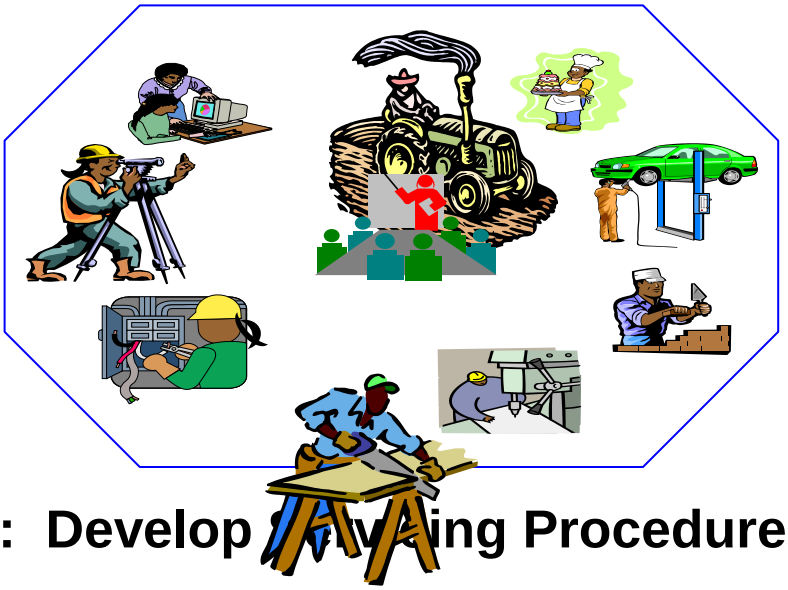
Intermediate Home/Office Electrical/ Electronic Equipment Servicing - Level-III

Based on May, 2011 Version OS and February, 2021 Version Curriculum



Module Title: Develop Servicing Procedures for Home/Office Electrical/Electronic Equipment

LG Code: EEL HOS3 03 04 0221 LO (1-3) LG (11-13)

TTLM Code: EEL HOS3 TTLM 0221 v1

February 2021

Bishoftu, Ethiopia

United Nations
Educational, Scientific and
Cultural Organization

Table of Contents
page

L #11	LO #1- Plan and prepare servicing system

Instruction sheet

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

- Planning and preparing OH&S policies and procedures with requirements.
- Consulting appropriate personnel to ensure programs for servicing and maintenance.
- Developing programs for servicing and maintenance.
- Identifying materials necessary with established procedures.
- Identifying tools, equipment and testing instruments with established procedure

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

- Plan and prepare OH&S policies and procedures with requirements.
- Consulting appropriate personnel to ensure programs for servicing and maintenance.
- Developing programs for servicing and maintenance.
- Identifying materials necessary with established procedures.
- Identifying tools, equipment and testing instruments with established procedure

- Ggggggg

Learning Instructions:

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

nformation Sheet 1-

Planning and preparing OH&S policies and procedures with requirements

1.1. Planning and preparing OH&S policies and procedures with requirements.

Your organization name is committed to the goal of providing and maintaining a healthy and safe working environment, with a view to continuous improvement. This goal is only achievable by adherence to established objectives striving to exceed all obligations under applicable legislation, and by fostering an enthusiastic commitment to health, safety and the environment within your company name personnel, contractors and visitors in particular:

Management, working in cooperation with the Joint Health and Safety Committee, will strive to take all reasonable steps to reduce workplace hazards to as low as reasonably achievable.

Supervisors and managers are held accountable for the health and safety of all employees under their supervision. This includes responsibility for applicable training and instruction, appropriate follow up on reported health and safety concerns, and implementation of recommended corrective action. This accountability is integrated into the performance appraisal system. Supervisors, workers and visitors are expected to perform their duties and responsibilities in a safe and healthful manner, and are accountable for the Health and Safety of themselves and others.

your company name is committed to providing all necessary training and instruction to ensure that appropriate work practices are followed on the job, and to promote their use off the job. If necessary, Your organization name will take disciplinary action where individuals fail to work in a healthy and safe manner, or do not comply with applicable legislation or corporate policies and procedures.

Health, safety, the environment and loss control in the workplace are everyone's responsibility. Your organization name expects that everyone will join in our efforts to

provide a healthy and safe working environment on a continuous day to day basis. Only through the dedication and efforts of all individuals can Your organization name succeed in providing a healthy safe working environment.

Part A – PLAN DETAILS

PURPOSE

The objective of this Health & Safety Management Plan [HSMP] is to establish and maintain an effective management system for all internal and host workplaces, management staff, employees and clients of FT Workforce (The Organization).

The organization are committed to implementing a structured approach to workplace health & safety in order to achieve a consistently high standard of safety performance. This plan will assist The organization in meeting its legal and other obligations in accordance with workplace safety, health and environmental legislation and associated Standards, Codes and Guidance materials. This Plan applies to all of The Organization's management, operational and casual employees and stakeholders with regard to all works and activities carried out by The organization.

This shall be achieved through;

- Development, implementation and commitment to the organization's Health and Safety Policy and Health and Safety Management System;
- The allocation of responsibilities and accountabilities of internal and external stakeholders towards defined objectives and targets;
- Strict adherence to all legal and other obligations required of the organization;
- Provision of collaborative instruction and training for all employment levels of the organization including:

    ✓Senior Management;
    ✓Branch Management;
    ✓Direct Employees; and,
    ✓Casual Employees as required.

- Hazard identification through pre-placement task risk assessments and site inspections of prospective host workplaces;
- Regular monitoring and review of Site, Task and Employee Safety Assessments where employees are placed/mobilised;
- Development, implementation and scheduled review of internal and site-based Emergency Management Systems;
- Application of measurable input and output based health and safety performance indicators;
- Consistent Monitoring and Review of all safety management systems for continual improvement.

LEGAL AND OTHER REQUIREMENTS

The Organizations shall comply with all health and safety laws, regulations, standards, codes of practice, statutory licenses and other legal requirements which apply to their activities and operations, and exercise their duty of care with respect to personnel and the communities in which they operate.

This shall be achieved by means of the following performance standards:

> All safety-related acts, regulations, by laws, licenses and other legislative and regulatory requirements applicable to The Organizations' operations shall be identified and their implications assessed.

> The Organizations shall ensure; that all amendments and changes to legislation and licenses (including new requirements) are identified and reviewed annually; that all personnel who need to be aware of these changes are advised; and that the appropriate action is taken.

> The Organizations' shall maintain compliance with all requirements related to regulatory reporting and record keeping.

The Organizations' shall ensure the exercise of all appropriate Legislative Compliance or Duty of Care, in relation to health and safety, owed to The organizations' employees, contractors and visitors, as the case may be.

> All safety-related acts, regulations, by laws, licenses and other legislative and regulatory requirements applicable to The Organizations' operations shall be identified and their implications assessed.

> The organizations shall ensure; that all amendments and changes to legislation and licenses (including new requirements) are identified and reviewed annually; that all personnel who need to be aware of these changes are advised; and that the appropriate action is taken.

> The organizations' shall maintain compliance with all requirements related to regulatory reporting and record keeping.

> The organizations' shall ensure the exercise of all appropriate Legislative Compliance or Duty of Care, in relation to health and safety, owed to The organizations' employees, contractors and visitors, as the case may be.

Self-Check -1	Written Test

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

I. Say true if the statement is correct otherwise say false(each 2 points)

1. Supervisors and managers are held accountable for the health and safety of all employees under their supervision.
2. Health, safety, the environment and loss control in the workplace are not everyone's responsibility.

Answer the following question!

Note: **Satisfactory rating - 2 and 4 points** **Unsatisfactory - below 2and 4points**

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

Answer Sheet

Name: _____ Date: _____

Score = _____

Rating: _____

nformation Sheet 2- Consulting appropriate personnel to ensure programs for servicing and maintenance.

1.1. Consulting appropriate personnel to ensure programs for servicing and maintenance.

ROLE OF THE MAINTENANCE MANAGEMENT CONSULTANT

The mission of the maintenance management consultant is to evaluate and assess maintenance performance – be it technical or organizational - within the corporation, by analyzing requirements and needs, with the aim of measuring and guaranteeing quality and efficacy in this field. He works in different functional areas of a business, ranging from the audits of the maintenance function, development and implementation of a Maintenance Management system, down to the transfer of knowledge (training actions). Consultation: is an act of seeking and giving of advice, information, and/or opinion, usually involving a consideration.

The purpose of a consultation is to get an advice in solving a problem. You want to change something, achieve something, attain something, or become something, you need help. The current state of things isn't how you want it to be. Therefore, your instructor or supervisors knows what desired state.

Responsibilities of Supervisor in Servicing and Maintenance

An excellent maintenance supervisor must be reliable and have a great eye for detail. They must have technical skills and knowledge of various crafts such as carpentry, plumbing etc. Leadership and knowledge of administrative tasks such as scheduling are also essential.

The goal is to ensure that facilities are in a good and safe condition at all times.

- Inspect facilities periodically to determine problems and necessary maintenance.
- Prepare weekly maintenance schedules and allocate work.

- Recruit, supervise and train maintenance technicians.
- Hire and supervise tradesmen during installations, repairs or maintenance (electricians, plumbers etc.).
- Inspect and maintain building systems (heating, ventilation etc.).
- Contribute to the development of maintenance budget and ensure compliance.
- Monitor inventory of materials and equipment.
- Participate in coordinaton of projects (e.g. renovations).
- Ensure adherence to quality standards and health and safety regulations.

Requirements

- Proven experience as maintenance supervisor or similar role
- Strong technical knowledge of all building systems (electrical, heating etc.)
- Knowledge of health & safety practices and regulations
- Understanding of budgeting and performance management
- Excellent planning and leadership abilities
- An eye for detail
- Computer savvy
- Excellent communication and interpersonal skills
- High school diploma; Degree from a vocational school will be a plus
- Professional Certifications

Self-Check -2	Written Test

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

I. Say true if the statement is correct otherwise say false(each 2 points)

1. The mission of the maintenance management consultant is to evaluate and assess maintenance performance.
2. An excellent maintenance supervisor must not be reliable and have a great eye for detail.

Answer the following question!

Note: **Satisfactory rating - 2 and 4 points** **Unsatisfactory - below 2 and 4 points**

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

Answer Sheet

Score = _____
Rating: _____

Name: _____ Date: _____

Short Answer Question

nformation Sheet 3. Developing programs for servicing and maintenance.

1.3 Developing programs for servicing and maintenance.

describes a proven process for developing, optimizing, and managing effective maintenance programs for new and in-service assets based on risk and cost-benefit principles.

The process calls for utilizing operational and maintenance experience as long as the experience is documented for the proper class of assets in the form of standard tasks. In absence of standard tasks, a more comprehensive analysis is performed using Reliability-Centered Maintenance (RCM2) or Failure Modes Effects Analysis (FMEA) to develop an optimum program. Asset performance data is used to continually adjust the maintenance program to meet user objectives.

A maintenance program is effective when it targets critical production equipment and puts emphasis on minimizing risk, which will lead to improved reliability, availability and resource utilization.

Maintenance Program Development/Optimization

This process consists of the following steps:-

1. Identifying business objectives.

2. Development of plant/asset technical model.

3. Condition assessment of installed assets.

4. Criticality and risk assessment.

5. Maintenance program development/review.

6. Loading of maintenance tasks to the CMMS system.

7. Maintenance spares strategy

1. **Business Objective**

Business objectives are set at the corporate and plant levels. They reflect market

conditions, shareholders expectations, and regulatory compliance. Objectives at this level include production levels, products qualities, safe operation policies and requirements,

environmental integrity requirements, and operating cost targets.

Objectives are then translated to major assets' specific performance expectations.

Measures at this level might include availability, asset utilization, efficiency, specific

products qualities, Overall Equipment Effectiveness (OEE), cost per unit produced, etc.

Target values are set by plant operating departments and approved by plant and corporate management.

Major assets or systems performance expectations are further refined to the individual equipment level. Here target vales for measures, such as Mean Time Between Failure (MTBF), Mean Time To Repair (MTTR), availability, etc., are set and approved. This process is repeated periodically, and the objectives are changed to reflect the company's position regarding the main business drivers.

Business objectives and performance expectations set the stage for defining equipment performance standards for high risk equipment in which RCM2 is the utilized method for developing/optimizing the maintenance programs.

2. Plant Technical Model

The plant technical model (also known as asset hierarchy) is composed of a hierarchy of systems and sub-systems that gradually represent increased levels of detail in describing the asset. The model reflects how systems and sub-systems fit together, interrelate and operate to provide the intended business function. As such, the hierarchy

reflects both the structural and process flow characteristics of the plant/asset. The model starts with the process flow diagram representing the overall operation of a plant.

This level consists of the major plant production units, utility systems (such as electricity, water, steam, air, fuel, etc.), feed and raw material preparation facilities, final product storage, plant control systems and local area network(s), infrastructures, etc.

The next level breaks down each unit into systems and sub-systems as depicted on unit process flow diagram and P&ID's. Examples at this level include systems such as feed filtration, feed pressurization, feed heating, atmospheric fractionation, etc.

