TVET CERTIFICATE III in **Plumbing**

BASIC SOFT SOLDERING AND WELDING

CSTSW301

Apply Basic soft soldering and welding

Competence

RTQF Level: 3

Credits: 7

Learning hours: 70

Sector: Construction

Sub-sector: Plumbing

Module Note Issue date: June, 2020

Purpose statement

This module describes knowledge and skills required to apply basic soft soldering and welding. It describes the skills, knowledge and attitudes required for the trainee to Prepare the site/workplace, perform arc welding, Perform oxy-acetylene welding, perform soft soldering, and Check the work done and Handover the work.

Table of Contents

LU & PC is linked in LO inside the content

Total Number of Pages: 7

Learning Unit 1- Prepare the site/workplace

LU & PC is linked in LO inside the content

LO 1.1 –: Proper identification of materials, tools and equipment

- Content/Topic 1: Metals differentiation

A **metal** (from Greek *métallon*, "mine, quarry, metal") is a material that, when freshly prepared, polished, or fractured, shows a lustrous appearance, and conducts electricity and heat relatively well. Metals are typically malleable (they can be hammered into thin sheets) or ductile (can be drawn into wires). A metal may be a chemical element such as iron; an alloy such as stainless steel; or a molecular compound such as polymeric sulfur nitride.

Metals (like copper and aluminium) are good conductors of heat and electricity. ***Majority elements in the periodic table are metals.*** This includes alkali metals, transition metals, lanthanides, actinides and alkaline earth metals. Metals are separated by nonmetals on a periodic table through a zigzag line starting from carbon, till radon. The elements between the two are phosphorus, selenium and iodine.

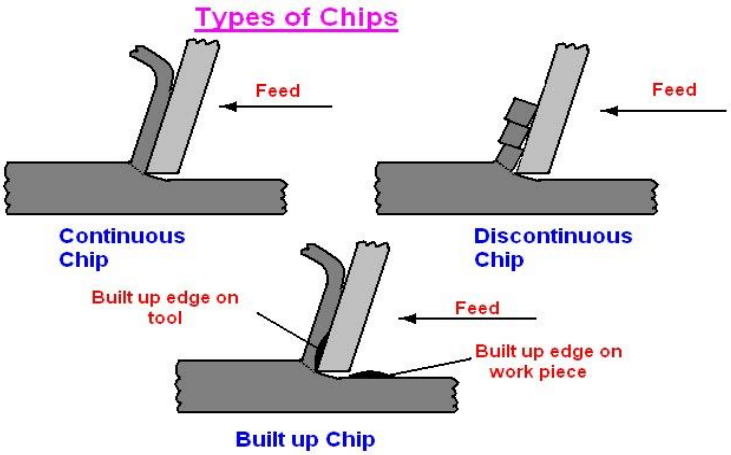
These elements and elements right to them in the periodic table are nonmetals. Elements present just to the left of the line are termed as semimetals or metalloids. These will have the combined properties of both metals and nonmetals.

A. **Colors :** it is a color that appears to be that of a polished metal. The visual sensation usually associated with metals is its metallic shine. Nature has given us 4 metal colors - **silver**, **gold**, **copper** and tarnished. Most mirrors are **silver**. We have the chemicals you need to deposit the other 3 colored metals on clear glass. Metals such as **bronze** and brass are alloys, a mix of metals. Example: Stainlessteel and copper
B. **Mass**: The **mass of an object** is a measure of the **object's** inertial property, or the amount of matter it contains. The **weight of an object** is a measure of the force exerted on the **object** by gravity, or the force needed to support it. The pull of gravity on the earth gives an **object** a downward acceleration of about 9.8 m/s^2. Example: aluminum and steel
C. **Soundness:** the ability to withstand force or stress without being distorted, dislodged, or damaged. the car manufacturer tested the **soundness** of the new model in various types of collisions. Ex: mild steel and cast iron
D. **Chip removal: Swarf**, also known as **chips** or by other process-specific names (such as **turnings**, **filings**, or **shavings**), are pieces of metal, wood, or plastic that are the debris or waste resulting from machining, woodworking, or similar subtractive (material-removing) manufacturing processes. Swarf or chips can be small particles (such as the gritty swarf from grinding metal or the sawdust from sawing or sanding wood); long, stringy tendrils (such as the springy chips from turning tough metals, or long shavings from whittling); slag-like waste (such as is produced within pipe during pipefitting work); or stone fragments and dust (as in masonry).
Basically there are **three types of chips** produced in the metal machining and these are continuous, discontinuous and continuous with built-up edge.

- Continuous: Continuous chips are formed by the continuous plastic deformation of metal without fracture in front of the cutting edge of the tool and is formed by the smooth flow of the chip up the tool face. Mild steel

and copper are considered to be most desirable materials for obtaining continuous chips.

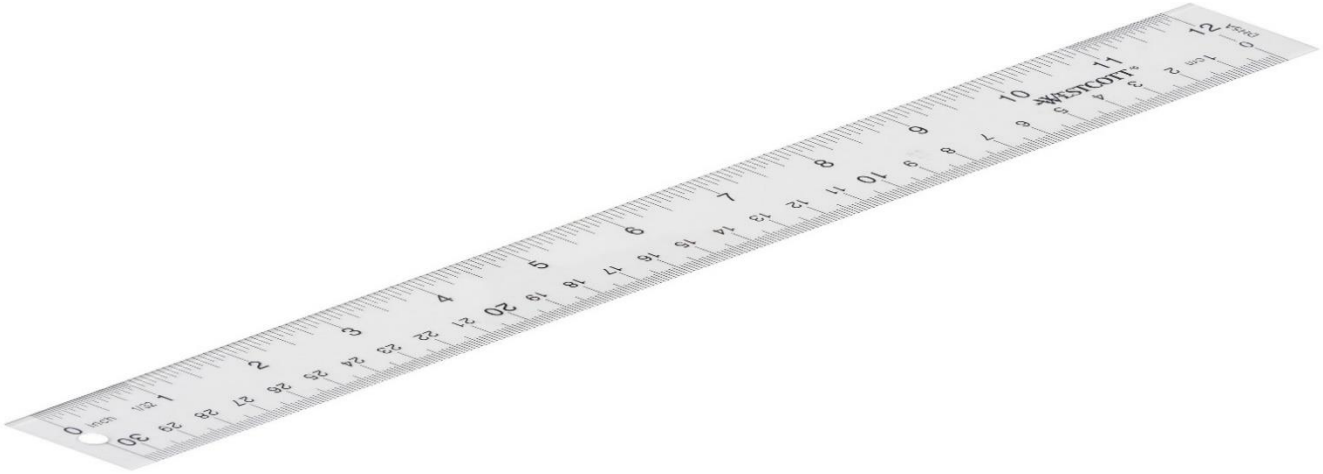
- Discontinuous: Discontinuous chips is formed by a series of rupture occurring approximately perpendicular to the tool place face' each chip element passing off along the tool face the chip element' in the form of small segment may adhere loosely to each other and becomes slightly longer.
- continuous with built-up edge: This type of chip is very similar to the continuous chip. With the difference that it has a built up edge adjacent to tool face and also it is not so smooth. It is obtained by machining on ductile material, in this condition of high local temperature and extreme pressure in the cutting and high friction in the tool chip interference, may cause the work material to adhere or weld to the cutting edge of the tool.



- Content/Topic 2 : *Tools*

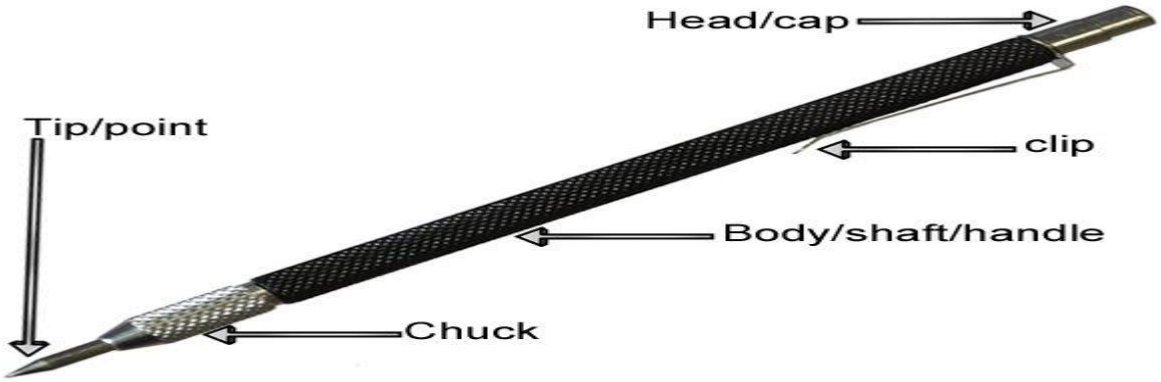
Tool: It is a device or implement, especially one held in the hand, used to carry out a particular function or job.

1. **Ruler,** A ruler, sometimes called a rule or line gauge, is a device used in geometry and technical drawing, as well as the engineering and construction industries, to measure distances or draw straight lines

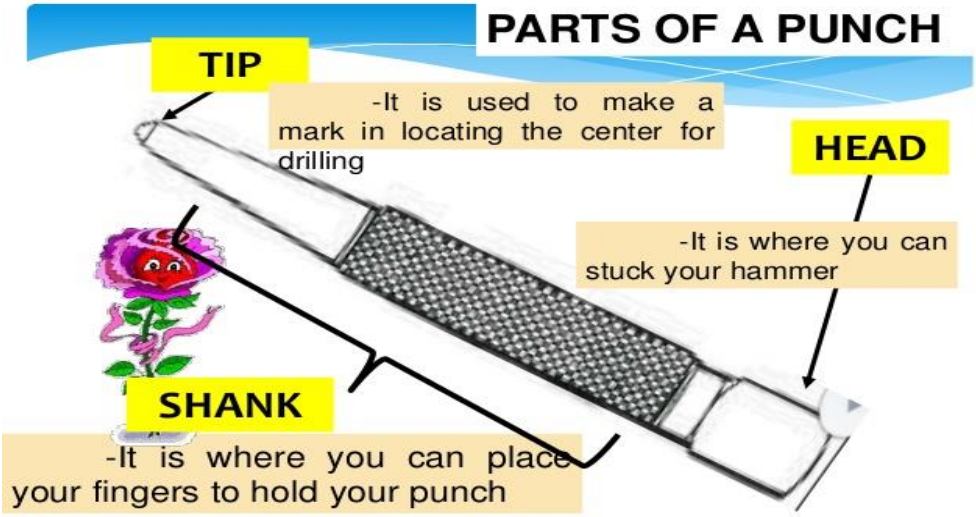


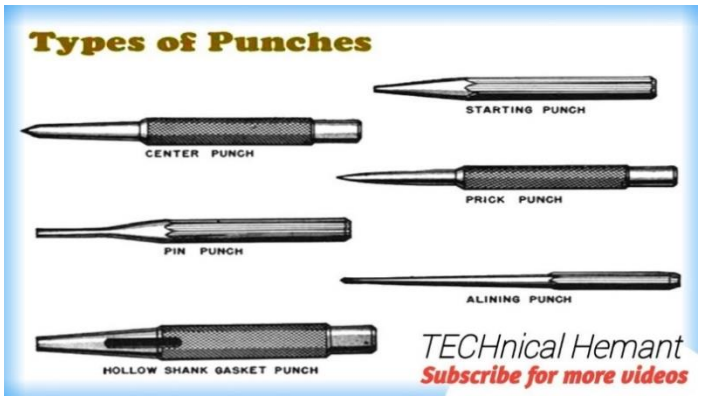
2. **Rubber,** a piece of rubber used for erasing pencil or ink marks.

3. **Scriber :** A scriber is a hand tool used in metal work to mark lines on workpieces, prior to machining. The process of using a scriber is called scribing and is just part of the process of marking out.

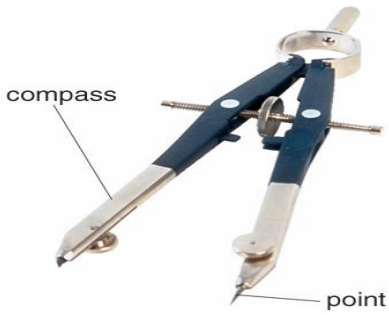


4. **Center punch**: a tool consisting of a metal rod with a conical point for making an indentation, to allow a drill to make a hole at the same spot without slipping.



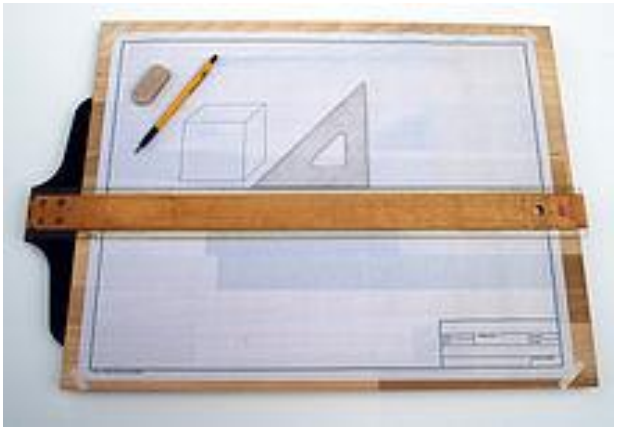


5. **Compasses:** an instrument for drawing circles and arcs and measuring distances between points, consisting of two arms linked by a movable joint, one arm ending in a point and the other usually carrying a pencil or pen.



6. **T-square,** a T-shaped instrument for drawing or testing right angles.

A T-square is a technical drawing instrument used by draftsmen primarily as a guide for drawing horizontal lines on a drafting table. It may also guide a set square to draw vertical or diagonal lines.



7. **Drawing board.** a large flat board on which paper may be spread for artists or designers to work on.

A drawing board is, in its antique form, a kind of multipurpose desk which can be used for any kind of drawing, writing or impromptu sketching on a large sheet of paper or for reading a large format book or other oversized document or for drafting precise technical illustrations.

8. **Bench:** It is a long work table in a workshop or laboratory.

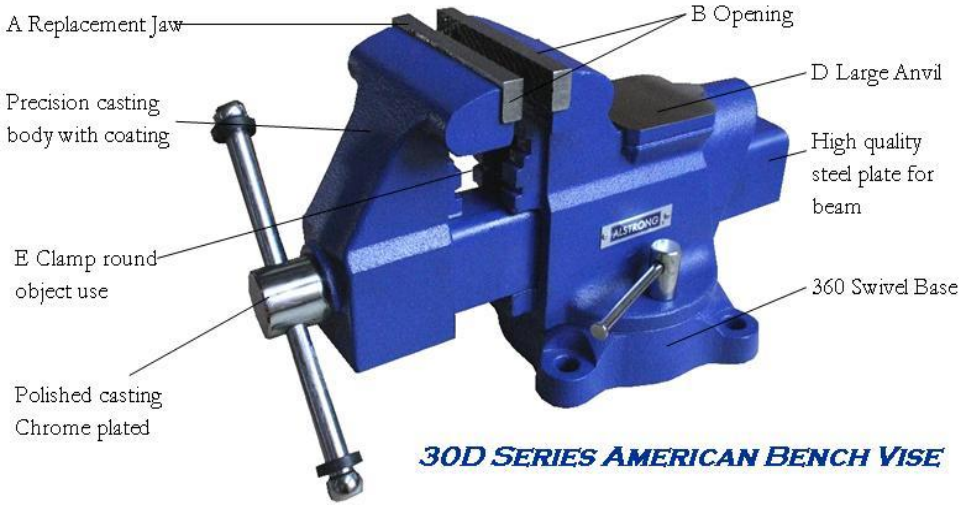
What Is a Welding Table?

Considered a basic necessity for any welder's workspace, a welding table is essentially a waist-level platform that serves as a workbench. Sizes can range from 20'' x 40'' to 6.5'' x 13.''

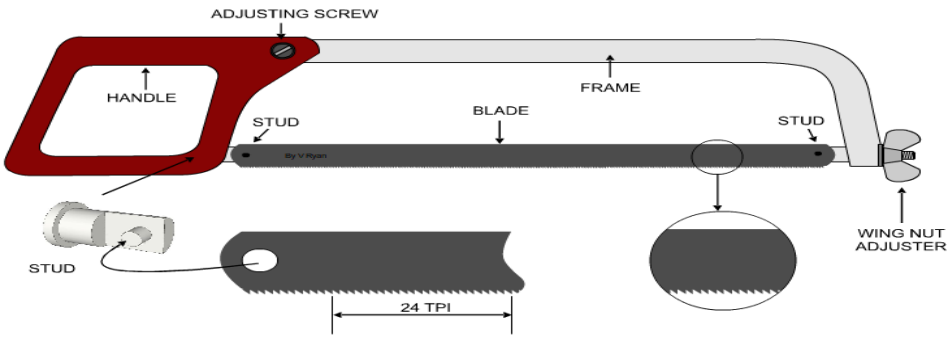
To prevent fire hazards, welding tables are made from steel as a rule. The surface they provide is helpful for both welding and metal fabrication.

