







ELOHR401 HAND
HELD METAL
REPAIR


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Acronyms

PPE: Personal protective equipment

ESD: Electrostatic discharge

CE: European Conformity" in French, is a mandatory conformity mark for products placed on the market in the European Economic Area

RF: Radio frequency

PCB: Printed circuit board

FFP: stands for filtering face piece - according to their filtering efficiency. It also classifies masks into "single shift use only" (not re-usable, marked NR) or "re-usable (more than one shift)" (marked R)

SRC: Safety, Rehabilitation and Compensation

ESWR: European Social Work Research

VDU: Stands for "Visual Display Unit

Introduction

This core module describes the skills, knowledge and attitudes required to repair handheld metal detector. The learner will be able to select and arrange different materials, equipment and tools used when repairing handheld metal detector. Moreover, he/she will be able to troubleshoot different faults of handheld metal detector.

ELOHR401 HAND HELD METAL REPAIR

Learning Units:

1. Prepare for hand held metal detector repair
2. Rectify the faults
3. Report the work done

Learning Unit 1: PREPARE FOR HAND HELD METAL DETECTOR REPAIR

Picture/s reflecting the Learning unit 1



STRUCTURE OF LEARNING UNIT 1

Learning outcomes:

- 1.1. Identify PPE according to the work to be done
- 1.2. Select tools, materials and equipment according to the work to be done
- 1.3. Prepare the workplace according to the work done

Learning outcome 1.1 Identify PPE according to the work to be done



Duration: 2hrs



Learning outcome 1.1 objectives:

By the end of the learning outcome, the trainees will be able to:

1. Explain clearly the concepts of PPE as used in electronic services
2. Identify correctly different types of PPE used for electronic repair work
3. Select adequately PPE according to the work to be done



Resources

Equipment	Tools	Materials
<ul style="list-style-type: none">✓ Gloves✓ Helmet✓ Safety shoes✓ Overall✓ Overcoat✓ Goggles✓ Nose mask✓ Earmuff✓ Projector	<ul style="list-style-type: none">✓ Books✓ Handout notes✓ Black board✓ Eraser	<ul style="list-style-type: none">✓ Chalks



Advance preparation:

- Trainer should prepare all resources required to deliver the session such as notes, PPT.
- Check the availability of Material, tools and equipment.
- Prepare Well the learning place



Topic 1: Description of PPE

What is PPE?

- ✓ PPE is equipment that will protect the user against health and safety risks at work.
- ✓ It can include items such as safety helmets and hard hats, gloves, eye protection, high-visibility clothing, safety footwear and safety harnesses.

Types of PPE

EYE PROTECTION
FOOT PROTECTION
HEARING PROTECTION
PROTECTIVE CLOTHING
OTOPLASTICS

HAND PROTECTION
HEAD PROTECTION
RESPIRATORY PROTECTION
INDIVIDUAL SAFETY SPECTACLES
MEDICARE

PROTECTION AGAINST OVERVOLTAGE

In many industrial companies, performing work on live electrical equipment is part of every day life. Complex switchgear and live components pose high risks for the workers concerned. In the event of an arc flash occurring, the focus is on protecting the hands, head and body. Clothing that meets the requirements of various standards, visors for short

circuit electric arcs and gloves for high voltage applications are every day essentials in these fields.

ESD- capable protection from head to toe

As a manufacturer of PPE for the whole body, uvex is committed to ensuring that in any areas where special protection of sensitive technology is additionally required. High cut protection must not be an impediment and is ensured thanks to the use of high-quality materials. Ergonomic clothing and shoes in accordance with ESD specifications enable wearers to comply with high product requirements even on long work days.

1. Eye protection for applications in the field of electrics and electronics Safety glasses



2. Hand protection for applications in the field of electrics and electronics



3. Foot protection for applications in the field of electrics and electronics



uvex 1 sandal
S1 P SRC



uvex 1 G2 Shoe S1 P
SRC



uvex 1 G2 perforated
shoe S1 P SRC



uvex 1 G2 sandal
S1 SRC



uvex 1 G2 sandal S1
SRC



uvex 1 sport S1 SRC
safety shoe

4. Head protection for applications in the field of electrics and electronics



suprabeam V3air
rechargeable



uvex pheos visor



uvex pheos E-S-WR
safety helmet

1. a hard or padded protective hat, various types of which are worn by soldiers, police officers, motorcyclists, sports players, and others.



5. Hearing protection for applications in the field of electrics and electronics

Do You wok in an environnements with high sound levels? In that case it is very important to consider hearing protection. Earplugs are very comfortable, but earmuffs are convenient on the work floor as you can quickly put these on or take them off.



uvex com4-fit
disposable earplugs



uvex x-fit disposable
earplugs



uvex whisper+
reusable earplugs

6. Respiratory protection for applications in the field of electrics and electronics

Wearing a mask at work is no luxury, definitely not when coming into contact with hazardous materials. 15% of the employees within the EU inhale vapours, smoke,

powder or dust while performing their job. Dust masks offer protection against fine dust and other dangerous particles. If the materials are truly toxic, use a full-face mask. This adheres tightly to the face, to protect the nose and mouth against harmful pollution.



7. Protective clothing for applications in the field of electrics and electronics

Preventing accidents is crucial in a crowded workshop. That is why a good visibility at work is a must: an overcoat and overall made of a strong fabric can help prevent accidents. Just like the hand protection, there are versions for different applications.



8. Prescription safety spectacles and VDU spectacles for applications in the field of electrics and electronics



9. Otoplastics for applications in the field of electrics and electronics



10. Medicare for applications in the field of electrics and electronics



Topic 2 : Using PPE

- ✓ Employers have duties concerning the provision and use of personal protective equipment (PPE) at work.
- ✓ Employers should provide appropriate personal protective equipment (PPE) and training in its usage to their employees wherever there is a risk to health and safety.
- ✓ PPE should be worn as a last resort. Whenever there are risks to health and safety that cannot be adequately controlled by other ways, the Personal Protective Equipment at Work Regulations require PPE to be worn.

✚ Can Employers charge for PPE?

- ✓ An employer cannot charge employees for their PPE, whether it is returnable or not. This includes agency workers, if they are legally regarded as employees.

✚ Assessing and choosing PPE

- ✓ Employers should make a suitable and sufficient assessment of the risks to health and safety from exposure to the hazards within the workplace.
- ✓ For example, if there is a risk of objects falling from above then a safety helmet or a hard hat should be worn.

- ✓ If there is a risk of crushing, then safety boots should be worn to guard against broken toes.
- ✓ The need for PPE must be identified through risk assessment. As with all risk assessments, those carrying them out must be competent to do so and have the necessary knowledge and experience of the methods of work.
- ✓ In addition to identifying the need for PPE, it is essential that the right type of PPE is specified and provided.)
- ✓ All new PPE must be CE marked. The CE mark signifies that the PPE satisfies certain basic, minimum safety requirements.

Training

- ✓ Employers should make sure employees using PPE are made aware as to why it is needed, when to use it, how it can be replaced and who to report it to if the PPE is damaged.
- ✓ Employers should train and instruct employees on how to use PPE properly and make sure they are doing this. Managers and supervisors should be included in the training to ensure they know how to use PPE correctly.
- ✓ It is important that users wear PPE all the time they are exposed to the risk.
- ✓ Employers should never allow exemptions for those jobs which take “just a few minutes”.
- ✓ Employers should regularly check that PPE is being used.
- ✓ Safety signs can be a useful reminder that PPE is required. Make sure that employees understand these signs, what they mean and where they can get PPE for visitors and contractors.

Maintenance

- ✓ Employees should look after their PPE and employers should provide proper storage facilities when it is not being used for example a clean, dry store room or cupboard.

- ✓ PPE should be kept clean and in good repair. Always follow the manufacturer's maintenance schedule (including recommended replacement periods and shelf lives).
- ✓ Simple maintenance can be carried out by the trained wearer, but more detailed repairs should only be done by specialists.
- ✓ Replacement parts for PPE should match the original. It is also necessary to ensure that suitable replacement PPE is always readily available.

Noise hazards

Anyone working in the vicinity of a noisy machine will require ear defenders to be worn to protect their hearing.



Summary

Definition PPE?

PPE is equipment that will protect the user against health and safety risks at work. It can include items such as safety helmets and hard hats, gloves, eye protection

Types of PPE

- ✓ Eye protection
- ✓ Hearing protection
- ✓ Foot protection
- ✓ Protective clothing, etc

Using PPE

- ✓ Duty of employer
- ✓ Maintenance of PPE
- ✓ Importance of PPE

2. State the means by which the risks of hearing loss can be minimized

Answer:

1. Yes, it is always best to control the risk at source and not rely on PPE for protection.

2. The following are some means by which the risk of hearing loss can be reduced: position a noisy machine outside the workplace and away from workers surround machine in a sound absorbing enclosure ensure machines are maintained and serviced regularly purchase machines that are less noisy



Practical learning Activity

Each trainee select PPE according to their types

Each trainee explains the importance of using PPE



Points to Remember (Take home message)

PPE - key points Consider whether there are ways other than using PPE to adequately control the risk. If not, ensure that the following points are taken into account:

- suitable PPE is provided
- PPE offers adequate protection for intended use
- those using PPE are adequately trained in its safe use
- PPE is properly maintained and any defects are reported
- PPE is returned to its proper storage after use



Learning out come 1.1 : formative assessment



Please mix different assessment instruments/tools for triangulation and relevancy of assessment

Written assessment

- Assessment instruments/tools
 - ✓ True or false questions
 - ✓ Multiple choice
 - ✓ Essay: Question with short responses and Open ended questions
 - ✓ Case studies

Practical assessment

- Assessment instruments/tools
 - ✓ Task to be performed with performance checklist/quality product checklist

Ex: Pick PPE that is suitable to assure protection of:

1. Hands
2. Ears
3. Eyes
4. Body
5. Feet

Checklist	Score	
	Yes	No
Selection of gloves		
Selection of nose mask		
Selection of Goggles		
Selection of overcoat/overall		
Selection of safety shoes		
Observation		

Learning outcome 1.2 Select tools, equipment and materials according to the work to be done



TOPIC : Selecting tools, equipment and materials.



Duration: 1hour



Learning outcome 1.2 objectives:


By the end of the learning outcome, the trainees should be able to:

1. Define clearly the terms “Tools, materials and equipment” as used in electronic services.
2. Select correctly tools required for handheld metal detector repair
3. Select correctly materials required for handheld metal detector repair
4. Select correctly equipment required for handheld metal detector repair



Resources

Equipment	Tools	Materials
Hand held MD	Lecture notes	Electronic components
Projector		
Personal safety equipment	Text books	Papers
Compressed air can		
Multimeter	Internet	Soldering tin
	Electronic Repair Tool Kit	Cleaning materials
	Whiteboard	Jumper wires and cables

	Marker	Glue
	Duster	Silicon
	Brushes	Insulator tape
	Soldering iron	Electronic components
	Soft cloth	Coils
 Advance preparation: Arrange well the working place Safety and precaution must be applied during working process		



Topic 1: Description of tools, material and equipment.

A tool is:

- ✓ any instrument or simple piece of equipment that you hold in your hands and use to do a particular kind of work. For example, spades, hammers, and knives are all tools
- ✓ a handheld instrument that aids in accomplishing a task.

Tools range from a traditional metal cutting part of a machine to an element of a computer program that activates and controls a particular function.

Materials:

- ✓ Materials are substances from which something is composed or made.

- ✓ Engineering materials are the materials we use to build our material world: appliances, bridges, buildings, communication facilities, devices, electricity systems, factories, furniture, instrumentation, irrigation systems, machines, pipelines, roads, transportation equipment, tools and various utilities.
- ✓ Electronic Equipment means large electronic devices that have been discarded, including but not limited to computers, monitors, televisions, cathode ray tubes, printers, scanners, and copying machines.