At progressively lower levels of the model, the breakdown of the plant becomes more detailed. At the end, the plant is reduced to a set of systems and sub-subsystems and the equipment items that support each one of the systems or sub-sub-systems.

Control and protective systems are incorporated in the hierarchy at the appropriate levels. In the case where a control or protective system is dedicated to one system or sub-system then it should be setup as a sub-element of that system. In the case that a control/protective system is controlling/protecting multiple systems, it should be setup as an element at the same level in the hierarchy.

Every hierarchy element - whether it is a system, sub-system or an equipment item - has a clearly defined boundary. Boundary definitions are standardized for classes of system/equipment items.

The steps involved in developing a plant technical model are as follows

A. Collect technical information and drawings (PFD's, P&ID's, line diagrams, datasheets, O&M manuals, etc.)

B. Establish a standard for defining systems' boundaries. See references 4 and 6 for details.

C. Develop plant technical hierarchy.

D. Define systems' functions (optional).

E. Load hierarchy into the plant maintenance information system (CMMS).

3. **Criticality and Risk Assessment**

Criticality and risk assessment is a qualitative analysis of assets failure events and the ranking of those events according to their impact on the business goals of the company. The process consists of the following main activities

1. Establish criticality assessment criteria.
2. Define for each assessment criteria the failure consequences and their scores.
3. Collect equipment condition assessment records or generic failure frequencies.
4. Determine failure frequencies and their ratings.
5. Define criticality ranking scores.
6. Define criticality ranking rules.
7. Select systems and/or equipment for assessment.
8. Perform the analysis.
9. Rank systems/equipment by criticality.
10. Rank systems/equipment by risk.

4**. Maintenance Tasks Development/Optimization (MTD/O)**

The MTD/O process described in this paper establishes a structured framework for developing or assessing maintenance programs for in-service or newly commissioned assets. The process emphasizes the use of operation and maintenance experience documented in a form of standard maintenance tasks (SMT).The steps involved in the development/optimization of maintenance tasks are as follows:

1. A system is identified for review by selecting an element from the plant technical hierarchy. As described earlier, the selected system boundary should be clearly defined. The selected system includes all lower level elements.

2. A risk analysis is performed per section 4 of this paper. If an analysis was conducted in the past, review of failure frequencies in lieu of the current system/equipment items' condition is conducted and the frequency scores changed as necessary. The system/equipment items selected are then ranked by their risk ranking.

3. In the case that the system under review belongs to an equipment class group that has a standard maintenance task (SMT) documented, it is only necessary to verify for low risk systems/equipment that any specific company, standards, and regulation requirements are applicable and simple service activities are adequate and cost efficient. For high and medium risk systems/equipment, verification of all SMT elements is required.

4. When an applicable SMT is not available, a more detailed analysis is required for high and medium risk systems/equipment. For high risk items, a complete RCM2 analysis is recommended, while for medium risk items, RCM2 (FMEA) is sufficient to develop/optimize the maintenance program. The outcome of RCM2 or RCM2 FMEA is a set of proposed tasks, their frequencies, and the crafts and skill levels of individuals performing the work, or recommended actions in case suitable routine tasks cannot be found.

5. For low risk items not governed by any company, standard or governmental requirements a run-to-failure strategy is adapted. When requirements exist, routine tasks are developed and incorporated into work packages.

6. From the output of RCM2 or RCM2 (FMEA), detailed routine task descriptions are developed and then incorporated into work packages.

7. SMTs are developed to reduce tasks development time, efforts, and to ensure consistency when dealing with equipment from the same equipment group. Developed SMTs are kept in a library for future reference. Routine updates are made to SMTs to

reflect current condition of equipment, gained maintenance and operating experience, and any new changes/modification to systems and equipment.

8. The final step in the analysis is to upload the developed work packages into Plant Reliability Information Management Systems (PRIMS). PRIMS include maintenance systems such as MAXIMO, SAP Plant Maintenance, Document Management Systems, Inspection Systems, etc.

9. Monitoring developed/optimized maintenance programs is essential to ensure their effectiveness in meeting the objective set by the organization. An established method for recording failure modes, failure effects, and failure causes as well as the corrective actions taken to eliminate/reduce the failure effects is critical to the successful implementation of any maintenance program.

Self-Check 3	Written Test

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

I. Say true if the statement is correct otherwise say false(each 2 points)

1. A maintenance program is effective when it targets critical production equipment and puts emphasis on minimizing risk.
2. Major assets or systems performance expectations are further refined to the individual equipment level.
3. In the case that the system under review belongs to an equipment class group that has a standard maintenance task.

Answer the following question!

Note: **Satisfactory rating - 3 and 6 points** **Unsatisfactory - below 3and 6 points**

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

Answer Sheet

Score = _____

Rating: _____

Name: _____ Date: _____

nformation Sheet 4- Identifying materials necessary with established procedures.

1.3 Identifying materials necessary with established procedures.

Checking materialsspecifications

This involves preparing for and receiving the materials according to defined procedures, and taking account of all health and safety requirements i.e. prepare your work area in readiness for the receipt of the materials which includes

- Ensuring accessibility for receipt and removal of the materials and ensuring the area is free from obstructions or potential hazards.
- Checking that materials conform to the relevant specification/s and that sufficient materials are available for the manufacturing operations being performed.
- Correcting any incorrect documentation, equipment, tools and / or materials within the limits of your responsibility, otherwise report promptly to the appropriate person.

Receiving and checking incoming materials involves

1. Working with minimum supervision
2. Preparation of work area for receipt of materials
3. Receiving materials
4. Confirming the status of the materials
5. Resolving problem within the limits of your responsibility
6. Completing any necessary documentation accurately and legibly
7. Working in ways which maintain the safety of yourself and others

An electronic circuit is composed of various types of components. Some of these components are termed as active components because they take part in the transformation of the energy while other components, which only dissipate or store energy, are called as passive elements. The vacuum tubes, rectifier, transistors are some of-the common active while the resistances, which dissipate the power and energy storing elements such as capacitances and inductances are known as passive elements.

Conductors

Conductors are the materials which have very high conductivity. The number of free electrons are very high in a conductor at room temperature, which is the basic reason of high conductivity of conductors.

Examples: Silver, Copper, Gold, Aluminum etc.

1. **Silver**

Identifying silver according to the established procedures:-

Active Components:-

They can be further classified as

Semiconductor Devices : Semiconductor diode, zener diode, and varactor diode etc. Uni-junction transistor, Bipolar junction transistor (BJT), FET, silicon, Controlled rectifier etc.

Vacuum Tube Devices : Vacuum tube diode, triode, Tetrode, Pentode, Hexode, Heptode etc.

Gas Tube Devices : Gas diodes, Thyratons etc.

Photo Sensitivity Devices : Gas photodiodes, photo multiplier tubes, photodiodes, light emitting diode, photosensitive transistor etc.

Though there are devices, which are specific to particular frequency range and applications like microwave devices etc.

PASSIVE DEVICES:

RESISTANCES: Resistors can be made to control the flow of current, to work as Voltage dividers, to dissipate power and it can shape electrical waves when used

in combination of other components. Basic unit is ohms,

RESISTIVE ELEMENTS:

Metal alloys, carbon and graphite used with binders etc. are the, usual resistive materials. The alloys used as resistance wire usually have higher specific resistances than the base metals and have lower temperature coefficient of resistance.

Resistors can be

(i) fixed resistors with two ends,

(ii) (ii) variable resistor or

potentiometers. Resistors are specified by the value of resistance, in ohms maximum power dissipation in watts, and precision in %.

Types: Resistors can be designed in many ways by usage, shape, physical

construction tolerances, resistances are of the following three types i.e.

- ✓ **FIXED RESISTORS:**
- ✓ **SEMIVARIABLE RESISTORS:**
- ✓ **VARIABLE RESISTORS:**

RHEOSTATE :

A wire wound pot that can dissipate 5 and more watts is often referred to as a rheostat. The resistance wire is wound on an open ring of ceramic which is covered with vitreous enable, except for the track of the wiper arm. Rheostats are used to control motor speeds, x-ray tube voltages, ovens and many other high power applications.

THERMISTORS:

A Thermistor is non-linear resistance made of semiconductor material that is extremely sensitive to change in temperature. For a small change in body temperature of a Thermistor, there is an appreciable change in its resistance, where as most conductors have a positive temperature coefficient, the thermistor can exhibits a positive or negative temperature coefficient, (NTC). The thermistor is mostly negative temperature coefficient resistances. The resistances of thermistor decreases rapidly for increased temperature.

The thermistor are used in wide variety of applications. They can be used in measurement and control of temperatures, time delay, temperature compensation and liquid level indicators. The thermistor is available in the form of a disk, bead, or bolted assembly packages.

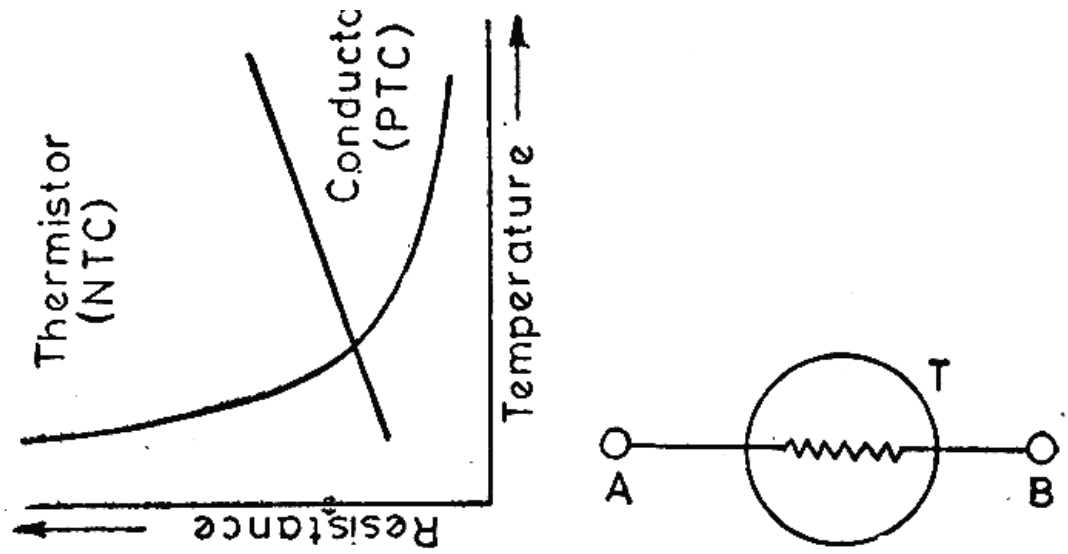


Fig.1 shows the temperature-resistance characteristics of thermistor.

VARISTORS

These are voltage dependent resistances. They also fall under the category of nonlinear resistors. According to the Ohm's Law the current is directly proportional to the impressed voltage but in case of varistors the current is proportional to the nth power of the impressed voltage i.e.

$$I \alpha V^n$$

where I is the current in Amperes and V is the impressed voltage on the Varistors.

Figure-2 shows the V-I characteristics of the Varistors.

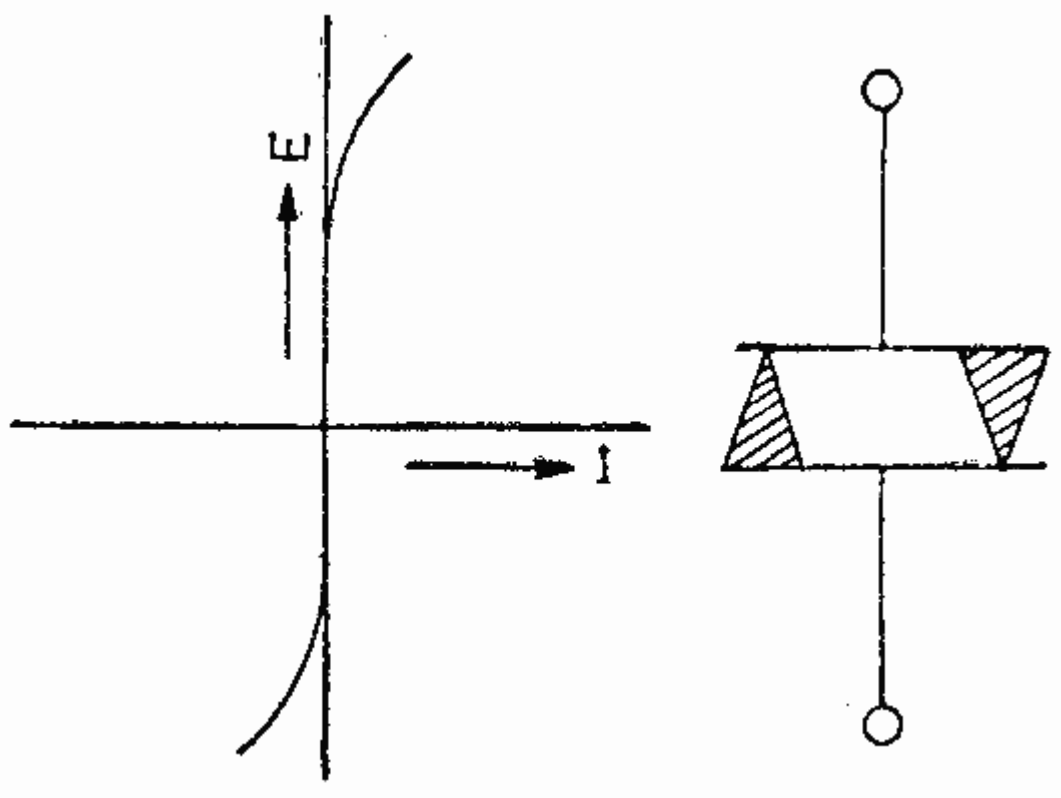


Fig. V-I characteristic of varistors

CAPACITORS :

It stores the charge across its two plates. Capacitor opposes the change of voltage across its plates; the electric field developed across the plate opposes the rapid change in voltages. It produces phase difference between voltage applied to it and the current, which passes through it. The current leads the voltage by 90o in the ideal

capacitance with infinite resistance across the plates.
Design of capacitor is connected with relation of the proper electric material for particular type of application. The dielectric material used for capacitors may be

grouped in the various classes.

