Types of sheet metals and their application

Objectives: At the end of this lesson you shall be able to
- **state the types of metals used in sheet metal work**
- **state the uses of the different types of metals.**

In sheet metal work, different types of metal sheets are used. The sheets are specified by standard gauge numbers.

It is very essential to know the different uses and applications of these metal sheets.

Black Iron

The cheapest sheet metal is black iron, which is rolled to the desired thickness. It has a bluish black appearance, and is often referred to as uncoated sheet. Since it is uncoated, it corrodes rapidly.

The use of this metal is limited to articles that are to be painted or enamelled such as tanks, fans, stoves, pipes etc.

Galvanised iron

Zinc-coated iron is known as 'galvanised iron'. This soft iron sheet is popularly known as GI sheet. The zinc coating resists rust, improves the appearance of the metal and permits it to be soldered with greater ease. Because it is coated with zinc, galvanised sheet iron withstands contact with water and exposure to weather.

Articles such as fans, buckets, furnaces, heating ducts, cabinets, gutters etc. are made mainly from GI sheets.

Stainless sheet

This is an alloy of steel with nickel, chromium and other metals. It has good corrosive resistance and can be welded easily. Stainless steel used in a sheet metal shop can be worked as galvanised iron sheets, but is tougher than GI sheets. The cost of stainless steel is very high. Stainless steel is used in dairies, food processing, chemical plants, kitchenware etc.

Copper sheet

Copper sheets are available either as cold-rolled or hot-rolled sheets. Cold-rolled sheets being resistant to corrosion and worked easily are commonly used in sheet metal shops. Copper sheet has better appearance than other metals.

Gutters, expansion joints, roof flashings, hoods, utensils and boiler plates are some of the common examples where copper sheet is used.

Aluminum

Aluminum cannot be used in its pure form, but is mixed with a very small amount of copper, silicon, manganese and iron. It is whitish in colour and is light in weight. It is highly resistant to corrosion and abrasion.

Aluminum is now widely used in the manufacture of articles such as household appliances, refrigerator trays, lighting fixtures, windows, and also in the construction of airplanes and in many electrical and transport industries.

Tinned plate

Tinned plate is sheet iron coated with tin to protect it against rust. This is used for nearly all solder work, as it is the easiest metal to join by soldering. This metal has a very bright silvery appearance and is used in the making of roofs, food containers, dairy equipment, furnace fittings, cans and pans, etc.

Lead

Lead is very soft and heavy. Lead sheets are used for making the highly corrosive acid tanks.

Properties of an auto body sheet metal

Objectives: At the end of this lesson you shall be able to
- **describe the properties of an auto body sheet metal.**

Properties of auto body sheet metal: The sheet metal used in the production of automobile surface panels must contain certain properties of qualities such as plasticity, elasticity and work hardening.

Direct and indirect damages: Damage to the body sheet metal can be classified as either direct or indirect damage.

Direct damage results from the impact of an object stilling the sheet metal. The area of damage is called the point of impact. Direct damage can be in the form of deep scratches, gauges, tears in the metal or in the case of severe impact, crumpled or mangled sheet metal.

The force of the direct damage is transmitted or transferred from the impact area to different parts of the panel thus causing indirect damage in the form of roll buckles, valleys or sharp ridges.

When straightening a panel with direct and indirect damage, the indirect damage should be straightened first.

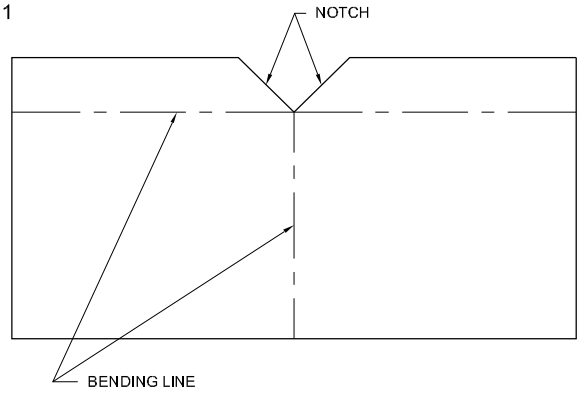
Notches in sheet metal

Objectives : At the end of this lesson you shall be able to
- **state the purpose of notches**
- **name the types of notches**
- **distinguish the features of different notch forms.**

Notches

Notches are the spaces provided for joining the edges when sheet metals are cut form the layout.

Fig 1



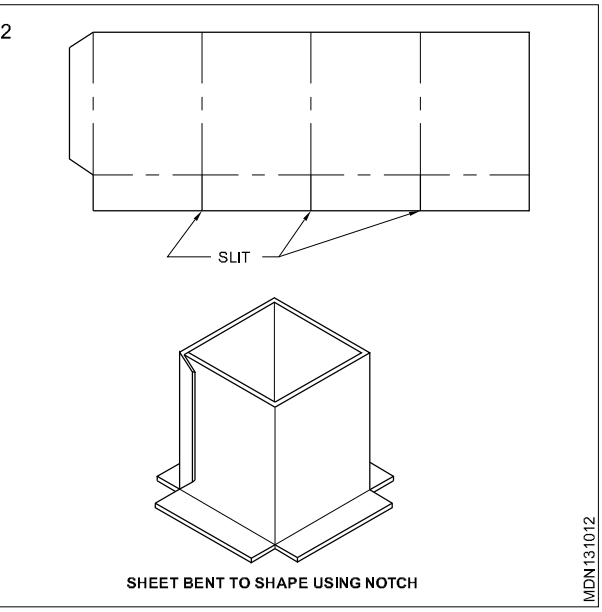
Purpose of notches

Notch helps:
- to prevent surplus material from overlapping and causing a bulge at the seam and edges.
- to allow the work to be formed to the required size and shape.
- to allow the work to assemble better.

Types of notches

Straight notch of slit (Figs 1 & 2)

Fig 2



Straight cuts made in the edge of the sheet where it is to be bent is know as a straight notch.

Square notch (Figs 3, 4 & 5)

A square notch is used for forming a square or rectangular box.

Fig 3

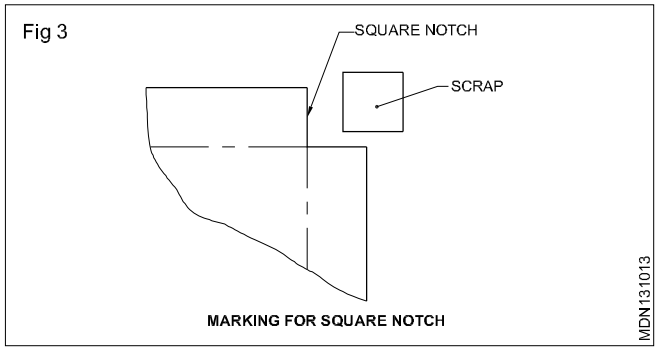


Fig 4

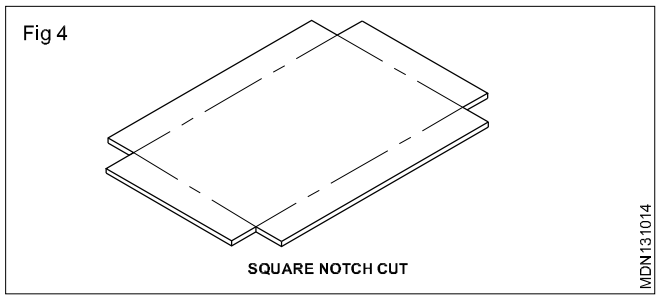
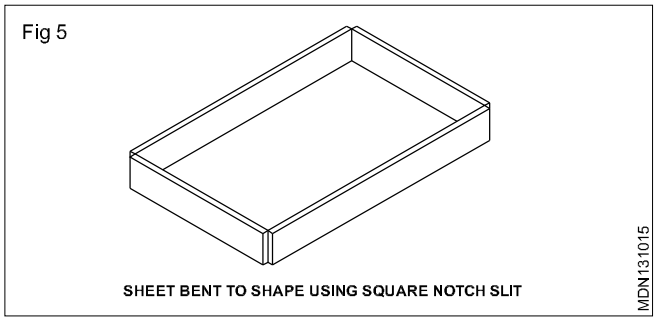


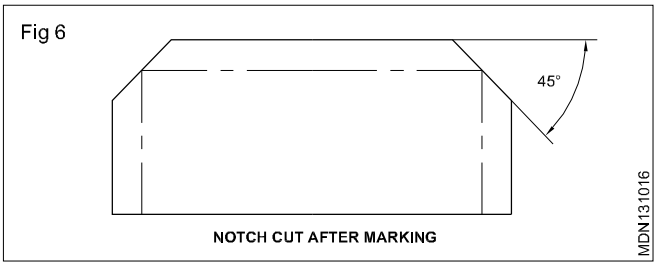
Fig 5



Slant notch (Fig. 6)

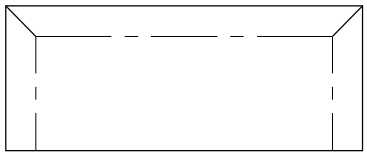
This Notch is cut at an angle of 45° to the corner of the sheet. It is used when a single hem meets at right angles.

Fig 6



'V' Notch (Figs 7 & 8)

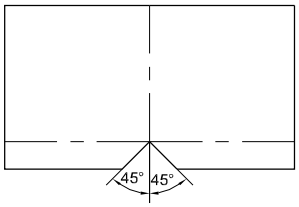
Fig 7



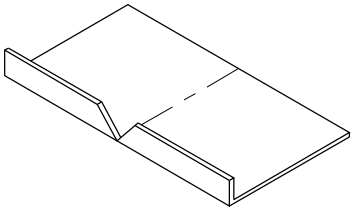
BENT TO SHAPE USING SLANT NOTCH

MDN131017

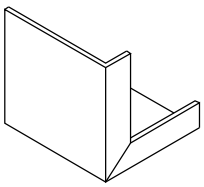
Fig 8



`V' NOTCH MARKED AND OUT



FIRST FOLDING NOTCH



BENT TO SHAPE USING `V' NOTCH

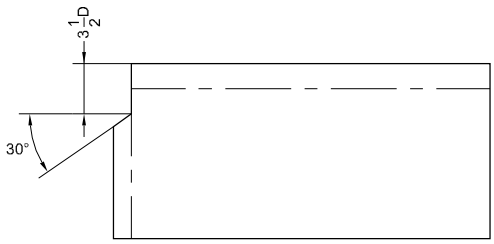
MDN131018

In this notch, both the sides are cut at a 45° angle to the edge of the sheet.

The sides of the notch meet at 90° . This notch is used when making a job with a 90° bend and an inside flange.

Wire notch (Figs 9 & 10)

Fig 9



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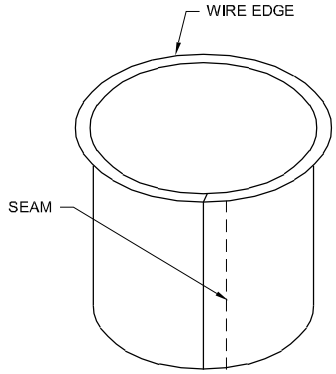
The angle of this notch is usually 30° and the distance from which the notch is started is 3 times the diameter of the wire.

