# SPECTRO MECH-2019

## DEPARTMENT OF MECHANICAL ENGINEERING

TECHNIQUE POLYTECHNIC INSTITUTE , HOOGHLY

AN APPLICATIONS OF MECHANICAL ENGINEERING

## Vision of the Institution

- To be a premier institute in pursuit of excellence in technical education and skill development committed to serve the society

## Mission of the Institution

- To promote excellence in learning, teaching and technology transfer
- To improve the quality of skilled workforce through a structured programme and professional skills training
- To inspire students to learn and facilitate their overall development with social orientation and values

## Vision of the Department

- To be a centre of excellence in Mechanical Engineering to impart technical & professional skills to cater industrial requirements while considering environmental aspects fulfilling societal obligations

## Mission of the Department

- To impart the necessary technical skills among students
- To enhance the interaction with industry
- To produce competitive& employable Diploma Engineers
- To inculcate ethical & professional values among students

## Program Educational Objectives (PEOs)

- **Successful career (PEO #1):** To provide students strong foundation of technological fundamentals, necessary to analyze, design, manufacture using modern technological tools to become successful professional in real life world
- **Adaptability with new learning environment (PEO #2):** To build up the aptitude for an understanding of requirement analysis, ability to adopt new working environment and solves complex problem especially in multidisciplinary in nature
- **Keeping pace with developing world (PEO #3):** To provide adequate exposure to promising radical change in technology, training and opportunity to work as teams in cross functions project with effective communication skill and leadership qualities
- **Integration with the society (PEO #4):** To promote student awareness on the life sustained learning by bringing them to their professional principles of practice based on professional ethics of codes so as to achieve the ability to integrate in to the world of practicing professionals for collaborations, mutual support and representing the profession to society

## Board of Editors

**Mr. S.K. Garai, Lecturer & Course In charge, Technique Polytechnic Institute**

**Mr. Subhankar Mukherjee, Lecturer ,Technique Polytechnic Institute**

**Faculty & staff members of Mechanical Department**

1. **Mr. S. N. Basu, Executive Director**
2. **Mr. Sujay Biswas, In charge**
3. **Mr. S.K. Garai, Course In charge**
4. **Mr. Subhankar Mukherjee, Lecturer**
5. **Mr. Sourav Panda, Lecturer**
6. **Mr. Abhik Adhikari, Lecturer**
7. **Mr. Suman Sikder, Lecturer**
8. **Mr. Anindya Sundar Sinha, Lecturer**
9. **Mr. Kalyan Biswas, Workshop Superintendent**
10. **Mr. Sayan Kumar, Technical Assistant**
11. **Mr. Tarak Kundu, Workshop Instructor**
12. **Mr. Tarun Chakraborty, Workshop Instructor**
13. **Mr. Probir Kumar Naskar, Workshop Instructor**

***Published by***
**DEPARTMENT OF MECHANICAL ENGINEERING**
**TECHNIQUE POLYTECHNIC INSTITUTE, HOOGHLY**
**WEST BENGAL-712102.**

# FOREWORD

***Heartily welcome to our fifth edition of Mechanical Engineering Technical magazine 'SPECTRO MECH' in 2019. We excited to report that the Department of Mechanical Engineering continues to grow to meet our vision of the department which is analyze by Faculty Course Assessment Report(FCAR). Mechanical Engineering is one of the largest enrolled department in the collage with more than 320 under graduate student over the period of 2010-2019 more than 220 students are already placed at various companies as well as higher studies. All the initiatives are possible by the efficient contributions of alumni, friends, faculty members and staffs.***

***I would like to express my appreciation to all the authors of the article in this issue of the Magazine. Our goal is to create quality education for the student of the twenty first century. The success of 'SPECTRO MECH' depends on energetic and joint effort of all stake holders of the Institution. I would appreciate your feedback and any suggestion for improvement.***

***SoumendraNath Basu***
***Executive Director***
***Technique Polytechnic Institute***

# *CONTENT*

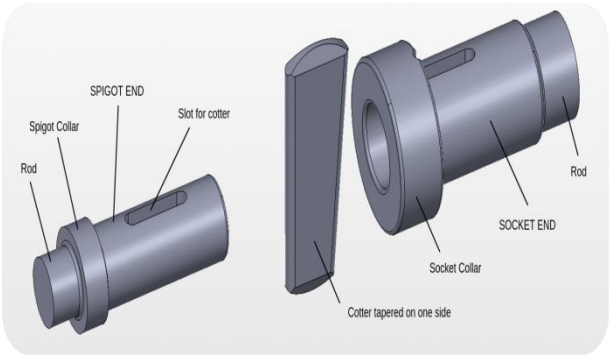
# COTTER JOINT

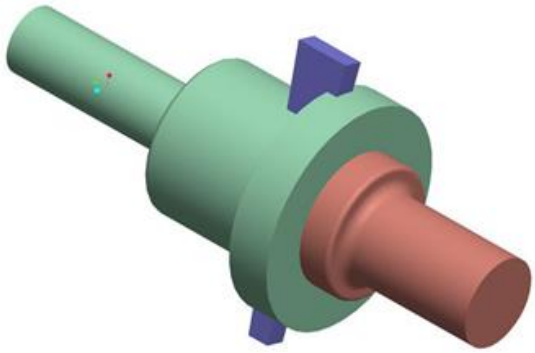
S.K. Garai
Course In charge& Lecturer, DME

This is mainly used to connect rigidly two rods which transmit motion in the axial direction, without rotation. These joints may be subjected to tensile or compressive forces along the axes of the rods.

A cotter joint is temporary fastening and using to connect rapidly two co-axial rods or bars which are subjected to tensile or compressive forces

Connection between piston rod and cross head of a steam engine, valve rod and its steam, steam engine connecting rod strap ends, etc.



**Design Of Cotter Joint**

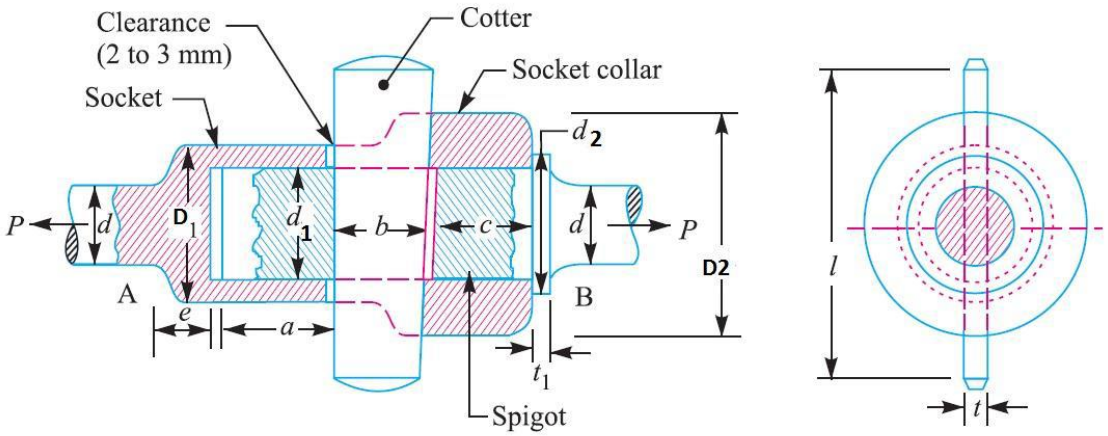
**•Cotter joint is also called as socket and spigot joint.**

