

## Tools used during work on Electrical systems or installations:

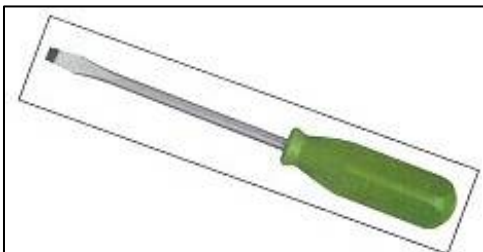
**Introduction:** As from the early years of existence human beings always thought about limiting the hard work as well as increasing productivity by reducing the time taken to do any kind of job. One of the main aspects which helped humans to reach this goal was certainly the inventing of tools. Tools, apart from helping reducing the hard work and increasing productivity, also help to extend the limited physical capabilities of ourselves, as well as extending the responses of the Human Body.

### (1). Common Hand tools.

#### **The Screw Driver:**



**Fig. 1**



**Fig. 2**

This is one of the most, if not the most common tools used in electrical installation. It is used fix screws. Various sizes of screw drivers exist according to the size of the screw to be fixed. Also the driving head of this tool can be found in different forms, again in accordance to the screw to be fitted. Most common used screwdrivers are the 'Phillips' (fig.2 – form of a cross) and the 'Flat' (fig.2)

The screwdriver shown in fig.1 is called '**The Electrician's Screwdriver**'. Note that the driving stem is almost fully covered, so that it is insulated. Also on the handle there will be stamped the maximum voltage the handle can withstand, normally in the range of Kilo Volts (thousands of volts).

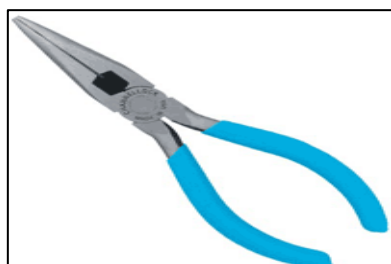
#### **The Pliers:**

##### **(i). Combination pliers:**



This is the most common pliers used by electricians. Again, it is very important to use pliers with handles covered with good insulation. Always get certified pliers showing the voltage they can withstand. This pliers is called 'combination' because there are a combination of functions it can perform like: holding, twisting, cutting of wires, crimping, etc.

##### **(ii). The long nose pliers:**



This is similar to the pliers explained above, with the main difference being that it has a longer nose so that one can hold tiny objects and work in deep spaces, where it would be impossible for a combination pliers to reach.

### The wire stripper:



Fig. 3

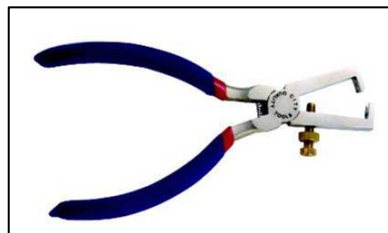


Fig. 4

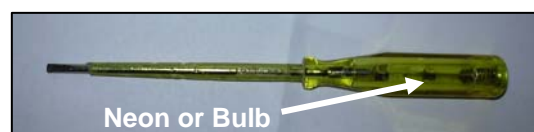
The wire stripper is a very useful tool for the electrician. It is used to strip off insulation from wires. There are different types of wire strippers. The one shown in fig. 3 is an automatic wire stripper. It adjusts itself automatically to different wire gauges to be stripped off. The stripper in fig. 4 is another type. This one has to be adjusted by the user according to the wire gauge to be stripped off. When using the wire stripper care should be taken so that the wire conductor strands are not damaged by the tool, which can cause them to break off when fixing in accessories or by time during use. This can be dangerous since the current rating of the wire will be reduced.

### The Side Cutters:



As the name implies, this tool is used for cutting wires. A special feature to note is again, the voltage rating of the handles insulation. Always use the proper size of cutters in accordance to the wire gauge to be cut, and use the cutters only for cutting wires. To cut other objects (like nails, screws, etc.) there are other tools available.

### The Screwdriver Tester:



This tool can also be classified as a very handy test equipment for the electrician. It has a neon or a lamp connected in series between the handle end and the driver tip.