Uses

The wire notch is used on a work which has wired edges. This notch must be provided to prevent the wired edge from overlapping at the seam.

Fig 10



AN EDGE WIRED USING WIRE NOTCHES

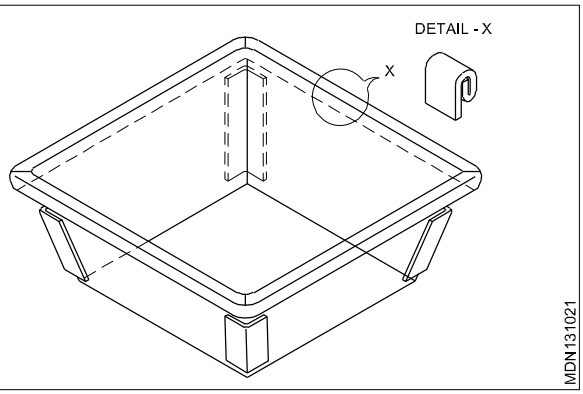
MDN131101A

Edge Stiffening

Objectives : At the end of this lesson you shall be able to
- **state what is a hem**
- **state the types of hems**
- **state the uses of the different types of hems.**

The edges of light gauge sheet metal articles (Fig. 1) are very sharp and unsafe to handle. Safe edges are provided to strengthen the sheet metal and to enhance the appearance of the finished article.

Fig 1



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What is a hem?

A hem is an edge or border made by folding.

It stiffens the sheet of the metal and avoids sharp edges.

Types of hems

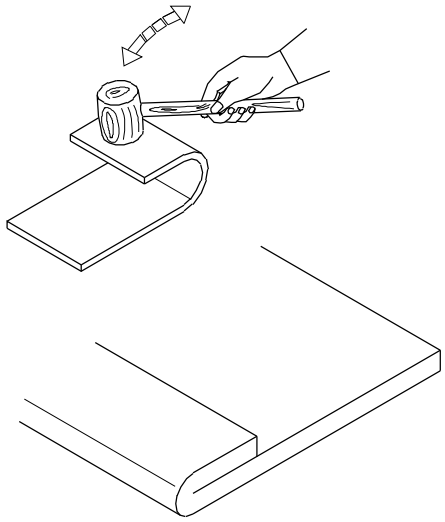
- Single hem
- Double hem
- Wired edge

Single hem (Fig. 2)

A single hem is made by folding the edge of the sheet metal with a single folding.

It makes the edge smooth and stiff and is done while making small articles.

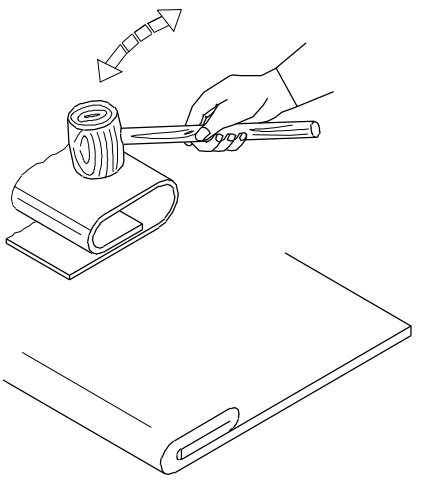
Fig 2



Double hem (Fig. 3)

A double hem is made by folding the edges over twice to make it smooth and this is done normally to strengthen the edges of lengthy articles.

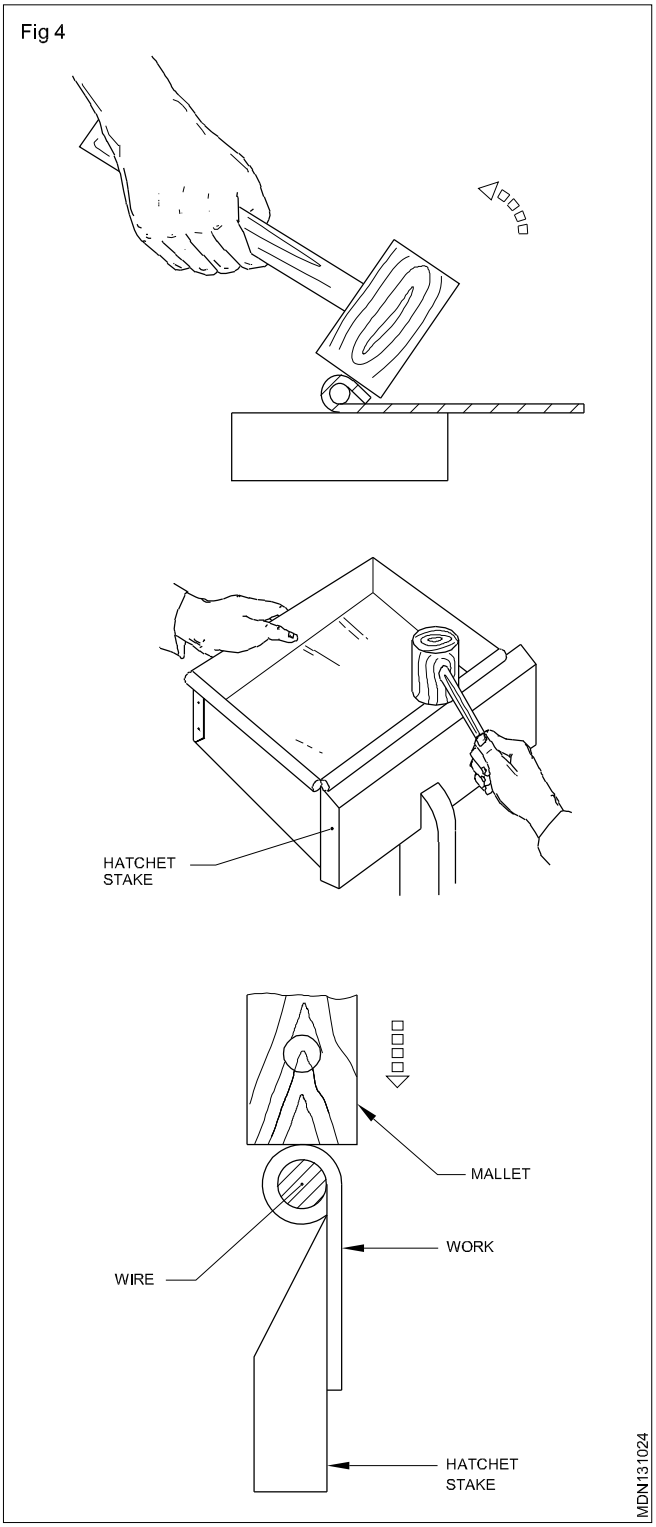
Fig 3



Wired edge (Fig. 4)

The wired edge is done for round and lengthy articles to enhance the appearance and increase the strength. The wired edge is smooth and is very strong.

Fig 4



Sheet Metal Joints

Objectives : At the end of this lesson you shall be able to

- **state what is a seam**
- **state the types of seams**
- **state the uses and application of the different types of seams.**

Sheet metal working incorporates a wide variety of seams

What is a seam?

A seam is a joint made by the fastening of two edges of two pieces of metal together.

Types of seams

Lap seam

The lap seam is the simplest type of seam and can be prepared as a lap joint. This joint is also known as edged

on joint. This joint is used to fit the top and bottom to cylindrical shapes. This joint is finally secured by soldering or brazing.

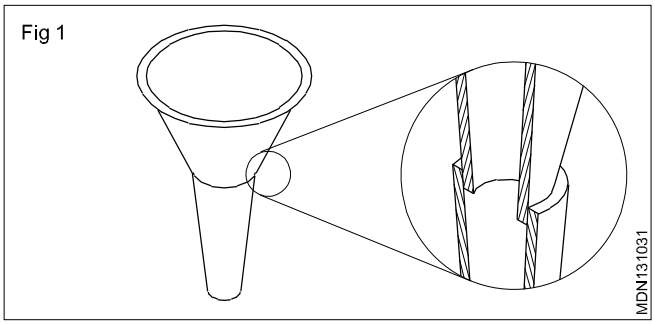
Grooved seam

A grooved seam is used to join two pieces of straight or curved metal of light gauge and then locking them by a groove.

Single seam (Fig. 1

The single seam is used to join a bottom to vertical bodies of various shapes. This joint is called paned-down joint. This joint is also secured by soldering or brazing.

Fig 1



Double seam (Figs 2 & 3)

The double seam is similar to a single seam joint except that its forward edge is bent upward against the body. This joint fulfils the same function as the edged-on and paned-down joints, but it is the strongest of the three.

Fig 2

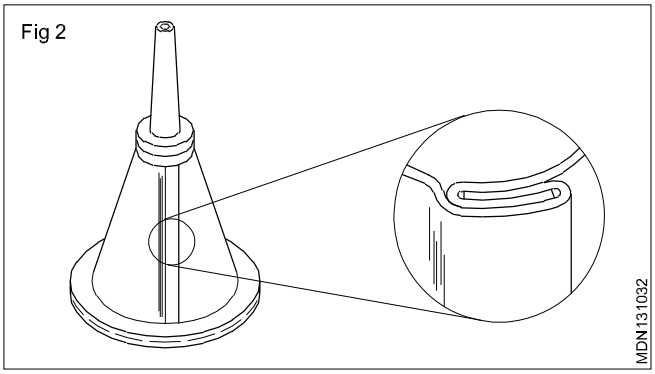
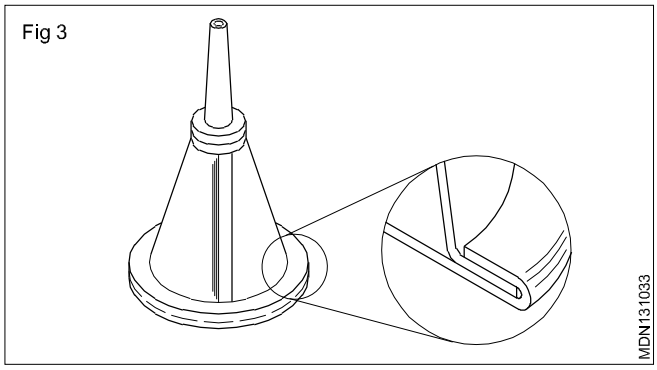


Fig 3



Double grooved seam (Figs 4 & 5)

The double grooved seam (Fig. 5) is similar to the dovetail joint in carpentry and it is used for roofing and paneling joints.

Fig 4

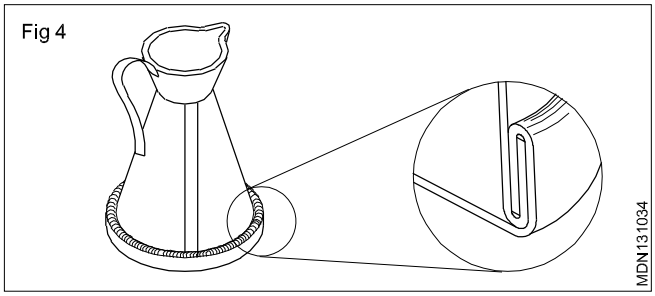
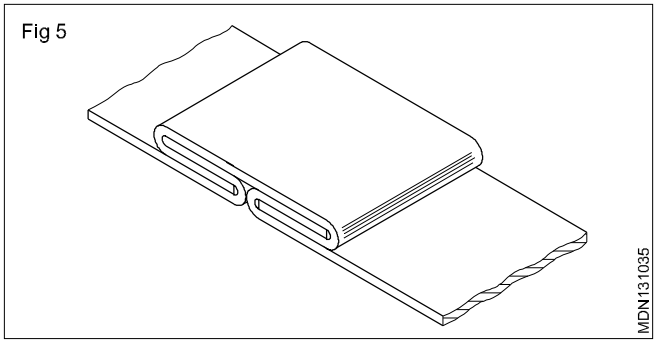


Fig 5



Folding and Joining Allowances

Objectives : At the end of this lesson you shall be able to

- **state the necessity for providing allowances in sheet metal operations.**

When making self-secured joints or seams, it is necessary to make an allowance for the extra material to be added for the preparation of the edges and seams.

