURPOSE
  - ✓ To develop , document and implement an effective planned preventive maintenance system and breakdown repairs of the all the key process machinery / equipment, to ensure continued process capability as a part of process control and
- SCOPE
  - ✓ All key process machinery / equipment used in the office
- REFERENCE
- RESPONSIBILITY

- ✓ Machine listing & Preparing Maintenance plan – HoDs/Regional/Chapter Heads
- ✓ Ensuring preventive maintenance- do
- ✓ Acknowledgement of products/materials/ services from the service providers/ suppliers –Process owners/ equipment owners

- PROCESS FLOW
- RECORDS

Sl No	Record	Form No	Retention Period
1	List of office Equipment and maintenance plan	F 11.1	Permanent till replaced with a new one
2	Logs of the service providers		1 year Do

LIST OF EQUIPMENT & MAINTENANCE PLAN

Location / Department _____

Sl No	EQUIPMENT	Make	Equipment Identification No	Quantity	Location	Maintenance plan	Records to be Maintained

Table 1.1

Self-Check -2	Written Test

Name: _____ Date: _____

Directions: Answer all the questions listed below.

PART I TRUE/FALSE

If the statement is correct write TRUE if the statement is in correct write FALSE **(3 points each)**

_____1. Reliability-centered maintenance programs are gaining in popularity and have been pilotedin a few Reclamation power facilities with good results.

_____2. Maintenance recommendations are based on industry standards and experience in Reclamation facilities.

PART II. Choose the best answer or the ollewing questions(3 points each)

1. Activities that involve using test equipment to assess condition in an offline state is known as_____

   A. Diagnostic tesing C. Maintenance tesing

   B. Routine tesing D. none

2. _____is the practice of maintaining equipment on a regular schedule, based on elapsed time, run-time meter readings, or number of operations.

   A. Maintenance Testing C. Routine

   B. Reliability Centered Maintenance D. Preventive maintenance

Note: Satisfactory rating – 6 and above points Unsatisfactory below 6 points

Answer Sheet

Score = _____

Rating: _____

Name: _____ Date: _____

Information Sheet- 3	Acquiring Service manuals and service information

3.1 Service manuals

Service manual is the full written information provided by the manufacturer regarding the equipment. This service manual usually accompanies the equipment at time of purchase. A service manual consists of some or all of the f/f

1. Safety & precautionary measures during dissembling
2. Dismantling or blow-up diagram
3. Block diagram of the equipment
4. Circuit diagram
5. PCB lay out
6. Parts-list
7. Service manual/schematic diagram/parts list
8. Operating instructions/User's/Owner's manual
9. Component data sheet/handbook

3.2 Service information

Record all information during maintaining/repairing electronically-controlled office equipments.

Directions: Provided with the defective office equipments use Maintain and Repair Form to gather and document the information about the equipments at hand. Follow the procedures below:

Resources:

Domestic appliance: ----------

Receiving/Check-up Form

Procedure:

1. Conduct an initial interview to the owner of the equipments.
- Ask what the problem is.
- Request for the details of the problem (how does it happen/since when/ nature of the problem)

2. As serviceman, you must confirm the problem/ complain.

3. Make an initial inspection/ testing of the appliance.
- Physical appearance
- Operating controls
- Power cord **etc**.

4. Take note of the information gathered and observed.
5. Accomplish Receiving and Repair Form.

Receiving and Repair Form

Customer's name: _____

Address: _____

Product/ Brand name: _____
Serial no: _____
Complain: _____
_____

Part of equipment	Condition	
	Good	Defective
Power cord		
Power switch		
.		
.		
.		
.		

Table 2.1 Receiving and Repair Form

Self-Check -3	Written Test

Name: _____ Date: _____

Directions: Answer all the questions listed below.

PART I TRUE/FALSE

If the statement is correct write TRUE if the statement is in correct write FALSE**(3 points each)**

_____1.Service **manuals** record all information during maintaining/repairing electronically-controlled office equipments.

_____2. Service information is the full written information provided by the manufacturer regarding the equipment.

Note: **Satisfactory rating – 3 points** **Unsatisfactory - below 3 points**

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

Answer Sheet

Score = _____

Rating: _____

Name: _____ Date: _____

Information Sheet-4	Arrangement of work place

4.1 Workplace Safety

The most important concept to remember is that you are responsible for your own safety and the safety of others. Most safety practices are common sense. Unfortunately, they can be forgotten or overlooked unless you make safe practices a habit or an instinct.
When we prepare sae working environment get:

- To preserve machinery, building and services, in good operating condition.
- To restore it back to its original standards, and
- To improve the facilities depending upon the development that is taking place in the building engineering.

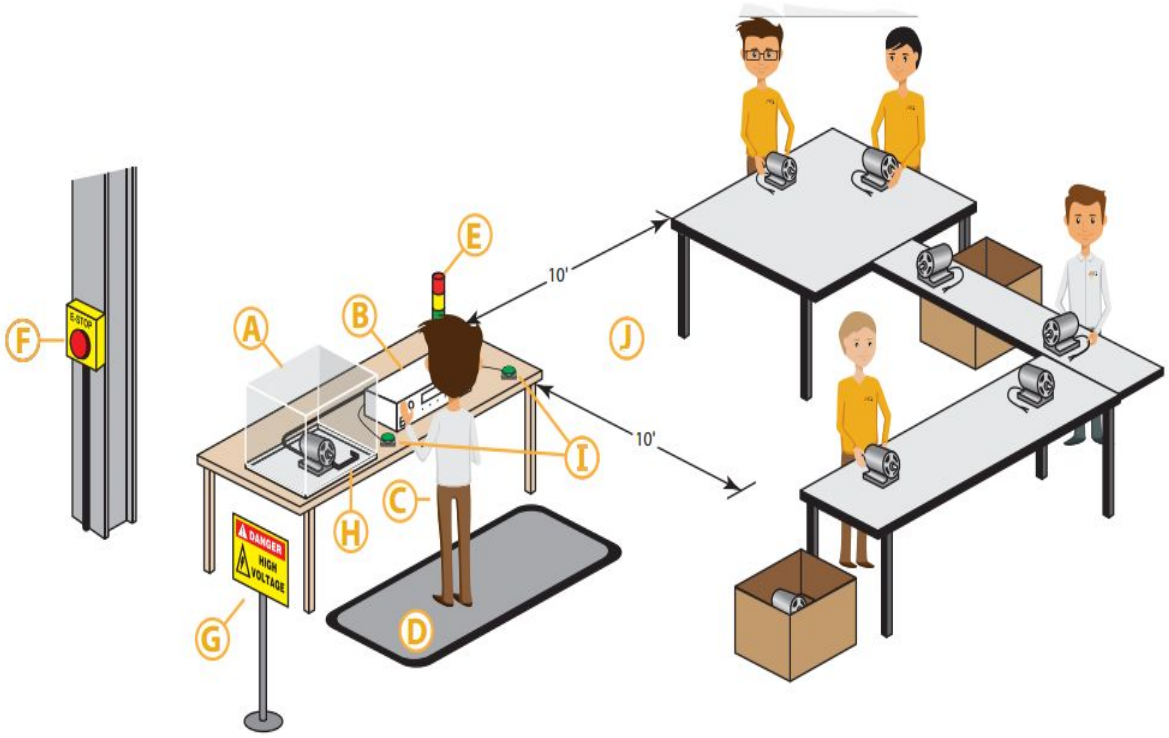
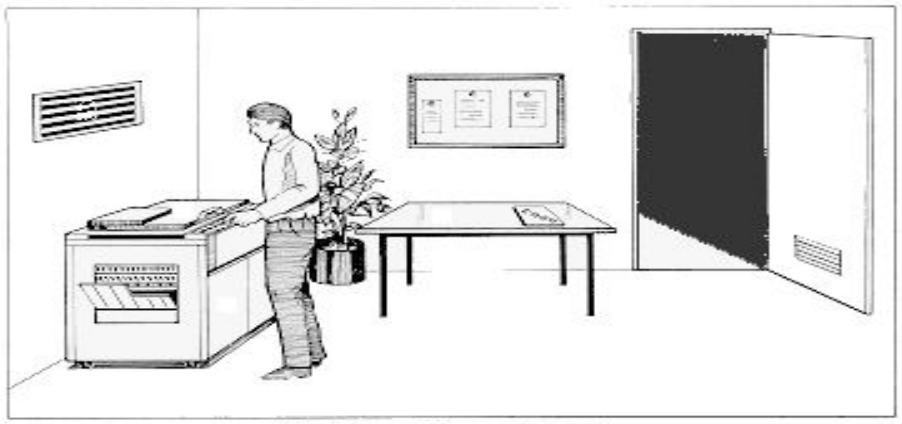
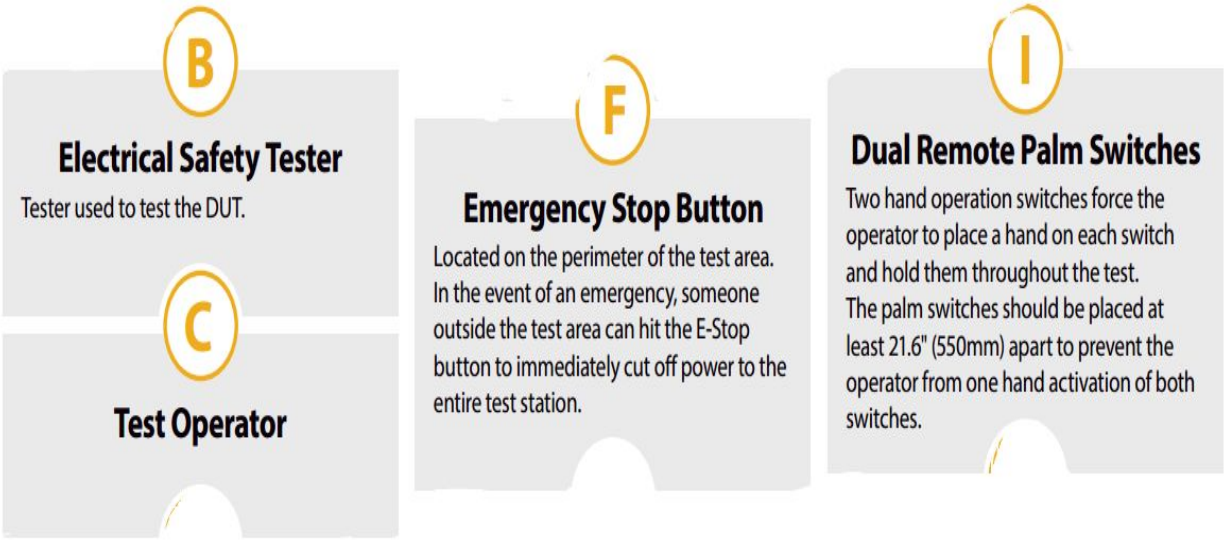


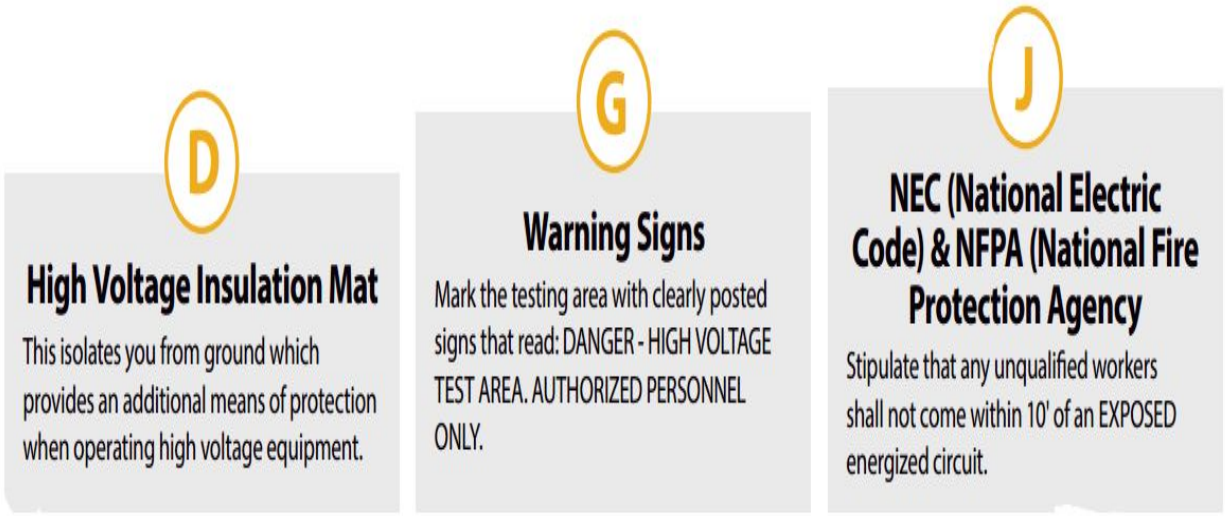
fig 4.1 Arrangement of work place



A healthy working environment

fig 4.1 work places safety




D
High Voltage Insulation Mat
This isolates you from ground which provides an additional means of protection when operating high voltage equipment.
G
Warning Signs
Mark the testing area with clearly posted signs that read: DANGER - HIGH VOLTAGE TEST AREA. AUTHORIZED PERSONNEL ONLY.
J
NEC (National Electric Code) & NFPA (National Fire Protection Agency
Stipulate that any unqualified workers shall not come within 10' of an EXPOSED energized circuit.

Self-Check 4	Written Test

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

1, The objective of setting workplace is **(3 points)**

A, To preserve machinery, building and services, in good operating condition.

B, To restore it back to its original standards, and

C, To improve the facilities depending upon the development that is taking place in the building engineering. D, all

2, one of the best ways to prevent injury is to ensure that the test station is set up safely and securely. (3 points)

A True

B, False

3,Test stations can be setup with or without direct protection depending on your requirements.(3points)

A. False

B. True

Note:Satisfactory rating – 5 and above points Unsatisfactory below 5 points

Answer Sheet

Score = _____

Rating: _____

Name: _____ Date: _____

Information Sheet- 5	Preparing tools, test instruments and personal protective equipment

5.1. Introduction

The tools, testing equipment and PPE for testing and fault finding must be suitable for the work, properly tested and maintained in good working order.

Workers carrying out electrical testing must be appropriately trained and competent in test being able to use the device safely and in the manner for which it was intended being able to determine, by inspection, that the device is safe for use, for example the device is not damaged and is fit for purpose understanding the limitations of the equipment, for example when testing to prove an alternating current circuit is de-energised, whether the device indicates the presence of hazardous levels of direct current being aware of the electrical safety implications for others when the device is being used, for example whether the device causes the electric potential of the earthing system to rise to a hazardous level knowing what to do to ensure electrical safety when an inconclusive or incorrect result is obtained. ESOPDF179 Electrical safety code of practice 2013 - Managing electrical risks in the workplace.

5.2. *Personal protective equipment (PPE)*

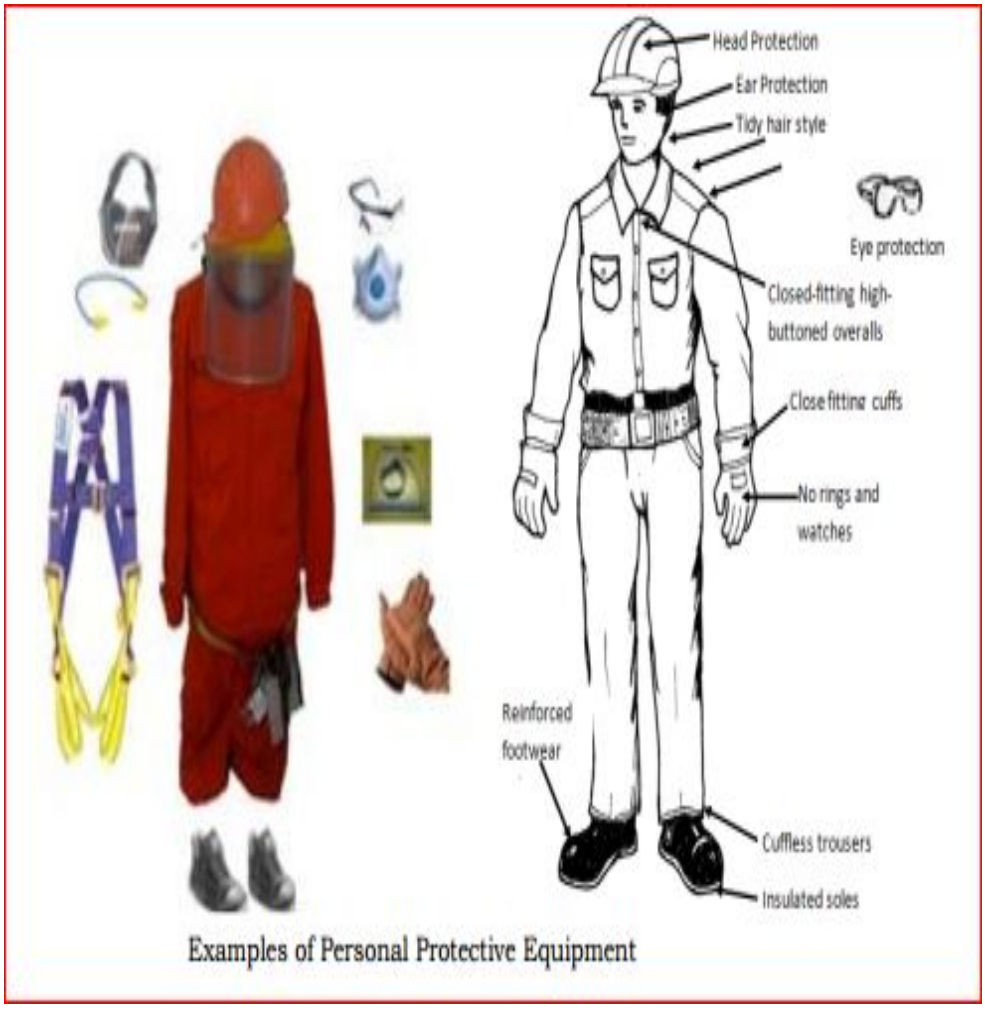


Figure 5.1 Personal protective equipment

PPE for electrical work, including testing and fault finding, must be suitable for the work, properly tested and maintained in good working order. The PPE must be able to withstand the energy at the point of work when working energised.

Training must be provided in how to select and fit the correct type of equipment, as well as training on the use and care of the equipment so that it works effectively.

Depending on the type of work and the risks involved, the following PPE should be considered:
Face Protection—use of a suitably arc rated full face shield may be appropriate when working where there is potential for high current and arcing.

Figure 5.2 Face Protection

Eye Protection—metal spectacle frames should not be worn.

Figure 5.3 eye Protection

Gloves—use gloves insulated to the highest potential voltage expected for the work being undertaken. Leather work gloves may be considered for de-energised electrical work.

Gloves and infection prevention

- ✓ Gloves can protect both patients and HCW from exposure to potentially infectious microorganisms that may be carried on the hands. As part of standard precautions they are used to prevent contamination of HCW hands when:
- ✓ anticipating direct contact with blood or body substances, mucous membranes, non-intact skin and other potentially infectious material
- ✓ handling or touching visibly soiled or potentially contaminated patient-care equipment
- there is potential exposure to toxic drugs during administration there is exposure to chemicals during the cleaning process

Figure 5.4 Gloves

Clothing—use non-synthetic clothing of non-fusible material and flame resistant. Clothing made from conductive material or containing metal threads should not be worn.

Footwear—use non-conductive footwear, for example steel toe capped boots or shoes manufactured to a suitable standard.

Safety Belt/Harness—safety belts and harnesses should be checked and inspected each time before use with particular attention being paid to buckles, rings, hooks, clips and webbing.

Rubber Protective Equipment —Rubber gloves are used to prevent the skin from coming into contact with energized circuits. A separate outer leather cover is used to protect the rubber glove from punctures and other damage. Rubber blankets are used to prevent contact with energized conductors or circuit parts when working near exposed energized circuits. All rubber protective equipment must be marked with the appropriate voltage rating and the last inspection date. It is important that the insulating value of both rubber gloves and blankets have a voltage rating that matches that of the circuit or equipment they are to be used with. Insulating gloves must be given an air test, along with inspection. Twirl the glove around quickly or roll it down to trap air inside. Squeeze the palm, fingers, and thumb to detect any escaping air. If the glove does not pass this inspection it must be disposed of.

Protection Apparel —Special protective equipment available for high-voltage applications include high voltage sleeves, high-voltage boots, nonconductive protective helmets, nonconductive eyewear and face protection, switchboard blankets, and flash suits.

Hot Sticks —hot sticks are insulated tools designed for the manual operation of high-voltage disconnecting switches, high-voltage fuse removal and insertion, as well as the connection and removal of temporary grounds on high-voltage circuits. A hot stick is made up of two parts, the head, or hood, and the insulating rod. The head can be made of metal or hardened plastic, while the insulating section may be wood, plastic, or other effective insulating materials.

Shorting Probes —Shorting probes are used on deenergized circuits to discharge any charged capacitors or built-up static charges that may be present when power to the circuit is disconnected. Also, when working on or near any high-voltage circuits, shorting probes should be connected and left attached as an extra safety precaution in the event of any accidental application of voltage to the circuit. When installing a shorting probe, first connect the test clip to a good ground contact. Next, hold the shorting probe by the handle and hook the probe end over the part or terminal to be grounded. Never touch any metal part of the shorting probe while grounding circuits or components.

Face Shields —listed face shields should be worn during all switching operations where there is a possibility of injury to the eyes or face from electrical arcs or flashes, or from flying or falling objects that may result from an electrical explosion. With proper precautions, there is no reason for you to ever receive a serious electrical shock. Receiving an electrical shock is a clear warning that proper safety measures have not been followed. To maintain a high level of electrical safety while you work, there are a number of precautions you should follow. Your individual job will have its own unique safety requirements. However, the following are given as essential basics.

• Never take a shock on purpose.

• Keep material or equipment at least 10 feet away from high-voltage overhead power lines.

• Do not close any switch unless you are familiar with the circuit that it controls and know the reason for its being open.

• When working on any circuit, take steps to ensure that the controlling switch is not operated in your absence. Switches should be padlocked open and warning notices should be displayed (**lockout/tagout**).

• Avoid working on “live” circuits as much as possible.
• When installing new machinery, ensure that the framework is efficiently and permanently grounded.
• Always treat circuits as “live” until you have proven them to be “dead.” Presumption at this point can kill you. It is a good practice to take a meter reading before starting work on a dead circuit.
• Avoid touching any grounded objects while working on electrical equipment.
• Remember that even with a 120-V control system, you may well have a higher voltage in the panel. Always work so that you are clear of any of the higher voltages. (Even though you are testing a 120-V system, you are most certainly in close proximity to 240-V or 480-V power.)
• Don’t reach into energized equipment while it is being operated. This is particularly important in high voltage circuits.
• Use good electrical practices even in temporary wiring for testing. At times you may need to make alternate connections, but make them secure enough so that they are not in themselves an electrical hazard.
• When working on live equipment containing voltages over approximately 30-V, work with only one hand. Keeping one hand out of the way greatly reduces the possibility of passing a current through the chest.
• Safely discharge capacitors before handling them. Capacitors connected in live motor control circuits can store a lethal charge for a considerable time after the voltage to the circuits has been switched off. Although Article 460 of the National Electric Code (NEC) requires an automatic discharge within 1 minute, never assume that the discharge is working! Always verify that there is no voltage present. Confined spaces can be found in almost any workplace.:
• Is not primarily designed or intended for human occupancy.
• Has a restricted entrance or exit by way of location, size, or means.
• Can represent a risk for the health and safety of anyone who enters, because of its design, construction, location, or atmosphere; the materials or substances in it; work activities being carried out in it; or the mechanical, process, and safety hazards present. All hazards found in a regular workspace can also be found in a confined space. However, they can be even more hazardous in a confined space than in a regular worksite. Hazards in confined spaces can include poor air quality, fire hazard, noise, moving parts of equipment.

5.3 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:

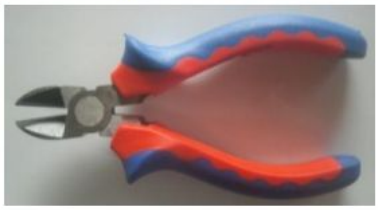
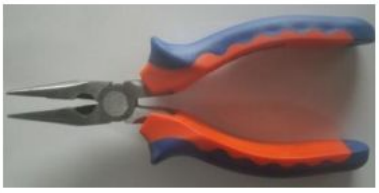
1. be suitable for the work in terms of their function, operating range and accuracy be in good condition and working order, clean and have no cracked or broken insulation. Particular care must be taken regarding the condition of the insulation on leads, probes and clips of test equipment pose no danger 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.
3. 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.

Tools

Commn tools are:

		
Soldering Iron with stand	Soldering Lead	Desoldering Tool
		
Diagonal Cutting Pliers	Long Nose Pliers	Wire Stripper

		
ESD Wrist Strap	Mask	Non-Static Brush
		
Apron	Cable Tie	Electrical Tape

Figure 5.5 common tools

Self-Check -5	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 termination..

_____2. Combination 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: _____

Operation Sheet1	Techniques for Preparing Workplace/equipment for maintenance

Techniques for Preparing Workplace/equipment for maintenance

Step 1- select work area

Step 2- select required tools, materials and equipments

Step 3- wear PPE.

Step 4- layout work area.

Step 5- arrange tools and equipments.

Operation Sheet 2	Setting Workplace for repair

Techniques for Setting Workplace for repair:

Step 1- select required materials tools and equipment.

Step 2- clean workshop.

Steps 3- design workshop.

Step 4- arrange workshop for work.

Operation Sheet 3	Preparing tools, test instruments and personal protective equipment

Techniques for Maintaining and storing tools and equipment's:

Step 1- wear PPE.

Step 2- Identifies tools and equipment's depends on their type.

Steps 3- set in order by placing the tools and equipment's in proper places.

Step 4- apply 5s

LAP Test	Practical Demonstration

Name: _____ Date: _____

Time started: _____ Time finished: _____

Instructions: Given necessary templates, tools and materials you are required to perform the following tasks within 4 hour.

Task 1. Preparing Workplace/equipment for maintenance

Task 2 Verifying maintenance history with the company procedures

Task3 Acquiring Service manuals and service information

Task4 Setting Workplace for repair

Task 5 Preparing tools, test instruments and personal protective equipment

Reference Books

1. "Physics for Scientists and Engineers" by F. Beuche;
2. http://www.uth.tmc.edu/anes/Assets/powerpoint/Electrical-Safety.pps ;
3. http://www.medtek.ki.se/medicaldevices/
4. http://www.bassengineering.com/e_effect.htm;
5. http//howstuffworks.com ;
6. http://www.mddionline.com/article/leakage-current-standards-simplified

Home/Office Electrical/Electronic Equipment Servicing

Level-II

Learning Guide-25

Unit of Competence: Maintaining and Repairing Electronically-Controlled Office Equipment
Module Title: Maintaining and Repairing Electronically-Controlled Office Equipment
LG Code: EEL HOS2 M09 1019 LO2-LG 25
TTLM Code: EEL HOS2 M09 1019 TTLM 1019v1

LO 2: Diagnose faults of the unit

Instruction Sheet:1	Learning Guide #25

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

- Checking electronically-controlled office equipment
- Observing pre-testing procedure
- Identifying system defect/fault symptoms
- Using Test instruments for the job
- Implementing Proper troubleshooting procedures
- Checking and isolating Circuits using specified testing procedures
- Explaining Identified defects and faults by the *responsible person*
- Checking settings/adjustments
- Documenting Results of diagnosis and testing
- Advising/Informing Customers

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

- Check electronically-controlled office equipment
- Pre-testing procedure observation
- Identify system defect/fault symptoms
- Use test instruments for the job
- Implemente troubleshooting procedures
- Check and isolate circuits using specified testing procedures
- Explaine Identified defects and faults by the responsible person
- Check set/adjustments
- Document the results of diagnosis and test
- Customers Advise/Inform

Learning Instructions:

Read the specific objectives of this Learning Guide.
Follow the instructions described below to __.
Read the information written in the information “Sheet 1, Sheet 2, Sheet 3 and Sheet 4”.
Accomplish the “Self-check 1, Self-check 2, Self-check 3, Self-check 4 , Self-check 5 , Self-check 6 , Self-check 7 , Self-check 8, Self-check 9 and Self-check 10” in page -, , and respectively.
If you earned a satisfactory evaluation from the “Self-check” proceed to “Operation Sheet 1, Operation Sheet 2 and Operation Sheet 3 ” in page -.
Do the “LAP test” in page – (if you are ready).

Information Sheet-1	Checking electronically-controlled office equipment

2.1 Checking electronically-controlled office equipment

Electronic control is also referred as electronic regulation that is done to an appliance, situation or load by electronic devices. Domestic appliances are commonly controlled directly or manually using electrical switches and timers. Same of these electronic controlled home equipment.

- Photo copy machine(analogue & Digital
- Fax machine
- Printer
- Scanner
- UPS
- PC In electronic devices, transformer is commonly used not just to reduce the supply voltage (220VAC) but also to isolate the load from the power source.

Checking the Operation of the Leakage Breaker

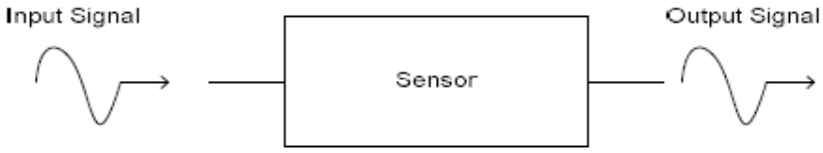
Advise the user to check the leakage breaker once or twice a month on a regular basis. Be sure also to ask the user
to keep a record of checks.

Inspection Procedure

- Turn on the main power switch.
- Push he test button of the leakage breaker with the tip of a ball-point pen .
- Check to make sure that the breaker switch shifts to the OFF side and the power is cut.
- Turn off the main power switch.
- Shift the breaker switch [1] back to the ON position.

Sensors:

- A device which provides a usable output in response to a specified measurand



- ➢ A sensor acquires a physical quantity and converts it into a signal suitable for processing (e.g. optical, electrical, mechanical)
- ➢ Nowadays common sensors convert measurement of physical phenomena into an electrical signal
- ➢ Active element of a sensor is called a transducer

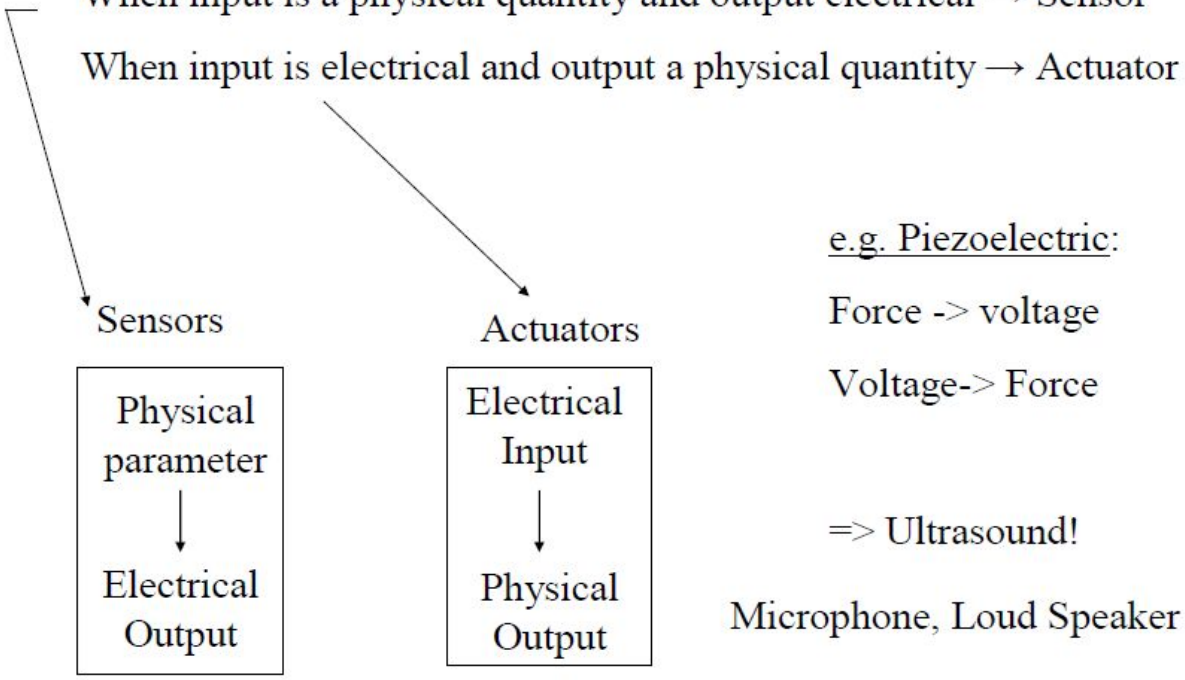
Transducer

Transducer?

