Hand taps and wrenches

Objectives: At the end of this lesson you shall be able to
- **identify the uses of hand taps**
- **state the features of each tap**
- **state the different types of tap wrenches, and state their uses.**

Taps: A tap cuts an internal (female) thread either left or right hand. Taps are usually made in sets of three.

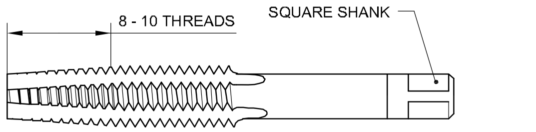
– First tap or taper tap

– Second tap or intermediate tap

– Plug or bottoming tap.

The taper tap is tapered off for 8 to 10 threads and is used first, cutting to the full thread gradually. (Fig 1)

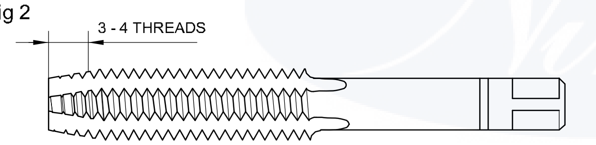
Fig 1



TAPER TAP (OR) 1ST TAP

The intermediate tap usually has three or four threads chamfered. This second tap can finish a through hole. (Fig 2)

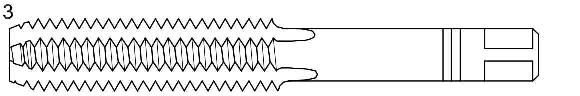
Fig 2



INTERMEDIATE TAP (OR) 2ND TAP

The plug tap has a full-sized untapered thread to the end, and is the main finishing tap. In the case of a blind hole, a plug tap must be used. (Fig 3)

Fig 3



PLUG TAP (OR) BOTTOMING TAP

Beware of the cutting edges of taps when handling them.

Tap wrenches: Tap wrenches are used to align and drive the hand taps correctly into the hole to be threaded.

Tap wrenches are of different types.

– Double - ended adjustable wrench

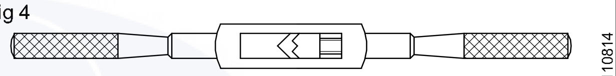
– T-handle tap wrench

– Solid type tap wrench

Double-ended adjustable tap wrench (Bar type tap wrench) (Fig 4)

This is the most commonly used type of tap wrench. These tap wrenches are available in various sizes. They are more suitable for large diameter taps, and can be used in open places where there is no obstruction to turn the tap. It is important to select the correct size of the wrench.

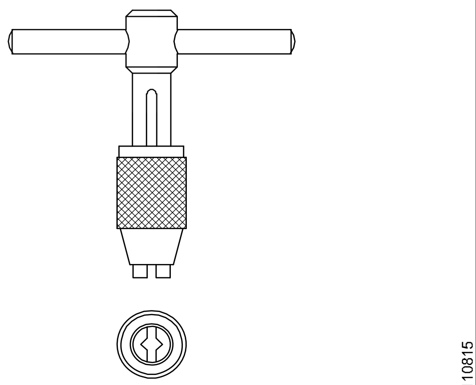
Fig 4



DOUBLE ENDED ADJUSTABLE TAP WRENCH

T-handle tap wrench (Fig 5)**:** These are small adjustable chucks with two jaws and a handle to turn the wrench.

Fig 5



T - HANDLE TAP WRENCH

Reamers

Objectives : At the end of this lesson you shall be able to
- **state the use of reamers**
- **state the advantages of reaming**
- **distinguish between hand and machine reaming**
- **name the elements of a reamer and state their functions.**

What is a reamer?

A reamer is a multipoint cutting tool used for enlarging by finishing previously drilled holes to accurate sizes. (Fig 1)

Advantages of 'reaming'

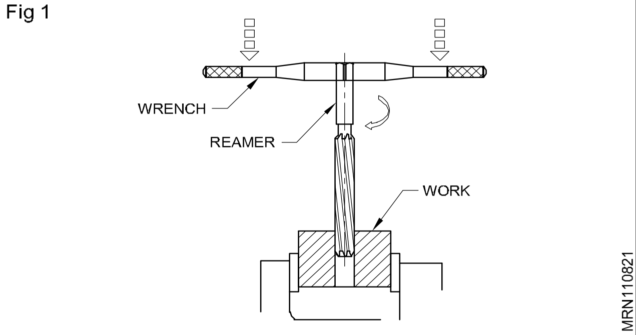
Reaming produces

high quality surface finish

dimensional accuracy to close limits.

Also small holes which cannot be finished by other processes can be finished.