The allowance is necessary for maintaining the correct size of the finished product and for improving the strength at joints of all edges.

Allowance is also necessary for avoid cracking or warping, and for obtaining the required finish.

This allowance depends upon the width of the folded edge and the thickness of the metal.

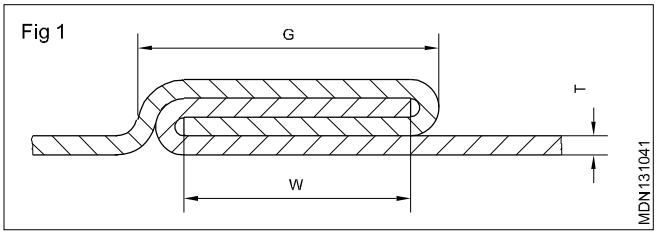
Allowances

In the making of various types of hems and seams, no allowance is necessary for thinner sheets of 0.4 mm or less.

Allowance for grooved joints/seams (Fig. 1)

If we fold over the edges to width W and form the joint, the final completed width of the joint G will be greater than W. It can be seen that the final width of the groove will have a minimum value of W + 3T, where T represents the metal thickness.

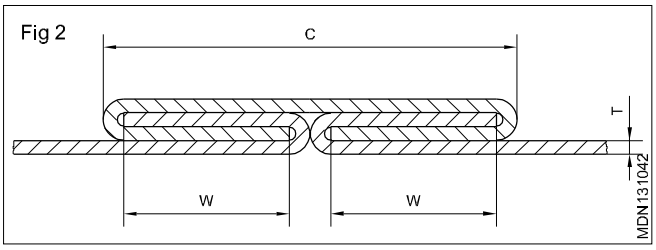
Fig 1



The allowance for a grooved seam is three times the thickness of the sheet.

Allowance for double grooved seam/joint (Fig. 2)

It will be seen from the figure that the width of the capping strip is equivalent to two times the width of the folded edge plus four times the thickness of the metal size.



C = 4W + 4T

The complete allowance for the double grooved seam/joint will be four times the width of the folded edge plus four times the thickness of the metal.

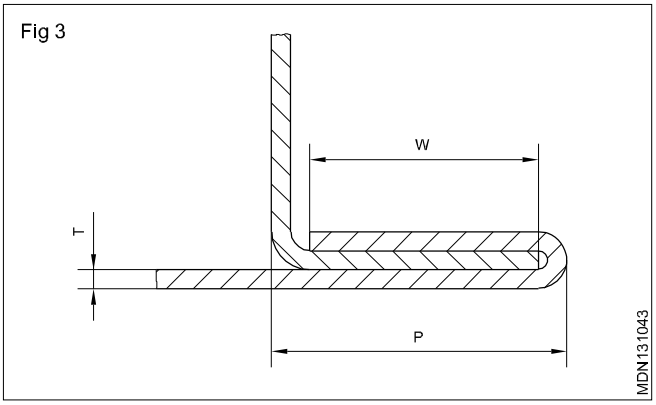
Allowance for paned down and knocked-up joints (Figs 3 & 4)

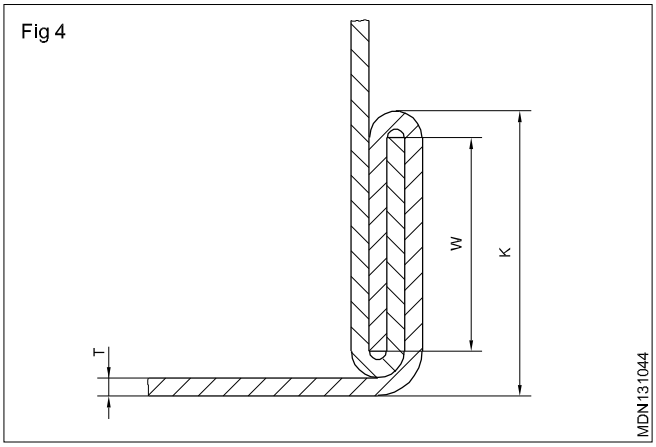
The size of paned down and knocked-up joints is determined by the width of the single folded edge.

'P' represents the size of the paned down joint and 'K' represents the size of the knocked-up joint.

P = 2W + 2T

K = 2W + 3T





Groovers

Objectives : At the end of this lesson you shall be able to
- **state what is a groover**
- **state the sizes of groovers**
- **state the uses and application of groovers.**

Any seam in sheet metal should be locked or closed properly for effective functioning. Otherwise the joint will be a failure.

What is a groover?

A groover is a hand tool used for closing and locking of seams in sheet metal work.

The end of the tool is recessed to fit over the lock making the grooved seams.

Sizes (Figs 1 & 2)

Groovers are available in various sizes viz.3mm, 4mm, 5mm etc.

Generally a groover 1.5 mm wider than the width of the fold is used.

For thicker materials, a groover 3 mm larger than the width of the fold is used.

The width of the groove is stamped on the tool body.

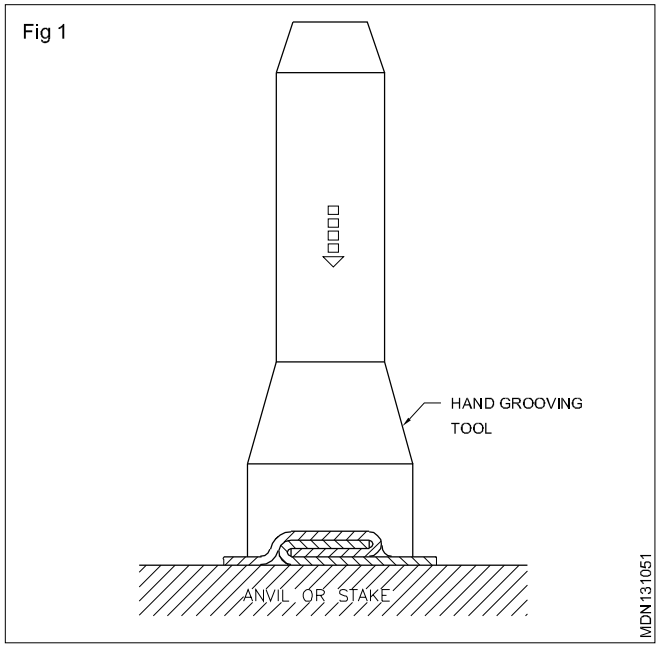
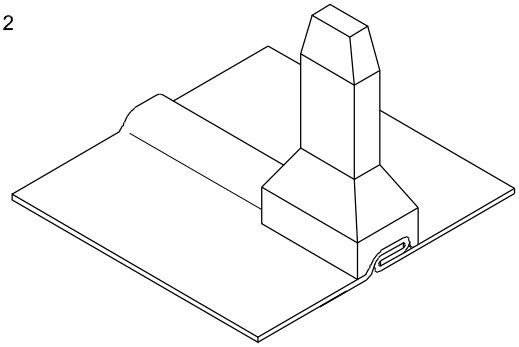


Fig 2



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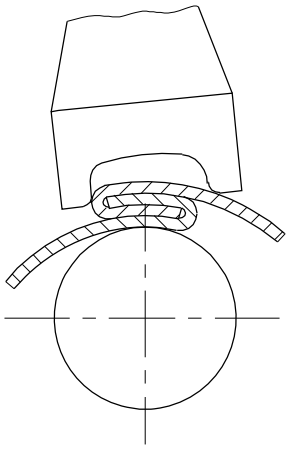
Closing and locking (Figs 3, 4 & 5)

Fig 3



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First the joint is held in position and then it is closed with a mallet.

Then the groover is placed over the closed end of the joint. The groover is positioned at a very slight angle. The edge of the joint acts as a guide to the groover position.

The grooving operations are repeated for the other end of the joint.

The joint is locked working along the joint in stages.

The seam is tightened using a mallet or a light planishing hammer.

Failure to lock the joints in stages with the end of the groover will result in bite marks along the joint.

Using too small groover will mark the metal and prevent locking.

Fig 4

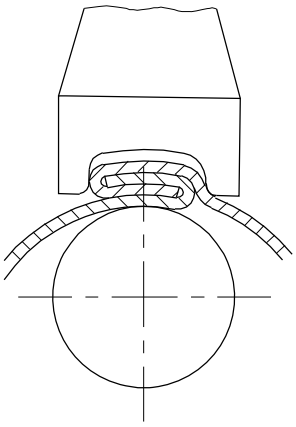

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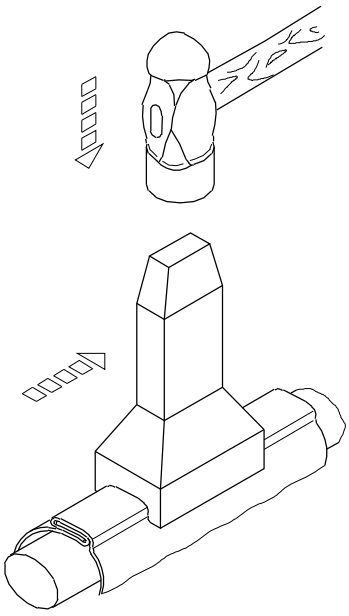
Fig 5



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Standard wire gauge

Objectives : At the end of this lesson you shall be able to

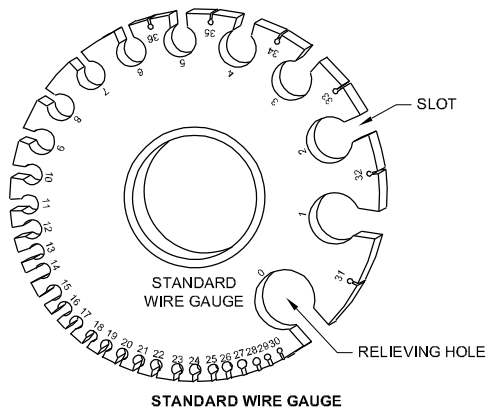
- **state the use of the standard wire gauge**
- **state some important hints in using standard wire gauge**
- **state the metal thickness in mm for the given gauge numbers.**

The job drawing indicates only gauge or thickness of the meet to be used. Before starting the work identify the correct thickness of the sheet. The thickness of the sheet is measured with the help of the standard wire gauge.

The gauge consist of a disc shape smoothened steel metal piece with numerous slots around the outside edge. These slots are of various width and correspond to certain gauge number (Fig.1)

Gauge number is stamped on one side of each slot and on the other side, the decimal part of an inch is stamped to show the thickness of the sheet and the diameter of the wire.