✚ Differentiating between tools, materials and equipment

- ✓ The key difference between equipment and materials is that materials form the actual product and are the parts, components, ingredients and raw materials that become a part of the product whereas equipment refers to the tools, machinery, devices that help create the product
- ✓ A tool is something you use to do something, while materials are consumable items on which you use tools to make, achieve or in whatever way create your product. A chisel is a tool and the piece of wood that you chisel is a material.

✚ Types of tools and their use

- ✓ SOLDERING IRON



- First things first, having a soldering iron is an absolute must.
- With this, you can assemble your components for the circuit you are making. Soldering is a technique of joining metal parts together, which involves melting a metal called solder or lead into spaces between metal components.

- A soldering iron supplies heat to melt solder so it will flow into the spaces between enjoined components or workpieces.
- When the melted solder hardens, it creates a permanent connection between the parts.
- It is composed of a metal tip that is heated and an insulated handle. Aside from assembling or putting elements together, a soldering iron can be used in repairs and installations You must take extra precautions in using this tool because it involves heat, and if used without proper care, you can get hurt.
- You can also destroy some components in the circuit if you aren't careful enough. Always be mindful of the safety requirements.

✓ SOLDER REMOVER



- As you can solder elements or components together, you can also desolder them. And such action is called desoldering.
- It is the removal of solder and parts from a circuit board or a PCB.
- The tools needed in this process are the solder removers, which are helpful for troubleshooting, repair, and replacement. Just be careful in using this tool to avoid possible damage to any of the components and even to the circuit itself.
- You can always use a soldering gun to desolder. However, there are also other tools used to remove solder. These are desoldering tweezers, also called hot tweezers, hot air guns, infrared heaters, and desoldering pumps or solder sucker.

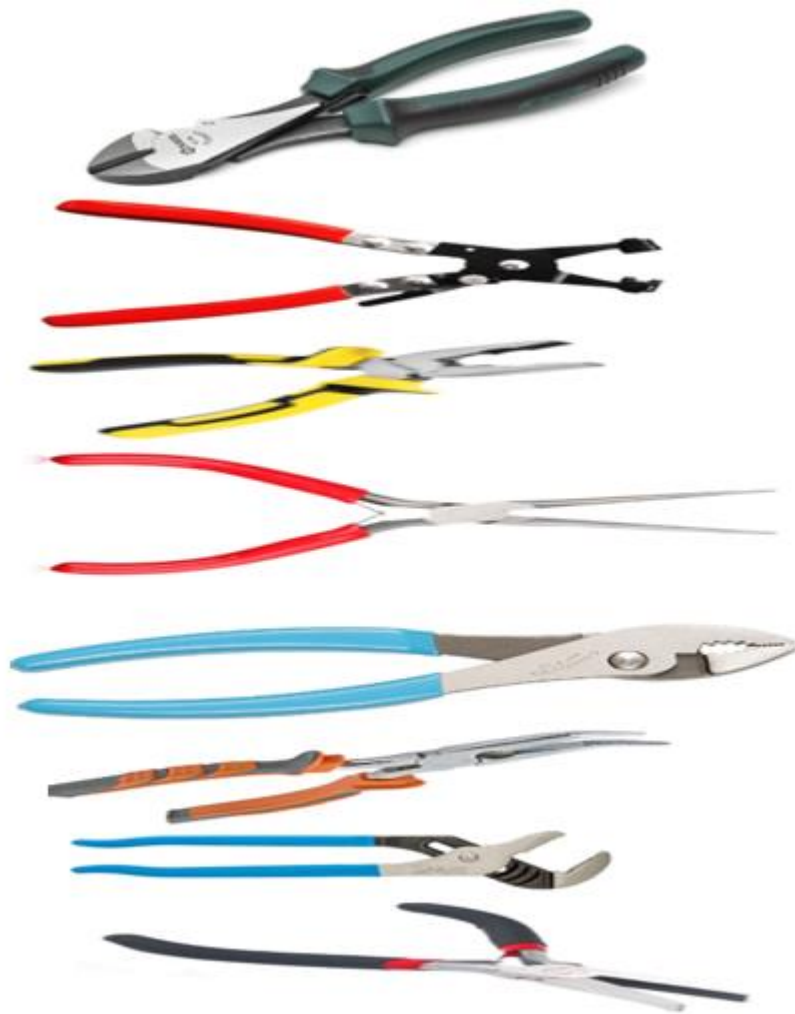
✓ PRECISION SCREW DRIVER SET 14



- Precision screwdrivers usually come in a set, and they are used mostly by jewelers.
- Screwdrivers are tools which can be manual or powered used for installing and uninstalling. A typical screwdriver has a handle and a shaft.
- Some manual screwdrivers have interchangeable tips that can be very helpful in making your craft.
- There is a wide variety of screwdrivers you can find in your local hardware and also online. They can come in different types and sizes.
- The difference over the normal ones is the precision of the tips of each driver.
- It is essential to use the right type and size to avoid possible damaging of the screw or bending the shaft in the process of tightening. Thus, it is best to select a tip made to fit precisely. When you are working with small, intricate devices, this set of screwdrivers is perfect for the job.

✓ Pliers:

Pliers are made in various shapes and sizes and for many uses. Some are used for **gripping** something round like a pipe or rod, some are used for twisting wires, and others are designed to be used for a combination of tasks including cutting wire.



- Pliers are hand tools used for holding things firmly. It has jaws that tightly grip any object as you press the two handles.
- Pliers can be used in bending and compressing a wide range of materials.
- A precision plier set comes in handy when working in tight spaces. They are instrumental in cutting, manipulating, or working in general, with smaller and more intricate or delicate materials. These usually have small and narrow jaws to reduce or tighten sensitive components on circuit boards. Jewelers also use these.
- WIRE CUTTER In electronics, it is a given that you will have to deal with wirings. Manipulating wirings means that you have to cut them. Wire cutters are used in cutting copper, aluminum, steel wires, etc.

These can also come with insulated handles to protect you from getting shocked when working with cables. A type of wire cutters is the diagonal cutters. These cutters have intersecting jaws that cut wires at certain angles, unlike the symmetrical cutters. It allows you to cut a cord very close to its base. Electricians or technicians

- commonly refer to these types of cutters as flush cutters. Wire cutters are essential when working with electronics projects.
- **WIRE STRIPPER** Wire strippers remove the insulation from electric cables to make contact. These handheld tools also come in manual and automatic types. With this tool, you can easily strip wires without damaging any part. Using wire strippers will save your time and your wires. When choosing a wire stripper, make sure that it has a comfortable grip for you to be able to cleanly remove insulation from wires while keeping the actual cable intact.

✓ MAGNIFYING GLASS



Having a magnifying glass is optional, but really helpful.

- A magnifying glass is a convex lens used to produce a magnified image of an object.
- They are useful when trying to see labels on components or trying to find broken solder joints. Thus, they are usually present in electronic and electrical laboratories.

🌈 Types of equipment and their use:

- ✓ Digital multi-meter (DMM)
- ✓ Soldering station
- ✓ PPE

- ✓ Screwdriver machine
- ✓ Air blow gun
- ✓ Di-soldering gun machine
- ✓ Handheld metal detector

MULTIMETER



A multimeter is an electronic measuring instrument that has multiple functionalities; hence it is also called a multitester. Typically, these functionalities include the ability to measure voltage, current, and resistance. This measurement equipment is essential for troubleshooting due to its capacity to measure with a high degree of accuracy. This device with a positive and a negative indicator is a useful tool that helps users from simple tests, faults detection, to sophisticated diagnostics. Electricians, engineers, and even students find it necessary to have a multimeter in their possession. Multimeters come in analog and digital versions. These are available in a wide range of features and prices.

SOLDERING STATION



A soldering station is the control station for your soldering iron. With this, you can make adjustments to set your desired temperature.

- The soldering station consists of controls, soldering irons, stand and desoldering tweezers.

- This equipment is used in electrical and electronics engineering.
Having a soldering station in an electronics lab is usually necessary. To avoid the frequent changing of soldering tips and readjusting soldering temperature, some soldering stations use several soldering irons simultaneously to make the process quicker and more convenient.

HOT GLUE GUN



A hot glue gun is always a question primarily among beginners in electronics. Is it okay to use hot glue when working with circuitries? Well, yes. Hot glue is a form of thermoplastic adhesives formed in a cylindrical stick loaded in the glue gun. Hot glue is an insulating material that can help fix or even protect your circuitry, and it does not create stray conducting paths or short circuits. However, do not use hot glue on thermally sensitive components if you don't want to damage your components. Also, you definitely don't want to use this on plastic parts for it may deform or melt due to the heat. You can use hot glue on rugged passive components such as resistors, ceramic capacitors, and coils. Always be careful when dealing with a heated material. It's better safe than sorry!

ROTARY TOOL (DREMEL)



Rotary tools are handheld power tools with a rotating tip.

- These tools accept a variety of attachments for different tasks, from grinding to cutting, which makes it very versatile.

- Rotary instruments are best for home improvements. These are also a staple for woodworking and hobby craft. Rotary tools employ a circular motion that makes them perfect for precision work and softer materials.
- Dremel is an American brand of power tools known primarily for its rotary tools. The Dremel concept relies on high speed as opposed to the high torque of a conventional power drill.
- It can perform drilling, grinding, sharpening, cutting, cleaning, polishing, sanding, routing, carving, and engraving. Both battery-powered and corded models are available.

DRILL AND DRILL BITS



Drills are electric tools primarily used for drilling holes or driving fasteners. Though it varies in speed, power, and sizes, among its uses are in wood and metal works, machine tool fabrication, construction, and utility projects. Hand-operated and cordless battery-powered types are both available in the market. Now, in using drills, you need to have the drill bits. These come in many sizes and shapes, which can create different kinds of holes in various materials. The drill bits are attached to the drill, which powers to cut through any workpieces, typically by rotation. To get the job done quickly, you must choose the right drill bit.

HELPING HANDS



- Helping hands are the nifty tools that hold together components when soldering or assembling projects. It has a magnifying glass, clippers that can keep the parts in place, and an adjustable jig used in craftwork.
- Like the other tools, this will save you time and avoid having many difficulties, especially when holding things together.
- Using helping hands, especially in soldering, is very important when working with circuitry in electronics. When purchasing this tool, make sure it has a strong base or stand.

VARIABLE POWER SUPPLY



- A variable power supply is essential for your circuitry to work.
- A battery is an example of a power supply. Now, in experimentation and tests, it is best to use a variable power supply that can provide a range of voltages and currents.
- Variable power supplies are always present in electrical or electronic laboratories. It is beneficial to have one.

OSCILLOSCOPE



- Oscilloscopes are used to test, service, and repair electronic circuits.

- Oscilloscopes can detect electronic waveforms and digital signals, and display them in an easy to read way on a monitor.
- They're the best way to troubleshoot any problems in your circuits.
- Oscilloscopes can detect sine waves, sawtooth waves, and square waves. The waveform can be analyzed for properties such as amplitude, frequency, rise time, time interval, distortion, and others.

SIGNAL GENERATOR



- Signal generators are electronic devices that generate electronic signals. These generated signals are used as a stimulus for electronic measurements, typically used in designing, testing, troubleshooting, and repairing electronic or electroacoustic devices.
- Signal generators have different types for different purposes and applications. It includes function generators, RF and microwave signal generators, pitch generators, arbitrary waveform generators, digital pattern generators, and frequency generators. Most of these are in electrical and electronics laboratories.
- A function generator is usually a piece of electronic test equipment or software used to generate different types of electrical waveforms over a wide range of frequencies.
- Some of the most common waveforms produced by the function generator are the sine wave, square wave, triangular wave, and sawtooth shapes. These waveforms can be either repetitive or single-shot.