**•It mainly consists of three parts.**

**1) Socket**

**2) Spigot**

**3) Cotter**



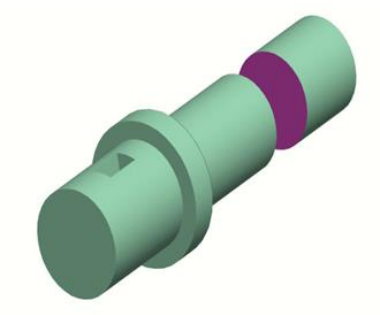

P = axial tensile or compressive force in rod.
d = diameter of rod in mm
d1 = diameter of spigot end or inside diameter of socket in mm
d2 = diameter of spigot collar in mm
D1 =outside diameter of socket in mm
D2 =diameter of socket collar in mm.
B = mean width of cotter in mm
C = thickness of socket collar in mm
t1 = thickness of spigot collar in mm

a = distance from the end of slot to the end of the spigot in mm

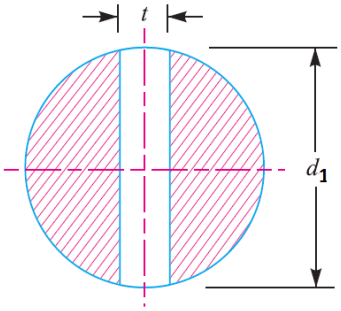
## Design of Spigot

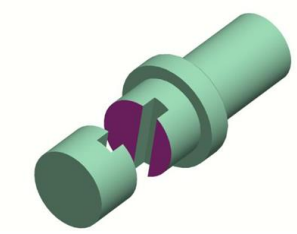
1. Tensile stress induced in the rod is shown in figure:

$$\sigma_t = \frac{P}{(\frac{\pi}{4})d^2} \text{---} (1)$$



2. Failure of spigot end in tension is marked in figure

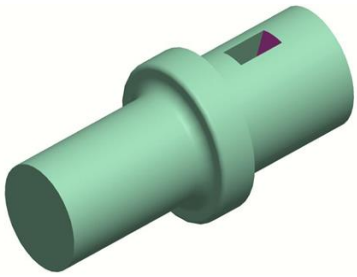


$$\sigma_t = \frac{P}{\frac{\pi}{4}d_1^2 - d_1 t} \text{---} (2)$$

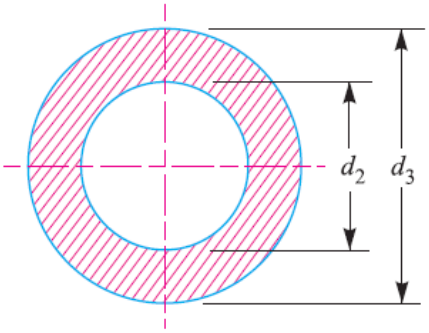
3. Failure of spigot end under crushing in the slot of cotter as marked in figure:

$$\sigma_{cr} = \frac{P}{d_1 t} \text{---} (3)$$



4. Crushing failure of spigot collar at the area between spigot collar and socket collar as shown in figure:

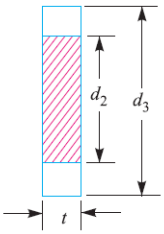
$$\sigma_{cr} = \frac{P}{\frac{\pi}{4}(d_2^2 - d_1^2)} \text{---} (4)$$

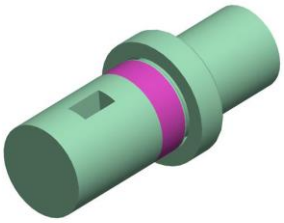



\

5. Failure of spigot collar in shear marked in figure:

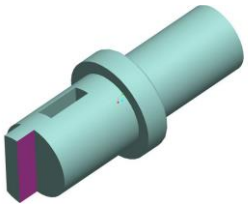
$$\tau = \frac{P}{\pi d_1 t_1} \text{---} (5)$$



6. Distance from end of slot to end of spigot as marked in figure:

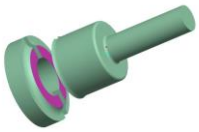
$$\tau = \frac{P}{2 d_1 a} \text{---} (6)$$

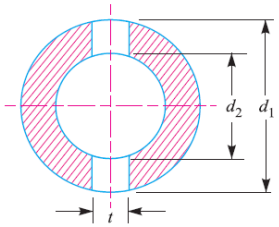


## Design of Socket

1. Crushing failure of socket collar at the area between socket collar and cotter as marked in figure:

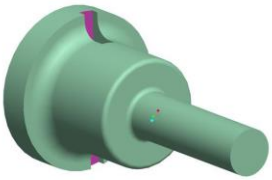
$$\sigma_t = \frac{P}{\left[\frac{\pi}{4}(D_1^2 - d_1^2)\right] - \left[(D_1 - d_1)t\right]} \text{----} (1)$$

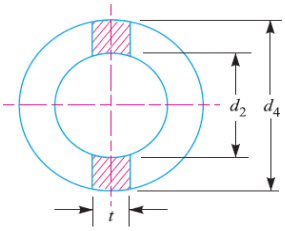





2. Crushing failure of socket collar at the area between socket collar and cotter as marked in figure:

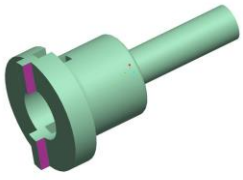
$$\sigma_{cr} = \frac{P}{(D_2 - d_1)t} \text{----} (2)$$





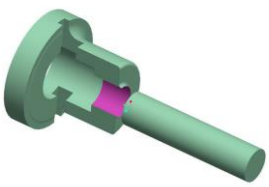

3. The socket collar is subjected to double shear as marked in figure:

$$\tau = \frac{P}{2(D_2 - d_1)C} \text{----} (3)$$



4. The socket end is subjected to shear failure as marked in figure:

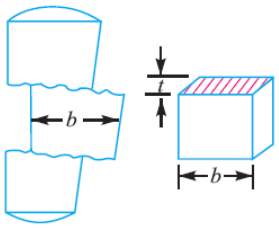
$$\tau = \frac{P}{\pi d e} \text{----} (4)$$



## Design of cotter

1. Double shearing in cotter pin as shown in figure:

$$\tau = \frac{P}{2bt} ----(1)$$




2. Bending failure of Cotter as shown in figure:

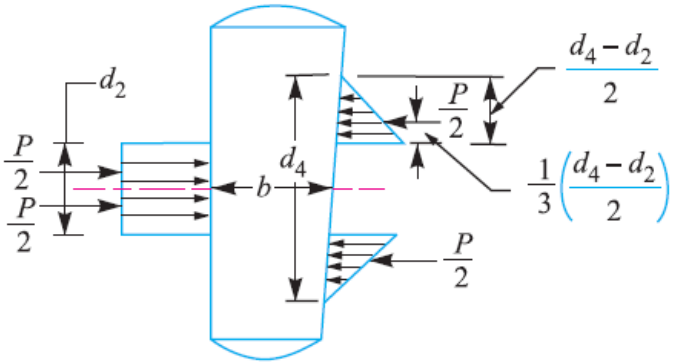
$$M_{max} = \frac{P}{2}\left[\frac{D_2 - d_1}{6} + \frac{d_1}{4}\right]$$

$$\therefore \sigma_b = \frac{M_{max}}{Z}$$

$$= \frac{M_{max}}{(\frac{tb^2}{6})} = \frac{6M_{max}}{tb^2}$$

$$\sigma_b = \frac{6 \times \frac{P}{2}(\frac{D_2 - d_1}{6} + \frac{d_1}{4})}{tb^2}$$

$$\sigma_b = \frac{P(2D_2 + d_1)}{4tb^2} ----(2)$$




**Solve the problem:**

**Example 12.1.** *Design and draw a cotter joint to support a load varying from 30 kN in compression to 30 kN in tension. The material used is carbon steel for which the following allowable stresses may be used. The load is applied statically.*

*Tensile stress = compressive stress = 50 MPa ; shear stress = 35 MPa and crushing stress = 90 MPa.*

---

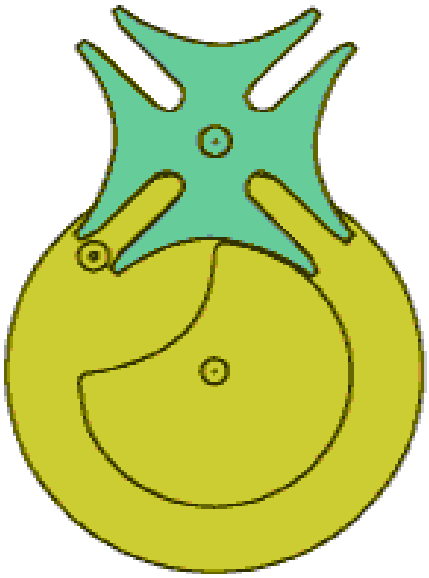
# IMPORTANCE OF GENEVE WHEEL

**Sujay Biswas**
In charge& Lecturer, DME

## INTRODUCTION

Geneva wheel mechanism is commonly used indexing mechanism where an intermittent motion is required. The inverse Geneva mechanism, which is a variation of the Geneva mechanism, is used where the wheel has to rotate in the same direction as the crank.