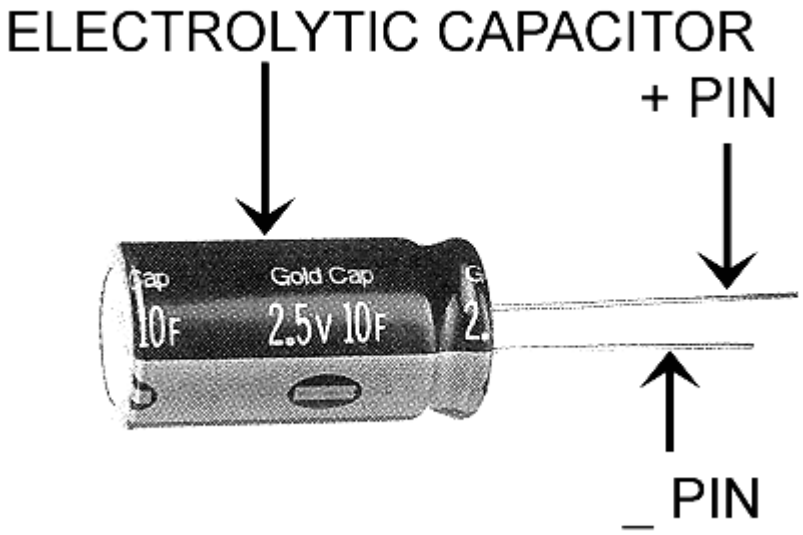


Fig.3 Electrolytic Capacitor

Mica, glass, air, and low loss ceramic capacitors are used from few kHz to few hundreds MHz.

Paper and metalized paper capacitor cover the frequency range from few Hz to few hundred kHz.

INDUCTORS:

Like capacitors, inductors also store energy in one part of AC cycle and return it during the next part of the cycle.

Inductance is that property of a device that reacts against a change in current through the device. Inductors are components designed for use in circuits to resist changes in current and thus serve important control functions.

Inductor designed is based on the principle that a varying magnetic field induces a voltage in any conductor in that field. Thus, a practical inductor may simply be a coil wire. The current in each loop of the coil produces a magnetic field that passes through neighboring loops. If the current through the coil is constant the magnetic

field is constant and no action takes place. A change in the current, however, produces a change in the magnetic field. The energy absorbed or released from the changing magnetic field reacts against the change in current, and this is exhibited as in induced voltage (electromotive force, emf), which is counter to the change in

applied voltage. The inductor thus behaves as an impedance to ac current.

Fig. Inductors

Self-Check -4	**Written Test**

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

Part I Say true if the statement is correct otherwise say false(each 2 points)

1. Transistor is one of the example of passive elements.
2. Rectifier is one of a good example of passive element
3. Conductors are the materials which have very high conductivity.
4. Diode is one of the semiconductor component.

Answer the following question!

Note: **Satisfactory rating 4 and 8 points** **Unsatisfactory below 4 and 8 points**

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

Score = _____
Rating: _____

Answer Sheet

Name: _____ Date: _____

Information Sheet 5. Identifying tools,equipment and testing instruments with established procedure

1.5 Identifying tools, equipment and testing instruments with established procedure

Introduction to Selecting appropriate tools and test instrument

The following table shows tools and instruments which are appropriate to perform the electrical/electronic tasks given under this topic.

Table 1: tools and instruments

Tools	**Test instrument & other equipments**	**Consumable materials**
Different Pliers	Multimeter	Wire, Cable
Screw Drivers	Megger	Solder lead, Flux
Wrenches	Frequency meter	PCB
Pipe cutter	Inductance meter	Capacitor
Steel rule	Oscilloscope	Resistor
Wire Stripper	Power supply	LED
	Soldering gun	
	Digital IC Tester	

Types of appropriate tools and test instrument

- ✓ **Pliers** are available with both insulated and uninsulated handles, which are used in handling and twisting wires. The handle insulation is not considered sufficient protection alone. Other safety precaution must be observed. Common types of pliers are:

Figure 1 *different kind of pliers*

Screw drivers come in various sizes and shapes. They are used to drive and pull out screws. They are made of insulated handles with either sharp or square tips. The width of the screw driver should match the width of the screw slot. Common types of screw

Figure1 : different screw drivers

Drilling Equipment:-

is needed to make holes in building structure for passage of wires and conduit in both new and old installation, indoor or outdoor wiring. Common types of drilling tools and equipments are:

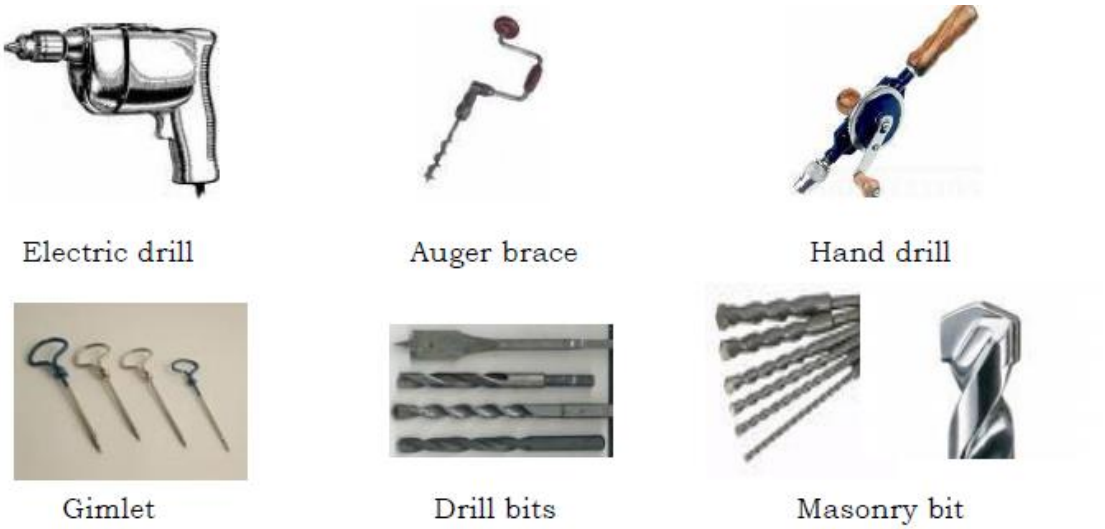


Figure 3: *different kinds of drilling equipments*

Soldering tools are used in making splices and taps connections of wires.

Figure 4: *different kinds of soldering tools*

Hammers are used to drive and pull out nails. They are made of either hard steel or plastic. Common examples of hammer are:

Claw hammer

Ball pin hammer

Mallet (Plastic or rubber hammer)

Figure 5: *Different kinds of hammers*

- ✓ **Measuring tools and instrument**:- The electrician uses the following measuring tools and instruments to measure value of voltage, current and resistance, wire length, opening sizes of wire, conduit and other items.

Metric rule

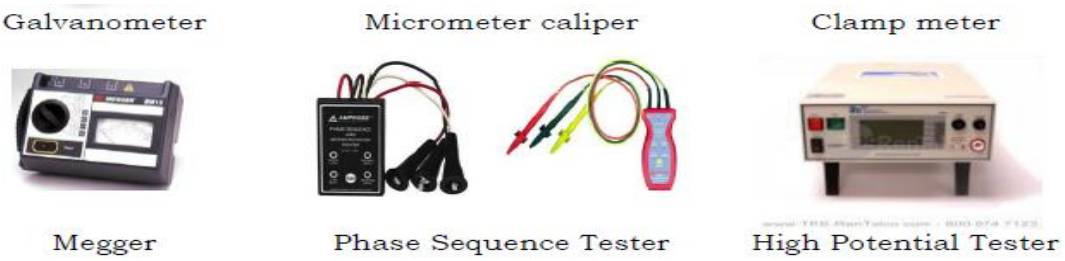
Wire gauge

Veneer caliper

Multitester

Voltmeter

Ammeter



Sawing and cutting tool. Two of the commonly used saw are:

***Figure 6**: tools and measuring instruments*

Self-Check 5	**Written Test**

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

I. Part I Say true if the statement is correct otherwise say false(each 2 points)

1. PCB is one of the consumable electronic materials.
2. Pliers are available with both insulated and insulated handles.
3. Hammers are not used to drive and pull out nails.

Answer the following question!

Note: Satisfactory rating 3 and 6 points Unsatisfactory below 3 and 6 points

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

Answer Sheet

Name: _____ Date: _____

Short Answer Question

Score = _____
Rating: _____

References

http://www.wrla.org

http://www.oliver-uploads.aus.s3.amazonaws.com

http://www.resources.workable.com

http://www.researchgate.net

BEEES(LG-M10)

L #12	LO #2- Implement servicing system

Instruction sheet

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

- Ascertaining normal function of home/office products and associated circuits.
- Detailing circuits isolation and specified testing procedure.
- Implementing servicing system on a trial basis.
- Detailing response to unplanned events with established procedures.
- Appropriate personnel makes approval to implement contingencies with established procedures.
- Implementing home/office products and associated circuit servicing and maintenance with requirements.
- Identifying and organizing technique and approach for maintenance of servicing.

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

- Ascertain normal function of home/office products and associated circuits.
- Detail circuits isolation and specified testing procedure.
- Implement service system on a trial basis.
- Detail response to unplanned events with established procedures.
- Appropriate personnel makes approval to implement contingencies with established procedures.
- Implement home/office products and associated circuit servicing and maintenance with requirements.
- Identify and organize technique and approach for maintenance of servicing.
- Ggggggg

Learning Instructions:

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

Information Sheet 1. Ascertaining normal function of home/office products and associated circuits

2.1 Ascertaining normal function of home/office products and associated circuits

Capacitance meter

is a piece of electronic test equipment used to measure capacitance, mainly of discrete capacitors. Depending on the sophistication of the meter, it may display the capacitance only, or it may also measure a number of other parameters such as leakage, equivalent series resistance (ESR), and inductance. For most purposes and in most cases the capacitor must be disconnected from circuit; ESR can usually be measured in circuit.

Simple checks without a true capacitance meter

Some checks can be made without a specialized instrument, particularly on aluminium electrolytic capacitors which tend to be of high capacitance and to be subject to poor leakage. A multimeter in a resistance range can detect a short-circuited capacitor (very low resistance) or one with very high leakage (high resistance, but lower than it should be; an ideal capacitor has infinite DC resistance).

A crude idea of the capacitance can be derived with an analog multimeter in a high resistance range by observing the needle when first connected; current will flow to charge the capacitor and the needle will "kick" from infinite indicated resistance to a relatively low value, and then drift up to infinity. The amplitude of the kick is an indication of capacitance. Interpreting results requires some experience, or comparison with a good capacitor, and depends upon the particular meter and range used.

Simple and non-bridge meters

Many DVMs (digital volt meters) have a capacitance-measuring function. These usually operate by charging and discharging the capacitor under test with a known current and measuring the rate of rise of the resulting voltage; the slower the rate of rise, the larger the capacitance. DVMs can usually measure capacitance from nanofarads to a few hundred microfarads, but wider ranges are not unusual.

- Measure the capacity of rotary capacitor with digital multimeter

C_{min} = 29 pF

C = 269 pF

C_{max} = 520 pF

It is also possible to measure capacitance by passing a known high-frequency alternating current through the device under test and measuring the resulting voltage across it (does not work for polarized capacitors).

When troubleshooting circuit problems, a few problems are intermittent or only show up with the working voltage applied, and are not revealed by measurements with equipment, however sophisticated, which uses low test voltages. Some problems are revealed by using a "freezer" spray and observing the effect on circuit operation. Ultimately, in difficult cases routine replacement of capacitors (relatively cheap components) is easier than arranging measurements of all relevant parameters in working conditions.

Some more specialized instruments measure capacitance over a wide range using the techniques described above, and can also measure other parameters. Low stray and parasitic capacitance can be measured if a low enough range is available. Leakage current is measured by applying a direct voltage and measuring the current in the normal way.