9. **Vice :**

What is a bench vise? To state in simple terms, a **bench vise** is a mechanical apparatus used to secure an object that is to be worked on. It features two parallel jaws as part of the design. The device is widely used in the mechanical and woodworking industries, among others.



10. **Hacksaw:** a hacksaw is a fine-toothed saw, originally and mainly made for cutting metal. The equivalent saw for cutting wood is usually called bow saw. Most hacksaws are hand saws with a C-shaped walking frame that holds a blade under tension.



11. **Wire brush:** A **wire brush** is a tool consisting of a **brush** whose bristles are made of **wire**, most often **steel wire**. The **steel** used is generally a medium- to high-carbon variety and very hard and springy. Other **wire brushes** feature bristles made from brass or stainless **steel**, depending on application.

12. **Chipping hummer:** Chipping hammers are lightweight, hand-held concrete breakers that can be easily positioned to break vertical and overhead surfaces. By offering a controlled **chipping** action, these **hammers** allow operators to precisely chip away only specific areas.

13. Slot pencil: an instrument for writing or drawing, consisting of a thin stick of graphite or a similar substance enclosed in a long thin piece of wood or fixed in a cylindrical case.

14. Drawing copy

The range is known as the '**A**' Size range. The Largest commonly used size is **A0** which is a piece of paper **1m²** in area with the sides in proportion 1: √2 (≈ 1:1.4).
A1 is half this size, **A2** is half that, **A3** is half again and **A4** is half that. **A4** is the smallest commonly used size for technical drawings.

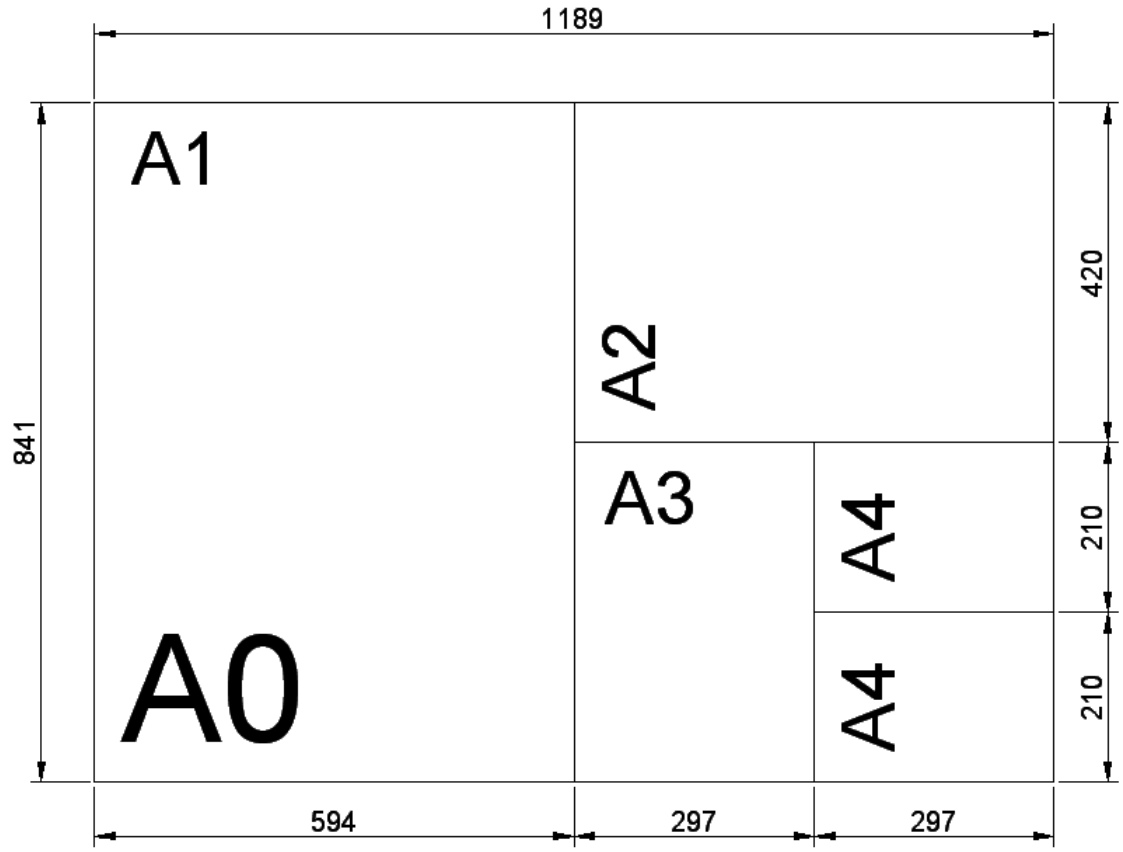


Table of sizes

DESIGNATION	LENGTH	WIDTH
A0	1189	841
A1	841	594
A2	594	420
A3	420	297
A4	297	210

15. **angle grinder:** it is a handheld power tool that can be used for a variety of metal fabrication jobs that include cutting, grinding, deburring, finishing and polishing. The most common types of angle grinders are powered by electricity; either corded or battery powered.

16. Measuring Tape: This is likely the most typical type of measuring device that you will think of when someone brings up a measuring tool. Measuring tape is a simple tool that will help you to measure the length of something. You can also measure how wide an object is and can generally figure out all of the information that you will need to know. Measuring tools like this are commonly used in many lines of work, and you will definitely see one on the hip of most carpenters.

These tools are very convenient because they are so portable. You can fit them in your tool belt without a problem and some of them will have a clip so that they can be placed on your belt. Most measuring

17. **Calipers** are used to accurately measure the distance between two sides of something. It is a simple measuring tool that is very important when you need accurate data about an object. This is one of the most common measuring tools that has been in use for many years. Even if you're not familiar with the term calipers, you have likely seen one of these in your lifetime.

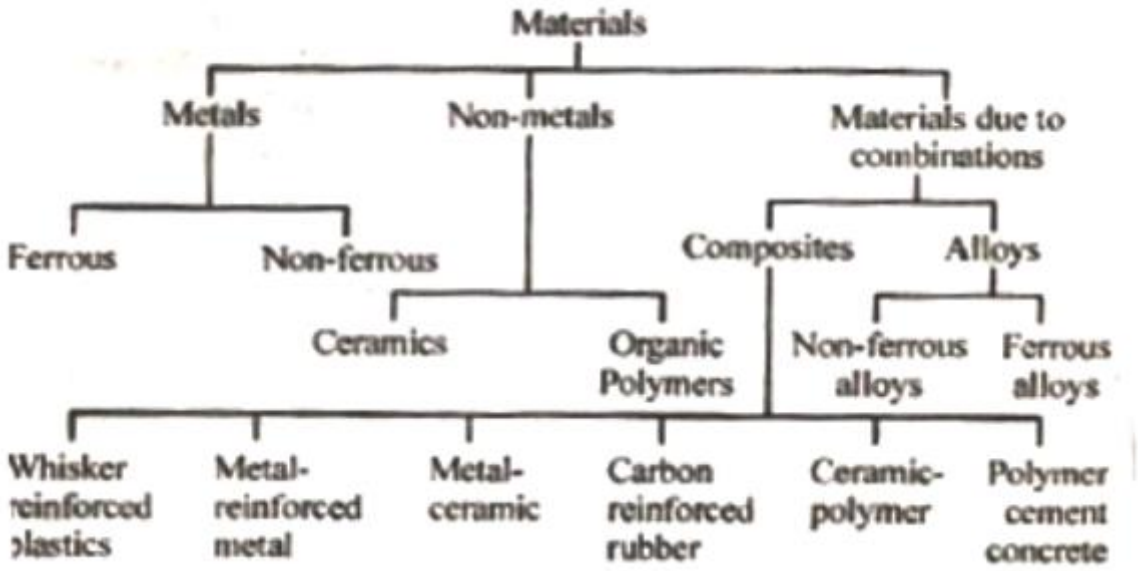
This caliper here is a digital measuring tool, which means that it has a convenient digital display. It's really handy for making it as easy as possible to read the measurements. If you want to have a caliper that is simple to use and very accurate, then this tool will work very nicely. It is made from stainless steel and will always give you proper data

- Content /Topic3: Materials

A material is a substance or mixture of substances that constitutes an object. Materials can be pure or impure, living or non-living matter. Materials can be classified based on their physical and chemical properties, or on their geological origin or biological function.

CLASSIFICATION OF ENGINEERING MATERIALS

1. Metals 2. Non-metals 3. Due to Combination



Metals: Metals are substances capable of changing their shape permanently. They are composed of elements which readily give up electrons to provide a metallic bond and electrical conductivity. Metals may be ferrous or nonferrous type.

A. Ferrous-metals: The ferrous metals contain Fe(Iron) and C(carbon) as their constituents. The behavior and properties of ferrous metals depend upon the percentage and the form of carbon present in them. They are iron and steel. **Example:** Stainlessteel, mild steel ,

B. Non-Ferrous metals: Non-ferrous metals not contain Fe(iron) and C as their constituents.

examples of commonly used non-ferrous metals are Al, Cu, Ag, Zn, Ni, Sn, Cr, Pb etc. Al, Cu, Ag, and Au are good conductors of electricity, Ag is most malleable, Au is most ductile and Cr is corrosion resistant. Zn is used in the metal plating. Sn is used to make bushes and Ni imparts strength and creep resistance.

Non-metals – They can be further classified as ceramics and organic polymers. Ceramics are generally metallic or non metallic oxides. physically separable and chemically Homogeneous constituents of materials consisting of phases are also called ceramics. rocks, fireclay and firebricks, cements and limes are some commonly used ceramics. Ferrites, garnets, ferro-electrics and ceramic superconductors are the latest development in this area. organic polymers are derived mainly from the hydrocarbons. These consist of covalent bonds formed by carbon, chemically combined with oxygen and hydrogen. The polymers are obtained from monomers bonded by a chemical reaction (a process called polymerization). In this process, long molecular chain having high molecular weight is generated. Organic polymers are relatively inert and light, and generally have a high degree of plasticity. Bakelite, polyethylene, nylon, Teflon are some examples. Materials

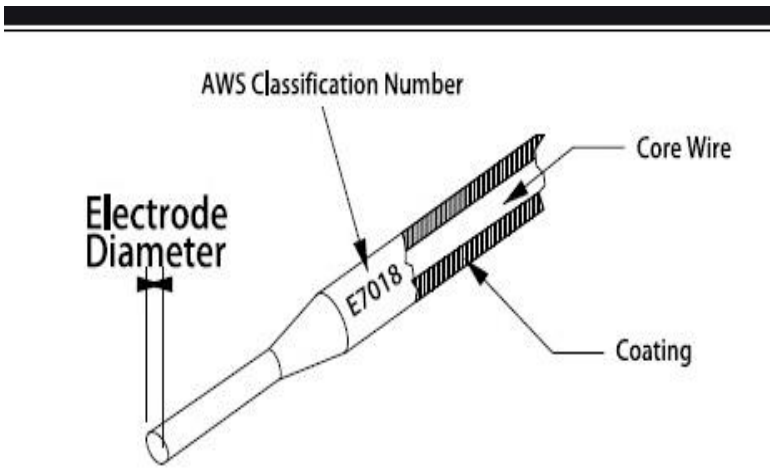
Due to Combination- They may be alloys or composites. an alloy is a combination of two or more metals. They possess properties which are quite different from those of their constituent metals. Alloys may be ferrous non-ferrous depending on the base metal used. An alloy is prepared for a specific purpose to meet the particular requirements of an application. Some common ferrous alloys

are invar, stainless steel and high speed steel (HSS). Non-ferrous alloys include phosphor bronze, brass, duralumin, babbits etc. Composites may be inorganic or organic . They have two or more constituents of dissimilar properties. The two major constituents may be metals and ceramics or metals and polymers, or ceramics and polymers or any other combination. instead of metals, alloys may also be used to make composites. Constituent of composites called reinforcing constituent may be in particulate form, fibrous form or flake form.

C. Electrodes: **Welding electrodes** are metal wires with baked on chemical coatings. The rod is used to sustain the **welding** arc and to provide the filler metal required for the joint to be welded. The coating protects the metal from damage, stabilizes the arc, and improves the weld.

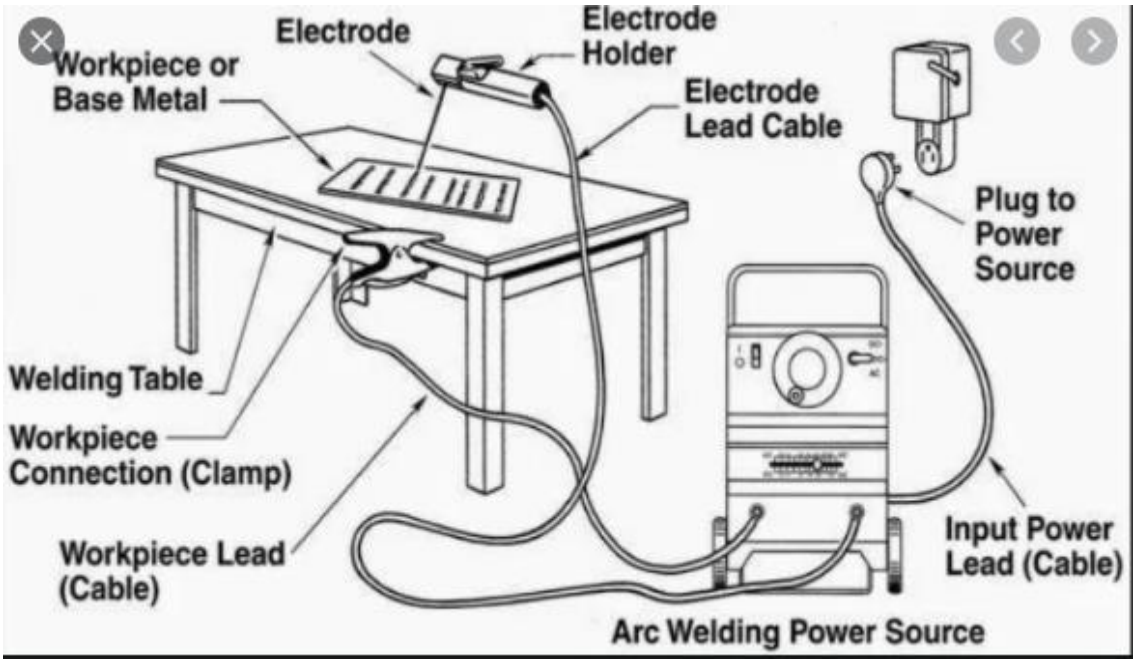
In arc **welding**, an **electrode** is used to conduct current through a work piece to fuse two pieces together. Depending upon the process, the **electrode** is either consumable, in the case of gas metal arc **welding** or shielded metal arc **welding**, or non-consumable, such as in gas tungsten arc **welding**.

Parts of welding electrode



- Content/Topic 4 :Equipment

A. **Welding machine**: It is a machine generate heat that melts metal parts, so that these parts can be joined. However, there is no single **welding machine** that is suitable for all **welding** projects.



B. Drilling machine: A **drill** or **drilling machine** is a tool primarily used for making round holes or driving fasteners. It is fitted with a bit, either a drill or driver, depending on application, secured by a chuck. Some powered drills also include a hammer function.