A device which converts one form of energy to another

When input is a physical quantity and output electrical → Sensor

When input is electrical and output a physical quantity → Actuator



Commonly Detectable Phenomena

- Biological
- Chemical
- Electric
- Electromagnetic
- Heat/Temperature
- Magnetic
- Mechanical motion (displacement, velocity, acceleration, etc.)
- Optical
- Radioactivity

Common Conversion Methods

•Physical

- thermo-electric, thermo-elastic, thermo-magnetic, thermo-optic
- photo-electric, photo-elastic, photo-magnetic,
- electro-elastic, electro-magnetic
- magneto-electric

•Chemical

- chemical transport, physical transformation, electro-chemical

•Biological

- Biological transformation, physical transformation

Need for Sensors

• Sensors are pervasive. They are embedded in our bodies, automobiles, airplanes, cellular

telephones, radios, chemical plants, industrial plants and countless other applications.
• Without the use of sensors, there would be no automation !!
–Imagine having to manually fill Poland Spring bottles

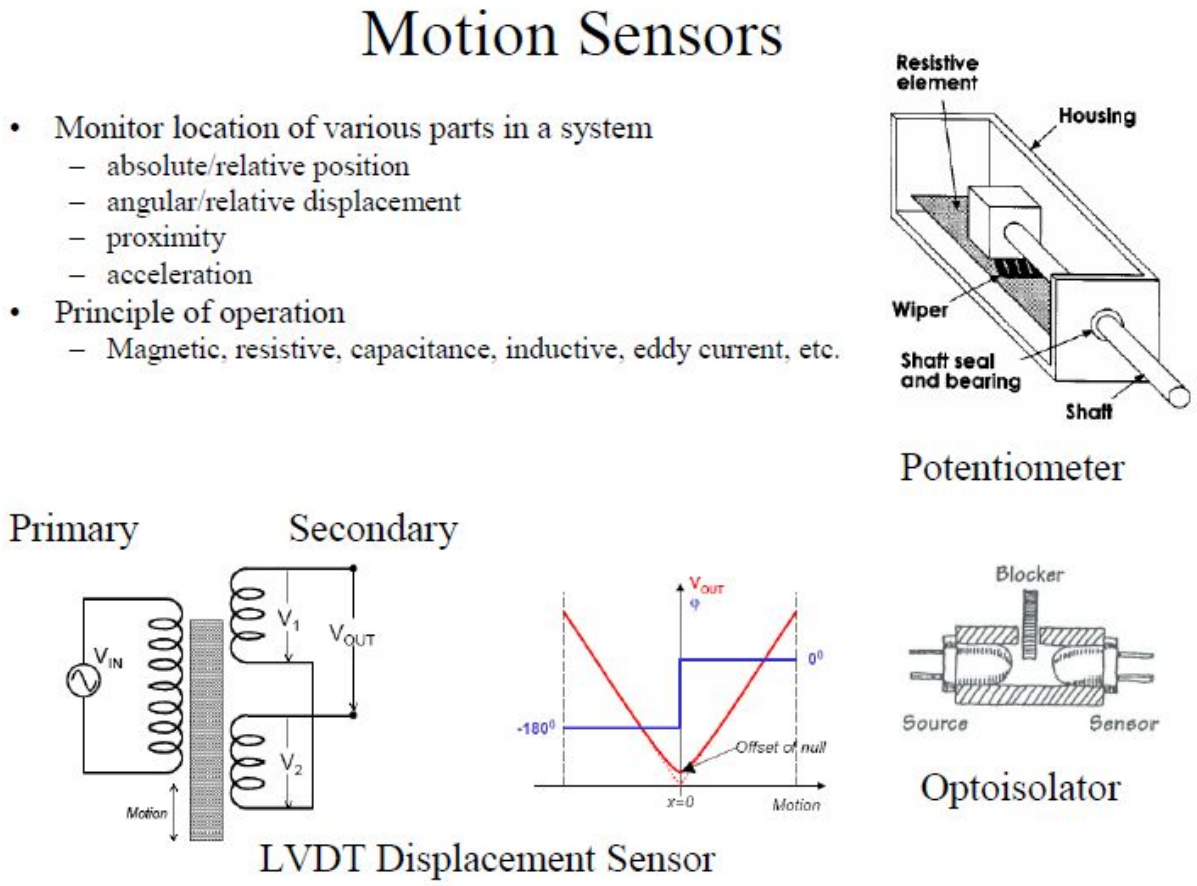


Figure 2.1 . displacement sensor

The toner density sensor (TDS) implemented in the Lexmark E series printer reduces these problems and eliminates the use of the current traditional “open-loop” (meaning feedback are parameters not directly affecting print darkness such as page count, toner level, etc.) calibration process where print darkness is adjusted using previously calculated and stored EP process parameters. The historical process does not have the ability to capture cartridge component variation and environmental changes which affect print darkness variation. The TDS captures real time data which is used to calculate EP process parameters for the adjustment of print darkness; as a result, greatly reducing variations uncontrolled by historical printer calibration. Specifically, the first and primary purpose of this research is to reduce print darkness variation using the TDS. The second goal is to mitigate the TDS EMI implementation issue for reliable data accuracy.
The toner density sensor (TDS) or (also termed) the toner patch sensor (TPS) measures toner developed on the PC (photoconductor) drum. Collected data from the TDS is used in an algorithm to adjust EP process parameters that control print darkness over the life of a cartridge.

Since the TDS is positioned in the midst of EP components, electromagnetic interference (EMI) can affect the TDS output signal. EMI exist in the printer due to motors rotating electrophotographic components.

- The first goal of the toner density sensor is to reduce current print darkness variation through the life of a given printer cartridge.
- The second goal of the TDS is to mitigate electromagnetic interference (EMI) affecting the TDS output signal during implementation. The new toner density sensor design meets these goals, functions well under environmental changes, maintains a fast response and requires little additional resource to implement.

The dissertation addresses the methods in which the toner density sensor was designed and tested to verify its performance while experiencing EMI and various environmental conditions. Also discussed is the reduction of print darkness variation using the TDS. Reduction of print darkness variation and EMI experienced by the TDS helps to provide consistent image quality over the life of every cartridge through the life of the printer.

Infrared(IR) light sensors have demonstrated their usefulness and versatility for solutions to existing problems and as a result, are being applied to future concepts in the printer industry. A few infrared (IR) light sensors presently used in laser printers are media sensors, environmental conditions sensor, toner concentration sensors, and toner amount sensors. The toner concentration sensor is primarily used for the developer unit. In many color printers, toner is a dual component system comprised of carrier beads and toner. The carrier beads attract toner and transfers toner from the developer to the PC drum. The change in permeability is sensed by the toner concentration sensor and this change determines the concentration of toner.Primarily in color printer systems, the toner amount sensor is used to read the specular and diffused light from toner on the transfer belt. The toner amount provides an indication of how much additional voltage is required to attract toner to the transfer belt.

The media sensor determines the media (or most commonly paper) type. Paper can change in thickness and texture ranging from card stock to plain office paper. Paper also carries a range of sizes and shapes such as legal (11.5” X 14”) or narrow. In addition, envelopes, labels, and transparencies are also media passed through printers. These types of media require different amounts of toner transfer at different EP process parameters.

The media sensor allows the printer to capture the type of media that is going into the printer and may adjust the EP process parameters or may adjust the speed in which the media is running through the printer.

The thermal sensor is used to detect the fuser’s heater temperature and provides an indication to turn off and on the fuser heater to maintain consistent fuser temperature during a print cycle. The environmental conditions sensor determines the temperature and humidity surrounding the printer to also adjust EP process parameters.

The commonality of these sensors is that most of them detect toner or media by brightness (density). Involved typically is the use of an emitter and receiver with an electronic circuit to convert light to a measurable output voltage .

The DC signal is then sent to an analog-to-digital (A/D) converter to be processed by the printer’s engine code.

The paper sensor circuit describes the typical circuit applied to sense various media types for appropriate amount of toner transfer. Depending on the reflection of the media, toner

transfer is adjusted by changing transfer voltage to produce optimal prints. The IR signal shown is a phototransistor; however, a photodiode can also be utilized instead. Sensor application to improve printer calibration is a similar concept to the sensor applications previously described. The sensor has optical components (i.e. an emitter and detector and electronic components). However, the development of a sensor for closed-loop detection of micron-sized toner with high efficiency, accuracy, and speed is challenging to design.

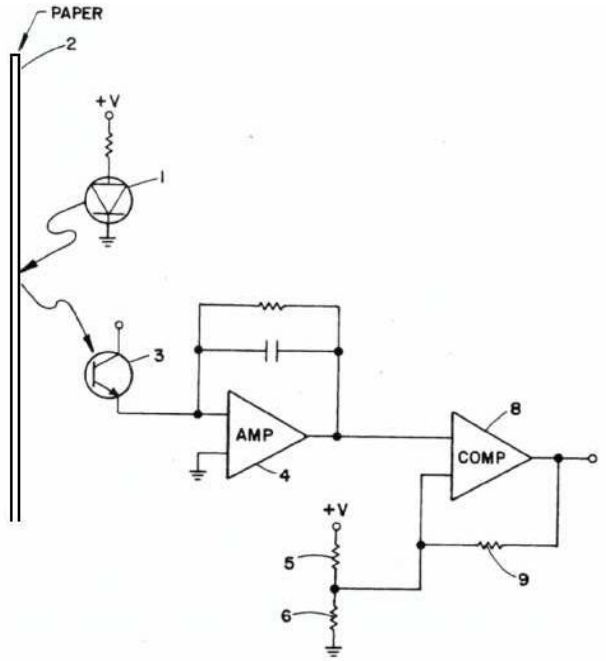


Figure 2.2 . paper sensor used in a laser printer

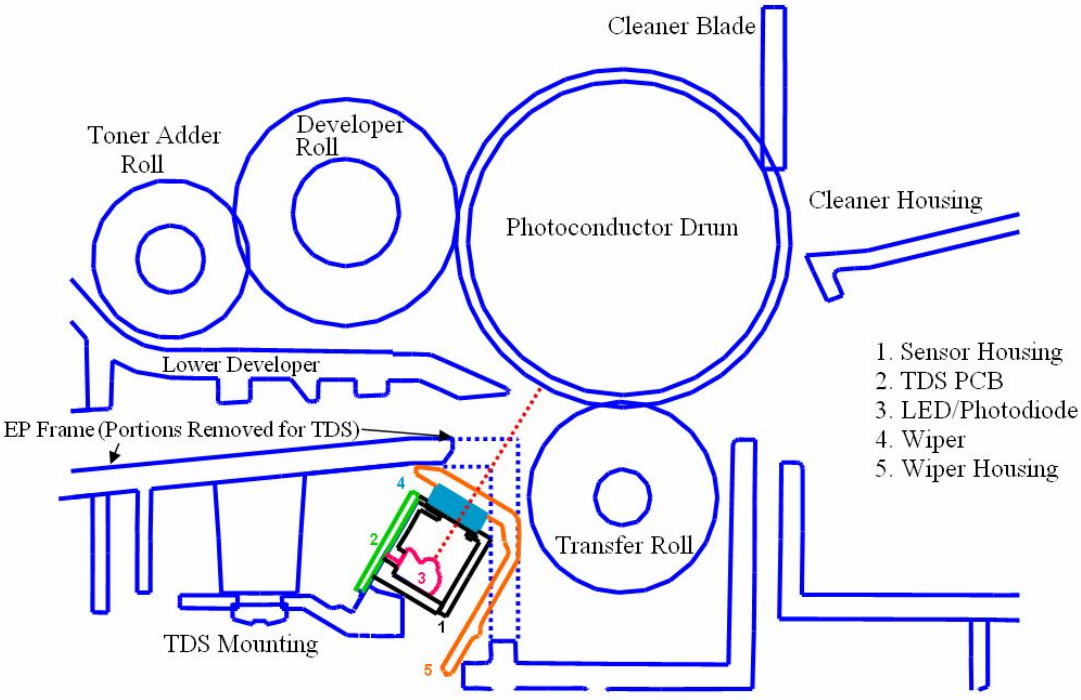


Figure 2.3 . TDS Implemented

Step-up Transformers

• A transformer in which the secondary voltage is greater than the primary voltage is called a step-up transformer

• The ratio of secondary voltage (Vsec) to primary voltage (Vpri) is equal to the ratio of the number of turns in the secondary winding (Nsec) to the number of turns in the primary winding (Npri)

Vsec/Vpri = Nsec/Npri

Step Up Transformer

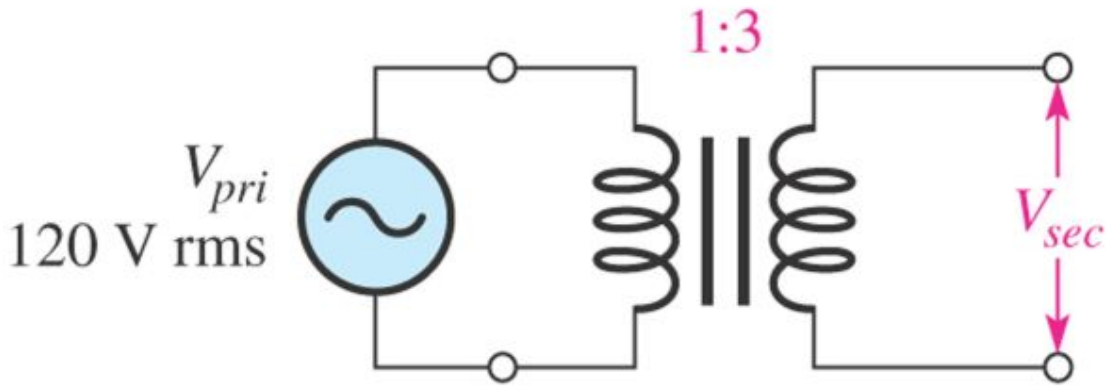


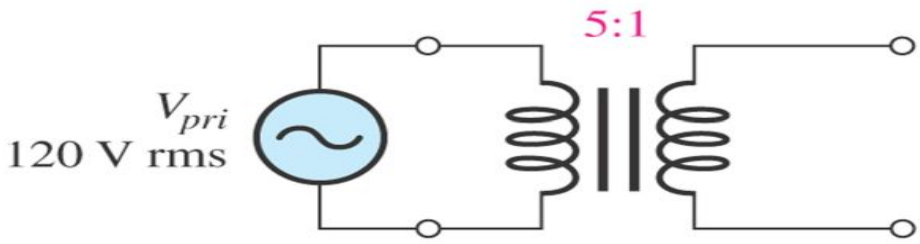
Figure 2.4 . Step Up Transformer

Step-Down Transformer

• A transformer in which the secondary voltage is less than the primary voltage is called a **step-down transformer**

• The amount by which the voltage is stepped down depends on the turns ratio

• The turns ratio of a step-down transformer is always less than 1



Step Down Transformer

Figure 2.5 . Step down Transformer

The Transformer as an Isolation Device

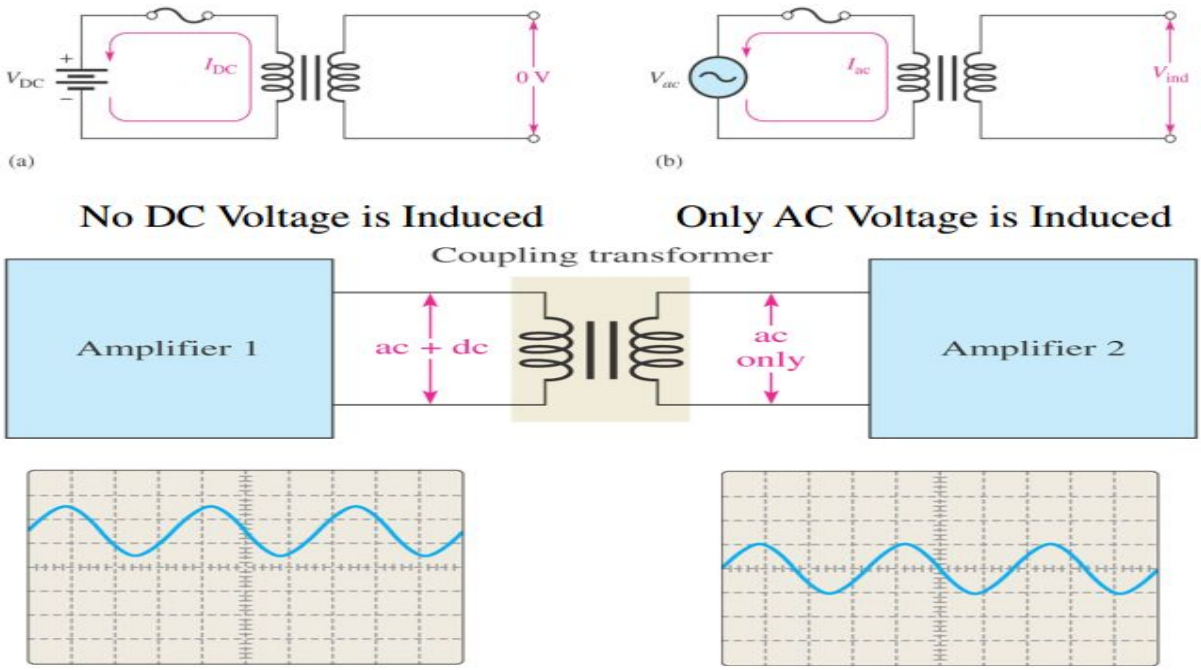
• Transformers are useful in providing electrical isolation between the primary circuit and the secondary circuit because there is no electrical connection between the two windings

• In a transformer, energy is transferred entirely by magnetic coupling

DC Isolation

• A transformer does not pass dc, therefore a transformer can be used to keep the dc voltage on the output of an amplifier stage from affecting the bias of the next amplifier

• The ac signal is coupled through the transformer between amplifier stages



Power Line Isolation

• Transformers are often used to electrically isolate electronic equipment from the ac power line

Testing of transformer

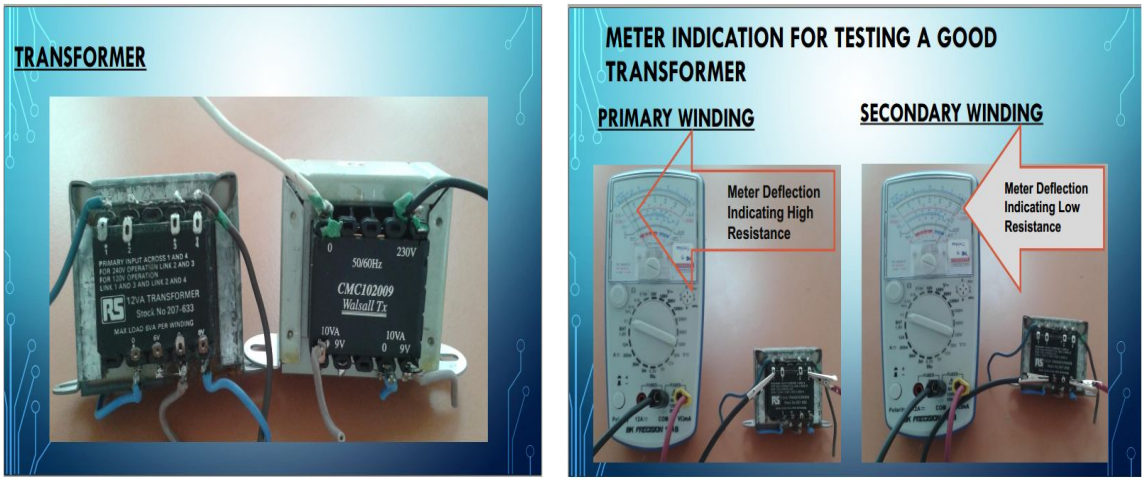


Figure 2.3 a . Transformer testing

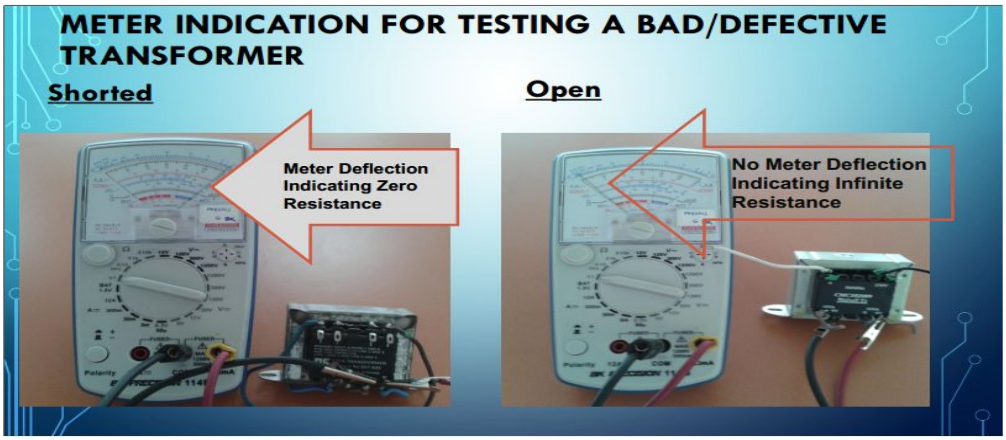


Figure 2.5.b . Transformer testing

To apply this safety feature to domestic appliance, a device (electrically or electronically operated) is needed. Relay and triac is just an example of devices that can be used.

Relay

A relay is an electrically operated switch. Various relays use an electromagnet to mechanically operate a switch, but other operating principles are also used, such as solid-state relays. Relays are used where it is necessary to control a circuit by a low-power signal or where several circuits must be controlled by one signal.

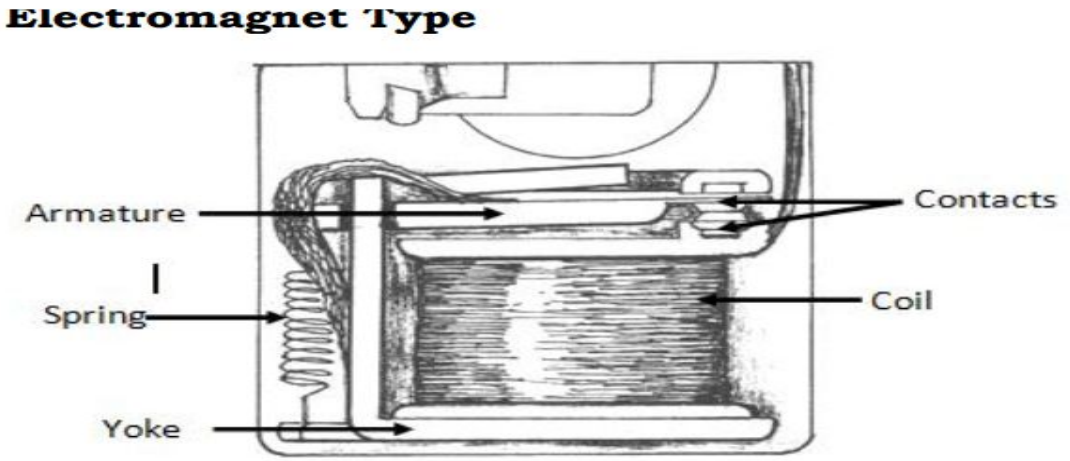
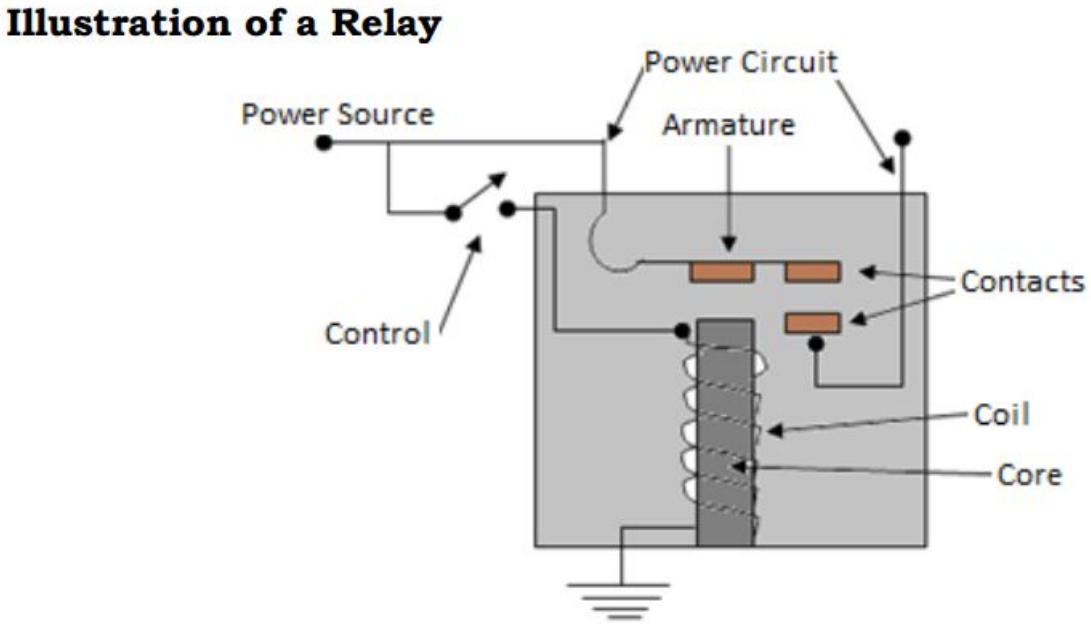


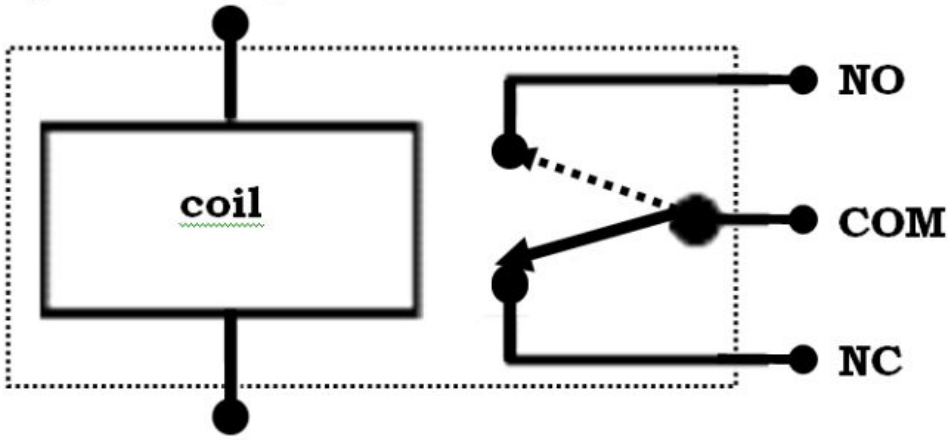
Figure 2.5.c . **Electromagnet Type Relay**

Parts of Electromagnet Type Relay

1. **Yoke:** Heavy-duty frame that enclose and supports the parts of the relay.
2. **Coil:** Magnetic wire that is wound around a metal core. Creates an electromagnetic field when energize.
3. **Armature:** A relays moving part. The armature opens and closes the contacts. An attached spring returns the armature to its original position.
4. **Contacts:** The conducting part of the switch that closes or opens a circuit.



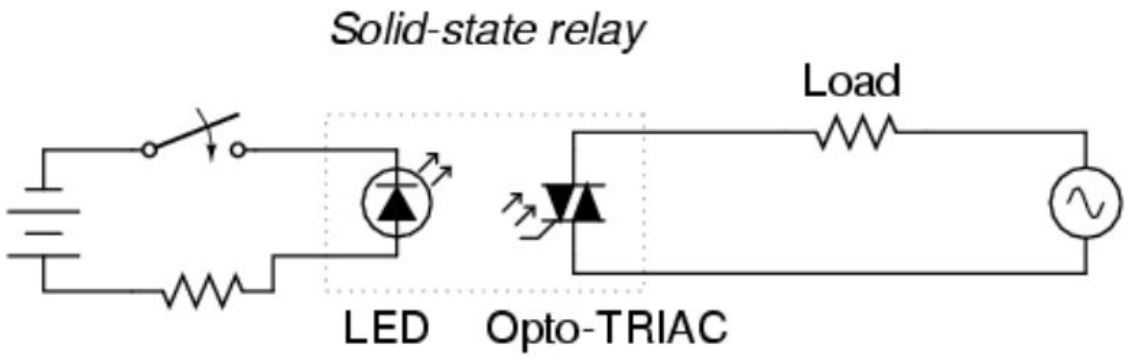
Schematic symbol of relay



Coil is a wire wound around a metal core. If this coil of wire is energized, electromagnetic field is produced causing the COM terminal to connect with NO terminal. If coil is not energized, COM is at NC terminal (COM-common/ NO- normally open/ NC- normally-closed). Relays involve two circuits: the energizing circuit and the contact circuit. The coil is on the energizing side; and the relays contacts are on the contact side. When a relays coil is energized, current flow through the coil creates a magnetic field. Whether in a DC unit where the polarity is fixed, or in an AC unit where the polarity changes, the basic function remains the same: the magnetic coil attracts a ferrous plate, which is part of the armature. One end of the armature is attached to the metal frame, which is formed so that the armature can pivot, while the other end opens and closes the contacts. Contacts come in a number of different configurations, depending on the number of Breaks, poles and Throws that make up the relay. For instance, relays might be described as Single-Pole, Single-Throw (SPST), or Double-Pole, Single-Throw (DPST). These terms will give an instant indication of the design and function of different types of relays.

Solid-State Type

Semiconductors such as Silicon-Controlled Rectifier (SCR), TRIAC, or transistor output are used instead of mechanical contacts to switch the controlled power. The output device (SCR, TRIAC, or transistor) is optically coupled to an LED light source inside the relay. The relay is turned on by energizing this LED, usually with low-voltage DC power. This optical isolation between inputs to output rivals the best that electromechanical relays can offer.



Being solid-state devices, there are no moving parts to wear out, and they are able to switch on and off much faster than any mechanical relay armature can move. There is no sparking between contacts and no problems with contact corrosion. Triac is one type of thruster that functions as an electrically controlled switch for AC loads. This device can switch the current in either direction by applying a small current of either polarity between the gate and one of the two main terminals. It is used in AC applications such as light dimming, motor-speed control, and in micro-controller power control.

Self-Check -2	Written Test

Name: _____ Date: _____

Directions: Answer all the questions listed below.

PART I TRUE/FALSE

If the statement is correct write TRUE if the statement is in correct write FALSE

_____1. Relay actas a switch.(3pts)

_____2. Step down transormer is used to increase the value AC voltage. .(3pts)

PART II CHOOSE THE BEST ANSWER

_____1. One is not part o a relay.(4 pts)

A. Coil **C. Yoke**

B. Armature **D. switch**

Note: Satisfactory rating 2 and above points Unsatisfactory below 2 points

Answer Sheet

Score = _____

Rating: _____

Name: _____ Date: _____

Information Sheet-2	Observing pre-testing procedure office equipment

2.1 Observe pre-testing procedure

Pre –testing means before diagnosing the faults using testing instruments by different mechinism test the equipments**.**

Why pre-test procedure is necessary?