Fig 1



Classification of reamers

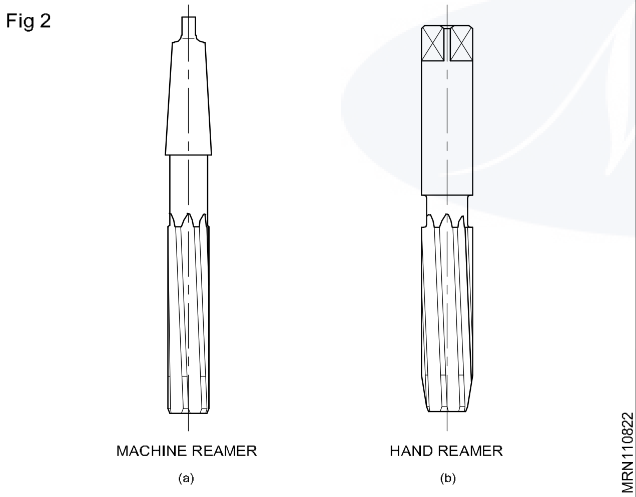
Reamers are classified as hand reamers and machine reamers. (Figs 2a,b) Reaming by using hand reamers is done manually for which great skill is needed.

Machine reamers are fitted on spindles of machine tools and rotated for reaming.

Machine reamers are provided with morse taper shanks for holding on machine spindles.

Hand reamers have straight shanks with 'square' at the end, for holding with tap wrenches. (Figs 2a,b)

Fig 2



Parts of a hand reamer

The parts of a hand reamer are listed here under. Refer to Fig 3.

Axis

The longitudinal centre line of the reamer.

Body

The portion of the reamer extending from the entering end of the reamer to the commencement of the shank.

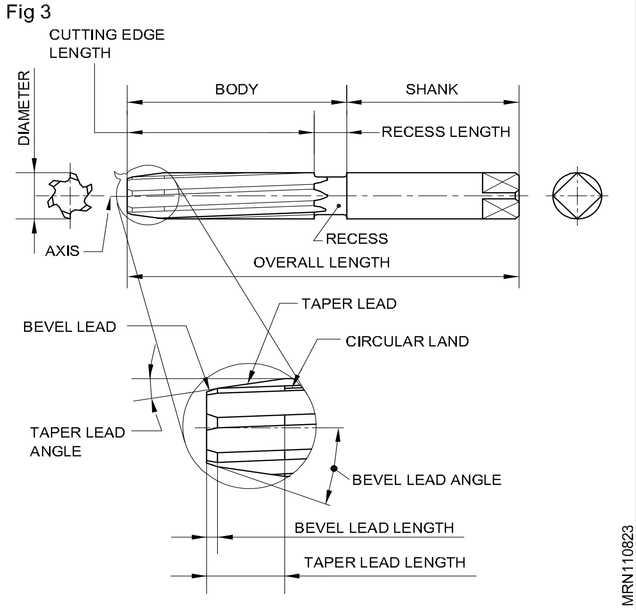
Recess

The portion of the body which is reduced in diameter below the cutting edges, pilot or guide diameters.

Shank

The portion of the reamer which is held and driven. It can be parallel or taper.

Fig 3



Circular land

The cylindrically ground surface adjacent to the cutting edge on the leading edge of the land.

Bevel lead

The bevel lead cutting portion at the entering end of the reamer cutting its way into the hole. It is not provided with a circular land.

Taper lead

The tapered cutting portion at the entering end to facilitate cutting and finishing of the hole. It is not provided with a circular land.

Bevel lead angle

The angle formed by the cutting edges of the bevel lead and the reamer axis.

Taper lead angle

The angle formed by the cutting edges of the taper and the reamer axis.

Terms relating to cutting geometry

flutes

The grooves in the body of the reamer to provide cutting edges, to permit the removal of chips, and to allow the cutting fluid to reach the cutting edges. (Fig 4)

Heel

The edge formed by the intersection of the surface left by the provision of a secondary clearance and the flute. (Fig 5)

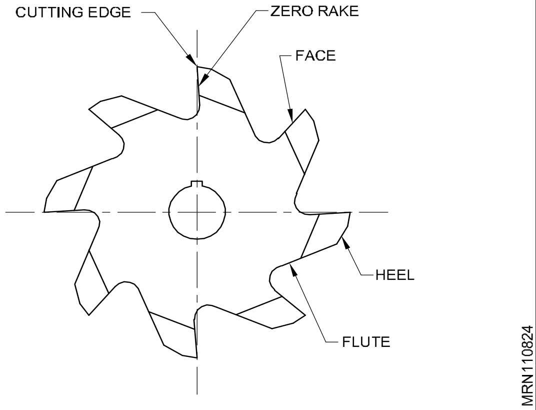
Cutting edge

The edge formed by the intersection of the face and the circular land or the surface left by the provision of primary clearance. (Fig 4)

Face

The portion of the flute surface adjacent to the cutting edge

Fig 4



on which the chip impinges as it is cut from the work. (Fig 5)

Rake angles

The angles in a diametric plane formed by the face and a radial line from the cutting edge. (Fig 6)

Clearance angle

The angles formed by the primary or secondary clearances and the tangent to the periphery of the reamer at the cutting edge. They are called primary clearance angle and secondary clearance angle respectively. (Fig 7)

Helix angle

The angle between the edge and the reamer axis. (Fig 8)