Types of materials and their use:

- PCB/Contact cleaners
- Soldering tin
- Glue Silicon

- Insulator tape Screws
- Electronic components

PCB/CONTACT CLEANERS



- Over time, your circuit boards or PCB can get dusty, so cleaning them would be necessary to maintain proper function.
- Among the possible ways to clean a PCB are by using baking soda, distilled water, or even compressed air. But the most common is by using isopropyl 23 alcohol or specialized cleaners.
- Some contact cleaners evaporate rapidly due to its composition, so it doesn't leave any residue. Isopropyl alcohol is a colorless, flammable chemical compound with a strong odor, used mostly for medical purposes. This chemical compound makes a great PCB cleaner because it evaporates quickly and is inexpensive. It also contains fewer chemicals compared to other PCB cleaners.
- For safety purposes, better to use gloves and goggles as you use them with care. Specialized cleaners include ultrasonic cleaner. This is the fastest and most efficient way to clean your PCB. It removes flux, dirt, dust, and other small particles that have accumulated on your circuit board over time. This also minimizes the wetting current across a pair of contacts.
- However, a specialized cleaner may tend to be pricey than isopropyl alcohol. Your choice, just make sure they are appropriate PCB or contact cleaners.

HEAT SHRINK TUBING



- Heat shrink tubing is a shrinkable plastic made of a wide range of thermoplastics. Among its uses are to insulate wires and provide protection for stranded and solid wire conductors, connections and terminals in electrical work.
- It is also useful for repair, sealing, and troubleshooting as it allows for barriers between cables and corrosive chemicals. Heat shrink tubing comes in different colors. Although colors don't matter much, you can make use of it for easy identification of your wires.

HEAT SINK PASTE



- Heat sink paste is used to bond a component with a mechanical heat sink.
- It is also called thermal grease, thermal paste, or heat paste.
- Although heat sink paste does not have the thermal conductivity of metals, the improvement over the air will increase thermal responsiveness. However, the metal-based thermal paste can be electrically conductive and capacitive; if some flows onto the circuits, it could lead to malfunction and damage.
- As opposed to thermal adhesive, thermal paste does not add mechanical strength to the bond between the heat source and heat sink.
- It is used to improve the heat coupling between different components such as filling the gap between the CPU (central processing unit) or other heat generating components.

Electronics maintaining tools

- ✓ Classification of tools and equipment

- ❖ tool is an instrument that can be used to produce an item or accomplish a task, but that is not consumed in the process. It can be considered as extension of the human hand thus increasing speed, power, and accuracy
- ❖ equipment includes any machine powered by electricity.
- ❖ Hand tools are tools manipulated by hands without using electrical energy such as: puller, hacksaw, pull-push rule, pliers, hammer, and others.
- ❖ Machine/power tools are tools manipulated by our hands and with the use of electrical energy such as: electric drill, grinding wheels, vacuum cleaner and others.
- ❖ Pneumatic tools are tools or instruments activated by air pressure. Pneumatic tools are designed around three basic devices: the air cylinder, the vane motor, and the sprayer.

a. Hand tools

- ❖ Screwdrivers are used to drive, or turn screws. The common type has a single flat blade for driving screws with slotted heads. The other type has the cross slotted head.
- ❖ Hammers are mostly used tools in the shop. They should be gripped at the end of the handle.
- ❖ Pliers are specified types of adjustable wrenches. The two legs move on a pivot so that items of various sizes can be gripped.
- ❖ Wrenches are used to turn screws, nuts and bolts with hexagonal heads. —hexagonal means six-sided. A variety of wrenches are used in the shop.
- ❖ Pullers are used to remove gears and hubs from shafts, bushings from blind holes, and cylinders' liners from the engine blocks.

b. Machine/power tools

- ❖ Electric drill has an electric motor that drives a chuck. The chuck has jaws that can be opened and then closed to grip a drill bit.
- ❖ Grinding tool can be either bench- mounted or installed on a pedestal. They may either have a grinding wheel, v-wheel, or two grinding wheels. Vacuum cleaner is used for cleaning the floor and car interiors after service.

c. Pneumatic tools

- ❖ Pneumatic torque wrench. This wrench uses compressed air to quickly and powerfully turn nuts, bolts, and other objects.
- ❖ Air chisel uses reciprocating motion to drive a cutting hammering tool.
- ❖ An air hammer drives a chisel to cut off a nut that has frozen to a stud. It can be used with a variety of tools- cutters and punches to do many jobs.
- ❖ Air drill is lighter than a comparable electric drill. Repeatedly stalling or overloading does not damage or overheat the air drill.
- ❖ Air ratchet uses the sockets and attachments from a standard socket set Pneumatic floor jack uses compressed air to flow into the jack cylinder and causes the ram to extend and raise the vehicle.

Basic maintenance of electrical tools and equipment

Clean out the dust. To make sure that your electric tools are ready to go when you are, keep them clean and free of dust. Spend some time to clean out the dust every once in a while on your tools while they are inactive in storage.

Check the cords. Look for tear/cut insulator on the power cords on your electric tools. This will ensure that your electric tool can get the power that it needs to function without an accident.

Use the right tool correctly. Use tools correctly and for their intended purposes. Follow the safety directions and operating procedures recommended by the manufacturer. When working on a circuit, use approved tools with insulated handles.

Protect your tools. Keep tools and cords away from heat, oil, and sharp objects. These hazards can damage insulation. If a tool or cord heats up, stop using it. Report the condition to a supervisor or instructor immediately.

Use double-insulated tools - portable electrical tools are classified by the number of insulation barriers between the electrical conductors in the tool and the worker storing your tools - keep your electric tools stored in their original cases and containers. This will keep them free of dust and dirt while they are not being used.

Personal protective equipment (PPE)

PPE are gadgets to protect workers from injury or illness caused by having contact with the dangers/hazards in the workplace whether they are chemical, biological, radiation, physical, electrical, mechanical and others.

Personal protective equipment should be taken care of as of the other tools and equipment. Wipe your helmets, gloves, safety shoes before keeping it.

It should also be cleaned, kept in proper tool rack/ cabinet. It should be stored in dry places so that it will not have mold build-up.

Over-all suits should be washed regularly so that perspirations and other dirt will be washed clean.

Classification of non-functional and functional tools

Tools are very useful to us in our homes especially to our job. But tools that are no longer functional may cause harm. make an inventory of functional and non-functional tools in your shop. Classify your tools according to its function.

Method of identifying non-functional tools and equipment

Non-functional tools and equipment

- ✓ non-functional tools and equipment are those that are not able to perform its regular function because of impaired and damage part.

Examples of these are the following:

1. Hammer with a broken handle
2. Screw driver with a broken handle
3. Long nose pliers with damage jaw
4. A broken/cut foot rule
5. Electrical equipment with damage cord

Visual inspection.

It refers to the visual observation of an expert on the appearance of the tools and equipment.

Functionality. Vibration or extra noise from the operation means problems on parts and accessories started to develop.

Performance. When there is something wrong with the performance of either hand tools or equipment they need an immediate repair or maintenance.

Power supply (for electrically operated only). Failure to meet the required power supply, malfunction will occur in the part of hand tools or equipment.

Person's involved. It refers to the technical person who has the knowledge and skills about the technology.

Classifications of tools and equipment according to their uses:

1. Measuring tools
2. Holding tools
3. Cutting tools
4. Driving tools
5. Boring tools
6. Electrical equipment
7. Miscellaneous tools/instrument/equipment

Proper tool selection

How do you select the best tool for the job?

- ✓ First, know and understand in detail the scope of work to be accomplished, second, plan for the scope taking into account the sequence of tasks.
- ✓ Selecting the best tool for each task requires training in the proper use of the tools, field experience in their safe use, and following the manufacturer's guidance and instructions for that specific tool.
- ✓ When obtaining the tool all the associated tooling and consumable parts, as recommended by the manufacturer, must be included. In addition, related consumable parts must also be selected and used according to their manufacturer's instructions.

Safe Use of tools

Once selected, use the tool for the purpose for which it was designed. Not all tools come with detailed instructions, but there are those that do spell out the safety —Do's and Don'ts|| for the your safety. If there are set- up/use options, operator judgment must always be based on what is the safest way to use the tool.

Environmental Safety and Health

Program requires the following: All tools be kept in good condition with regular maintenance. The right tool be used for the job Each tool be examined before use AND damaged or defective tools NOT to be used Tools be operated according to manufacturer's instructions.

The right protective equipment for the tool and activity be used

HARDWARE TOOLS

To complete hardware repairs, it is important to have a toolkit that should contain all of the necessary tools.

Hardware tools are grouped into these four categories:

- ✓ Electro-Static Discharge (ESD) tools
- ✓ Hand tools Cleaning tools
- ✓ Diagnostic tools
- ✓ Electro-Static Discharge (ESD) Tools

Static electricity is easily generated by friction on carpets, tile flooring, clothing, hair, fabric, and etc. The friction of moving air alone will charge suspended particles and cause the buildup of static electrical charges on people and objects in the environment. Grounded antistatic work mats used with antistatic wrist straps provide the most basic means for the controlled discharge of electrostatic electricity.

- ✓ Anti-static wrist strap – used to prevent ESD damage to computer equipment. Anti-static mat – used to stand on or place hardware on to prevent static electricity from building up.

Hand Tools

A hand tool is a device for performing work on a material or a physical system using only hands. The hand tools can be manually used employing force, or electrically powered, using electrical current. For example:

- ✓ Flat head screwdriver – used to loosen or tighten slotted screws.
- ✓ Philips head screwdriver – used to loosen or tighten crosshead screws.
- ✓ Torx screwdriver - used to loosen or tighten screws that have a star-like depression on the top, a feature that is mainly found on laptop.
- ✓ Hex driver – sometimes called a nut driver, is used to tighten nuts in the same way that a screwdriver tightens screws.
- ✓ Needle- nose plier – used to hold small parts.
- ✓ Wire cutter – used to strip and cut wires.
- ✓ Tweezers – used to manipulate small parts.
- ✓ Part retriever – used to retrieve parts from location that are too small for your hand to fit.
- ✓ Flashlight – used to light up areas that you cannot see well.

Cleaning Tools

Having the appropriate cleaning tools is essential when maintaining or repairing electronic equipment/devices. Using these tools ensures that electronic equipment/device (ex: computer) components are not damaged during cleaning.

- ✓ Lint-free cloth – used to clean different computer components without scratching or leaving debris.

- ✓ Compressed air – used to blow away dust and debris from different computer parts without touching the components.
- ✓ Cable ties – used to bundle cables neatly inside and outside of a computer.
- ✓ Parts organizer – used to hold screw, jumpers, fasteners and other small parts and prevents them from getting mixed together.

Diagnostic Tools

Here's the most popular tools for diagnosing your electronic equipment problems:

Multimeter – used to test the integrity of circuits and the quality of electricity in electronic equipment components.