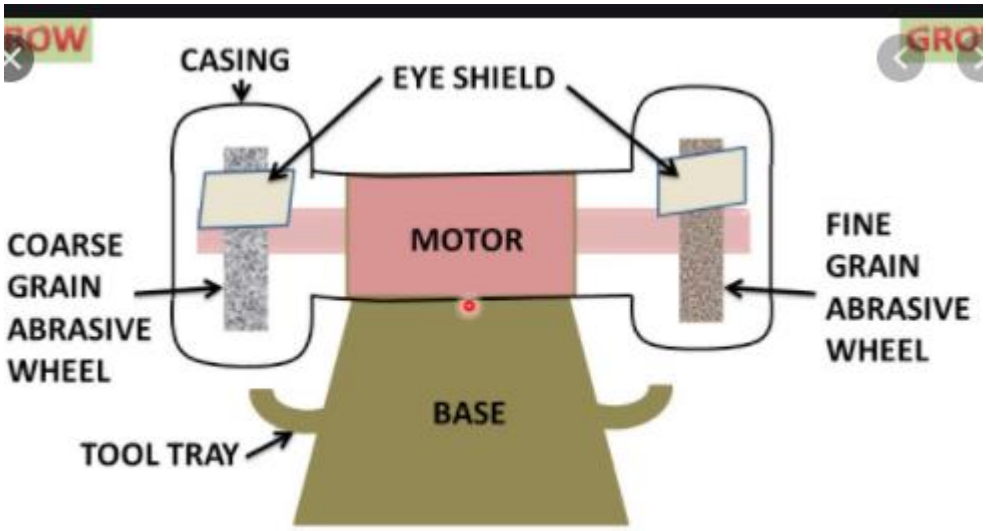
Grinding machine: A grinding machine is a machine for material removal with geometrically non-defined, bonded cutting edges, where the relative movement between tool and work piece is rotational or linear. The machine further must provide relative feed and positioning movements between tool and workpiece. The movements between tool support (spindle) and workpiece follow a defined geometrical path – it is path defined.

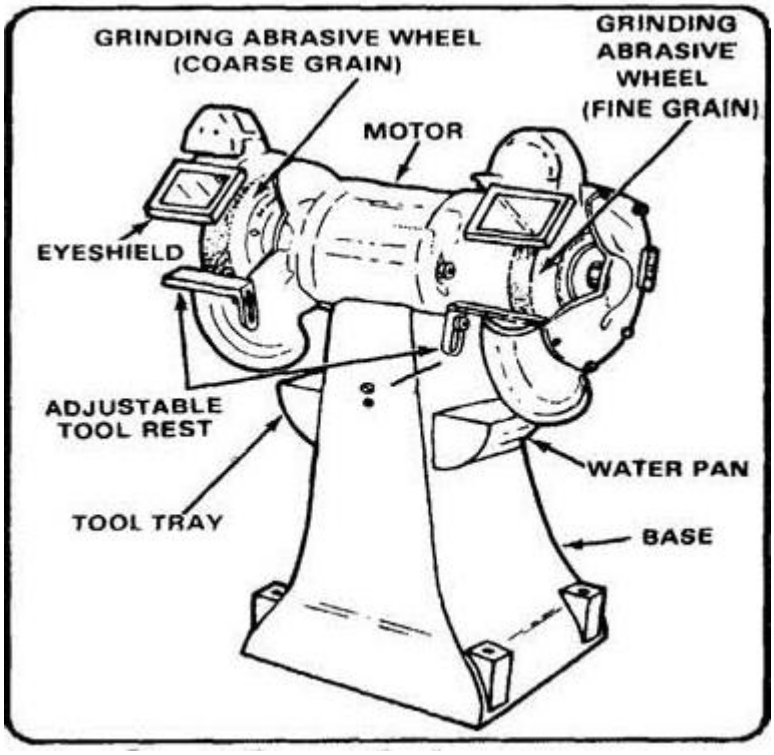
Material removal with geometrical non-defined cutting edges is considered as material removal that is made by a large number of cutting edges normally on abrasive grains, which are undefined, with respect to number, shape, and/or position, where the envelope over all stochastically distributed cutting edges defines the tool geometry.

Grinding with linear relative movement is called pitch grinding. If the reciprocating linear movement is coupled with a continuous rotational movement, the process is called honing. Belt grinders, where a belt to which the abrasive wheel.

It can also use for sharpening cutting tools

Parts of grinding machine





Abrasive wheels: Are cutting tools consisting of **abrasive** grains, held together by organic or inorganic bonds. Diamond and reinforced **wheels** are included. Organic **wheels**: Bonded by an organic material. For example, resin, rubber, shellac, or other similar bonding agent.

Types of abrasive wheel

1. Rough grinding wheel: It is used for removal of larger material (roughing process)

2. Smooth grinding wheel: It is used for smoothing work piece (smoothing process)

C. **PPE:** stands for personal protective equipment. It is equipment worn to minimize exposure to hazards that cause serious workplace injuries and illnesses.

1. **safety goggles:** are intended to shield the wearer's eyes from impact hazards such as flying fragments, objects, large chips, and particles. Goggles fit the face immediately surrounding the eyes and form a protective seal around the eyes.

2. **welding shield:** A welding helmet is a type of headgear used when performing certain types of welding to protect the eyes, face and neck from flash burn, ultraviolet light, sparks, infrared light, and heat. They are necessary to prevent arc eye, a painful condition where the cornea is inflamed

3. **overall: Overalls**, also called bib-and-brace overalls or dungarees, are a type of garment usually used as protective clothing when working. The garments are commonly referred to as a "pair of overalls" by analogy with "pair of trousers"

4. **apron:** Safety is the key issue when wearing a welding apron; meaning that it protects you and your clothing from hot metal and slag that is generated while welding, grinding or using a cutting torch.

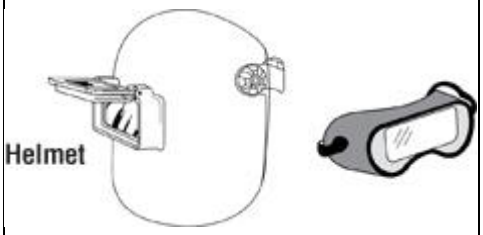
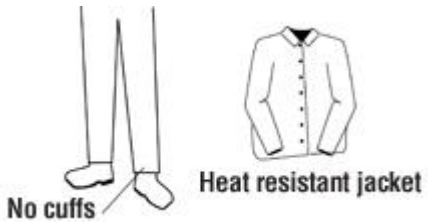
5. **gloves:** Welding gloves are personal protective equipment (PPE) that protect the hands of welders from the hazards of welding.

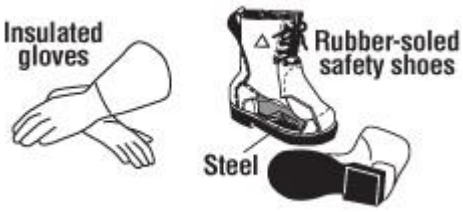
These gloves allow digit articulation while protecting the operator from electrical shock, extreme heat, and ultraviolet and infrared radiation, and also provide abrasion resistance and enhanced grip.

6. **safety shoes:** These welding safety shoes are intended to keep your feet protected from all the day by day struggles at the working areas. The workers need to get the correct safety shoes to work under uncertain conditions.

Safety footwear is designed to protect feet against a wide variety of injuries. Impact, compression, and puncture are the most common types of foot injury. Choose footwear according to the hazard.

The steel toe cap will protect your feet from falling of heavy objects on your toe. The heat resistant and oil resistant sole will add to the complete protection of your feet.

Welding - Personal Protective Equipment			
Body Part	**Equipment**	**Illustration**	**Reason**
Eyes and face	Welding helmet, hand shield, or goggles		Protects from: • radiation • flying particles, debris • hot slag, sparks • intense light • irritation and chemical burns Wear fire resistant head coverings under the helmet where appropriate
Lungs (breathing)	Respirators		Protects against: • fumes and oxides
Exposed skin (other than feet, hands, and head)	Fire/Flame resistant clothing and aprons		Protects against: • heat, fires • burns • radiation Notes: pants should not have cuffs, shirts should have flaps over pockets or be taped closed

Ears - hearing	Ear muffs, ear plugs	 Ear protection	Protects against: • noise Use fire resistant ear muffs where sparks or splatter may enter the ear, rather than plugs.
Feet and hands	Boots, gloves		Protects against: • electric shock • heat • burns • fires

LO 1.2 –: Choose materials, tools and equipment

Steps to take off personal protective equipment (PPE)including gown All reasonable precautions have been taken by the World Health Organization to verify the information contained in this publication.

However, the published material is being distributed without warranty of any kind, either expressed or implied. The responsibility for the interpretation and use of the material lies with the reader. In no event shall the World Health Organization be liable for damages arising from its use

- Content/Topic 1 Metals differentiation

A **metal** (from Greek *métallon*, "mine, quarry, metal") is a material that, when freshly prepared, polished, or fractured, shows a lustrous appearance, and conducts electricity and heat relatively well. Metals are typically malleable (they can be hammered into thin sheets) or ductile (can be drawn into wires). A metal may be a chemical element such as iron; an alloy such as stainless steel; or a molecular compound such as polymeric sulfur nitride.

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E. **Colors :** it is a color that appears to be that of a polished metal. The visual sensation usually associated with metals is its metallic shine. Nature has given us 4 metal colors - **silver**, **gold**, **copper** and tarnished. Most mirrors are **silver**. We have the chemicals you need to deposit the other 3 colored metals on clear glass. Metals such as **bronze** and brass are alloys, a mix of metals. Example: Stainlessteel and copper

F. **Mass**: The **mass of an object** is a measure of the **object's** inertial property, or the amount of matter it contains. The **weight of an object** is a measure of the force exerted on the **object** by gravity, or the force needed to support it. The pull of gravity on the earth gives an **object** a downward acceleration of about 9.8 m/s^2. Example: aluminum and steel

G. Soundness: the ability to withstand force or stress without being distorted, dislodged, or damaged. the car manufacturer tested the **soundness** of the new model in various types of collisions. Ex: mild steel and cast iron

H. Chip removal: Swarf, also known as **chips** or by other process-specific names (such as **turnings**, **filings**, or **shavings**), are pieces of metal, wood, or plastic that are the debris or waste resulting from machining, woodworking, or similar subtractive (material-removing) manufacturing processes. Swarf or chips can be small particles (such as the gritty swarf from grinding metal or the sawdust from sawing or sanding wood); long, stringy tendrils (such as the springy chips from turning tough metals, or long shavings from whittling); slag-like waste (such as is produced within pipe during pipefitting work); or stone fragments and dust (as in masonry).
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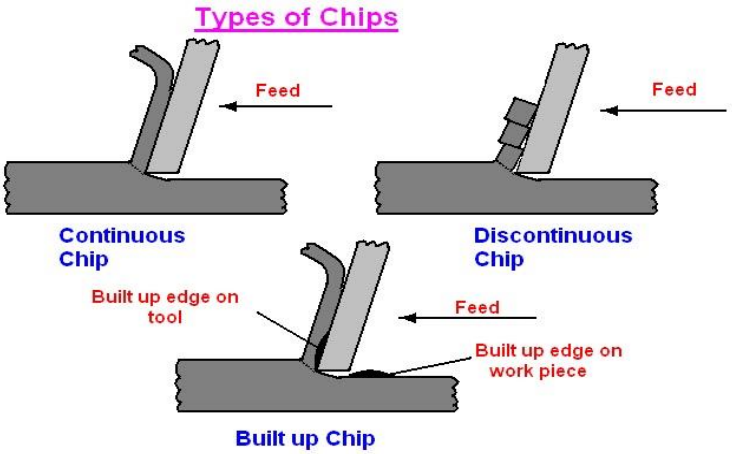
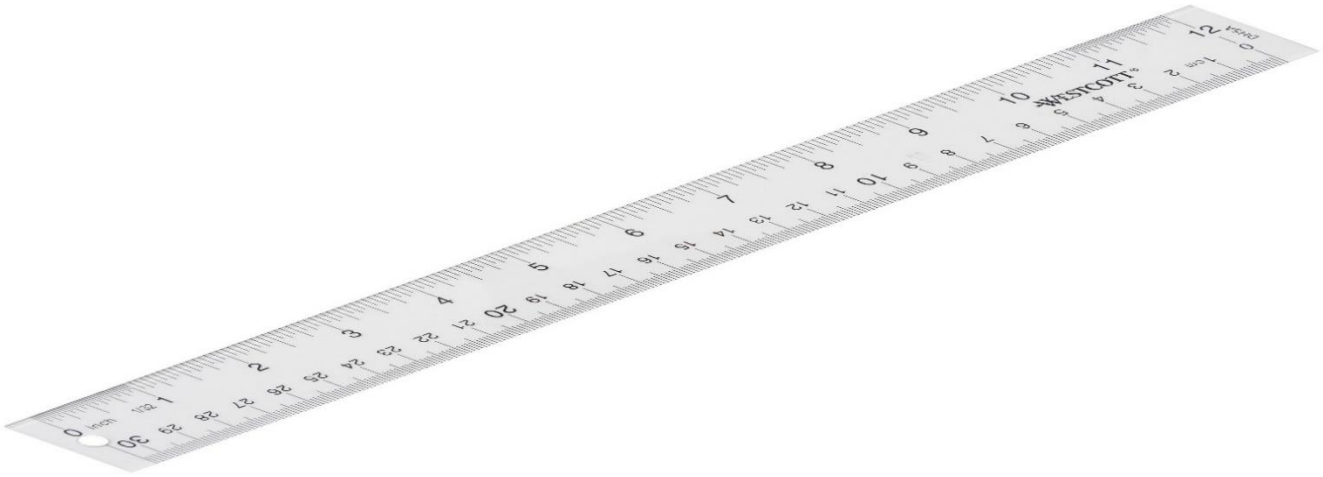
- Continuous: Continuous chips are formed by the continuous plastic deformation of metal without fracture in front of the cutting edge of the tool and is formed by the smooth flow of the chip up the tool face. Mild steel and copper are considered to be most desirable materials for obtaining continuous chips.
- Discontinuous: Discontinuous chips is formed by a series of rupture occurring approximately perpendicular to the tool place face' each chip element passing off along the tool face the chip element' in the form of small segment may adhere loosely to each other and becomes slightly longer.
- continuous with built-up edge: This type of chip is very similar to the continuous chip. With the difference that it has a built up edge adjacent to tool face and also it is not so smooth. It is obtained by machining on ductile material, in this condition of high local temperature and extreme pressure in the cutting and high friction in the tool chip interference, may cause the work material to adhere or weld to the cutting edge of the tool.



- Content/Topic 2 : *Tools*

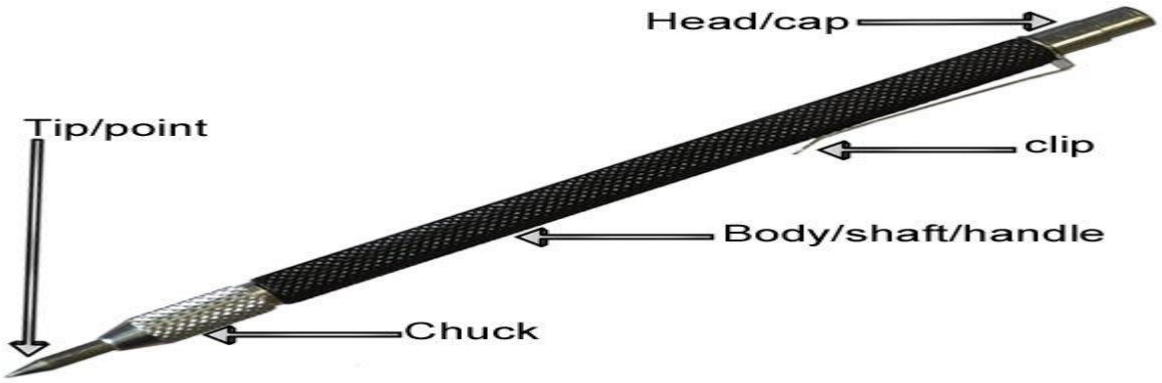
Tool: It is a device or implement, especially one held in the hand, used to carry out a particular function or job.