The Geneva drive is often called Maltese cross, which is a gear mechanism that translates a continuous rotation movement into intermittent rotary motion.



The name, Geneva drive is derived from the device's earliest application in mechanical watches, which were popularized in Geneva, being the classical origin of watch making industry.

The rotating drive wheel is usually equipped with a pin that reaches into a slot located in the other wheel (drive wheel) that advances it by one step at the time.

The main wheel also has a elevated circular blocking disc that "locks" the rotating driven wheel in position between steps.

One application of the Geneva wheel mechanism is in film movie projectors and movie cameras, where the film is pulled through an exposure gate with periodic starts and stops. The film advances frame by frame, each frame standing still in front of the lens for a portion of the frame cycle (typically at rate of 24 cycles per second), and rapidly accelerating, advancing and decelerating during the rest of the cycle.

## DESIGN OF GENEVA WHEEL

The basic design criterion of a Geneva wheel is that the centerlines of the slot and crank are mutually perpendicular at engagement and at disengagement. The crank, which usually rotates at a uniform angular velocity, carries a roller to engage with the slots. During one revolution of the crank the Geneva wheel rotates a fractional part of the revolution, the amount of which is dependent upon the number of slots. The circular segment attached to the crank effectively locks the wheel against rotation when the roller is not in engagement and also positions the wheel for correct engagement of the roller with the next slot.

The design of the Geneva mechanism is initiated by specifying the crank radius, the roller diameter and the number of slots. At least 3 slots are necessary but most problems can be solved with wheels having from4 to 12 slots.

The angle ($\beta$) is half the angle subtended by adjacent slots i.e. $\beta = 360/2N$

Where n is the number of slots in the wheel.

Then, defining $r_2$ as the crank radius we have, $c = r_2/\sin\beta$

Where, c is the center distance.

Note that the actual Geneva wheel radius is more than that which would be obtained by a zero-diameter roller. This is due to the difference between the sin and the tangent of the angle subtended by the roller, measured from the wheel center.

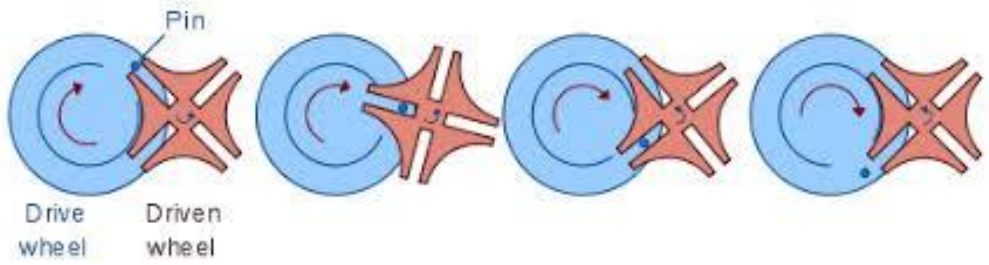
The final step in the design process is to choose a convenient radius for the circular pert of the Geneva wheel, which meshes with the input wheel locking the Geneva wheel.

## PRINCIPLE OF GENEVA WHEEL

The Geneva wheel drive or Maltese cross is a gear mechanism that translates a continuous rotation into an intermittent rotary motion ,The rotating drive wheel has a pin that reaches into a slot of the driven wheel advancing it by one step .The drive wheel also has a raised circular locking disc the driven wheel in position between steps.

In the most common arrangement ,the driven wheel has 4 slots and thus advances for each rotation of the drive wheel by one step of 90 ,if the driven wheel has n of slots ,it advances by 360/n per full rotation of the drive wheel.

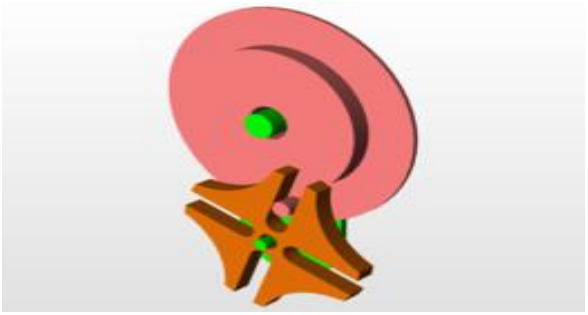
The different parts of a internal Geneva wheel mechanism are, Geneva wheel with four number slots, the crank pin, the locking disk with a semicircular part .The function the Geneva wheel is to transform the continuous motion in the intermittent rotary motion. The fiction of the crank pin is to drive the Geneva wheel with entering or leaving the slots of the wheel. The main function of the locking disk is to provide proper dimension of motion to keep the slot alignment in right position. The drive pin is also used for proper operation the drive pin must enter and leave the slot tangentially .Incase of internal Geneva drive the distance of the crank centre from the wheel centre is less than the wheel radius .The dwell period of internal Geneva wheels is less than 180. The highest value of acceleration occurs when the crank pin enters of leaves the slot. In fact this is the maximum angular acceleration of the system during the non-dwell phase. Once again this leads to a singularity.




## CLASSIFICATION OF GENEVA WHEEL MECHANISM

EXTERNAL GENEVA WHEEL MECHANISM:

In this type of mechanism, the Geneva cross is connected with cam drive externally which is most popular and can withstand higher mechanical stresses. The driver grooves lock the driven wheel pins during dwell. During movement, the driver pin mates with the driven-wheel slot.

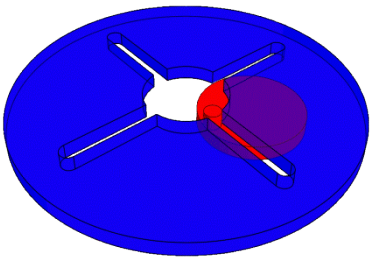


SPHERICAL GENEVA WHEEL MECHANISM:

In this type of mechanism, the Geneva cross is in spherical shape and cam drive is connected externally, which is extremely rare. The driver and driven wheel are on perpendicular shafts. The duration of dwell is exactly 180 degree of driver wheel

INTERNAL GENEVA WHEEL MECHANISM:

In this type of mechanism, the Geneva cross and cam drive are connected internally in the closed box. The driver and driven wheel rotate in same direction. The duration of dwell is more than 180 degree of driver rotation.



---

# HYBRID VEHICLE

ABHIK ADHIKARI
Lecturer, DME

**Defining Hybrids:**

A vehicle is a hybrid if it utilizes more than one form of onboard energy to achieve propulsion. In practice, that means a hybrid will have a traditional internal-combustion engine with a fuel tank, as well as one or more electric motors with its battery pack.

Hybrid cars are sometimes mistakenly confused with **electric vehicles**. Hybrids are most often gasoline-burning machines that utilize their electric bits to collect and reuse energy that normally goes to waste in standard cars. Theoretically, diesel-electric hybrids would be even more fuel-efficient, but hybrid systems and diesel engines both represent extra cost. So far, installing both in the same vehicle has proven to be prohibitively expensive.