When putting the tip onto a **LIVE** wire or terminal, and touching the handle end with your finger, the lamp or neon will light up to indicate that there is current flowing through the wire or terminal. **Never try to modify this tool as it can be very dangerous. For example, never replace the voltage dropper inside the tool handle with one of less value or a piece of wire. Never remove the insulation that covers almost all of the driving stem. This can cause an electric shock to anyone that will go to check for live wire/terminal.**

### Spanners:



**Open ended**



**Combination**



**Adjustable**

Spanners are used to fix bolts and nuts sometimes found in fitting heavy duty electrical terminals, and most of the times used in fixing equipment. Three types of spanners are shown above. The first type is called 'Open-ended', the second is 'Combination' since it has an open-ended type at one end, and a 'ring spanner' at the other end. Ring spanners are useful when tightening or loosening bolts and nuts that are found in awkward positions. The other type shown is the Adjustable spanner which can be adjusted according to the size of nut or bolt to be tightened/loosened. On bolts and nuts always use spanners. Never replace a spanner with pliers. This can be dangerous, can damage the bolt head or the nut, and pliers will never tighten the accessory enough like a spanner will do. Another safety fact related to spanners is: Always use the correct size of spanner as the incorrect size can be dangerous.

## **(2). Tools used during conduit or trunking layout/fixing:**

### **(i). Marking tools and aids:**

Before start hands-on work on an electrical installation, following good planning for how the installation will be conducted, it is very important that the electrician makes the necessary markings where the equipment will be installed or fixed. Here are some tools that are useful in this stage of work.

### **The spirit level:**



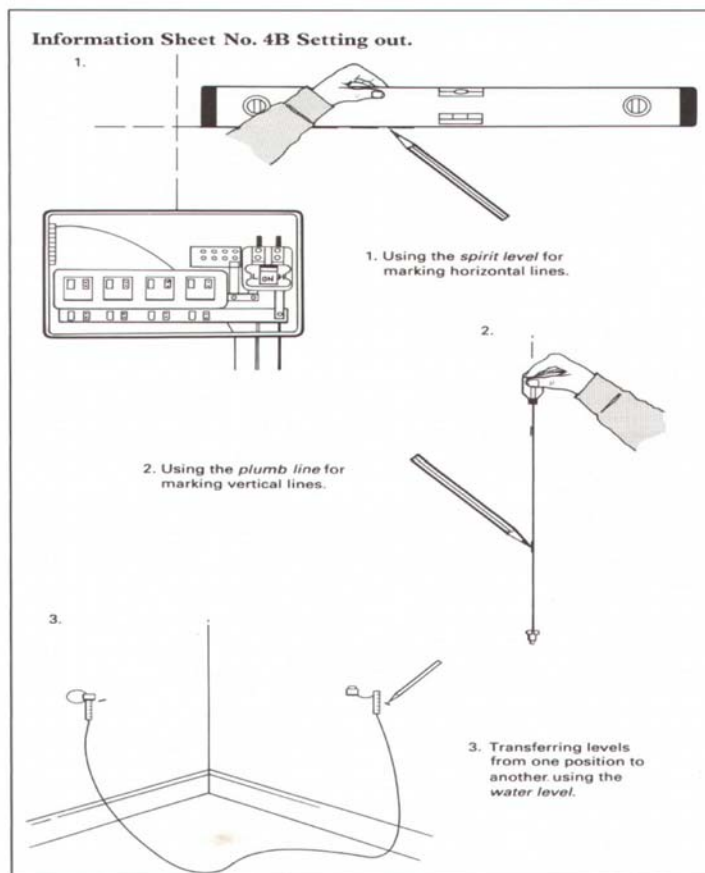
This type of tool will help the worker in marking perfect horizontal lines. It is also very useful when fixing equipment and accessories on walls. Using a spirit level will result in perfect horizontally laid accessories and will reflect a very good workmanship of the electrician !!

### The plumb chalk line:



While the spirit level served for marking perfect horizontal lines, the plumb chalk line will help us marking perfect vertical lines. It consist of a string attached by a weight at the bottom end. When it is hanged on a wall and the weight brought to rest, the string will be hanging in a perfect vertical line which can be used as reference to mark vertical lines.

### The water level:



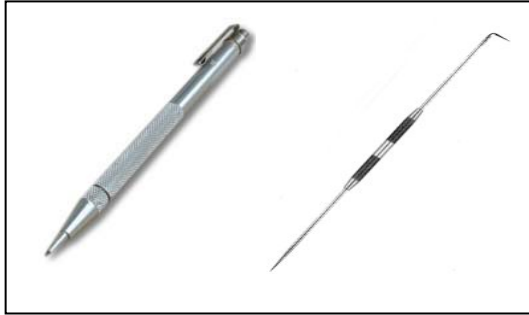
The water level is another useful aid in marking. It helps in transferring levels from one position to another, say transferring position from one wall in the room to another wall round a corner. This can be in practice a pipe filled with water and marked at both ends. One position is marked on one wall. The level of water is brought in line with both markings on the pipe. When this is done and one end is put in line with the marking done, a second mark can be done on the second wall where the marking has to be transferred. The figure shows a practical illustration in using the 3 tools just described.