The main reason why you should safety test.

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

1. The equipment must be disconnected from the supply.
2. The Main Protective Conductor must be disconnected from the supply neutral.
3. All fuses are intact and all protective elements and switches are closed.
4. All current using equipment including lamps, pilot lights, bell transformers, smoke alarm units, timers etc. are disconnected or otherwise excluded from the test between live conductors.
5. Note:- Where disconnection or removal of these items is impractical the control switches should be in the off position. Items left in circuit will cause false low readings.
6. Any equipment containing electronic circuitry must be disconnected or switched off in order to prevent damage by the high test voltage.

Self-Check -2	Written Test

Name: _____ Date: _____

Directions: Answer all the questions listed below.

PART I write the correct answer

1. Why pre-test procedure is necessary?

Note: Satisfactory rating 5 and above points Unsatisfactory below 5 points

Answer Sheet

Score = _____

Rating: _____

Name: _____ Date: _____

Information Sheet-3	defect/fault symptoms Identification

3.1. Introduction

Fault is a deviation from a prescribed function of a system due to undesirable deviation in the propertyof a system. Or fault is deviation between perfect performance and complete failure. Fault detection and diagnosis is a common term in industries with the aim of ensuring reliability and safety of industrial equipment. In houses and offices, where electrical and electronic appliances are use for social and commercial purposes among other, fault detection and diagnosis is also essential. The appliances may untimely breakdown due to personal, social and environmental factors. The faults or malfunctioning in appliance can be caused by poor handling, poor maintenance, poor design, age of an appliance, and inconsistence nature.Thus,fault detection and diagnosis is required to reduce electrical/electronic appliances waste.

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.

3.2 Fault Finding procedures

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.

Self-Check -3	Written Test

Name: _____ Date: _____

Directions: Answer all the questions listed below.

PART I TRUE/FALSE(4 PTS)

If the statement is correct write TRUE if the statement is in correct write FALSE _____1. Fault deviation from a prescribed function of a system due to undesirable deviation in the propertyof a system.

PART II Write correct answer(6 pts)

1. list Fault Finding procedures.

Note: Satisfactory rating 5 and above points Unsatisfactory below 5 points

Answer Sheet

Score = _____

Rating: _____

Name: _____ Date: _____

Information Sheet-4	Test instruments

4.1 Test instruments

The tools, testing equipment and PPE for testing and fault finding must be suitable for the work, properly tested and maintained in good working order.

Workers carrying out electrical testing must be appropriately trained and competent in test procedures and in the use of testing instruments and equipment, including:

- being able to use the device safely and in the manner for which it was intended
- being able to determine, by inspection, that the device is safe for use, for example the device is not damaged and is fit for purpose understanding the limitations of the equipment, for example when testing to prove an alternating current circuit is de-energised, whether the device indicates the presence of hazardous levels of direct current.
- being aware of the electrical safety implications for others when the device is being used, for example whether the device causes the electric potential of the earthing system to rise to a hazardous level knowing what to do to ensure electrical safety when an inconclusive or incorrect result is obtained.

ESOPDF179 Electrical safety code of practice 2013 - Managing electrical risks in the workplace

- ***Checks carried out on test instruments***

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

- 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.

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.

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

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.

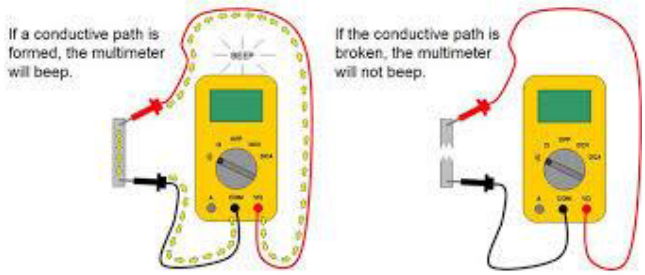
Testers for detecting an electric field surrounding an energised conductor may not be suitable for testing cables that are surrounded by a metallic screen, enclosed in a metallic pipe or duct, or cables carrying direct current and in some other circumstances.

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.

MULTIMETER INDICATION FOR GOOD AND BLOWN FUSE

GOOD **BLOWN**

Using the continuity test function of the multimeter



METER INDICATION FOR TESTING A GOOD TRANSFORMER

PRIMARY WINDING **SECONDARY WINDING**

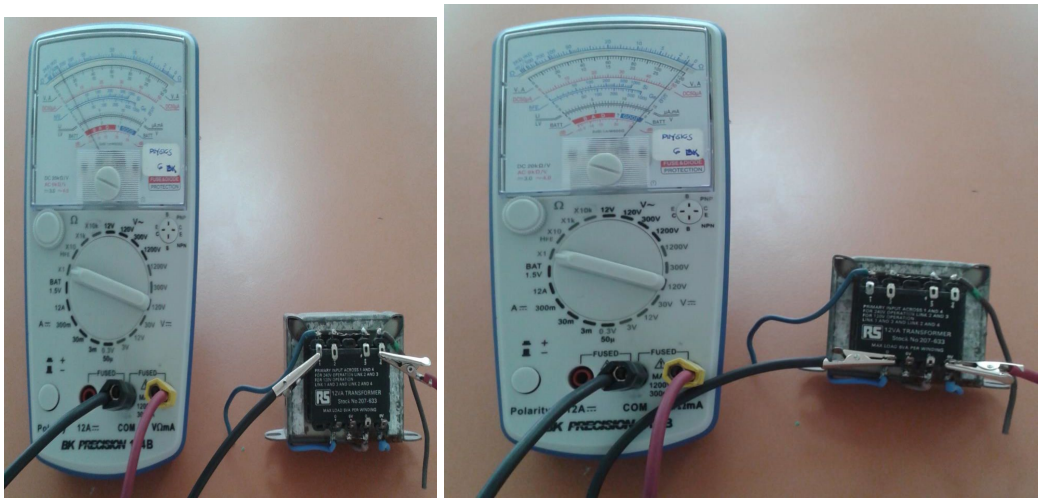


Figure 4.1 test transformer

The Oscilloscope

The oscilloscope, or scope for short, is a device for drawing calibrated graphs of voltage vs time very quickly and conveniently. Such an instrument is obviously useful for the design and repair of circuits in which voltages and currents are changing with time. There are also many devices, called transducers, which convert some non-electrical quantity such as pressure, sound, light intensity, or position to a voltage. By using a transducer the scope can make a plot of the changes in almost any measurable quantity. This capability is widely used in science and technology.

The heart of the oscilloscope is a cathode ray tube or CRT, of the sort you have already studied. Looking at the face of the instrument, you are viewing the screen that the electron beam strikes. Electronic circuits in the scope apply voltages to one set of deflection plates to sweep the beam across the screen from left to right at a constant rate, thereby providing the time axis. Other circuits amplify or attenuate the input signal as needed, and apply voltages to the other set of deflection plates to move the beam vertically, providing the voltage axis. Controls are provided to select the time and voltage scales needed for any given situation. At the end of each sweep, the beam is shut off and the horizontal deflection voltage is reset so the beam would start at the left edge of the screen again. Since a scope is usually used to plot a rapidly changing quantity, one sweep and therefore one plot may last only a few microseconds. If the phenomenon we are studying can be made repetitive, we can repeat the sweep sequence many times to get a display suitable for a more leisurely examination. A special circuit, called a trigger circuit, examines the incoming voltage signal and starts the sweep at the same point in the repetitive cycle for each new sweep. This results in a visually steady display of the input. Several controls are provided to set the trigger as needed.

The scope you will use is a very flexible instrument, typical of those available in a research laboratory. It has two channels, so that two different voltages may be plotted simultaneously for direct comparison, and a variety of triggering options. The front panel, shown in Fig. 1, is

correspondingly formidable at first glance. Fortunately, the myriad of controls can be considered in several independent groups, which are marked in the figure. In the remainder of this section we will examine each group in turn, concentrating on the controls we will need in subsequent experiments. The experimental procedure section will then take you through a series of measurements designed to demonstrate the operation of each section.
At the left side of the instrument, the CRT screen is divided into a one centimeter grid, ruled on the inside surface of the tube. Each solid line is one division for the horizontal and vertical deflection. The dotted lines are provided for pulse rise-time measurements. Moving across the panel, we come to the power switch and the CRT controls. The trace rotation and probe adjust are used only when repairing the instrument. The intensity control should be set to give a visible trace, but excessive brightness will defocus the spot and may damage the screen. Both the intensity and focus may need to be adjusted when the sweep rate is changed drastically. The beam finder is provided as an aid to setting the scope. When pushed, it reduces the deflection voltages enough that the beam will always appear on the screen. The position controls are then used to center the spot, and you should obtain a display suitable for final adjustments when the beam finder button is released.

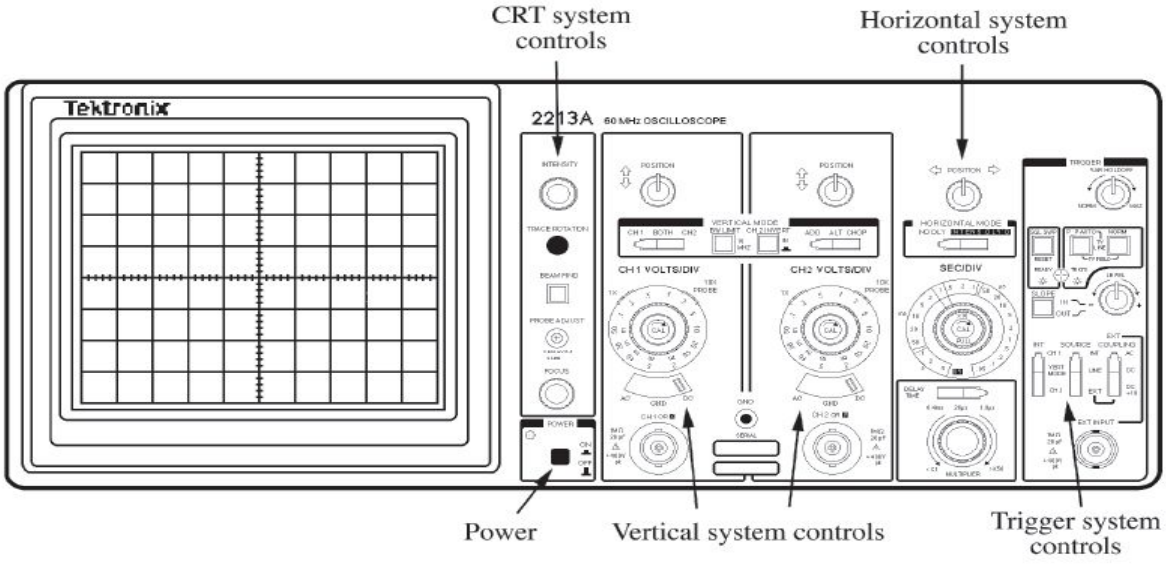


Fig. 2.2. Oscilloscope front panel with functional blocks marked.

The vertical system accepts input signals and develops appropriate deflection voltages for the CRT. Because this is a two-channel scope there are two identical sets of vertical controls, one for each trace. The block diagram in Fig. 2 shows the flow of signals in one channel. Voltages are applied between a grounded terminal labeled GND and either CH 1 or CH 2 for the channel desired. The coupling switch allows the input circuit to accept all signals when set at DC, or only the time-varying part when set for AC. The middle position, GND, connects the vertical amplifier input to ground, so that you can see where the zero-voltage height is on the screen. (Using the GND setting does not connect the external input terminal

to ground, so your circuit will not be disturbed.) The position control allows you to place the trace on the screen as desired, for example aligning the zero-voltage position with one of the grid lines.
The vertical sensitivity control, labeled VOLTS/DIV is used to set the vertical scale factor. For example, when the 50m marking is next to the 1X symbol, the scope is set for a vertical scale of 50 mV per centimeter, and a deflection of 2 cm, equal to 2 large divisions, would indicate an input voltage of 100 mV. This control is normally set to make the vertical part of the signal a convenient size on the screen. The red knob in the center of the control allows you to continuously vary the vertical scale factor, rather than using the fixed settings. This feature is occasionally useful for relative measurements, but for quantitative work you need to know the calibration, and you must use the fixed steps. Turning the red knob fully clockwise sets the control for the fixed steps marked on the main control.
The controls labeled VERTICAL MODE select several related functions. Starting at the left, you can display the signal from channel 1, channel 2 or from both channels. The switch at the right determines how the display is done when both channels are in use. In CHOP mode the beam

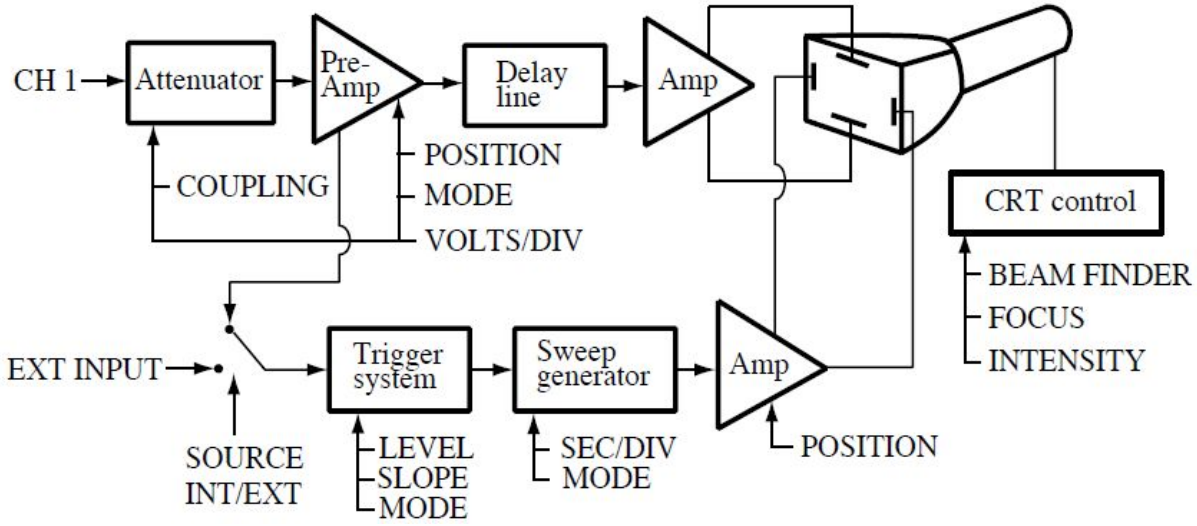


Fig. 2.3. Block diagram of the oscilloscope

Block diagram of the oscilloscope, showing the control functions is switched back and forth between the channels very rapidly, drawing many short pieces of the voltage-time graph for both channels as the sweep proceeds. In ALT mode, an abbreviation for alternate sweep, the channel 1 signal is displayed for one full sweep, the channel 2 signal is displayed on the next sweep, and so forth. If the sweep time is short, ALT mode appears to display two steady graphs, but if the sweep time is long you will see an irritating flicker as one line and then the other is swept. The CHOP mode is therefore better for slow sweeps because it draws both traces together, although it cannot switch quickly enough to handle very fast signals. As a general rule, use ALT mode unless the display is slow enough to be irritating, and then

switch to CHOP. The third setting, ADD, algebraically adds the input of channel 1 and 2. We will not have much use for this feature.
The BW LIMIT (bandwidth limit) button allows you to cut off signals with frequencies higher than 10 MHz, so that they do not appear on the display. Most of our signals are at lower frequencies, so leaving this button in will cut out some noise without losing any information. The CH 2 INVERT button inverts the signal from channel two, so that increasing positive voltages are plotted downward, rather than upward. This button should be out for normal operation. The horizontal system controls the time scale of our plots. The main control, labeled SEC/DIV, works much like the vertical sensitivity controls, with a series of fixed settings and a red variable control. Note that the scale is divided into regions for seconds, milliseconds and microseconds per division. When set for 1 ms/division, as in the figure, each one centimeter division on the screen corresponds to one millisecond. The position labeled X-Y disables the timed sweep, and allows you to plot the voltage applied to channel 2 vs the voltage applied to channel 1. The horizontal mode switch and the delay time controls are used only for special tricks, which we will not need. Leave the mode switch at NO DLY for no delay. The position knob works just like its vertical counterpart. The trigger system is used to start successive sweeps at corresponding points on the input waveform on each successive sweep. This operation is indicated schematically in Fig. 3. The

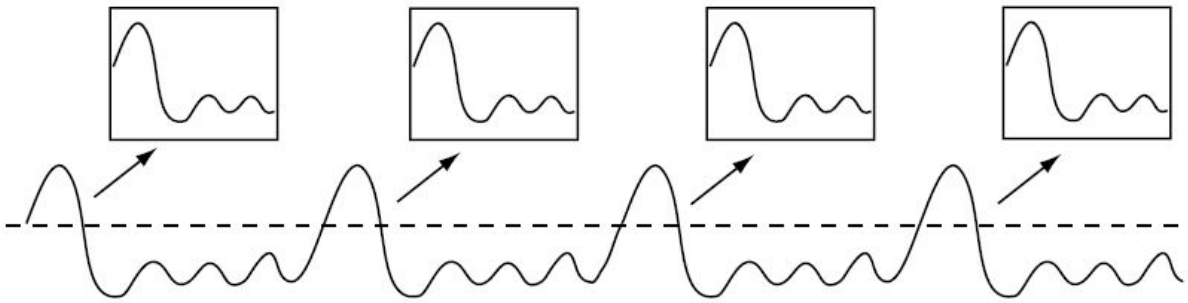


Fig. 2.4. A continuous input waveform and four successive sweeps on the scope screen. The trigger is set for positive slope with the trigger level at the dashed line.

LEVEL knob controls the voltage at which the trigger starts the sweep. The SLOPE button is used to specify whether the signal should have a positive or negative slope at the trigger voltage. The source of the triggering signal is chosen with a set of switches. You may choose to trigger off the signals applied to the vertical channels, off the power lines, or off of a signal applied to the EXT INPUT connector. Internal triggering is most common, and you may choose to use channel 1 or channel 2, independently of which one you are displaying at the time. VERT MODE triggering is odd, in that the trigger is obtained, in ALT sweep, from whichever channel is supposed to start next. This is usually confusing, and we will not use it. Triggering from the power lines is useful if you want to study something that might be synchronized with the AC power. External triggering is useful when your experiment produces a signal that occurs a fixed time before the signal of interest, since you can then see the early parts of your signal easily. The other three buttons set the sweep mode. In SGL SWP, for single sweep, the trace moves across the screen only once, and then waits until the button is pressed again. This is an archaic feature formerly used when photographing the trace. P-P AUTO, for peak-to-peak automatic is the standard mode, since it will almost

always produce a usable trace. If the trace is not stable in P-P AUTO you can try NORM, for normal mode. This is useful for slowly varying signals, and for situations where the triggering is tricky, for example because of noise. The LEVEL control must be set carefully to get a trace in NORM mode, so a small light is provided to tell you when the scope has found a satisfactory trigger. If the light is on but you have no trace, something other than triggering is the problem. Other trigger modes are provided for television service work, but we will not use them. The VAR HOLDOFF control is usually left full counterclockwise. Its use will be explained when needed.

Self-Check -4	Written Test

Name: _____ Date: _____

Directions: Answer all the questions listed below.

PART I TRUE/FALSE (3 pte each)

If the statement is correct write TRUE if the statement is in correct write FALSE

_____1. 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**.**

_____2.Multi meter is used to measure distance.

_____3. Osciloscope is an electronics device measure the level of voltage.

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

Answer Sheet

Score = _____

Rating: _____

Name: _____ Date: _____

Information Sheet-5	Implementing Proper troubleshooting procedures

2.5 Troubleshooting procedures

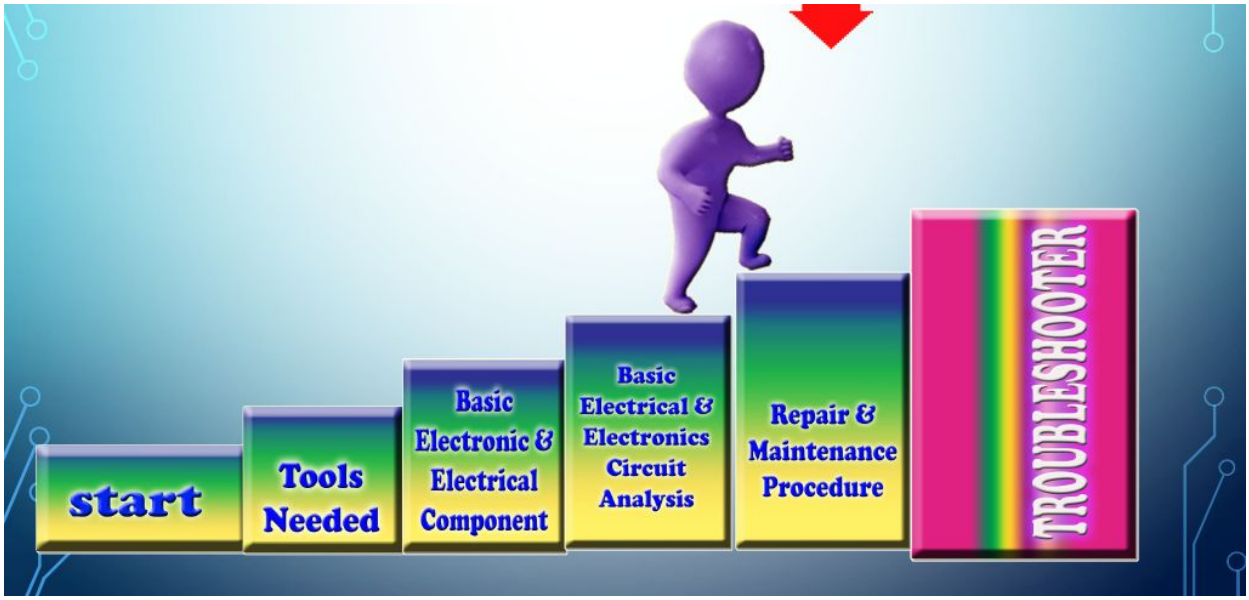
Troubleshooting is a term which we in the electronics field use daily. But what does it mean?

Troubleshooting is sometimes thought to be the simple repair of a piece of equipment when it fails to function properly. This, however, is only part of the picture. In addition to repair, you, as a troubleshooter, must be able to evaluate equipment performance. You evaluate performance by comparing your knowledge of how the equipment should operate with the way it is actually performing. You must evaluate equipment both before and after repairs are accomplished.

Equipment performance data, along with other general information for various electronic equipment's, is available to help you in making comparisons. This information is provided in performance standards books for each piece of equipment. It illustrates what a particular waveform should look like at a given test point or what amplitude a voltage should be, and so forth. This data aids you in making intelligent comparisons of current and baseline operating characteristics for the specific equipment assigned to you for maintenance. ("Baseline" refers to the initial operating conditions of the equipment on installation or after overhaul when it is operating according to design.)

To be a "troubleshooter" you must have :

- knowledge on:
  - ✓ tools needed
  - ✓ basic electrical and electronic components
  - ✓ circuit analysis
  - ✓ repair and maintenance procedures


start
Tools Needed
Basic Electronic & Electrical Component
Basic Electrical & Electronics Circuit Analysis
Repair & Maintenance Procedure
TROUBLESHOOTER

Self-Check -5	Written Test

Name: _____ Date: _____

Directions: Answer all the questions listed below.

PART I TRUE/FALSE(4 pts each)

If the statement is correct write TRUE if the statement is in correct write FALSE

_____1. Troubleshooting is a term which we in the electronics field use daily.

Part II write the correct answer or the ollowing questions (6 pts)

1. write the main procedures troubleshooting of circuits?

Note: Satisfactory rating 5 and above points Unsatisfactory below 5 points

Answer Sheet

Score = _____

Rating: _____

Name: _____ Date: _____

Information Sheet-6	Checking and isolating Circuits using specified testing procedures

6.1 Introduction

First, you have to understand how all the circuits on the board work before you can figure out how to test them. Once you've gotten over this hurdle, you have to write test procedures specifving exactly how the board will be tested. Remember, you want *to* test all the circuits; otherwise, you can't be sure the board will work properlv under all normal operatiny conditions.

Fig 6.1 how to test parts

Once you've written the test procedures, you have to assemble all the necessary test equipment: oscilloscopes, voltage sources, current sources, meters. and so on.

Fig 6.2 preparation parts

Manual testing

Now, connect all this equipment to the appropriate points on the pc board. Some of those points may be hard to reach. If **you** have many boards to test, you may want to build a fixture to simplify connecting the test leads.

Finally, turn on the equipment, apply known inputs to the circuit, **check** the outputs and determine if the circuit is operating **properlv.** And, oh yes, if the circuit is not operating properly, find the dckctive part and replace it.

The term **automatic test equipment (ATE) applies to** many forms of programmable, computer-controlled *test* **instruments** and **systems.** This **equipment is** used in **many stages** of the manufacturing process, including:

- Component manufacturing
- Quality assurance
- Inconme inspection
- PC board testing
- System testing
- Field service

What Es an in-circuit sestet?

It's a tester that tests each component on a pc board, one at a time. And it does this while the component is "in-circuit," thar is, while it's connected to other components on the board. A divide-and-conquer approach is taken. First, the tester checks the loaded pc board for unwanted shorts and opens. Then, it isolates and tests each separate component on the board, one at a time.

The tester performs all the manual procedures that were described :

- Writes test procedures
- Connects the test equipment to the board
- Turns the equipment on and sets it up
- Applies known input signals and checks outputs
- Determines if the circuit is OK
- Locates defective components when the circuit is not OK and last, but not least,
- Repeats this for all the circuitry on *the* board

In-circuit testings

Test the individual components on ully assembled pc board :

It must **have** access to all the circuit nodes on the board. Obviously, to test each component individually, the rester

must he able to connect test instruments to each pin of **each** component.

Also, it must be able to **isolate** each component-under-tc5t from surrounding components. Since coniponents .Ire intc-rconnected on the board, some special isolation techniques are needed to prevent the component-under-test from being affected by other components.

Analog testing

To perform analog testing. the tester uses the following instruments:

- DC Current Source
- DC Voltage Source
- DC Voltmeter
- DC Ammeter (Current fileter)
- AC Impedance measurement **module**

Now, the question is, how can the tcstcr connect any one of these instruments to any one of hundreds of' circuit node.; on *the* hoard.

Isolating and testing analog components Suppose you wanted to test an analog component, such as a

resistor. that is not connected in a circuit. You could apply a known voltage across that resistor, measure the

resulting current, and calculate resistance by using Ohm's **Law:**

R=V/I.

For example, if the applied voltage were 1.0 V and the measured current were 1.0 mA, the calculated resistor value would be

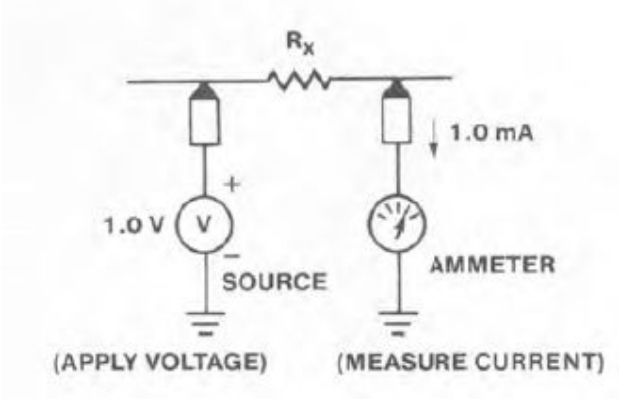


Fig 6.2 voltage/current

Test program

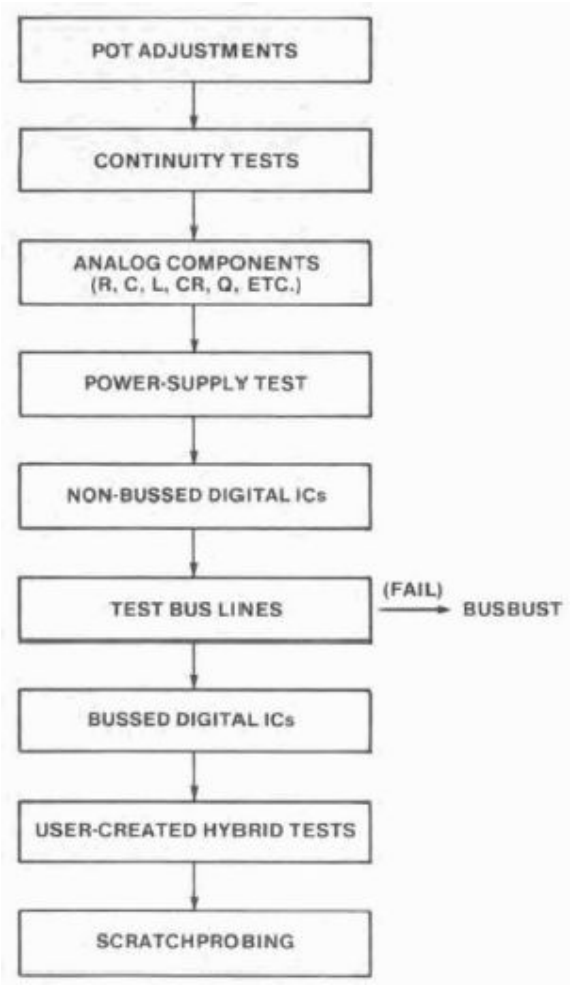


Fig6.3. testing procedures

Self-Check -6	Written Test

Name: _____ Date: _____

Directions: Answer all the questions listed below.

PART I TRUE/FALSE(3 pts each)

If the statement is correct write TRUE if the statement is in correct write FALSE

_____1. Anlogue test is a tester that tests each component on a pc board, one at a time. And it does this while the component is "in-circuit," thar is, while it's connected to other components on the board.

_____2. The term automatic test equipment (ATE) applies to many forms of programmable.

Note: Satisfactory rating 3 and above points Unsatisfactory below 3 points

Answer Sheet

Score = _____

Rating: _____

Name: _____ Date: _____

Information Sheet-7	Explaining Identified defects and faults by the *responsible person*

7.1. Roles of a Supervisor

If you are charged with managing others' performance, including conducting performance evaluations, you are considered to be a UVa supervisor. UVa supervisors are expected to understand and be able to assume many roles. The five key supervisory roles include Educator, Sponsor, Coach, Counselor, and Director. Each is described below. Note that in your role as a supervisor, you will be using these five roles, in some combination, simultaneously, depending on the needs of the team members.

- **Educator:** You will act as an educator when employees and team members are new, when you are new to a team, when processes or conditions change, and when discussing performance expectations with your direct reports.

Additionally, you will most likely educate when you hold or attend meetings, write and distribute policies, manuals, or other documents, and provide cross-training opportunities. (Refer to the Toolkit document, "Talking with Employees, The Conversation Process" for more information on having productive conversations.)

- **Sponsor**: When acting as a sponsor, you assume your employees have the skills they need to perform their current jobs and work to provide opportunities for them to showcase their talents and strengths. Additionally, you are expected to support employee career development, even if it means that the employee will move to position outside your team. (Refer to the Toolkit document, "Developing Your Employees, Questions to Ask During Career Conversations" for more information on questions to ask and consider.)

Example: Helping employees identify and complete the Career Development Action Plan (CDAP)

- **Coach:** You will be coaching a customer when you are explaining, encouraging, planning, correcting, or just checking in with your employees. (Refer to Toolkit document, "Coaching Employees, The Take 10 Check In".)

Example: You should take ten minutes a week to check in with each of your employees. During those ten minutes, ask the following three questions and document the result of your conversation:

  - How do you think the team is doing?
  - How can things be improved?
    UHR – Employee Development 2
  - How are you doing?