Fig 5

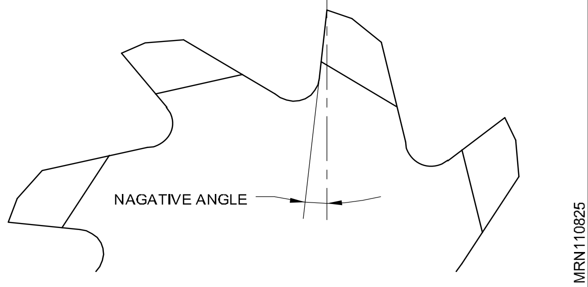


Fig 6

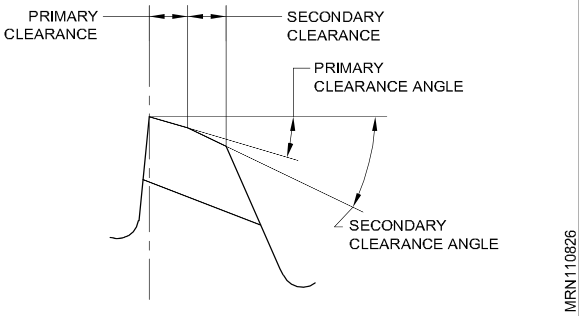
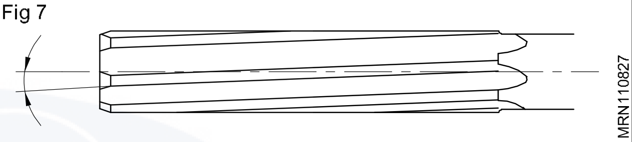


Fig 7

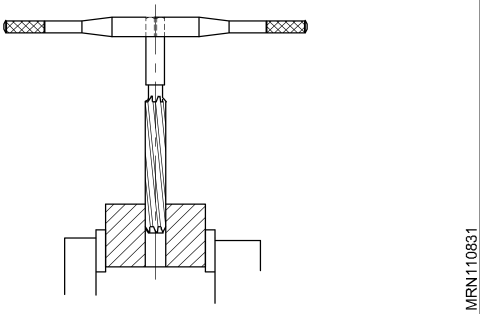


Hand reamers

Objectives: At the end of this lesson you shall be able to
- **state the general features of hand reamers**
- **identify the types of hand reamers**
- **distinguish between the uses of straight fluted and helical fluted reamers**
- **name the materials from which reamers are made and specify reamers.**

General features of hand reamers (Fig 1)

Fig 1



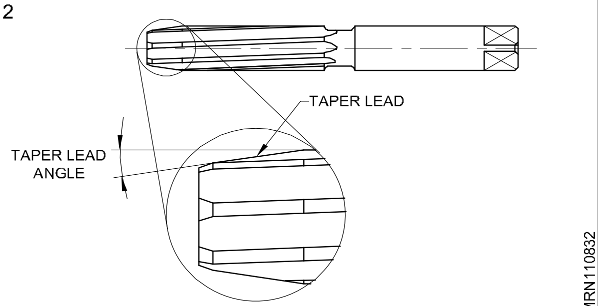
Hand reamers are used to ream holes manually using tap wrenches.

These reamers have a long taper lead.(Figure 2) This allows to start the reamer straight and in alignment with the hole being reamed.

Most hand reamers are for right hand cutting.

Helical fluted hand reamers have left hand helix. The left

Fig 2



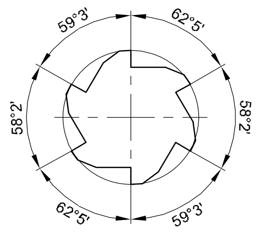
hand helix will produce smooth cutting action and finish.

Most reamers, machine or hand, have uneven spacing of teeth. This feature of reamers helps to reduce chattering while reaming. (Fig 3)

Types, features and functions

Hand reamers with different features are available for meeting different reaming conditions. The commonly used types are listed here under:

Fig 3



1 Parallel hand reamer with parallel shank (Fig 4a)

A reamer which has virtually parallel cutting edges with taper and bevel lead. The body of the reamer is integral with a shank. The shank has the nominal diameter of the cutting edges. One end of the shank is square shaped for tuning it with a tap wrench. Parallel reamers are available with straight and helical flutes. This is the commonly used hand reamer for reaming holes with parallel sides.

Reamers commonly used in workshop produce H8 holes.

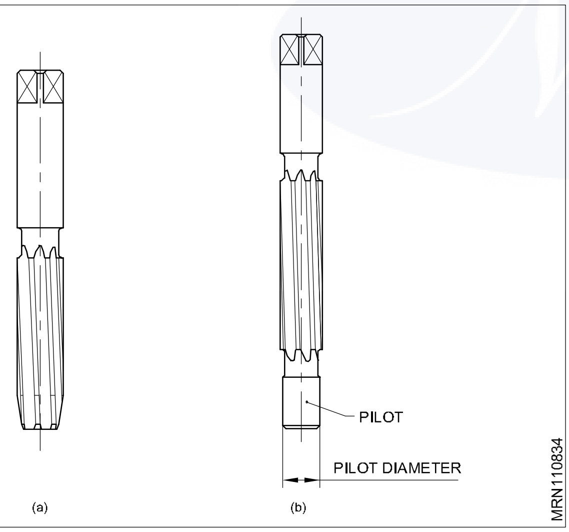
2 Hand reamer with pilot (Fig 4b)

For this type of reamer, a portion of the body is cylindrically ground to form a pilot at the entering end. The pilot keeps the reamer concentric with the hole being reamed.