Ammeter

An ammeter (from Ampere Meter) is a measuring instrument used to measure the current in a circuit. Electric currents are measured in amperes (A), hence the name. Instruments used to measure smaller currents, in the milliampere or microampere range, are designated as *milliammeters* or *microammeters*. Early ammeters were laboratory instruments which relied on the Earth's magnetic field for operation. By the late 19th century, improved instruments were designed which could be mounted in any position and allowed accurate measurements in electric power systems. It is generally represented by letter 'A' in a circle.

Digital

In much the same way as the analogue ammeter formed the basis for a wide variety of derived meters, including voltmeters, the basic mechanism for a digital meter is a digital voltmeter mechanism, and other types of meter are built around this.

Digital Ammeter

Digital ammeter designs use a shunt resistor to produce a calibrated voltage proportional to the current flowing. This voltage is then measured by a digital voltmeter, through use of an analog to digital converter (ADC); the digital display is calibrated to display the current through the shunt. Such instruments are often calibrated to indicate the RMS value for a sine wave only, but many designs will indicate true RMS within limitations of the wave crest factor.

There is also a range of devices referred to as integrating ammeters. In these ammeters the current is summed over time, giving as a result the product of current and time; which is proportional to the electrical charge transferred with that current. These can be used for metering energy (the charge needs to be multiplied by the voltage to give energy) or for estimating the charge of a battery or capacitor.

Pico ammeter

A picoammeter, or pico ammeter, measures very low electric current, usually from the picoampere range at the lower end to the milliampere range at the upper end. Picoammeters are used for sensitive measurements where the current being measured is below the theoretical limits of sensitivity of other devices, such as Multimeters.

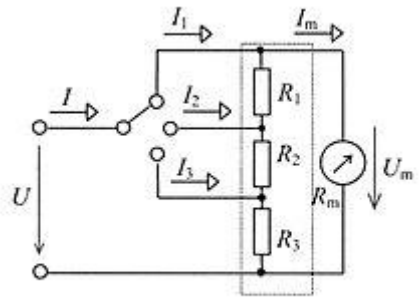
Pico Ammeter

Most picoammeters use a "virtual short" technique and have several different measurement range that must be switched between to cover multiple decades of measurement. Other modern picoammeters use log compression and a "current sink" method that eliminates range switching and associated voltage spikes. Special design and usage considerations must be observed in order to reduce leakage current which may swamp measurements such as special insulators and driven shields. Triaxial cable is often used for probe connections.

Application

The majority of ammeters are either connected in series with the circuit carrying the current to be measured (for small fractional amperes), or have their shunt resistors connected similarly in series. In either case, the current passes through the meter or (mostly) through its shunt. Ammeters must not be connected directly across a voltage source since their internal resistance is very low and excess current would flow. Ammeters are designed for a low voltage drop across their terminals, much less than one volt; the extra circuit losses produced by the ammeter are called its "burden" on the measured circuit.

Ordinary Weston-type meter movements can measure only milliamperes at most, because the springs and practical coils can carry only limited currents. To measure larger currents, a resistor called a *shunt* is placed in parallel with the meter. The resistances of shunts are in the integer to fractional milliohm range. Nearly all of the current flows through the shunt, and only a small fraction flow through the meter. This allows the meter to measure large currents. Traditionally, the meter used with a shunt has a full-scale deflection (FSD) of 50 mV, so shunts are typically designed to produce a voltage drop of 50 mV when carrying their full rated current.



Ayrton shunt switching principle

Transistor tester

Transistor testers are instruments for testing the electrical behavior of transistors and solid-state diodes.

Types of tester

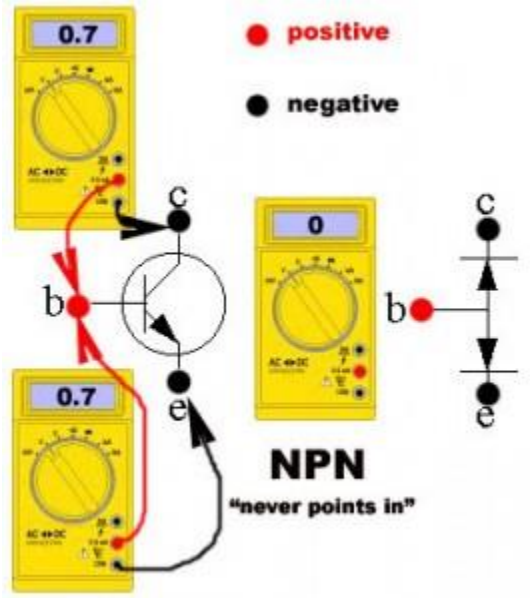
There are three types of transistor testers each performing a unique operation.

- Quick-check in-circuit checker
- Service type tester
- Laboratory-standard tester

In addition, curve tracers are reliable indicators of transistor performance.

Circuit Tester

A circuit tester is used to check whether a transistor which has previously been performing properly in a circuit is still operational. The transistor's ability to "amplify" is taken as a rough index of its performance. This type of tester indicates to a technician whether the transistor is dead or still operative. The advantage of this tester is that the transistor does not have to be removed from the circuit.



Transistor Tester(Circuit Tester)

Service type transistor testers

These devices usually perform three types of checks:

- Forward-current gain,or beta of transistor.
- Base-to-collector leakage current with emitter open(ico)
- Short circuits from collector to emitter and base.

Some service testers include a go/no-go feature, indicating a pass when a certain h_{fe} is exceeded. These are useful, but fail some functional but low h_{fe} transistors.

Service Type Transistor Tester

Some also provide a means of identifying transistor elements, if these are unknown. The tester has all these features and can check solid-state devices in and out of circuit.

Transistor h_{fe} varies fairly widely with Ic, so measurements with the service type tester give readings that can differ quite a bit from the h_{fe} in the transistor's real life application. Hence these testers are useful, but can't be regarded as giving accurate real-life h_{fe} values.

Laboratory-standard transistor tester or Analyzer

This type of tester is used for measuring transistor parameters dynamically under various operating conditions. The readings they give are absolute. Among the important characteristics measured are:

- I_{cbo} collector current with emitter open (Common base)
- ac beta (Common emitter)
- R_{in} (Input resistance)

LCR meter

Handheld LCR Meter

Non-portable LCR meter

Bench top LCR meter with 4-wire (Kelvin sensing) fixture

LCR meter is a type of electronic test equipment used to measure the inductance (L), capacitance (C), and resistance (R) of an electronic component. In the simpler versions of this instrument the impedance was measured internally and converted for display to the corresponding capacitance or inductance value. Readings should be reasonably accurate if the capacitor or inductor device under test does not have a significant resistive component of impedance. More advanced designs measure true inductance or capacitance, as well as the equivalent series resistance of capacitors and the Q factor of inductive components.

Operation

Usually the device under test (DUT) is subjected to an AC voltage source. The meter measures the voltage across and the current through the DUT. From the ratio of these the meter can determine the magnitude of the impedance. The phase angle between the voltage and current is also measured in more advanced instruments; in combination with the impedance, the equivalent capacitance or inductance, and resistance, of the DUT can be calculated and displayed.

The meter must assume either a parallel or a series model for these two elements. An ideal capacitor has no characteristics other than capacitance, but there are no physical ideal capacitors. All real capacitors have a little inductance, a little resistance, and some defects causing inefficiency. These can be seen as inductance or resistance in series with the ideal capacitor or in parallel with it, and so likewise with inductors. Even resistors can have inductance (especially if they are wire wound types) and capacitance as a consequence of the way they are constructed. The most useful assumption, and the one usually adopted, is that LR measurements have the elements in series (as is necessarily the case in an inductor's coil) and that CR measurements have the elements in parallel (as is necessarily the case between a capacitor's 'plates'). Leakage is a special case in capacitors, as the leakage is necessarily across the capacitor plates, that is, in series.

An LCR meter can also be used to measure the inductance variation with respect to the rotor position in permanent magnet machines. (However, care must be taken, as some LCR meters will be damaged by the generated EMF produced by turning the rotor of a permanent-magnet motor; in particular those intended for electronic component measurements.)

Handheld LCR meters typically have selectable test frequencies of 100 Hz, 120 Hz, 1 kHz, 10 kHz, and 100 kHz for top end meters. The display resolution and measurement range capability will typically change with the applied test frequency since the circuitry is more sensitive or less for a given component (i.e., an inductor or capacitor) as the test frequency changes.

Multimeter

Analogue Mulltimeter

A **multimeter** or a **multitester**, also known as a **VOM** (volt-ohm-milliammeter), is an electronic measuring instrument that combines several measurement functions in one unit. A typical multimeter can measure voltage, current, and resistance. **Analog multimeters** uses a microammeter with a moving pointer to display readings. **Digital multimeters** (DMM, DVOM) have a numeric display, and may also show a graphical bar representing the measured value. Digital multimeters are now far more common due to their lower cost and greater precision, but analog multimeters are still preferable in some cases, for example when monitoring a rapidly varying value.

A multimeter can be a hand-held device useful for basic fault finding and field service work, or a bench instrument which can measure to a very high degree of accuracy. Multimeters are available in a wide range of features and prices.

Operation

A multimeter is the combination of a DC voltmeter, AC voltmeter, ammeter, and ohmmeter. An un-amplified analog multimeter combines a meter movement, range resistors and switches; VTVMs are amplified analog meters and contain active circuitry.

Clamp meters

Clamp meters clamp around a conductor carrying a current to measure without the need to connect the meter in series with the circuit, or make metallic contact at all. Those for AC measurement use the transformer principle; clamp-on meters to measure small current or direct current require more exotic sensors like for example hall effect based systems that measure the non changing magnetic field to determine the current.

Clamp meter

Ohmmeter

An ohmmeter is an electrical instrument that measures electrical resistance, the opposition to an electric current. Micro-ohmmeters (microhmmeter or micro ohmmeter) make low resistance measurements. Megohmmeters (also a trademarked device Megger) measure large values of resistance. The unit of measurement for resistance is ohms (Ω).

An analog ohmmeter

Self-Check 1	Written Test

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

I. Part I Say true if the statement is correct otherwise say false(each 2 points)

1. Capacitance meter is a piece of electronic test equipment used to measure capacitance.
2. An ammeter is not a measuring instrument used to measure the current in a circuit.
3. LCR meter is a type of electronic test equipment used to measure the inductance (L), capacitance (C), and resistance (R) of an electronic component.

Answer the following question!

Note: Satisfactory rating 3 and 6 points Unsatisfactory below 3 and 6 points

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

Answer Sheet

Score = _____

Rating: _____

Name: _____ Date: _____

2.2 Detailing circuits isolation and specified testing procedure

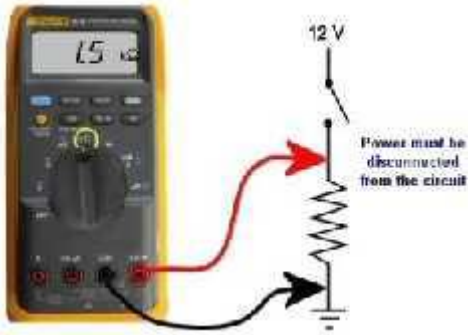
Testing (measuring) resistors:

1**.** Adjust the meter in resistance range which is greater than the expected value

2. Turn a circuit off before measuring resistance.

3. Hold the leads of the meter across the resistor legs

4. Read the values of the resistor.



Testing Resistor

If the reading is equal to the expected one, the resistor is normal and we can use the reading,

but if the value is unexpectedly large (infinite) or very small (approximately zero) it is expected to be open or short circuit faulty respectively.

Notice: if a resistor is not disconnected from the circuit during measurement and any voltage is present, the value of resistance will be incorrect. You cannot measure a component while it is in-circuit. You should disconnect at least one of the leg of the resistor to be measure from a circuit.

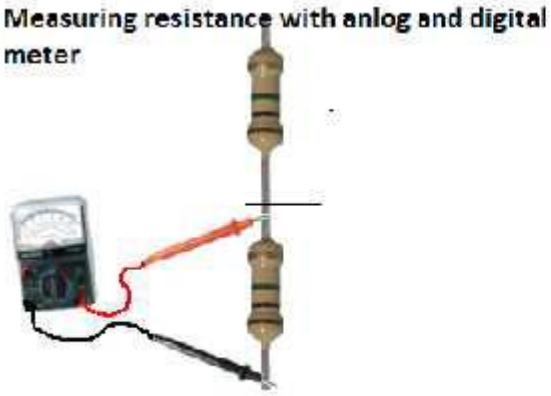
This is because the meter is actually measuring a voltage across a component and calling it

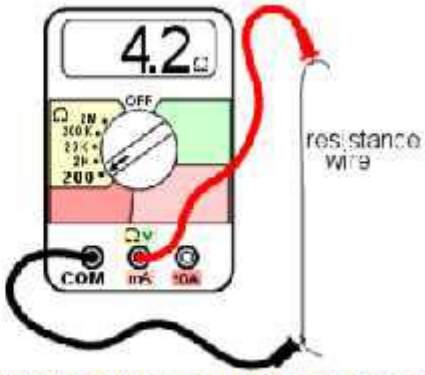
a "resistance."