Oscilloscope- used to measure voltages at different stages of an electrical circuit and display the measured voltage on screen

. Practical learning Activity Task: Select tools, equipment and materials needed for ha



Summary for the trainer related to the content (key notes using bullets such as ticks etc)

- ✓ Differentiating between tools, materials and equipment
- ✓ Types of tools, materials and equipment
- ✓ Classification of tools, materials and equipment according to the work to be done
- ✓ Maintenance of tools and equipment



Theoretical learning Activity

- ✓ Ask trainees to brainstorm about the types of tools and equipment and their use.
- ✓ Ask trainees to brainstorm about the types of different repairing tools
- ✓ Ask trainees to brainstorm about the classification of tools and equipment according to their functions
- ✓ Ask trainees to brainstorm about the maintenance of tools and equipment according to their functions



Practical learning Activity

Each Trainee identify tools, equipment and materials used to repair hand held metal detector

Each Trainee identify distinguish between materials, tools and equipment

Each Trainee classify tools and materials basing on their function



Points to Remember (Take home message)

- ✓ Definition of tools, material and equipment.
- ✓ Types of tools and their use
- ✓ Types of equipment and their use
- ✓ Types of materials and their use
- ✓ Difference between tools, materials and equipment
- ✓ Maintenance of tools and equipment
- ✓ Selection of tools, materials and equipment



Learning out come 1.2: formative assessment



Please mix different assessment instruments/tools for triangulation and relevancy of assessment

Written assessment

- Assessment instruments/tools
 - ✓ True or false questions
 - ✓ Multiple choice
 - ✓ Essay: Question with short responses and Open ended questions
 - ✓ Case studies

Practical assessment

- Assessment instruments/tools

Task: Select tools, equipment and materials needed for handheld metal detector repair

Checklist	Score	
	Yes	No
Selection of tools required for handheld metal detector repair		
Selection of materials required for handheld metal detector repair		
Selection of equipment required for handheld metal detector repair		
Observation		

Learning outcome 1.3 Prepare the workplace according to the work to be done



TOPIC: Preparation of the workplace



Duration: 1hour



Learning outcome 1.3 objectives:

By the end of the learning outcome, the trainees should be able to:

1. Arrange adequately required tools at the workplace according to the arrangement techniques
2. Arrange adequately required materials at the workplace according to the arrangement techniques
3. Arrange adequately required equipment at the workplace according to the arrangement techniques



Resources

Equipment	Tools	Materials
Computer	Lecture notes	Electronic components
Projector		
Personal safety equipment	Text books	Papers
Compressed air can		
Multimeter	Internet	Soldering tin
Hand held metal detector		
Batteries/ 9v dc power supply	Screwdrivers	Cleaning materials
		Screws
	Duster	coils
	Brushes	
	Soldering iron	
	Soft cloth	



Advance preparation:

Arrange well the working place

Safety and precaution must be applied during working process



Topic 1 : Arrangement techniques of tools, materials and equipment in the workplace

Arrangement by:

- ✓ type
- ✓ use/function
- ✓ size/weight
- ✓ manufacturer's instructions

Steps to prepare the workplace

- ✓ Lay everything in a single row. (This makes it easy to see what you have, and how it should be organized.
- ✓ Choose a place where they could be organized.
- ✓ Hang them to a flat panel board mounted on the wall
- ✓ If you have a tool chest organize tools in categories ex.metal work one drawer or bin and woodworking tools in another.
- ✓ If the above suggestions are not available, hang them on a bar mounted on the wall.
- ✓ Clean the workshop. Nothing feels more organized than a clean workshop. Polishing the windows is not necessary but sweep the floor and the bench. Don't forget to remove cobwebs from the top corners
- ✓ Throw away unwanted items. These include small pieces of wood and thorn nails.
- ✓ If you don't have a cupboard, make one or buy a cheap one. Put the robust tools in it to avoid things piling up.

- ✓ Don't leave duplicate or spare tools. For example, if you have 3 identical screwdrivers, keep one in the workshop and put the others elsewhere.
- ✓ Categorize the tools. For example, put cutting tools near other cutting tools. Put tools you use more often nearer to your workplace and less used tools further.

Tips to follow

- ✓ Don't use the workshop as a dump for old and malfunctioning things.
- ✓ Don't store broken tools in your workshop, apart from the danger they create junk.
- ✓ Look into replacing or repairing them.
- ✓ After organizing, try to keep things organized.
- ✓ Polish your tools for a nicer finish.
- ✓ Consider building mobile workstations for larger power tools such as a band saw, table saw, sanders, router table, etc. The key here is to be able to move it out of the way when you don't need it, but still have a readily available. You could make a workstation yourself.



Summary for the trainer related to the content (key notes using bullets such as ticks etc)

Arrangement techniques of tools, materials and equipment in the workplace

- ✓ Arrangement by type
- ✓ Arrangement by size/weight
- ✓ Arrangement by Use/function
- ✓ Arrangement by instruction

Steps to follow while preparing the workplace



Theoretical learning Activity

- ✓ **Ask trainee to explain the techniques used to arrange tools, materials and equipment**
- ✓ **Ask trainee to explain the steps to prepare the workplace**



Practical learning Activity

- ✓ Each Trainee arrange tools, materials and equipment using different arrangement techniques
- ✓ Each Trainee try to prepare the workplace



Points to Remember (Take home message)

Arrangement techniques:

- ✓ Arrangement by type
- ✓ Arrangement by size/weight
- ✓ Arrangement by Use/function
- ✓ Arrangement by instruction

Steps to follow in workplace preparation



Learning out come 1.3 : formative assessment



Please mix different assessment instruments/tools for triangulation and relevancy of assessment

Written assessment

- Assessment instruments/tools
 - ✓ True or false questions
 - ✓ Multiple choice
 - ✓ Essay: Question with short responses and Open ended questions
 - ✓ Case studies

Practical assessment

- Assessment instruments/tools

Task: Prepare the workplace for handheld metal detector repair

Checklist	Score	
	Yes	N
Arrangement of required tools		
Arrangement of required materials		
Arrangement of required equipment		
Observation		

Learning Unit 2: Repair computer hardware

STRUCTURE OF LEARNING UNIT

Learning outcomes:

1. Identify the faults according to their types
2. Adjust/Repair the defective part/device according to the technical specifications
3. Test the handheld metal detector according to the testing techniques
4. Clean the working area according to the cleaning techniques

Learning outcome 2.1 Identify the faults according to their types





Duration: 30hrs



Learning outcome 2.1 objectives:

By the end of the learning outcome, the trainees should be able to:

1. Identify correctly the hand held metal detector main components and their functions
2. Identify correctly general faults that occur in handheld metal detector system

 Resources		
Equipment	Tools	Materials
Power supply Computer Projector Hand held MD 9v battery	Whiteboard Markers Eraser Handout-notes Internet Screwdrivers	Wires/cables Electronic components Coils screws Papers
 Advance preparation: <ul style="list-style-type: none"> • Availability of HHMD • Prepare material, tools and equipment necessary to assemble and disassemble HHMD 		



Topic 1: Introduction to handheld metal detector operation (main components and their functions)



What is the purpose of a hand held metal detector?

- ✓ Handheld metal detectors are designed to detect suspect items that contain metallic components, such as weapons or illicit contraband. Responders use

these metal detectors at access control checkpoints to conduct security screening of individuals.

How do metal detectors work?

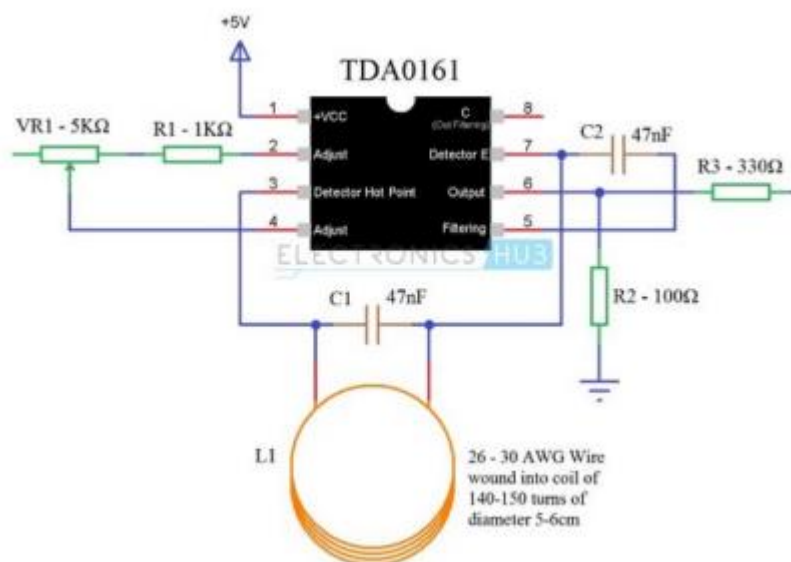
- ✓ Different metal detectors work differently, but each has a common science of working.
- ✓ Metal detectors have a wire coil which we know as a transmitter coil. When electricity flows through this coil, it creates a magnetic field around it.
- ✓ Now when you move this metal detector over a metal object, some changes will take place in the atom located inside the metal object. This means that the magnetic field from the metal detector will change the orbit of the electron in the metal object. Now we know from Maxwell's theory that if a magnetic field changes the atom of a metal object, there is a generation of electricity here.
- ✓ In other words, a metal detector injects a small amount of electricity into a metal object. Maxwell's theory states that magnetism is created when electricity is transmitted over a piece of metal. That is, when we move a metal detector over a metal object, the magnetism of the metal detector inserts electricity into the metal object, and there is the creation of another magnetism for the electricity to enter. This is the second magnetism.
- ✓ Now, we can detect this second magnetism by a metal detector. The metal detector has a second wire coil which goes by the name the receiver coil. Furthermore, the connection of it is to a circuit that has a loudspeaker. I have already said that there is a creation of another magnetism in the metal object which detects the coil in the detector. Again, we can generate electricity in that coil. Now, this electricity goes into the loudspeaker and starts to make a beeping beeping sound. As a result, this is how a metal detector detects a metal object by repeatedly using magnetism and electricity.

Use

The use of metal detectors is in almost all security today, not just to find lost coins. This technology is especially in use in any:

- ✓ airport,
- ✓ hospital,
- ✓ shopping mall,
- ✓ scientific laboratory, etc. Moreover, its use is exclusively for any historical research

Below is the circuit diagram of HHMD



✚ Component Description

- ✓ **TDA0161 Proximity Detector IC:** is a Proximity Detector IC manufactured by STMicroelectronics. It can be used to detect metal objects by detecting the slight changes in the high frequency Eddy current losses.

The TDA0161 IC acts as an oscillator with the help of externally tuned circuit. The changes in supply current will determine the output signal i.e. current is high when a metal object is near and it is low when there is no metal object.

TDA0161 has 8 pins and it comes in Dual in – line Package (DIP). The following image shows the pin diagram of TDA0161 IC.

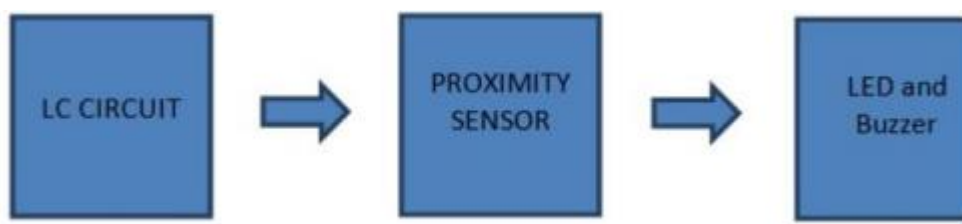
NOTE: According to STMicroelectronics, TDA0161 Proximity Detector IC is obsolete. If it is available in the market, go ahead and make this fun project. If it isn't available, try to find a replacement IC. We will try to update if any similar IC is available. If you find any Proximity Detector ICs, please mention it in the comments section.

- ✓ **Coil (Inductor):** A 30 AWG Copper wire is taken for this circuit diagram. It is then wound in to a coil using a 5.8cm diameter reference. The coil consists of 140 – 150 turns.

Metal Detector Circuit Explanation

- ✓ When the LC circuit that is L1 and C1 has got any resonating frequency from any metal which is near to it, electric field will be created which will lead to induces current in the coil and changes in the signal flow through the coil.
- ✓ Variable resistor is used to change the proximity sensor value equal to the LC circuit, it is better to check the value when there is coil not near to the metal. When the metal is detected the LC circuit will have changed signal. The changed signal is given to the proximity detector (TDA 0161), which will detect the change in the signal and react accordingly. The output of the proximity sensor will be of 1mA when there is no metal detected and it will be around 10mA when coil is near to the metal
- ✓ When the output pin is high the resistor R3 will provide positive voltage to transistor Q1. Q1 will be turned on and led will glow and buzzer will give the buzz. Resistor r2 is used to limit the current flow.