### The try square:



This tool is very useful in marking right angles (90 degrees). It must be used when marking trunking before cutting to length desired. This is essential for the work to look right and for edges to be cut square. Before placing this tool for marking always check there id no dirt and burrs lying under the tool as this will result in non right angled markings.

### **The scribe:**



This is a thin steel bar which is ground to a fine point at the tip.

It is used in marking metals. Veru useful in marking metal trunking .

### **(ii). Measuring Aids:**

#### **Tape measure:**



This tool is used in taking long and not so accurate measures. The measure is a long springy metal strip which is extracted from the case for taking measures. When ready it is rolled back into the case. This measuring tool has a lug attached to the end. IT serves to hook over ends of work to be measured.

#### **The steel rule:**



This is used to take more accurate measures. The tape measure cannot be used for accurate measured since the tape can be distorted and does not indicate the correct measure.

The steel rule is also useful, in conjunction with the scribe or a pen/pencil, in marking lines.

### **(iii). Tools used during conduit and trunking fixing:**

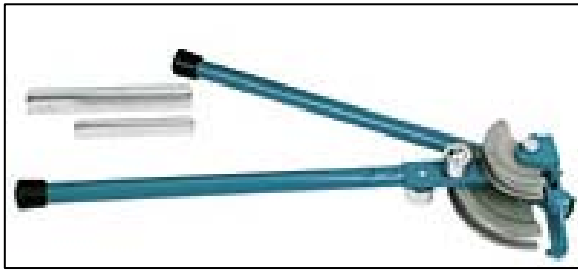
#### **Plastic pipe bending spring:**



This tool is inserted into the pipe to be bended. A string must be attached at one end of the spring. It has two functions: (i). It helps the user to get a rough idea of the position where the spring has arrived in the pipe. (ii). It is a means from where you can pull out the spring after the bending is ready.



### **Metal pipe bender:**



the pipe is bent over this semi-circular groove until the desired bend is achieved.

To bend metal pipes we need a heavy duty tool like the one illustrated. Other, and more heavy duty metal pipe benders exist. They can be identified from a large stand which is opened so that the bender will be firmly lying on the ground. The pipe is inserted over a groove in the form of a semi-circle. With the aid of an arm

### **The Hack-saw:**



coarse. The fine blade, which has 24-32 teeth per inch, should be used on hard metals. The coarse blade (14-18 teeth per inch) should be used on soft metals.

This tool is used to cut pipes, trunking, or other equipment to the desired length or size. When using the hack-saw, some points must be given special attention. (i). The teeth of the blade must be facing forward. (ii). There are two types of blades, the fine and the

### **The Plastic or soft metal pipe Cutter:**



**Fig. 5**



**Fig. 6**

When cutting plastic or other soft metal pipes there is a special pipe cutting tool. The one shown in fig. 5 can be used also to cut soft metal pipes such

as brass pipes used for plumbing and gas. The cutter has a roller blade in the bottom and 2 rollers mounted on a frame which can be adjusted by a knob. The pipe is inserted to touch with the blade. The rollers are brought in touch with the pipe by tightening the knob. The cutter is moved around the pipe to give the first cut. The knob is tightened and the cutter again moved around the pipe. The procedure is repeated until the pipe is fully cut.

The cutter shown in fig. 6 is used only on plastic pipes. It is opened and the pipe is inserted. The handle is closed by a ratchet mechanism. The cutter is turned and the handle progressively closed until the pipe is fully cut.

### **The conduit pipe reamer:**



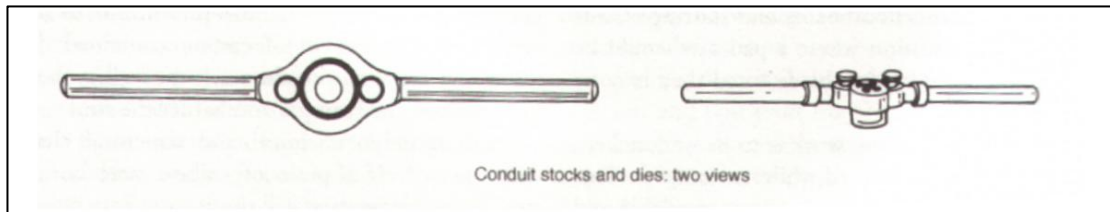
When cutting a pipe with a hack-saw, the cut is never a perfect clean. A reamer is inserted inside the pipe and turned so that any burrs left by the hack-saw are removed away.