3 Socket reamer with parallel shank (Figs 5a,b)

This reamer has tapered cutting edges to suit metric morse tapers. The shank is integral with the body, and is square shaped for driving. The flutes are either straight or helical.

Fig 4



The socket reamer is used for reaming internal morse tapered holes.

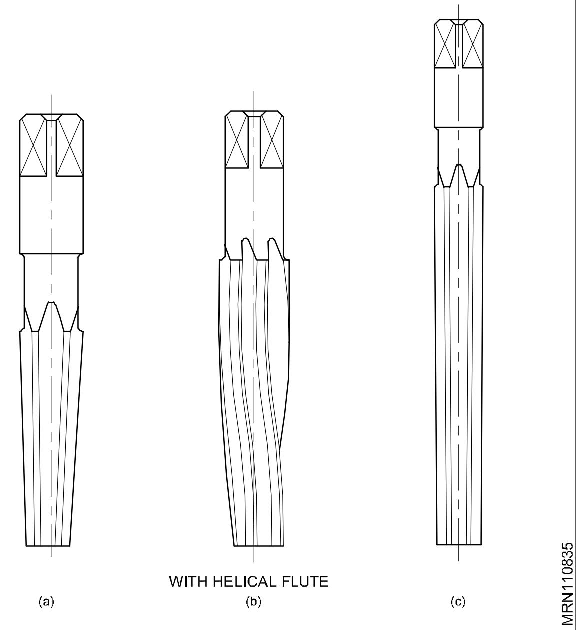
4 Taper pin hand reamer (Fig 5c)

This reamer has tapered cutting edges for reaming taper holes to suit taper pins. A taper pin reamer is made with a taper of 1 in 50. These reamers are available with straight or helical flutes.

Use of straight and helical fluted reamers (Fig 6)

Straight fluted reamers are useful for general reaming work. Helical fluted reamers are particularly suitable for reaming holes with keyway grooves or special lines cut into them.

Fig 5

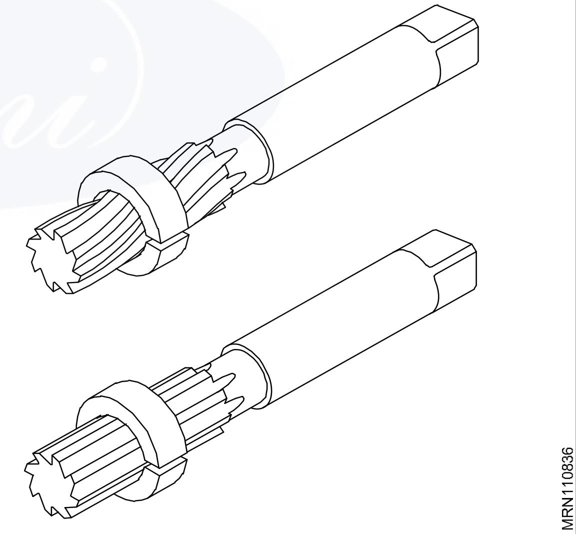


The helical flutes will bridge the gap and reduce binding and chattering.

Material of hand reamers

When the reamers are made as a one-piece construction, high speed steel is used. When they are made as two-

Fig 6



piece construction then the cutting portion is made of high speed steel while the shank portion is made of carbon steel. They are butt-welded together before manufacturing.

Specifications of a reamer

To specify a reamer the following data is to be given.

Type, Flute, Shank end Size

Example: Hand reamer, Straight flute, Parallel shank of f 20 mm.

Drill size for reaming

For reaming with a hand or a machine reamer, the hole drilled should be smaller than the reamer size.

The drilled hole should have sufficient metal for finishing with the reamer. Excessive metal will impose a strain on the cutting edge of the reamer and damage it.

Calculating drill size for reamer

A method generally practiced in workshop is by applying the following formula.

Drill size = Reamed size – (Undersize + Oversize)

Finished size

Finished size is the diameter of the reamer.

Undersize

Undersize is the recommended reduction in size for different ranges of drill diameter. (See Table 1)

Under sizes for reaming

TABLE 1

Diameter of ready reamed hole (mm)	Undersize of rough bored hole (mm)
under 5	0.1.....0.2
5......20	0.2.....0.3
21....50	0.3.....0.5
over 50	0.5.....1

Snips

Objectives: At the end of this lesson you shall be able to
- **state the six types of metal sheets used in sheet metal work**
- **state how the plate and the sheet are differentiated from each other**
- **state the features of a snip**
- **identify the different types of snips.**

Sheet metal work

A large quantity of sheet metal used in the sheet metal industry is steel, rolled into sheets of various thicknesses and coated with zinc, tin or other metals. Other than steel, the worker uses sheets made out of zinc, copper, aluminium, stainless steel etc.