Block Diagram of Metal Detector



There are three main parts in the metal detector circuit:

- ✓ the LC Circuit (The coil and the capacitor C1, which are connected in parallel, will form the LC circuit.),
- ✓ the Proximity Sensor (Proximity sensor(TDA0161), is triggered by this LC circuit if any metal is detected) ,
- ✓ output LED and the Buzzer.

The Proximity sensor will then turn on the led and produces alarm using buzzer.

LC Circuit: LC circuit has inductor and capacitor connected in parallel.

This circuit starts resonating when there is same frequency material near to it.

The LC circuit charges capacitor and inductor alternatively. When the capacitor is charged fully, charge is applied to inductor.

Inductor starts charging and when charge across the capacitor is nil, it draws charge from the inductor in reverse polarity. Then inductor charge is reduced and again the process repeats. Note inductor is a magnetic field storage device and capacitor is electric field storage device.

Proximity Sensor: The proximity sensor can detect the objects without any physical interference. The proximity sensor will work same as infrared sensor, proximity also release a signal, it will not give output unless and until there is no change in the reflected back signal.

If there is a change in signal it will detect and give the output accordingly. There are different proximity sensors for example to detect plastic material we can use capacitive type proximity and for metals we should use inductive type.

Working

- ✓ The LC Circuit, which consists of L1 (coil) and C1, is the main metal detector part of the circuit. With the help of this LC Circuit, which is also called as Tank Circuit or Tuned Circuit, the TDA0161 IC acts as an oscillator and oscillates at a particular frequency.
- ✓ When the LC circuit detects any resonating frequency from any metal which is near to it, electric field will be created which will lead to induces current in the coil and changes in the signal flow through the coil.
- ✓ Variable resistor is used to change the proximity sensor value equal to the LC circuit, it is better to check the value when the coil is not near any metal object. When the metal is detected, the LC circuit will have changed signal.

- ✓ The changed signal is given to the proximity detector (TDA 0161), which will detect the change in the signal and react accordingly. The output of the proximity sensor will be less than 1mA when there is no metal detected and it will be around 10mA (usually greater than 8mA) when coil is near to the metal.
- ✓ When the output pin is high, the resistor R3 will provide positive voltage to transistor Q1. Q1 will be turned on and LED will glow (not shown in the circuit) and buzzer will be activated.

Advantages:

- ✓ The Proximity Detector IC TDA0161 based Metal Detector Circuit is a very simple and easy to construct metal detector that can be used to detect small metals in our homes, offices and gardens.

Disadvantages

- ✓ The main disadvantage of this Metal Detector Circuit is the range of detection. The metal object has to be at a distance of 10mm for the detector to detect it.

Applications •

- ✓ This simple Metal Detector can be used to identify metals like iron, gold, silver etc.
- ✓ Since it is a simple project, we can use this in our home to scan for nails, metal scraps etc. which are not easily supportable by naked eye.
- ✓ Handheld metal detectors work by emitting an electromagnetic field that detects the presence of metal or metallic objects. A security wand has two main components, a transmitter coil that creates an electromagnetic field and a receiver coil that detects electromagnetism.

General faults that occur in handheld metal detector system;

- ✓ Battery failure
- ✓ Electronic circuit failure;
- ✓ Open-circuit faults

- ✓ Short-circuit faults
- ✓ Sensor faults

Common faults and solutions of hand held metal detectors:

- ✓ Vibration or alarm will not stop after 1-2 seconds after booting. In most cases, the sensitivity of the instrument is too high or the voltage is insufficient.
- ✓ The red light is always on when starting up, no alarm or vibration.
- ✓ It will alarm if anything is detected after starting up, or even if there is slight shaking.
- ✓ For handheld metal detectors with vibration, sometimes the buzzer works normally, but the vibration motor cannot stop when it turns to vibration.
- ✓ It appears from time to time when it is turned on, and from time to time it is not normal. It will alarm for a while, but there will be nothing. This is generally caused by poor battery contact. Open the battery box and re-press it; if the battery buckle is too loose, use pliers to gently clamp it; if the battery buckle is not flexible or damaged, replace it with a new one. When replacing, pay attention to whether the positive and negative poles are connected reversely

 Handheld metal detector maintenance steps:

- ✓ When the metal detector wand is not in use, set the switch to "OFF" and keep the surface of the metal detector clean and dry.
- ✓ The battery must be removed if it is not used for a long time, and be careful to prevent the battery from short-circuiting during storage.
- ✓ The voltage of the dry battery or Ni-MH battery placed in the battery slot is 9V, and cannot exceed 9V, otherwise the internal components of the detector may be damaged. (V160E with power supply by 2xAA batteries)
- ✓ Under no circumstances should the hand-held metal detector be placed in water or exposed to large amounts of water to prevent short-circuit damage of internal components.
- ✓ During use, avoid the detector from colliding with hard objects vigorously or falling from a height to damage the internal components.

- ✓ When charging, be sure to put a usable rechargeable battery in the battery compartment. Do not charge the dry battery to avoid explosion.
- ✓ In order to keep the appearance of the hand-held metal detector tidy, it can be cleaned with a damp cloth, but not with chemical cleaners.



Summary for the trainer related to the content

- ✚ Introduction to handheld metal detector operation (main components and their functions)
- ✚ General faults that occur in handheld metal detector system;
 - ✓ Battery failure
 - ✓ Electronic circuit failure; Open-circuit faults Short-circuit faults Sensor faults



Theoretical learning Activity

- ✓ **Ask Trainees to brainstorm about working principle of HHMD.**
- ✓ **Ask Trainees to brainstorm about common faults that occur in HHMD.**



Practical learning Activity

- ✓ **Trainees in pair explain the characteristics of common faults in HHMD**



Points to Remember (Take home message)

Main block elements of HHMD:

- ✓ LC circuit
- ✓ Proximity sensor
- ✓ Alarm system

General faults :

- ✓ Battery failure
- ✓ Electronic circuit failure; Open-circuit faults Short-circuit faults Sensor faults



Learning outcome 2.1: formative assessment



Please mix different assessment instruments/tools for triangulation and relevancy of assessment

Written assessment

- Assessment instruments/tools
 - ✓ True or false questions
 - ✓ Multiple choice
 - ✓ Essay: Question with short responses and Open ended questions
 - ✓ Case studies

Practical assessment

- Assessment instruments/tools

Task to be performed with performance checklist/quality product checklist

Checklist	Score	
	Yes	No
Identification of battery failure fault		
Identification of open circuit fault		
Identification of short circuit fault		
Identification of sensor fault		
Observation		

Learning outcome 2.2 Adjust/replace the defective part/device according to the technical specifications



Duration: 1hour



Learning outcome 2.2 objectives:

By the end of the learning outcome, the trainees should be able to:

1. Disassemble and assemble properly hand held metal detector according to disassembling and assembling techniques
2. Identify correctly faults components of handheld metal detector.
3. Replace adequately defective components of the hand held metal detector.
4. Test correctly the functionality of the hand held metal detector according to testing techniques



Resources

Equipment	Tools	Materials
Computer	Lecture notes	Electronic components
Projector	Text books	Papers
Personal safety equipment	Internet	Soldering tin
Compressed air can	Screwdrivers	Cleaning materials
Multimeter	Whiteboard	Jumper wires and cables
Hand Held Metal Detector	Marker	Connectors and ports
9V battery	Duster	Coils
	Brushes	
	Soldering iron	
	Soft cloth	



Advance preparation:

Arrange well the working place

Prepare HHMD repair work



Content: Adjusting/replacing the defective part/device according to the technical specifications

Disassembling and assembling hand held metal detector

- Soldering and disoldering different components of handheld metal detector.
- Replacement of defective devices/components.
- Testing techniques:
 - ✓ Continuity testing
 - ✓ Voltage measurement
 - ✓ Functionality testing

A continuity test- is a quick check to see if a circuit is open or closed. Only a closed, complete circuit (one that is switched ON) has continuity. During a continuity test, a digital multimeter sends a small current through the circuit to measure resistance in the circuit.

Functional testing- is done mainly to avoid assembly issues including shorts, opens, missing components or the installation of incorrect parts. Functional testers typically use a computer that is connected to test points or a test-probe point in order to perform FCT.

The in-circuit test (ICT)- involves the measurement of all individual components of an assembly. Defective components are detected and can be replaced if necessary.

The function test (FCT)- checks an assembly functions 100 percent as intended. The testing environment simulates the intended field of application and the electrical behaviour of the assembly is tested.

How to do Functional Testing

Following is a step by step process on How to do Functional Testing :

- ✓ Understand the Functional Requirements
- ✓ Identify test input or test data based on requirements
- ✓ Compute the expected outcomes with selected test input values
- ✓ Execute test cases
- ✓ Compare actual and computed expected results

Voltage Measurements

Voltages are usually measured by placing the measuring device in parallel with the component or circuit (load) to be measured. The measuring device should have an infinite input impedance (resistance) so that it will absorb no energy from the circuit under test and, therefore, measure the true voltage. The accuracy of the voltage measurement depends on the total impedance of the measuring device compared to the load being measured. When the input impedance of the measuring device is 10 times greater than the load being measured, the error usually can be tolerated. If this error cannot be tolerated, a higher input impedance measuring device should be used.

Multimeter Method A common piece of test equipment is multimeter. The multimeter contains circuitry that allows it to be used as a voltmeter, an ammeter, or an ohmmeter. It is usually capable of measuring both AC and DC voltages of up to several hundred volts. Most multimeters have a high input impedance and are not likely to disturb the circuit being tested. The obvious disadvantage of the analog multimeter is the inherent low accuracy associated with meter movements (moving pointers), which are used in the multimeter. When performing measurements with any analog multimeter, you should be aware of inaccuracies introduced as a result of parallax. Parallax is defined as the apparent displacement of the position of an object because of the difference between two points of view. In the case of meters, this means the position of a meter's pointer will appear to be at different positions on the scale depending on the angle from which the meter is viewed.

The digital multimeter in many cases provides an accuracy of about $\pm 0.1\%$. They display the reading numerically. These direct-reading displays eliminate the problem of parallax, reduce error, and increase measurement speed. Data from these meters in digital format can also be processed by computers, printers, and recording equipment. Digital multimeters are typically compact and lightweight; many come with rechargeable batteries, making them ideal for portable field use.

Oscilloscope Method

Voltage measurements can be made with an oscilloscope. Oscilloscopes have a high input impedance and normally will not load down the circuit under test. However, oscilloscopes are primarily designed for waveform observation and are typically less accurate than other pieces of test equipment used to measure DC or AC voltages.

Measuring a DC voltage with an oscilloscope is convenient only under certain circumstances; for example, when other measurements are being made on the same equipment with the oscilloscope or when a multimeter is not available. A distinct advantage of the oscilloscope is its ability to monitor the level of AC ripple voltage riding the DC voltage. This feature makes the oscilloscope an indispensable aid in troubleshooting DC power supplies with excessive ripple caused by component failure. A major advantage of using an oscilloscope for AC voltage measurements is that the waveform can be observed; consequently, errors in measuring complex peak voltages are minimized.