### Hand Files:



When a reamer is not available, hand files can be used to clean pipes from burrs left following cutting. There are different forms of hand files. Some of them are the Flat file (illustrated), the round file, the triangular file, the square file, etc.

### Stocks and dies:



Sometimes it is required to carry out unburred installations. In most cases this is done in workshops or on ceilings where all conduit will be covered up by decorative soffit-ceilings. For safety reasons the conduit pipes installed in these cases will be of the metallic type. Metallic conduit pipes are coupled to accessory boxes via a thread. Hence the ends of the pipes have to be threaded. This is done by Stocks and dies by which the thread is cut on the pipe. Before and after cutting the thread any burrs left have to be removed using the conduit pipe reamer or the hand file.

### The Stillson wrench:



This type of wrench is used to hold firmly and turn metallic conduit pipes. It is very useful when connecting metallic pipes to fittings and accessory boxes. When fitting threaded pipes it is good practice to use a lubricant which will help for easier pipe fitting.

### Ratchet and socket set:



Used to do the same job as spanners do. They are however designed to make the job of a spanner easier as there is no need to repeatedly remove the spanner during tightening/loosening of bolts or nuts. Set consist of a drive with which different sized sockets are attached. Mechanism is designed so that drive is set both for tightening and loosening. Also it is of utmost importance that for electrical work these tool sets are properly insulated.

## The Hammer:



Hammers are other useful tools used in electrical installation. They are mostly used in two stages of installation: (i). A type of heavy duty hammer is used in conjunction with a chisel to cut grooves inside walls which will serve as housing for conduit. This is the type 1 hammer illustrated. (ii). Another hammer (type 2 in illustration) is used to fix trunking and conduit inside grooves cut in the walls or on the walls in case of externally mounted conduit.

The hammer is used to install clips or nails which hold the conduit/trunking in place.

## Floorboard chisels:



This tool together with a heavy duty hammer, is used to open up grooves in the wall which will serve as housing for the conduit piping which is installed inside walls in domestic electrical installation. On the chisel illustrated, please note the accessory installed on the handle. This will serve as protection for your hands during use, in the case a hit from the hammer will not be precisely applied to the handle,

with consequence that the hit will be transferred to your hands. This accessory will prevent hammer hits to come to your hands.

## (3). Power tools:

### The Electric Driller:



The electric driller is a tool used very frequently during electrical installations. Its job is to drill holes for screws which are then used to fix conduit and accessory boxes inside grooves cut into the wall, or onto the walls as in the case of externally mounted installations.

### The Grinder:

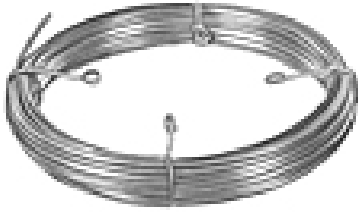


The grinder is used to cut grooves on walls. Grooves are then opened using a hammer and a chisel, and inside them conduit pipes are installed. Great care should be taken when using the grinder as this is a very dangerous tool. This tool has a guard which serves as protection from debris thrown away by the cutting action and in case the disk is broken.



#### (4). Tools used during wiring:

##### The Fish Wire:



This is a long length of steel or plastic wire. It is inserted into conduit from one end to another. The wires are then attached to the Fish wire at one end. The Fish wire is pulled from the other end so that wires are inserted in the conduit.

#### (5). Test equipment:

Alongside with the tester screwdriver described earlier in these notes, there are some other useful and more sophisticated test equipment used by the electrician. These type of tools are in most cases needed when the installation is ready and before supply is connected to the installation.

##### The Multimeter:



This test equipment is used to check ac/dc voltage, ac/dc current (up to 20 Amps), resistance and continuity. Nowadays these type of instruments give readings in digital format. However one may still encounter multimeters of the analogue type, where the reading are given by a pointer moving over a marked scale.