- **Counsel:** Counseling is used when an employee's problems impact performance and is intended to mitigate any further action, including formal disciplinary action. The employee should solve the problem and your role is to be positive, supportive, and encouraging in that process. (Refer to the Toolkit documents, "Counseling Your Employees, The 2-Minute Challenge" and "Counseling Your Employees, The Role of a Good Supervisor".)

Example: One of your classified staff employees is habitually 15-20 minutes late and provides no explanation for her behavior. As soon as you notice her repetitive behavior, you should counsel her, seeking her ownership of the issue, and hopefully avoid any further action.

- **Director**: Directing is used when performance problems continue and assumes you have educated, coached, and counseled. During “directing” conversations, you should make recommended alternatives and consequences clear, be calm and serious, get your school or department HR or HRCS involved, and make sure the meeting is thoroughly documented.

Example: Unfortunately the employee mentioned in the last example continues to be late. You should have a meeting with the employee clearly outlining the problem, the desired result, and the consequences of not correcting the problem. Additionally, you should document yourconversation with the employee and forward it to HR.

Self-Check -7	Written Test

Name: _____ Date: _____

Directions: Answer all the questions listed below.

PART I TRUE/FALSE(3 pts each)

If the statement is correct write TRUE if the statement is in correct write FALSE

_____1. Coaching isused when a customers problems impact performance and is intended to mitigate any further action, including formal disciplinary action.

_____2. Counseling is the roles o immidiate suppervisors.

PART II CHOOSE THE BEST ANSWER(4 pts)

1. _____used when performance problems continue and assumes you have educated, coached, and counseled.

   A. Sponsor C. counseling

   B. Coach D.Directing

Note:Satisfactory rating – 5 and above points Unsatisfactory below 5 points

Answer Sheet

Score = _____

Rating: _____

Name: _____ Date: _____

Information Sheet-8	Checking settings/adjustments

Checking settings/adjustments

Sensors is a device which provides a usable output in response to a peciic measurand

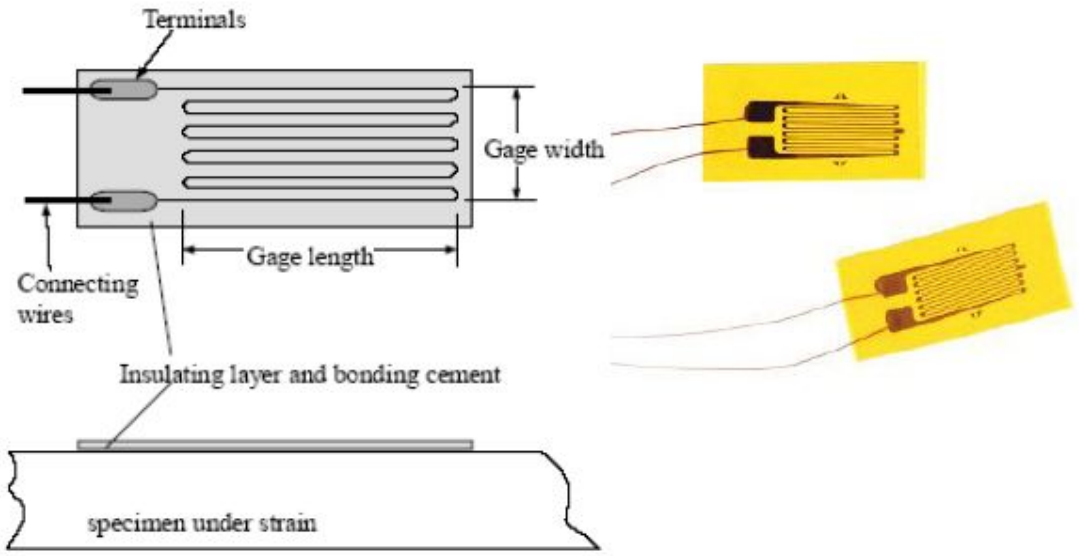
Temperature Sensor: RTD

- Resistance temperature device (RTD)

$$R = R_0[1 + \alpha(T - T_0)]$$

$$R = R_0 e^{\gamma\left[\frac{1}{T} - \frac{1}{T_0}\right]}$$

Strain Gauge: Motion, Stress, Pressure



Strain gauge is used to measure deflection, stress, pressure, etc.
The resistance of the sensing element changes with applied strain
A Wheatstone bridge is used to measure small changes in the strain gauge resistance

push button returns to its 'out' position after being pressed.

latch button or latch knob stays 'in' after pressing and is released when pressed again.

latch slider has two positions 'released' and 'latched'. When it is slid to the latched position it stays in this position until the process is finished when it automatically releases. Alternatively it may be released by an interrupt button or by pushing the slider out of the latched position. This control is often used with a toaster appliance as the process of moving the slider down to the latched position also lowers the base that the toast is resting on into the toaster.

An **LED numeric display** (light emitting diode) shows numeric values (e.g. time left or program number).

A **simple LED** indicator is a single light that is either on or off. LED may be in one of a range of colours e.g. red, green, yellow, and appear bright against a black background. In future, appliances may have small black and white or colour LCD (liquid crystal display) equivalent to that on a portable games console or mobile phone.

Self-Check -8	Written Test

Name: _____ Date: _____

Directions: Answer all the questions listed below.

PART I TRUE/FALSE

If the statement is correct write TRUE if the statement is in correct write FALSE. **true**

1. An LED numeric display (light emitting diode) shows numeric values .(6 pts)

Note: Satisfactory rating 3 pts and above, points Unsatisfactory below 3pts points

Answer Sheet

Score = _____

Rating: _____

Name: _____ Date: _____

Information Sheet-9	Documenting Results of diagnosis and testing

Documentation

The Organisational Unit is to keep testing and inspection records which are to be stored on a shared system drive.

Record to be kept by:	Organisational Unit, Academic Unit
Records	Records of inspection and testing of electrical equipment, including: • register of all electrical equipment • record of formal inspection and tests • repair register and • record of all faulty equipment showing details of services or corrective actions.
To be kept for:	Records should be kept in alignment with the Records Management Policy and Guidelines

Table 9.1 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.
- Maintenance recommendations contained in this volume should be used as the basis for establishing or refining a maintenance schedule. Recommendations can be converted into Job Plans or Work Orders in MAXIMO or another maintenance management system. Once these job plans and work orders are established,implementation of well-executed maintenance is possible.
- The maintenance record keeping 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 Power O&M Reviews.
- 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.

Self-Check -9	Written Test

Name: _____ Date: _____

Directions: Answer all the questions listed below.

PART I TRUE/FALSE

If the statement is correct write TRUE if the statement is in correct write FALSE _____1.Documentation Complete, accurate, and current documentation is essential to an effective maintenance program..(4pts)

Note: Satisfactory rating 2 pts and above, points Unsatisfactory below 2 pts points

Answer Sheet

Score = _____

Rating: _____

Name: _____ Date: _____

Information Sheet-10	Customers Advise/Inform

10.1 Introduction

When most people think of a the equipment technician, they don't jump to anyone in the service department first. Service advisors come from all over: they could be former technicians or people who love to communicate with others, mixed with a passion for cars. Success in the service department can lead to promotion within the company or the equipment because there are clear measurable outcomes that are easy to track. Service advisors exist to facilitate sales within a repair facility, and their job is to push additional sales. However, the job title is service, so there is a whole other layer to the field. Service advisors are also viewed in the repair facility or dealership as the main customer support line for customers. Strong customer support is often overlooked but is sometimes the key to making sales. Their role is to provide customers with a trustworthy place to bring their equipment and to create a long-term relationship with customers. Once the bond between customer and service department has been successfully created, the advisor is able to use the tools provided to create a mutually beneficial bond for both parties. This isn't done by guessing or using lingo to convince customers. Instead, successful dealerships use extensive inspectionand diagnostic-based selling to ensure accurate repairs for customers' needs and recommendations that make sense for their machines.

Create the Repair Order

After all the information has been gathered, the service advisor returns with the customer to the advisor's desk in the service department. At this point, the advisor takes all of the information gathered to generate a repair order, which is the beginning of the record stored in the computer system. The repair order is the document used to authorize the work being requested by the customer and any additional recommendations they have approved. After this has been generated, the next step is to give an accurate cost estimate to the customer and let them review the repair order.

After the initial part of the service agreement has been completed, the service advisor is then responsible for ensuring that the customer is aware of a timeline for the repair and for gathering appropriate contact information. Once the repair has been authorized the communication and relationship building continues throughout the service process between the advisor and the customer. For example, if the advisor were to tell the customer that the repair will be done right away, but the car is in the shop for the entire day, the advisor would not be providing an accurate representation of the repair. Each instance is different:

Some customers may be in for only a routine oil change and may opt to wait for the vehicle to be repaired. That is why it is crucial to provide accurate repair estimates with timelines, so that there are no questions or flags raised that could affect how the customer trusts the dealership.

Reporting a Diagnosis

Customers bring their machines into the service department for a variety of reasons: one of the main reasons customers return to the dealership is that they want factory-certified technicians to diagnose their machines issues. Customers expect the dealership of their equipments to be the expert, and they understand that such expertise might come with a premium cost. Dealerships have this level of legitimacy typically as an assumption, something that local shops have to build up over time with their customer base.The service advisor is the main point of contact for the repair estimate. After the technician performs the multipoint inspection and diagnoses the vehicle, it is their job to gather the quote for necessary parts and hours to complete the job . They pass this information onto the advisor to call the customer and report their findings. This quote may also include other recommendations found by the technician during their diagnostic.

- Advising is used when an employee's problems impact performance and is intended to mitigate any further action, including formal disciplinary action. The employee should solve the problem and your role is to be positive, supportive, and encouraging in that process. (Refer to the Toolkit documents, "Counseling Your Employees, The 2-Minute Challenge" and "Counseling Your Employees, The Role of a Good Supervisor".)
  Advising customers depend on :-
  - How to safe from accidents
  - How to use equipments
  - How to safe the equipments rom aults
  - When/how to clean the equipments

Self-Check -10	Written Test

Name: _____ Date: _____

Directions: Answer all the questions listed below.

PART I TRUE/FALSE

If the statement is correct write TRUE if the statement is in correct write FALSE
_____1. Technician is responsible or advising customers.(4pts)

1. List approaches how to advise customers.(6 pts)

Note: Satisfactory rating 3 pts and above, points Unsatisfactory below 3pts points

Answer Sheet

Score = _____

Rating: _____

Name: _____ Date: _____

REFERENCE

[1] M. Mese, P. Vaidyanathan, “Look-Up Table (LUT) Method for Inverse Halftoning”, IEEE Transactions on Image Processing, vol. 10, no. 10 October 2001, pp. 1566-1578.
[2] G. Goertzel, G. Thompson, “Digital Halftoning on the IBM 4250 Printer”, IBM Journal of Research Development, vol. 31, No.1, January 1987, pp. 2-15.
[3] T. Pappas, D. Neuhoff, “Printer Models and Error Diffusion”, IEEE Transactions on Image Processing, vol. 4, No. 1, January 1995, pp. 66-80.
[4] L. Schaaf, William Henry Fox Talbot, Phaidon Press, London, 2008, pp. 1-15.
[5] D. Lau, G. Arce, Modern Digital Halftoning, 2nd Edition, Marcel Dekker, New York, 2001, pp. 1-25.
[6] S. Graham, “Comparison of Selected Digital Halftoning Techniques”, Microprocessors and Microsystems, vol. 15, no. 5, June 1991, pp. 249-255.

Operation Sheet 1	Reassemble units Techniques

Techniques for reassembling units:

Step 1- wear PPE.
Step 2- select required tools and materials
Steps 3- reassembling units.
Step 4- testing reassembling units.

Operation Sheet 2	Final testing and cleaning

Techniques for Final testing and cleaning Service Completing:

Step 1-wear ppe
Step 2- Step3- select required tools and equipment.
Step 4- perform final test.
Steps 5- apply 5s.
Step 6- turn the equipment to normal position.

LAP Test	Practical Demonstration

Name: _____ Date: _____
Time started: _____ Time finished: _____
Instructions: Given necessary templates, tools and materials you are required to perform the following tasks within 3:30 hour.

Task 1. Check electronically-controlled domestic appliances
Task 2. Pre-test procedure
Task 3. Identify System defect/fault symptoms
Task 4. Use Testing instruments in accordance with user manuals and safety procedures
Task 5. Implement Proper troubleshooting procedures
Task 6. Test Circuits
Task 7. Explain Identify defects and faults
Task 8. Check Control settings/adjustments
Task 9. Document Results of diagnosis and testing
Task 10. Advis/inform Customers regarding the status and serviceability

Home/Office Electrical/Electronic Equipment Servicing

Level-II

Learning Guide-26

Unit of Competence: Maintaining and Repairing Electronically-Controlled Office Equipment
Module Title: Maintaining and Repairing Electronically-Controlled Office Equipment
LG Code: EEL HOS2 M07 1019 LO3-LG-26
TTLM Code: EEL HOS2 M07 1019 TTLM 1019v1

LO 3: Maintain/repair the unit

Instruction Sheet	Learning Guide #25

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

- Use Personal protective equipment
- Follow Electro-static discharge (ESD) protection procedure
- Solder/de solder Replacing Defective parts/components
- Soldering/mounting replaced parts/components
- Control settings/adjustments
- Performing Repair activity within the required timeframe
- Observing Handling the unit/product
- Cleaning of unit

Advising/Informing CustomersThis guide will also assist you to attain the learning outcome stated in the cover page. Specifically, **upon completion of this Learning Guide, you will be able to**:

- Use Personal protective equipment
- Follow Electro-static discharge (ESD) protection procedure
- Solder/de solder Replacing Defective parts/components
- Soldere/mount replaced parts/components
- Control set/adjustments
- Perform Repair activity within the required timeframe
- Observe Handling the unit/product
- Clean units

Learning Instructions:

7. Read the specific objectives of this Learning Guide.
8. Follow the instructions described below to __.
9. Read the information written in the information “Sheet 1, Sheet 2, Sheet 3 and Sheet 4”.
10. Accomplish the “Self-check 1, Self-check t 2, Self-check 3 and Self-check 4” **in page -, , and** respectively.
11. If you earned a satisfactory evaluation from the “Self-check” proceed to “Operation Sheet 1, Operation Sheet 2 and Operation Sheet 3 ” **in page -.**
12. Do the “LAP test” **in page –** (if you are ready).

Information Sheet-1	following occupationalhealth and saety

1.1. OHS guidelines and PPE

Introduction

What is an occupational health and safety (OH&S) program?

A health and safety program is a definite plan of action designed to prevent accidents and occupational diseases. A health and safety program must include the elements required by the health and safety legislation as a minimum.

1.2 What we are correct work procedures established?

Governmental health and safety regulations represent minimum requirements. In almost all cases, organizations will have to augment these regulations with specific rules.

We need rules – to protect the health and safety of workers – but there are dangers in having either too few or too many rules. Too few rules may be interpreted as a sign that health and safety are not important, or that common sense is all that is required to achieve them. Too many rules may be seen as not treating employees as thinking adults and makes enforcement of all rules less likely. Following are some guidelines for establishing rules:

- Rules should be specific to health safety concerns in the workplace.
- The joint health and safety committee should participate in their formulation.
- Rules should be stated in clearly understandable terms.
- Rules are best stated in positive terms ("employees shall" not "employees shall not").
- The reasons for the rule should be explained.
- Rules must be enforceable, since disregard for one rule will lead to disregard for others.
- Rules should be available to all employees in written form, in the languages of communication of employees.
- Rules should be periodically reviewed to evaluate effectiveness and to make changes for improved effectiveness.

The employer must establish procedures for dealing with repeat rule violators. Supervisors are responsible for correcting unsafe acts, such as a breach of rules, and they must be supported in this duty. Points that should be considered in establishing procedures on this issue are:

- Ensure that employees are aware of the rule.
- Ensure that employees are not encouraged, coerced, or forced to disregard the rule by fellow employees.
- All rules are to be observed.
- No violation will be disregarded.
- The role of discipline is that of education, not punishment.

- Action is taken promptly.
- While having guidelines for penalties for the first offence or infractions may be desirable, some flexibility is required when applying the guidelines since each case will vary in its circumstances.
- Action is taken in private, and recorded.

How do you establish correct work procedures?

Correct work procedures are the safest way of doing a job, job instruction, monitoring performance, and accident investigation.

Job safety analysis (JSA), also known as "job hazard analysis", is the first step in developing the correct procedure. In this analysis, each task of a specific job is examined to identify hazards and to determine the safest way to do the job. Job safety analysis involves the following steps:

1. Select the job.
2. Break down the job into a sequence of steps.
3. Identify the hazards.
4. Define preventive measures.

Hazards exist in every workplace in many different forms: sharp edges, falling objects, flying sparks, chemicals, noise and a myriad of other potentially dangerous situations. The Occupational Safety and Health Administration (OSHA) require that employers protect their employees from workplace hazards that can cause injury.

Controlling a hazard at its source is the best way to protect employees. Depending on the hazard or workplace conditions, OSHA recommends the use of engineering or work practice controls to manage or eliminate hazards to the greatest extent possible. For example, building a barrier between the hazard and the employees is an engineering control; changing the way in which employees perform their work is a work practice control.

1.2. Requirement of PPE

To ensure the greatest possible protection for employees in the workplace, the cooperative efforts of both employers and employees will help in establishing and maintaining a safe and healthful work environment.

In general, employers are responsible for:

- Performing a "hazard assessment" of the workplace to identify and control physical and health hazards.
- Identifying and providing appropriate PPE for employees.
- Training employees in the use and care of the PPE.
- Maintaining PPE, including replacing worn or damaged PPE.
- Periodically reviewing, updating and evaluating the effectiveness of the PPE program.

In general, employees should:

- Properly wear PPE,
- Attend training sessions on PPE,
- Care for, clean and maintain PPE, and
- Inform a supervisor of the need to repair or replace PPE.

Specific requirements for PPE are presented in many different OSHA standards, published in 29 CFR. Some standards require that employers provide PPE at no cost to the employee while others simply state that the employer must provide PPE. Appendix A at page 40 lists those standards that require the employer to provide PPE and those that require the employer to provide PPE at no cost to the employee.

1.3. **The Hazard Assessment**

A first critical step in developing a comprehensive safety and health program is to identify physical and health hazards in the workplace. This process is known as a "hazard assessment." Potential hazards may be physical or health-related and a comprehensive hazard assessment should identify hazards in both categories. Examples of physical hazards include moving objects, fluctuating temperatures, high intensity lighting, rolling or pinching objects, electrical connections and sharp edges. Examples of health hazards include overexposure to harmful dusts, chemicals or radiation. The hazard assessment should begin with a walk-through survey of the facility to develop a list of potential hazards in the following basic hazard categories:

- Impact,
- Penetration,
- Compression (roll-over),
- Chemical,
- Heat/cold,
- Harmful dust,
- Light (optical) radiation, and
- Biologic.

In addition to noting the basic layout of the facility and reviewing any history of occupational illnesses or injuries, things to look for during the walk-through survey include:

- Sources of electricity.
- Sources of motion such as machines or processes where movement may exist that could result in an impact between personnel and equipment.
- Sources of high temperatures that could result in burns, eye injuries or fire.
- Types of chemicals used in the workplace.
- Sources of harmful dusts.
- Sources of light radiation, such as welding, brazing, cutting, furnaces, heat treating, high intensity lights, etc.

- The potential for falling or dropping objects.
- Sharp objects that could poke, cut, stab or puncture.
- Biologic hazards such as blood or other potentially infected material.

When the walk-through is complete, the employer should organize and analyze the data so that it may be efficiently used in determining the proper types of PPE required at the worksite. The employer should become aware of the different types of PPE available and the levels of protection offered. It is definitely a good idea to select PPE that will provide a level of protection greater than the minimum required to protect employees from hazards.

The workplace should be periodically reassessed for any changes in conditions, equipment or operating procedures that could affect occupational hazards. This periodic reassessment should also include a review of injury and illness records to spot any trends or areas of concern and taking appropriate corrective action. The suitability of existing PPE, including an evaluation of its condition and age, should be included in the reassessment.

Documentation of the hazard assessment is required through a written certification that includes the following information:

- Identification of the workplace evaluated;
- Name of the person conducting the assessment;
- Date of the assessment; and
- Identification of the document certifying completion of the hazard assessment.

Training Employees in the Proper Use of PPE

Employers are required to train each employee who must use PPE. Customers must be trained to know at least the following:

- When PPE is necessary.
- What PPE is necessary.
- How to properly put on, take off, adjust and wear the PPE.
- The limitations of the PPE.
- Proper care, maintenance, useful life and disposal of PPE.

“**For more information reer privious learning guides**”

Examples of Personal Protective Equipment

Self-Check -1	Written Test

Name: _____ Date: _____

Directions: Answer all the questions listed below.

PART I TRUE/FALSE(3 pts each)

If the statement is correct write TRUE if the statement is in correct write FALSE

_____1. The Occupational Safety and Health Administration (OSHA) require that employers protect their employees from workplace hazards that can cause injury.T

_____2. Occupational Health and Safety is not important or maintaining equipments.NOT

PART II CHOOSE THE BEST ANSWER(2 pts each)

_____1. Customers must be trained to know at least the following:

A. When PPE is necessary.
B. What PPE is necessary
C. How to properly put on, take off, adjust and wear the PPE.
D. The limitations of the PPE
E. All

_____2. Job safety analysis involves the following steps except one

A. Select the job.
B. Break down the job into a sequence of steps.
C. Does not dentify the hazards.
D. Define preventive measures.

Note:Satisfactory rating – 5 and above points Unsatisfactory below 5 points

Answer Sheet

Score = _____

Rating: _____

Name: _____ Date: _____

Information Sheet-2	Following Electro-static discharge (ESD) protection procedure

2.1. Intrduction to electrostatic discharge(ESD)

What is ESD? Electrostatic Discharge is a high voltage event from the release of electrical energy caused by static electricity or electrostatic induction.
ESD can cause permanent damage to electronics and integrated circuits.
ESD Principle Protect the IC by suppressing incoming transient voltage to an acceptable level (Output of Vc: Clamping voltage).

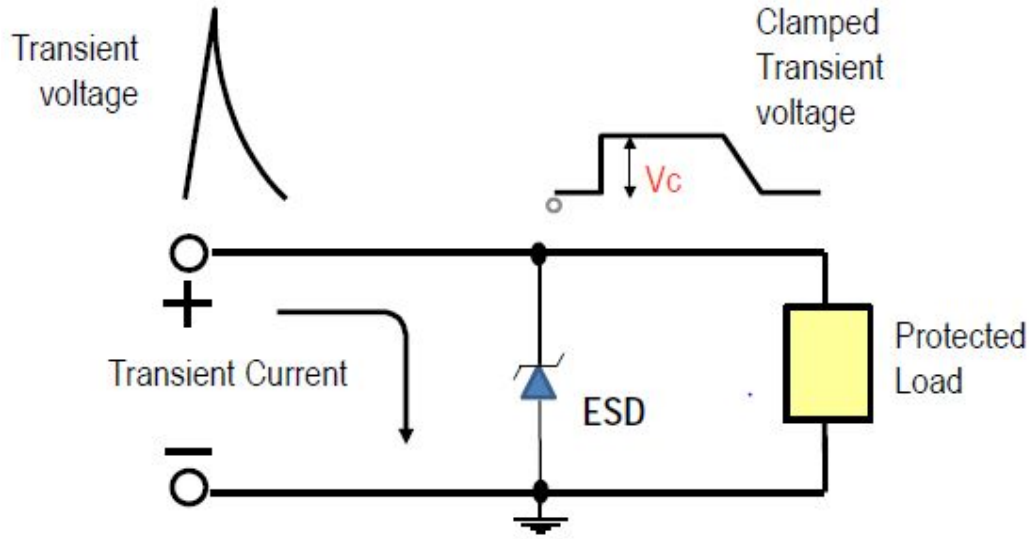


Fig 2.1 Electrostatic Discharge discharge

2.2. Types of ESD

1) **Sparks** – A spark is triggered when the electric field strength exceeds approximately 4-30kV/cm. This may cause a very rapid increase of free electrons and ions in the air, temporarily causing the air to abruptly become an electrical conductor. eg, lightning.
2) **Corona discharge** – A corona discharge occurs between a highly curved electrode (eg, tip of pen) and an electrode of low curvature (eg flat plate)
3) **Brush discharge** – A brush discharge occurs between an electrode with a curvature between 5mm and 50mm and a voltage of about 500 kV/m. The resulting discharge paths have the shape of a brush.

ESD Simulations

There are three models for assessing the survivability/susceptibility of electronic devices to ESD:
1)Human Body Model, HBM
2)Machine Model, MM
3)Charged Device Model, CDM

Human Body Model - HBM

- Simulates ESD from human contact.

- A person accumulates static electricity from walking or moving and discharges the static through the IC. The leads become the conductive path to a grounded surface due to contact.

Fig 2.2 **Human Body Model test**

- HBM (Human Body Model) test circuit simulates ESD from human contact and consists of 100pF and 1.5KΩ to simulate the equivalent capacitance and resistance of a human body.
- The capacitor is charged to a predetermined high voltage from an external source, and then suddenly discharged through the resistor into an electrical terminal of the device under test (DUT).

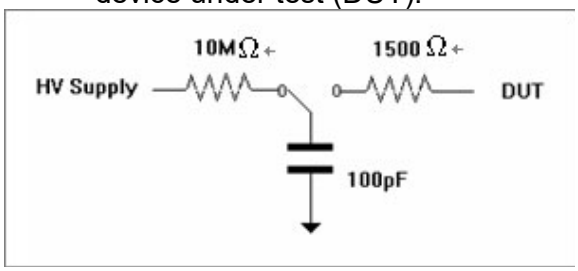


Fig 2.3: Human Body Model (HBM) test circuit

Machine Model - MM

This simulates the discharge of static electricity accumulated from machines and equipment (i.e. moving mechanical arms, test probes, etc.)

The test circuit consists of charging a 200pF capacitor to a predetermined high voltage from an external source, and then suddenly discharging the DUT through an electrical terminal.

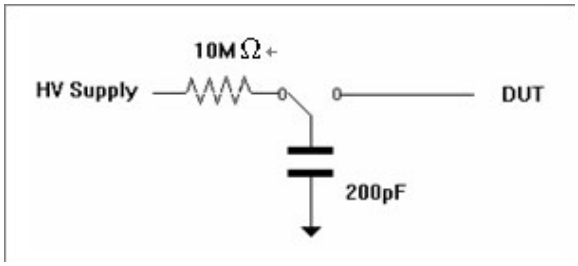


Fig 2.4 : Machine Model (MM) test circuit

Charged Device Model – CDM

- The CDM test simulates how the device acts when the device itself has an electrostatic charge and the effects of the discharge when it comes in contact with a metallic surface. This type of discharge is the most common type of ESD

in electronic devices and is the main cause of ESD damage during the manufacturing process.

- CDM discharge depends mainly on parasitic parameters of the discharge and is strongly dependent on the size and type of component package.

CDM Scenario：

When the IC slides from the packaging tube, friction causes static to form on the device. The IC discharges as the terminals contact a grounded surface (i.e. metal table), or when the part is picked up with metallic tweezers.

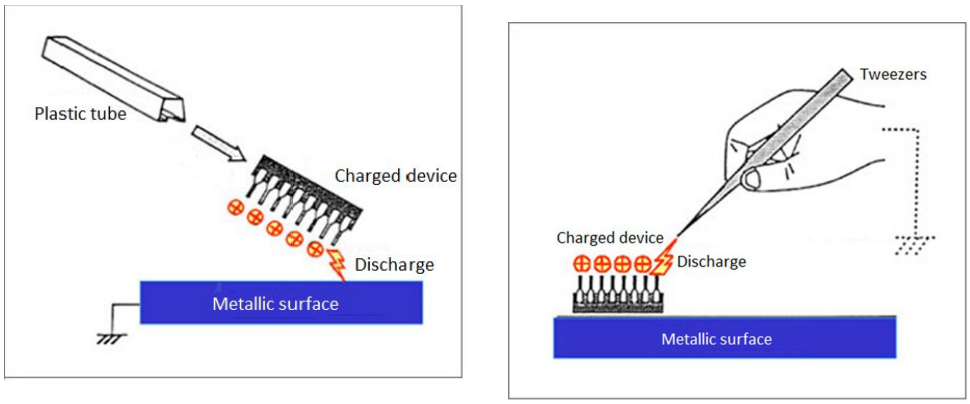
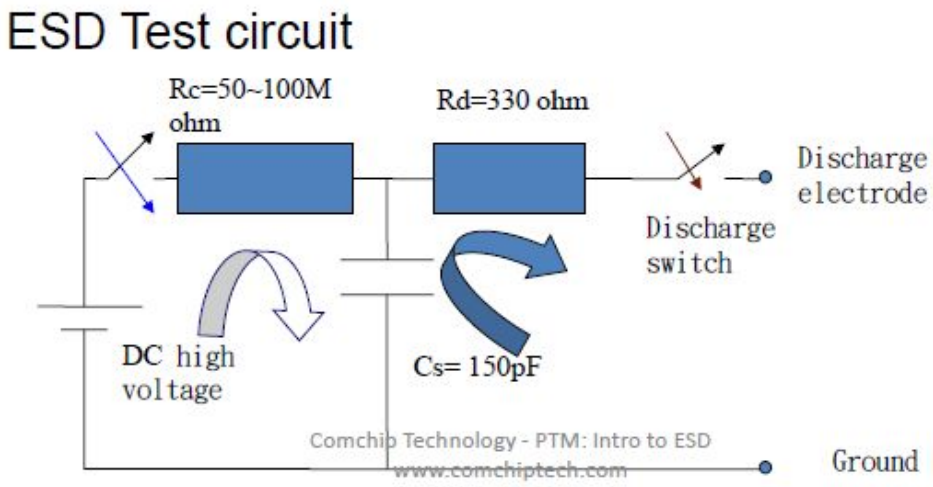


Fig 2.4 discharges IC

2.3 Electrostatic discharge testing (CDM)

Simulates ESD in a charged device at 150pF and 330Ω.

The capacitor is charged to a specific high voltage from an external source, and then suddenly discharged through the resistor into an electrical terminal of the device under test (DUT).



IEC – International Electrotechnical Commission: standards & specifications

61000: Electromagnetic Compatibility (EMC)

Parts 1, 2, & 3: General, Environment, Limits

Part 4: Testing & Measurement Techniques

1. Electrostatic Discharge Immunity
2. Radiated, RF, Electromagnetic Field Immunity
3. Electrical Fast Transients/Burst Immunity
4. Surge Immunity

IEC61000-4-2 is the series of specifications used to test the susceptibility of electronic devices to ESD.

- Embodies the guidelines and requirements for the test cell geometries, generators, test levels, discharge rate and waveform, types and points of discharge, and functional criteria for gauging product survivability.

Purpose: to establish a benchmark for testing

- Testing methods and standards are set for Direct Discharge and Air Discharge.

Contact Discharge

- Discharge via contact with a conductor.
- Preferred test method; more stringent.

Air Discharge

Discharge without direct contact and used only in special circumstances. For example, when the metal (conductive) part of a remote control is covered in insulation.

Contact discharge test

In the contact discharge test, direct discharges should be applied to all points accessible to the operator during normal use. For example: keyboard controls, display monitor, knobs, power cords, etc.
Before choosing a discharge point, test susceptible areas 20 times per second, then test selected area using 10 discharges.

2.3.1. ESD Protection Procedure

1. Anti-static kit can be purchased from a computer or electronics store. The main component is an ESD wrist strap with a wire several feet long having an alligator clip at the other end.
2. Before troubleshooting any domestic appliance, wear an ESD wrist strap and wear it as you go under the covers, handle ICs, and circuit boards.
3. Put the adjustable strap around your wrist. If you are wearing an ESD wrist strap connected to frame or ground, it drains static charges of your body, thus, it prevents damaging ESD sensitive devices.