Fig 1



STANDARD WIRE GAUGE

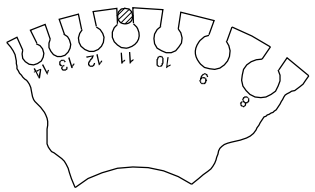
MDN131061

Thickness of the sheet is checked by inserting the edge of the sheet in the appropriate slot of the standard wire gauge.

Wire diameter is checked by inserting the wire only in the slot, and not in the circle (Fig.2)

Higher the SWG gauge number lessen the thickness of the sheet.

Fig 2



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Following is the table showing the thickness in inch and mm corresponding to the gauge No.

Table for G.No.to inches and mm

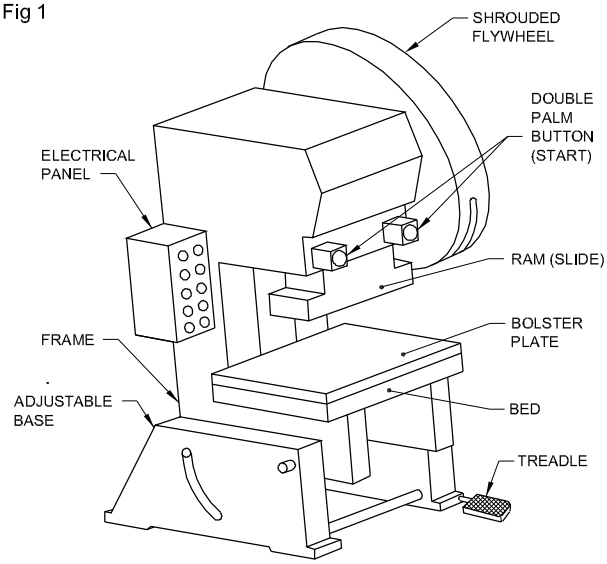
No. of the gauge	Approx. Th. in inch	Approx. Th. in mm	No. of the gauge	Approx. Th in inch	Approx Th. in mm
00	.3437	8.729	18	0.480	1.257
0	.3125	7.937	19	.0418	1.118
1	.2812	7.142	20	0.359	0.996
2	.2656	6.846	21	0.329	.886
3	.2391	5.895	22	.0299	.794
4	.2321	5.895	23	.0269	.707
5	.2092	5.312	24	.0230	.629
6	.1943	4.935	25	.0179	.498
7	.1793	4.770	26	.0179	.498
8	.1644	3.988	27	.0164	.443
9	.1495	3.551	28	.0149	.396
10	.1280	3.175	29	.0135	.353
11	.1196	2.827	30	.0120	.315
12	.1046	2.517	31	.0109	.276
13	.0897	2.240	32	.0101	.256
14	.0747	1.994	33	.0093	.236
15	.0673	1.775	34	.0085	.251
16	.0640	1.587	35	.0073	.185
17	.0538	1.412	36	.0070	.177

Sheet metal shearing, drawing, squeezing .

Objectives : At the end of this lesson you shall be able to
- **state the constructional features of the power press**
- **name the different types of power presses**
- **state and explain the different operations that can be performed on the power press**
- **state the safety precautions while working in the press shop.**

The constructional feature of the power press is almost similar to that of a fly press or hand press. (Fig 1) Except that the ram is driven by power. The power presses may be identified as Mechanical or Hydraulic, according to the type of working mechanism used to transmit power to the ram. In a mechanical press, the rotary motion of the electric motor is converted into a reciprocating motion of the ram by using various mechanical devices. In a hydraulic press, the fluid under high pressure is pumped on one side of the piston and then to the other side in a hydraulic cylinder to drive the reciprocating movement. The power presses are designated according to the power sources, Frame construction, Number of slides in action.

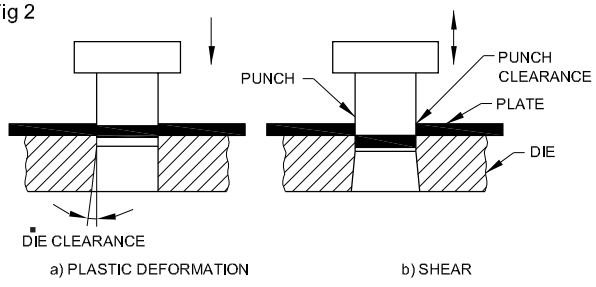
Fig 1



POWER PRESS

Power press operations (Fig 2)**:** The press operations are classified based on the operations performed.

Fig 2

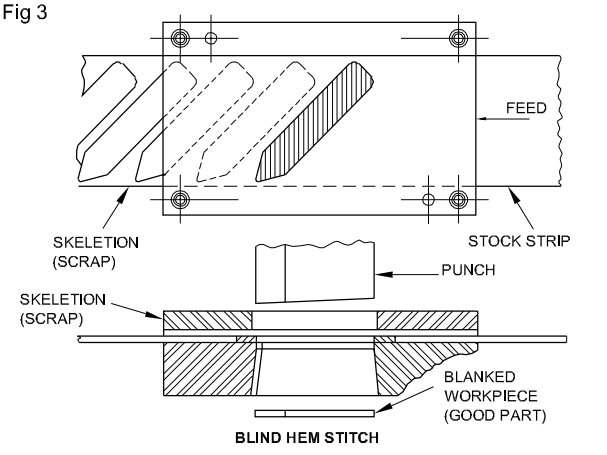


SHEARING OPERATION

Shearing : Shearing is an operation of cutting sheet metal with the help of a punch and die on a power press. The sheet is placed on the die and when the punch descends on the metal, it causes a rupture and forces the metal to be severed and ram the sheet metal. As the clearance between the punch and die is very small it forces the metal to drop down from the die opening.

a) Blanking (Fig 3)**:** Blanking is an operation of producing a flat component from a strip of sheet metal. The metal cutout is the required component and the sheet with the cut on the die is the scrap. In blanking, the size of the blank is governed by the size of the die and the clearance is left on the punch.

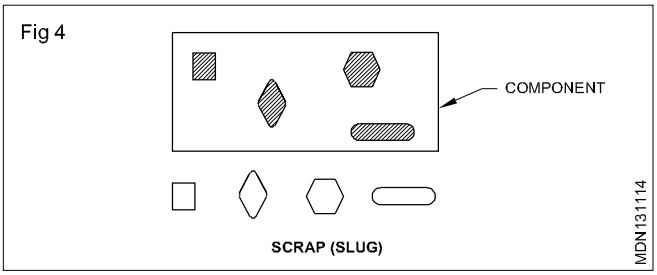
Fig 3



BLIND HEM STITCH

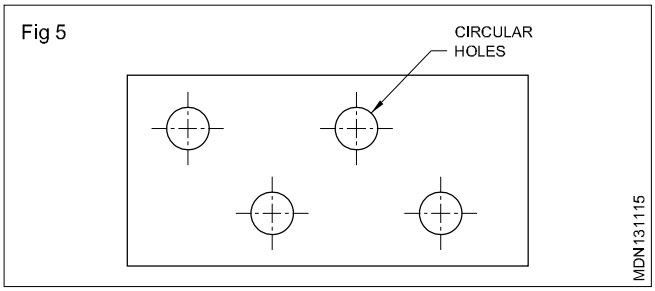
b) Piercing (Fig 4)**:** Piercing is an operation of making a cutout on a component. The cutout can be of any shape. The material punched out which comes out of the die is the scrap and the metal with the cutout which is on the die is the component. The punch governs the size of the cutout and the clearances is provided on the die.

Fig 4



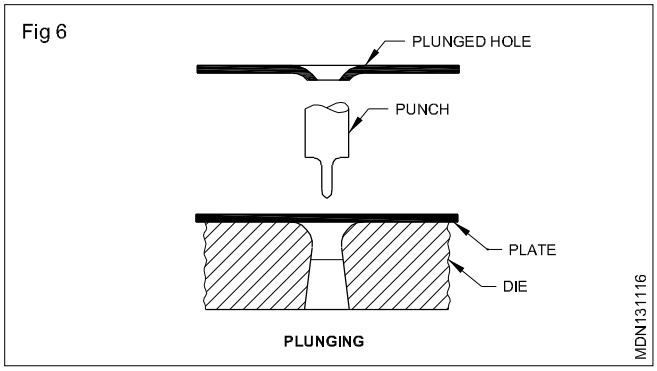
c) Punching (Fig 5)**:** Punching is an operation of punching out circular holes. The difference between punching and piercing is that this cutout made by piercing can be of any shape. But in punching only circular holes are made. The size of the hole is governed by the size of the punch and the clearance is provided on the die. (Fig. 4)

Fig 5



d) Perforating (Fig. 6)**:** Perforating is an operation of punching circular holes in a regular pattern or evenly spaced. Metal this is done by dimpling operation where the metal will be punched and a dimpling tool will be kept at the extreme of the hole and using a hammer the forming will be completed to accommodate the heads of countersunk screws and countersunk rivets.

Fig 6



PLUNGING

Drawing: Drawing is the operation of producing cup shaped articles from flat sheet metal blanks. The blank is placed on the die and while the punch comes down, the pressure pad holds the blank firmly on the die. As the punch further comes down the metal blank is pushed into the die opening and the metal is made to flow down the die plastically to form the sides of the cup. The pressure pad avoids the formation of wrinkles developed while forming. The size of the blank required to draw out a cup can be calculated by the formula given below.

D = O d2 +4dh

Where D = The diameter of the blank

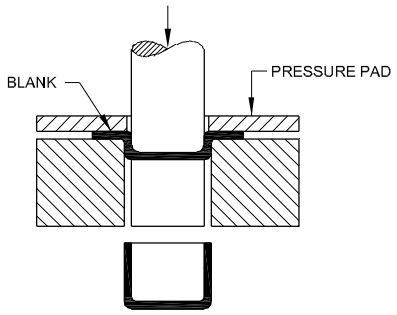
d = The diameter of the cup

h = The height of the cup

a) Cupping (Fig. 7)**:** Cupping is the operation of forming cup shaped articles by drawing operation.

Squeezing: Squeezing operation is the most sever of all cold press operations. More pressure is required to squeeze the metal into the cavity of the die and punch to get the required shape. Hydraulic presses are most suited for this operation.

Fig 7



DRAWING OPERATION

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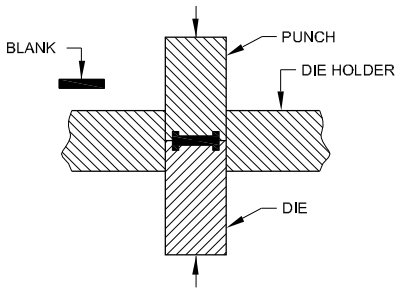
b) Coining (Fig. 8)**:** Coining is the operation of producing coins, medals or other ornamental work. The metal having good plasticity and correct size is places into the tool and pressure is applied on the tool form both ends.

Compressive load the metal flows under severe and fills into the cavity of the punch and die. The component gets sharp impression on both sides according to the engravings on the punch and die.

Fig 8



COINING

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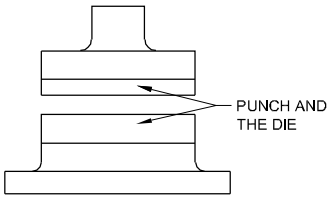
c) Embossing: Embossing is the operation of forming impressions of figures, letters or designs on sheet metal. The punch or the die or both of them may have the design engraved on them which are formed on the sheet metal by squeezing and with the plastic flow of metal.