1. **Ruler,** A ruler, sometimes called a rule or line gauge, is a device used in geometry and technical drawing, as well as the engineering and construction industries, to measure distances or draw straight lines

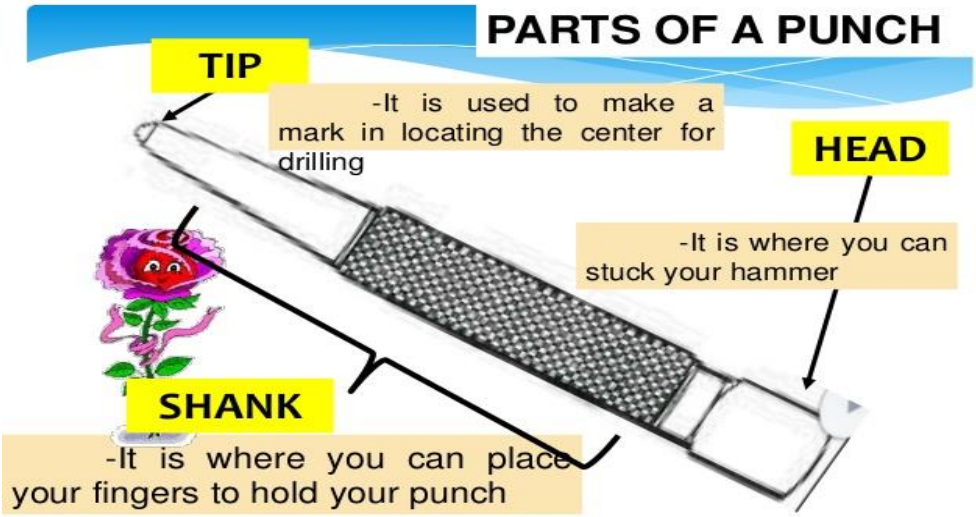


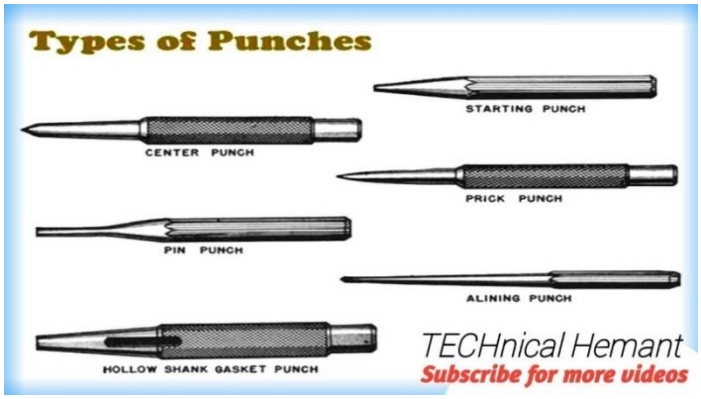
2. **Rubber,** a piece of rubber used for erasing pencil or ink marks.

3. **Scriber :** A scriber is a hand tool used in metal work to mark lines on workpieces, prior to machining. The process of using a scriber is called scribing and is just part of the process of marking out.

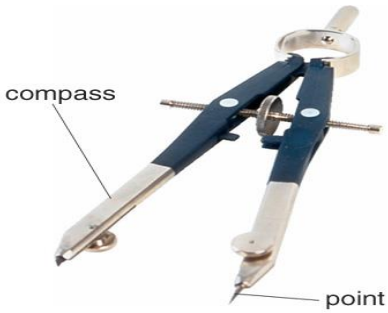


4. **Center punch**: a tool consisting of a metal rod with a conical point for making an indentation, to allow a drill to make a hole at the same spot without slipping.



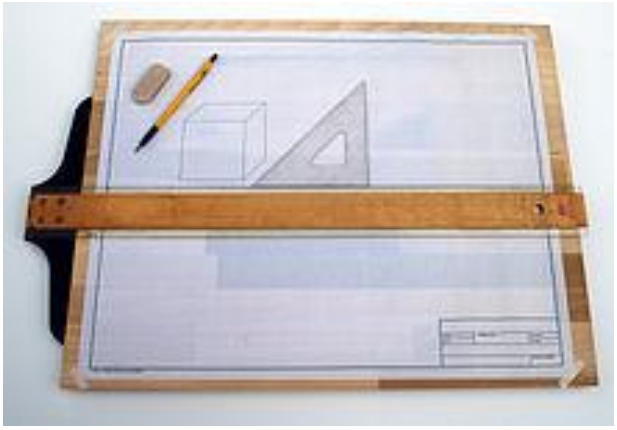


5. **Compasses:** an instrument for drawing circles and arcs and measuring distances between points, consisting of two arms linked by a movable joint, one arm ending in a point and the other usually carrying a pencil or pen.



6. **T-square,** a T-shaped instrument for drawing or testing right angles.

A T-square is a technical drawing instrument used by draftsmen primarily as a guide for drawing horizontal lines on a drafting table. It may also guide a set square to draw vertical or diagonal lines.



7. **Drawing board.** a large flat board on which paper may be spread for artists or designers to work on.

A drawing board is, in its antique form, a kind of multipurpose desk which can be used for any kind of drawing, writing or impromptu sketching on a large sheet of paper or for reading a large format book or other oversized document or for drafting precise technical illustrations.

8. **Bench:** It is a long work table in a workshop or laboratory.

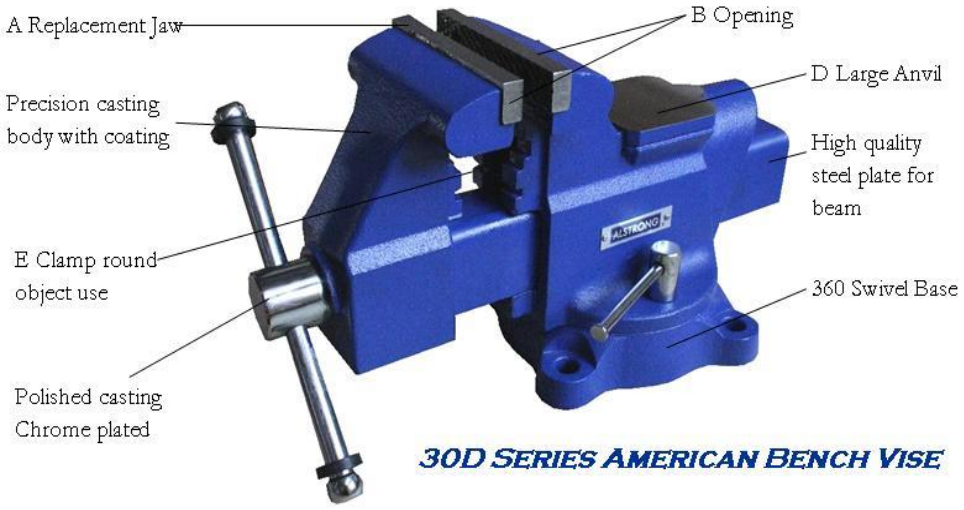
What Is a Welding Table?

Considered a basic necessity for any welder's workspace, a welding table is essentially a waist-level platform that serves as a workbench. Sizes can range from 20'' x 40'' to 6.5'' x 13.''

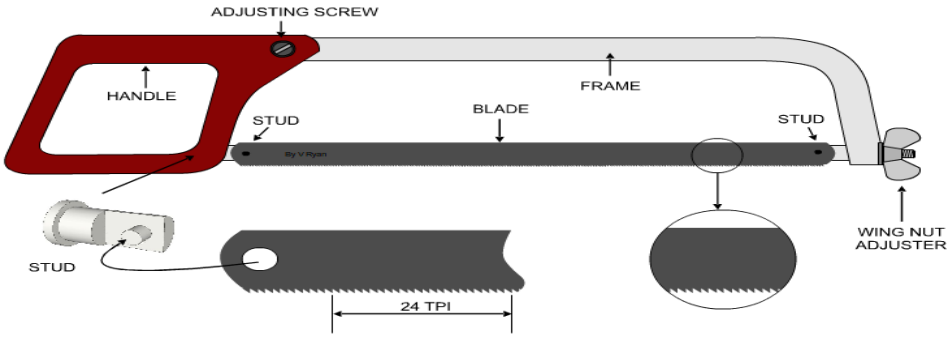
To prevent fire hazards, welding tables are made from steel as a rule. The surface they provide is helpful for both welding and metal fabrication.

9. **Vice :**

What is a bench vise? To state in simple terms, a **bench vise** is a mechanical apparatus used to secure an object that is to be worked on. It features two parallel jaws as part of the design. The device is widely used in the mechanical and woodworking industries, among others.



10. **Hacksaw:** a hacksaw is a fine-toothed saw, originally and mainly made for cutting metal. The equivalent saw for cutting wood is usually called bow saw. Most hacksaws are hand saws with a C-shaped walking frame that holds a blade under tension.



11. **Wire brush:** A **wire brush** is a tool consisting of a **brush** whose bristles are made of **wire**, most often **steel wire**. The **steel** used is generally a medium- to high-carbon variety and very hard and springy. Other **wire brushes** feature bristles made from brass or stainless **steel**, depending on application.

12. **Chipping hummer:** Chipping hammers are lightweight, hand-held concrete breakers that can be easily positioned to break vertical and overhead surfaces. By offering a controlled **chipping** action, these **hammers** allow operators to precisely chip away only specific areas.

13. Slot pencil: an instrument for writing or drawing, consisting of a thin stick of graphite or a similar substance enclosed in a long thin piece of wood or fixed in a cylindrical case.

14. Drawing copy

The range is known as the '**A**' Size range. The Largest commonly used size is **A0** which is a piece of paper **1m²** in area with the sides in proportion 1: √2 (≈ 1:1.4).
A1 is half this size, **A2** is half that, **A3** is half again and **A4** is half that. **A4** is the smallest commonly used size for technical drawings.

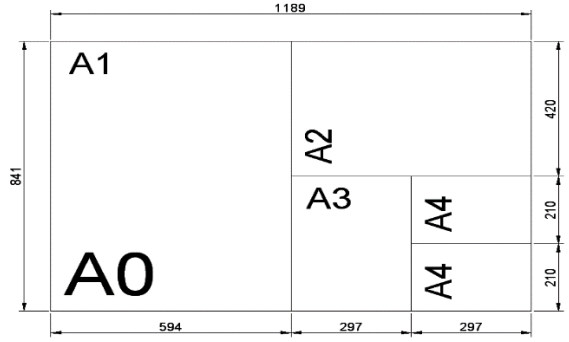


Table of sizes

DESIGNATION	LENGTH	WIDTH
A0	1189	841
A1	841	594
A2	594	420
A3	420	297
A4	297	210

15. **angle grinder:** it is a handheld power tool that can be used for a variety of metal fabrication jobs that include cutting, grinding, deburring, finishing and polishing. The most common types of angle grinders are powered by electricity; either corded or battery powered.

16. Measuring Tape: This is likely the most typical type of measuring device that you will think of when someone brings up a measuring tool. Measuring tape is a simple tool that will help you to measure the length of something. You can also measure how wide an object is and can generally figure out all of the information that you will need to know. Measuring tools like this are commonly used in many lines of work, and you will definitely see one on the hip of most carpenters.

These tools are very convenient because they are so portable. You can fit them in your tool belt without a problem and some of them will have a clip so that they can be placed on your belt. Most measuring

17. **Calipers** are used to accurately measure the distance between two sides of something. It is a simple measuring tool that is very important when you need accurate data about an object. This is one of the most common measuring tools that has been in use for many years. Even if you're not familiar with the term calipers, you have likely seen one of these in your lifetime.

This caliper here is a digital measuring tool, which means that it has a convenient digital display. It's really handy for making it as easy as possible to read the measurements. If you want to have a caliper that is simple to use

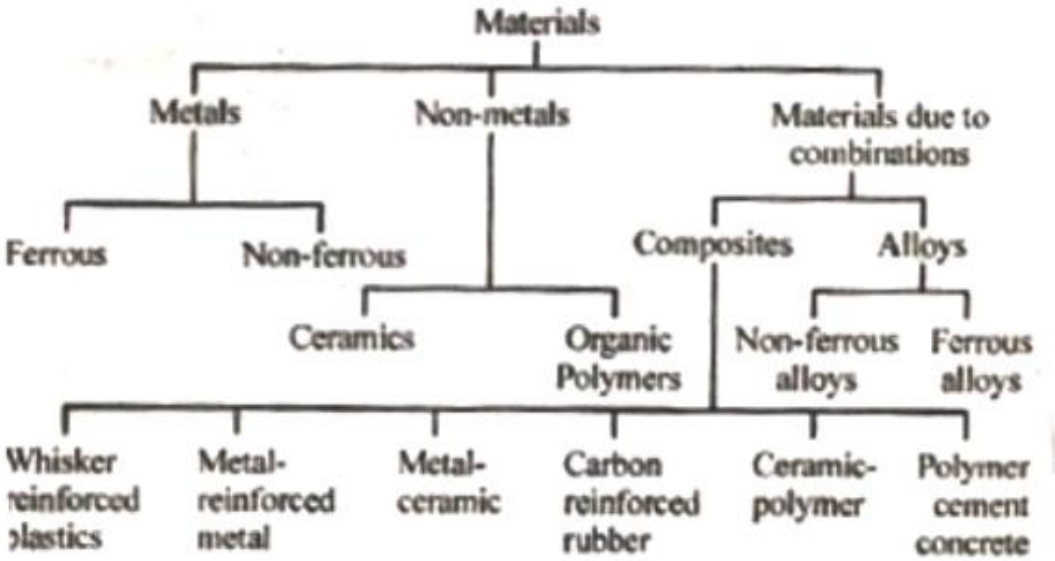
and very accurate, then this tool will work very nicely. It is made from stainless steel and will always give you proper data

- Content /Topic3: Materials

A material is a substance or mixture of substances that constitutes an object. Materials can be pure or impure, living or non-living matter. Materials can be classified based on their physical and chemical properties, or on their geological origin or biological function.

CLASSIFICATION OF ENGINEERING MATERIALS

1. Metals 2. Non-metals 3. Due to Combination



Metals: Metals are substances capable of changing their shape permanently. They are composed of elements which readily give up electrons to provide a metallic bond and electrical conductivity. Metals may be ferrous or nonferrous type.

D. Ferrous-metals: The ferrous metals contain Fe(Iron) and C(carbon) as their constituents. The behavior and properties of ferrous metals depend upon the percentage and the form of carbon present in them. They are iron and steel. **Example:** Stainlessteel, mild steel ,

E. Non-Ferrous metals: Non-ferrous metals not contain Fe(iron) and C as their constituents.

examples of commonly used non-ferrous metals are Al, Cu, Ag, Zn, Ni, Sn, Cr, Pb etc. Al, Cu, Ag, and Au are good conductors of electricity, Ag is most malleable, Au is most ductile and Cr is corrosion resistant. Zn is used in the metal plating. Sn is used to make bushes and Ni imparts strength and creep resistance.

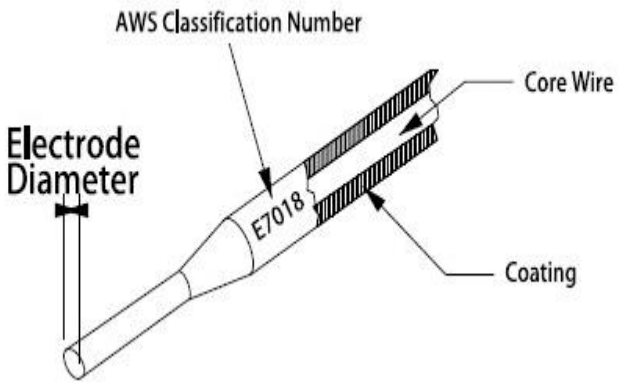
Non-metals – They can be further classified as ceramics and organic polymers. Ceramics are generally metallic or non metallic oxides. physically separable and chemically Homogeneous constituents of materials consisting of phases are also called ceramics. rocks, fireclay and firebricks, cements and limes are some commonly used ceramics. Ferrites, garnets, ferro-electrics and ceramic superconductors are the latest development in this area. organic polymers are derived mainly from the hydrocarbons. These consist of covalent bonds formed by carbon, chemically combined with oxygen and hydrogen. The polymers are obtained from monomers bonded by a chemical reaction (a process called polymerization). In this process, long molecular chain having high molecular weight is generated. Organic polymers are relatively inert and light, and generally have a high degree of plasticity. Bakelite, polyethylene, nylon, Teflon are some examples. Materials

Due to Combination- They may be alloys or composites. an alloy is a combination of two or more metals. They possess properties which are quite different from those of their constituent metals. Alloys may be ferrous non-ferrous depending on the base metal used. An alloy is prepared for a specific purpose to meet the particular requirements of an application. Some common ferrous alloys are invar, stainless steel and high speed steel (HSS). Non-ferrous alloys include phosphor bronze, brass, duralumin, babbits etc. Composites may be inorganic or organic . They have two or more constituents of dissimilar properties. The two major constituents may be metals and ceramics or metals and polymers, or ceramics and polymers or any other combination. instead of metals, alloys may also be used to make composites. Constituent of composites called reinforcing constituent may be in particulate form, fibrous form or flake form.

F. Electrodes: **Welding electrodes** are metal wires with baked on chemical coatings. The rod is used to sustain the **welding** arc and to provide the filler metal required for the joint to be welded. The coating protects the metal from damage, stabilizes the arc, and improves the weld.

In arc **welding**, an **electrode** is used to conduct current through a work piece to fuse two pieces together. Depending upon the process, the **electrode** is either consumable, in the case of gas metal arc **welding** or shielded metal arc **welding**, or non-consumable, such as in gas tungsten arc **welding**.

Parts of welding electrode



Content/Topic 4 Equipment:

1. **Welding machine**: It is a machine generate heat that melts metal parts, so that these parts can be joined. However, there is no single **welding machine** that is suitable for all **welding** projects.