If a voltage to be measured is large and cannot be attenuated to a usable value by attenuation circuits within the oscilloscope, an external resistive or capacitive voltage divider can be used. Such voltage dividers are often furnished with oscilloscope test sets and are called high voltage probes. When the voltage of pulses or other complex waveforms is being measured, the high voltage probe selected must be so designed as not to distort the measured signal. Most probes have adjustable (compensating) capacitors that are used to adjust the symmetry of the displayed waveform. You adjust the probe by monitoring either the calibrator output of the oscilloscope or a known good signal and adjusting the probe for a symmetrical display. When using the oscilloscope for AC voltage measurements, ensure the upper frequency range of the oscilloscope is not exceeded; otherwise, inaccurate values will be displayed. Most commonly used oscilloscopes have a frequency response from DC up to about 50MHz

Technical Specification

- ✓ Sensitivity : Detect 0.1 gm metal
- ✓ Search coil area : 120 sqmm
- ✓ Supply (dual): 9VDC (Rechargeable/Dry)
- ✓ Dimension: 390x57x37 (WxDxH)mm
- ✓ Weight : 340 gms incl battery(Aprox)

TROUBLESHOOTING GUIDE

There are some common issues that many hobbyists experience that are universal to all makes and models of metal detectors. Here are a few proven remedies to some of these common symptoms.

SYMPTOM	SOLUTION
Erratic sounds or Target ID cursor movement	1. Ensure your searchcoil is securely connected and the coil is tightly wound around the stem, etc
	2. Ensure you are not using the detector indoors or where excessive amounts of metal are found

	3. Reduce your sensitivity setting
	4. Determine if you are close to other metal detectors or other metal structures such as electrical power lines, wire fences, benches. (NOTE: Iron targets may cause erratic sounds or Target ID Cursor movement. You can identify iron targets in an All-Metal Mode)
Intermittent Signals	Intermittent signals typically mean you've probably found a deeply buried target or one that is positioned at a difficult angle for your detector to read. Increase the sensitivity on your detector and scan from different directions until the signal becomes more definite. In the case of multiple targets switch to the All-Metal Mode or press PINPOINT to precisely locate all targets. (NOTE: Iron targets may cause Intermittent Signals. You can identify iron targets in an All-Metal Mode).
I'm not finding specific targets	Ensure you are using the correct mode for the type of hunting you are doing. If you are hunting for coins, ensure you are in the COINS mode. You may also use the All-Metal mode, which detects all metal targets to ensure desired targets are present.

Target ID Cursor bounces	<p>If your Target ID Cursor bounces erratically, chances are you've found a trash target.</p> <p>However, a Target ID Cursor may bounce if a good target (such as a coin) is not parallel to the searchcoil (e.g. on edge). It may also bounce if there is one or multiple "junk" targets laying next to the good target. Scan from different directions until your Target ID Cursor becomes more stable.</p>
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Basic Characteristics

- Power source: 9V battery standard (Included)
- Detecting temperature range: -10 ~ 65°C
- Alarm modes 1. Audio alarm: Buzzer and red LED, metal indicator 49 2. Vibration alarm: Vibration and red LED, metal indicator
- Alarm indication
 1. Blinking green LED: Power on;
 2. Blinking red LED: Target has been detected;
 3. Continuing yellow LED: Low voltage directive;
 4. Metal indication LED (10PCS): Indicator lights gradually change from green to red while detecting metal objects of different sizes.





Summary for the trainer related to the content

- ✓ Disassembling and assembling hand held metal detector
- ✓ Soldering and desoldering different components of handheld metal detector.
- ✓ Replacement of defective devices/components.
- ✓ Testing techniques:
 - ✓ Continuity testing
 - ✓ Voltage measurement
 - ✓ Functionality testingprecautions



Practical learning Activity

Task: Each trainee should be asked to replace any defected parts of HHMD

Checklist	Score	
	Yes	No
Desassembling the HHMD		
Replacement of the defected part		
Adjustment of the defected part		
Reassembling the HHMD		
Continuity testing is conducted		
Voltage measurement is conducted		
Functionality test is conducted		
Observation		

Learning outcome 2.4 Clean the working area according to the cleaning techniques



Duration: 1hour



Learning outcome 2.4 objectives:

By the end of the learning outcome, the trainees should be able to:

1. Identify correctly cleaning tools, materials and equipment used to clean the workplace
2. Collect and arrange suitably tools and equipment according to the arrangement techniques
3. Collect and manage properly waste materials according to their types




Resources

Equipment

Tools

Materials

Computer	Lecture notes	Soldering tin
Projector	Text books	Cleaning materials
Personal safety equipment	Internet	Connectors and ports
Compressed air can	Duster	
Vacuum cleaner	Brushes	
	Soft cloth Lags or cotton	
	waste Brush	
	Towel/soft cloth	
	Coton waste	


Advance preparation:

Arrange well the working place

Prepare HHMD repair work



Content: description of tools, materials and equipment used to clean the workplace

- ✓ Vacuum cleaner: Vacuum cleaners are majorly used to remove dirt and dust from upholstery, carpets, velveteen furniture and floors made of hardwood and many varieties of floors, including laminated floors. They are also used to clean cars and stairs. Based on the uses, Vacuum cleaners are made into different types.



- ✓ Lags or cotton waste: Cotton waste is used in upholstery, mattress and bedding industries, and are used for wiping and polishing in automotive and hardware industries. In non-woven industries, they are used for embroidery backing paper. Waste cotton has uses in general and in nonwovens in particular.



- ✓ Cleaning solutions
- ✓ Brush: Cleaning brushes are used to carry out heavy duty cleaning tasks in the kitchen, bathroom, they are also used to clean floors and ceilings. Not only that, they are indispensable in cleaning hard-to-reach areas like bottles, sprouts, refrigerator coils and much more.



Top 6 Tips For A Clean And Effective Workplace

1. Get The Right Cleaners. The basic task of a workplace cleaning team is to check it for cleanliness. ...
2. Prevent Slips, Trips, And Falls.
3. Control Dust.
4. Prevent Fire Hazards.
5. Clear Away Clutter.
6. Avoid Falling Objects.

Take Away.

- ✓ Cleaning is the most important and primary aspect of housekeeping. It is a process of removing dirt, dust and grime by using methods such as dusting, shaking, sweeping, mopping, washing or polishing. There are certain areas you may clean daily, whereas you may clean other areas occasionally or once /twice in a year.

What are the Six Stages of Cleaning?

- ✓ Cleaning is a core part of daily life. Whether you're cleaning your hands, a kitchen countertop at home, or high-touch surfaces in a workplace, everyone carries out cleaning at some point during their day. In many businesses, cleaning is crucial to the ongoing health and safety of staff and customers. Plus, in light of the COVID-19 pandemic, it has become even more central to people's lives.
- ✓ Adopting an effective cleaning method is crucial for ensuring you fully remove harmful microorganisms. The specific cleaning procedure and the substances involved may vary depending on what you're cleaning, but there are generally six stages of cleaning that are important to completely disinfect contaminated surfaces.



In this article, we'll explain what these six stages of cleaning involve and how to carry them out when you clean. We'll also cover the importance of cleaning procedures, as well as how to improve the effectiveness of your cleaning activities and improve your safety while doing so. Finally, we discuss the differences between cleaning, sanitising, and disinfecting, which are often used interchangeably but do have some differences.

Some examples of health risks that cleaning can prevent include:

- Common viruses, such as COVID-19, flu, and cold, in all types of workplaces.
- Food-borne viruses, such as E. coli, salmonella and campylobacter, which can pose a risk in hospitality for example.
- Infections that can transfer via body fluids, such as HIV, for example in healthcare settings and those which involve puncturing skin like tattoo parlours.
- Food allergens, e.g. from food in a restaurant. Even tiny traces of an allergen can cause a reaction in those who are allergic.
- Non-food allergens, such as dusts, which can be present in all types of workplaces and could trigger a reaction in people who have a sensitivity.

By following an effective cleaning procedure, you can help to prevent these from harming people's health and safety.

✓ What are the Six Stages of Cleaning?

Following an effective cleaning procedure is vital for preventing health and safety risks. It ensures that you fully remove microorganisms, that you do not inadvertently spread them, and that any additional risks are minimised.



Each of the six stages of cleaning help you to focus on a certain key aspect of effective cleaning, from preparing the surface for a thorough clean by removing debris, to destroying microorganisms, to removing any chemicals, so the surface is

properly disinfected and ready for use. For example, if it will be used to prepare food. The six stages of cleaning are:

1. Pre-Clean

2. The first stage of cleaning is to remove loose debris and substances from the contaminated surface you're cleaning. You can do this by wiping with a disposable towel, sweeping, or rinsing. The aim is to remove as much loose debris as possible to prepare the area for the next stage of cleaning.

2. Main Clean

The second stage of cleaning is to loosen any substances, dirt, grease, and debris that you were unable to remove during the pre-clean stage. This involves using hot water and a detergent. You may be able to wipe away the loosened substances right away with something suitable, such as a cloth or mop, or you may have to allow the disinfectant to do its work for a certain amount of contact time before doing so.



3. Rinse

The third stage of cleaning is to remove all the loosened substances, dirt, and debris as well as the detergent, that was present in the second stage. You can do so using clean, hot water with a cloth, mop, squeegee, etc.

4. Disinfection

The fourth stage of cleaning is to disinfect the surface, which will destroy bacteria and other microorganisms. For example, by using heat or a chemical disinfectant for an adequate contact time. Follow the instructions for any products or equipment you use.

5. Final Rinse

The fifth stage of cleaning is to remove any disinfectants from the previous stage using clean, hot water. This step may not always be carried out however, depending on the disinfectant and surface you're cleaning. As stated in the previous stage, follow the manufacturer's guidance and seek further advice if needed.



6. Drying

The sixth and final stage of cleaning is to dry the surface, and it's recommended that you air dry where possible. You can use drying cloths if needed, but they should be single use if so, especially in a commercial setting. You must not air dry any drying cloths that are damp from use and reuse them, as bacteria could grow on the cloths and pose a contamination risk. By this point, the surface will be fully cleaned and most, if not all, microorganisms will have been destroyed, depending on the substances you used.

Note: You should thoroughly clean any cloths and other reusable cleaning products that you use, including drying cloths after their single use. Wash them in soap and water after finishing and dry them either in a dryer or via air drying (this is suitable for clean, wet cloths, not ones that are damp from use).



Some effectiveness and safety factors to consider include the following:

- Follow any cleaning schedules or risk assessments for cleaning, if cleaning at work. This ensures that you carry out cleaning in an organised and effective way, as well as address the key areas that have been identified in the risk assessment.
- Follow any training you have received, if cleaning at work. For example, you will likely receive some COSHH training, which will familiarise you with ways to minimise the risks posed by hazardous substances that you may use or create during cleaning.
- Use the right products for the cleaning activities you carry out. They should be able to kill the microorganisms that pose a risk in the premises, e.g. food-borne ones in a catering setting or COVID-19 in most workplaces currently. They should also be suitable for the surfaces and environments where you'll be using them, such as for the specific material of a kitchen countertop.
- Always follow the manufacturer's instructions and guidance, including any recommended concentrations and dilutions of chemical substances. Likewise, you should store them safely and in accordance with instructions. This is important for minimising exposure and for ensuring that any incompatible substances are kept apart. Remember to never mix different chemicals together, as this can cause dangerous reactions.
- Follow the NHS guidance for effective cleaning. Their guidance is to always work from the cleanest area towards the dirtiest area (to minimise further contamination of the cleaner areas), from top to bottom rather than going

between different areas, and covering all areas with an 'S' shaped pattern. Be careful to not go over the same area twice.

- Wear PPE, such as gloves and aprons. Gloves are important for protecting your hands from the risks posed by wet work and chemical products, such as contact dermatitis. It may also be useful to wear an apron, to prevent any potential chemical contamination that could penetrate your clothes and harm your skin, or that you could carry away on your personal clothing and that can continue to pose a risk
- Ensure that there is sufficient ventilation. This will minimise harmful substances in the air, e.g. the fumes that some chemicals could give off while in use, and which could cause health issues like occupational asthma. Make sure to always wash your hands after cleaning, with an effective handwashing procedure, even if you were wearing gloves.

What is the Difference Between Cleaning, Sanitising, and Disinfecting?