**Why Hybrid?**

Pollution is increasing day by day caused by heavy usage of both commercial and personal vehicles which run on fossil fuels like gasoline and diesel. On the other hand the energy sources stored in Earth in form of fossil fuel is decreasing. Burning fossil fuel leads to pollution as well as global warming. So, we need some change in vehicle technology to address the above challenges. Fortunately, we have one….the HYBRID technology. A hybrid vehicle has an internal combustion engine as well as a motor driven by a battery pack.

In a traditional hybrid vehicle, we have a dual set of power. It includes an **electric motor** which is fed by a battery pack. It also has a completely separate **internal combustion engine** powering a **generator**. The engine is very small -- perhaps 10 to 20 horsepower -- and it is designed to run at just one speed for maximum efficiency. The purpose of this small, efficient engine is to provide enough power for the car at its cruising speed. During times of acceleration, the batteries provide the extra power needed. When the car is decelerating or

Standing still, the batteries recharge. This sort of hybrid car is essentially an electric car with a built-in recharger for longer range. The advantage is that the small, efficient gasoline engine gets greater mileage.

**Hybrid Application On Automotive:**

The scope application of hybrid on automotive industry is huge and it will occupy the whole automotive sector in near future. Many people have probably owned a hybrid vehicle at some point. For example, a **moped**(a motorized pedal bike) is a type of hybrid because it combines the power of a gasoline engine with the pedal power of its rider. In fact, hybrid vehicles are all around us. Most of the **locomotives**. we see pulling trains are **diesel-electric hybrids**. Cities like Seattle have diesel-electric **buses** these can draw electric power from overhead wires or run on diesel when they are away from the wires. Giant **mining trucks** are often diesel-electric hybrids. **Submarines** are also hybrid vehicles some are **nuclear-electric** and some are **diesel-electric**. Any vehicle that combines two or more sources of power that can directly or indirectly provide propulsion power is a hybrid.

Most hybrid cars on the road right now are gasoline-electric hybrids, although French car maker PSA Peugeot Citroen has two diesel-electric hybrid cars in the works. Since gasoline hybrids are the kind you'll find at your local car dealership, we'll focus on those in this article.

**Types of Hybrid Vehicles:**

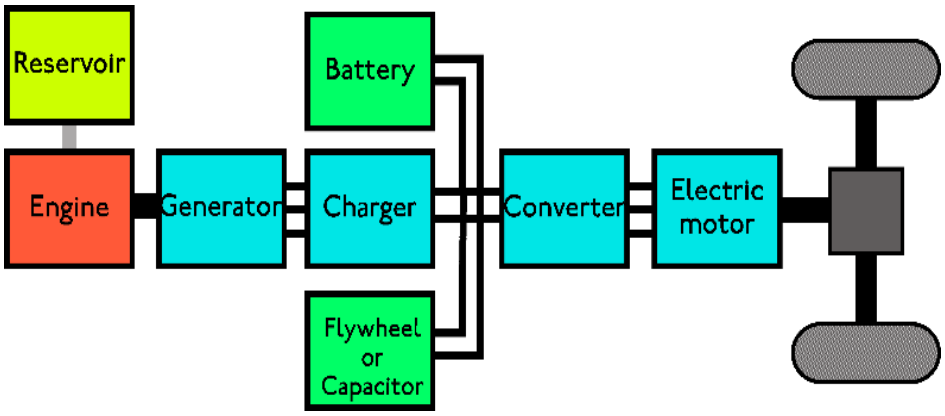
**BY CONSTRUCTION:** Parallel hybrid, Series Hybrid and combined hybrid.
**BY POWER SOURCE:** Diesel – electric, Nuclear – electric and gasoline-electric.

 **Needs three main components:**

- Engine Electric generator
- Electric traction motor
- The gasoline engine turns

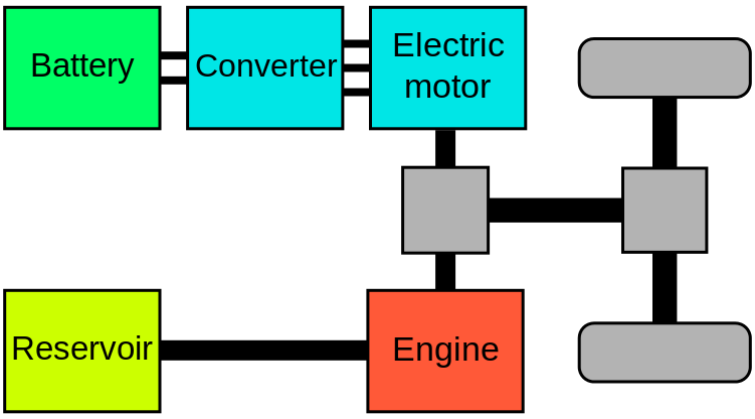
**SERIES HYBRID DIAGRAM:**

A generator, and the generator can either charge the batteries or power an electric motor that drives the transmission. Thus the gasoline engine never directly powers the vehicle.




**PARALLEL HYBRID VEHICLE:**

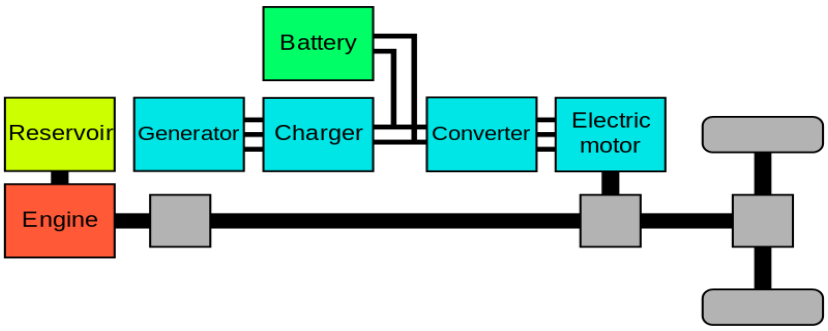
 Have a fuel tank, which supplies gasoline to the engine.
 They also have a set of battery that supplies power to an electric motor.
 Both the engine and the electric motor can turn the transmission at the same time, and the transmission then turns the wheels.




**COMBINED HYBRID VEHICLE:**

 Act mostly as a parallel but have the features of a hybrid series.
 They introduced the usage of a Planetary Gear Set (PGS).

 They introduced as well the combination of a chain driven generator of mild parallel hybrids and a crankshaft-mounted motor as in full parallel hybrids coupled at the DC link level




**Major Benefits of Hybrids:**

**Emissions** – Available HEV technology will decrease emissions of conventional air pollutants substantially as compared to a standard vehicle on the roads today. While similar emission reductions can be achieved with, e.g. CNG and clean diesel vehicles with advanced emission control technologies, the HEV combines both non-$CO_2$ and $CO_2$ reductions.

**Energy** - HEVs decrease fuel consumption substantially compared to conventional vehicles used today and also compared to CNG and the new generation of cleaner diesel vehicles. Calculations have shown that over the average HEV useful life time savings can amount to 6,000 L of fuel.

**Life Cycle Cost**– While HEVs are more expensive initially, the fuel savings are recouped based on mileage and driving conditions. Analysis has shown that the HEV life cycle cost, including the cost of purchase, fuel and maintenance costs, is, in most cases, less than owning a conventional vehicle. However, these calculations are strongly dependent on fuel prices and taxes.

**Strategic Stepping Stone Technology** - HEVs, plug-in hybrids (PHEVs), full electric vehicles (EVs), and fuel cell vehicles (FCVs) share basic technologies such as electric motors, batteries, and power electronics. Therefore, HEVs and plug-in hybrids function as stepping stone technologies to the large-scale electrification of fleets that is required for a long-term reduction of $CO_2$ emissions from road transport, and a low carbon transport sector.