LU & PC is linked in LO inside the content

2. **Drilling machine:** A **drill** or **drilling machine** is a tool primarily used for making round holes or driving fasteners. It is fitted with a bit, either a drill or driver, depending on application, secured by a chuck. Some powered drills also include a hammer function.

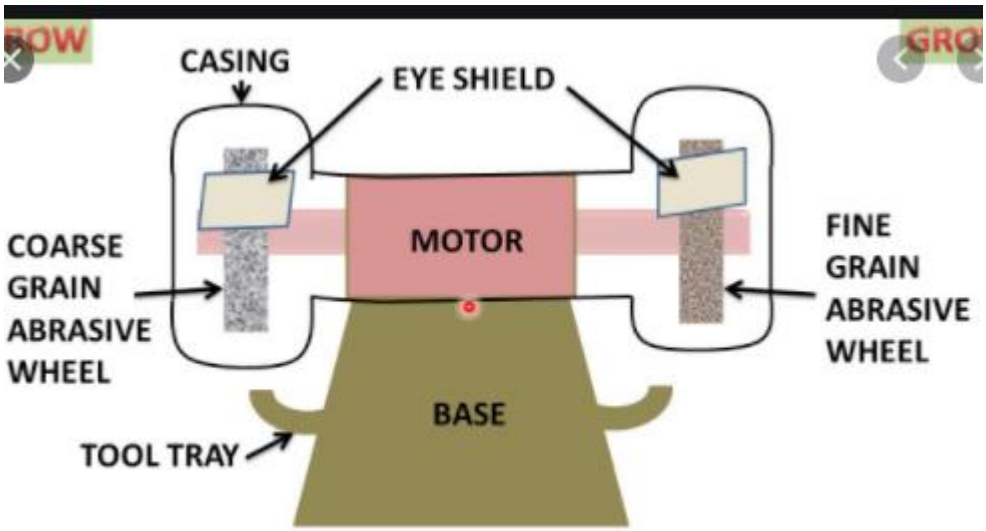
Grinding machine: A grinding machine is a machine for material removal with geometrically non-defined, bonded cutting edges, where the relative movement between tool and work piece is rotational or linear. The machine further must provide relative feed and positioning movements between tool and work piece. The movements between tool support (spindle) and work piece follow a defined geometrical path – it is path defined.

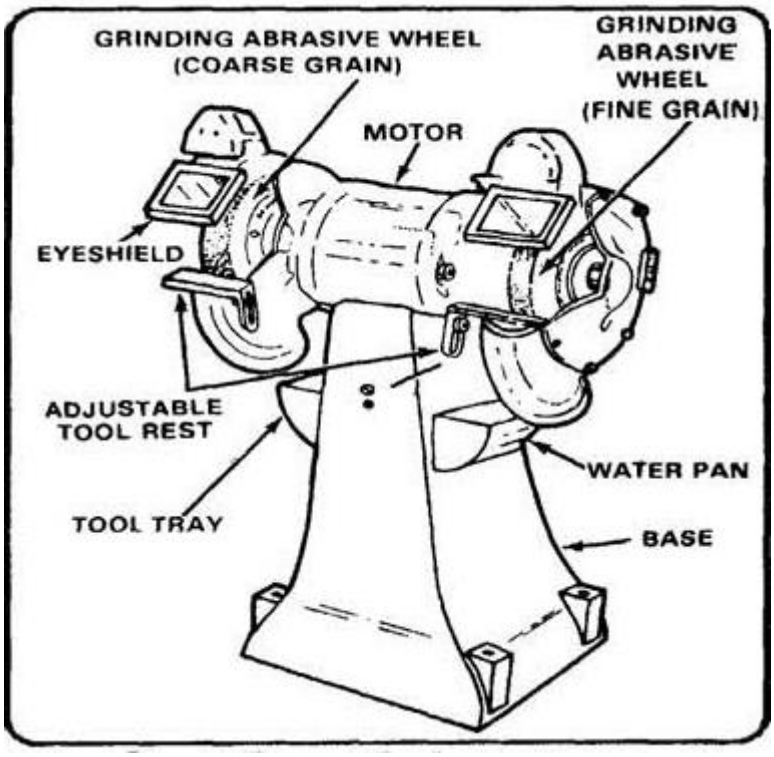
Material removal with geometrical non-defined cutting edges is considered as material removal that is made by a large number of cutting edges normally on abrasive grains, which are undefined, with respect to number, shape, and/or position, where the envelope over all stochastically distributed cutting edges defines the tool geometry.

Grinding with linear relative movement is called pitch grinding. If the reciprocating linear movement is coupled with a continuous rotational movement, the process is called honing. Belt grinders, where a belt to which the abrasive wheel.

It can also use for sharpening cutting tools

Parts of grinding machine





Abrasive wheels: Are cutting tools consisting of **abrasive** grains, held together by organic or inorganic bonds. Diamond and reinforced **wheels** are included. Organic **wheels**: Bonded by an organic material. For example, resin, rubber, shellac, or other similar bonding agent.

Types of abrasive wheel

1. Rough grinding wheel: It is used for removal of larger material (roughing process)

2. Smooth grinding wheel: It is used for smoothing work piece (smoothing process)

LO 2.1 – Perform measurements, cutting and marking for ferrous metals

- Content/Topic 1 Ferrous metal

1. Cast iron: Cast iron is a group of iron-carbon alloys with a carbon content more than 2%.

Types of cast iron

Grey cast iron, Grey cast iron is characterized by its graphitic microstructure, which causes fractures of the material to have a grey appearance. It is the most commonly used cast iron and the most widely used cast material based on weight.

White cast iron, White cast iron displays white fractured surfaces due to the presence of an iron carbide precipitate called cementite

Malleable cast iron

Malleable iron starts as a white iron casting that is then heat treated for a day or two at about 950 °C (1,740 °F) and then cooled over a day or two. As a result, the carbon in iron carbide transforms into graphite and ferrite plus carbon (austenite).

Ductile cast iron

Developed in 1948, *nodular* or *ductile cast iron* has its graphite in the form of very tiny nodules with the graphite in the form of concentric layers forming the nodules. As a result, the properties of ductile cast iron are that of a spongy steel without the stress concentration effects that flakes of graphite would produce.

2. **mild steel:** Mild steel is a type of carbon steel with a low amount of carbon – it is actually also known as "low carbon steel." Although ranges vary depending on the source, the amount of carbon typically found in mild steel is 0.05% to 0.25% by weight, whereas higher carbon steels are typically described as having a carbon content from 0.30% to 2.0%. If any more carbon than that is added, the steel would be classified as cast iron.

   Common Applications of Mild Steel

   Here are some examples of where it is used in the world:

   - ✓ Structural steel
   - ✓ Signs
   - ✓ Automobiles
   - ✓ Furniture
   - ✓ Decorations
   - ✓ Wire
   - ✓ Fencing
   - ✓ Nails

3. stainless steel: **stainless steel** is a group of iron-based alloys that contain a minimum of approximately 11% chromium, a composition that prevents the iron from rusting, as well as providing heat-resistant properties.

LO 2.2 –: Apply proper welding techniques

- Content/Topic 1 Welding techniques

1. Flat position

Also referred to as a “down hand” position, the flat position weld is the easiest and often the first weld that new students learn. The metals to be joined are placed flat, and the welder passes the electric arc over them, moving across the work piece in a horizontal direction. The joint’s top side is welded together allowing the molten material to move downward into its edges or groove.

2. Horizontal Position

The horizontal position is considered an out-of-position weld. Along with the vertical and overhead, the horizontal position can be more challenging to perform and require a higher level of skill.[2]

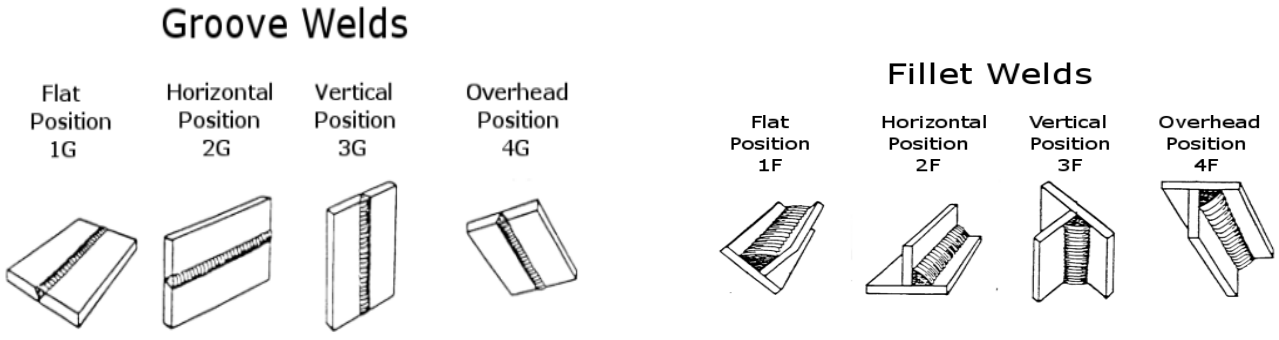
The weld axis is horizontal. How the position is executed depends on the type of weld. For a fillet weld, the weld bead is placed where a vertical and a horizontal piece of metal meet at a 90-degree angle. When performing a groove weld, the weld face will be along a vertical plane.

3. Vertical Position

For a vertical position weld, both the weld and plate will lie vertically. One of the major problems when performing this weld is the molten metal flowing downward and piling up. Welding in a downhill or upward vertical position can prevent this issue.

4. Overhead Position

The overhead position weld is the most difficult position to work in. The welding will be performed with the two pieces of metal above the welder, and the welder will have to angle him or herself and the equipment to reach the joints.



- Content/Topic 2 Various types of joints

- **T Joints**

  This weld joint occurs when two pieces are joined at right angles. The weld joint forms a “T” shape.

In T-join the two member which are located approximately at right angle to each other in the form of letter T

- **Lap Joints**

This weld joint is where the two pieces of metal partially overlap one another.

In lap joint is formed when two pieces’ overlap each other and solder is applied between the two pieces. The strength of this joint depends on how much of an overlap is created. The larger the overlapped area, the stronger the soldered joint.

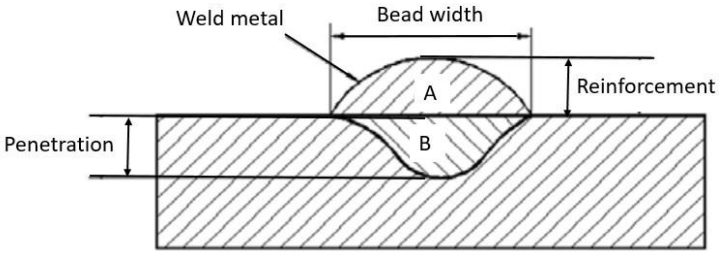
- **Butt Joints**

Butt joints occur when two pieces of metal in the same plane are joined with their edges meeting.

In a butt joint, two pieces of metal are joined with their ends abutting each other. The ends must be clean and flat in order for the solder to adhere properly to both edges. This joint doesn't have a lot of strength, and shouldn't be used for any type of load-bearing project. However, it's useful for smaller projects. A butt joint is often used to close jump rings in jewelry.

- **Bead** it is a result of soldering pass that deposit filler material.

A **bead weld** or **weld bead** is the result of a **welding** pass that deposits filler material. **Welding** is a process that combines multiple pieces of metal by heating and softening them. With **bead welding**, a filler material is inserted in the space between the two materials.



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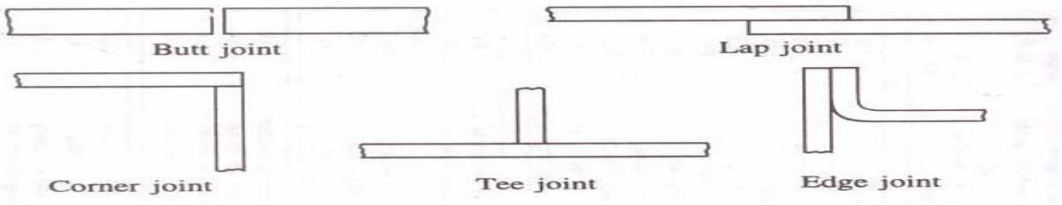
- **Corner Joints**

The corner joint weld is where the two pieces are fused at a 90-degree angle

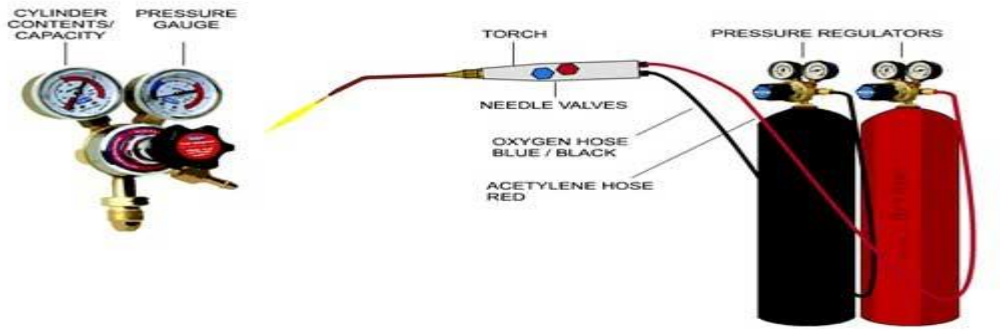
- **Edge Joints**

Edge joints occur when the flat sides of two pieces of metal are welded together.

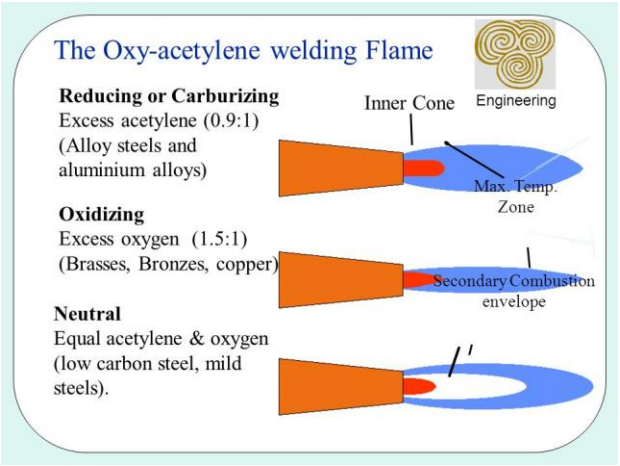


Learning Unit 3 –: Perform oxy-acetylene welding

Oxyacetylene welding, commonly referred to as gas welding, is a process which relies on combustion of oxygen and acetylene. When mixed together in correct proportions within a hand-held torch or blowpipe, a relatively hot flame is produced with a temperature of about 3,200^{0}C. The chemical action of the oxyacetylene flame can be adjusted by changing the ratio of the volume of oxygen to acetylene.



TYPES OF GAS FLAMES



Oxidizing flame: When the volume if oxygen gas is more than the volume of acetylene mixed into the torch. This flame is used for welding brass and is also used for cutting the metals.

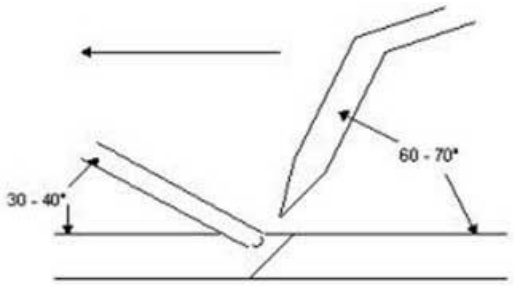
Carburizing flame: When the volume of acetylene mixed is more than oxygen, carburizing flame is formed. This flame is used for welding nickel, Monel etc.

Neutral flame: It is known as balanced flame. Oxygen and acetylene gases are mixed in equal volumes. Neutral flame is used for normal welding of steel, cast iron etc.

OXY-ACETYLENE GAS WELDING TECHNIQUES

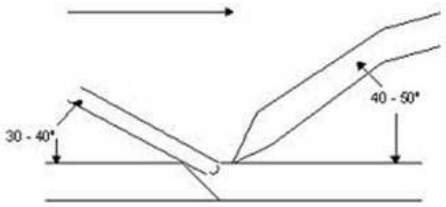
Leftward welding:

In this welding the tip of the torch is held at 600-700 to the plates. And the filler rod is inclined at 300-400 in opposite direction. In this method the plate edges are heated immediately after the molten metal. The torch tip and filler rod are moved slowly in the direction towards left.