These three terms are often used interchangeably to refer to the process of cleaning a surface and removing harmful microorganisms. However, they do refer to slightly different things, and it's useful for you to be aware of this if you actively carry out cleaning. Knowing the difference between the three will help you ensure you're adopting the right procedures and cleaning to the necessary standards.

What is cleaning? Although cleaning is a suitable, general term to use for the entire task of making a surface free of debris and microorganisms, from a technical standpoint it actually only refers to one stage of the process. Cleaning refers to removing visible contamination from the surface, such as spillages, dirt, debris, and other obvious contaminants. In the context of the six stages of cleaning as discussed earlier, this is step one and two.



Doing so makes the area more visibly clean and tidy, removes contaminated materials and substances, and prepares the surface for deeper cleaning if needed, so any chemical products can achieve sufficient contact with it. To achieve a proper clean, one of the next stages are required, as cleaning on its own does not kill microorganisms on the surface.

What is sanitising? Sanitisation refers to the process of reducing microorganisms on a surface to a safe level, as established by international health standards. It's particularly important for surfaces that may come into contact with food, to prevent any ingestion risks.



While sanitisation will reduce the risk of infections from microorganisms and kill the majority of bacteria, it is not guaranteed to completely eliminate all microorganisms.

What is disinfection? Disinfection is a step up from sanitisation, as it is designed to fully destroy all microorganisms and pathogens. There are varying levels of strength and effectiveness of disinfectants, which will be used for different settings depending on the level of risk. For example, a much higher-grade disinfectant will be used in hospitals compared to an office or restaurant.



It is up to the user to identify which level of disinfectant they need for the area in which they're carrying out cleaning. For a workplace, this will usually be identified during a risk assessment and with consultation of specialists and the suppliers and manufacturers of cleaning products, where needed.

Carrying out effective cleaning, whether at home or at work, is crucial for protecting people's health and safety. A good way to do this is by following the six stages of cleaning, as outlined throughout this article, as well as following good practices to improve the effectiveness of your cleaning methods and your safety.

- Collection and arrangement of tools and equipment
- Arrangement of non-used materials (consumables)
- Cleaning of working area
 - ✓ Cleaning techniques
 - ✓ Tools used in cleaning
- Waste materials management
 - ✓ Types of waste materials (recyclable, bio-degradable, non- bio-degradable)
 - ✓ Treatment of waste materials



Summary for the trainer related to the content

- ✚ Tools, materials and equipment used to clean the workplace Vacuum cleaner
 - ✓ Lags or cotton waste
 - ✓ Cleaning solutions
 - ✓ Brush
- ✚ Collection and arrangement of tools and equipment
 - ✓ Arrangement of non-used materials (consumables)



Theoretical learning Activity

- ✓ Ask trainees to discuss about different workplace cleaning techniques and required cleaning tools, materials and equipment



Practical learning Activity

Task: Each trainee should be asked to clean the workplace

Checklist	Score	
	Yes	No
Selection of cleaning tools		
Selection of cleaning materials		
Selection of cleaning equipment		
Arrangement of non-used materials		
Management of waste materials		
Application of cleaning techniques		
Observation		

Learning outcomes:

1. Elaborate the repair report according to reporting techniques
2. Provide the invoice according to the work done
3. Suggest the maintenance contract according to manufacturer instructions

Learning Unit 3 Report the work done**STRUCTURE OF LEARNING UNIT**

Learning outcome 3.1 Identify the faults according to their types

Learning outcomes:

1. Identify the faults according to their types
2. Adjust/Repair the defective part/device according to the technical specifications
3. Test the handheld metal detector according to the testing techniques
4. Clean the working area according to the cleaning techniques



Duration: 30hrs



Learning outcome 3 .1 objectives:

By the end of the learning outcome, the trainees should be able to:


1. Elaborate the repair report according to reporting techniques
2. Provide the invoice according to the work done
3. Suggest the maintenance contract according to manufacturer instructions



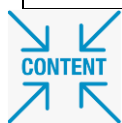
Resources

Equipment	Tools	Materials
Power supply	Whiteboard	Wires/cables

Computer	Markers	Electronic components
Projector	Erasor	Coils
Hand held MD	Handout-notes	screws
9v battery	Internet	Papers
	Screwdrivers	


Advance preparation:

- Avaibility of HHMD
- Prepare material, tools and equipment necessary to assemble and disassemble HHMD



Content 1: Elaboration of the repair report according to reporting techniques

Types of reports

- ✓ Written
- ✓ Oral
- ✓ Format of repair report :

Cover page presentation (Business full address) Content (introduction, body, conclusion/recommendation/way forward)

What is a report?

- ✓ A report is a specific form of writing that is organized around concisely identifying and examining issues, events, or findings that have happened in a physical sense, such as events that have occurred within an organization, or findings from a research investigation.
- ✓ A repair report is document that describes in detail the correct repair procedures. This can involve a machine, a device or an appliance. When you write a repair report, it must be kept organized and detailed.

- Elements of the repair report:

- ✓ **BUSINESS FULL ADDRESS:** -Business address: means where the business is located - Address: means the place where a person or organization can be found or communicated with.
- ✓ **INTRODUCTION:** It is a beginning section which states the purpose and goals of the following writing. This is generally followed by the body and conclusion. The introduction typically describes the scope of the document and gives the brief explanation or summary of the document.

To report the work done follow the tips below:

1. Carefully plan the report. Identify the purpose of writing the report. ...
 2. Take your time in writing the report. ...
 3. Give your report a structure. ...
 4. Be honest. ...
 5. Write simply. ...
 6. Keep a backup copy of your report. ...
 7. Proofread
- ✓ **BODY:** the body text or body copy is the text forming the main content of a book, magazine, web page or any other printed or digital work.
 - ✓ **CONCLUSION:** is the last part of the report, its end or result. The phrase in conclusion means “finally, to sum up,” and is used to introduce some final comments at the end of a speech or piece of writing. The phrase to conclusions means “to come to come to a judgement without enough evidence
 - ✓ **RECOMMENDATION:** Is a suggestion or proposal as to the best course of action, especially one put forward by an authoritative body.

How to write repair report?

When you write a repair report, it should be kept organized and detailed. While here is no proper format required for a repair report, you should include the basic repair steps, safety concerns and repair checklists sections to help the reader understand what the repair requires. Organize the sections in order they are needed,

so give an introduction of the device being repaired and the safety precautions before the repair process

1. Write an introduction to your repair report This should include a description of the item being repaired, its function and the problem it has got.
2. Provide a list of suspected parts or components.
3. Provide steps to follow while attempting a repair
4. Provide a list of all materials needed
5. Provide detailed sketches or images of the item being repaired
6. Write a conclusion that focuses on the rectification of the problems
7. Save the repair report as a PDF.

Task: Elaborate the handheld metal detector repair report

Checklist	Score	
	Yes	No
Identification of types of report		
Respect of repair report format		
Observation		



Content2: Provide the invoice according to the work done

- ✚ Types of invoices
 - ✓ Proforma invoice
 - ✓ Invoice Learning outcome
- ✚ Difference between proforma invoice and invoice
 - ✓ Elaboration of invoice /Proforma invoice
 - ✓ Format of the invoice (Business name, Tin number, company name and address, customer bank account, item number, item name, item specification, item quantity, item unit price and item total price)

1. INVOICE

- ✓ An invoice is a document that lists the products and services a business provides to a client and establishes an obligation on the part of the client to pay the business for those products and services. Invoicing is crucial for small businesses, because invoices are the business documents that enable companies to get paid for their services.
- ✓ An invoice is a document issued by a seller to the buyer that indicates the quantities and costs of the products or services provided by the seller. ... Payment terms indicate the maximum amount of time that a buyer has to pay for the goods and/or services that they have purchased from the seller.
- ✓ Invoices serve an important purpose for both the business sending the invoice and the client receiving it. For small businesses, an invoice helps expedite the payment process by giving clients a notification of the payment that's due. For clients, invoices provide an organized record of an expense with itemized details, and can help with record keeping.

What Is an Invoice Used for?

Invoices are used as a source document for business accounting.

Invoices are helpful for recording all the sales transactions a business makes with its clients. Invoices are used by businesses for a variety of purposes, including:

- To request timely payment from clients
- To keep track of sales
- To track inventory, for businesses selling products
- To forecast future sales using historical data
- To record business revenue for tax filings

What Is an Invoice ID?

An invoice ID, also referred to as an invoice number, is a unique number that's assigned to each invoice a business generates. The invoice number is a crucial invoice element because it allows a business to easily identify and refer to individual transactions with clients. An invoice ID can include both numbers and letters. While invoice don't necessarily need to be numbered sequentially, you'll need to establish a consistent invoice ID system and ensure you don't assign an invoice number more than once.

How to Assign Invoice Numbers

There are different approaches businesses can adopt to assign invoice numbers. Here are some common approaches to assigning invoice numbers:

- ✓ **SEQUENTIAL** This is the simplest way to assign invoice numbers and is the default method adopted by most cloud-based invoicing software. To assign sequential invoice numbers, you would start with any number (usually 1) and assign each proceeding invoice the next number in the sequence. For example: Invoice #001 Invoice #002 Invoice #003 Sequential invoice numbers make it easy to stay consistent and ensure you're never assigning duplicate invoice IDs.
- ✓ **CHRONOLOGICAL**
To assign invoice numbers using the chronological method, you will sort all invoices by the date they're generated.
The first series of numbers in the ID will therefore always refer to the date. After the date, your invoice number will also include unique numbers assigned to that invoice. You can use any date format you like for chronological invoice numbers. For example, if an invoice is created on September 30, 2018 and the unique invoice number is 0022, you could assign this number to the invoice: 2018-09-30-0022.
- ✓ **BY CUSTOMER ID**

Some businesses assign unique customer IDs to each of their clients, and you can use the customer ID to assign invoice numbers.

The process for assigning invoice numbers by customer ID is similar to the process for chronological numbering.

The invoice ID will begin with the customer ID number and then a unique number will follow. For example, if you've assigned your client a customer ID number of 490 and the unique number you're using is 004, you can use the customer ID approach to assign an invoice number of 490-004.

✓ BY PROJECT ID

If your business works on a number of projects at a time and you bill clients by project, then you may wish to assign invoice numbers by project ID.

This method is common in the construction industry.

To assign invoice numbers by project ID, the first part of your invoice number will refer to the project ID and the second part will be a sequential number to differentiate between different invoices issued for this specific project. For example, if you were creating an invoice for your project 6221, you could assign your first invoice number for the project as 6221-001.

What Does an Invoice Look Like?

A professional invoice will look clean, readable and simple while providing all the details on the services provided and the payment required by the client. A professional invoice should always include:

- Your business contact information
- Your client's contact information
- An invoice ID or invoice number
- Payment terms and deadlines
- An itemized list of services rendered
- The amount due

How Do I Invoice Clients?

To invoice your clients, you should create and send an invoice as soon as you've completed work on a project. That way, the details of the work will be fresh in your mind and you should receive payment as quickly as possible. Make sure your invoice includes all the details your clients will need to pay you, including your business name, the invoice due date and the total amount due.

2. Proforma invoice is:

- ✓ An abridged or estimated invoice sent by a seller to a buyer in advance of a shipment or delivery of goods. It notes the kind and quantity of goods, their value, and other important information such as weight and transportation charges.
- ✓ Proforma invoices are commonly used as preliminary invoices with a quotation, or for customs purposes in importation. They differ from a normal invoice in not being a demand or request for payment.
- ✓ used for the creation of sales, whereas invoice is used for confirmation of sale.
- ✓ Provided by the seller, on the request of the buyer before the placement of the order. As opposed to invoice, which is issued by the seller to the buyer to request payment of goods delivered.
- ✓ Basically a document that provides information related to the particulars of the goods and services yet to be delivered to the buyer/customer. It has the details of the estimated prices for available goods or services. Besides, contains the estimate of any commissions, applicable taxes, the weight of a shipment, shipping costs etc

When can you use a Proforma invoice?