The term `sheet metal' generally applies to metals and alloys in sheets rolled into various thicknesses less than 5mm. Sheets over 5 mm thick are called plates.

Earlier, the sheets were specified by standard wire gauge numbers. Each gauge is designated with a definite thickness. (Table 1) The larger the gauge number, the lesser the thickness. Now the sheet thickness is specified in mm, say 0.40, 0.50, 0.63, 0.80, 0.90, 1.00, 1.12, 1.25 etc.

Sheet thickness

Gauge No.	Inch	mm
18	0.048	1.22
19	0.040	1.02
20	0.036	0.91
21	0.032	0.81
22	0.028	0.71
23	0.024	0.61
24	0.022	0.56
25	0.020	0.51
27	0.0164	0.42
28	0.0148	0.38

Types of sheets

Sheet steel: It is an uncoated sheet with bluish-black appearance. The use of this metal is limited to articles that are to be painted or enamelled.

Galvanised iron sheet: The zinc-coated iron sheet is known as galvanised iron sheet, popularly known as GI sheet. The zinc coating resists rust. Articles like pans, buckets, furnaces, cabinets are made with GI sheet.

Copper sheets: Copper sheets are available either as cold-rolled or hot-rolled sheets. Cold-rolled sheets are worked easily in sheet metal shops. Gutters, roof flashing and hoods are common examples where copper sheet is used.

Aluminium sheets: Aluminium sheets are highly resistive to corrosion, whitish in colour and light in weight. They are widely used in the manufacture of a number of articles such as household utensils, lighting fixtures, windows etc.

Tin plates: Tin plate is sheet iron coated with tin to protect the iron sheet against rust. The size and thickness of the tin plate are denoted by special marks, not by gauge numbers. Tin plates are used for food containers, dairy equipment, furnace fittings etc.

Brass sheet: Brass is an alloy of copper and zinc in various proportions. It will not corrode and is extensively used in craft.

Snips

A snip is a cutting tool and is used for cutting thin sheets of metal.

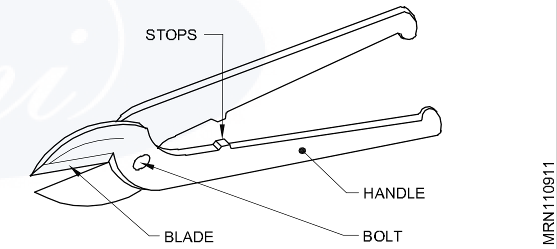
There are two types of snips.

- Straight snips
- Bent snips

Parts of a straight snip (Fig 1)

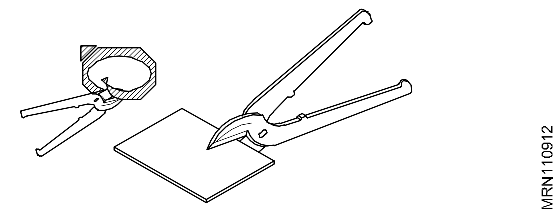
- Handle (1)
- Blade (2)
- Stops (3)

Fig 1



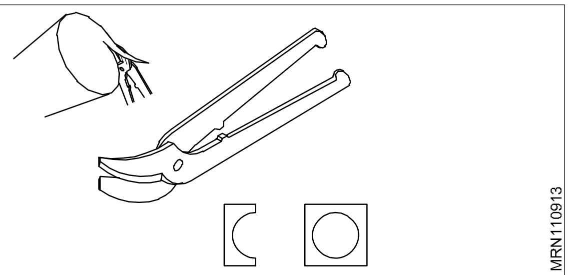
Straight snips: A straight snip has straight blades for straight line cutting. It can also be used for external curved cuts.(Fig 2)

Fig 2



Bent snip: Bent snips have curved blades used for cutting internal curves. For trimming a cylinder keep the lower blade on the outside of cut. (Fig 3)

Fig 3



Sheet metal seams and folding tools

Objectives: At the end of this lesson you shall be able to
- **state the types of seams.**

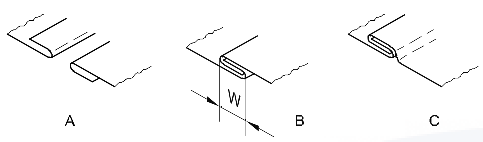
Introduction

In Sheet metal construction, mechanical seams are employed when joining light and medium gauge metal sheets. While fabricating sheet metal articles, the sheet metal worker should be able to select the type of seam that is best suited for the specific job.

Types of seams

1 **Grooved seam :** Grooved seam is most commonly used for joining sheet metal. This seam consists of two folded edges called locks as shown in Fig 1. The edges are hooked together and locked with a hand groover or a grooving machine.

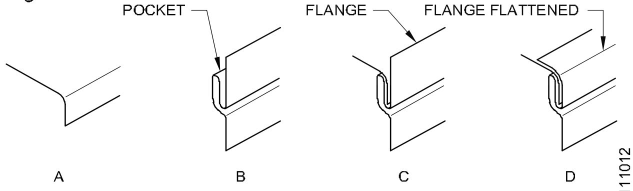
Fig 1



STEPS IN FORMING A GROOVED SEAM.