The voltage comes from the battery inside the meter. If any other voltage is present, the meter
will produce a false reading. If you are measuring the resistance of a component while still "in
circuit," (with the power off) the reading will be lower than the true reading.

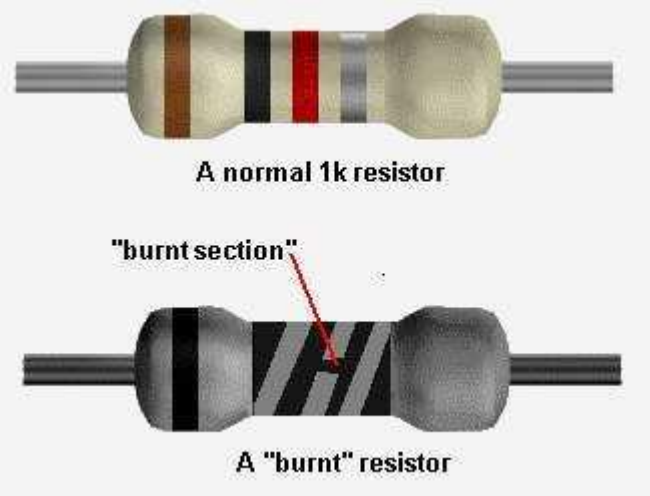
1. Do not measure the "resistance of a battery." The resistance of a battery (called the internal
impedance) is not measured as shown in the diagrams above. It is measured by creating a current flow
and measuring the voltage across the battery. Placing a multimeter set to resistance (across a
battery) will destroy the meter.

2. Do not try to measure the resistance of any voltage or any "supply."





Measuring the resistance of a piece of resistance-wire



Clean the "spot" (burnt section of the spiral) very carefully and make sure you can get a good contact
with the spiral and the tip of your probe. Measure from one lead of the resistor to the end of the
damaged spiral. Then measure from the other lead to the other end of the spiral.

Add the two values and you have an approximate value for the resistor. You can add a small amount
for the damaged section.
This process works very well for damaged wire-wound resistors.
They can be pulled apart and each section of the resistance-wire (nichrome wire) measured and added to get the full resistance.

There is another way to determine the value of a damaged resistor.
Get a set of resistors of the same wattage as the damaged component and start with a high value. It's
handy to know if the resistor is in the range: 10ohm to 100ohms or 1k to 10k etc, but this is not
essential.

Start with a very high value and turn the circuit ON. You can perform voltage tests and if you know the
expected output voltage, decrease the resistance until this voltage is obtained.
If you do not know the expected voltage, keep reducing the value of resistance until the circuit works
as designed.

This is the best advice in a situation where you do not know the value of a resistor.

TESTING A CAPACITOR

There are two things you can test with a multimeter:
1. A short-circuit within the capacitor
2. Capacitor values above 1u.
You can test capacitors in-circuit for short-circuits. Use the x1 ohms range.
To test a capacitor for leakage, you need to remove it or at least one lead must be removed from the
circuit. Use the x10k range on an analogue or digital multimeter.
For values above 1u you can determine if the capacitor is charging by using an analogue meter. The needle will initially move across the scale to indicate the cap is charging, then go to "no deflection."

Any permanent deflection of the needle will indicate leakage.
You can reverse the probes to see if the needle moves in the opposite direction. This indicates it has been charged.
Values below 1u will not respond to charging and the needle will not deflect.

Finding the Value of a Capacitor

If you want to find the value of a surface-mount capacitor or one where the markings have been
removed, you will need a capacitance meter. Here is a simple circuit that can be added to your

meter to read capacitor values from 10p to 10u.

REPLACING A CAPACITOR

Always replace a capacitor with the exact same type.
A capacitor may be slightly important in a circuit or it might be extremely critical.
A manufacturer may have taken years to select the right type of capacitor due to previous failures.
A capacitor just doesn't have a "value of capacitance."
It may also has an effect called "tightening of the rails."
In other words, a capacitor has the ability to react quickly and either absorb or deliver energy to
prevent spikes or fluctuations on the rail.
This is due to the way it is constructed. Some capacitors are simply plates of metal film while others are wound in a coil. Some capacitors are large while others are small.
They all react differently when the voltage fluctuates.
Not only this, but some capacitors are very stable and all these features go into the decision for the type of capacitor to use.

You can completely destroy the operation of a circuit by selecting the wrong type of capacitor.
No capacitor is perfect and when it gets charged or discharged, it appears to have a small value of resistance in series with the value of capacitance.
This is known as "ESR" and stands for EQUIVALENT SERIES RESISTANCE. This effectively makes the capacitor slightly slower to charge and discharge.

The only solution is to replace a capacitor with an identical type.
However if you get more than one repair with identical faults, you should ask other technicians if the original capacitor comes from a faulty batch.
Some capacitor is suitable for high frequencies, others for low frequencies.

TESTING ACTIVE COMPONENTS

TESTING DIODES

Diodes can have 4 different faults.

1. Open circuit in both directions.
2. Low resistance in both directions.
3. Leaky.
4. Breakdown under load.

TESTING A DIODE ON AN ANALOGUE METER

Testing a diode with an Analogue Multimeter can be done on any of the resistance ranges. [The high
resistance range is best - it sometimes has a high voltage battery for this range but this does not affect
our testing]

There are two things you must remember:-

1. When the diode is measured in one direction, the needle will not move at all. The technical term for this is the diode is reverse biased. It will not allow any current to flow. Thus the needle will not move.

When the diode is connected around the other way, the needle will swing to the right (move up scale) to about 80% of the scale.
This position represents the voltage drop across the junction of the diode
and is NOT a resistance value.

If you change the resistance range, the needle will move to a slightly different position due to the resistances inside the meter.
The technical term for this is the diode is forward biased.

This indicates the diode is not faulty. The needle will swing to a slightly different position for a "normal diode" compared to a Schottky diode.

This is due to the different junction voltage drops. However we are only testing the diode at very low voltage and it may break-down when fitted to a circuit due to a higher voltage being present or due to a high current flowing.

2. The leads of an Analogue Multimeter have the positive of the battery connected to the black probe and the readings of a "good diode" are shown in the following two diagrams:

TESTING A DIODE ON A DIGITAL METER

Testing a diode with a Digital Meter must be done on the "DIODE" setting as a digital meter does not deliver a current through the probes on some of the resistance settings and will not produce an accurate reading.

The best thing to do with a "suspect" diode is to replace it. This is because a diode has a number of characteristics that cannot be tested with simple equipment. Some diodes have a fast recovery for use in high frequency circuits.

They conduct very quickly and turn off very quickly so the waveform is processed accurately and efficiently. If the diode is replaced with an ordinary diode, it will heat up as does not have the high-speed characteristic.

Self-Check 2	**Written Test**

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

I. Part I Say true if the statement is correct otherwise say false(each 2 points)

1. If a resistor is not disconnected from the circuit during measurement and any voltage is present, the value of resistance will be incorrect.
2. Always replace a capacitor with the exact same type.
3. The best thing to do with a "suspect" diode is not to replace it.

Answer the following question!

Note: Satisfactory rating 3 and 6 points Unsatisfactory below 3 and 6 points

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

Score = _____
Rating: _____

Answer Sheet

Name: _____ Date: _____

2.3 Implementing servicing system on a trial basis.

Service manuals

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

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

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

- ✓ Operating instructions/User's/Owner's manual
- ✓ Component data sheet/handbook

Operating instructions/User's/Owner's manual

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

Component data sheet/handbook

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

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

Self-Check 3	Written Test

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

Part I Say true if the statement is correct otherwise say false(each 2 points)

1. Ultimate success for an electronic or electrical product design can only be achieved through judicious selection of component parts for use in that design.
2. Before using the machine/equipment the user must read the manual carefully for his/her safety and benefit.

Answer the following question!

Note: Satisfactory rating 2 and 4 points Unsatisfactory below 2 and 4 points

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

Score = _____
Rating: _____

Answer Sheet

Name: _____ Date_____

Information Sheet 4. Detailing response to unplanned events with established procedures

2.4 Detailing response to unplanned events with established procedures

In order to know how to respond to unplanned events or conditions, one must first start in assessing or analyzing the situation. The first response should not be making an action right away, but thinking of the situation and possible solutions.

After fully understanding the situation and listing down possible solutions, it's time to take action by trying all possible means to cope with the changes or unexpected events.

If working on a project, it's helpful to create a list of planned vs unplanned events so you can also think of safety measures on how to prevent the unplanned ones even before starting on the project.

Accidents, Malfunctions and Unplanned Events refers to events or upset conditions that are not part of any activity or normal operation of the project as has been planned by Northcliff. Even with the best planning and the implementation of preventative measures, the potential exists for accidents, malfunctions or unplanned events to occur during any Project phase, and if they occur, for adverse environmental effects to result if these events are not addressed or responded to in an environmentally appropriate manner.

Many accidents, malfunctions and unplanned events are, however, preventable and can be readily addressed or prevented by good planning, design, emergency response planning, and mitigation. By identifying and assessing the potential for these events to occur, Northcliff can also identify and put in place prevention and response procedures to minimize or eliminate the potential for significant adverse environmental effects, should an accidental event occur.

As was described in Chapters 2 and 3, the Project is being designed, and will be constructed and operated, according to best practice for health, safety, and environmental protection to minimize the potential environmental effects that could result from the Project, as well as those that could result from accidents, malfunctions or

unplanned events. Prevention and mitigation will be accomplished by the following general principles:

- Use best management practices and technology for carrying out the Project while controlling permitted/allowable releases to the environment and consequent environmental effects;
- incorporate safety and reliability by design, and application of principles and practices of process and mine safety management;
- develop and apply procedures and training aimed at safe operation of the facilities that prevent or avoid the potential upsets that might lead to accidents, malfunctions or unplanned events; and
- implement effective emergency preparedness and response.

The project design, mitigation, and response procedures implemented as part of the planning stage of the project and as adapted throughout the project life are intended to minimize the potential for accidents, malfunctions and unplanned events to occur, and with their development and implementation, the potential for such events to occur will be greatly reduced. In the unlikely event of an accident, malfunction or unplanned event, emergency response plans and corrective action procedures will be implemented to minimize the resulting environmental effects. The Project will have safety measures built in to mitigate or manage potential upsets, should they occur. Employees will be trained in operational procedures and environmental emergency response procedures, including safety measures to prevent and respond to Accidents, Malfunctions and Unplanned Events.

Methodology

The focus of the assessment is on credible accidents or scenarios, namely those that although unlikely can reasonably be contemplated to possibly occur and for which the resulting adverse residual environmental effects could potentially be significant. Credible accidents and scenarios were identified based on knowledge of the project and past professional experience of northcliff, the Project designers and engineers.

While not all potential accidents, malfunctions or unplanned events can reasonably be reviewed or assessed, scenarios have been selected to conservatively represent higher consequence events that would tend to address the consequences of less likely and/or lower consequence credible accidents and scenarios.

Accidents, Malfunctions and Unplanned Events identified as credible were evaluated in isolation, as the likelihood of a series of accidental events triggered by natural events occurring in combination with each other is very low (e.g., extreme weather coincident with an extreme seismic event).

It is not reasonable, nor possible, to assess the occurrence of a series of accidental events occurring in series or in parallel, particularly if the focus is on the environmental effects themselves rather than the mechanism by which the accident and associated environmental effects may occur. These possible events, on their own, generally have a low probability of occurrence and thus their environmental effects are of low likelihood.

They have an even lower probability or likelihood of occurring together— thus their combination is not considered credible, nor of any measurable likelihood of occurrence. likewise, the assessment of cumulative environmental effects of accidents, Malfunctions and unplanned events in combination with the planned project activities, as well as any overlap of such accidents, malfunctions or unplanned events with other projects or activities that have been or will be carried out, is not a credible or reasonably likely outcome—these highly unlikely scenarios have thus not been assessed herein.

Following identification of credible accidents and scenarios, a preliminary screening was conducted on these credible accidents, malfunctions and unplanned events to determine if and how the accident and/or scenario is likely to interact with each identified valued environmental component.

Selection of Accidents, Malfunctions and Unplanned Events

To accomplish this requirement, a list of potential accidents, malfunctions and unplanned events was created by the EIA Study Team in consultation with Northcliff and its engineering team based on its knowledge of the Project as conceived during the feasibility study, and based on experience with other mines.

This listing was then reviewed by various technical experts on the Project Team (e.g., biologists, planners, design engineers, geotechnical engineers, and other scientists, engineers and professionals), and subsequently refined to only include events that were considered to be credible, i.e., those that although unlikely can reasonably be contemplated to possibly occur and for which the resulting adverse residual environmental effects could potentially be significant.

Environmental effects of those credible accidents, malfunctions or unplanned events on each applicable VEC were assessed, and a determination of significance was made in consideration of the various significance criteria previously defined for each VEC. The accidents, malfunctions or unplanned events that were considered to be non-credible and the rationale why they are considered non-credible are discussed, but their environmental effects are not evaluated further as they are not considered possible, and thus more than not likely to occur.