4. Attach the clip at the end of the wire to an electrical ground connection or metal framework of the washing machine.
5. If you work on a washing machine without a conductive wrist strap, touch an electrical appliance such as a lamp or the screw in a wall outlet cover plate before touching the PCB. An electrostatic discharge of just a few hundred volts is too small to feel in most cases but can be usually deadly to ESD sensitive devices.

Self-Check -1	Written Test

Name: _____ Date: _____

Directions: Answer all the questions listed below.

PART I TRUE/FALSE(3 pts each)

If the statement is correct write TRUE if the statement is in correct write FALSE(3ptseach)

_____1. ESD can not cause permanent damage to electronics and integrated circuits.

_____2. Machine Model is simulates the discharge of static electricity accumulated from machines and equipment.

_____3. corona discharge occurs between a highly curved electrode (eg, tip of pen) and an electrode of low curvature.

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

Answer Sheet

Score = _____

Rating: _____

Name: _____ Date: _____

Information Sheet-3	Replacing Defective parts/components

3.1 Introduction to Scanners

- A scanner, simply put, is a device used to analyze an image and process it.

Fig 3.1 scanner machines

3.2. Types of scanner

There are different types of scanners for different types of documents that need to be scanned.

- Flatbed Scanners
- Sheet-fed Scanners
- Handheld Scanners
- Drum Scanners

Flatbed Scanners

- Used for scanning most documents, photos, and even flat objects from a PC or laptop
- Works like a copy machine
- Scans documents placed face down on the glass (scan bed)
- Most common type of scanner

Fig 3.2 Flatbed scanner machines

Sheet-fed Scanners

- More portable than a flatbed scanner
- Used to scan paper documents and photos
- The paper moves through the scanner
- Usually smaller than a flat-bed and portable

Handheld Scanners

- Smaller than the previous two scanners
- The user must move the scanner across the document
- Image quality is usually lower

Fig 3.3 Handheld Scanner

- Used by the publishing industry
- Document is placed on a glass cylinder
- Generates very high-quality scans

Fig 3.4 hendheld scanner

- Most flatbed scanners are connected to the computer via the Universal Serial Bus (USB).
- A software program called a TWAIN driver is used by the computer to communicate with the scanner.
- An image editing program can then be used to manipulate the scanned image.
- The TWAIN driver controls the scanner and serves as the interface between the scanner and your graphics program.
- The TWAIN driver controls the scanner and serves as the interface between the scanner and your graphics program.

3.3. Photo copy machines

Introduction

Chester Carlson, the inventor of photocopying, was originally a patent attorney, as well as a part-time researcher and inventor. His job at the patent office in New York required him to make a large number of copies of important papers. Carlson, who was arthritic, found this to be a painful and tedious process. This motivated him to conduct experiments with photo conductivity. Carlson used his kitchen for his "electrophotography" experiments, and, in 1938, he applied for a patent for the process. He made the first photocopy using a zinc plate covered with sulfur. The words "10-22-38 Astoria" were written on a microscope slide, which was placed on top of more sulfur and under a bright light. After the slide was removed, a mirror image of the words remained. Carlson tried to sell his invention to some companies, but failed because the process was still underdeveloped. At the time, multiple copies were most commonly made at the point of document origination, using carbon paper or manual duplicating machines, and people did not see the need for an electronic machine. Between 1939 and 1944, Carlson was turned down by over 20 companies, including IBM and General Electric—neither of which believed there was a significant market for copiers.

A photocopier (also known as a copier or copy machine) is a machine that makes copies of documents and other visual images onto paper or plastic film quickly and cheaply.

3.4. Parts of photocopier

If you take a photocopier apart, you might be overwhelmed by how many different parts there are photocopying process relies on only a few, key pieces:

- Photoreceptor drum (or belt)
- Corona wires
- Lamp and lenses
- Toner
- Fuser

1. Photoreceptor Drum

The photoreceptor drum (or, in some photocopiers, belt) is the heart of the system. A drum is basically a metal rollercovered by a layer of photoconductive material. This layer is made out of a semiconductor such as selenium, germanium or silicon. What makes elements like selenium so cool is that they can conduct electricity in some cases, but not in others. In the dark, the photoconductive layer on the drum acts as an insulator, resisting the flow of electrons from one atom to another. But when the layer is hit by light, the energy of the photons liberates electrons and allows current to pass through!

These newly freed electrons are what neutralizes the positive charge coating the drum to form the latent image.

Various photocopier drums

It's easy to imagine how you might project a copy of an image on a photoreceptive belt that has roughly the same dimensions as the sheet of paper containing the image. A problem emerges when you think about doing the same thing on a thin, cylindrical drum. How can the surface area of the drum possibly match the real estate on a sheet of paper? The solution is to simply rotate the drum while you're making a copy. If you rotate the drum in lockstep with the movement of the light beam across the original document, you can build the image strip by strip. After one strip of light is focused onto a corresponding swath of the drum, the drum

rotates to expose a fresh area of the photoconductor. Meanwhile, the previously exposed region of the drum swings into contact with the toner, and then with the paper.
Because the length of a standard printed page is a lot larger than the circumference of the drum in a modern photocopier, one full rotation of the drum will only replicate a small piece of the page. The drum actually has to be cleaned, recharged with ions, exposed to photons, and sprinkled with toner multiple times in order to duplicate the entire original. To the casual observer, the process appears continuous, because it's all seamlessly coordinated inside the photocopier as the drum rotates.

2. **Corona Wires**

For a photocopier to work, a field of positive charges must be generated on the surface of both the drum and the copy paper.
These tasks are accomplished by the **corona wires**. These wires are subjected to a high voltage, which they subsequently transfer to the drum and paper in the form of static electricity.

.

3. **Lamp and Lenses**

Making a photocopy requires a light source with enough energy to boot electrons out of the photoconductive atoms. What wavelengths of light can do this? It turns out that most of the visible spectrum of light contains enough energy to drive the process, especially the green and blue end of the spectrum. Anything lower than the red portion of the visible spectrum doesn't have enough gusto to activate the photoconductor. And, although UV light has more than enough firepower to make a photocopy, it can be very damaging to our eyes and skin. This is why photocopiers use a plain old incandescent or fluorescent bulb to flash light onto the original document.
When the lamp in the copier is turned on, it moves across the inside of the copier, illuminating one strip of the paper at a time. A mirror attached to the lamp assembly directs reflected light through a lens onto the rotating drum below. The lens works just like the one on your camera. It allows you to focus a copy of the image in a specific place. Although you can't really focus the image on a photocopier to make the final product more or less blurry, you can change the distance between the lens and the original or between the lens and drum to either reduce or magnify the size of the original image on your copy.

4. **Toner**

Toner is sometimes referred to as dry ink, but toner isn't actually ink at all! Ink is a pigmented liquid. Toner is a fine, negatively charged, plastic-based powder. The black color in photocopier toner comes from pigments blended into the plastic particles while they are being made.
In your photocopier, toner is stuck on larger, positively charged beads and stored inside a toner cartridge. When toner-coated beads are rolled over the drum, the toner particles find the positively charged ions on the unexposed areas on the drum's surface much more attractive than the weakly charged bead. The same particles are subsequently even more drawn to the electrostatically charged paper.
The plastic in the toner lets you keep it from jumping ship once you've finally got it on the paper; all you have to do is apply heat to the toner, and the plastic particles melt and fuse the pigment to the paper.

5. **The Fuser**

The fuser provides the finishing touches that make the toner image on a sheet of paper permanent. The fuser has to do two things:

- Melt and press the toner image into the paper
- Prevent the melted toner and/or the paper from sticking to the fuser

All that's required to accomplish these tasks is quartz tube lamps and Teflon-coated rollers. The sheet of paper is sentbetween two of the rollers. Then, the rollers gently press down on the page to embed the toner in the paper fiber. Meanwhile, inside the rollers, the lamps are on, generating enough heat to melt the toner. Why doesn't the toner melt onto the rollers instead? Just like non-stick coating prevents your dinner from becoming glued to the bottom of your frying pan, the Teflon coating the rollers keeps the toner and paper from sticking to them.

Putting It All Together

In a photocopier, the light-induced conductivity of the drum is exploited to create a latent image in the form of electrical charges on the surface of the drum. This image is made visible and transferred to paper using a special, charged toner.

Here's how it all comes together to make a copy:

1. For the photocopier to work its magic, the surface of the photoconductive material must first be coated with a layer of
2. In the places that light strikes the rotating drum, the energy of the photons kicks electrons away from the photoconductive atoms.
3. Opposites attract -- the positively charged ions coating the photoconductive layer attract the freed electrons. The marriage of one ion and one electron produces a neutral particle. Charged particles remain only in places where light didn't hit the drum because it wasn't reflected from the original -- the dark spaces taken up by text and pictures on the page!

This part of the process loosely resembles how a camera takes a picture. If you've read How Photographic Film Works, you know that when film is exposed to light, the energy of the photons causes chemical changes in the silver halide grains coating the film. This creates a negative image of what you see through the viewfinder. With a photocopier, however, you end up with a real image created from a pattern of positive charges left after exposure to light. And while you have to develop film using special chemical processes and print it on light-sensitive photographic paper, the photocopier produces a visible image with only dry ink, heat and regular paper.

4. Voltage is applied to the aluminum core of the drum. Since light renders selenium conductive, current can flow through the photoconductive layer while the drum is being illuminated, and the electrons released by the atoms are quickly replaced by the electrons that form the current flowing through the drum.
5. The exposed areas of the drum rotate past rollers encrusted with beads of toner. Tiny particles of toner are pressed against the drum's surface. The plastic-based toner particles have a negative charge and are attracted to areas of positive charges that remain on the drum's surface.
6. The corona wire passes over a sheet of paper so that the paper's surface becomes electrically charged.The area of the drum freshly coated with toner spins into contact with a positively charged sheet of paper. The electric field surrounding the paper exerts a stronger pull than the ions coating the drum's surface, and the toner particles stick to the paper as the drum passes by.
7.Once the entire original has been recreated on toner in the page, the paper proceeds on through the copier to the fuser. The weak attraction between the toner particles and the surface of the sheet of paper can easily be disrupted. To fix the toner image in place on the paper's surface, the entire sheet is shunted through the fuser's heated rollers.The heat melts the plastic material in the toner and fuses the pigment to the page.

8. By the time you reach for your copy in the collection tray, the photocopier has already prepared for the next go-round by again cleaning off the drum's surface and applying a fresh coat of positively charged ions to it.

3.5. Printers

Principle & Troubleshooting

Laser printer

- A Laser printer is the most commonly used type of computer printer that produces high quality printing, and is able to produce both text and graphics.
- The first laser printer was created by Gary Starkweather in 1978, by modifying a photocopier.
- The slowest printers of this type print about four ppm, but the fastest print mass mailings can print at several thousand ppm.
- Range from small, personal desktop models to large network printers capable of handling and printing large volumes continuously
    - The primary principle at work in a laser printer is **static electricity**.Said another way, Laser printers use a mechanism called electro-photographic imaging.

Fig 3.5 laser printer

- Laser printers:
    - ✓ Produce high-quality and high-speed output of both text and graphics
    - ✓ More expensive than inkjet or impact printers.
    - ✓ Use lasers as a light source.
- Hence laser printers require interaction of ***mechanical, electrical,*** and ***optical technologies.***

Laser Printer Parts

Toner Cartridge

- To reduce maintenance costs, many laser printer parts, including those that suffer most wear and tear, have been incorporated into the toner cartridge.

Fig 3.5 **Toner Cartridge**

- Drawback:
  - ✓ It makes replacement of individual parts nearly impossible.
- Advantage:
  - ✓ It greatly reduces the need for replacement; those parts that are most likely to break are replaced every time you replace the toner cartridge.

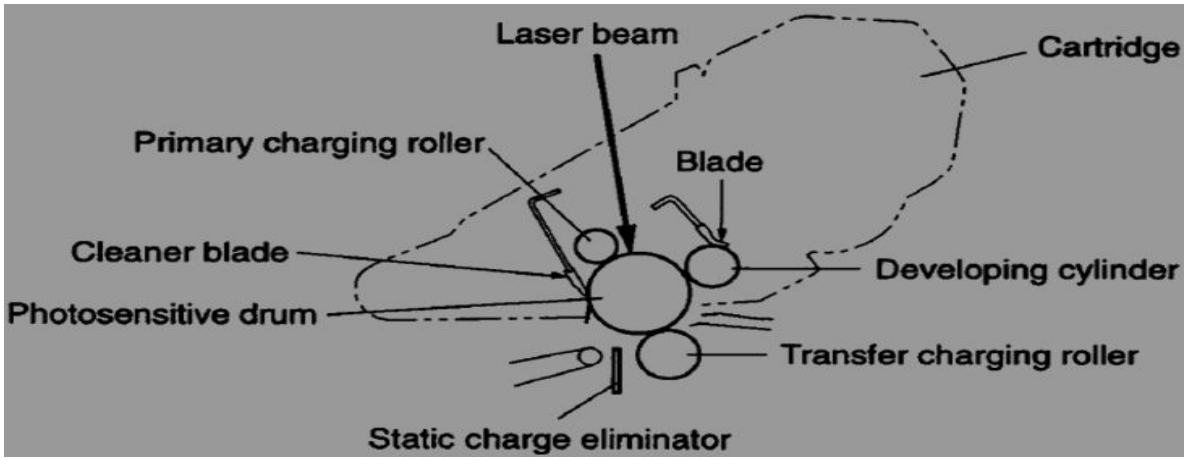


Fig 3.6 units of photocopy units

- ❖ A major portion of the image Formation system is contained in the cartridge as shown in the figure above
- ❖ The toner cartridge is the "heart" of the image Formation system. It houses the cleaning, conditioning, and Developing steps of the process.

- The cartridge contains the photosensitive Drum, Primary Charging Roller, developing station, Toner cavity, and cleaning station. Including these components are consumed in the replaceable Toner cartridge eliminates the needs for a service call when replacement is required.

DRUM

- Sometimes called photosensitive drum.
- The drum is a metal cylinder, usually made of aluminum. It's coated/covered with a special material /or with particles of photosensitive compounds/ called photoconductor.
- This material has the property of being to store an electrical charge on its surface in darkness.
- In order to charge the drum, it is rotated against an insulated roller which has a voltage of 600AC volts applied to it.

    - The drum itself is grounded to the power supply, but the coating is not. When light hits the particles, whatever electrical charge they have drains out through the grounded cylinder.

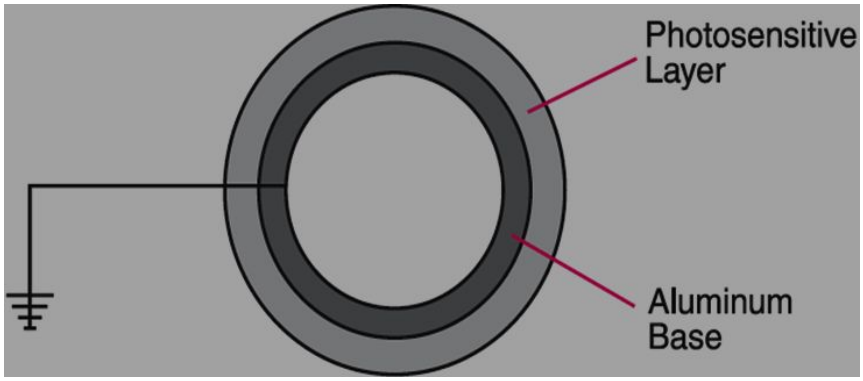


Fig 3.7drum unit

- The drum, usually contained in the toner cartridge, Can be wiped clean if it becomes dirty. However, exercise extreme caution! If the drum becomes scratched.The scratch will appear on every page printed from that point on.
- The only repair in the event of scratch is replacing the toner cartridge.

    - ✓ The drum's photosensitivity can be damaged

by exposure to light. To accomplish this, red plastic is placed over the lamps.

- 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. The outside of the cylinder is coated with a layer of Organic-Photoconductive Material (OPC) which is NON-Toxic.
- The OPC material has properties similar to a Photo-Resistor. 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.)

Laser

- ✓ Acts as the writing mechanism of the printer.
- ✓ Any particle on the drum that is struck by the laser becomes conductive, allowing its charge to be drained away into the ground core of the drum. The entire surface of the drum has a uniform negative charge of b/n ~600 and ~1000 volts following its charging by the primary corona wire.
- ✓ When particles are struck by the laser, they are discharged and left with ~100 volt negative charge. Then the laser can write a positive image onto the drum.

TONER

- The toner in a laser printer is electrically-charged powder with two main ingredients: pigment and plastic.
- Toner consists of plastic resin particles and iron oxide (the particles that are affected by magnetic attraction and electrical charges).
- It's a fine powder made up of plastic particles bonded to iron particles..
- It provides the coloring that fills in the text and images.
- The tonner cylinder charges the toner with a uniform negative charge of b/n -200AC and - 500AC volts.
- Because that charge falls b/n the drum's original uniform negative charge (b/n -600AC and -1000AC volts) and the charge of the particles on the drum's surface hit by the laser

(-100AC volts), particles of the toner are attracted to the areas of the photosensitive drum that have been hit by the laser (i.e., the areas that has positive charge relative to the toner particles).

- This pigment is blended into plastic particles, so the toner will melt when it passes through the heat of the fuser.

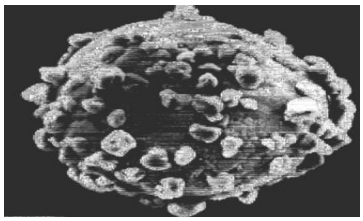


Fig 3.7 toner

Printer parts

- All laser printers are distinguished by at least two power supplies. The first is called the **primary power supply** or simply a **power supply** and the 2nd is called the **high-voltage power supply**.
- **Primary power supply**
  - ✓ Provides power to the motors that move the paper, system electronics, the laser and the transfer corona.
- **High-voltage power supply**
  - ✓ Provides power to the primary corona.
  - ✓ The extremely high voltage of this power supply makes it one of the most dangerous device in the world of PC's.
  - ✓ When inserting a new toner cartridge, always turn the laser **printer off** before opening it.

System boards

- This board contains the main processor, the printer's ROM & RAM. It is sometimes called the **printer controller**.

Fig 3.8 System boards

- The printer controller is the laser printer's main onboard computer. It talks to the host computer (PC) through a communications port (USB).
- The controller must organise all of the data it receives from the host computer. This includes all of the commands that tell the printer what to do -- **what paper to use, how to format the page**, etc.
- One big problem with laser printers is when the printer doesn't have enough memory (**RAM**) to store the image before it prints, creating a MEMORY OVERFLOW situation.
- Also, some printers store other information in RAM, such as FONTS and SPECIAL COMMANDS.
- Adding RAM is a very simple job-just snapping a SIMM stick or two-but getting the **right RAM** is important.

Ozone filter

- The corona inside the printer generates ozone (O_3). While not harmful to humans, the high concentrations of ozone will cause damage to printer components. To counter this problem, most laser printers have a special ozone filter that needs to be replaced periodically.

Sensors and Switches

- Every laser printer has a large number of sensors and switches spread throughout the machine.
- The sensors are used to detect a broad range of functions such as paper jams, empty paper trays, low toner levels, and so on.
- Many of these sensors are tiny switches that detect open doors, etc.
- Most of the time these sensors or switches work reliably, but they can become dirty or broken, sending a false signal to the printer. Simple inspection is usually sufficient to determine if the problem is real or just the result of a faulty sensor/switch.

Laser scanning assembly

- The traditional laser scanning assembly includes:
  - ✓ A laser
  - ✓ A moveable mirror
  - ✓ A lens
- The laser receives the page data - the tiny dots that make up the text and images - one horizontal line at a time. As the beam moves across the drum, the laser emits a pulse of light for every dot to be printed, and no pulse for every dot of empty space.
- Raster Image Processor (RIP) chip is used in laser printers to communicate raster images to a laser.

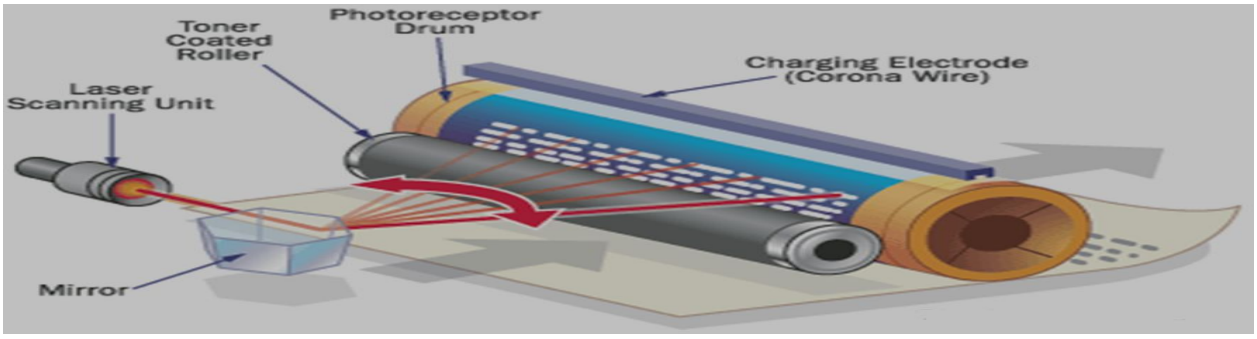


Fig 3.8

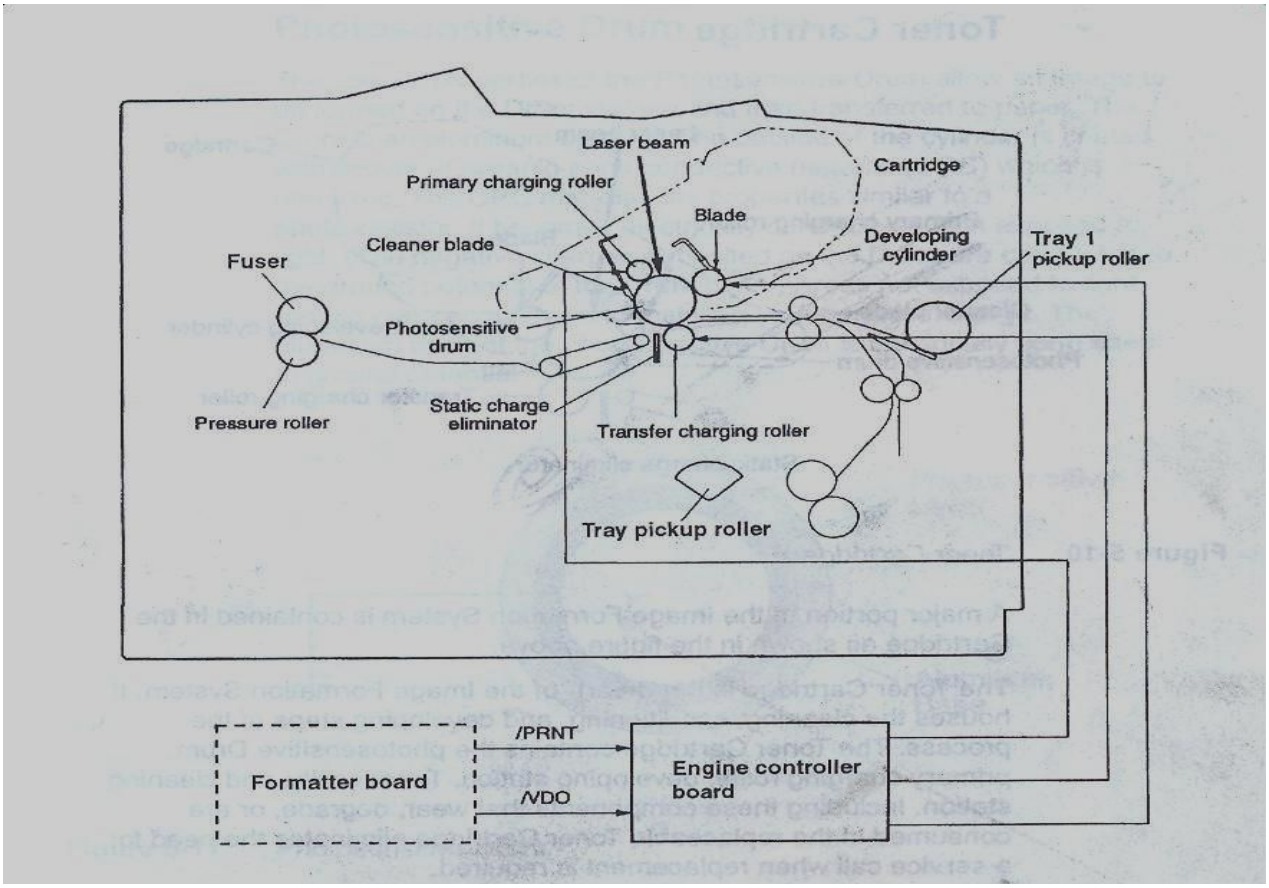


Fig 3.9 Laser scanning assembly

IMAGE FORMATION SYSTEM

- The image formation system is the main system in the printer. it consists of seven steps.

1. Cleaning 2. Conditioning3. Writing

4. Developing 5. Transferring6. Separation

7. Fixing (Fusing)

- When the formatter Boards send the printed signal to the Engine controller Boards, it drives the Main Motor to rotate the *Photosensitive Drum, theDeveloping Cylinder*, *the Primary charging Roller,* and *the Transfer charging Roller.*

Step-1 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 stored in the waste toner receptacle.

step-2conditioning the Drum

- After the Drum is cleaned, it must be conditioned. This 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 to create a uniform negative potential on the Drum surface.
- The amount of DC voltage is modified by the print density setting.

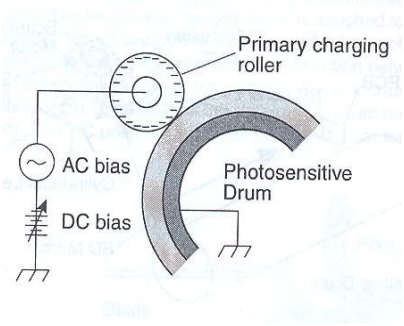


Fig 3.10 primary charging Roller

step-3*Writing the Image*

- During the writing process, a modulated Laser Diode projects the beam onto the rotating six-sided Scanning Mirror.
- As the mirror rotates, the beam reflects off the mirror, through a set of focusing lenses, through a slot in the rear of the Toner Cartridge, and onto the Photosensitive Drum.
- The beam sweeps the Drum from left to right, discharging the negative potential wherever the beam strikes the surface. This creates a latent electrostatic image, which later is developed into a visible image.

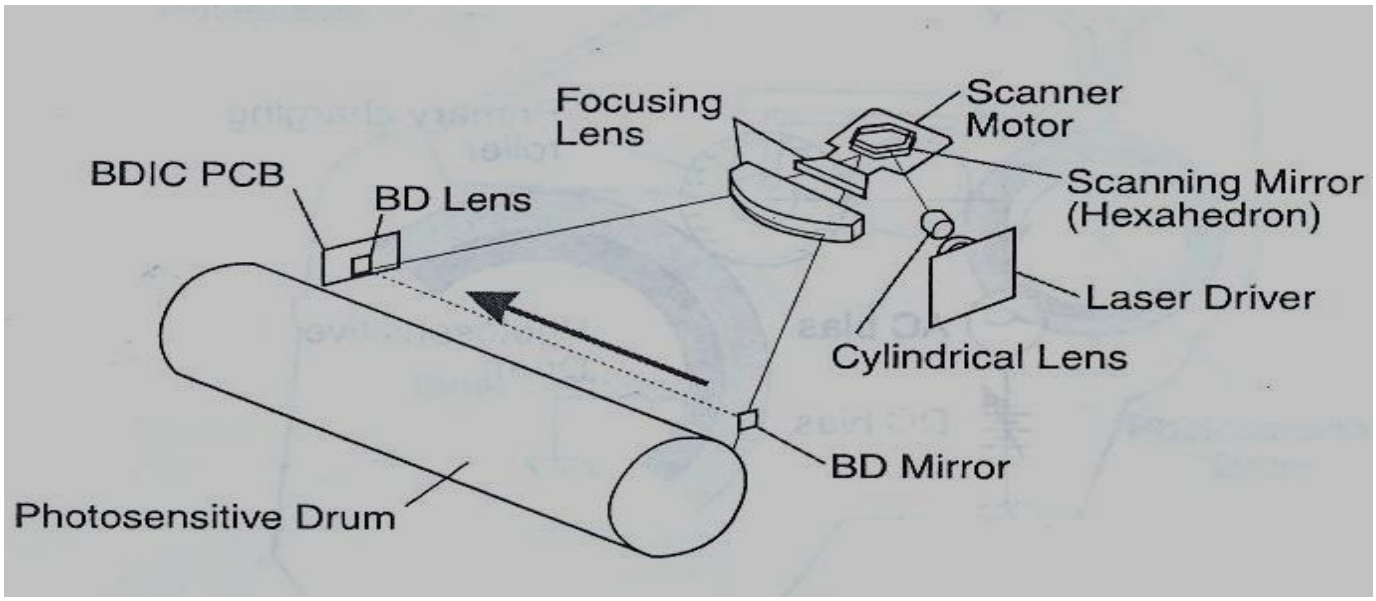


Fig 3.10 Fig 3.10

- Because the beam is sweeping the entire length of the Drum and the Drum is rotating, the entire surface area of the Drum can be covered.
- The speed of the Scanner Motor (which turns the Scanning Mirror)and the speed of the Main Motor (which turns the Drum) are synchronized.
- After the writing process, the Drum surface has an invisible (latent) electrostatic image. At the end of each sweep, the beam strikes the Beam Detect Lens, generating the Beam Detect Signal (BD).
- The BD signal is sent to the Engine Controller Board, where it is converted to an electrical signal used to synchronize the output of data (/VDO) for one sweep (scan line) and to diagnose problems with the Laser Diode or Scanner Motor.

Step 4: Developing

- 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.
- 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 attached to the discharged (exposed, grounded) areas. 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.

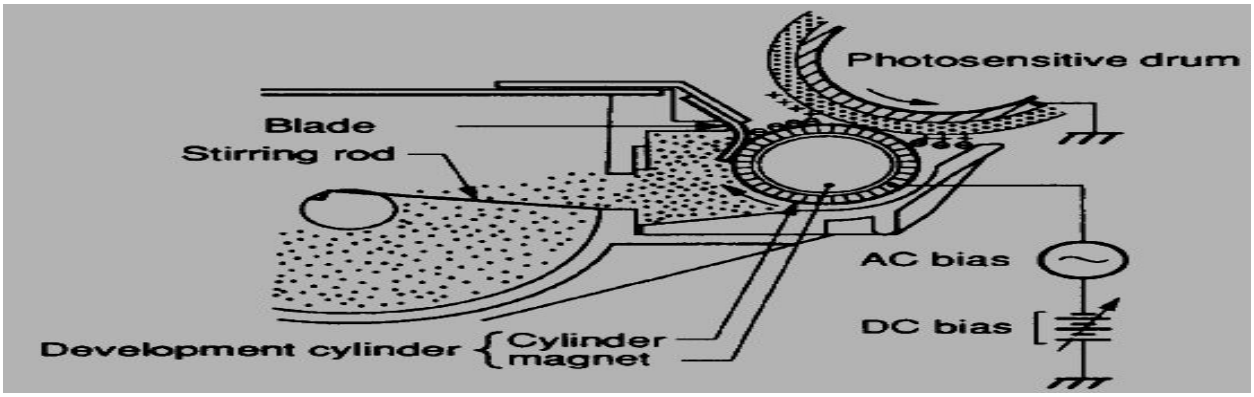


Fig 3.11 Developing unit

Step 5: Transferring

- Strong electrical charge draws toner off drum onto paper; takes place outside the cartridge
- During the transferring process the Toner image on the Drum surface is transferred to the paper. A positive charge applied to the back of the paper by the transfer roller causes the negatively charged Toner on the Drum surface to be attracted to the page.
- The small diameter of the Drum, combined with the stiffness of the paper, causes the paper to peel away from the Drum. The static eliminator teeth also help separate the paper from the Drum. The static eliminator teeth weaken the attractive forces between the negatively charged Drum surface. After separation, the Drum is cleaned and conditioned for the next image.