Flattening or Planishing (Fig. 9)**:** Flattening or Planishing is the operatioin of straightening the curved or bent sheet metal parts, on a press using a planishing tool.

Fig 9



PLANISHING PUNCH AND DIE SET UP

MDN131119

Bending Sheet Metal

Objectives : At the end of this lesson you shall be able to

- **state what is a bend radius**
- **state the need for a bend radius**
- **state what is a spring back**
- **state the factors governing spring back.**

Bending sheet metal neutral line (Figs 1, 2 & 3)

Fig 1

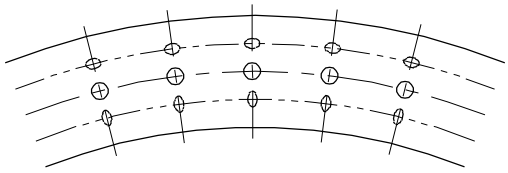


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Fig 2

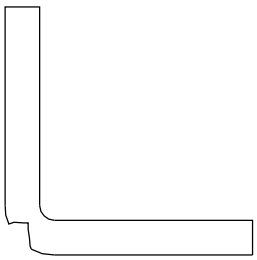

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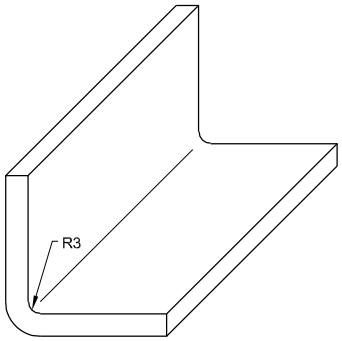
Fig 3



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When a sheet metal is bent the plane (or line) Where neither extension nor contracton occurs but only a bend takes place, is called the neutral plane (or line).

While performing a bend, if the inside of the sheet is not rounded, the outside of the sheet will be much pulled. In order to avoid it, the sheet is often bent after providing the radius as shown in the (Fig 3).

The radius of the roundness is called the bend radius.

Least bend radius

The radius of the least roundness with which the sheet can be bent without occurances of a crack in the outside of the bend is called the least bend radius.

The least bend radius varies depending on the :

- material
- thickness
- direction of the plate
- working temperatures. etc.

Table 1 gives the least bend radius generally used.

Where the material is soft and the bend line is at right angle to the rolling direction of the sheet, a small value is used, and where the metal is hard and the bend line is parallel with the rolling direction, a higher value is used.

Table 1

Least bend radius

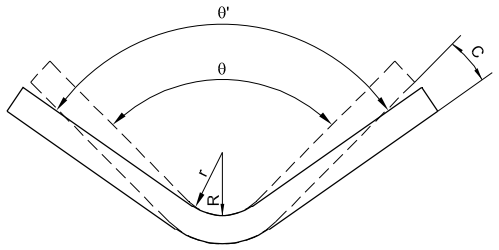
Material	Least bend radius R
Cold rolled steel plate	t x (0 - 0.5)
Semi-hard steel plate	t x (0.3 - 1.5)
(C 0.35 - 0.40%)	
Sheet of copper group	t x (0 - 2.0)
Brass/Aluminium sheet	t x (0 - 1.0)
Soft Aluminium	t x (1.0 - 2.5)
Duralumin	t x (2.0 - 4.0)

Plate thickness

What is spring back (Fig. 4)

When a sheet of steel is bent, if the bending force is removed, a part of the elastic deformation returns to the original state of the material before deformation. This phenomenon is called spring back.

Fig 4



Factors governing spring back

The spring back varies depending on the :

- material
- thikness of the sheet
- system of working
- bend radius
- bending pressure, etc.

It is difficult to calculate the accurate degree of spring back. When the job is actually performed, the sheetis experimentally bent and the pressure adjusted so that an accurate bend angle can be made after allowing for the spring back.

Manual Bending

Objectives : At the end of this lesson you shall be able to
- **state the function of the folding bar**
- **state the method of bending a sheet over the hatchet stake**
- **define a hand seamer and its function**
- **state the method of bending by a fly press.**

Folding bars (Fig 1 & 2)

The sheet metal to be bent is clamped in the folding bar. The folding line coincides with the top of the folding bar. The folding bar clamped in the vice as shown in the figure. While tightening the vice, pull the projecting part of the folding bar towards yourself to prevent the sheet from dropping from the bars, in most cases a wooden or rubber mallet is used for bending at right angles with bending bar.

Fig 1

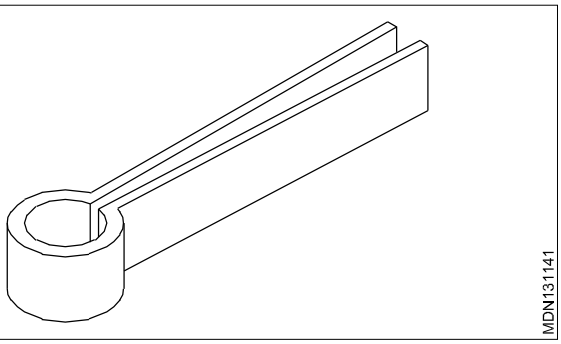
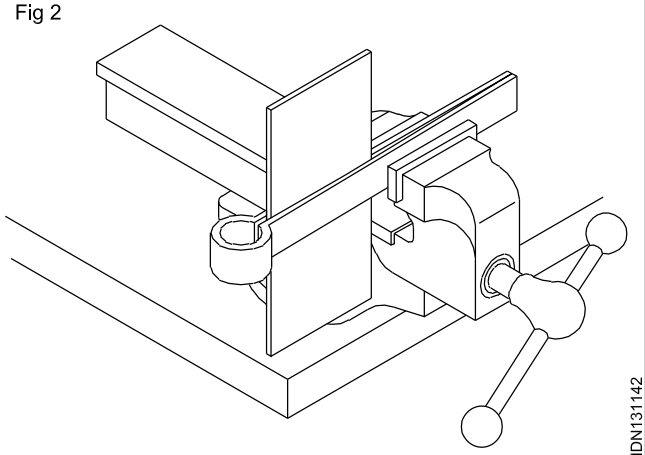


Fig 2



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Bending over hatchet stake (Fig 3 & 4)

The folding line is to coincide with the edge of the stake, and the sheet pressed with both the hands and hammered for the required bend.

Fig 3

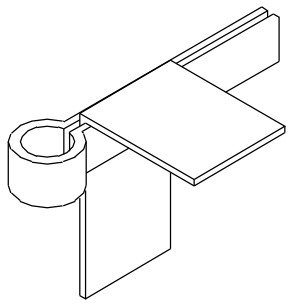

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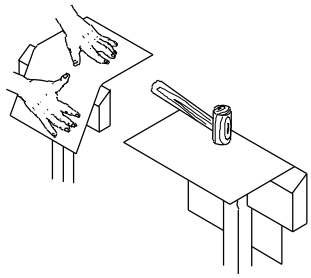
Fig 4



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Another method of bending is shown in the figure. The work is clamped to the edge of the bench by means of a piece of hardwood and two `C' clamps (Fig. 5). Then the projecting parts of the plate can be folded downwards.

If folding bars are not available, two pieces of angle iron (Fig. 6) can be used. The ends are clamped together by means of a `C' clamp.

For bending narrow edges (Fig. 7) on small pieces of sheet, for eg. if seams must be folded, a hand seamer can be used.

Fig 5

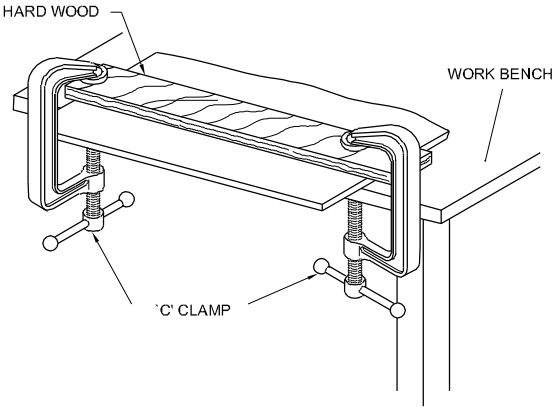

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Fig 6

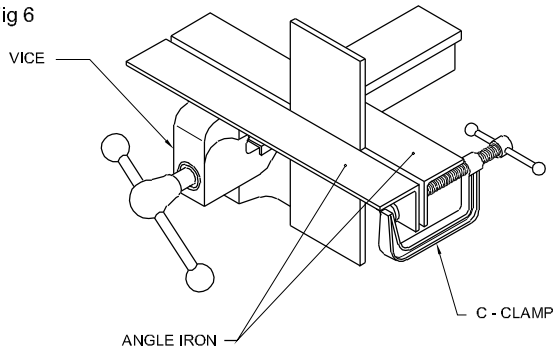

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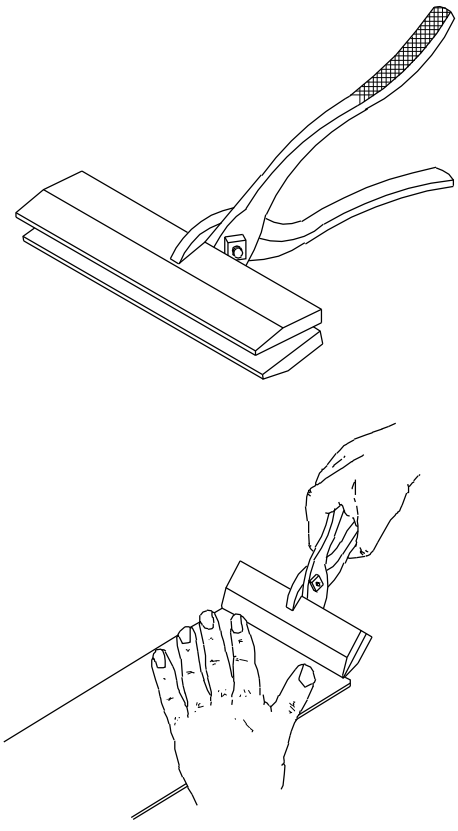
Fig 7



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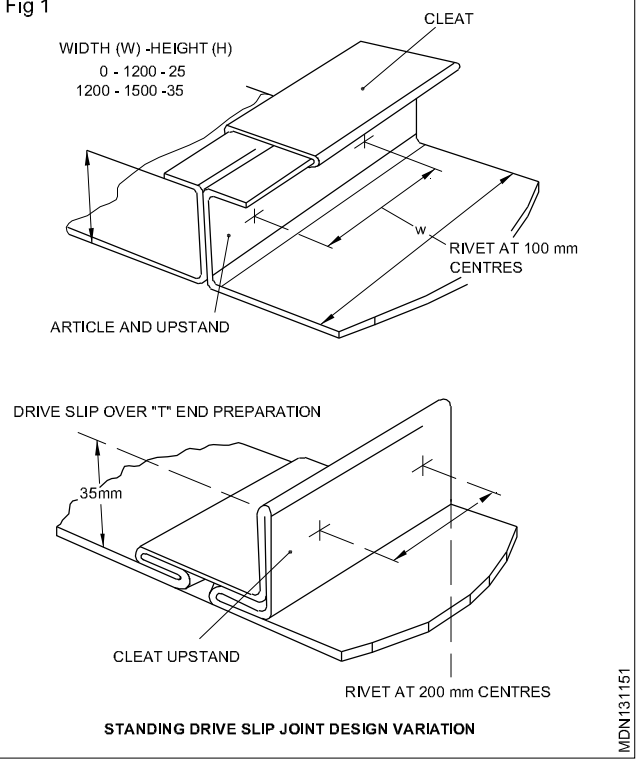
Bending metals to an angle

Objectives : At the end of this lesson you shall be able to
- **state the methods of bending rods and pipes in a bench vice**
- **state the methods of bending rods and pipes with a fixture.**

Bending is a process of shaping materials without cutting.(Fig.1)

Fig 1



Different methods are used for bending rods, sheets and pipes.