Based on these considerations, the potential accidents, malfunctions and unplanned events that were considered by the Study Team for the Sisson Project are:

- Loss of Containment from Tailings Storage Facility (TSF);
- Erosion and Sediment Control Failure;
- Pipeline Leak;
- On-Site Hazardous Materials Spill;
- Release of Off-Specification Effluent from the Water Treatment Plant;

- Failure of a Water Management Pond;
- Failure of a Water Management Pond Pump;
- Off-Site Trucking Accident;
- Vehicle Collision;
- Uncontrolled Explosion; and
- Fire.

Self-Check 4.	Written Test

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

Part I Say true if the statement is correct otherwise say false(each 2 points)

1. It is not reasonable, nor possible, to assess the occurrence of a series of accidental events occurring in series or in parallel, particularly if the focus is on.
2. In order to know how to respond to unplanned events or conditions, one must not first start in assessing or analyzing the situation.

Answer the following question!

Note: Satisfactory rating 2 and 4 points Unsatisfactory below 2 and 4 points

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

Answer Sheet

Score = _____
Rating: _____

Name: _____ Date: _____

2.5 Appropriate personnel makes approval to implement contingencies with established procedures.

Contingency planning isn't just about major crises and natural disasters. It can also prepare you for more commonplace problems, such as the loss of data, staff, customers, or business relationships. That's why it's important to make contingency planning a routine part of the way you work.

Contingency planning is one response to risk. But in some cases it may be safer or more cost-effective to tackle it in other ways: to avoid the risk, by investing in new equipment, for example; or to share the risk, by purchasing an insurance policy. Or you may choose not to formally plan for some lower-priority risks at all, but to manage them if they do happen.

What Does a Contingency Plan Cover?

A good contingency plan can prevent your business from "going under" when unexpected events occur, so it's vital to ensure that it's fit for purpose.

Here are the key elements to include:

Scenarios

Refer to your risk assessment and impact/probability charts and choose the most damaging or most likely scenarios that you want to plan for. Then, map out what should happen in each case.

Aim to include a broad range of scenarios – for instance, cyber attacks, prolonged staff absences, IT malfunctions, loss of suppliers, serious power outages.

Triggers

Specify what, exactly, will cause you to put your contingency plan into action. If you have a plan for heavy snow, will it be triggered by a severe weather warning, or only by actual snowfall?

One event could also have multiple triggers, each of which initiates a different part of your plan.

Response

Include a brief overview of the strategy that you will follow in response to the event. This provides a context for the actions that you ask your people to take.

Who to Inform

Identify the people who need to know about what's happened. This could include employees, suppliers, customers, and the wider public, as appropriate. Our article, explores how to plan and deliver effective communication in difficult situations.
Also, make sure that you are aware of your legal obligations, and that incidents are reported to the relevant authorities where necessary.

Key Responsibilities

Define who's responsible for each element of the plan, who will be in charge at each stage, and what you expect them to accomplish.

Timeline

State what needs to be done within the first hour, day and week of the plan being implemented.

This could be as simple as, "Inform employees of the situation immediately." But you may need far more detailed timelines for certain situations, such as data breaches , serious workplace injuries, or leaks of hazardous materials.

Also include details of when you would expect normal business to resume, and what will signal that your organization is ready for this.

Contingency Plan Examples

Scenario	Trigger	Response	Who to inform?	Key Responsibilities		Timeline	
One team member has expertise in one of your most important systems, and nobody else knows how it works. His or her absence could delay essential work.	The team member is absent/sick/ leaves the company unexpectedly.	Use instruction manual for software.	Head of department.	Who	What	What	When
			Team manager.	Head of department.	Oversee situation.	Alert head of department.	As soon as absence is confirmed.
			Team members.	Team manager.	Maintain contact with team; assess situation and offer support.	Team manager and team members to be informed of situation and necessary actions.	As soon as possible.
				Team members			

Note:

These examples show just one possible way to present your contingency plan. You may prefer to use another format, such as a flow chart or slideshow. Choose a style that suits your needs and which captures all of the necessary information.

Developing Your Contingency Plan

When you develop your contingency plan, remember that your primary aim is to maintain or restore critical business operations, so look closely at how these might be affected by each scenario.

Be aware of knock-on effects. Will your organization be able to function at full capacity when you implement your "Plan B," or will it reduce your productivity? If so, for how long?

Involve Your People

To answer questions like these, it's useful to consult people from across your organization.

Managers from different departments can advise you on the impact of disruptive events on services, staff, resources, and business functions. And "frontline" employees are often best placed to tell you about the minimum tools and support they require to maintain essential operations.

Take the time to share your plan across your organization, so that people can offer feedback and ask questions. Use this process to make your plan even more robust.

And, if possible, conduct drills to assess the efficacy of your plan. This can highlight areas for improvement, and reveal skills gaps or training needs .

Self-Check 5	Written Test

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

Part I Say true if the statement is correct otherwise say false(each 2 points)

1. Take the time to share your plan across your organization, so that people can offer feedback and ask questions.
2. State what needs to be done within the first hour, day and week of the plan being implemented.
3. Define who's responsible for each element of the plan, who will be in charge at each stage, and what you expect them to accomplish.

Answer the following question!

Note: Satisfactory rating 3 and 6 points Unsatisfactory below 3 and 6 points

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

Answer Sheet

Score = _____

Rating: _____

Name: _____ Date: _____

Information Sheet 6. Implementing home/office products and associated circuit servicing and maintenance with requirements.

2.6 Implementing home/office products and associated circuit servicing and maintenance with requirements.

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

Just one mishap could spark an electrical fire, so be sure to keep these steps in mind for proper electrical maintenance.

1. Remember the golden rule: Safety first

You should never start any home maintenance or repair work without proper preparation and safety tools. When working with electrical items, make sure to unplug the unit or turn off the power to the specific circuit. Don't forget that water and electricity don't get along, so make sure to unplug anything electric before cleaning. Never use a metal ladder when performing electrical tasks.

When you have children in the house, put protectors over plugs to make sure their curious hands won't be shocked by the outlet. If you notice the lights are constantly flickering or you feel a mild electric shock when plugging an item into an outlet, call a professional to inspect your home for potentially serious electrical issues.

2. **Use electronics accordingly**

It's important to be smart about how you're using electronics. Avoid plugging in too many things into one circuit, which can overload it and cause a power outage. Be mindful of where you place small appliances and electronics, such as toaster ovens and hair dryers. Make sure they're not under any vents that could potentially drip on them or are too close to a source of water, such as sinks and showers.

Further, the Occupational Safety and Health Administration recommends installing ground-fault circuit interrupters for all of the outlets in wet locations, such as kitchens, bathrooms and laundry rooms. They're designed to turn off electric power immediately in the event of an incident, which can be a potentially life-saving feature.

Another simple maintenance step is to keep cords clear, making sure they aren't covered by furniture or rugs. It's also important to save electricity when you can, turning lights and appliances off when they're not in use and using energy-efficient light bulbs.

Be mindful of plugs, wires

Treat your plugs kindly and don't force them to fit into outlets. Don't try to bend and adjust the prongs, as this could cause an electric shock. Alternatively, if it's loose inside the outlet, it may be time to replace the cord for a fresh plug. Replace old outlets with new electric sockets with advanced safety features, such as built-in surge protectors. Unplug extension cords when you're not using them to avoid an electric and fire hazard. When you're outside, only use cords and electrical items that are specifically for the outdoors.

If you notice any frayed wires, make sure to replace them before they cause shocks or fires. Ideally, you should turn off, unplug and cut the power to the appliance or item with the frayed wire. You can call a professional to help replace damaged appliance wires. If you have just purchased an older home, you may want to have a professional perform a full wiring inspection before doing any electrical DIY.

1. **Schedule routine professional check ups**

Electricity can be dangerous, so never hesitate to call a licensed electrician for help. In fact, one of the most important steps in good electrical maintenance is having a professional inspect your system at least once a year. An electrician can check your electric panel, replace damaged wires and test circuit breakers.

Being prepared for an electrical emergency is the best defense. Having an interior electrical home warranty and/or an exterior electrical home repair plan is always a good idea.

Acquiring Service manuals and service information

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

Service information

Record all information during maintaining/repairing electronically-controlled domestic appliance.

Self-Check 6	Written Test

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

Part I Say true if the statement is correct otherwise say false(each 2 points)

1. Service manual is not the full written information provided by the manufacturer regarding the equipment.
2. Electricity can be dangerous, so never hesitate to call a licensed electrician for help.
3. Treat your plugs kindly and don't force them to fit into outlets.

Answer the following question!

Note: Satisfactory rating 3 and 6 points Unsatisfactory below 3 and 6 points

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

Answer Sheet

Score = _____
Rating: _____

Name: _____ Date: _____

1.7 Identifying and organizing technique and approach for maintenance of servicing

Maintenance Techniques

1. Preventive Maintenance
2. Corrective (Pre-determined) Maintenance

1. Preventive Maintenance

Preventive maintenance can be defined as follows: Actions performed on a time- or machine-run-based schedule that detect, preclude, or mitigate degradation of a component or system with the aim of sustaining or extending its useful life through controlling degradation to an acceptable level.

- Advantages
  - ✓ Cost effective in many capital-intensive processes.
  - ✓ Flexibility allows for the adjustment of maintenance periodicity.
  - ✓ Increased component life cycle.
  - ✓ Energy savings.
  - ✓ Reduced equipment or process failure.
  - ✓ Estimated 12% to 18% cost savings over reactive maintenance program.
- Disadvantages
  - ✓ Catastrophic failures still likely to occur.
  - ✓ Labor intensive.
  - ✓ Includes performance of unneeded maintenance.
  - ✓ Potential for incidental damage to components in conducting unneeded maintenance.

Depending on the facilities current maintenance practices, present equipment reliability, and facility downtime, there is little doubt that many facilities purely reliant on reactive maintenance could save much more than 18% by instituting a proper preventive maintenance program.

While preventive maintenance is not the optimum maintenance program, it does have several advantages over that of a purely reactive program.By performing the preventive maintenance as the equipment designer envisioned,we will extend the life of the equipment closer to design. This translates into cost savings.

Preventive maintenance (cleaning, lubrication, tightening, re-soldering etc.) will generally run the equipment more efficiently resulting in dollar savings. While we will not prevent equipment catastrophic failures, we will decrease the number of failures. Minimizing failures translate into maintenance and capital cost savings.

A quality preventive maintenance program requires a highly motivated preventive maintenance crew. To provide proper motivation, the following activities are suggested:

- Establish inspection and preventive maintenance as a recognized, important part of the overall maintenance program
- Assign competent, responsible people to the preventive maintenance program
- Monitor and follow-up on tasks to ensure quality performance and to show everyone that management does care
- Provide training in precision maintenance on specific equipment
- Set high standards
- Publicize reduced costs with improved up-time and revenues, which are the result of effective preventive maintenance

2. Corrective (Predetermined) Maintenance

Corrective maintenance is reactive in nature. Every time a product or system fails, repair or restoration must follow to restore its operability.

The following steps constitute corrective maintenance:

- Once the failure has been detected, it must be confirmed. If the failure is not confirmed, the item generally is returned to service. This no-fault-found problem leads to a considerable waste of time at significant cost. It also entails carrying an unnecessarily large inventory all the time.

- If the failure is confirmed, the item is prepared for maintenance and the failure report is completed.
- Localization and isolation of a failed part in the assembly is the natural next step in corrective maintenance.
- The failed part is removed for disposal or repair. If disposed of, a new part is installed in its place. Examples of repairable parts and connections include broken connections, an open circuit board on a PCB, or a poor solder.
- The item may be reassembled, realigned, and adjusted after repair. It is checked before being put back to use.

The chief disadvantage of this maintenance procedure is the inherent amount of uncertainty associated with it. Similarly, the procedure is extremely reactive in nature, capable of shutting down an entire operation because of a single failure in a single machine under extreme conditions (often leading to a severe bottleneck and lost productivity).

As a result of its drawbacks, another, more proactive maintenance method (recognizing that equipment needs periodic maintenance to function smoothly, which should be provided before a breakdown occurs) was developed.

Self-Check 7.	Written Test

Directions: Answer all the questions listed below. Use the Answer sheet provided in the next page(each 5 points)

1. Write the disadvantages of preventive maintenance!
2. Write maintenance techniques!

Answer the following question!

Note: Satisfactory rating 6 and 10 points Unsatisfactory below 6 and 10 points

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

Answer Sheet

Score = _____
Rating: _____

Name: _____ Date: _____

References

BEEES Level-1(M10)

Basic Home/Office Level-2

Stantec (Environmental Impact Assessment) Report

http://www.ceaa-acee.gc.ca

MindTools (http://www.mindtools.com)

HomeServe (http://www.homeserve.com)

ScienceDirect (http://www.sciencedirect.com)

L #13	LO #3- Evaluate and document servicing system

Instruction sheet

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

- Making adjustment with established procedures.
- Rectifying and replacing faulty components without damage to the surrounding
- Undertaking on going checks of the quality of the work.
- Testing consumer electronic products and associated circuits to ensure safety of installation.
- Servicing electronic products and associated circuits with established procedures.