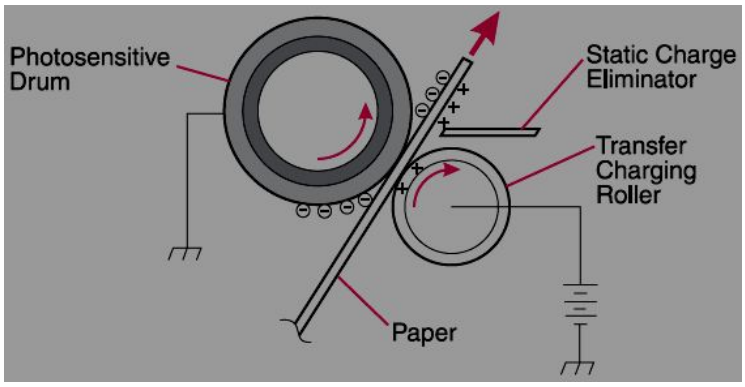


Fig 3.12 transering unit

Step: 6 separations

- The small diameter of the Drum, combined with the stiffness of the paper, causes the paper to peel away from the Drum. The static charge eliminatorteeth also help separate the paper from the Drum. The static charge eliminator teeth weaken the attractive forces between the negatively charged Drum surfaces. After separation, the Drum is cleaned and conditioned for the next image.

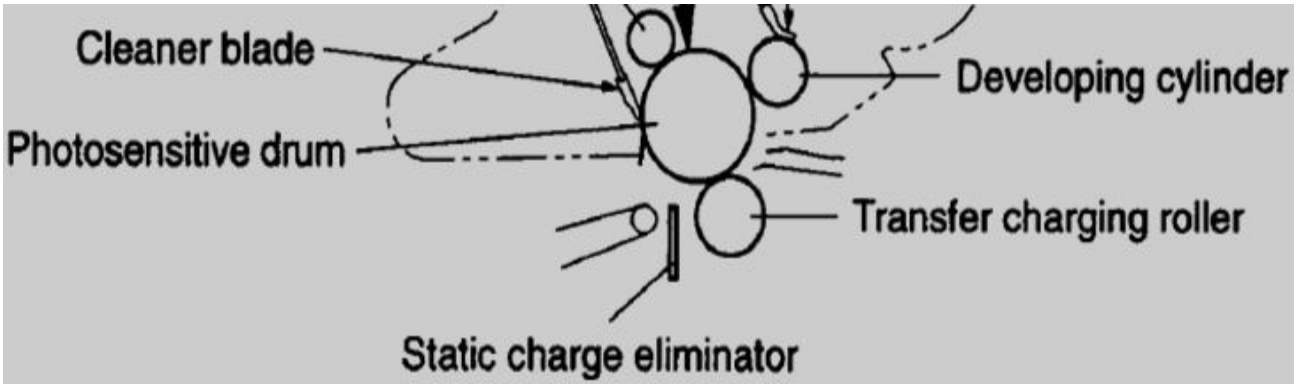


Fig 3.11 separations

Step 7: Fusing

- Heat and pressure fuse toner to paper
- During the fusing process, the Toner is fused into the paper by heat and pressure to produce a permanent image. The paper passes between a heated Fusing Roller and a soft Pressure Roller. This melts the Toner and presses it into the paper.
- The Fusing Roller contains a ceramic heating element that provides heat for the fusing process. Fusing temperature is monitored by the Engine Controller Board, via the Thermistor TH9O1. The engine controller Board maintains a temperature of about 383℉ (195 ℃) during printing mode.
- If the Fusing System overheats (about 428℉/220℃), a relay opens, interrupting power to the Fusing Heater, causing a Fuser error message (50.X FUSER ERROR). If the

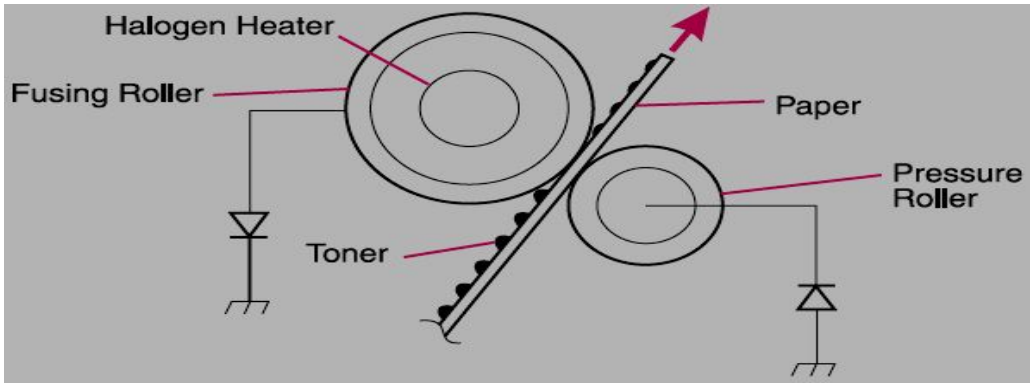


Fig 3.11 Fusing System

- Fusing System exceeds 464℉ (240℃) the thermal fuse will open, cutting off power to the Fuser.

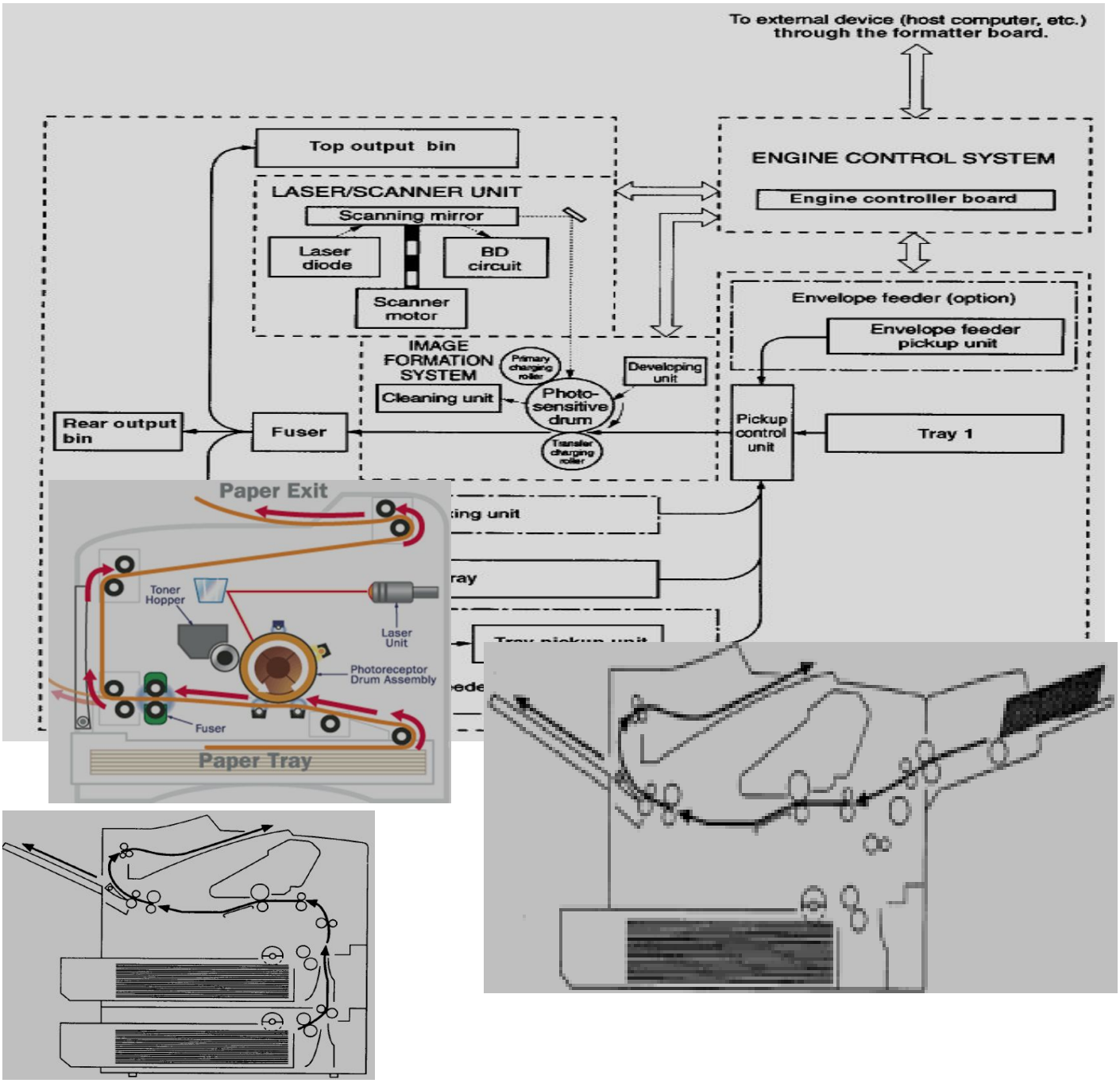


Fig 3.12 Fusing System

Parallel Connections, Cabling, and Electricity

- A standard printer cable
  - A male DB-25 connector on one end and a 36-pinCentronics connector on the other.
- Acceptable for transferring data at 150 KBps at distances of less than six feet
- IEEE 1284-compliant cable
  - Can be up to 32 feet

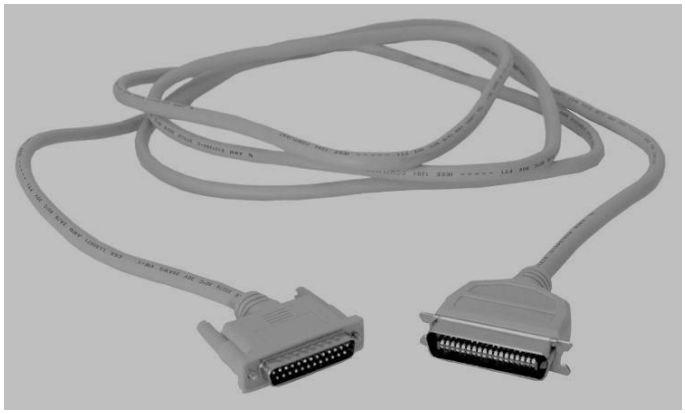


Fig 3.13 standard printer cable

USB and FireWire Printers

- Most new printers now use USB connections
  - Most use USB type A on one end and USB type B on the other end
  - FireWire
  - Works as easily as USB

General Printer Troubleshooting

- Isolate the problem

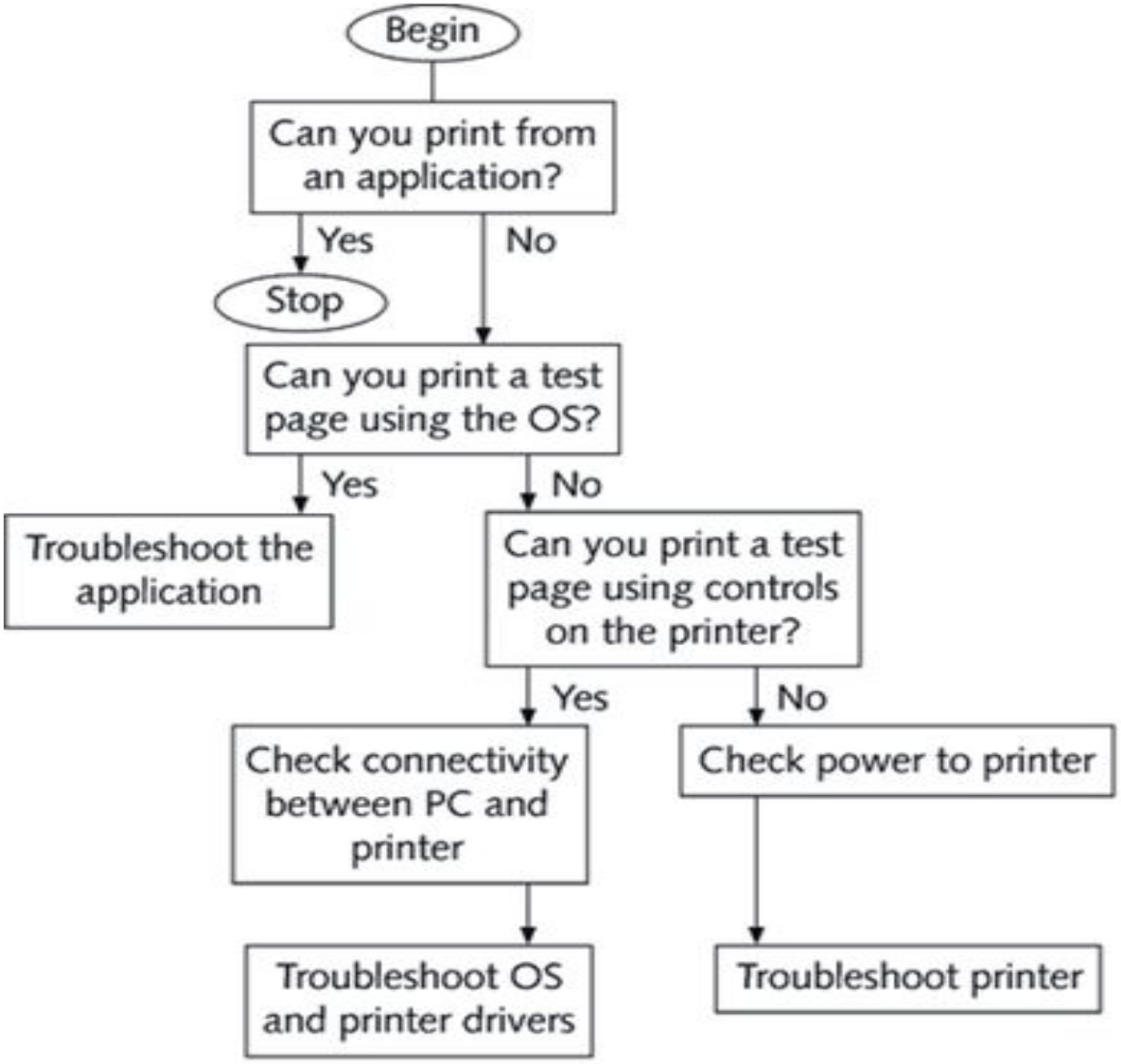


Fig. How to isolate a printer problem

Troubleshooting Laser Printers…

- Properly installed laser printers are quite reliable when operated and maintained within the guidelines set by the manufacturer.
- The following table lists a few problems that can be encountered with laser printing and their possible causes.

Symptom	Possible Cause
Ghost images appear at regular intervals on the printed page.	Photosensitive drum is not fully discharged. Previous images used too much toner, and the supply of charged toner is either insufficient or not adequately charged to transfer to the drum.
Light ghosting appears on pages.	Previous page(s) used too much toner; therefore, the drum could not be properly charged for the image (called developer starvation).
Dark ghosting appears on pages.	Drum is damaged.
Page is completely black.	Primary corona, laser scanning module, or main central board has failed.
Random black spots or streaks appear on page.	Drum was improperly cleaned; residual particles remain on drum.
Marks appear on every page.	Drum is damaged and must be replaced.
Printing is too light (appears in a column-like streak).	Toner is low.
Memory overflow error	Not enough RAM—printing resolution too high.
Characters are incomplete.	Print density is incorrect. (Adjust the darkness setting on the toner cartridge.)
Pages are creased.	Paper type is incorrect.

Characters are warped, overprinted, or poorly formed.	**There is a problem with the paper or other media or with the hardware. (For media: avoid paper that is too rough or too smooth. Paper that is too rough interferes with fusing of characters and their definition. If the paper is too smooth, it can feed improperly, causing distorted or overwritten characters. For hardware: run the self-test to check for connectivity and configuration problems.)**
After clearing a paper jam from the tray, printer still indicates a paper jam.	**Printer has not reset. (Open and close the cover.)**
Paper continues to jam.	**Problem with the pickup area, turning area, and registration (alignment) area. (Look for worn parts or debris.)**

Table 3.1 Troubleshooting Laser Printers

- **Blank Paper**
  - May be out of toner
  - Check the imaging drum to see if image is on drum but just not transferred to paper
  - Could be transfer corona or high-voltage supply
- **Dirty printouts**
  - Light dusting of toner on the paper (front or back) indicates dirty printer
  - Clean the printer
- **Ghosting**
  - Can be light ghosting or dark ghosting
    - Light ghosting explored on next slide
  - Dark ghosting can be from a damaged drum-replace the toner cartridge.
  - Low temperature or low humidity can aggravate ghosting problems
- Light ghosting

- Caused by printing an extremely dark or complex image
- Referred to as developer starvation
    - Lower the resolution
    - Use different pattern
    - Avoid 50% grayscale and dot-on/dot-off patterns
    - Change the layout so grayscale patterns do not follow black areas
    - Make dark patterns lighter and light patterns darker
    - Print in landscape
    - Adjust print density and RET settings
    - Print a completely blank page before the next one

- Vertical white lines
    - Clogged toner
    - Try shaking the toner cartridge or replacing it

- Blotchy print
    - Uneven dispersion of toner
    - Try shaking the toner cartridge from side to side
    - Make sure the printer is level
    - Make sure the paper is not wet in spots
    - Check the fusing rollers and photosensitive drum for foreign objects
- Spotty print
    - Try wiping off the fuser rollers
    - Check the drum for damage
- Embossed effect
    - Like putting a penny under a piece of paper and rubbing it with a lead pencil

- A foreign object on a roller
- A foreign object on the photosensitive drum
- Replace the toner cartridge

- Incomplete characters
  - These may occur on transparencies
  - Try adjusting the print density
    - Creased pages
  - Cotton bond paper is more susceptible
  - Try using a different paper type
- Paper jams
  - Do not pull on the paper to remove it
    - Can damage the printer by pulling jammed paper out
    - Check manufacturer's jam removal procedure
  - If there is no jammed paper, sensors may be bad
- Pulling multiple sheets
  - Try using a different ream of paper-if that works, the issue is humidity.
  - Check the separation pad-a small piece of rubber or cork that separates the sheets as they are pulled from the paper tray.
- Warped, overprinted, or poorly formed characters
  - Paper that is too rough or too smooth
  - Don’t open a ream of paper until it is loaded into the printer
  - Always fan the paper before loading it in the printer
  - Do a printer self-test to determine if it is the printer or the computer
  - Replace the toner cartridge, check the cabling, replace the data cable
  - Turn off advanced functions and high-speed settings to see if they may not be supported by your software configuration
- The following are symptoms of laser printer faults:

- Printer dead, power on, but no printing.
- The print on the page is light or washed out.
- A blank page is produced.
- Stains or black dust on paper.
- Vertical lines on paper.
- The printer will not load paper.
- Paper jams in printer.
- A paper jam has been cleared, and the unit still indicates a jam is present.

Computer

- Computers are machines that perform tasks or calculations according to a set of instructions, or programs.

computer is an electronic device that:

- accepts input
- processes data
- stores data
- produces output

Types of Computer

The categories of computers are:

- Personal computers
  - Desktop
  - Notebook (Laptop)
  - Tablet PC

Cheap and easy to use. Often used as stand-alone computers or in a network. May be connected to large mainframe computers within big companies.

Fig 3.13 Personal computers

- Hand-helds
  - PDAs
  - MP3 players
  - Cell phones
- Mainframes
- Supercomputers

Self-Check 4	Written Test

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

1. Not parts of printers **(3 points)**
   A. laser
   B. moveable mirror
   C. Lens
   D. None

2. A part o computers.
   A. RAM B. Lens C. Hard disk D. ROM

3. Printer is used to convert hardcopy to sot copy. (3 points)
   A True
   B, False

4. Test stations can be setup with or without direct protection depending on your requirements.(3points)
   A True
   B, False

Note:Satisfactory rating – 5 and above points Unsatisfactory below 5 points

Answer Sheet

Score = _____

Rating: _____

Name: _____ Date: _____

Information Sheet-3	Replacing Defective parts/components

3.1 Solder/de solder Replacing Defective parts/components

3.1.1. Soldering Technique

solder is applied into the joint, not to the iron directly. This way, the solder is melted by the joint, and both metal surfaces of the joint (the lead and the PC pad) are heated to the necessary temperature to bond chemically with the solder. The solder will melt into the hole and should fill the hole entirely. Air or gaps in the hole can cause static discharges which may damage some components.

Figure 3.2 shows the typical result of a bad solder joint. This figure shows what happens if the solder is \painted" onto the joint after being applied to the iron directly. The solder has \balled up," refusing to bond with the pad (which did not receive enough heat from the iron).

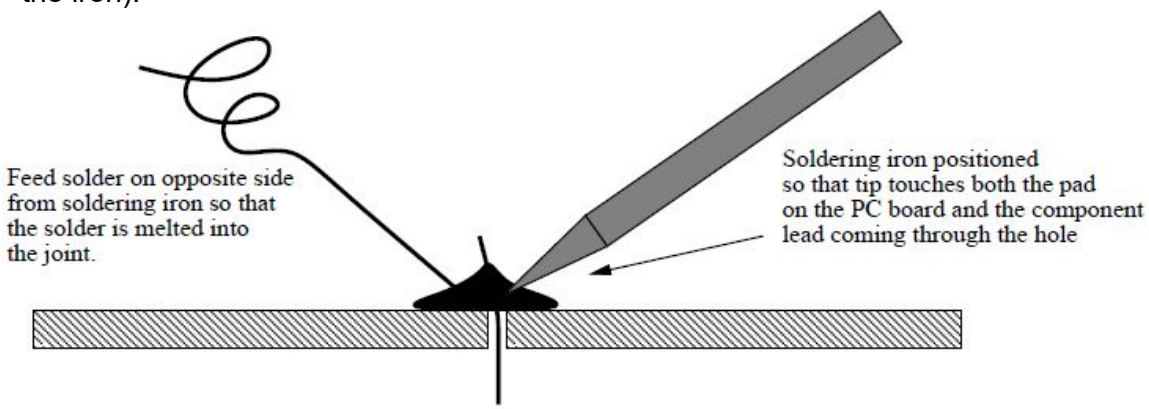


Figure 3.1 : Proper Soldering Technique

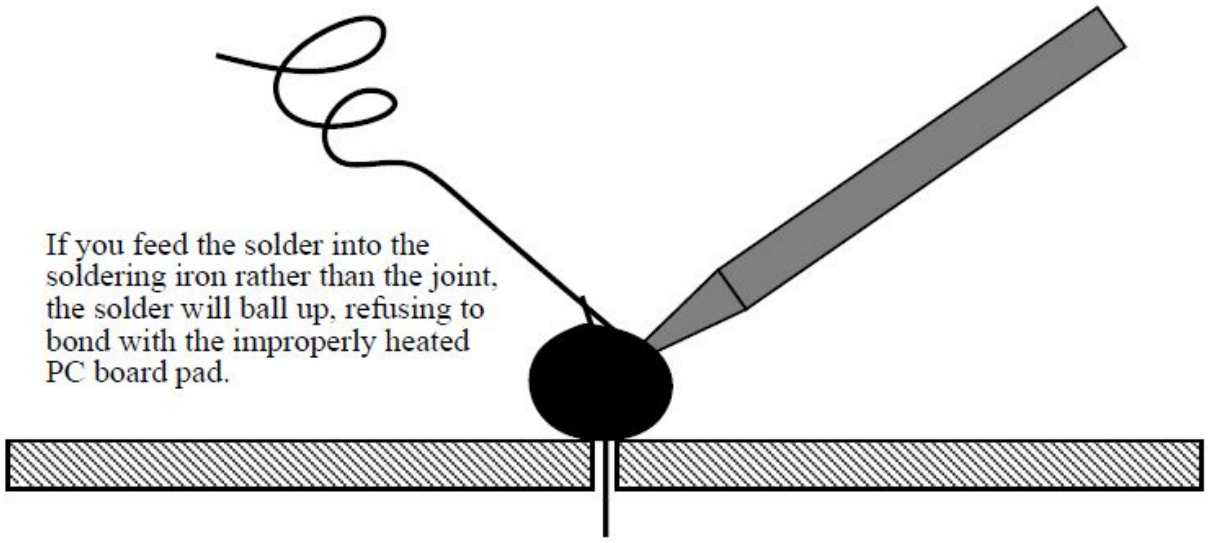


Figure 3.2 : Improper Soldering Technique

3.1.2 Desoldering Technique

It takes about ten times as long to desolder a component than it did to solder it in the first place. This is a good reason to be careful and take one's time when assembling boards; however, errors will inevitably occur, and it's important to know how to fix them.

The primary reasons for performing desoldering are removing an incorrectly-placed component, removing a burnt-out component, and removing solder from a cold solder joint to try again with fresh solder.

Two main methods of desoldering are most common: desoldering pumps and des-oldering wick.

To use a desoldering pump, first load the pump by depressing the plunger until it latches. Grasp the pump in one hand and the soldering iron the other, and apply heat to the bad joint. When the solder melts, quickly remove the soldering iron and bring in the pump in one continuous motion. Trigger the pump to suck up the solder while it is still molten.

Adding additional solder to a troublesome joint can be helpful in removing the last traces of solder. This works because the additional solder helps the heat to ow fully into the joint. The additional solder should be applied and de-soldered as quickly as possible. Don't wait for the solder to cool o_ before attempting to suck it away.

The desoldering pump tip is made of Teon. While teon is heat-resistant, it is not invincible, so not jam the teon tip directly into the soldering iron. Solder will not stick to Teon, so the desoldering operation should suck the solder into the body of the pump.

Desoldering works e_ectively when the joint is hot, and there is ample solder to be removed. Additional solder can be added to joints that are di_cult to desolder. The additional solder transfers heat to the existing solder, allowing it to be de-soldered more easily.

Parts Replacement Procedure of photocopy machines

Ref:www.northwestern.edu

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 Sheet-4	Soldering/mounting replaced parts/components

4.1. Introduction

Soldering is a process used for joining metal parts to form a mechanical or electrical bond. It typically uses a low melting point metal alloy (solder) which is melted and applied to the metal parts to be joined and this bonds to the metal parts and forms a connection when the solder solidifies. It is different to welding in that the parts being joined are not melted and are usually not the same material as the solder.

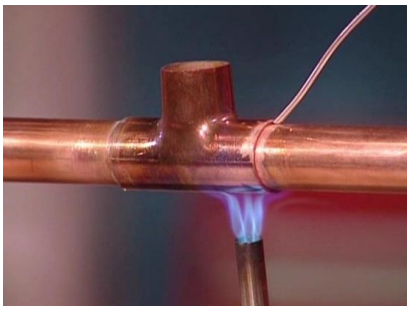


Figure 4.1 – Different Types of Soldering

Soldering is a common practice for assembling electrical components and wiring. Although it can be used for plumbing, sheet metal fabrication or automotive radiator repair the techniques and materials used are different to those used for electrical work. This document is intended to provide guidance on the safe working methods and proper tools and techniques for soldering of electrical components.

4.2 Types of Solder

There are different types of solder used for electrical work. They are broadly classified as tin/lead solders or lead free solders. Tin/lead solders have been used for many years because of their ease of use however they have been phased out of commercial use due to the harmful effects on humans and the environment.Tin/lead solder is still available and is used by “hobbyists” and other non-commercial users as it is still easier to use than lead free types. When using tin/lead (or leaded) solder there are additional safety precautions that must be observed.

Figure 4.2 – Different Types of Soldering

4.3 Types of PCB

Printed circuit boards (PCBs) are populated by electronic components and these may be "surface mount" or "through-hole" types.

4.3.1 Through-Hole Components

As the description "through-hole" suggests, the leads of the component are passed through holes in the PCB and then soldered to a "pad" on the reverse side of the PCB. Soldering is accomplished by heating the component lead and PCB pad with a soldering iron and melting solder wire into the joint. This type of construction was common from the 1960's until early 2000's and is still used by hobbyists and in small scale production where manual assembly is preferred.

4.3.2 Surface Mount Components

Commercial circuits are mostly of the surface mount type as these are cheaper to make, more compact and easier to automate assembly. For surface mount construction the component's pads are on the same side of the PCB as the component and the component connections sit onto these pads. Soldering is accomplished by applying solder paste onto component pads on the PCB, placing the component onto the paste and then heating the entire assembly to melt the solder. Commercial assembly uses ovens to heat the boards. Hobbyists can also use surface mount components and soldering can be accomplished by applying solder paste and melting with a hot plate, small oven or soldering iron. Some surface mount joints can be soldered using a soldering iron and solder wire.

4.4 Flux

For electrical soldering both solder wire and solder paste contain flux. This helps to clean the surfaces being soldered and prevent oxidization of the hot solder. The composition of the flux will vary depending on whether it is in a paste or wire, leaded or unleaded solder. Solder wire usually contains a flux called "rosin". Most fluxes will produce fumes when the solder is heated and these fumes are likely harmful to your health. For occasional soldering it may be sufficient to have a well-ventilated workspace but for longer or repeated exposure a fume extractor should be used. Solder flux can also cause solder to spatter and eye protection should be worn when soldering.

4.5 Soldering Irons

Soldering irons come in many varieties and sizes. Soldering irons may be electric, gas powered or externally heated. Most common types are electric. Simple electric soldering irons have no controls and you simply plug them in and wait for them to heat up. Their temperature is regulated by the power of the heating element and heat loss to the environment. Some soldering irons have temperature controls which allow the user to set a desired operating temperature for the soldering iron. This is useful if the soldering iron is being used for different types of solders which have different melting points or if the soldering iron is being used for other purposes such as heating heatshrink. It also introduces a problem if the user does not set an appropriate temperature for the work, solder can be overheated and decompose. Hotter is not better! A temperature of around 320 °C works well for 60/40 leaded solder. Some temperature controlled soldering irons use interchangeable tips to change the temperature at which they operate.

Self-Check -3	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 inspectionis 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-5	Control settings/adjustments

5.1. Introduction

Electronic control is also referred as electronic regulation that is done to an appliance, situation or load by electronic devices. Domestic appliances are commonly controlled directly or manually using electrical switches and timers. In electronic devices, transformer is commonly used not just to reduce the supply voltage (220VAC) but also to isolate the load from the power source. To apply this safety feature to domestic appliance, a device (electrically or electronically operated) is needed. Relay and triac is just an example of devices that can be used.

Performance Check

Directions: Read each item and check the appropriate box.

Tasks	YES	NO
1. Prepared the resources needed.		
2. Inserted the components on the breadboard properly.		
3. Connected the each component accordingly.		
• Relay		
• SPST switch		
• Bulb		
• Power supply		
4. Energized the circuit (it should be functional).		
6. Observed proper use of tools.		
7. Performed housekeeping.		
8. Finished the activity within the timeframe.		

Self-Check -4	Written Test

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

1, For measuring differences of potential (voltage) between two points in an electrical circuit .A, home meter *B,* volt meter *C,* ammeter D, none of the above *(3 pt each)*

2, **Clamp onmeter** is also called tong-tester is used to measure current flowing in a conductor It is clamped or hanged in a conductor. *(3 pt each)*A, true B, false *(3 pt each)*

3, Test equipment is necessary for determining proper set-up, adjustment, operation, and maintenance of electrical/electronic systems and control panels.. 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-6	Performing Repair activity within the required timeframe

6.1. Introduction

Provided with a defective Machine, use maintain and repair form to gather and document the information about the appliance at hand. Follow the procedures :

Conduct an initial interview to the owner of the equipment.

- Ask what the problem is.
- Request for the details of the problem (how does it happen/ since when/ nature of the problem)

2. As a serviceman, you must recognize the problem/ complain.

3. Make an initial inspection of the appliance.

- Physical appearance
- Operating controls and other parts
- Power cord

4. Take note of the information gathered and observed.

5. Accomplish Receiving and Repair form.

Receiving and Repair Form

Customer's name: _____
Address:_____

Product/ Brand name: _____

Serial no: _____

Complain: _____
_____

Oice machine Checklist

Parts	Good	deective

Student's Signature_____ Date prepared: _____ Teacher's Signature_____ Date checked: _____

Self-Check -6	Written Test

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

1, Hot Test is the test performing with power sorce.