2 **Pittsburgh seam:** This seam is also called hammer lock or hobo lock. This seam is used as a longitudinal corner seam for various types of pipes such as duct work. The single lock is placed in a pocket lock and then the flange is hammered over, step by step as shown in Fig 2.

Fig 2



STEPS IN FORMING THE PITTSBURGH SEAM.

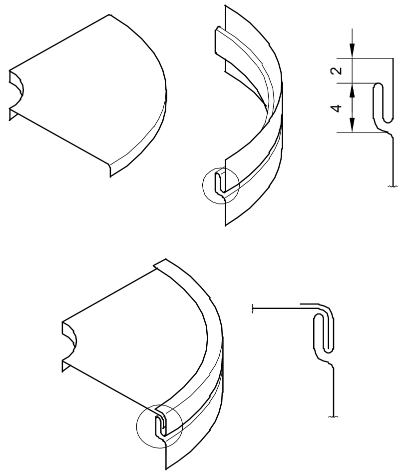
The advantage of the Pittsburgh seam is that the single lock can be turned on a curve and the pocket lock can be formed on a flat sheet and rolled to fit the curve as shown in Fig 3. If roll forming machine is not available in shop, Pittsburgh seam is formed on the brake.

3 **Dovetail seam :** This seam is an easy and convenient method of joining flanges to collars. There are three types of dovetail seams - plain dovetail, beaded dovetail and the flange dovetail as shown in Fig 4.

Dovetail seams are used mainly on round or elliptical pipe and rarely on rectangular ducts.

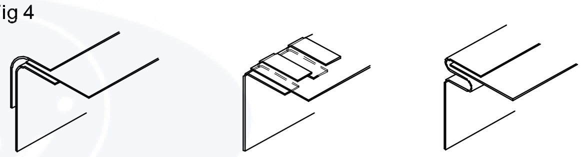
A **Plain dovetail seam :** It is used when joining a collar to a flange without the use of solder, screws or rivets. It is made by slitting the end of the collar and bending every other tab as shown in Fig 5

Fig 3



PITTSBURGH SEAMS CAN BE FORMED ON CURVES.

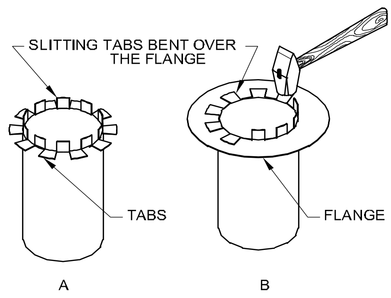
Fig 4



FLANGE DOVETAIL SEAM — PLAIN DOVETAIL SEAM — BEADED DOVETAIL SEAM

The straight tabs are bent over the part to be joined and the bent tabs act as stops. This seam may be made water tight by soldering around the joint.

Fig 5

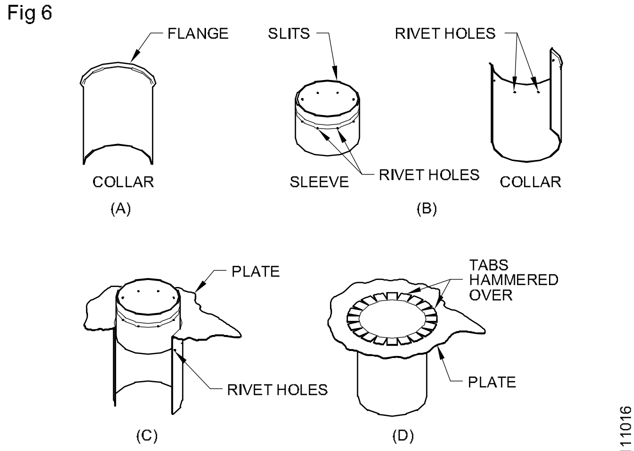


PLAIN DOVETAIL SEAM.

B **Flange dovetail seam**

This seam is used where neat appearance and strength are important. The seam shown in Fig 6 is the assembly of a flange type dovetail seam for a cylindrical pipe. It is commonly used where pipes intersect with a metal plate such as furnace flues, ceilings etc. Steps in forming a flange dovetail seam are shown in Fig 6. First, a flange is turned on the collar, next, slits are cut at regular intervals at the end of the sleeve and matching rivet holes are drilled in the sleeve and the collar. The rivet holes are aligned and the rivets are installed and finally the tabs are hammered over to complete the seam.

Fig 6



STEPS IN FORMING A FLANGE DOVETAIL SEAM.

C Beaded dovetail seam

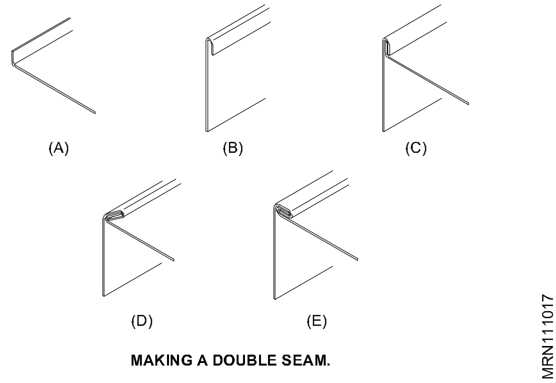
This is similar to the plain dovetail seam, except a bead is formed around one end of the cylinder by a beading machine. This bead acts as the stop for the flange to rest upon and the tabs are bent over to hold the flange in the desired place.