##### The Clamp Ammeter:



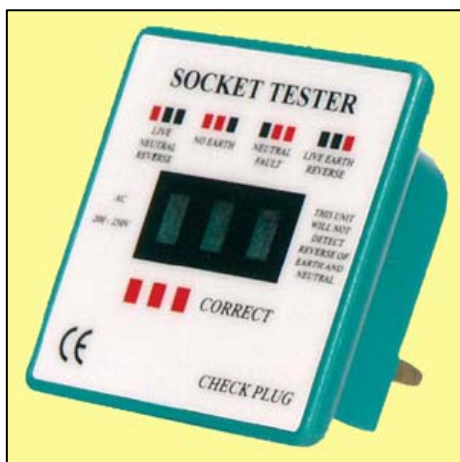
For **a.c. currents** greater than 20 Amps the clamp ammeter should be used. The wire is inserted into the upper opening of the ammeter. When a wire is carrying an a.c. current, it emits an alternating magnetic field proportional to the current flowing. By sensing the magnetic field emitted from the wire, this instrument can give a reading of the current flowing through the wire.

### The Insulation tester:



When an electrical installation is complete, one of the tests that are required prior connecting supply is the insulation test. For this test an insulation tester is required. This tester checks the insulation of the wiring and accessories at 500V dc. For an electrical circuit to have good insulation it must have a resistance in the range of Mega Ohms between the 3 conductors (Live, Neutral and Earth).

### The Polarity tester:



This tool is used when the supply has been applied to the electrical installation. It checks that the correct polarity, in most cases on the socket outlets, has been connected. Normally this tester is plugged into each socket outlet and by a set of LED indicators it gives if correct polarity has been connected. If polarity is incorrect this instrument can have other LED's which indicate what is wrong with the polarity.

### (6). Extra tooling required for electronics:



For electronics the basic tools are the same as for electrical with the only difference that they do not have to be of such heavy duty as those required for electrical work. However there are some extra tools which are specifically required for electronics work.

The figure on the left shows a toolkit for a professional electronics servicing engineer. We should now be considering some extra tools which are specifically required if we want to do electronics maintenance work.

## The watchmaker's screwdrivers and trimming tools:



Watchmaker Screwdrivers



A Trimmer

Watchmakers screwdrivers are small and precise screwdrivers which are required to assemble/disassemble tiny electronics parts. They could be flat, phillips, allen type, torx, etc.

A trimmer is a similar tool to a watchmaker screwdriver with the difference that it is often made of plastic material. It is used to calibrate and adjust presets, variable capacitors or inductors. Plastic material serves to prevent any short circuiting and/or any electrical disturbance. Remember these tools are used when the circuit is connected to the power supply and operating.

## Tweezers:



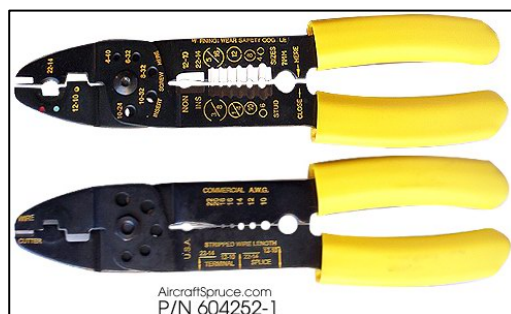
Tweezers are very useful in handling very small parts used in electronics. Mainly used during assembly and disassembly. Sometimes it is important that they are suitably insulated just in case they are used on a circuit with power on.

## Magnifying Glasses:



Just to continue mentioning the very small parts used in electronics. A magnifying glass could be very useful in physically identifying a component part number, a component value or polarity marking. It is also useful in checking for solder or track short circuiting bridges following assembly or maintenance/repair on a pcb

## Crimping Tool:



Used to attach various terminals, connectors, attachments, etc. to wires or components. This is to provide a firm electrical connection. Crimping is usually used to replace soldering in equipment to be used in environment where high vibration is present, as soldering removes extra flexibility to an electrical connection or joint. Such tools can be designed for a range of commercial terminals or professionally

designed for special terminals. It all depends on the electronic equipment and the standard requirements.

### Integrated Circuit Extractor:



Sometimes it is very difficult to remove an IC from its base. When trying to remove by hand there is a risk that the pins are bent and even can cause personal injury. This special tool helps the IC to be extracted without any risk of damage or personal injury. It is similar to tweezers with the difference that the tips are bent to be inserted underneath the IC. The tool is then used to pull the IC out of its base or socket.

### Soldering and de-soldering tools:



Soldering (Solder - a low melting point alloy) is used to make a firm electrical connection between electronic components and wires, pcb tracks, other components, etc. Main tool is the soldering iron which is used to melt the solder and heat up the connections to be attached together. Other tools are

used to remove excessive soldering when it is required to remove a component from a pcb. These are the De-soldering pump and the de-soldering wick. The figure shows the basic tools required for soldering and de-soldering. Separate notes cover in more detail these tools and other tools used for this electronics job.