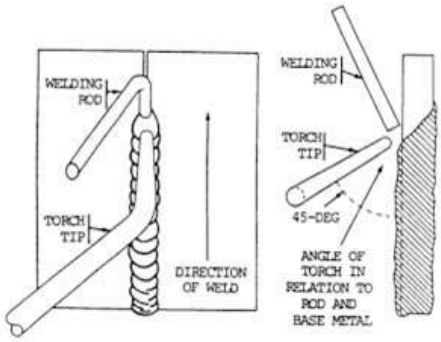
Rightward welding:

In right ward welding the torch is kept at 400-500 to the job to be welded. Torch is moved toward right. Right ward welding is done for heavy sections.



Vertical welding:

This is a method by which metal of any thickness can be welded. In case the thickness of the sheet is lesser then welding from one side will be sufficient but for thicker sheets welding should be done from both the sides. Preparation of edges to be weld is not required. In this case welding starts from bottom and moves till top and the welding blow pipe follows the filler rod. The inclination of the blow pipe is 30-80 degree whereas filler rod is inclined at an angle of 30.



LO 3.1 – Check state of embroidery machine

- Content/Topic 1: Aluminium, copper, brass, bronze

Aluminium: Aluminium (aluminum in American and Canadian English) is a chemical element with the symbol Al and atomic number 13. It is a silvery-white, soft, non-magnetic and ductile metal in the boron group.

Aluminium is remarkable for its low density and its ability to resist corrosion through the phenomenon of passivation.

Copper: Copper is a chemical element with the symbol Cu (from Latin: cuprum) and atomic number 29. It is a soft, malleable, and ductile metal with very high thermal and electrical conductivity. A freshly exposed surface of pure copper has a pinkish-orange color.

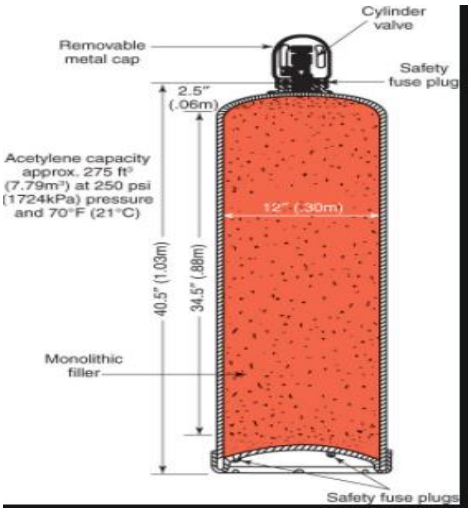
Brass: Brass is an alloy of copper and zinc, in proportions which can be varied to achieve varying mechanical and electrical properties. It is a substitutional alloy: atoms of the two constituents may replace each other within the same crystal structure.

Bronze: Bronze is an alloy consisting primarily of copper, commonly with about 12–12.5% tin and often with the addition of other metals (such as aluminum, manganese, nickel or zinc) and sometimes non-metals or metalloids such as arsenic, phosphorus or silicon

LO 3.2 – Apply oxy-acetylene gas welding

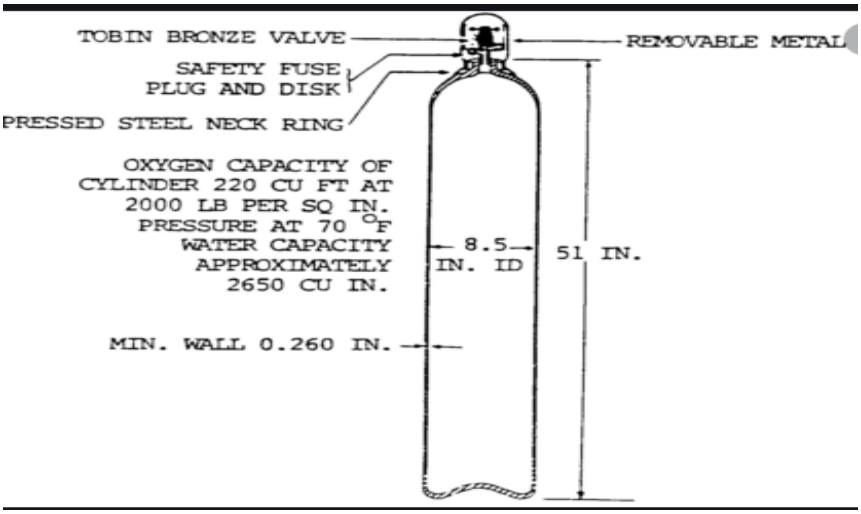
- Content/Topic 1 Oxy-acetylene equipment

A. Acetylene cylinder. It is a cylinder that contains acetylene gas during welding.



B. Oxygen cylinder: It is a cylinder that contains oxygen gas during welding.

Oxygen exhibits many unique physical and chemical properties. For example, oxygen is a colorless and odorless gas, with a density greater than that of air, and a very low solubility in water. In fact, the latter two properties greatly facilitate the collection of oxygen in this lab.



C. Nozzle: Welding **Tip** (engineering) A replaceable **nozzle** for a gas torch used in **welding.**

D. **Torch: Welding Torch:** A welding torch is a vital device used to combine both the gases -fuel or acetylene and oxygen - to create a flame that is hot and strong enough to cut the metals. It has been designed and developed in a manner so that the operator can control both the shape of the flame and its intensity via a pair of valve knobs placed towards the end of the handle. These needle valves work to change the flow of oxygen and fuel as needed.

The welding torch head is used to weld metals. There are only one or two pipes going to the nozzle and no oxygen-blast trigger and two valve knobs at the bottom of the handle allowing the operator adjust the oxygen flow and fuel flow. It is also a one of the vital equipment.

Cutting Torch: Similar to a welding torch, a cutting torch head is used to cut materials. But the torch can be identified by the oxygen blow out trigger or lever. Once the desired temperature is attained, oxygen is supplied to the heated parts by pressing the "oxygen-blast trigger". The supplied oxygen reacts with the metal, and thus forming iron oxide and producing heat. This heat is used for the cutting process.

E. **Oxygen Hose**: It is a small flexible pipe used to convey oxygen gas, oxygen has right-handed threaded as usual.
A blue **color** and green **color** indicates the **hose** as suitable for use with **oxygen**

F. **Acetylene Hose:** It is a small flexible pipe used to convey acetylene gas, acetylene gas has left-handed threaded. a red **hose** is used for acetylene and other fuel gases.

G. **Regulator (manifold):** The gas regulators are also vital equipment with the primary function to control gas pressure. It controls high pressure of the bottle-stored gas to the working pressure of the torch and maintains during welding process. The gas regulators have two separate gauges - a high pressure gauge works to determine remaining gas in the cylinder and a low pressure gauge to determine pressure of gas fed to the torch.

Note: Acetylene gas is filled in cylinders under a pressure of about 15 bar, while welding process is carried out with torch gas pressures typically up to 2 bar.

H. Adjustable spanner: An **adjustable spanner** (UK, and most other English-speaking countries) or **adjustable wrench** (US and Canada) is an open-end wrench with a movable jaw, allowing it to be used with different sizes of fastener head (nut, bolt, etc.) rather than just one fastener size, as with a conventional fixed spanner. Several other names are in use, including casually imprecise use of the US trademark **crescent wrench**.

I. Filler metal:

Filler metals are alloys or unalloyed **metals** which, when heated, liquefy and melt to flow into the space between two close fitting parts, creating a brazed or soldered joint. A **filler metal** has suitable melting and flow properties to permit distribution by capillary attraction in properly prepared joints.

TYPES OF FILLER METAL

Covered electrodes

Covered electrodes are used extensively in shielded metal arc welding and are a major factor in that method's popularity.

Bare electrode wires

Bare electrode wires are used in gas metal arc welding and bare electrode rods are used in gas tungsten arc welding.

Tubular electrode wires

Tubular electrode wire is used in flux-cored arc welding.

Welding fluxes

Welding fluxes are used in submerged arc welding.

J. **Flux:** The chemicals which de-oxidizes the metal surface and provides inert atmosphere around the molten metal are known as fluxes.

Function:

- To prevent oxides from the hot surfaces.
- To reduce the viscosity of molten metal.
- It maintains a steady arc in case of arc welding

Advantages Of Oxy-Acetylene Welding

- Easy to learn and execute, and is Low cost
- Required equipment is cheaper than other types of welding equipment
- Equipment is more portable than the most other types of welding equipment
- Oxy/Acetylene equipment can also be used to "flame-cut" large pieces of material
- Versatility - readily applied to a variety of applications and a wide choice of electrodes
- Relative simplicity and portability of equipment
- Adaptable to confined spaces and remote locations
- Suitable for out-of-position welding

- Mild Steel
- Brazing can be done on many other materials such as aluminium, stainless steel, copper, and brass

- Content/Topic 2 Welding techniques

1. Flat position

Also referred to as a “down hand” position, the flat position weld is the easiest and often the first weld that new students learn. The metals to be joined are placed flat, and the welder passes the electric arc over them, moving across the work piece in a horizontal direction. The joint’s top side is welded together allowing the molten material to move downward into its edges or groove.

2. Horizontal Position

The horizontal position is considered an out-of-position weld. Along with the vertical and overhead, the horizontal position can be more challenging to perform and require a higher level of skill.[2]

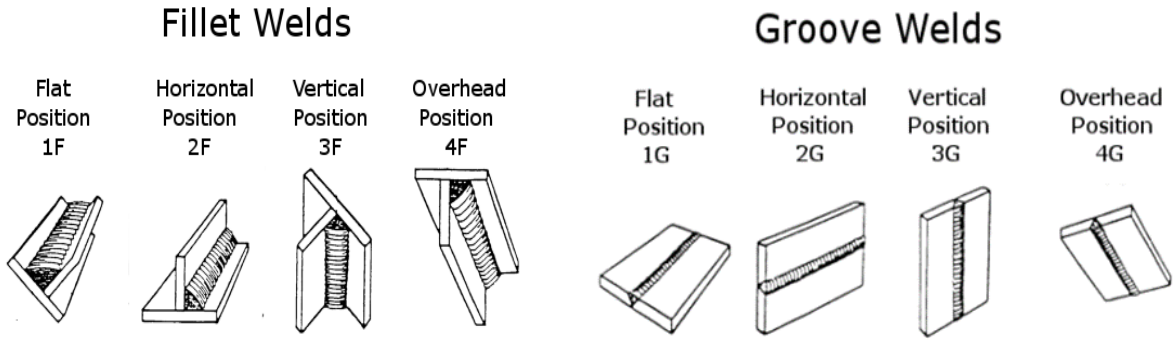
The weld axis is horizontal. How the position is executed depends on the type of weld. For a fillet weld, the weld bead is placed where a vertical and a horizontal piece of metal meet at a 90-degree angle. When performing a groove weld, the weld face will be along a vertical plane.

3. Vertical Position

For a vertical position weld, both the weld and plate will lie vertically. One of the major problems when performing this weld is the molten metal flowing downward and piling up. Welding in a downhill or upward vertical position can prevent this issue.

4. Overhead Position

The overhead position weld is the most difficult position to work in. The welding will be performed with the two pieces of metal above the welder, and the welder will have to angle him or herself and the equipment to reach the joints.

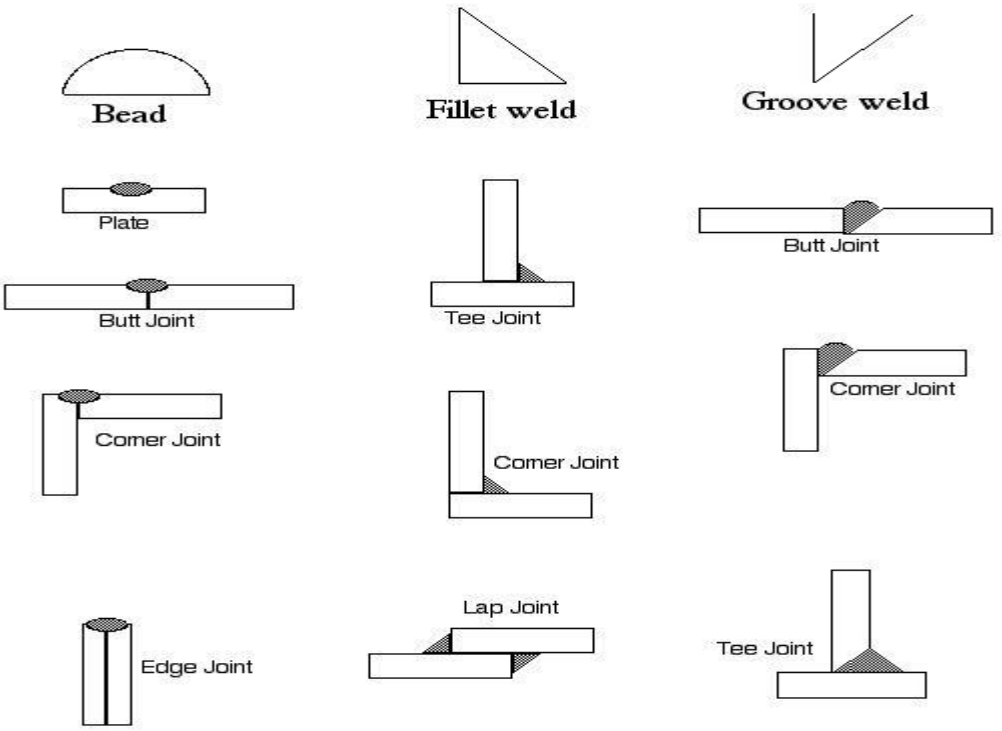


Main Types of Welds

Two main types of welds can be used with any of the four positions:

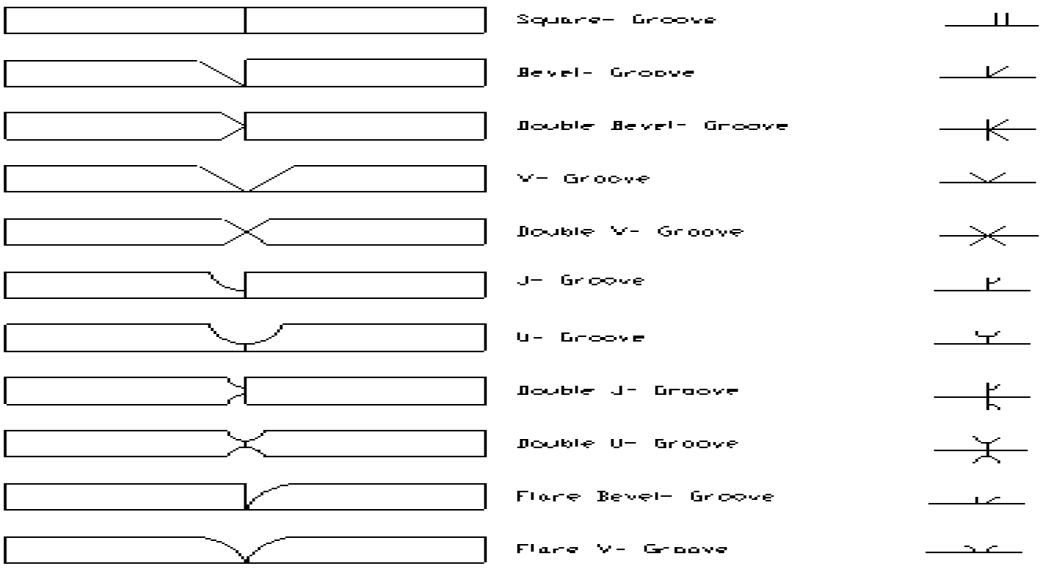
Fillet Weld (F)

Often considered the most popular type of weld, a fillet weld fuses two pieces of metal at an approximate right angle triangle to each other.



Grove Weld (G)

Grove welds are the second most common type of weld. A grove weld is formed when filler metal is deposited in the groove between two pieces of metal.



- Content /Topic3 Various types of joints

1. T Joints

This weld joint occurs when two pieces are joined at right angles. The weld joint forms a “T” shape.

In T-join the two member which are located approximately at right angle to each other in the form of letter T

2. Lap Joints

This weld joint is where the two pieces of metal partially overlap one another.

In lap joint is formed when two pieces’ overlap each other and solder is applied between the two pieces. The strength of this joint depends on how much of an overlap is created. The larger the overlapped area, the stronger the soldered joint.

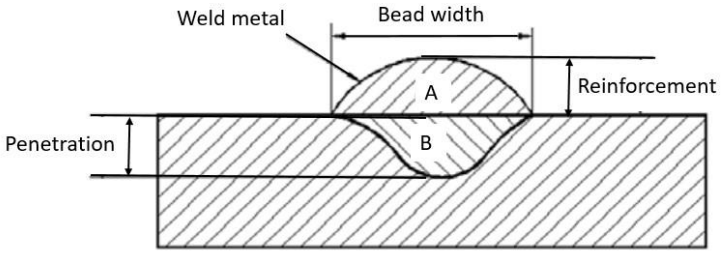
3. Butt Joints

Butt joints occur when two pieces of metal in the same plane are joined with their edges meeting.