4 Double seam

There are two types of double seams. One type is used for making irregular fittings such as square elbows, boxes, offsets, etc. This seam is used on corners and can also be used as a longitudinal seam on small square and rectangular ducts. A double edge is formed and placed over the single edge and the seam is completed step by step as shown in Fig 7.

The other type is used to fasten bottoms to cylindrically shaped jobs such as pails, tanks etc.

Fig 7

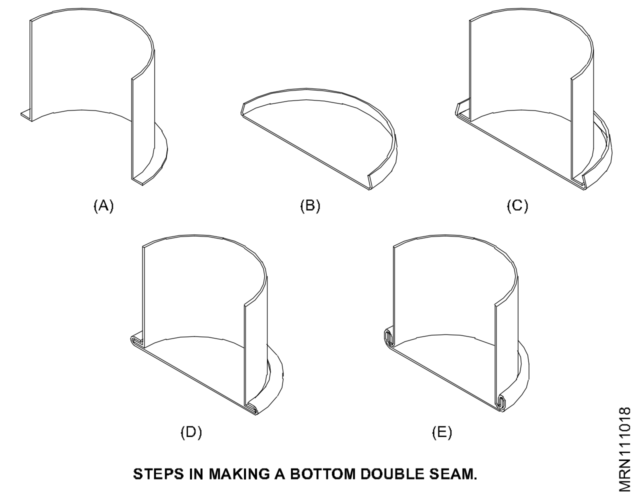


MAKING A DOUBLE SEAM.

The steps in making this type of double seam is shown in Fig 8, where A is turned on the machine. B is burred on the burring machine. The bottom is snapped on the body as in C and is peened down as in D. Finally the seam is completed by using a mallet as in E. This seam is called Bottom double seam or Knocked up seam.

If the seam is not turned up, as in D, the seam is called paned down seam.

Fig 8

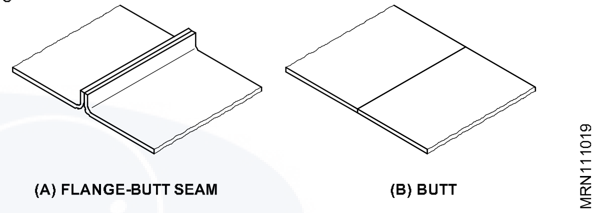


STEPS IN MAKING A BOTTOM DOUBLE SEAM.

5 Butt seam

This seam has two pieces butt together and soldered as shown in Fig 9. Figure shows two types of butt seams. One is flanged butt seam and the other one is butt seam.

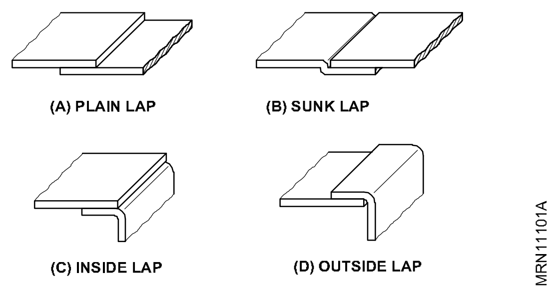
Fig 9



6 Lap seam

The lap seam is made by lapping the edge of one piece over the other piece and soldered as shown in Fig 10. Figure shows plain lap, sunk lap, inside lap and outside lap seams.

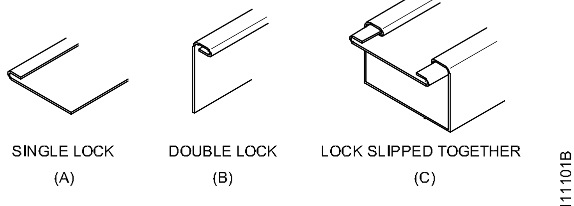
Fig 10



7 Slip joint seam

This seam is used for a longitudinal corner seam as shown in Fig 11.

Fig 11

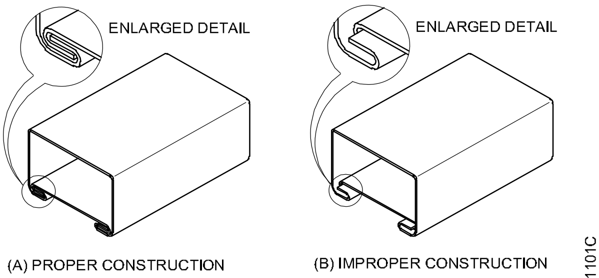


SLIP JOINT SEAM.

The assembly of the seam consists of a single lock A and a double lock B. The single lock is slipped into the double lock C to complete the seam.