Bending on vice

Work is held in the vice and bent with hand force or with a hammer according to the diameter of the rod or the thickness of the sheet. (Fig. 2) A hammering block (Fig 3 and 4) is used to prevent hammer marks and also to direct the force at the correct place.

Fig 2

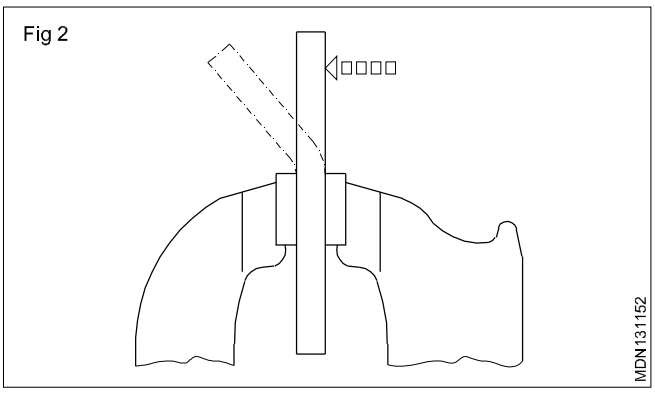


Fig 3

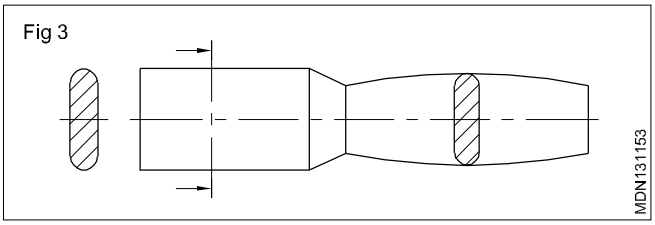
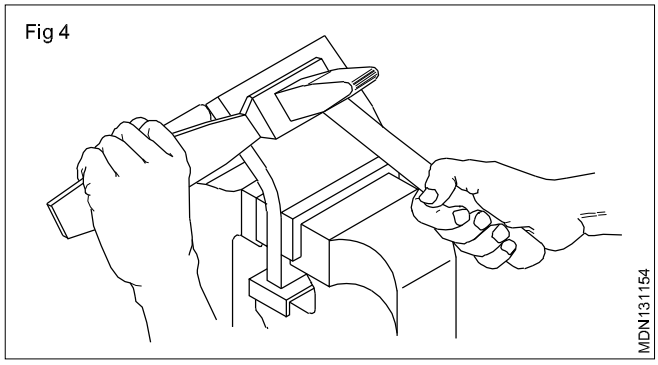


Fig 4



Bending using bending jaw or bending block

To form bends to a required radius on workpieces, bending jaws or bending blocks are used (Figs 5 and 6)

Fig 5

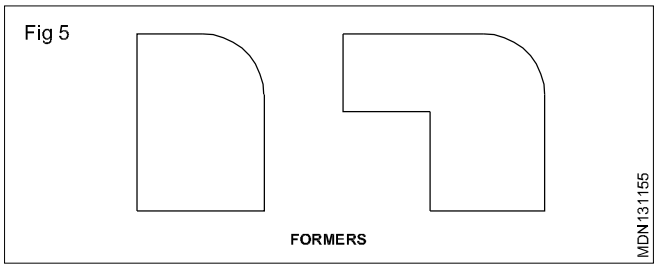
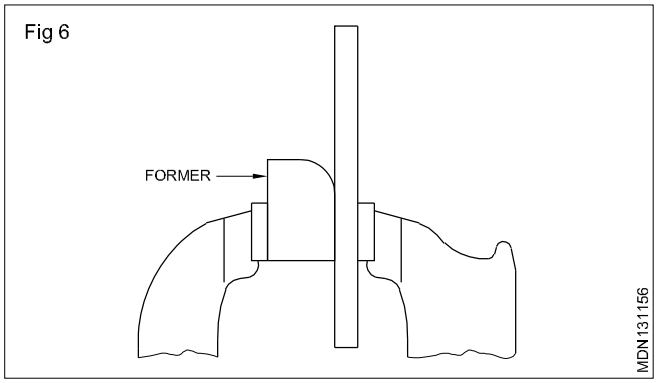
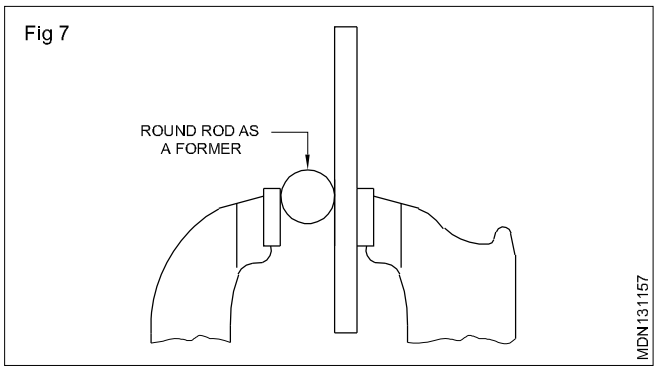


Fig 6



Round rods are also used sometimes for forming radius on sheets or rods (Fig 7)

Fig 7



Bending with fixtures (Figs 8, 9 & 10)

A bending fixture can be prepared and used when a large number of workpieces is required to be bent (Fig 8a and 8b)

Fig 8

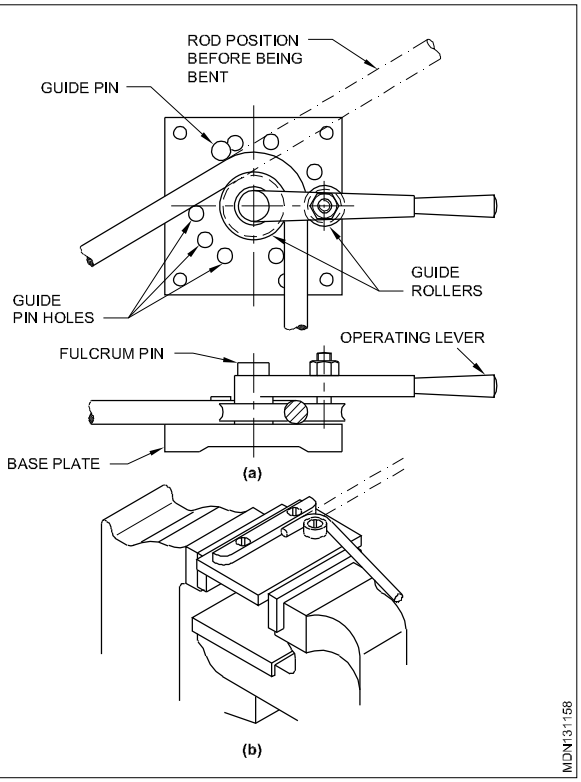
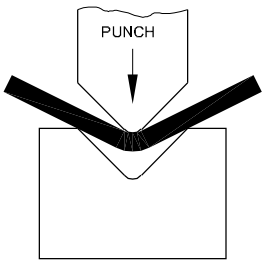


Fig 9



BENDING DIE

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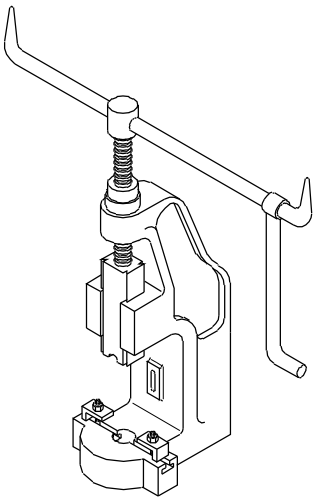
Fig 10



FLY PRESS

MDN13115A

Pipe bending machines

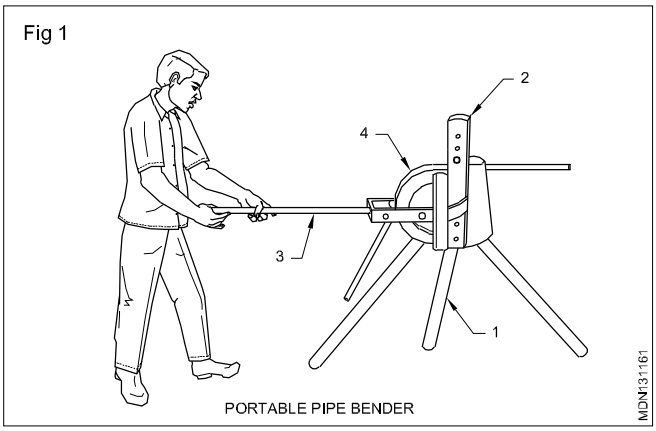
Objectives : At the end of this lesson you shall be able to
- **name the three most common pipe benders**
- **differentiate their constructional features**
- **name the parts of bending machines**
- **state the uses of bending machines.**

There are some situations in plumbing jobs, where it is preferable to bend a pipe rather than use a pipe fitting.

The most common pipe benders are listed here.

Portable hand operated pipe bending (Fig.1)

Fig 1



PORTABLE PIPE BENDER

The portable hand-operated pipe bender consists of the following parts.

1 Tripod stand

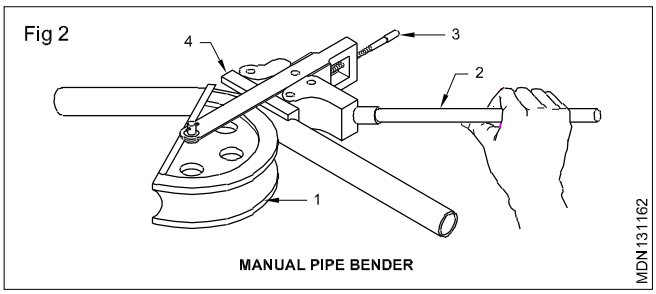
2 Pipe stop lever

3 Handle or lever

4 Inside former

Bench type hand operated pipe bender (Fig 2)

Fig 2



MANUAL PIPE BENDER

This consists of the following parts. It is used for bending galvanized iron and steel pipes.