In a butt joint, two pieces of metal are joined with their ends abutting each other. The ends must be clean and flat in order for the solder to adhere properly to both edges. This joint doesn't have a lot of strength, and shouldn't be used for any type of load-bearing project. However, it's useful for smaller projects. A butt joint is often used to close jump rings in jewelry.

4. **Bead** it is a result of soldering pass that deposit filler material.

A **bead weld** or **weld bead** is the result of a **welding** pass that deposits filler material. **Welding** is a process that combines multiple pieces of metal by heating and softening them. With **bead welding**, a filler material is inserted in the space between the two materials.



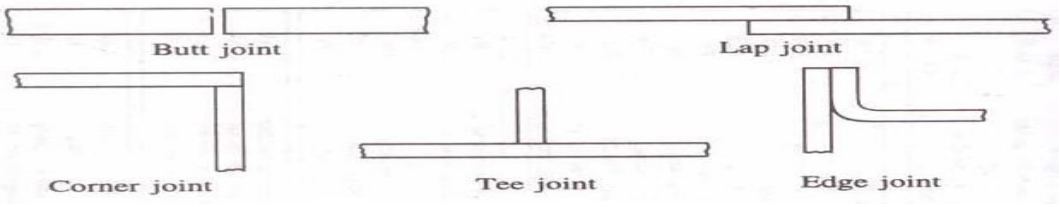
%Dilution= (B/(A+B))*100

5. Corner Joints

The corner joint weld is where the two pieces are fused at a 90-degree angle

6. Edge Joints

Edge joints occur when the flat sides of two pieces of metal are welded together.



the Welding Symbols for the Different Positions

Let's bring all of these concepts together so you know which welding position to use when reading the welding symbols on an architect's blueprints:

Welding Symbol	Welding Position	Weld Type
1 F	Flat position	Fillet weld
1 G	Flat position	Groove weld
2 F	Horizontal position	Fillet weld
2 G	Horizontal position	Groove weld
3 F	Vertical position	Fillet weld
3 G	Vertical position	Groove weld
4 F	Overhead position	Fillet weld
4 G	Overhead position	Groove weld

L O 3.3 –: Apply various joints using soldering process

soft soldering, which originally used a tin-**lead** alloy as the filler metal.

Soldering is a process in which two or more items are joined together by melting and putting a filler metal (solder) into the joint, the filler metal having a lower melting point than the adjoining metal. Unlike welding, soldering does not involve melting the work pieces. In brazing, the work piece metal also does not melt, but the filler metal is one that melts at a higher temperature than in soldering. In the past, nearly all solders contained lead, but environmental and health concerns have increasingly dictated use of lead-free alloys for electronics and plumbing purposes.

- Content/Topic 1 Various types of joints

1. **T-Joint**
   In T-join the two member which are located approximately at right angle to each other in the form of letter T
2. **Lap joint,**

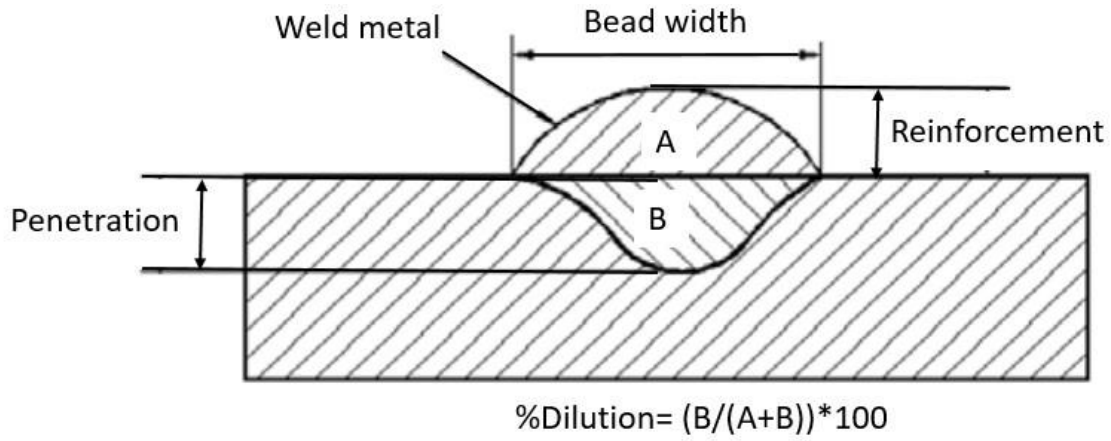
A lap joint is formed when two pieces' overlap each other and solder is applied between the two pieces. The strength of this joint depends on how much of an overlap is created. The larger the overlapped area, the stronger the soldered joint.

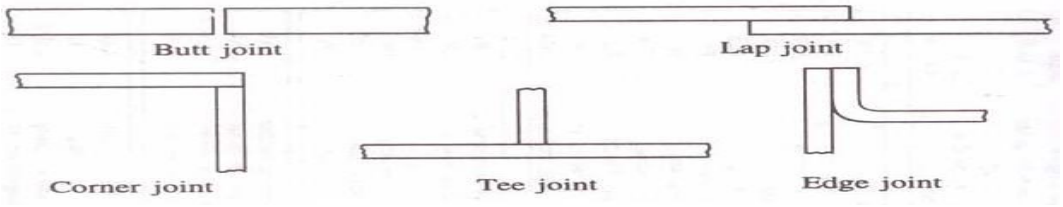
3. **Butt Joint**

In a butt joint, two pieces of metal are joined with their ends abutting each other. The ends must be clean and flat in order for the solder to adhere properly to both edges. This joint doesn't have a lot of strength, and shouldn't be used for any type of load-bearing project. However, it's useful for smaller projects. A butt joint is often used to close jump rings in jewelry.

4. **Bead** : it is a result of soldering pass that deposit filler material.

A **bead weld** or **weld bead** is the result of a **welding** pass that deposits filler material. **Welding** is a process that combines multiple pieces of metal by heating and softening them. With **bead welding**, a filler material is inserted in the space between the two materials





- Content/Topic 2 Types of soldering rods

soldering rods/ Solder is a fusible metal alloy used to create a permanent bond between metal work pieces. Solder is melted in order to adhere to and connect the pieces after cooling, which requires that an alloy suitable for use as solder have a lower melting point than the pieces being joined.

Sequence of operations:

The following operations are required to be performed sequentially for making soldered joints.

1. Shaping and fitting of metal parts together: The two parts to be joined are shaped to fit closely so that the space between them is extremely small and filled completely with solder by capillary action. If a large gap is present, capillary action will not take place and the joint will not be strong.

2. Cleaning of surfaces: In order to obtain a sound joint, the surfaces to be soldered are cleaned to remove dirt grease or any other foreign material.

3. Apply of flux: The flux is applied when the parts are ready for joining.

4. Apply of heat and solder: The parts are held in a vice or with special work holding devices so that parts do not move while soldering

Types of soldering rods

1. Lead: A: 50%, B :60%, C: 7o%:
   Lead is a chemical element with the symbol Pb and atomic number 82. It is a heavy metal that is denser than most common materials. Lead is soft and malleable, and also has a relatively low melting point.

Melting point: 327.5 °C

Lead Rod has been **used** in a many industrial **applications** including electrical interconnection in computers, lighting equipment, motor leads, heating and cooling equipment, harness fabrication and automotive.

Tin: A: 50%, B:40%, C: 30%: **2.Tin:A: 50%,B:40%,C: 30%:** Tin is a chemical element with the symbol Sn. large application for tin is corrosion-resistant tin plating of steel

Alloys that combine tin and lead have a number of different names and applications. Solder is an alloy of tin and lead used to create electrical joints. Termed plate is an alloy of tin and lead used to coat steel. Some antique pewter contains both tin and lead, sometimes in combination with other metals.

Example 1: lead/tin 50/50: 50% TIN / 50% LEAD STAINED GLASS WIRE SOLDER: The ideal solder for copper foil seams and general purpose use. Melting temperature: 361° - 421°F.

Example 2: Alloys commonly used for electrical soldering are 60/40 Sn-Pb, which melts at 188 °C (370 °F), and 63/37 Sn-Pb used principally in electrical/electronic work. This mixture is a eutectic alloy of these metals, which: has the lowest melting point (183 °C or 361 °F) of all the tin-lead alloy.

Example3: This Solder has good corrosion resistance and tensile strength. With a melting range beginning at 376 Deg. F.

Table 9-8.--Tin-lead Melting Points

TIN-LEAD MELTING POINTS	
Composition (percent)	Melting Point (° F)
10/90	573
20/80	533
30/70	496
40/60	460
50/50	418
60/40	374
70/30	376
80/20	396
90/10	421

LO 3.4 –: Apply various joints using soldering process

Soldering is a joining process used to join different types of metals together by melting **solder**. **Solder** is a metal alloy usually made of tin and lead which is melted using a hot iron. The iron is heated to temperatures above 600 degrees fahrenheit which then cools to create a strong electrical bond.

- Content /Topic1 Various types of joints

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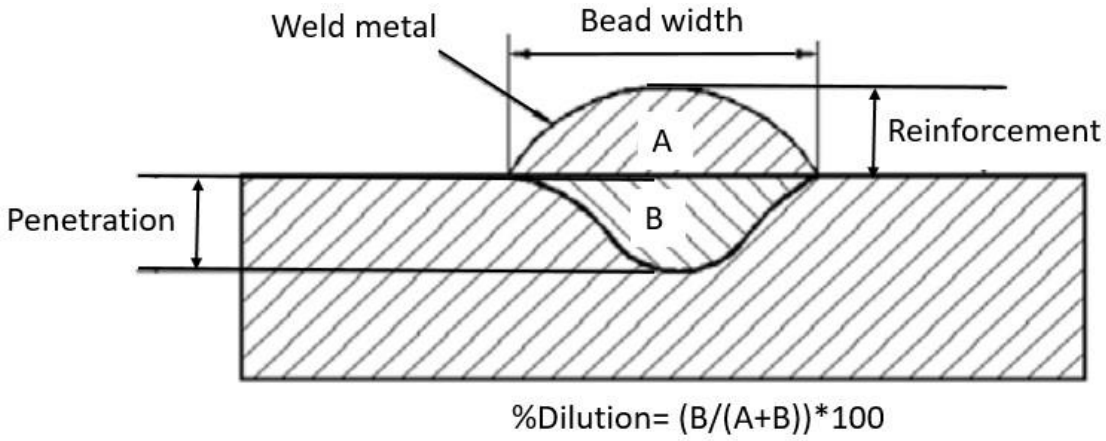

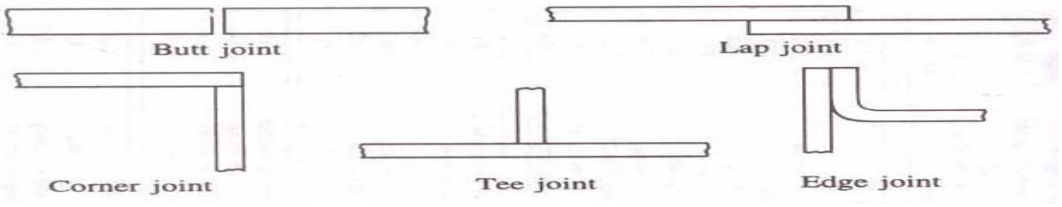

5. Content /Topic2 Types of soldering rods

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Melting point: 327.5 °C

Lead Rod has been **used** in a many industrial **applications** including electrical interconnection in computers, lighting equipment, motor leads, heating and cooling equipment, harness fabrication and automotive. It is inexpensive and has suitable properties. Worse wetting than tin. Toxic, being phased out. Retards growth of tin whiskers, inhibits tin pest. Lowers solubility of copper and other metals in tin.

2.Tin:A: 50%,B:40%,C: 30%: Tin is a chemical element with the symbol Sn. large application for tin is corrosion-resistant tin plating of steel

Alloys that combine tin and lead have a number of different names and applications. Solder is an alloy of tin and lead used to create electrical joints. Termed plate is an alloy of tin and lead used to coat steel. Some antique pewter contains both tin and lead, sometimes in combination with other metals.

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80/20	396
90/10	421

LO 3.5 –: Identify different types of fluxes

The purpose of flux is to facilitate the soldering process.

When solder melts and forms a joint between two metal surfaces, it forms a metallurgical bond by chemically reacting with the other metal surfaces. A good bond requires two things:

-A solder that is metallurgical compatible with the metals being bonded.

-Good metal surfaces free of the oxides, dust, and grime that prevent good bonding.

1. Content /Topic3 : types of fluxes

a) **Liquid flux:** Liquid flux is a chemical agent that serves several purposes: it cleans a metal surface, creates a barrier that prevents oxidation and allows solder to flow more freely over a work area.

b) **Paste flux**: Solder paste flux is a gelatinous chemical compound used mainly in combination with solder powder to create solder paste, generally mixed as a 50/50 ratio. Once combined, the paste is a gray, putty-like material. Solder paste flux serves a threefold purpose: Removing any oxidized metal from the surfaces to be soldered.

c) **Powder flux**: Powder fluxes are necessary for specialized applications in order for the flux to work properly when connecting a join. Particularly in a furnace brazing process. Advantages are that they have a longer shelf life as powder doesn't require water. It is cost effective as you should be able to convert it into paste by adding water or alcohol.

Learning Unit - 4: Check the work done

LO 4.1 –: Inspect the work done

Content /Topic1 : The tools for measurement

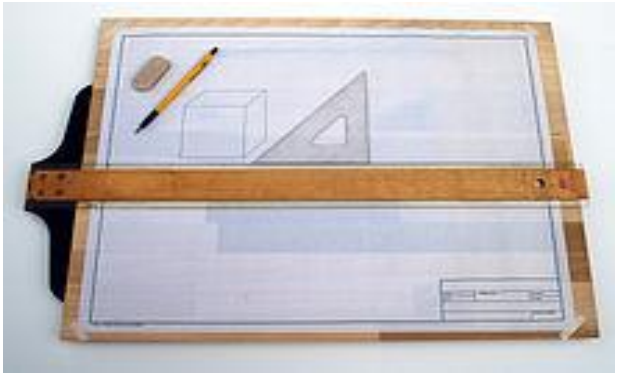
Measurement and inspection of welded joint is an important step in quality control and reliability of welded constructions. Meters of welded joints and welding templates (templates welder) allow us to determine the size of joints, joint width and height, angle of bevel, depth and width of preparation, included angle, root gap, depth of root face, convexity, smoothness of transition weld to the base metal, leg length, etc.

- ✓ **Tap measure:** This is likely the most typical type of measuring device that you will think of when someone brings up a measuring tool. Measuring tape is a simple tool that will help you to measure the length of something. You can also measure how wide an object is and can generally figure out all of the information that you will need to know. Measuring tools like this are commonly used in many lines of work, and you will definitely see one on the hip of most carpenters.

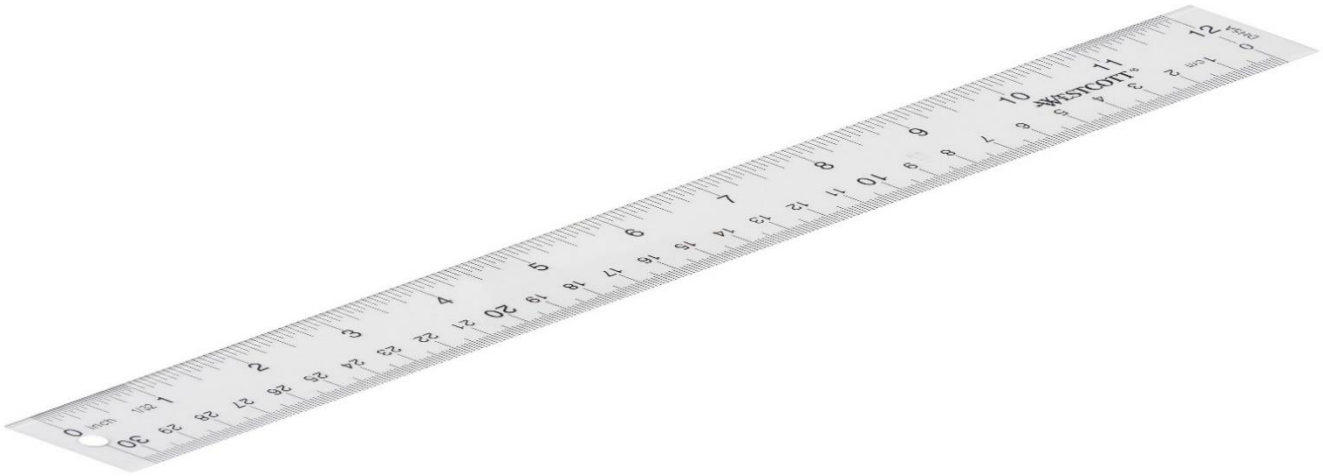
These  tools are very convenient because they are so portable. You can fit them in your tool belt without a problem and some of them will have a clip so that they can be placed on your belt.