---

## SINE BAR

SUBHANKAR MUKHERJEE
Lecturer, DME

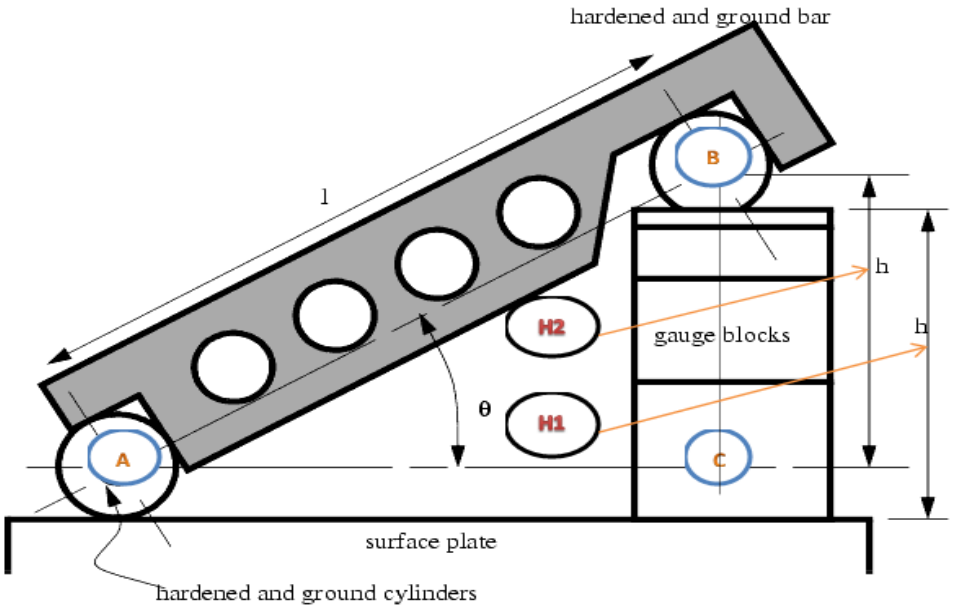
A sine bar is used in conjunction with slip gauge blocks for precise angular measurement. A sine bar is used either to measure an angle very accurately or face locate any work to a given angle. Sine bars are made from a high chromium corrosion resistant steel, and is hardened, precision ground, and stabilized.


Two cylinders of equal diameter are placed at the ends of the bar. The axes of these two cylinders are

mutually parallel to each other, and are also parallel to, and at equal distance from, the upper surface of the sine bar. Accuracy up to 0.01mm/m of length of the sine bar can be obtained. A sine bar is generally used with slip gauge blocks. The sine bar forms the hypotenuse of a right triangle, while the slip gauge blocks form the opposite side. The height of the slip gauge block is found by multiplying the sine of the desired angle by the length of the sine bar: **H = L * sin(θ)**. For example, to find the gauge block height for a **13**° angle with a **5.000″** sine bar, multiply the **sin(13°)** by **5.000″**: **H = 5.000″ * sin(13°)**. Slip gauge blocks stacked to a height of **1.124″** would then be used elevate the sine bar to the desired angle of **13**°.

## SINE BAR PRINCIPLES

i. The application of trigonometry applies to sine bar usage.
ii. A surface plate, sine bar, and slip gauges are used for the precise formation of an angle.
iii. It is possible to set up any angle **Θ** by using the standard length of side **AB**, and calculating the height of side **BC** using **BC = AB * sin(Θ)**.
iv. The angle **Θ** is given by **Θ = $\sin^{-1}$(BC/AB)**.
v. Figure 1, shows a typical sine bar set up on a surface plate with slip gauge blocks of the required height **BC** to form a desired angle **Θ**.




l = distance between centres of ground cylinders (typically 5" or 10")
h = height of the gauge blocks
**θ** = the angle of the plate

$$\theta = \operatorname{asin}\left(\frac{h}{l}\right)$$

**Figure 1: Forming an Angle with a Sine Bar and Gauge Blocks**

**WRINGING:** The term wringing refers to a condition of intimate and complete contact by tight adhesion between measuring faces. Wringing is done by hand by sliding and twisting motions. One gauge is placed perpendicular to other using standard gauging pressure then a rotary motion is applied until the blocks are lined up. In this way air is expelled from between the gauge faces causing the blocks to adhere. This adherence is caused partially by molecular attraction and partially by atmospheric pressure. Similarly, for separating slip gauges, a combined sliding and twisting motion should be used.

**INSTRUCTION FOR USING A SINE BAR**

i. Always use a perfectly flat and clean surface plate.
ii. Place one roller on the surface plate and the other roller on the slip gauge block stack of height **H**.
iii. Let the sine bar be set to an angle Θ.
iv. Then sin(Θ) = H/L, where L is the distance between the center.
v. Thus knowing Θ, H can be found and any work can be set out at this angle as the top face of the sine bar is inclined at angle Θ to the surface plate.
vi. For better result both rollers must placed on slip gauge block of height H1 and H2 respectively.

---

# STEAM BOILER

SOURAV PANDA
Lecturer, DME

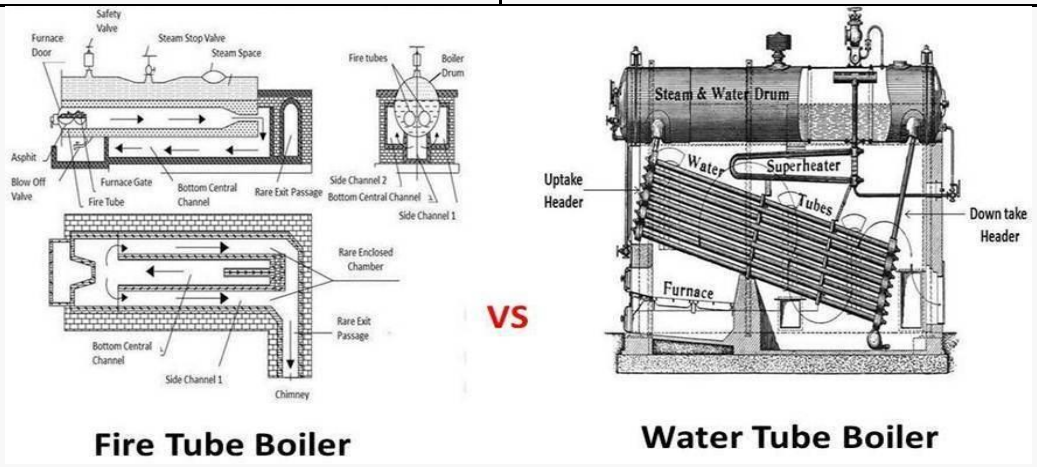
A steam boiler is a closed vessel, generally made of steel, in which water is heated by some source of heat produced by combustion of fuel and ultimately to generate steam. The steam produced may be supplied at low pressure for industrial process work in cotton mills, sugar industries etc. and for producing hot water which can be used for heating installations at much low pressure. Logically a steam boiler should have a minimum capacity of containing 10 liters of water and its minimum working pressure should be 3.4 Kgf/cm$^2$.