### Cutting/trimming tools (Utility Knife and Scissors):



Sometimes very useful to keep in an electronics servicing tool kit. They could be utilized for mechanical object trimming and/or cutting during assembly of electronic parts. Sometimes labelling in electronics is very useful. For this job the scissors will be very useful for sure!

### Anti-static strap:



An elastic conductive strap connected to a coiled flexible lead which is then attached to a 0V (Ground) potential point. The strap is worn around the wrist. This dissipates any static build up on our body to Ground. Static build up can easily be dissipated through electronic components if touched with bare unprotected hands. This could damage electronic components and even entire systems. Such components are called Electro-static Discharge Sensitive Devices (ESDS parts).



### Miniature Flashlight:



This tool might be very useful to locate components; as an aid to inspect solder joints, short circuit bridging; as an aid for reading component physical identification or part numbers; as an aid when doing maintenance in dark ambient conditions, and more! Nowadays miniature flashlights are fitted with high intensity LED's which may provide brighter light of different colours at a much less power consumption.

### Cleaning tools (Bristle brushes and miniature vacuum cleaner):



Cleaning is necessary following assembly or maintenance of electronic equipment. This can be done using various models of bristle brushes. It is important to use brushes made of anti-static materials to avoid static charge build up and prevent damage to equipment. Bristle brushes in conjunction with alcohol can be very useful in removing excessive



flux residues left after soldering.

Another method of cleaning (which could be even safer, easier and more effective) is using miniature vacuum cleaners to remove excessive dust from electronic equipment. Such vacuum cleaners can be battery operated or nowadays USB powered since they are also used to clean computer peripherals such as keyboards, printers, scanners, etc. Again, use of anti-static materials is recommended.

### PCB drilling equipment:



Miniature drilling machine used for manual drilling of PCB holes which are then used to accommodate through hole components to be assembled on the PCB. This equipment nowadays could be just useful only for hobbyists since the use of CAD machinery has become very popular. PCB design is generated using specialized CAD software which then generates special files which contain drilling information. The file is fed to the CAD machine which automatically selects the proper drilling tool and drills all the holes on the PCB according to the ECAD generated PCB design.



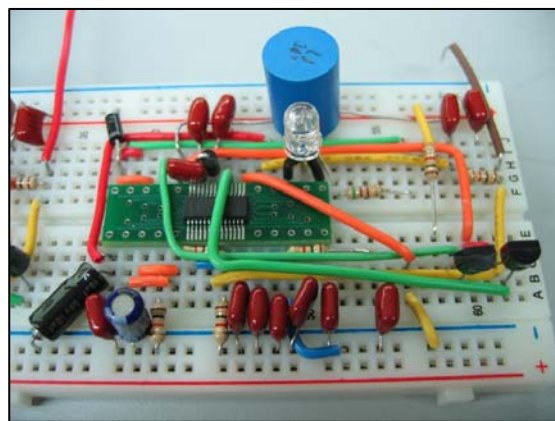
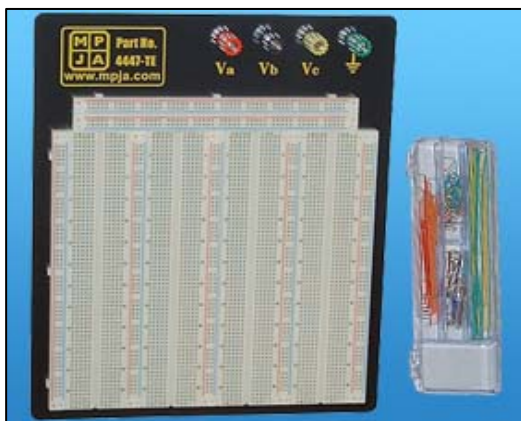
### Inspection Mirror:



An inspection mirror can be very useful during inspection procedures in areas difficult to access with the human eye. For example a PCB found hidden under other equipment can be inspected using such a mirror. Most of these mirror are adjustable and have a telescopic insulated handle as shown.

### Bread Board:

The bread board, also called prototyping board, is used to temporarily construction and testing of electronic circuits. Components and wire links can be easily inserted and removed from the board. The board is used during prototyping stage of electronic equipment design. It is also very useful to students studying electronics to construct circuits used during experiments and projects. This tool can be found in different sizes, to be able to accomodate circuits of different complexity.



Figures above show a bare bread board (left) and a prototype/experimental electronic circuit constructed on a bread board (right).