.A, true *B,* false *(3 pt each)*

2, which one is the method to identifying non-functional tools and equipment.

. *(3 pt each)*A, *Visual inspection* B, *Functionality* C, *Performanced, all*

3 ,write Types of tasting. *(3 pt each)*

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

Answer Sheet

Score = _____

Rating: _____

Name: _____ Date: _____

Information Sheet-8	Observing Care and extreme precaution during handling the unit/product as per procedures

.

7.1 Maintaining and Storing Tools & Equipment

An important aspect of any business is the maintenance and storage of tools and equipment. The investment in tools and equipment is a significant part of the overhead expenses in any operation. Proper selection and maintenance of equipment are important factors in managing business. Selecting the proper tool for the job and using the tool properly will increase efficiency and reduce maintenance problems. Purchase tools, which are well-made and suited to the intended use. Commercial usage may entail more heavy duty demands on equipment.

Hand tools:

1. Clean dirt and debris from tools after each use.
2. Oil metal parts to prevent rust.
3. Lightly sand rough wooden handles and apply linseed oil.
4. Repair loose handles.
5. Sharpen blades of cutting tools.
6. Store tools in a clean dry storage area.
7. Protect surfaces of cutting tools in storage.

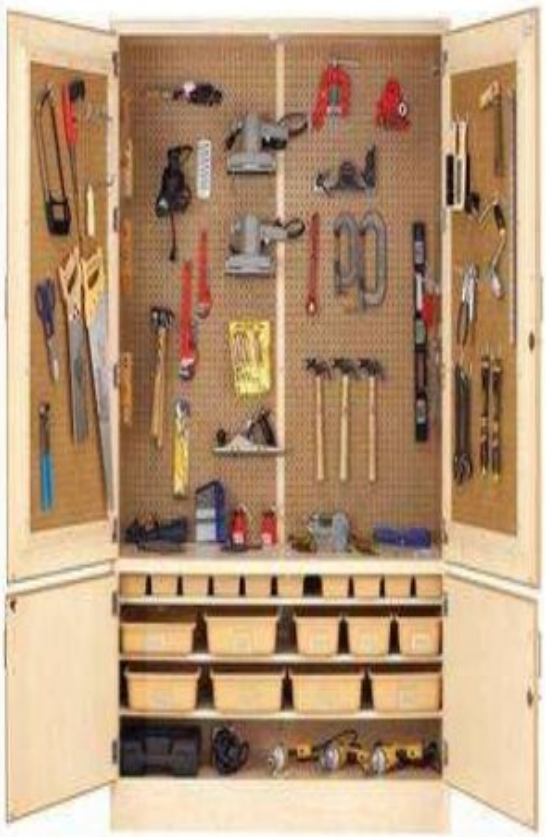
Power tools:

1. Read and follow the maintenance schedule in the owner's manual for each piece of power equipment.
2. Change the oil.
3. Clean the air filter.
4. Lubricate moving parts.
5. Sharpen dull blades or replace worn blades according to the owner's manual.
6. Replace spark plugs.
7. Drain oil and gasoline before long-term storage.
8. Check electric cords and connections on electric-powered tools.
9. Store tools in a clean dry storage area.

Equipment:

1. Store equipment in a clean dry storage area.
2. Rinse and clean spray equipment after each use.
3. Clean spreaders and check wheel-driven gears.
4. Clean carts and wheelbarrows after use.

Sample Proper Arrangement and storage of tools and equipment



Self-Check -7	Written Test

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

1, An important aspect of any business is the maintenance and storage of tools and equipment. *(3 pt each)*

A. true

B. false

2, One of the following is not true about equipment handling? *(3 pt each)*

A. Store equipment in a clean dry storage area.

B. Rinse and clean spray equipment after each use.

C. Clean spreaders and check wheel-driven gears.

D. Clean carts and wheelbarrows after use.

E.None of the above

Note:Satisfactory rating 3 and above points Unsatisfactory below 3 points

Answer Sheet

Score = _____

Rating: _____

Name: _____ Date: _____

Information Sheet-8	Cleaning

8.1 DEFINITIONS

- **Cleaning** means the physical removal of foreign material, e.g., dust, soil, organic material such as blood, secretions, excretions and microorganisms. Cleaning physically removes rather than kills microorganisms.

- is an essential process within electronics manufacture and has been used for many years to remove potentially harmful contaminants during PCB manufacture. Such contaminants include flux, solder and adhesive residues, and other more general contaminants such as dust and debris present from other manufacturing processes.

Cleaning PCBs has been a vast topic formany years, particularly sosince the ban of CFCs and HCFCs.These products offered solvency power, low surface tension properties to dissolve, remove and dry within minutesany parts of any de-sign. The electronic industry has grown so rapidly since the 80s, that today,nearly 50% of any individual'sbelongings are composed of electronics: e.g.: Mobile phones,remote controls, TVs, radios, cars, IPods, computers, HiFi, hard discs, memory sticks, cameras, videos, refrigerators, dish and laundry washers, cars, planes , satellites, implants, etc…
Since the 90s, the electronic evolution has been exponential, andthe miniaturization has advancedproportionally. The introduction of such new smallparts not only raised some designproblems, but also some practicalaspects such ashan-dling andsomereliability problems. In meantime, the suppliers of solder fluxes and pastes had to adjust new formula-tions for the new markets, the new demands and the newregulations.
Accordingly, the electronic suppliers adapted their production to the customers' demands with cleanable andno clean fluxes, also called consumable devices. The non consumable devices such asmedical implants, military tools, satellites, safety parts for cars, trains, medical equipments and many otherproducts, should be reliableand thus cleaned. To achieve a good cleaning result, it is worth understanding the various parameters present and the physical laws which are ruling this chemical operation.

1) Miniaturization

Today, miniaturization is a hundred times greater than during the 80's.This reduction in size means reduction of solder pads and alsoamount offlux residues. But it also means a reduction of space between legs and board/components. Today,size of components aredown to 0,1mm.In addition, the components became of high capacity with resistors, diodes,quartz, selfs, BGA and others. The reliabilityof these componentsshould be always increased. This miniaturization should not become a reason of instability and unreliability. The cleanliness should be performed and pass the norms.

2) Contaminants

The contaminants on a circuit board are mainly composed of: organics such asnatural and/or syntheticrosins,ions, acids, solder balls, fingerprints, and particulates of PCBs. The lead-free

alloys need higher soldering temperatures than thestandard Sn/Pb which are carrying significant evolutions on the fluxes to be used. These fluxes are most of the time more active and must resist to higherreflow profiles. They present more risks than the one formerly used,and the temptation is high to choose production parameters allowing shining soldering pads. The ionic cleaning of thePCBs is then more criti-calbefore tropicalisation, but will also help to control the assembling process and help to establish final assemblylife-time. Theio Znic contamination is a goodquality indicatorfor the long termreliability.Please see next Figure

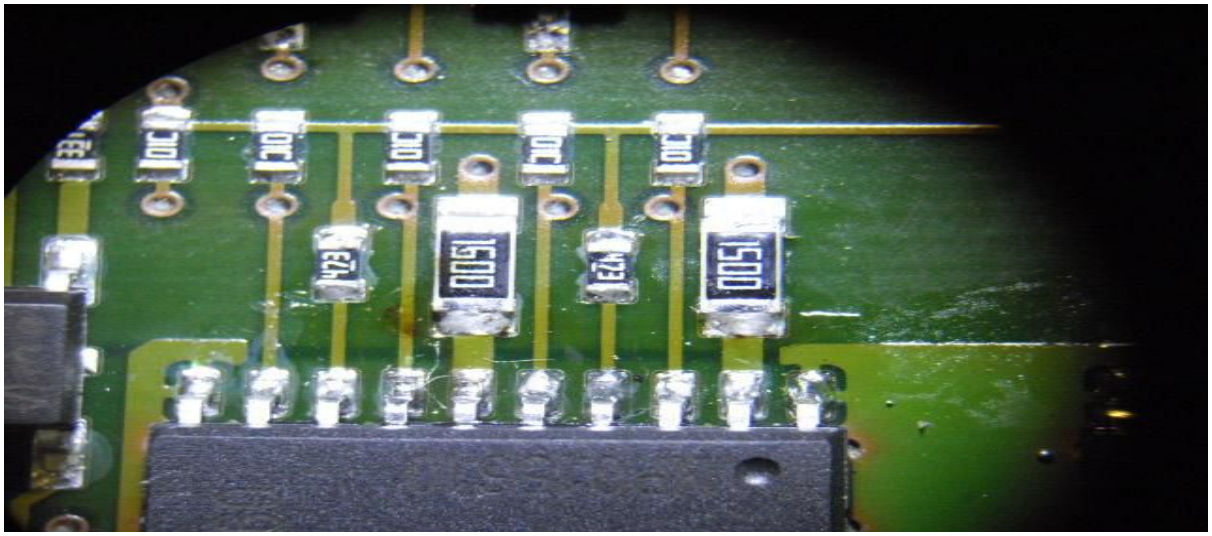


Figure 8.1 Contaminants soldering

3) Specifications set up

Every end-user has his own typical specifications which are depending on his own or his customers. For this study,the specifications have been taken as described in Table 1. Six hundredPCBsfor trialswere produced in large quantities to triple the cleaning results (Figure 3). Each trial contains 30 components. All residues must disappear, including the contaminants under the components. No fingerprint, particlenor dust should remain, including residues of cleaning products. The components, the rosins, the underfill and the substrate should not be damaged by the cleaning operation. The partsshould be dried at the end of the washing step. The ink markings shouldbe resistantto the cleaning.
The main considerations in the cleaning procedure are:

- Waste and scrap is removed following workplace procedures
- Equipment and work area are cleaned and inspected for serviceable conditions in accordance with workplace procedures
- Serviceable equipment is tagged and faults identified in accordance with workplace procedures
- Maintenance is completed in accordance with manufacturer/component supplier specifications and site procedures
- Tooling is maintained in accordance with workplace procedures

Self-Check -8	Written Test

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

1) Cleaning is an essential process within electronics manufacture and has been used for many years to remove potentially harmful contaminants during PCB manufacture. *(3 pt each)*
   C. true
   D. false
2) The purpose of cleaning, specifically within the rapidly expanding electronics industry, is to essentially improve product lifetime by ensuring good surface resistance and by preventing current leakage leading to PCB failure. *(3 pt each)*
   A. true
   B. false
3) General Recommendations For Cleaning *(3 pt each)*.
   A. Replace computer components when:
   B. Grossly contaminated e.g. saturated with blood or body fluids or
   C. Cleaning doesn't remove visible soil, e.g., keyboards.
   D. all

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

Answer Sheet

Score = _____

Rating: _____

Name: _____ Date: _____

REFERENCES
[1] http://www.cie.co.at/index_ie.html
[2] http://www.digibarn.com/collections/printers/xerox-9700/index.html
[3] http://thelongestlistofthelongeststuffatthelongestdomainnameatlonglast.com/first362.html
[4] G. Starkweather, “Electronic Color-Printer Technologies”, Color Research and Application, vol. 11, 1986, pp. 73-74.
[5] R. Shaffert, Electrophotography, Focal Press Limited, London, 1969, pp. 1-376.
[6] C. Elzinga, T. Hallmark, R. Mattern, J. Woodward, “Laser Electrophotographic Printing Technology”, IBM Journal of Research Development, vol. 25, no. 5, September 1981, pp. 767-773.

Operation Sheet 1	Occupational Health and Safety

Techniques for Occupational Health and Safety:

Step 1- selects appropraite PPE.
Step 2- wear PPE.
Steps 3- apply safety procedures.

Operation Sheet 2	**Replacing Defective parts/components**

Techniques for **Replacing Defective parts/components**:

Step 1-wear ppe
Step 2-prepar work stations/equipments
Step3- select required tools and equipment.
Step 4- Replacing Defective parts/components..
Step 5- test.
Step 6-apply 3s

Operation Sheet 3	**Soldering/mounting Repaired or replaced parts/components**

Techniques for **Soldering/mounting Repaired or replaced parts/components**:

Step 1- wear PPE.
Step 2- prepare tools, materials and equipment’s.
Steps 3-solder/mount repaired or replaced parts/components.
Step 4- apply 5s.

Operation Sheet 4	Performing Control settings/adjustments in conformity with service-manual specifications

Techniques for **Performing Control settings/adjustments in conformity with service-manual specifications**:

Step 1- wear PPE.
Step 2- prepare, tools and equipment's depends on west type.
Steps 3- identify control settings.
Step 4- apply control settings.

Operation Sheet 5	Performing Repair activity within the required timeframe

Techniques for **Performing Repair activity within the required timeframe**:

Step 1- wear PPE.
Step 2- prepare, tools and equipment's depends on west type.
Steps 3- identify faults.
Step 4- perform repairing activities .
Step5- apply 5s

Operation Sheet 6	Observing Care and extreme precaution during handling the unit/product as per procedures

Techniques for **Observing Care and extreme precaution during handling the unit/product as per procedures**:

Step 1- wear PPE.
Step 2- prepare, tools and equipment's depends on west type.
Steps 3- handle equipments.

Operation Sheet 7	Cleaning with standard procedures

Techniques for **Cleaning with standard procedures**:

Step 1- wear PPE.
Step 2- prepare, tools and equipment's depends on west type.

Steps 3- sort /identify wastes.
Step 4- do clean activities.

LAP Test	Performing Control settings/adjustments in conformity with service-manual specifications

Name: _____ Date: _____
Time started: _____ Time finished: _____

Instructions: Given necessary templates, tools and materials you are required to perform the following tasks within 3:30 hour.

Task 1. Occupational Health and Safety's
Task 2. Electro-static discharge (ESD) protection procedure
Task 3. Replacing Defective parts/components
Task 4.Soldering/mounting Repaired or replaced parts/components
Task 5. Performing Control settings/adjustments in conformity with service-manual specifications
Task 6. Performing Repair activity within the required timeframe
Task 7. Observing Care and extreme precaution during handling the unit/product as per procedures
Task 8. Cleaning with standard procedures

Home/Office Electrical/Electronic Equipment Servicing

Level-II

Learning Guide-27

Unit of Competence: Maintaining and Repairing Electronically-Controlled Office Equipment
Module Title: Maintaining and Repairing Electronically-Controlled Office Equipment
LG Code: EEL HOS2 M07 1019 LO4-LG-27
TTLM Code: EEL HOS2 M07 1019 TTLM 1019v1

LO 4: Test repaired unit

Instruction Sheet	Learning Guide #27

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

- Reassembling Repaired units
- Final testing and cleaning
- Completing procedures and documentations
- Disposing Waste materials

Advising/Informing CustomersThis guide will also assist you to attain the learning outcome stated in the cover page. Specifically, **upon completion of this Learning Guide, you will be able to**:

- Reassemble Repaired units
- Teste and clean
- Complete procedures and documentations
- Dispose Waste materials

Learning Instructions:

13. Read the specific objectives of this Learning Guide.
14. Follow the instructions described below to __.
15. Read the information written in the information “Sheet 1, Sheet 2, Sheet 3 and Sheet 4”.
16. Accomplish the “Self-check 1, Self-check t 2, Self-check 3 and Self-check 4” **in page -, , and** respectively.
17. If you earned a satisfactory evaluation from the “Self-check” proceed to “Operation Sheet 1, Operation Sheet 2 and Operation Sheet 3 ” **in page -.**
18. Do the “LAP test” **in page –** (if you are ready).

Information Sheet-1	Reassembling Repaired units

1.1. REASSEMBLE AND TEST REPAIRED UNITS

Perform final test for reassembled units in conformity with manufacturer's specifications.

Reassembling Procedure:

- After replacing the defective part of the appliance, prepare the parts for reassembling. Make sure that there are no missing parts or component and as well as the screws.
- Review the operating and service manual if available.
- Fix all the disassembled parts in the housing/compartment, considering the fittings, lock etc.
- Wires should be in their proper places and loose parts should be tightened to avoid damaged due to misalignment.
- All sides of the housing should fit. See to it that Selector Switch is moving appropriately and the rest of the movable parts.
- Clean the unit before doing the testing procedure.

1.2. REASSEMBLING AND TESTING REPAIRED

Provided with the resources, follow the procedures in reassembling and testing repaired the units depend on the above procedures.

PERFORMANCE CHECK

Rate yourself on how competent you have applied the skill in pre-testing and diagnosing office equipments.

Criteria	%	Points					Rating
		5	4	3	2	1	
Workmanship	50						
Use of Tools	30						
Use of Personal Protective Equipment	10						
SPEED	5						
House Keeping	5						
					TOTAL		

Self-Check -1	Written Test

PART I CHOOSE THE BEST ANSWER

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

1, A reassemble unit is the process of assembling each parts of the appliance. *(3 pt each)*

A, true B, false

PART II WRITE THE CORRECT ANSWER

2, write reassembling Procedure of a domestic equipments *(9 pt each)*

Note: Satisfactory rating 6 and above points Unsatisfactory below 6 points

Answer Sheet

Score = _____

Rating: _____

Name: _____ Date: _____

Information Sheet-2	Testing and cleaning

2.1 Introduction Cleaning

Cleaning is an essential process within electronics manufacture and has been used for many years to remove potentially harmful contaminants during PCB manufacture. Such contaminants include flux, solder and adhesive residues, and other more general contaminants such as dust and debris present from other manufacturing processes.

Cleaning PCBs has been a vast topic formany years, particularly sosince the ban of CFCs and HCFCs.These products offered solvency power, low surface tension properties to dissolve, remove and dry within minutesany parts of any de-sign. The electronic industry has grown so rapidly since the 80s, that today,nearly 50% of any individual'sbelongings are composed of electronics: e.g.: Mobile phones,remote controls, TVs, radios, cars, IPods, computers, HiFi, hard discs, memory sticks, cameras, videos, refrigerators, dish and laundry washers, cars, planes , satellites, implants, etc…

Since the 90s, the electronic evolution has been exponential, andthe miniaturization has advancedproportionally. The introduction of such new smallparts not only raised some designproblems, but also some practicalaspects such ashan-dling andsomereliability problems. In meantime, the suppliers of solder fluxes and pastes had to adjust new formula-tions for the new markets, the new demands and the newregulations.

Accordingly, the electronic suppliers adapted their production to the customers' demands with cleanable andno clean fluxes, also called consumable devices. The non consumable devices such asmedical implants, military tools, satellites, safety parts for cars, trains, medical equipments and many otherproducts, should be reliableand thus cleaned. To achieve a good cleaning result, it is worth understanding the various parameters present and the physical laws which are ruling this chemical operation.

Χλεανινγ ηασ α χοστ ανδ ιτ σηουλδ βε αδαπτεδ το τηε νεεδσ ωηιλε μαινταινινγσταβιλιτψ ιν τιμε, εφφιχιενχψ, θυαλιτψ ανδ περ–φορμανχε.

1) Miniaturization

Today, miniaturization is a hundred times greater than during the 80's.This reduction in size means reduction of solder pads and alsoamount offlux residues. But it also means a reduction of space between legs and board/components. Today,size of components aredown to 0,1mm.In addition, the components became of high capacity with resistors, diodes,quartz, selfs, BGA and others. The reliabilityof these componentsshould be always increased. This

miniaturization should not become a reason of instability and unreliability. The cleanliness should be performed and pass the norms.

2) Contaminants

The contaminants on a circuit board are mainly composed of: organics such asnatural and/or syntheticrosins,ions, acids, solder balls, fingerprints, and particulates of PCBs. The lead-free alloys need higher soldering temperatures than thestandard Sn/Pb which are carrying significant evolutions on the fluxes to be used. These fluxes are most of the time more active and must resist to higherreflow profiles. They present more risks than the one formerly used,and the temptation is high to choose production parameters allowing shining soldering pads. The ionic cleaning of thePCBs is then more criti-calbefore tropicalisation, but will also help to control the assembling process and help to establish final assemblylife-time. Theionic contamination is a goodquality indicatorfor the long termreliability.Please see next Figure

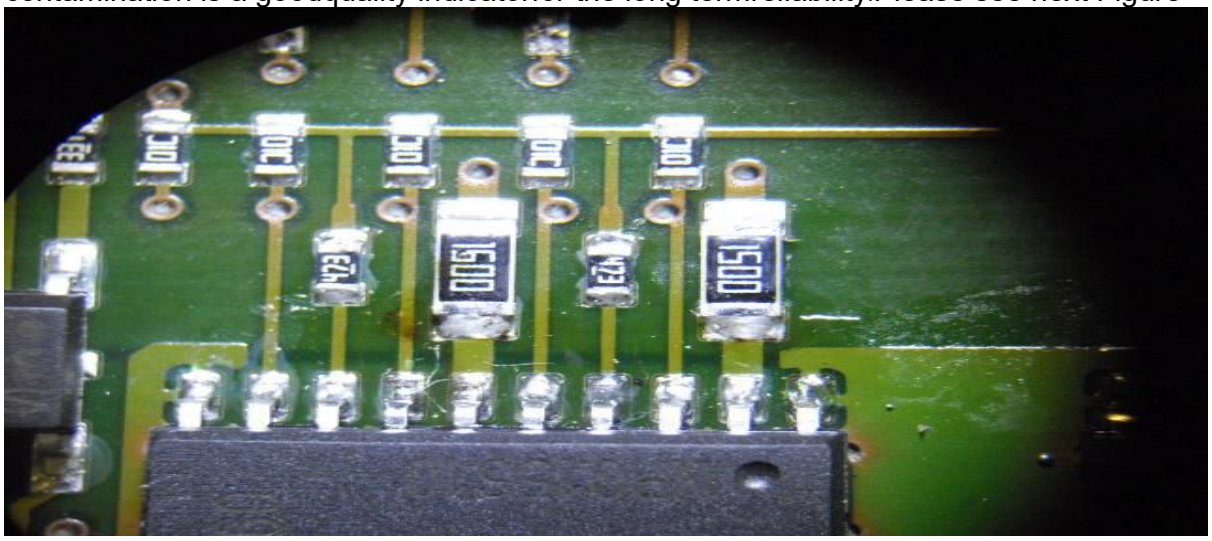


Figure 2.1

3) Specifications set up

Every end-user has his own typical specifications which are depending on his own or his customers. For this study,the specifications have been taken as described in Table 1. Six hundred PCBsfor trials were produced in large quantities to triple the cleaning results (Figure 2). Each trial contains 30 components. All residues must disappear, including the contaminants under the components. No fingerprint, particlenor dust should remain, including residues of cleaning products. The components, the rosins, the underfill and the substrate should not be damaged by the cleaning operation. The partsshould be dried at the end of the washing step. The ink markings shouldbe resistant to the cleaning.

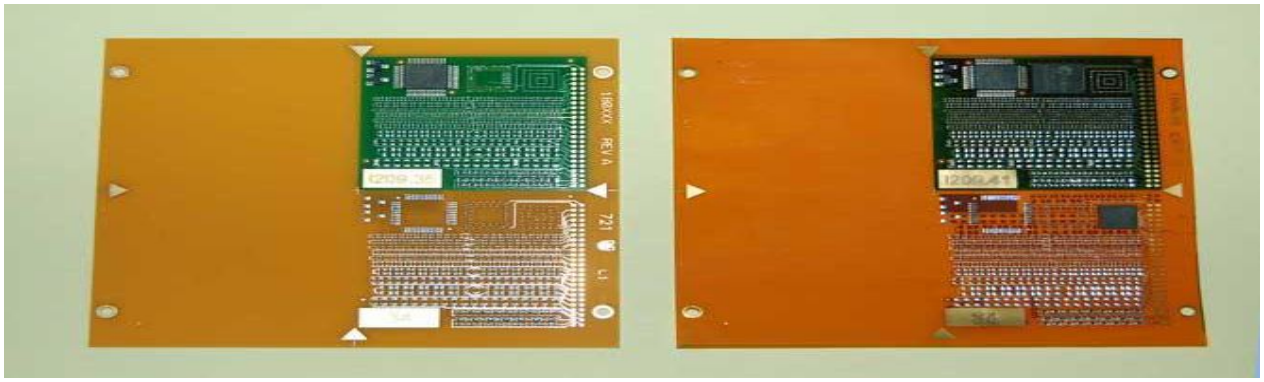


Figure 2.2

4) Cleaning products available

The most important part of the job is to remember whichchemical families are available in the market.The cleaning products available can be classifiedin five different families: The detergents, the light petroleum distillates, Formulated hydrocarbons, Brominated solvents, glycols and fluorinated solvents.

a) The detergents

Detergents A are good most of the time, butvery specific to the type of fluxes to be removed. Itsconcentration is very important in water and can vary between 3 to 50 %wt in some cases. The temperature can vary from 20-60°C, and the agi-tation used, sprays, spray under immersion or ultrasonic'sshould be considered.It is the aqueous cleaning process.The drawbacksof these detergents are:the removal of all residues under components because of the poor/high surface tensionincluded between 40-50mN/m, the aggressionof these formulations and its compatibility with materials, the rinsing with tap or DI water (high surface tension70-80mN/m), the drying operation, the water-proof compatibility and the disposal of soiled mixture. (Figure 5). The total cost of these should also be considered.

b) The petroleum distillates

The petroleum distillatesB, such as alcohols and ketones are mainly used for the cold cleaning operation, even though used they can be found used at warm temperatures. There should be no needto mention that these products are very flammable at room temperatures and used under warm conditions are very risky. Costsare acceptable, but disposal and annual cost can be significant.

c) Formulated hydrocarbons

Formulated hydrocarbonsChave been developed mainly after the CFCs and HCFCs storyand when perfectly formulated, easily outperform any other cleaner. They are able to remove flux residues, solid residues and salts under any type of components because of their very low surface tension (approx. 20mN/m). They must be rinsed with a rinsingproduct which can be water or solvent(fluorinated base F). The water rinse system is the semi-aqueous process and the solvent based system is a co-solvent process.With the aqueous process,the same detergents' drawbacks are found,where as, withthe co-solvent process, the PCBs are very nicely rinsed and dried with the vapour phase. The rinsing solvent can be recy-cled by distillation and the formulated hydrocarbon is disposed easily. The lifetime of the formulated hydrocarbons is very extensive and the total costs are the lowest of all type of

cleaning systems. The surface tension of bothC and F are outstanding to reach specifications. It is one of the most user-andenvironmental-friendly process.

Main Cleaning Processes

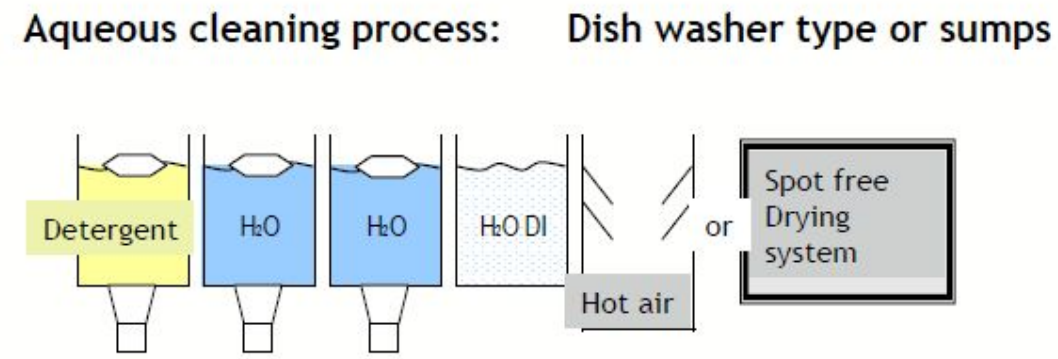


Figure 2.3

Miniaturization has a direct impact on cleanability

• No clean fluxes and Lead-free trends impact cleanliness

• The Surface tension parameter should be understood with respect to design

• A Cleaning process and a mechanical agitation should be chosen

• The ultrasonics effects on Quartz were evaluated, and no damage has been observed so far.

• The separated co-solvent used with HFE azeotrop shows the best cleaning result vs many others.

• Jets under immersion with Co-solvent/HFEs provide excellent results

• High optical quality and ionic contamination were achieved

2.2 pruposes of cleaninig

The purpose of cleaning, specifically within the rapidly expanding electronics industry, is to essentially improve product lifetime by ensuring good surface resistance and by preventing current leakage leading to PCB failure. This developing market sees modern and future electronics becoming smaller and smaller and the requirement for high performance and reliability is stronger than ever. In order to achieve good insulation resistance and ensure adequate adhesion of conformal coatings and encapsulation resins, the cleanliness of the electronic assemblies is essential.

There are many stages where cleaning is required; prior to stencilling and soldering in order to remove contaminants from the many previous production stages, after stencilling to remove excess solder paste/adhesive and after soldering to remove corrosive flux residues and any solder balls.

In industry today, many manufacturers are turning to ‘no clean’ processes, implying that cleaning is not required after soldering. In the ‘no clean’ process the solids content of the flux is lower than traditional types, however they still contain rosin and activator. Such residues, along with any other unwanted elements collected due to the missing cleaning stage, could cause issues with adhesion and possibly affect the performance of the protecting media applied, ie. Encapsulation Resins or Conformal Coating. It can therefore be stated that even

with advances in new technologies, such as 'no clean' fluxes, cleaning is still an essential multi-stage process within the electronics industry.

Finally, there are also cleaning stages required for the removal of coatings and adhesives when re-work is necessary, for the cleaning of individual components and for maintenance of the production line.

ΓΕΝΕΡΑΛ ΡΕΧΟΜΜΕΝΔΑΤΙΟΝΣ ΦΟΡ ΧΛΕΑΝΙΝΓ

2.1 Ελεχτρονιχ δεωιχεσ ιν βοτη χλινιχαλ ανδ νον–χλινιχαλ αρεασ βεχομε χονταμινατεδ ωι τη μιχροοργανισμσ, ωηιχη αρε τρανσμιττεδ ωια χονταμινατεδ ηανδσ. Φολλοω τηε γυιδανχε ιν Ταβλε 1 φορ χλεανινγ ανδ δισινφεχτινγ ελεχτρονιχ δεωιχεσ.

2.2 Υνλεσσ τηερε ισ α προτεχτιωε, ωασηαβλε χοωερ φορ τηε ελεχτρονιχ μοβιλε δεωιχε ιτ ση ουλδ νοτ χομε ιντο χονταχτ ωιτη τηε πατιεντ ενωιρονμεντ.

2.3 Ρεπλαχε χομπυτερ χομπονεντσ ωηεν:

2.3.1 Γροσσλψ χονταμινατεδ ε.γ. σατυρατεδ ωιτη βλοοδ ορ βοδψ φλυιδσ ορ

2.3.2 Χλεανινγ δοεσν□τ ρεμοωε ωισιβλε σοιλ, ε.γ., κεψβοαρδσ.