1 Inner former

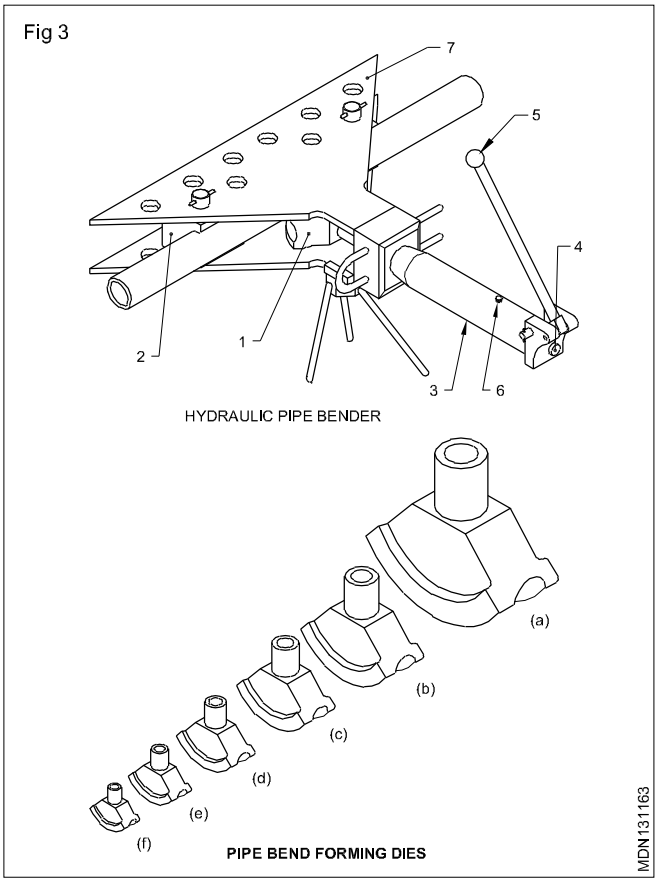
2 Lever or handle

3 Adjusting screw with lock nut

4 Pipe guide

Hydraulic bending machine (Fig 3)

Fig 3



This machine can be used bending G.I. and M.S. pipes without sand filling to any direction.

It consists of the following the parts.

1 Inner former

2 Back former

3 Hydraulic ram

4 Pressure release valve

5 Operating lever

6 Bleed screws

7 Base plate.

Inner formers are interchangeable and are able to bend pipes up to 75 mm diameters (Figs 3a, b, c, d, e & f)

Pipes and pipe fittings

Objectives : At the end of this lesson you shall be able to
- **state the uses of pipes**
- **name the common types of pipes**
- **list the standard pipe fittings and state their uses.**

Various types of pipes and tubes are used for the following purposes.

- Domestic hot and cold water supplies
- Waste water outlets
- High pressure steam supplies.
- Hydraulic oil supplies
- Lubricating oil supplies
- Special fluid and gases for industrial processes.
- Pneumatic systems
- Refrigeration systems
- Fuel oil supplies

The common types of pipes classified according to material are:

- galvanized iron pipes
- mild steel pipes
- C.I. soil pipes
- copper pipes
- aluminum pipes
- brass pipes
- lead pipes
- P.V.C. pipes
- rubber pipes
- plastic pipes
- stoneware pipes

Standard pipe fitting: Pipe fittings' are those fittings that may be attached to pipes in order to:

- change the direction of the pipe
- connect a branch with a main water supply pipe
- connect two or more pipes of different sizes
- close the pipe ends

Standard Pipe Fittings

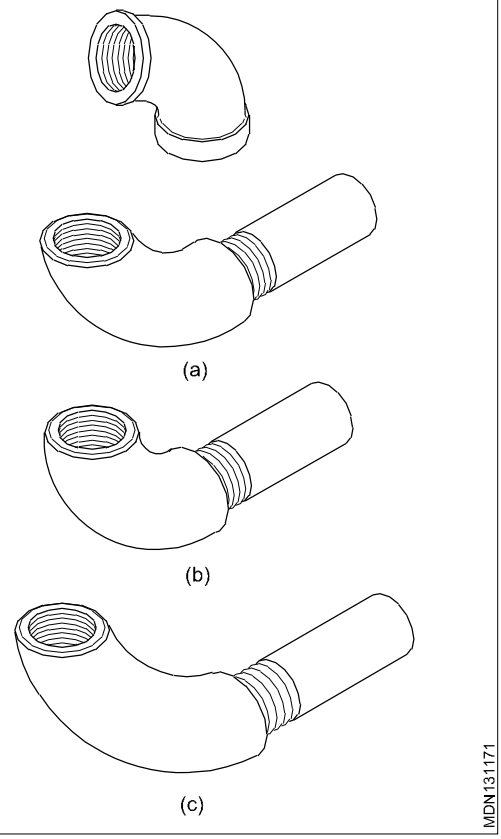
Elbows (Fig 1**):** Elbows and bends provide deviations of 90 and 45o in pipe work systems.

Long radius elbows have a radius equal to 1 1/2 times the bore of the pipe (Fig 1a)

Short radius elbows have a radius equal to the bore of the pipe. (Fig 1b)

The 45° elbows allow pipe deviation of 45° (Fig 1c)

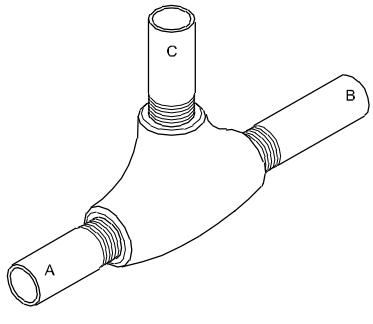
Fig 1



Tee branch: A tee joint helps the pipe line to branch off at 90°. The branches may be equal in diameter or there may be one reducing branch.

Dimensions of a branch are always quoted as A x B x (Fig 2)

Fig 2



Reducing tee branch : Reducers are fitted where a change in pipe diameter is required (Fig 3)

Eccentric reducer : Used mainly in horizontal position (Fig 4)

Fig 3

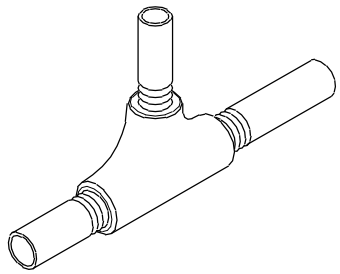


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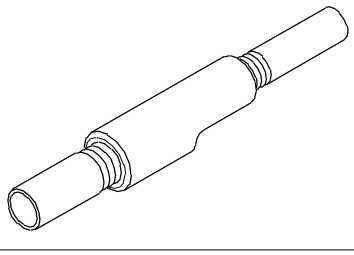
Fig 4



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Concentric reducer : Used mainly in vertical position (Fig5)

Caps: Caps are used for closing the end of a pipe or fitting which has an external thread. (Fig 6)

Plug: A plug is used for closing a pipeline which has an internal thread (Fig 7)

Fig 5

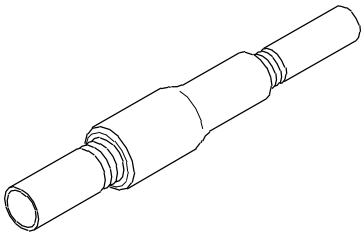

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Fig 6

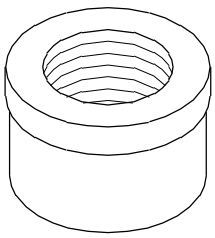

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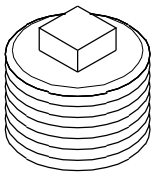
Fig 7



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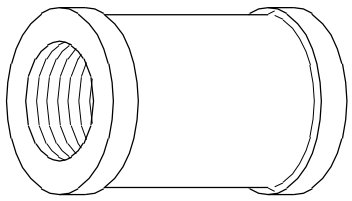
Coupling: (Fig 8) A coupling is used to connect two pipes. Couplings have internal threads at both ends of fit the external threads on pipes.

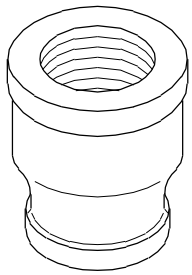
Fig 8



MDN131178

Reducer (Fig 9)**:** A reducer coupling is used to connect two pipes with different diameters.

Fig 9



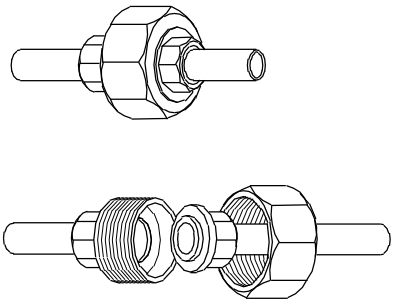
MDN131179

Union : A device used to connect pipes. Unions are inserted in a pipe line to permit connections with little change to the position of the pipe. (Fig10)

When unions are used in pipe lines, it is easy to dismantle and repair.

Pipe nipples (Figs 11, 12, 13 & 14)**:** Pipe nipples are tubular pipe fittings used to connect two or more pipes of different sizes

Fig 10



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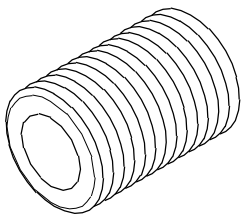
Close nipple (Fig 11)

Fig 11



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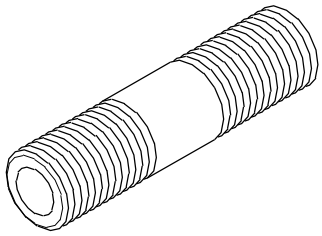
Short nipple (Fig 12)

Fig 12



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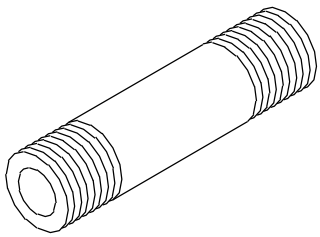
Long nipple (Fig 13)

Fig 13



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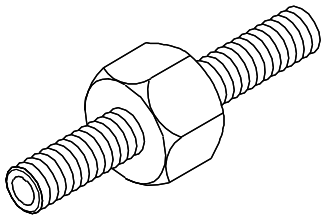
The hexagonal nut (Fig 14)**:** The hexagonal nut in the centre of the nipple is for tightening with a spanner or wrench (Fig 14)

Fig 14



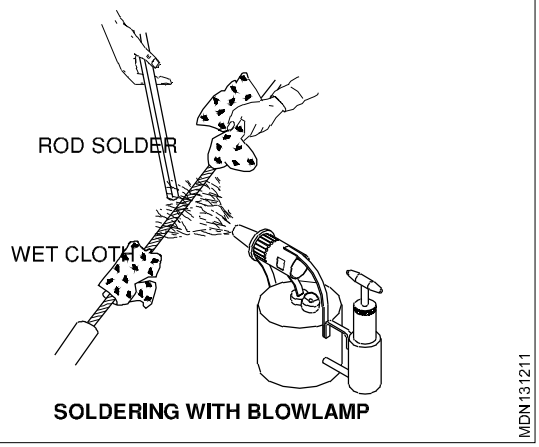
MDN13117E

Blow lamp

Objectives : At the end of this lesson you shall be able to
- **state the constructional feature of blow lamp**
- **name the parts of blow lamp**
- **describe the operation of blow lamp.**

Blow lamp (Fig 1)**:** the kerosene is pressurized to pass through pre-heated tubes, thus becoming vaporised. The kerosene vapour continues through a jet to mix with a air and when ignited directed through a nozzle, producing a forceful flame.

Fig 1



SOLDERING WITH BLOWLAMP

The flame within the housing provides the heat to maintain vaporisation of the kerosene. The free flame at the nozzle outlet is used to heat the soldering bit.