- ✓ A supplier issues a proforma invoice before the sale actually happens. He makes it if a customer requests him to produce a document for goods and/or services yet to be delivered. Let's take an example:
- ✓ A customer who is having two-wheeler might agree to the price of a bike on the proforma invoice. So, his supplier will deliver the bike once it is ready and the customer will pay when the invoice is received. But the final invoice amount will be the same or close to the amount on the Pro-forma invoice.

- ✓ These Pro-forma invoices are more often used for the purposes of customs on imports or exports for a smooth delivery process.

- Contents of Proforma invoice

- ✓ Unique invoice number.
- ✓ Date of preparation/issue.
- ✓ Address of the supplier.
- ✓ Address of the prospective buyer.
- ✓ Description of good and/or services including their unit costs and line-item totals.
- ✓ The validity of the pro forma invoice
- ✓ Proposed terms of sale.
- ✓ Proposed terms of payment, if any.
- ✓ Certifications required by “Customs Authorities” if any.
- ✓ Signature by an authorized person from the supplier’s company

The format of Proforma invoice

- ✓ Actually, there is no specific format prescribed for this invoice. It may look like a commercial invoice.
- ✓ Therefore, it should be clearly labeled “proforma” that reflects the fact that it is only an estimate and should not be paid until the work is done. Then the final tax invoice will be issued

3. Bill is:

- ✓ an amount of money owed for goods supplied or services rendered, set out in a printed or written statement of charges", while an invoice is "a list of goods sent or services provided, with a statement of the sum due for these"
- ✓ a term used to describe transactions that are owed to vendors. When your vendors send you an invoice to collect money from you, it is referred to as a Bill. Since you are a customer to the

vendor, you will receive an invoice from them and enter it as a bill you are expected to pay.

The significant difference between the two is that the invoice is issued prior to the payment while the receipt is issued after the payment. The invoice is used to track the sale of goods or services. On the contrary, receipt acts as documentation for the buyer that the amount of the merchandise has been paid.

SAMPLE OF INVOICE

Company Name	Invoice No:
Address:	Invoice Date:
.....	Banking Details:
.....	A/C No:
State Code:	IFSC Code:
GSTIN:	

State Code:

NOTE: This is not a GST invoice.

INVOICE



INVOICE NUMBER DATE OF ISSUE
00001 mm/dd/yyyy

BILLED TO
Client Name
Street address
City, State, Country
ZIP Code

Your company name
123 Your Street
123 Your Street
564-555-1234
your@email.com
yourwebsite.com

DESCRIPTION	UNIT COST	QTY /HR RATE	AMOUNT
Your item name	\$0	1	\$0
Your item name	\$0	1	\$0
Your item name	\$0	1	\$0
Your item name	\$0	1	\$0
Your item name	\$0	1	\$0
Your item name	\$0	1	\$0
Your item name	\$0	1	\$0

INVOICE TOTAL
\$2,000

SUBTOTAL \$0
DISCOUNT \$0
(TAX RATE) 0%
TAX \$0
TOTAL \$0

TERMS
E.g. Please pay invoice by MM/DD/YYYY

FreshBooks makes it easier to get paid faster.



INVOICE



Invoice number
00001

Date of issue
mm/dd/yyyy

Billed to
Client Name
Street address
City, State, Country
ZIP Code

Your company name
123 Your Street
564-555-1234
your@email.com
yourwebsite.com

Description	Unit cost	Qty / Hr rate	Amount
Your item name	\$0	1	\$0
Your item name	\$0	1	\$0
Your item name	\$0	1	\$0
Your item name	\$0	1	\$0
Your item name	\$0	1	\$0
Your item name	\$0	1	\$0
Your item name	\$0	1	\$0
Your item name	\$0	1	\$0
	Subtotal		\$0
	Discount		\$0
	(Tax rate)		0%
	Tax		\$0

Invoice total

\$2,000

Terms
E.g. Please pay invoice by MM/DD/YYYY

FreshBooks makes it easier to get paid faster.






GST: Goods and Services Tax is a value added tax levied on most goods and services sold for domestic consumption. GSTIN: Goods and services tax identification number is a unique 15 digit number, which has replaced by the tax identification number (TIN). Differentiation between Pro-forma invoice, invoice, estimates, and purchase order

PARTICULARS	INVOICE	PROFORMA INVOICE	QUOTATION/ESTIMATES	PURCHASE ORDER
MEANING	It refers to commercial document issued by the supplier to the buyer containing all details of goods	It is a document that provides information regarding the particulars of the goods and/or services yet to be	It is a formal estimate that shows the goods and/ or services needed and the total amount owed to the	It is a document issued by the buyer and sent off to the supplier detailing the lists of goods

	and/or services supplied to him and notify the buyer that payment is due.	delivered to the buyer/customer.	product or services.	and/ or services, with an aim of making purchase.
OBJECTIVES	To notify the buyer that payment is due.	To help the buyer in taking decision, regarding whether to place the order or not.	To provide estimate sale price of goods yet to be delivered.	To order goods and/ or services from the supplier.

Summary

-  Types of invoices
 - ✓ Proforma invoice
 - ✓ Invoice
-  Difference between proforma invoice and invoice
-  Elaboration of invoice /Proforma invoice



Theoretical learning Activity

Ask trainees to brainstorm about:

- ✓ The types of invoice and their difference
- ✓ The format of invoice



Practical learning Activity

Task: Elaborate the invoice for handheld metal detector repair activity

Checklist	Score	
	Yes	No
Identification of types of invoices		
Respect of invoice format		
Observation		



Points to Remember

- ✓ Difference between proforma invoice and invoice
- ✓ Elements of invoice
- ✓ Format of invoice
- ✓ Bill, Estimate and purchase order

Learning outcome 3.3 Suggest the maintenance contract according to manufacturer's instructions



Duration: 1hour



Learning outcome 3.3 objectives:


By the end of the learning outcome, the trainees should be able to:

1. Define correctly the term "maintenance contract" used in electronic services
2. Identify clearly the elements of maintenance contract used in electronic services
3. Elaborate adequately contract according to the work done



Resources

Equipment	Tools	Materials
Computer Projector Whiteboard	Books Handout notes Internet	Papers

	Samples of maintenance contract Marker Duster	
 Advance preparation: Arrange well the working place Prepare sample of invoice		



Content: Elaboration of maintenance contract

What should be included in a maintenance contract?

Sections to Be Included in a Product Maintenance and Repair Agreement

- Provider and buyer contact information.
- Definitions of common terms.
- General service terms and specifications.
- Response time and returns procedure.
- Support conditions and obligations.
- Service exclusions.
- Price, Invoicing, and Payment terms.

What is the difference between a service contract and a maintenance contract?

Service contracts may include towing, rental and emergency road service... **Under a maintenance agreement, the maker of the agreement is obligated to perform regularly scheduled maintenance of property**, such as regularly scheduled oil changes for an automobile.

What is a standard maintenance agreement?

A maintenance agreement **outlines the steps one party will undertake to insure the upkeep, repair, serviceability of another party's property**. Maintenance contracts are commonly used by companies that take care of vehicle fleets, industrial equipment, office and apartment buildings, computer networks, etc.

What is a Maintenance Agreement?

A maintenance agreement outlines the steps one party will undertake to insure the upkeep, repair, serviceability of another party's property. Maintenance contracts are commonly used by companies that take care of vehicle fleets, industrial equipment, office and apartment buildings, computer networks, etc.

Maintenance contracts include service level parameters such as response time and performance of the equipment to be maintained (99 percent network availability, for example). Other provisions of these agreements may include the timeliness and timeframe of services to be rendered and the annual or monthly fee.

Common Sections in Maintenance Agreements

Below is a list of common sections included in Maintenance Agreements. These sections are linked to the below sample agreement for you to explore.

- [DEFINITIONS](#)
- [LICENSE](#)
- [LICENSE RESTRICTIONS](#)
- [PAYMENTS](#)
- [MAINTENANCE AND SUPPORT](#)
- [WARRANTIES AND LIMITATION OF LIABILITY](#)
- [INDEMNIFICATION](#)
- [CONFIDENTIAL INFORMATION AND OWNERSHIP](#)
- [TERM AND TERMINATION](#)
- [GENERAL](#)
- [APPLICABLE LAW AND DISPUTE RESOLUTION](#)

Elements of the contract:

- ✓ Obligation agreements of both parties
- ✓ Job description
- ✓ Job timeframe
- ✓ Allocation of risks
- ✓ Insurance
- ✓ Price review and adjustments when amendments is required
- ✓ Full contact of contracting parties
- ✓ Stamps and signature of contracting parties
- ✓ Termination of contract



Summary

- ✓ Manufacturers instructions on maintenance activities for different types of handheld detector
- ✓ Suggestion/negotiation of the maintenance contract based on manufacturers instructions;



Theoretical learning Activity

. Ask trainees to brainstorm about:

- ✓ The maintenance contract elements
- ✓ The format of maintenance contract




Practical learning Activity

Task: Elaborate a maintenance contract

Checklist	Score	
	Yes	No
Identification of recommended maintenance activities		
Respect of maintenance contract format		
Terms of contract		
Proper suggestion of maintenance contract		
Observation		

Summative Assessment

Integrated situation	Resources
<p>Falcon Trust Ltd Company located in Kigali city, Gasabo district, Kimironko sector has assigned different tasks to its technicians. You as one of them, you are requested to repair a single 9V battery, - 35° F (- 37° C) to 158° F (70° C), 2kHz Warble Garrett super scanner Handheld metal detector. The handheld metal detector in question is not turning ON and it must be submitted to its owner within 3 hours. You must also submit the repair report and invoice. Note: The user manual of single 9V battery, -35° F (-37° C) to 158° F (70° C), 2kHz Warble Garrett super scanner Handheld metal detector is provided.</p>	<p> Tools, equipment and materials:</p> <ul style="list-style-type: none"> ✓ single 9V battery, -35° F (-37° C) to 158° F (70° C), 2kHz Warble Garrett super scanner Handheld metal detector ✓ Universal screw ✓ drivers - Flat ✓ screw drivers ✓ Screw driving machine ✓ Universal pliers ✓ Cutting pliers ✓ Stripping pliers ✓ Blower ✓ Soldering iron ✓ Di-soldering pump ✓ Digital multimeter ✓ Cleaning brush ✓ Soldering gun ✓ Gun glue stick ✓ Gloves and nose mask ✓ Overcoat

	✓ Goggles ✓ Safety shoes
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Assessment Criterion 1: Quality of Process

Checklist	score	
	YeS	No
Indicator: Tools, measurement instruments and PPE are selected		
Opening tools		
Cutting tools		
Soldering and desoldering tools		
Measurement instruments		
PPE		
Indicator: Tools, materials and equipment are arranged into the working area		
Arrangement according to the type		
Arrangement according to the use		
Indicator: The handheld metal detector is disassembled		
Unscrewing the cover		
Removal of cover		
Indicator : The fault / damaged part is identified		
Application of fault identification techniques (visual inspection, testing or assumption)		
Recognition of exact fault		
Recognition of defected component		
Indicator : The fault is rectified		
Di-soldering of defected component		
Replacement of defected component		
Soldering of new component		
Indicator : The handheld metal detector is tested		
Functionality testing		

Indicator : The handheld metal detector is re-assemble	

References:

1. <https://www.google.com/search?q=hand+held+metal+detector&oq=hand+held+metal+detector&aqs=chrome..69l57j0l512l2j0l457l512j0l512l6.10466j0j7&sourceid=chrome&ie=UTF-8>
2. <https://www.amazon.com/V%C2%B7RESOURCING-Sensitivity-Indicator-Inspection-Electronic/dp/B08TBYKC7R?th=1>