**Classification of Boiler**

Boilers can be classified in a number of ways, but the following are important from the subject point of view:

1. Horizontal, vertical and inclined boilers
2. Stationary, portable and marine boilers
3. Water tube and fire tube boilers
4. Single tube and multi tube boilers
5. Internally fired and externally fired boilers
6. Naturally circulated and forced circulated boilers
7. Source of heat (solid fuel, liquid and gaseous fuel, electrical and nuclear energy)
8. Low pressure, medium pressure and high pressure boilers

**Difference between fire tube boiler and water tube boiler**

| S. No | **Fire tube boiler** | **Water tube boiler** |
|---|---|---|
| 1. | In this boiler the hot flue gases is present inside the tubes and water surrounds them | The water is present inside the tubes and the hot flue gases surrounds them |
| 2. | They are low pressure boilers. The operating pressure is about 25 bar | They are high pressure boilers and the operating pressure is about 165 bar |
| 3. | The steam generation rate in fire tube boiler is low, i.e.9 tonne per hour | Steam generation rate in water tube boiler is high i.e. 450 tonne per hour |
| 4. | For a given power the floor area required for steam generation is more i.e. 8 $m^2$ per tonne per hour | The floor area required for the steam generation is less, i.e. 5 $m^2$ per tonne per hour |
| 5. | The transportation and erection in this type of boiler is difficult | The transportation and erection is easy as its parts can be separated |
| 6 |  | |



**Constructional Futures of Boilers: Cochran Boiler**

**Working**

Cochran boiler consists of an external cylindrical shell. Basically, the construction of Cochran boiler can be divided into three parts such as fire box, combustion chamber and steam space. The shell and fir box are both hemispherical shape. The hemispherical crown of the boiler shell gives maximum space and strength to withstand the pressure of steam inside the boiler. Fire box is also hemispherical in shape, and advantages for resisting intense heat. Flue gases flow from fire box to refractory material linked combustion chamber through a flue pipe. These flue gases flow

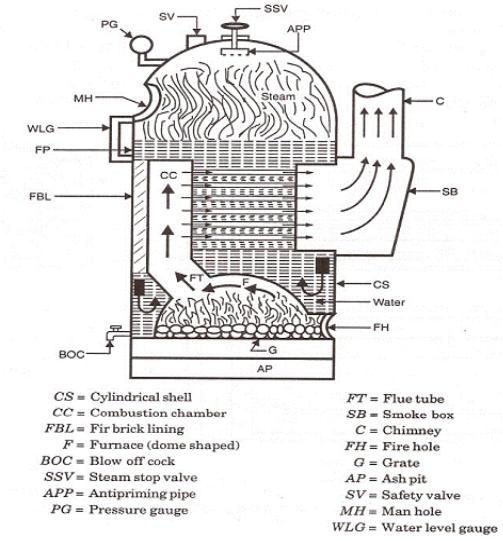



Fig.1 Cochran boiler

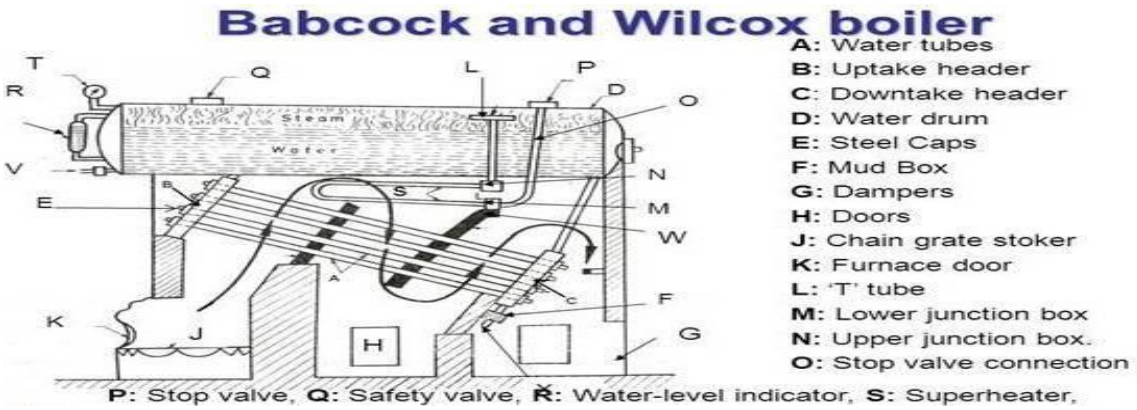
through a number of smoke tubes. The gases from the smoke box pass to atmosphere through a chimney. A manhole near the top of crown on the shell is provided for cleaning. At the bottom of the fire box, there is a grate and the coal fed through the fire hole. If the boiler is used for oil firing, than no grate is provided, but the bottom of the fire box is linked with fire bricks.

- **Uses of Cochran boiler**: The **Cochran boiler** was produced by **Cochran** & Co. of Annan, Scotland. It is widely **used** in marine practice, either fired directly by coal or oil fuels, or else **used** for heat recovery from the exhaust of large diesel engines. The **boiler** is a cylindrical vertical water drum with a hemispherical domed top.

**Babcock and Wilcox Boiler**

**Working:**

- First the water starts to come in the water tubes from drum through down take header.
- The water present in the inclined water tubes gets heated up by the hot flue gases. The coal burning on the grate produces hot flue gases and it is forced to move in zigzag way with the help of baffle plates.
- As the hot flue gases come in contact with water tubes, it exchanges the heat with water and converts it into steam.
- The steam generated is moved upward and through up take header it gets collected at upper side in the boiler drum.
- An anti-priming pipe is provided in the drum. This anti-priming pipe filters the water content from the steam and allows only dry steam to enter into super-heater.
- The super heater receives the water free steam from the anti-priming pipe. It increases the temperature of steam to desired level and transfers it to the steam stop valve.
- The superheated steam from the steam stop valve is either collected in a steam drum or made to strike on the steam turbine for electricity generation.




**T:** Pressure gauge, **V:** Feed check valve, **W:** Baffles, **X:** Below off cock

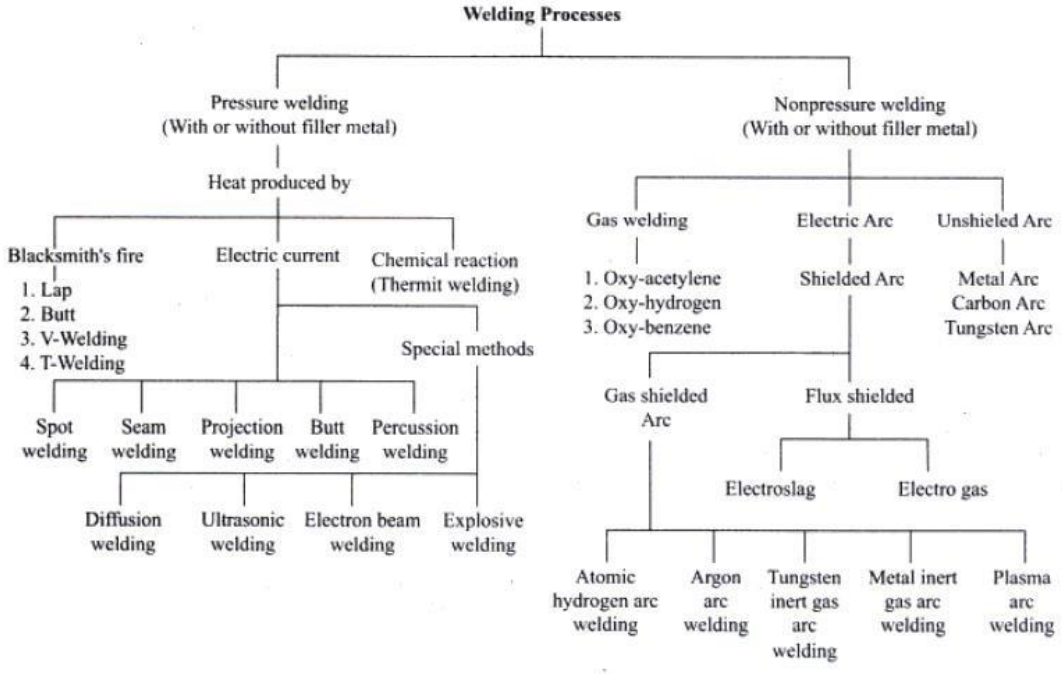
**Figure 2 Babcock and Wilcox boiler**

# WELDING

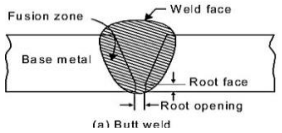
*PRABIR KUMAR NASKAR*
*Work shop instructor, DME*

Welding is a process for joining two similar or dissimilar metals by fusion. It joins different metals/alloys, with or without the application of pressure and with or without the use of filler metal. The fusion of metal takes place by means of heat. The heat may be generated either from combustion of gases, electric arc, electric resistance or by chemical reaction.