Blow lamp is a portable heating appliance used as a direct source of heat for soldering irons or other parts to be soldered. Fig.1 shows parts of blow lamp.

It has an tank made of brass, filler cap is fitted at its top to fill kerosene. A pressure relief valve is connected to the mouth to switch ON/OFF and control the flame.

Priming trough is provided for filling mentholated spirit for lighting the blow lamp. Set of nozzle is provided to direct the kerosene vapor to produce forceful flame. Burner housing is mounted on support brackets on which soldering iron is placed for heating as shown in figure.

Pump is provided to pressurise the kerosene in the tank.

Flux

Objectives : At the end of this lesson you shall be able to
- **state the criteria for the selection of fluxes**
- **distinguish between corrosive and non-corrosive fluxes**
- **name the different types of flux and their application.**

Fluxes are non-metallic materials which are used at the time of soldering.

Functions of flux

- Flux removes oxides from the soldering surface.
- It prevents corrosion.
- It helps molten solder to flow easily in the required place.
- It promotes the wet surface.

Selection of flux

The following criteria are important for selecting a flux.

- Working temperature of the solder
- soldering process
- materials to be joined

Classes of flux

Flux can be classified into corrosive flux, and non corrosive flux

Corrosive flux in acid form is corrosive and should be washed immediately after the soldering operation is completed.

Non-corrosive flux is in the form of lump, powder, paste or liquid.

DIFFERENT TYPES OF FLUX

Hydrochloric acid

Concentrated hydrochloric acid is a liquid which fumes when it comes into contact with air. After mixing with water, 2 or 3 times the quantity of the acid, it is used as dilute hydrochloric acid.

Hydrochloric acid combines with zinc forming zinc chloride and acts as a flux. So it cannot be used as a flux for sheet metals other than zinc, iron or galvanised sheets.

Zinc chloride

It is mainly used for soldering copper sheets, brass sheets and tin plates.

As it is extremely corrosive, the flux must be perfectly washed off after soldering.

Ammonium chloride

This is the form of powder or lump. It evaporates when heated.

Ammonium chloride is used as a flux for soldering steel.

A solution of a mixture of hydrogen chloride, zinc chloride and ammonium chloride is used as a flux for stainless steel sheets.

Resin

As resin is not very effective for removing oxidation coating, and, as it is not highly corrosive, it is used as flux for copper and brass. Resin melts at about 80° to 100°C.

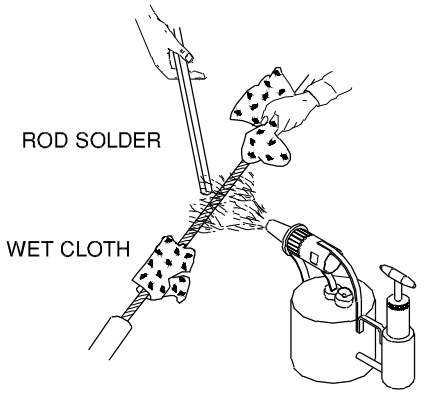
Paste

This is a mixture of Zinc chloride, resin, glycerin and others and is available as a paste.

As it is effective for removing oxidation coating, it is used for soldering small handworks and radio wiring.

Soldering with blowlamp

Fig 1



SOLDERING WITH BLOWLAMP

Soldering with a blowlamp is done when the heat capacity of a soldering iron is not sufficient.

The method, shown in Fig 1, permits rapid heating and is used primarily for larger jobs, such as piping and cable work, vehicle, body repairs and some applications in the building trade.

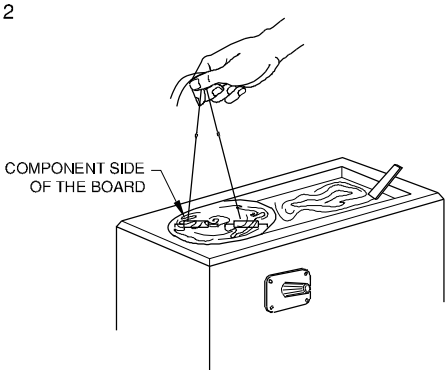
This requires skillful management of the flame.

Dip soldering

This method, shown in Fig 2, is used for bulk production and for tinning work similar to component soldering on printed Circuit Boards (PCB). Components to be soldered or tinned are dipped into a bath of molten solder, which is heated electrically. The solder is kept in motion by an agitator in order to obtain an even temperature and to keep the surface free from oxides. If no agitator is provided, the surface must be protected or skimmed at regular intervals to remove the oxides.

The temperature can be controlled very accurately.

Fig 2

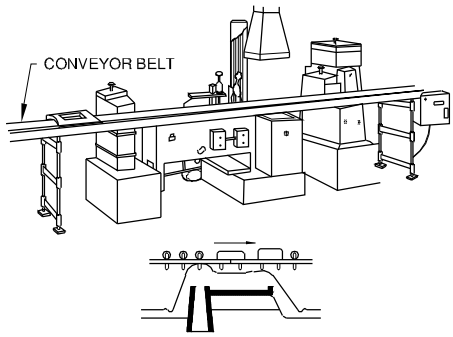


DIP SOLDERING

Machine soldering

The method, shown in Fig 3, is used for quantity production and is based on the principle, when molten solder is set in rapid motion, the oxide film breaks without setting on the surface. The solder comes into direct contact with the components to be soldered.

Fig 3



MACHINE SOLDERING

Soldering machines are of different designs for wave soldering, cascade soldering and jet soldering.

Equipment for machine soldering is expensive and the cost of production is high.

Accurate temperature control can be arranged.

Brazing Techniques

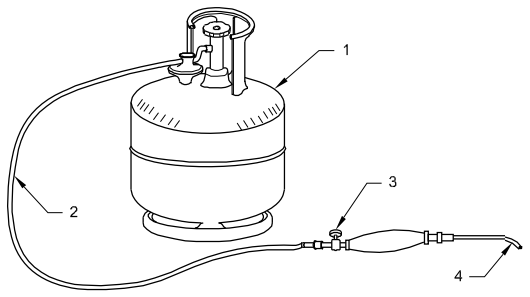
Objectives : At the end of this lesson you shall be able to
- **explain the brazing technique**
- **Study copper to copper pipe brazing swaged joint**
- **Studies braze copper with MS tube**

Brazing techniques

Acetylene torch (Fig 1): (Danger: Acetylene is very inflammable, Do not allow anyone to smoke while you are brazing)

- Connect the torch with a flexible hose to the gas regulating valve of the acetylene cylinder; make sure that all of the connections are tight to prevent gas leakage. Check all connections for leaks with soap water before lighting the torch.

Fig 1



ACETYLENE TORCH

- Open the cylinder valve one turn, only. Open the regulating valve fully. Open the torch control valve just enough to give a flow of gas. Light the escaping gas at the tip of the torch.
- Adjust the torch control valve to get the correct flame. The flame should be blue. It should have a sharp bright cone in the middle with pale outer flame. If the flame is yellow more gas is required. open the control valve.
- The size of the torch tip or nozzle determines the size of the inner cone. use a cone size that gives the required amount of heat.

Propane turbo torch (Fig 2): (Danger: Propane is very inflammable. Do not allow anyone to smoke while you are brazing)

- This gives a smaller outside flame. The tip of the inner cone is much hotter than an acetylene flame of the same size. Always work with a smaller flame than acetylene.
- Connect, adjust and use this torch in the same way as acetylene described above, check all connections for gas leaks with soap water before lighting the torch.
- Follow exactly the instruction supplied with the torch.

1 This is the cylinder that holds the gas for brazing

2 Check the connections for leaks at each end of this hose with soap water.

3 Use the torch control valve to control the gas flow.

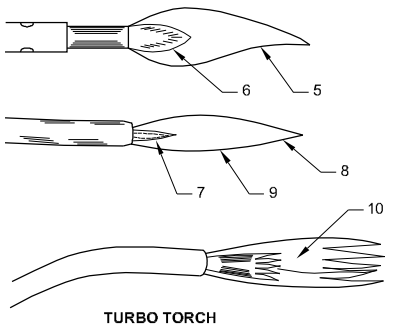
4 Fit a torch tip which gives the correct flame.

5 This is an acetylene flame suitable for pipe brazing

6 The bright cone is the hottest part of the flame work with the tip of the cone.

7 The high bright cone is the hottest part of the flame with the tip of the cone

Fig 2



TURBO TORCH

8 This is an acetylene flame suitable for capillary tube brazing required.

9 The other flame should be pale yellow. If it is yellow,

10 This is a propone turbo torch flame. The end tractions will tell you what size of flame of use.

Kerosene blow lamp

- This gives a larger flame than a propane or acetylene torch.
- When lighting, follow carefully the instructions supplied with the torch. Wherever possible light the blow lamp in an open space for safety.

Silver brazing: One of the best method of connection copper pipes after swaging or by the use of coupling, in a leak proof manner is by silver brazing,. By this method the copper pipes can be connected to the compressor, service valves and the other parts also.

Silver brazing can be easily done if the correct procedure is followed.

Clean the inside and outside of the tube end using sand paper of wire brush. Fit the joint closely and support the joint. Apply flux required for the brazing rod. (Flux is used to prevent chemical action during heating the metal. The flux used for soldering refrigeration fittings is made of alcohol and resin.

There are various silver alloys in the market. The rod used to join copper pipes is called copper to copper brazing rod'. These have 35 to 45 percent silver content. This material melts at 1120°F and flows 1145°F

Precautions: Do not apply the solder at the joint if it is not red hot

Any oxy-acetylene torch is excellent heat source for silver brazing. While using blow lamp the joint is to be heated longer time.

To join copper pipe to steel pipe and any pipe to the compressor dome only oxy acetylene torch can be used. This torch can also used for refrigerator cabinet patch work.

While brazing keep away the flame from rubber plastic parts and insulating materials of the refrigerator or AC.

The pipes joined by brazing can be separated by heating it again.

Flux: Flux is a substance which works as an agent help the solder to flow easily. It cleans the surface and prevents oxidation. Melting point of flux is much less than that of solder.

Various types of flux and their uses are given below.

Ammonium chloride NH_4CI - For soldering cast iron

Hydrochloric acid HCL - For soldering G.I sheets

Zinc chloride $ZnCI_2$ - For soldering mild iron sheets

Tallow - For soldering lead and electrical joints

Resin - For soldering electrical joints

Phosphoric - For soldering stainless steel

Braze a copper tube with swaged joint

Fit two pipes to braze. If it is a loose fit the joint will be weak. Insert the end of one pipe into the swage of the other. Apply a small amount of flux to the surfaces to be joined, with the help of blow torch heat the joint. The brazing rod must be meted by the heat. Complete ring of brazing material can be seen at the end of the swage remove the torch and allow the joint to cool.

Braze copper with ms tube: In most tube and fitting connections are made by either soldering or silver brazing. Soldering joints are used for water pipes and drains. silver brazed joint are used for refrigerant pipes and rubbing.

The best methods of making leak proof connection while providing maximum strength is to silver braze the joints. These joints are very strong and will stand up under the most extreme temperature condition.

An oxyacetylene torch is an excellent heat source for silver brazing. The proper silver brazing temperature will be indicated by the colour of green shade.