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

- Make adjustment with established procedures.
- Rectify and replacing faulty components without damage to the surrounding
- Undertake on going checks of the quality of the work.
- Test consumer electronic products and associated circuits to ensure safety of installation.
- Service electronic products and associated circuits with established procedures.
- Ggggggg

Learning Instructions:

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

nformation Sheet 1 Making adjustment with established procedures.

2.1 Making adjustment with established procedures.

Many adjustments cost little or nothing, are quite straightforward to arrange and are often a matter of flexibility and developing a creative approach to working practice. There is an expectation that managers and employees will work together to develop workable solutions.

Procedure for making reasonable adjustments

1. Difficulties identified/disability established

2. Sources of support identified and requests for advice (if required)

3. Reasonable adjustments assessment completed in all cases

4. Tailored adjustments agreement completed, filed and diarized for review

Reasonable Adjustments Assessment Form

The reasonable adjustments assessment form should be completed by the manager in consultation with the employee. It has been designed to assist managers who may be unsure whether adjustments being requested are reasonable.

The questions are formulated to assist the manager in to coming to a decision on whether or not an adjustment is reasonable. If the adjustment is deemed to be reasonable after completion of this form a tailored adjustment agreement should be completed and recorded.

There may be situations where you, as the manager may need to consult other employees with regards to reasonable adjustments. If the employee does not agree to your involving other employees, you must not breach their confidentiality by telling the other employees about the disabled person's situation.

If an employee is reluctant for other staff to know, and you believe that a reasonable adjustment requires the co-operation of the employee's colleagues, explain that you cannot make the adjustment unless they are prepared for some information to be

shared. It does not have to be detailed information about their condition, just enough to explain to other staff what they need to do.

There may be occasions when a manager feels it is not reasonable to make the adjustments identified, particularly if this impacts on contractual, equality or health and safety issues. On these occasions the Manager should seek advice from Human Resources.

Tailored Adjustments Agreement

The attached Tailored Adjustment Agreement Form should be completed when agreeing any adjustments with an employee.

It is designed to allow discussions to take place between an employee and their manager to identify appropriate adjustments that will provide support for the employee to carry out their role effectively, and without barriers.

Adjustments may be required at any time during the employment process; an employee does not have to have had a period of sickness in order for adjustments to be considered.

If a manager is unsure what adjustment may be appropriate they should contact Human Resources or the Occupational Health department for advice and support.

Tailored Adjustment Agreement – individually tailored reasonable adjustments

This 'Tailored adjustment agreement' is a living record of reasonable adjustments agreed between a disabled employee and their line manager.

The purpose of this agreement is to:

Ensure that both parties, the individual and the manager acting on behalf of the employer, have an accurate record of what has been agreed.

Minimise the need to re-negotiate reasonable adjustments every time the employee changes jobs, is re-located or assigned a new manager within the council.

Provide employees and their line managers with the basis for discussions about reasonable adjustments at future meetings.

This is a live document and should be reviewed regularly by both the employee and manager and amended as appropriate. Remember, however, that expert advice from third parties, such as occupational health, Access to Work or I.T. specialists may be needed before changes can be agreed and implemented.

Where management responsibility for an employee with a 'Tailored adjustment agreement' changes then the new manager should accept the adjustments outlined in the agreement as reasonable and ensure that they continue to be implemented. The agreement may need to be reviewed and amended at a later date but this should not happen until both parties have worked together for a reasonable period of time.

The agreement allows the employee to:

• Explain the impact of your disability on you at work

• Suggest adjustments that will make it easier for you to do your job

• Offer further information from your doctor, specialist or other expert

• Request an assessment by occupational health, Access to Work or another expert (there may be a cost with Access to Work or another expert)

• Review the effectiveness of the adjustments agreed

• Explain any change in your circumstances

• Be reassured that your manager knows what to do if you become unwell at work and who to contact if necessary

• Know how and when your manager will keep in touch with you if you are absent from work because of illness or a disability related reason.

Adjusting redundancy selection criteria:

For example:

An employee with an autoimmune disease has taken several short periods of absence during the year because of the condition. When their employer is taking the absences into account as a criterion for selecting people for redundancy, they discount these periods of disability related absence.

It may sometimes be necessary for an employer to take a combination of steps.

For example:

A woman who is blind is given a new job with her employer in an unfamiliar part of the building. The employer:

• Arranges facilities for her assistance dog in the new area

• Arranges for her new instructions to be in Braille, and

• Provides disability equality training to all staff.

In some situations, a reasonable adjustment will not work without the co-operation of other employees. Your other staff may therefore have an important role in helping make sure that a reasonable adjustment is carried out in practice. You must make Sure that this happens. It is unlikely to be a valid 'defence' to a claim under equality law for a failure to make reasonable adjustments to argue that an adjustment was unreasonable because your other staff were obstructive or unhelpful when you tried to make an adjustment happen. You would at least need to be able to show that you took all reasonable steps to try and resolve the problem of the attitude of your other staff.

Self-Check -1	Written Test

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

1. Write down the procedures for making reasonable adjustments!

Answer the following question!

Note: **Satisfactory rating - 3 and 5 points** **Unsatisfactory - below 3 and 5points**

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

Answer Sheet

Name: _____ Date: _____

Score = _____
Rating: _____

Information Sheet 2 Rectifying and replacing faulty components without damage to the surrounding

3.2.Rectifying and replacing faulty components without damage to the surrounding

How to Remove Electronic Components from a Flexible Circuit Board

Flexible circuit boards consist of various electronic components that are soldered in order to form a complete circuit.

However, sometimes one or more of these components may get damaged or start malfunctioning because of any technical issue.

In such cases, damaged components can render the entire flex PCB of no use. To rectify this issue, you will need to desolder the malfunctioning component from the circuit board and replace it with a new one.

Desoldering is not as easy process as soldering, because if you are not careful enough, you might end up causing damage to the neighboring components as well.

Operation Sheet 1 Procedures of replacing faulty components

1. Preheat the soldering iron

In order to melt the solder, preheat a soldering iron (25W or 30W capacity, not more than that) for approximately five to ten minutes.

2. Clean the tip of your soldering iron.

While the iron is heating, clean its tip with the help of a wet sponge. Wipe the sponge two or three times in order to thoroughly clean the tip.

3.Locate the terminals of the components to be removed.

In this step, you will need to locate or roughly mark the components that you need to take off the flex PCB and identify their terminals.

4. Place the desoldering braid on flexible circuit board.

From a spool of desoldering braid, unroll approximately 1 inch (2.5 cm) and place it on the board in such a way that its tip is pressed over the solder and one leg of the electronic component on the PCB.

5. Melt the solder using heated iron.

Place the tip of the heated solder iron on top of the desoldering braid in such a way that it will cause melting of the solder around the electronic component that is to be removed. The melted solder will get wicked into the braid and the leg of component will come off of the circuit board.

6. Remove the solder iron and desolder braid.

As soon as the solder gets absorbed in the desoldering braid, you need to take the iron and braid away from the flexible circuit board to avoid undesired melting of solder surrounding other components.

7. Take off other legs of the electronic component.

In order to remove the component completely, repeat steps 5 and 6 and take off other legs of the component. Once the component is completely free, let it cool for some time and then lift it off the board. If the electronic component is very small in size, then you can use a fork or tweezers (forceps) to pick it off the board.

Self-Check -2	Written Test

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

Say true if the statement is correct otherwise false if it is incorrect(each 2 points)

1. Flexible circuit boards consist of one electronic component that is soldered in order to form a complete circuit.
2. Desoldering is not as easy process as soldering, because if you are not careful enough, you might end up causing damage to the neighboring components as well.
3. As soon as the solder gets absorbed in the desoldering braid, you need not to take the iron and braid away from the flexible circuit board to avoid undesired melting of solder surrounding other components.
4. When the soldering iron is getting heat we have to clean its tip.

Answer the following question!

Note: **Satisfactory rating - 4 and 8 points** **Unsatisfactory - below 4 and 8 points**

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

Answer Sheet

Name: _____ Date: _____

Score = _____

Rating: _____

nformation Sheet 3 Undertaking on going checks of the quality of the work.

3.3 Undertaking on going checks of the quality of the work.

High levels of quality are essential to achieve Company business objectives. Quality, a source of competitive advantage, should remain a hallmark of Company products and services. High quality is not an added value; it is an essential basic requirement. Quality does not only relate solely to the end products and services a Company provides but also relates to the way the Company employees do their job and the work processes they follow to produce products or services.

The work processes should be as efficient as possible and continually improving. Company employees constitute the most important resource for improving quality. Each employee in all organizational units is responsible for ensuring that their work processes are efficient and continually improving.

Top management should provide the training and an appropriate motivating environment to foster teamwork both within and across organizational units for employees to improve processes.

Ultimately, everyone in a Company is responsible for the quality of its products and services.

A Company in the role of a sponsor of clinical trials can best achieve its business objectives by establishing and managing robust quality systems with their integral quality documents including standard operating procedures.

Quality system

A quality system is defined as the organizational structure, responsibilities, processes, procedures and resources for implementing quality management. Quality management includes those aspects of the overall management function that determine and implement the Company quality policy and quality objectives. Both quality control and quality assurance are parts of quality management.

Top management commitment and active involvement in the establishment, management and monitoring of quality systems is critical and is achieved by:

- Defining and documenting a quality policy and quality objectives and ensuring that both the policy and objectives are understood and implemented by all employees at all levels;
- Ensuring that appropriate processes are implemented to fully satisfy customer needs and expectations and Company objectives;
- Defining and documenting the responsibility, authority and interrelation of key personnel managing the quality systems;
- Providing adequate resources for implementing and maintaining the quality systems;
- Conducting scheduled management reviews of the quality systems to assess their continued suitability, adequacy, effectiveness and efficiency; and
- Deciding on actions for continual quality improvement.

Quality control is focused on fulfilling quality requirements, and as related to clinical trials, it encompasses the operational techniques and activities undertaken within the quality assurance system to verify that the requirements for quality of the trial-related activities have been fulfilled.

Quality control is generally the responsibility of the operational units and quality is infused into the outputs and verified as they are being generated. Therefore, quality control is an integral part of the daily activities occurring within each operational unit.

It’s not enough to make sure you get a project done on time and under budget. You need to be sure you make the right product to suit your stakeholders’ needs. Quality means making sure that you build what you said you would and that you do it as efficiently as you can. And that means trying not to make too many mistakes and always keeping your project working toward the goal of creating the right product.

Everybody “knows” what quality is. But the way the word is used in everyday life is a little different from how it is used in project management. Just like the triple constraint (scope, cost, and schedule), you manage quality on a project by setting goals and taking measurements. That’s why you must understand the quality levels your

stakeholders believe are acceptable, and ensure that your project meets those targets, just like it needs to meet their budget and schedule goals.

Quality reports and indicators provide documentation of the quality features of statistical products. They are the key reference documents for quality assessment. For this reason they form an important input for auditing and self-assessment

Self-Check -3	Written Test

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

Say true if the statement is correct otherwise false if it is incorrect(each 2 points)

1. Quality reports and indicators provide documentation of the quality features of statistical products.
2. Quality control is generally the responsibility of the operational units and quality is infused into the outputs and verified as they are being generated.
3. Conducting scheduled management reviews of the quality systems to assess.
4. The work processes should not be as efficient as possible and continually improving.

Answer the following question!

Note: **Satisfactory rating - 4 and 8 points** **Unsatisfactory - below 4 and 8 points**

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

Answer Sheet

Name: _____ Date: _____

Score = _____

Rating: _____

nformation Sheet 4 Testing consumer electronic products and associated circuits to ensure safety of installation.

3.4.Testing consumer electronic products and associated circuits to ensure safety of installation.

Electricity revolutionized society, and quickly spread from industries to offices, shops and homes. Nowadays, electrically powered equipment is everywhere.

No wonder this is one of the building blocks of safety testing! Much more than merely meeting the latest recognized standards, electrical safety testing is about protecting the people for whom a product was designed and the environment in which it will be used. Safety testing is the fundamental building block in obtaining access to global markets.

Here are five important reasons to have your product tested for electrical safety before it goes to market.

1. Safety testing is legally required

Remember that there is always a legal obligation to ensure that your product is safe before bringing it to market. The legal requirements for electrical safety may be determined by the Low Voltage Directive, the Medical Device Directive, the Radio Equipment Directive, the Machinery Directive, or other relevant directives. If a product is not already covered by other directives, the General Product Safety Directive (GPSD) serves as a catch-all.

A common misconception is that there are no safety requirements for electronic products as long as the voltage is low enough. Indeed, some low-voltage products are not covered by the Low Voltage Directive, but in those cases, another applicable directive will still impose electrical safety requirements. Dangerous products may not be sold.

2. It minimizes the risk of injury during product use

An electrical safety test provides insight into whether or not one's product is safely designed, such that one can avoid or reduce the risk of the product being the cause of damage or injury to people, pets and property. The product must therefore be designed

and produced in such a way that a potentially dangerous condition, in which an internal or external event may result in damage - that is, a hazard - does not arise.