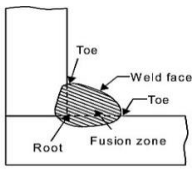
Welding provides a permanent joint but it normally affects the metallurgy of the components. It is therefore usually accompanied by post weld heat treatment for most of the critical components. The welding is widely used as a fabrication and repairing process in industries. Some of the typical applications of welding include the fabrication of ships, pressure vessels, automobile bodies, off-shore platform, bridges, welded pipes, sealing of nuclear fuel and explosives, etc.




Most of the metals and alloys can be welded by one type of welding process or the other. However, some are easier to weld than others. To compare this ease in welding term 'weld-ability' is often used. The weld-ability may be defined as property of a metal which indicates the ease with which it can be welded with other similar or dissimilar metals.



(a) Butt weld



(b) Fillet weld

Elements of welding process used with common welding joints such as base metal, fusion zone, weld face, root face, root opening toe and root are depicted in Figure.

**Edge preparations**

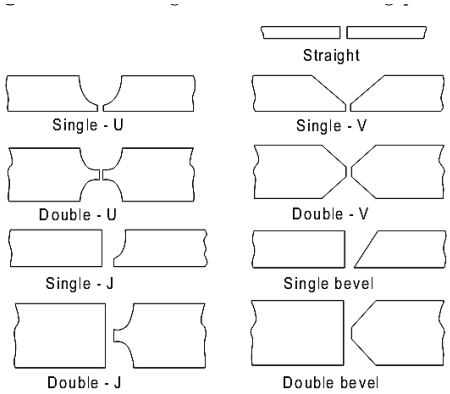
For welding the edges of joining surfaces of metals are prepared first. Different edge preparations may be used for welding butt joints, which are given in Figure.

**Welding joints**

Some common welding joints are shown in Figure. Welding joints are of generally of two major kinds namely lap joint and butt joint. The main types are described as under.

**1. (a) Lap welding joint / single lap** This joint, made by overlapping the edges of the plate, is not recommended for most work. The single lap has very little resistance to bending. It can be used satisfactorily for joining two cylinders that fit inside one another.

**(b) Double-Lap Joint**




This is stronger than the single-lap joint but has the disadvantage that it requires twice as much welding.

**(c) Tee Fillet Weld**

This type of joint, although widely used, should not be employed if an alternative design is possible.

**2. Butt weld joint**

**a. Single-Vee Butt Weld**

It is used for plates up to 15.8 mm thick. The angle of the vee depends upon the technique being used, the plates being spaced approximately 3.2 mm.

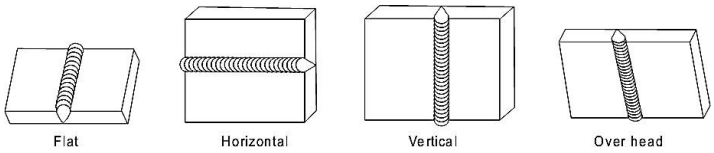
**b. Double-Vee Butt Weld**

It is used for plates over 13 mm thick when the welding can be performed on both sides of the plate. The top vee angle is either 60° or 80°, while the bottom angle is 80°, depending on the technique being used.

**3. Welding Positions**

As shown in Fig. there are four types of welding positions, which are given as:

a. Flat or down hand position
b. Vertical position
c. Horizontal Position
d. Overhead position




**Flat or Down-hand Welding Position**

The flat position or down hand position is one in which the welding is performed from the upper side of the joint and the face of the weld is approximately horizontal.

**Horizontal Welding Position**

In horizontal position, the plane of the work piece is vertical and the deposited weld head is horizontal. This position of welding is most commonly used in welding vessels and reservoirs.

**Vertical Welding Position**

In vertical position, the plane of the work-piece is vertical and the weld is deposited upon a vertical surface. It is difficult to produce satisfactory welds in this position due to the effect of the force of gravity on the molten metal.

**Overhead Welding Position**

The overhead position is probably even more difficult to weld than the vertical position. Here the pull of gravity against the molten metal is much greater.

## ARC WELDING PROCESSES

The process, in which an electric arc between an Electrode and a work-piece or between two electrodes is utilized to weld base metals, is called an arc welding process. The basic principle of arc welding is shown in Figure1. However the basic elements involved in arc welding process are shown in Figure2. Most of these processes use some shielding gas while others employ coatings or fluxes to prevent the weld pool from the surrounding atmosphere.

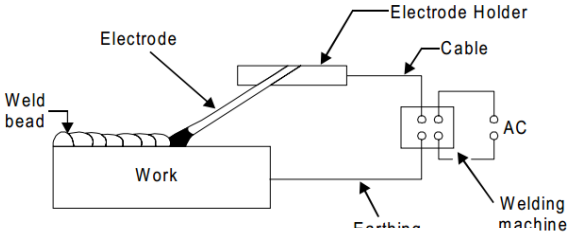



Fig1.The basic principle of arc welding

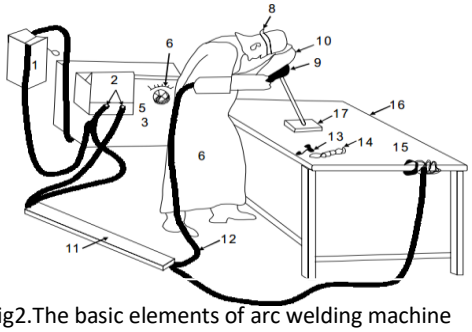


Fig2.The basic elements of arc welding machine

1) Switchbox.
2) Secondary terminals
3) Welding machine.
4) Current reading scale.
5) Current regulating hand wheel.
6) Leather apron.
7) Asbestos hand gloves.
8) Protective glasses strap
9) Electrode holder.
10) Hand shield
11) Channel for cable protection.
12) Welding cable.
13) Chipping hammer.
14) Wire brush.
15) Earth clamp.
16) Welding table (metallic).
17) Job.

# Drill Machine

*TARAK KUNDU*
*Work shop instructor, DME*

## Definition

Drill is a machine tool used for drilling the holes in solid equipment like metal and wood with drill bit or driver bit. Drills are used in wide variety of applications in metalworking, constructions and woodworking industries. The small drill is used for our domestic requirements to make holes on wall and materials. These are presented in different sizes and power capacities. Drill is one of the oldest handy tools used from very foundation of the industrial era.

### Types of Drills

Varieties of drills are pretend as per the industrial requirements. They are categorized based on special parameters like manual drills and automatic drill machines. Manual drills are referred as hand milled drills used with hand force on the device/material to drill a hole. Physical drill variants are Bow drill, Gimlet, Breast drill and push drill etc. These are mechanical with electricity or packed in air known as electronic drill and pneumatic drill respectively. Drilling works is carried out at different locations with various types of drills including construction drill, wells drill, thermal drill etc. All drills have special applications of drilling from little to larger size hole.

Pistol grip drill is normally used in our daily work. Right angle drill is used in plumbing and electrical mechanism. Hammer drill is likes to electrical drill with adding of hammer action on the same device. Rotary hammer drill is equipped with rotation device used for drilling in solid constructions. Cordless drills with natural rechargeable battery power are used where electrical supply is not reachable for drilling. Cordless drills consume high power. Thus need more spare batteries on charge throughout the drilling work to replace effectively on discharge of installed batteries?