Equipment	Minimum frequency	Product
Mobile electronic devices taken into the patient's room, but not directly into the patient environment, for activities, such as charting in an electronic health record, order entry, or data collection, e.g., computer or workstation on wheels, tablets, wireless laptops	Before use on the next patient; and when visibly soiled	Follow manufacturer's instructions for use for specific recommendations. • Use a disposable soft, non-abrasive, lint-free damp cloth or wipe, pre-moistened with a ready to use (RTU) AHS provided cleaner/**disinfectant**. • Squeeze out excess liquid before use. • Never spray products directly onto electronic devices Examples of disinfectants that may be indicated in the manufacturer's instructions for use: • Alcohol swabs and wipes (often used for phones, mouse, pagers) • Combination products such as alcohol/quaternary ammonium e.g. CaviWipes® • Hydrogen peroxide products such as accelerated hydrogen peroxide (AHP) products e.g. Virox RTU®, Accel®, Oxivir®, Percept Wipe® Example a of product not usually recommended: • Sodium hypochlorite (bleach) such as Clorox® Do not use compressed air to clean electronic devices, e.g., keyboards
Mobile electronic devices taken into the patient's room and used directly in the patient environment, e.g., pager, smart phone, cell phone, or personal digital assistant	Before contact with a patient or patient's environment; after contact with a patient or patient's environment; and when visibly soiled	
Telehealth equipment in all clinical areas	Before use on the next patient; when equipment leaves the patient environment; and when visibly soiled	
Fixed electronic devices including key boards used in the patient environment, e.g., wall-mounted computers	Daily; when visibly soiled; and at discharge	
Electronic devices including keyboards used near the patient environment, e.g., computers in the hallway and outside the patient's room	Daily, and when visibly soiled	
All other fixed electronic devices located in clinical areas, e.g., nursing station.	Daily, and when visibly soiled	

Equipment	Minimum frequency	Product
Electronic devices in public areas for patient use.	Daily, and when visibly soiled	
Desk phones	Daily	• Use alcohol swabs or wipes. • Other cleaning wipes such as CaviWipes®, Lysol®, and Green Works® may leave a residue which can compromise the keys and affect the internal electronics.

Table2. 1: Cleaning and Disinfection of Electronic Devices.

2.1 Post-testing Procedure:

1. Test the resistance at the AC plug to determine the continuity of the power line to the AC unit . A resistance reading must be observed as you turn the switch to ON position. This indicates that the circuit connection is good.
2. In the case of electronically-controlled domestic equipment, there is no resistance reading as you test the AC plug. The reason is that there is a low-voltage power supply circuit that controls the functions of the appliance.
3. Energize the unit to check its functionality. Plug the AC cord to the power source (the switch is at OFF position and power ON button for electronically-controlled must be OFF too). Turn the switch accordingly and observe if the unit functions as it should be. In the case of electronically-controlled, press button one at a time observing the behavior. This time, the unit should operate normally. If not, review the documentation and the problem for the second time.

2.2 Testing Procedure:

1. Test the resistance at the AC plug to determine the continuity of the power line to the AC unit. A resistance reading must be observed as you expect in normal.
2. Energize the unit to check its functionality. Press button one at a time observing the behavior. This time, the unit should operate normally. If not, review the documentation and the problem for the second time.

Following are definitions of three categories of test that shall apply:

1 Operational Test

- That procedure required to ascertain only that a system or unit is operable. These tests should require no special equipment or facilities other than that installed on the aircraft and should be comparable to the tests performed by the flight crews.
- It is not intended that the operational test of the unit shall meet the specifications and tolerances ordinarily established for overhaul, or major maintenance periods.

2 Functional Tests

- That procedure required to ascertain that a system or unit is functioning in all aspects in accordance with minimum acceptable system or unit design specifications. These tests may require supplemental ground support equipment and should be more specific and detailed than an operational test. It should contain all necessary information to perform proficiency tests to maintain system or unit reliability at an acceptable level, without reference to additional documents.

3. System Test

- That procedure containing all adjustment specifications and tolerances required to maintain system and/or unit performance at maximum efficiency and design specifications. It shall be self-contained and may duplicate other tests. It is normally used at major maintenance periods.

Self-Check -2	Written Test

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

PART I <u>CHOOSE THE BEST ANSWER</u>

1. Functional Tests procedure required to ascertain that a system or unit is functioning in all aspects in accordance with minimum acceptable system or unit design specifications.(3 pt each)
2. A pre testing unit is the process of testing after assembling of each parts of the appliance. *(3 pt each)*

PART II <u>WRITE THE CORRECT ANSWER</u>

1. write the post testing procedures of a domestic equipments *(6 pt each)*

Note: Satisfactory rating 8 pts and above points Unsatisfactory below 8 points

Answer Sheet

Score = _____

Rating: _____

Name: _____ Date: _____

Information Sheet-3	Completing procedures and documentations

Documentation

Service Based on manual

Record all information during maintaining/repairing electronically-controlled domestic appliance**.** This recorded Service information may include but not limited to:

- job report sheets
- job order
- bill of materials
- customer index
- service flowchart
- stock and inventory record
- requisition slips (for acquisition of parts)supplier index
- Apply **5S** - Sort, Set inorder, Shine, Standardize, and Sustain for service compilation.

The Organisational Unit is to keep testing and inspection records which are to be stored on a shared system drive.

Record to be kept by:	Organisational Unit, Academic Unit
Records	Records of inspection and testing of electrical equipment, including: • register of all electrical equipment • record of formal inspection and tests • repair register and • record of all faulty equipment showing details of services or corrective actions.
To be kept for:	Records should be kept in alignment with the Records Management Policy and Guidelines

The Organisational Unit is to keep testing and inspection records which are to be stored on a shared system drive.

- 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.
- Maintenance recommendations contained in this volume should be used as the basis for establishing or refining a maintenance schedule. Recommendations can be converted into Job Plans or Work Orders in MAXIMO or another maintenance management system. Once these job plans and work orders are established,implementation of well-executed maintenance is possible.
- 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 Power O&M Reviews (section 1.7).

- 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.

Self-Check -3	Written Test

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

1, Record all information during maintaining/repairing electronically-controlled domestic appliance*(4 pt each)*A, true B, false

2, write the recorded Service information may include *(10 pt each)*

Note:Satisfactory rating 7 and above points Unsatisfactory below 7 points

Answer Sheet

Score = _____

Rating: _____

Name: _____ Date: _____

Information Sheet-4	Dispose Waste materials

WASTE MANGEMENT

4.1. Materials Management Overview

How society uses materials fundamentally affects our economic and environmental future. Inefficient and wasteful use of materials now challenges the capacity of the Earth – air, water and land. We can fulfill our needs and prosper while using less material, reducing toxics, and recovering more of the material we consume. By acting less wastefully and considering systemwide
impacts in the design, marketing, reuse, recycling, and disposal of products, life-cycle materials assessment represents an important change in how we think about waste and chemicals management. Actions are being taken by EPA to:

(1) manage materials and products on a life-cycle basis;
(2) build the nation's capacity to manage materials, and
(3) accelerate the public dialogue necessary to create a green, resilient, competitive, and sustainable economy in the future.

1.a Environmental protection agency (EPA) Materials Management Responsibilities

EPA's Strategic Plan http://www.epa.gov/finance/plan/plan.htm identifies priority approaches to protect the land, including reducing waste at its source, recycling waste for materials or energy values, managing waste effectively by preventing spills and releases of toxic materials,
and cleaning up contaminated properties. EPA's waste management office, the Office of Resource Conservation and Recovery, http://www.epa.gov/epawaste/index.htm is primarily responsible for overseeing implementation of certain provisions of the nation's Resource Conservation and Recovery Act (RCRA). RCRA's central goals are to:

- Protection from the hazards of waste disposal
- Reduce or eliminate waste
- Conserve energy and natural resources by recycling and recovery
- Reduce or eliminate waste
- Clean up waste, which may have spilled, leaked, or been improperly disposed.

EPA works in close partnership with the States, Tribes, industry, environmental groups, and the
public to achieve these goals. Hazardous waste http://www.epa.gov/epawaste/basichazard.htm regulated under RCRA is waste with properties that make it dangerous or potentially harmful to human health or the environment, if mismanaged. Non-hazardous waste may include household garbage, industrial waste, and commercial waste. Under RCRA, much of the responsibility for regulating these wastes is delegated to the States.

Green remediation embraces the idea that all aspects of environmental protection should be considered when cleaning up contaminated properties. Using green remediation principles, EPA is taking actions to encourage the sustainable reuse of these properties. In addition to clean up, these actions can result in lower energy demand, reduced greenhouse gas emissions, less water use, and other health and environmental benefits that contribute to economic and environmental sustainability.

2. Domestically-Focused Agencies and Programs

EPA largely has focused on developing hazardous and municipal solid waste programs in the
United States and fostering a strong societal commitment to recycling and pollution prevention.
Since the enactment of RCRA, EPA has built a comprehensive cradle-to-grave regulatory program for hazardous waste management; set national baseline standards for municipal solid
waste landfills; identified priority pollutants on which to focus hazardous waste reduction efforts; worked in successful partnerships to reduce waste, promote recycling, and build markets for recycled-content products; and provided education and technical assistance to further in these efforts. While safe waste management and cleanup remain a critical foundation necessary to protect human health and the environment, EPA increasingly is emphasizing the importance of work in resource conservation, sustainability, and safe materials management.

2.a Reducing Environmental Impacts of Products

Product stewardship calls on all parties in the product life cycle - material feedstock suppliers, manufacturers, retailers, and consumers—to share responsibility for reducing the environmental impacts of products. Beginning with design, products can be made and used in ways that conserve materials and foster reuse to save energy, reduce waste, preserve resources, and protect the environment. Life cycle assessment (LCA) is an important technique used to help achieve this goal. LCA allows users to make more informed decisions through a better understanding of the human health and environmental impacts of products, processes, and activities. EPA has created the WAste Reduction Model to help solid waste planners and organizations calculate, track, and voluntarily report reductions in these emissions from alternative materials management practices such as source reduction (e.g., using less packaging material, recycling, and composting that reduce waste quantities and toxicity. EPA created the Recycled Content (ReCon) tool to help companies and individuals estimate life-cycle greenhouse gas (GHG) emissions and energy impacts from purchasing and/or manufacturing material with varying degrees of post-consumer recycled content.

2.a.a Product Design and Development

Pollution prevention http://www.epa.gov/p2/pubs/p2policy/framework.htm means changing the culture from one that tolerates pollution to a sustainable approach that increasingly eliminates pollution at the source and prevents the creation of waste in the first place. Important opportunities for applying pollution prevention principles exist in product design and development:

• Process Improvement and Waste Minimization. Design for the Environment is an EPA program that promotes cleaner technologies and safer chemical alternatives by assisting manufacturers to select safer chemicals in processes and product design. The Green Suppliers Network works with large manufacturers to engage their small and medium-sized suppliers in low-cost technical reviews that focus on process improvement and waste minimization through lean manufacturing techniques. The Suppliers Partnership for the Environment provides a forum in which automotive and vehicle suppliers can share environmental best practices and common-sense approaches that benefit smaller companies in the industry through increased energy efficiency, waste elimination, and technology optimization.

• **Energy Star**. The Energy Star Program uses energy-efficiency-labeling and tax credits to conserve energy and reduces waste by promoting the use of energy-efficient products and practices. Products in more than sixty categories are eligible for the Energy Star.

• **Green Building** Green, or sustainable, building is the practice of creating structures and using processes that are environmentally responsible and resource-efficient throughout a building's life cycle - from siting to design, construction, operation, maintenance, renovation, and deconstruction. The use of green building approaches is important to EPA's Brownfields Program, which supports the sustainable reuse of properties complicated by the presence or potential presence of hazardous substances, pollutants, or contaminants.

2.a.b Product Marketing and Sales

EPA encourages the marketing and sale of products that reduce waste and are better for the environment:

• The Comprehensive Procurement Guideline (CPG) Program

The CPG Program is part of EPA's continuing effort to promote the use of recovered materials. Buying recycledcontent products ensures that the materials collected in municipal recycling programs will be used again in the manufacture of new products. Under RCRA and Executive

Order 13101, EPA is required to designate products that are or can be made with recovered materials, and to recommend practices for buying these products. Once a product is designated, procuring agencies are required to purchase it with the highest recovered material content level practicable.

• Environmentally-Preferable Purchasing (EPP).

EPP resources for electronics , for example, encourage federal government facilities and agencies to purchase greener electronic products, reduce their environmental impacts during use, and manage obsolete electronics in an environmentally safe way. The Federal Electronics Challenge is a government partnership program to support these goals.

□□Recycling Markets Development. Materials and waste exchanges are markets for buying and selling reusable and recyclable commodities. EPA provides resources, including information on international and national markets for buying and selling reusable and recyclable commodities in order to support the development of markets for recycled products.

2.b Reducing Chemical Risks

Priority and toxic chemicals reduction is an important objective of the RCC. To achieve this goal, EPA promotes the use of advanced production and management tools, including green chemistry

Examples of EPA programs that focus on the reduction of wastes from chemicals of concern include:

• Reducing Priority Chemicals. Misuse of products containing toxic metals such as mercury, cadmium, and lead is a serious concern. Through the National Partnership for Environmental Priorities (NPEP), EPA partners with industry, business, municipalities, federal facilities, and Tribes to reduce the use of potentially hazardous chemicals in products and processes through improved chemicals management. The National Lead Free Wheel Weight Initiative for example, is a broad public-private NPEP partnership that encourages a transition from the use of lead for wheel weights to lead-free alternatives. EPA also encourages consumers and businesses to use non-mercury alternatives to mercury-containing products and to recycle mercury-containing products when possible. Some batteries contain mercury and cadmium, and electronic products may contain these toxic constituents.

2.c Reuse and Recycling

EPA promotes the many benefits, including resource conservation and cost savings, of reuse and
recycling, which converts materials that otherwise would be considered waste into valuable resources. WasteWise for example, is an EPA partnership program that seeks to reduce and recycle municipal sold waste and selected industrial waste streams. Working with businesses, schools, hospitals, local communities, and government agencies, WasteWise saves energy and prevents the release of greenhouse gases.

2.c.a Municipal Materials Management

EPA has established an action plan to achieve a National Recycling Rate of 35% for municipal
solid waste including household and office waste. The action plan lays out a framework or road map and targets actions for particular waste streams (e.g., paper and paperboard, organic waste, and packaging/containers) to achieve this goal. EPA initiatives to foster the recycling of household and office materials include:

• Organic Materials

Many opportunities exist to reduce, reuse, and recycle organic materials. Excess food can be donated to feed hungry people. Greenscapes

GreenScapes' on-line calculators promote sustainable landscaping decisions by allowing readers to compare costs between environmentally-preferable methods and the use of virgin materials.

Through composting yard trimmings, food waste, and wood waste can prevent soil erosion and provide valuable nutrients.

• Electronics EPA is working to educate consumers and others about the importance of reusing and recycling electronics. Plug in to Ecycling is a partnership program between EPA and leading consumer electronics manufacturers, retailers, and mobile service providers of televisions and computers to foster and promote shared responsibility for safe recycling of electronics,. Responsible Recycling (R2) Practices are a set of guidelines for accredited certification programs to assess electronics recyclers' environmental, worker health and safety, and security practices.

• Mercury-Containing Lamps

EPA is working with manufacturers and major U.S. retailers to develop, implement and expand
recycling options for all mercury-containing light bulbs, including compact fluorescent light bulbs.

2.c.b Industrial and Building Materials Management

Nearly every industrial process, from manufacturing consumer goods to generating energy, produces different types of usable materials. Hundreds of millions of tons of nonhazardous industrial materials are often wasted. Industrial materials recycling also referred to as beneficial use, involves reusing or recycling byproduct materials generated from industrial processes. These materials can be used as substitutions for raw materials in the manufacture of consumer
products, roads, bridges, buildings, and other construction projects. Similarly, construction and
demolition (C&D) materials recycling involves the use of heavy materials, such as concrete, wood, metals, glass, and salvaged building components debris generated during the construction, renovation, and demolition of buildings, roads, and bridges. EPA initiatives to promote the reuse and recycling of industrial and building materials include:

2.c.c Hazardous Materials Management

EPA has established hazardous waste recycling regulations to promote the reuse and reclamation of useful materials in a manner that is safe and protective of human health and the
environment. Hazardous waste recycling opportunities includes used oil, precious metals, and
scrap metal. Appropriate reuse and recycling of hazardous household products also can save money and reduce the need for generating hazardous substances.

3. Internationally-Focused Agencies and Programs

Relevant EPA international responsibilities include agreements, regulations, and initiatives

4.3.a Transboundary Movement of Hazardous Waste

4.3.a.a U.S. Import/Export Requirements

The United State is a party to various international agreements which provide for prior notification of shipment of wastes (i.e., both importing and exporting of waste). EPA processes
notifications documenting individual shipment of waste and receives annual export reports for the regulated community. Importers and exporters of hazardous wastes must comply with applicable US domestic laws and regulations, which include regulations under the Resource Conservation and Recovery Act (RCRA). The Import-Export Program (IEP) in EPA's Office of Enforcement and Compliance Assurance is responsible for overseeing international trade in hazardous waste involving the United States.

3.a.b International Agreements

The United States is party to agreements with Canada, Mexico, Costa Rica, Malaysia, the Philippines, and the OECD concerning the transboundary movement of waste. In addition, the
U.S. is a signatory to the Basel Convention on the Control of Transboundary Movements of Hazardous Wastes and their Disposal.

• Canada. The original 1986 agreement between Canada and the U.S. on the transboundary shipment of hazardous waste between the two countries seeks to provide the U.S. and Canada with safe, low cost options for managing waste for which there is a lack either of domestic capacity or the technology to manage this waste appropriately. This agreement was amended in 1992

• Mexico. A 1986 agreement between Mexico and the U.S. controls the transboundary shipment of hazardous wastes between the two countries.

• OECD. A 2001 OECD Decision on the control of transboundary movements of hazardous wastes destined for recovery operations establishes hazardous waste shipment requirements between OECD countries, including the U.S.

• Basel Convention on the Control of Transboundary Hazardous Wastes and their Disposal. The Basel Convention regulates the import and export of hazardous waste among party nations and establishes legal obligations to ensure that such wastes are managed in an environmentally-sound manner. As a non-party to the Convention, the U.S. participates in Convention meetings and initiatives, including the Basel Mobile Phone Partnership Initiative (MPPI). MPPI was established as a sustainable partnership on the environmentally-sound management of used and end-of-life mobile telephones.

• Costa Rica, Malaysia, and the Philippines. The Agreement Between the Government of America and the Government of Malaysia Concerning the Transboundary Movement of Hazardous Wastes from Malaysia to the United States (1995), the Agreement on the Transboundary Movement of Hazardous Waste from Costa Rica to the United States (1997), and the Agreement Between the Government of the United States of America and the

Government of the Republic of the Philippines Concerning the Transboundary. Movement of Hazardous Wastes from the Philippines to the United States (2001) are bilateral agreements that govern the export of hazardous wastes from these countries into the U.S. .

3.b International Initiatives.

EPA international work involves the OECD, Border Plan 2012, the Commission for Environmental Cooperation (CEC), and methane capture:

• OECD. The U.S. actively participates in and supports the OECD Working Group on Waste Prevention and Recycling (WGWPR), whose work includes: Sustainable Materials Management (SMM); Environmentally Sound management of Waste (ESM) Transboundary Movements of Waste and Waste Prevention and Minimisation .

Methane Capture The Methane to Markets Partnership is an international initiative that advances cost-effective, near-term methane gas recovery and use as a clean energy source. The goal of the Partnership is to reduce global methane emissions in order to enhance economic growth, strengthen energy security, improve air quality, improve industrial safety, and reduce emissions of greenhouse gases. EPA is involved in a number of international activities to better understand and quantify global methane emissions, assess the costs and benefits of emission reduction options, and facilitate costeffective emission reduction opportunities.

All printing operations produce wastewater. It is illegal to discharge hazardous waste water into the sanitary sewer or storm drain. Industrial waste may be discharged provided all pretreatment standards are met.

The primary focus of this pamphlet is on printing facilities and their best management practices.

Many printing facilities also conduct photoprocessing. However, photoprocessing practices are addressed in another pamphlet. For a pamphlet on the Best Management Practices for Photoprocessing Facilities, please contact the Santa Cruz County Sanitation District at (831) 477-3907.

This pamphlet does not cover regulatory requirements concerning air emissions. For questions regarding Air Emissions, contact the Monterey Bay Unified Air Pollution Control District (MBUAPCD) at (831) 647-9411.

Floor Drains and Floor Cleaning

Discharge of any wastewater other than storm water directly or indirectly to a storm drain, a creek, an underground percolation sump, or other water body is strictly prohibited.

All indoor floor drains and/or sumps that are connected to the storm drain system must be permanently plugged.

Floor drains in work areas are prohibited.
Utilize dry clean-up methods wherever possible.
Clean up spills by using a shop vacuum, sweeping, and/or by using rags or dry absorbents. Oil spills may be cleaned up using a hydrophobic mop. Remove all unnecessary hoses to discourage employees from washing down floors and outdoor paved areas. Once the dry clean up is complete, floor and paved areas may be mopped.
Take the following steps while mopping floors:

- Clean up spills with rags or dry absorbent, or hydrophobic mops for oil.
- Sweep the floor. Collect all solid debris from the floor and dispose of properly. Mop the floor using a bucket of non-corrosive cleaner and water diluted as specified on the label.
- If possible, only spot mop the area that requires cleaning.
- Discharge the mop water to the sanitary sewer via a sink or toilet.

Training
Make sure that all employees understand and follow Best Management Practices. Mistakes and misunderstandings can lead to violations and costly cleanups!
The following page can be used as a training log. Ensure that all employees are trained on Best
Management Practices upon hiring and annually thereafter. Log the training. See the following for an example log.
Use the following as training and education tools:

- This Best Management Practice pamphlet.
- Your written Spill Response Plan.
- Drills on emergency spill cleanup.

Post and/or label the following:

- Post multiple copies of this pamphlet throughout your facility.
- Emergency telephone numbers to your local Fire Department and the City e.g adiss ababa 931
- Post signs above all sinks prohibiting the discharge of solvents and wastes.
- Label all drains and pipes within your facility indicating whether they flow to a treatment system, directly to the sanitary sewer, or to the storm drain.

- Stencil or post signs near all storm drains on your property with a message- “No Dumping-Flows to Ocean.”

How do you know you’re complying? Use the Green Press Inspection Checklist at the end of this pamphlet. Enlist a different employee to perform this inspection every month so that they familiarize themselves with the Best Management Practices and solidify their training.

Hazardous Materials Storage

No hazardous materials or waste may be discharged to the sanitary sewer or storm drain!

Keep a record of disposal of hazardous wastes to their final resting place. You are liable for these wastes after they leave your facility.

Typical hazardous wastes generated by printers include the following:

- Press/screen cleaning solution
- Waste inks
- Untreated fixer
- Coatings or adhesives
- Parts cleaning solvents
- Waste oil

All hazardous materials and waste must be secondarily contained, or placed in a bin that can contain up to 110% of the entire contents of the containers should there be a leak.

Keep these items stored indoors or in a covered area outdoors.

Do not store these items near a sanitary sewer drain or near a storm drain. If these items are stored near a drain, a spill has the potential to travel off of your property, making cleanup more costly and exposing poor business practices to the public.

Check all containers on a regular basis for potential holes and leaks.

Leaks on steel drums can appear as rusted out spots or indentations initially. If a leak is discovered, place drip pans or absorbent material under the leak and then attempt to repair the leak immediately. Keep lids, bungs, and tops secured on waste barrels and containers at all times, except when adding waste to containers or dispensing product.

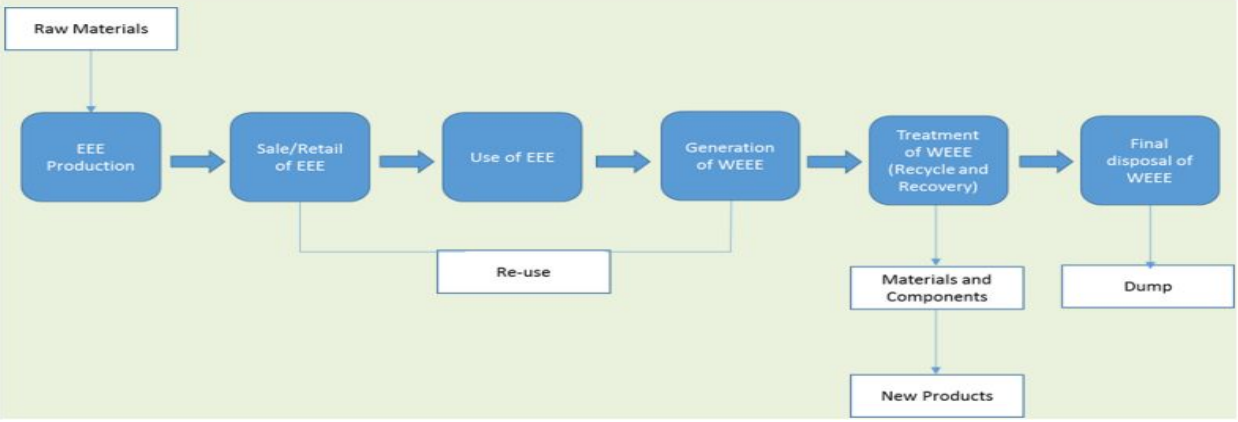
In areas where hazardous materials are stored, make sure there are adequate spill cleanup materials (see the section on Spill Prevention, Control, and Response). Hazardous waste containers must be labeled and stored according to hazardous waste regulations. Only store hazardous waste in your shop for as long as necessary and use only reputable, licensed waste management facilities.

RECYCLING INSTRUCTIONS:

• All mail points have been supplied with two bags for the collection of used toner cartridges.
• When a bag is sufficiently full it should be returned in / with the mail bag and you should start using the second bag provided.
• When the first bag is received back at the mail room a replacement bag and cable tie will be sent out and this process will then continue.
• The contractor then collects all the used cartridges from this central point.
• Toner cartridges which are currently sent back to the supplier (such as HP) via the mail can continue as this returns the item back to the manufacturer but our appointed contractor will take any that we are unable to return in this manner.
• Should you be in need of a bag please email manzonipost@lboro.ac.uk.

PLEASE NOTE:
Due to the potentially hazardous nature of the toner please ensure all used cartridges are first placed in the packaging which accompanies the new cartridge before placing this in the bag provided, this will help contain any used/unused toner. If for any reason you do not have this packaging then please seal the used toner cartridge in a plastic bag. If you have unused and unwanted toner cartridges, these can first be offered to other departments but if not claimed they also can go in these bags in their original packaging. Please can staff then use the cable tie provided, which will be sent out with all new bags, to seal the bag once sufficiently full (please consider manual handling restrictions and do not overfill the bag). Staff exchanging toner cartridges should familiarise themselves with the manufacturers health & safety guidance and follow the instructions provided. Our contractor for the toner cartridges will ensure any packaging which accompanies the toner cartridge is also recycled.
Under no circumstances should toner cartridges be placed in the general waste.

Sustainable management of e-waste
The majority of the e-waste and its components are recycled or reused by formal or informal programmers, depending on the recycling capacities of the country where the e-waste is generated. If e-waste is properly managed, business opportunities can be created to meet the need for reconditioning of equipment and recovery of raw materials. Governments, non-governmental organizations (NGOs) and the ICT sector consider e-waste management a tool and opportunity for sustainable development. (ITU, 2014) E-waste is a complex mixture of hazardous and non-hazardous materials that requires specialized processes of collection, transportation, segregation, treatment and disposal. It is important to be familiar with the life cycle of EEE to understand its potential environmental impacts. Figure 1 describes the life cycle of EEE and the processes it undergoes once it becomes e-waste.



Figer 2 e-waste process
There are some basic principles and definitions of environmental sustainability for the management ofe-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.

Control of Printer and Photocopier

Toner Hazards

Using chemicals or hazardous substances at work can put people's health at risk, so the law requires employers to control exposure to hazardous substances to prevent ill health.
Employers have to protect both employees and others who may be exposed by complying with The University the *Control of Substances Hazardous to Health Regulations 2002(COSHH*) (as amended).
Toners are generally a mixture of plastic resin and carbon black often with other additives. Carbon black is classified as a nuisance dust but will contain impurities known to be carcinogens. Toners should be handled with care and dust release minimised.
Contact with the tongue, e.g. by touching copied papers with a wetted finger can lead to small growths on the tongue. Other health effects may be irritated eyes, headache and itching skin. Maintenance workers are at risk from repeated exposure which can lead to skin and eye sensitisation.

Control

Ways to control the exposure to toner cartridges include

- Ventilation – a constant source of fresh air should be available to the room housing the photocopier/printer.
- Limit the number of employees who handle the cartridges.
- Reduction in periods of exposure
- Regular cleaning and maintenance of the printers and photocopiers
- Prohibition of eating and drinking in areas where the toners are used, stored and disposed of.
- Hands to be washed after handling a toner cartridge

- Use of suitable personal protective equipment

Disposal of Waste Toner Cartridges

- If possible, follow the instructions on the packaging and return the cartridges to the manufacturer.
- If it is not possible to do this:
  - Put the cartridge back into the original packaging (where this is possible).
  - Put the packaged cartridges into a plastic bag.
  - There are a number of recycling boxes throughout the University. The most central is located in the IT Suite at The University Library.

3. Key Actions

- Identify areas where photocopiers/printers are not in well ventilated rooms and rectify.
- Ensure all machines are well maintained and cleaned.
- Provide a safe system for disposal/recycling.
- Employees handling toner cartridges should wear gloves.

Self-Check -4	Written Test

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

PART I <u>CHOOSE THE BEST ANSWER</u> (3pts each)

1. Not a central goals of RCRA's
   A. Protection from the hazards of waste disposal
   B. Reduce or eliminate waste
   C. Conserve energy and natural resources by recycling and recovery
   D. Does not eliminate waste
2. One is not hazardous wastes generated by printers
   A. Press/screen cleaning solution
   B. Waste inks
   C. Untreated fixer
   D. Coatings or adhesives
   E. none

PART II <u>WRITE THE CORRECT ANSWER</u>

1. write the steps Disposal of Waste Toner Cartridges *(6 pt each)*

Note: Satisfactory rating 7 pts and above, points Unsatisfactory below 7pts points

Answer Sheet

Score = _____

Rating: _____

Name: _____ Date: _____

Operation Sheet 1	Reassemble units Techniques

Techniques for reassembling units:

Step 1- wear PPE.
Step 2- select required tools and materials
Steps 3- reassembling units.
Step 4- testing reassembling units.

Refer……
www.port.ac.uk/departments/services/humanresources/healthandsafety/

Operation Sheet 2	Final testing and cleaning

Techniques for Final testing and cleaning Service Completing:

Step 1-wear ppe
Step 2- Step3- select required tools and equipment.
Step 4- perform final test.
Steps 5- apply 3s.
Step 6- turn the equipment to normal position.

Operation Sheet 3	Completing maintain/repairing Service

Techniques for maintain/repairing Service Completing:

Step 1-wear ppe
Step 2-prepar work stations/equipments
Step3- select required tools and equipment.
Step 4- maintain and repair.
Steps 5- reassemble units.
Step 6- test.
Step7-applay 3s

Operation Sheet 4	Disposing Waste materials

Techniques for Disposing Waste materials:

Step 1- wear appropraite PPE.
Step 2- prepare, tools and equipment's depends on wast type.
Steps 3- sort /identify wastes.
Step 4- dispose un necessary wastes.

LAP Test	Practical Demonstration

Name: _____ Date: _____
Time started: _____ Time finished: _____
Instructions: Given necessary templates, tools and materials you are required to perform the following tasks within 5 hour..
Task 1. Reassemble units Techniques.
Task 2. Final testing and cleaning.
Task3. Completing maintain/repairing Service.
Task4. Test repaired unit
Task5. Disposing Waste materials.

Reference Materials

A. http://www.epa.gov/waste/partnerships/stewardship/basic.htm

B. http://www.epa.gov/climatechange/wydc/waste/calculators/Recon_home.html
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H. • CDC. 2008. Notice to Readers: Medical Equipment Malfunctions Associated with Inappropriate Use of Cleaning and Disinfecting Liquids – United States, 2007. Retrieved from http://www.cdc.gov/mmwr/preview/mmwrhtml/mm5706a6.htm.

No	Name of trainer	Qualification	Region	E-mail
1	ENIYEY YIRSAW	MSC	AMHARA	ene.fre12@gmail.com
2	Fasil Dawit	BSC	Dire Dawa	
3	GETNET ALELIGN	MSC	BENISHANGUL	
4	MOGES CHERE	MSC	ADISS ABABA	Mog.cher2@gmail.com
5	TAMIRU HAILU	MSC	Dire Dawa	