3. accredited electrical safety tests lead to greater safety

If a test is accredited, that means that the testing facility is subject to quality inspections (audits) from an authority and/or professional organization (for FORCE Technology, these are DANAK and IECEE CB Scheme). The auditor verifies that a test is performed in a methodically correct manner, and that personnel are trained to perform the test, which includes ensuring that they are capable of making the many technical assessments that are part of the standards in use.

An accredited and certified test report from a testing facility like force technology is the best proof of proper, independent testing, and is therefore more useful to you than unaccredited test reports.

4. It leads to improved technical documentation

The results of an electrical safety test are recorded in a test report, which is collected in the product's technical file. The technical file must be made available for inspection by a significant part of an electrical safety test is a design documentation review. Often, far less than half of the testing period is spent actually performing tests. Most of the time is spent examining the product and its documentation. Authorities while the product is available for sale, and for ten additional years after that.

For this reason, manufacturers virtually always find that their technical documentation is significantly improved when they perform electrical safety tests. This gives you the confidence that, upon request from national authorities and in the event that any damage or injury should occur, you have taken the appropriate steps to make your product safe and secure.

5. It leads to design improvements

In the course of electrical safety testing, many businesses find that they develop new, detailed technical knowledge of their own product. Initially, the manufacturer simply becomes certain of how to make the product safe. Gradually, however, as the approval

project continues on, the product developer often gains insight into their own product, creating opportunities to optimize the product's design. In this manner, a foundation for the growth of new ideas and general improvements is created, while the product is made legal and safe.

Self-Check -4	Written Test

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

Say true if the statement is correct otherwise false if it is incorrect(each 2 points)

1. The results of an electrical safety test are recorded in a test report, which is collected in the product's technical file.
2. A common misconception is that there are no safety requirements for electronic products as long as the voltage is low enough.
3. Remember that there is no always a legal obligation to ensure that your product is safe before bringing it to market.

Answer the following question!

Note: **Satisfactory rating - 3 and 6 points** **Unsatisfactory - below 3 and 6 points**

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

Answer Sheet

Name: _____ Date: _____

Score = _____

Rating: _____

nformation Sheet 5 Servicing electronic products and associated circuits with established procedures.

1.5 Servicing electronic products and associated circuits with established procedures.

Some basic servicing tools

1. wire cutters, clippers and nippers

These wire cutters are small and accurate.

Great for cutting, clipping and nipping of small diameter wires and component leads. These precision flush cutting nippers wire cutters/clippers help you clip leads as close to the board surface as you want to.

2. soldering iron

They are hand tools used in soldering. They supply heat to melt solder so that it can flow into the joint between two work pieces. Some of the more common types are the soldering iron, soldering gun, resistance soldering set. The soldering iron is composed of a heat metal tip and insulated handle.

Heating is often achieved electrically by passing electric current through a resistive heating element. All high quality soldering irons operate in the temperature range of 500 to 600°F.

3. screw drivers

A screw driver is used to tighten or remove screws from electrical and household components. There are two major types of screw drivers:flat head screw driver and star screw drivers. There are other types of screw drivers for different types of screws. .

Note : always use original part number of the replacement purpose.

Replacing defective parts/components

Once the fault location and the type of faulty component is identified in the fault diagnosis section, obviously the next task is to correct (trouble shoot) it. It is act of connecting the disconnecting circuit or replacing the faulted component with the same type, rate and size components. The selection of components according to their correct specification and soldering skill are determining factor for the replacement is effective.

To replace the defective component:

- ✓ Prepare soldering tools and equipment's, new component to be replaced
- ✓ Remove the defective one by applying correct disordering technique.
- ✓ Put in place the new component in the correct direction (keep correct polarity)
- ✓ Solder it by applying good soldering technique

Safety

- ✓ Take care of not to touch high voltage side
- ✓ Wear apron, Glove, safety shoe
- ✓ Follow all cautions, warnings, and instructions marked on the equipment.
- ✓ Ensure that the voltage and frequency rating of the power outlet matches the electrical rating labels on the system.
- ✓ Use properly grounded power outlets.
- ✓ Disconnect the power before you replace/repair the faulty device
- ✓ Discharge capacitor first before replacing it.

Replacing a capacitor

Always replace a capacitor with the exact same type. A capacitor may be slightly important in a circuit or it might be extremely critical. A manufacturer may have taken years to select the right type of capacitor due to previous failures.

A capacitor just doesn't have a "value of capacitance." It may also have an effect called "tightening of the rails." In other words, a capacitor has the ability to react quickly and either absorb or deliver energy to prevent spikes or fluctuations on the rail.

This is due to the way it is constructed. Some capacitors are simply plates of metal film while others are wound in a coil. Some capacitors are large while others are small. They all react differently when the voltage fluctuates. Not only this, but some capacitors are very stable and all these features go into the decision for the type of capacitor to use.

You can completely destroy the operation of a circuit by selecting the wrong type of capacitor. No capacitor is perfect and when it gets charged or discharged, it appears to have a small value of resistance in series with the value of capacitance. This is known as "ESR" and stands for Equivalent series resistance. This effectively makes the capacitor slightly slower to charge and discharge.

We cannot go into the theory on selecting a capacitor as it would be larger than this book so the only solution is to replace a capacitor with an identical type. However, if you get more than one repair with identical faults, you should ask other technicians if the original capacitor comes from a faulty batch. Some capacitor are suitable for high frequencies, others for low frequencies.

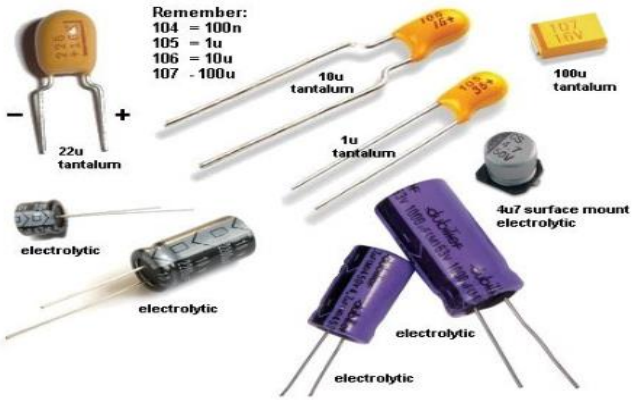


Figure12.1. Different types Capacitors

Remember:

- ✓ Please do not use any replacement that has smaller capacitance value and lower Voltage than the original one. Otherwise the equipment may not work and in worst cases, it could blow up the Capacitor.

Replacing Transistor

If you can't get an exact replacement, refer to a transistor substitution guide to identify a near equivalent.

The important parameters are:

- Voltage
- Current
- Wattage
- Maximum frequency of operation

The replacement part should have parameters equal to or higher than the original. Points to remember:

- Polarity of the transistor i.e. PNP or NPN.
- At least the same voltage, current and wattage rating.
- Low or high frequency type.
- Check the pinout of the replacement part
- Use a de-soldering pump to remove the transistor to prevent damage to the printed circuit board.
- Fit the heat sink.
- Check the mica washer and use heat-sink compound
- Tighten the nut/bolt - not too tight or too loose.
- Horizontal output transistors with an integrated diode should be replaced with the same type.

Replacing a Diode

It is always best to replace a diode with the same type but quite often this is not possible. Many diodes have unusual markings or colours or "in-house" letters.

This is only a general guide because many diodes have special features, especially when used in high frequency circuits. However, if you are desperate to get a piece of equipment working, here are the steps:

- Determine if the diode is a signal diode, power diode, or zener diode.
- For a signal diode, try 1N4148.
- For a power diode (1 amp) try 1N4004. (for up to 400v)
- For a power diode (3 amp) try 1N5404. (for up to 400v)
- For a high-speed diode, try UF4004 (for up to 400v)
- If you put an ordinary diode in a high-speed application, it will get very hot very quickly.
- To replace an unknown zener diode, start with a low voltage such as 6v2 and see if the circuit works.
- The size of a diode and the thickness of the leads will give an idea of the current capability of the diode.

- Keep the leads short as the PC board acts as a heat-sink.
- You can also add fins to the leads to keep the diode cool.

Replacing IGBT/SCR:

As for these component use the explanation of The bipolar transistors to find the equivalent part number or replacement.

Replacing Power IC

It is always recommended to Replace Power IC with the original part number, in fact if you carefully study the internal specification of the Power IC, you could get a replacement.

Although there are some successes in finding a replacement and you can face a problem with replacement Power IC.

Self-Check -5	**Written Test**

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

Say true if the statement is correct otherwise false if it is incorrect(each 2 points)

1. Please do use any replacement that has smaller capacitance value and lower Voltage than the original one.
2. Take care of not to touch high voltage side while servicing.
3. Once the fault location and the type of faulty component is identified in the fault diagnosis section, obviously the next task is to correct it.
4. Always do not use original part number of the replacement purpose.

Answer the following question!

Note: **Satisfactory rating - 4 and 8 points** **Unsatisfactory - below 4 and 8 points**

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

Answer Sheet

Name: _____ Date: _____

Score = _____

Rating: _____

Reference

Guide-Reasonable Adjustments V1.0

1. ICH Harmonized Tripartite Guideline. Guideline for Good Clinical Practice [E6 (R1)] Current step 4 version (including the post step 4 correction): http://www.ich.org [last dated on 1996 June 10]

2. BS EN ISO 9001:2008. Quality Management Systems. Requirements [Google Scholar]

3. BS EN ISO 19011:2002. Guidelines for Quality and/or Environmental Management Systems Auditing [Google Scholar]

4. Brian L Cheetham., editor. Prepared by European Forum for GCP Audit Working Group. 2005. The ENGAGE (European Network of GCP Auditors and other GCP Experts) Guideline. Optional Guideline for Good Clinical Practice Compliance and Quality Systems Auditing. [Google Scholar]

5. Tague NR. The Quality Toolbox. 2nd ed. Milwaukee, Wisconsin, ASQ Quality Press; 2005. pp. 390–2. [Google Scholar]

6. BS EN ISO 9004:2009. Managing for the Sustained Success of an Organization. A Quality Management Approach [Google Scholar]

Safety Testing for Electrical products (DEKRA)

Force Technology (http://www.forcetechnology.com)

Trouble shooting AC/DC power supply Level-1(M13)

Electronic and Electrical Servicing (http://www.routledge.com)

AKNOWLEDGEMENT

We wish to extend thanks and appreciation to the many representatives of TVET instructors and who donated their time and expertise to the development of this TTLM.

We would like also to express our appreciation to the TVET instructors, TVET College/ Institutes, and Federal Technical and Vocational Education and Training Agency (FTVET) who made the development of this curriculum with required standards and quality possible.

This TTLM developed on February 2021 at Bishoftu Bin International Hotel.

The trainers who developed the TTLM

No	Name	Qual.	Educational background	Region	E-mail
1	Kedir Abdi	B	Communication	Dire Dawa	acdckedir@gmail.com
3	Moges Chere	A	Communication	Addis Ababa	Engc147@gmil.com
2	Mamo Gnamo	A	Control	South	mamognamo@gmail.com

Answer key for self-check

Module Title: Develop Servicing Procedures for Home/Office Electrical/Electronic Equipment

LO #1- Plan and prepare servicing system

Self-Check -1	**Written Test**

Directions: Answer all the questions listed below.

I. Say True or False

1**.** T

2. F

Self-Check -2	**Written Test**

Directions: Answer all the questions listed below.

I. Say True or False

1**.** T

2. F

3. T

Self-Check -3	**Written Test**

Directions: Answer all the questions listed below.

I. Say True or False

1**.** T

2. T

3. T

Self-Check -4	**Written Test**

Directions: Answer all the questions listed below.

I. Say True or False

1. F

2. T

3. T

4. T

Self-Check -5	Written Test

Directions: Answer all the questions listed below.

I. Say True or False

1. T

2. T

3. F

Module Title: Develop Servicing Procedures for Home/Office Electrical/Electronic Equipment

LO #2- Implement servicing system

Self-Check -1	Written Test

Directions: Answer all the questions listed below.

I. Say True or False

1. T

2. F

3. T

Self-Check -2	Written Test

Directions: Answer all the questions listed below.

I. Say True or False

1**.** T

2. T

3. T

Self-Check -3	Written Test

Directions: Answer all the questions listed below.

I. Say True or False

1**.** T

2. T

Self-Check -4	Written Test

Directions: Answer all the questions listed below.

I. Say True or False

1**.** T

2. F

Self-Check -5	Written Test

Directions: Answer all the questions listed below.

I. Say True or False

1**.** T

2. T

3. T

Self-Check -6	Written Test

Directions: Answer all the questions listed below.

I. Say True or False

1**.** F

2. T

3. T

Self-Check -7	Written Test

Directions: Answer all the questions listed below.

1.

- Catastrophic failures still likely to occur.
- Labor intensive.
- Includes performance of unneeded maintenance.
- Potential for incidental damage to components in conducting unneeded maintenance.

2.

- Preventive Maintenance
- Corrective (Pre-determined) Maintenance