### Drill Press/Pillar Drill Machine

Drill press is the drill machine that can be position mounted or fixed with floor or workbench through bolting. Drill press also well-known as pillar drill consist base, column, table, drill head and spindle. This bench drill use induction motor provides to carry out the drilling process faster with little or larger drill bit. Drill press is quite lighter and capable for operator compare to hand drill. The clamping of drill press makes the suitable positioning for precision and accurate drilling operation.

### Radial Drill Machine

Radial drill machine with geared beginning put up press on huge area without relocation the work piece. Radial arm drill press is pretend with several dimensions of drill head and unreliable base plate.

Different width and size of drill bits are used here to drill from small to large size holes. These are very much popular and commonly used in automotive, workshops and garages.

### Drilling cum Milling Machine

Drilling cum milling machine is used for both drilling and milling process. This lighter machine is having great choice of milling capabilities to save the space including the added functionalities of determining the materials.

### Applications of Drill Machines

The basic function of drill machine is to construct hole of different size in solid materials. Different drills are used for industry particular applications. Drill rigs are used to drill water wells and oil wells. Hand drills are used for screwing and fastening. Electrical pistol grip drill is used in general masonry workings by builders, electricians and plumbers. Hammer drill is particularly used by carpenters to drill and fix the wooden parts.

Cordless drills are useful where electrical provide is not feasible to get for drilling. Pillar drill machine (also referred as drill press) is used in marketable applications where it required bulk manufacture of drilled materials in a selection of size and shape like metal sheets, plastic, wood, glass and physical construction applications. The orientation based power supply is easily controlled in drill press to increase or decrease the drilling speed and capacity.

The capability of drill press differs with pillar diameter, spindle nose, spindle travel, spindle speed and electronic motor used in the machine. These are extensively used in automobile, printing and engineering field to increase the constancy and tensile power of the machine with efficient moving out to the resistive materials with quality performance. Milling cum drilling machine is broadly adopted in the industries where required mixing and grinding of solid and liquid substances.

---

## FITTING TOOLS

*TARUN CHAKRABORTY*
*Work shop instructor, DME*

Fitting shop tools are classified as below:

- Work Holding Devices/ Clamping Tools.
- Measuring and Marking Tools.
- Cutting Tools.
- Striking Tools.
- Drilling Tools.
- Threading Tools.

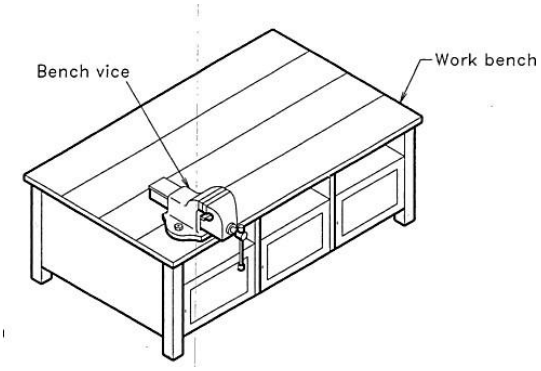
**A) WORK HOLDING DEVICES /CLAMPINGTOOLS:**

**1. Work Bench**

A fitting process can be done at various places, but most of the important operations of fitting are generally carried out on a table called workbench.

The work bench is a strong, heavy and rigid table made up of hard wood.

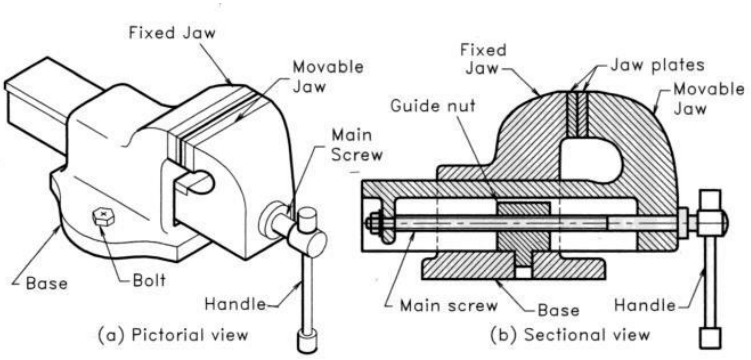
The size of the work bench required is about 150 to 180 cm length, nearly 90 cm width and approximately 76 to 84 cm height.



**2. BENCH VICE:**

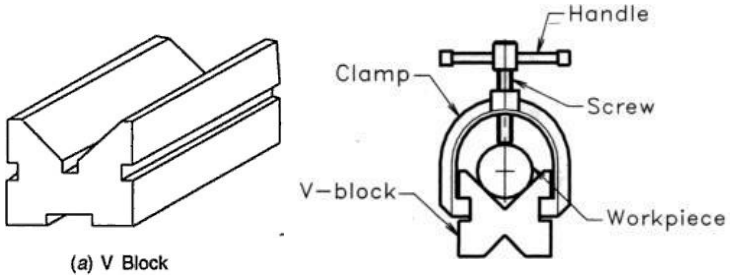
It is firmly fixed to the bench with the help of nuts and bolts. It consists of a cast Iron body and cast iron jaws. Two jaw plates are fitted on both the jaws. The holding surface of the jaw plates is knurled in order to increase the gripping. Jaw plates are made up of carbon steel and are wear resistant. One jaw is fixed to the body and the second slides on a square threaded screw with the help of a handle.

The jaws are opened up to required length; job is placed in the two jaws and is fully tightened with the help of handle. Handle is used to move the movable jaw




**3. V-Block**

In V Block, V grooves are provided to hold the round objects longitudinally. The screw of the clamp applies the holding pressure. When the handle is rotated there is movement in the screw.



(a) V Block

**B) MEASURINGTOOLS**

**1. Steel Rule**

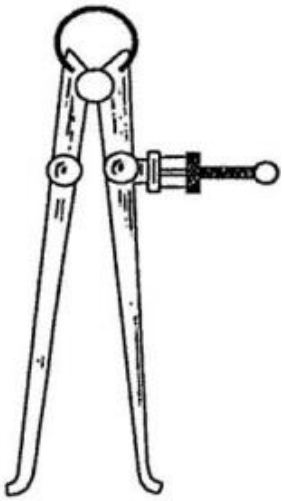
These are made up of stainless steel and are available in many sizes ranging from ½ ft. to 2 ft. These are marked in inches or millimeters. All the faces are machined true. The edges of steel rule should be protected from rough handling**.**

**Fig. 10.15.** *Steel Rule.*

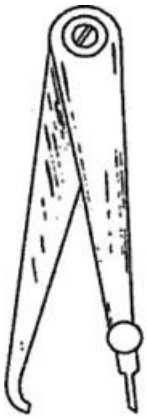
**2. Calipers**

These are generally used to measure the inside or outside diameters. Different types are:

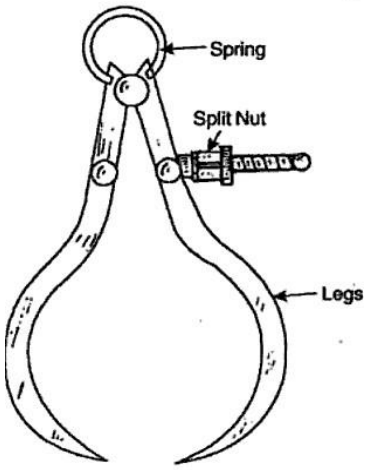
- Outside Calliper: It is used to measure the outside dimensions.
- Inside Calliper: It is used to measure the inside dimensions.
- Spring Calliper: Spring is provided to apply the pressure and lock nut is provided to lock any desired position.
- Hermaphrodite, Jenny or Odd leg Calliper: One leg is bent at the tip inwardly and the other has a straight pointed end. It is used to scribe lines parallel to the straightedges.



(*b*) Inside Spring Caliper



(*c*) Odd Leg Calipers




(*a*) Outside Spring Caliper

**Fig. 10.20.** *Calipers.*

---