- ✓ **T-square:** a T-shaped instrument for drawing or testing right angles.

A T-square is a technical drawing instrument used by draftsmen primarily as a guide for drawing horizontal lines on a drafting table. It may also guide a set square to draw vertical or diagonal lines.



- ✓ **Ruler:** A ruler, sometimes called a rule or line gauge, is a device used in geometry and technical drawing, as well as the engineering and construction industries, to measure distances or draw straight lines



Content /Topic2: Physical inspection

To ensure the satisfactory performance of a welded structure, the quality of the welds must be determined by adequate testing procedures. Therefore, they are proof tested under conditions that are the same or more severe than those encountered by the welded structures in the field

Physical inspection allows you to detect such external defects such as undercuts, uncertified craters facing surface cracks, lack of fusion, flows, etc.

This page contains visual inspection tips. The following pages contain inspection methods for GMAW and physical weld testing.

These tests reveal weak or defective sections that can be corrected before the materiel is released for use in the field. The tests also determine the proper welding design for ordnance equipment and forestall injury and inconvenience to personnel.

NDT refers to nondestructive testing. It is an approach to testing that involves evaluating the weld without causing damage. It saves time and money including the use of remote visual inspection (RVI), x-rays, ultrasonic testing and liquid penetration testing.

In most welds, quality is tested based on the function for which it is intended. If you are fixing a part on a machine, if the machine functions properly, then the weld is often considered correct. There are a few ways to tell if a weld is correct:

- **Distribution**: Weld material is distributed equally between the two materials that were joined.
- **Waste**: The weld is free of waste materials such as slag. The slag after cooling should peel away from the project. It should be removed easily. In **MIG** welding, any residue from the shielding gas should also be removed with little problem. **TIG**, being the cleanest process, should also be waste free. In TIG, if you see waste, it usually means that the material being welded was not cleaned thoroughly.
- **Porosity**: The weld surface should not have any irregularities or any porous holes (called porosity). Holes contribute to weakness. If you see holes it usually indicates that the base metal was dirty or had an oxide coating. If you are using Mig or Tig, porosity indicates that more shielding gas is needed when welding. Porosity in aluminum welds is a key indicator of not using enough gas.
- **Tightness**: If the joint is not tight, this indicates a weld problem. In oxyacetylene welding, if using autogenous welding, where there is no filler material, the weld must be tight. Same for Tig

autogenous welding. The gap is not as critical in other types of welds since any gap is filled in by the filler material. That said, gaps, in general, indicate a potential quality problem.

- **Leak-Proof**: If you are repairing an item that contains liquid, a leak is a sure-fire way (and obvious way) to see that there is a problem. Same for something that will contain a gas. One testing method is to use soap bubbles to check for problems (can be easily applied with a squirt bottle.
- **Strength**: Most welds need to demonstrate the required strength. One way to ensure proper strength is to start with a filler metal and electrode rating that is higher than your strength requirement.

1. **Eyes:** Visual inspection (VT) is arguably the oldest and most widely used NDT method there is. For thousands of years, craftsmen have used their eyes to determine the quality of the products they made. In essence, this is still the case with visual inspection.

   This method involves the visual observation of the surface of a test object to evaluate the presence of surface discontinuities such as corrosion, misalignment of parts, physical damage and cracks.

   Visual testing can be done by looking at the test piece directly, or by using optical instruments such as magnifying glasses, mirrors, borescopes and computer-assisted viewing systems. VT can be applied to inspect castings, forgings, machined components and welds and is used in all branches of industry.
2. **hands:** it is the use of hands to check the sizes of welded patrs

Weld Testing

- Types
  - Destructive
    - Physical damage to w/p and welded join.
    - Quantitative data obtained
  - Non Destructive
    - Without Physically damaging the workpiece and joint
    - Qualitative data is obtained

LO 4.2 –: Apply physical testing of welded pieces

Content /Topic1: Hammering

hammers are used for general carpentry, framing, nail pulling, cabinet making, assembling furniture, upholstering, finishing, riveting, bending or shaping metal, striking masonry drill and **steel** chisels, and so on. Hammers are designed according to the intended purpose.

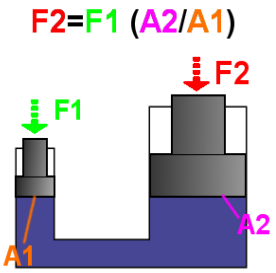
It is they use of hammer to detect weld defect like slag inclusion, porosity ,undercut ,lack of penetration lack of fusion ,incomplete fusion etc.

Inspection and Testing for Fillet Welds (Tee Joints) - This involves visual inspection of the completed weld, followed by two macro etches, and one fillet weld break test. The welded sample is first inspected for any visual discontinuities and then sectioned, and two small samples removed at predetermined locations. These small samples are polished across their cross-section and then etched using some type of mild acid mixture, dependent on the base material used. The remaining welded sample is used as the fillet weld break test and is broken against the weld to reveal the internal structure of the weld for inspection.

Inspection and Testing for Groove welds (Butt Joints) – This involves visual inspection, followed by two transverse tensile tests, two root bend test and two face bend tests. (These tests are typical but may differ dependent on material thickness, type and standard requirements. Different and/or additional testing, such as side bends, all weld tensile tests, impact testing or other testing may be required.) The completed weld coupon, after visual inspection, is divided into predetermined small sections. Each section is prepared, usually by machining, to specific dimensions as prescribed by the standard. Each small sample is then tested mechanically to determine its characteristics. These samples are then inspected to determine their acceptability, against specified acceptance criteria, as laid down by the applicable code or standard. Typically the standard will provide the maximum size and location of various weld discontinuities and/or, as relevant, values such as minimum tensile strengths or minimum desired impact properties.

Content /Topic2: Testing machine (hydraulic press)

A hydraulic press is a machine press using a hydraulic cylinder to generate a compressive force.



The hydraulic press depends on Pascal's principle-the pressure throughout a closed system is constant. One part of the system is a piston acting as a pump, with a modest mechanical force acting on a small cross-sectional area; the other part is a piston with a larger area which generates a correspondingly large mechanical force. Only small-diameter tubing (which more easily resists pressure) is needed if the pump is separated from the press cylinder.

Pascal's law: Pressure on a confined fluid is transmitted undiminished and acts with equal force on equal areas and at 90 degrees to the container wall.

Pressure of fluid due to the application force F_1

$$P = \frac{F_1}{A_1} \text{ (1)}$$

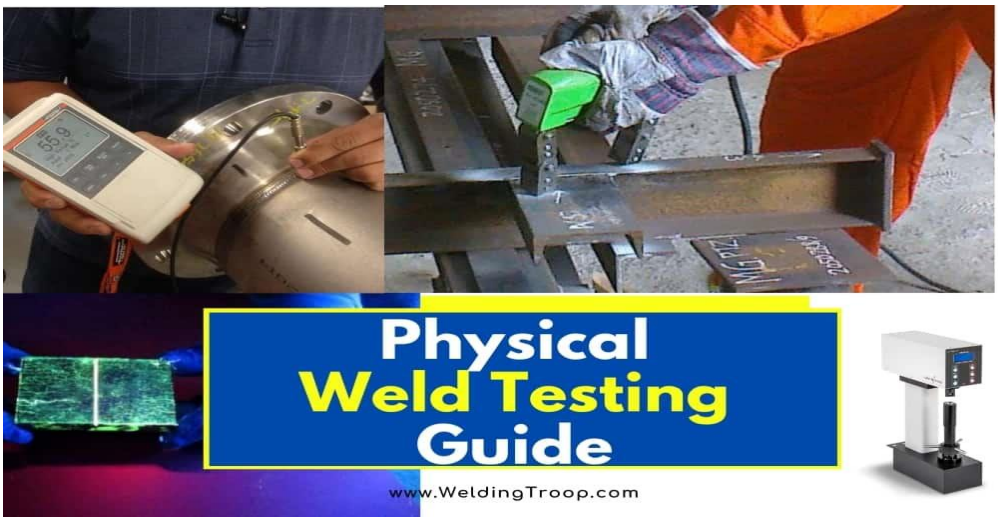
Resulting force F_2 on the larger cylinder due to the pressure of the fluid. With A_1 and A_2 being the areas of cylinder 1 and 2 respectively.

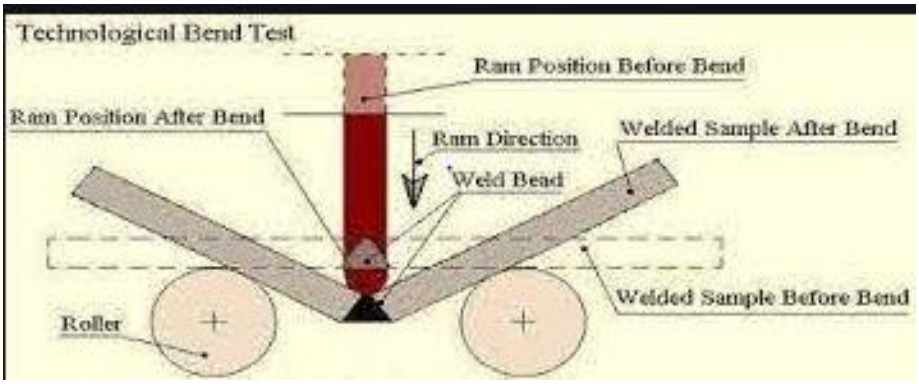
$$F_2 = PA_2 = F_1 \frac{A_2}{A_1} \text{ (2)}$$

$$\frac{F_2}{F_1} = \frac{A_2}{A_1} \text{ (3)}$$

A small effort force acts on a small piston. This creates a pressure which is transferred through the hydraulic fluid to apply a greater force on the larger piston

additional testing, such as side bends, all weld tensile tests, impact testing or other testing may be required.) The completed weld coupon, after visual inspection, is divided into predetermined small sections. Each section is prepared, usually by machining, to specific dimensions as prescribed by the standard. Each small sample is then tested mechanically to determine its characteristics.





Learning Unit - 5 : Handover the work

LO 5.1 –: Store tools, equipment and remaining materials

Content /Topic1: Cleaning the workplace

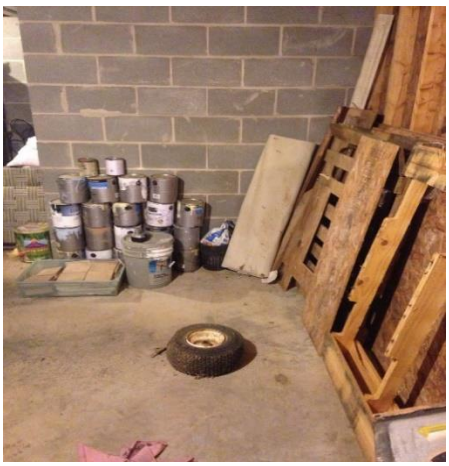
The importance of a clean workplace

The workplace environment influences employees' productivity, performance and well-being. No matter the industry, maintaining a clean workplace may help keep staff members safe, healthy and efficient. However, busy production schedules and increasing workloads may cause standards to dip.

While it may be tempting to put off dusting or other types of cleaning around the office or worksite, doing so may put employees at risk of suffering an injury or illness and may even impact performance levels. Maintaining a clean workplace is vital for employers to reduce their worker's compensation claims and keep efficiency high.

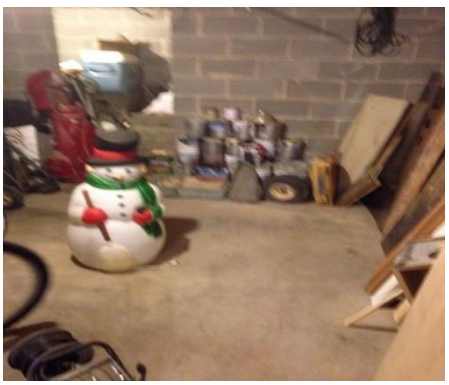
Those are steps conducting the workman to make a workplace or workshop clean

Step 1: Bigger Things I started with the bigger things it may not look that messy but it was horrible. I had a bunch of 50 lb. boxes of 16d and 8d nail gun strips, I stacked them up to where they were easily accessible. Then I threw a bunch of junk in the trash. I then started sorting out my wood stock.



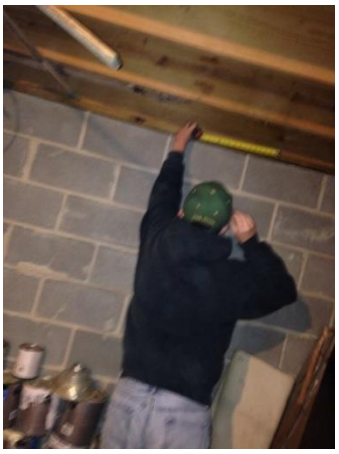
Step 2: Smaller Things and Sweeping

I then started to pickup and throw away smaller things . I started to move things to where I wanted them . There's not much more to explain in this step.

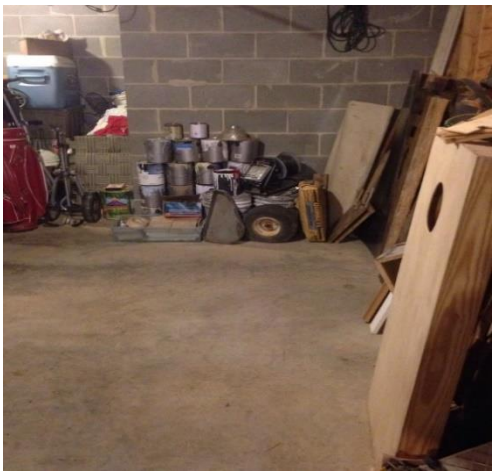


Step 3: Putting Things Up

I started to put things up by making things to help organize things . I put some nails in a floor joist (they are really ceiling joist because my shop is in a basement) . These are to put up drop cords but only temporally , I eventually want to use the design Mike and Lauren use for there drop cord organizer .



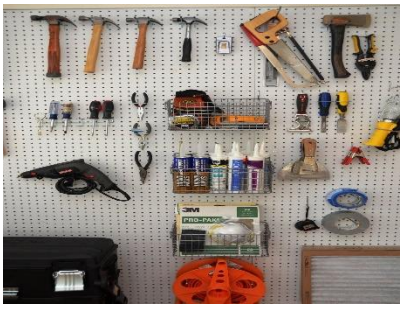
Step 4: Finished: So this is it . I eventually want to clean some more and add some things . I will probably put in some shelves and organize some more . I do know I will eventually build another workbench for the Rockwell bladerunner x2 I plan to get .



Content /Topic2: storing tools, equipment and remaining material

PROPER STORAGE OF TOOLS AND EQUIPMENT
The proper care and storage of tools and equipment are not only the concern of the management but of the workers who use the equipment.
Importance of proper storage of tools and equipment
1. It is an important factor for safety and health as well as good business.
2. Improves appearance of general-shop and construction areas.
3. Reduces overall tool cost through maintenance.
4. This also ensures that tools are in good repair at hand.
5. Teaches workers principles of (tool) accountability.
Pointers to follow in storing tools and equipment:
1. Have a designated place for each kind of tools.
2. Label the storage cabinet or place correctly for immediate finding.
3. Store them near the point of use.

4. Wash and dry properly before storing.
5. Store knives properly when not in use with sharp edge down.
6. Put frequently used items in conveniently accessible locations.
7. Gather and secure electrical cords to prevent entanglement or snagging.
8. Cutting boards should be stored vertically to avoid moisture collection.
9. Metal equipment can be stacked on one another after drying such as storage dishes and bowls.
10. Make sure the areas where you are storing the equipment are clean, dry and not overcrowded.



L.O 5.2 –: Prepare a report on work done

Content /Topic1: Writing the work done report

Work reports are typically used to explain your progress on a work project or provide your conclusions and recommendations regarding a workplace issue. To easily write an effective work report, start by considering your purpose, audience, research, and message.

A work report is a formal document that discusses information about a specific topic related to an aspect of your job. Most work reports are addressed to a particular audience such as a manager. There are a variety of reports that may need to be written at work, including sales reports, daily reports, budget reports and business data analysis reports. Depending on the type, you may be given a report brief that outlines what you should include in your report. Most reports should be written in a structured format to clearly demonstrate what the report is trying to convey.

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