For making pipes with a slip joint seam, proper care should be taken to see that the corners of the metal are squared and the edges are trimmed. The proper slip joint is shown as A and improper as B in Fig 12. If the edges are not trimmed, it will twist the pipe out of shape and may cause the edges of the pipe to be uneven.

Fig 12



PROPER AND IMPROPER JOINING OF SLIP JOINT SEAMS.

Locked grooved joint (Seam)

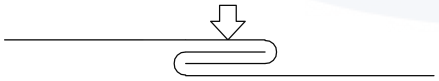
Objectives: At the end of this lesson you shall be able to
- **state the purpose of a joint**
- **state the use of the groover**
- **determine the allowance for the locked grooved joint**
- **know the type of shears**
- **know the uses of shears**
- **know about the shearing force**
- **know the blade clearance for optimum cutting.**

Locked grooved joint: Many methods are employed to join and strengthen the pieces of a sheet metal. One of the common joint is called locked grooved joint.

This is usually done on straight lines. The work pieces to be joined are made in the form of a hook, inserted and locked using a groover.

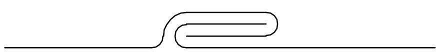
When they are interlocked and tightened only then it is called a “grooved joint” (Fig 1).

Fig 1



When the grooved joint is clinched down, making one side plane using a groover is called a “Locked grooved joint”. (Fig 2)

Fig 2



External and internal locked grooved joints: This joint is used to join the two ends of a sheet metal to form a circular shape in longitudinal direction. When the seam is formed outside as shown in Fig 3 then it is called ‘external locked grooved joint’.

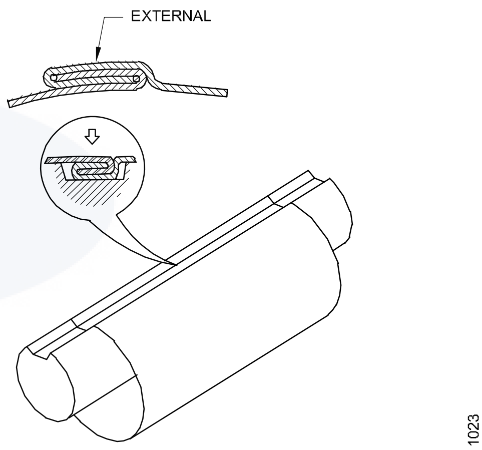
If the seam is formed using grooved mandrel then it is called ‘Internal locked grooved joint’ (Fig 3)

Hand groover: The hand groover is made up of cast steel and is used to make external locked grooved joint.

A groove is made at the bottom of this tool to the required width and depth.

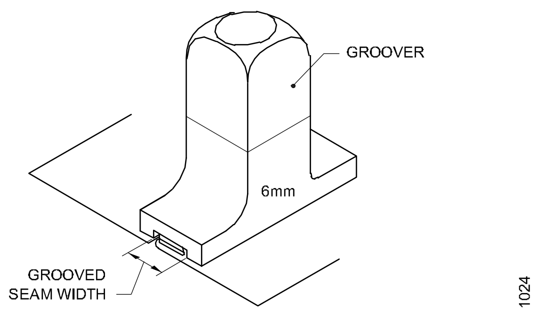
This has a handle in square or hexagonal shape like chisel to hold. This whole part is hardened and tempered. (Fig 4)

Fig 3



INTERNAL GROOVE

Fig 4

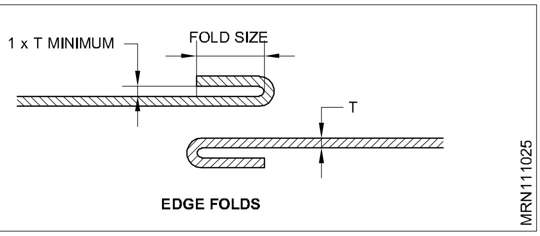


SIZE OF GROOVE & SEAM

The hand groover is specified according to the size of the groove of the groover.

Locked grooved joint allowance: To arrive the size (width) of the fold to suit a particular groover, subtract the thickness by 3 times from the width of the groove. (Fig 5)

Fig 5



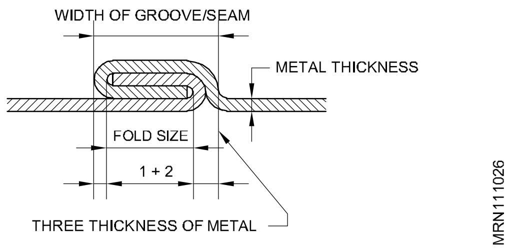
For example, the width of the groover is 6 mm and the sheet thickness is 0.5 mm,

Then the width of the fold

= 6 - (3 x 0.5)

= 4.5 mm (See Fig 6).

Fig 6



Stake Joint

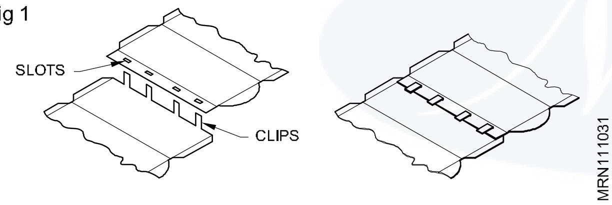
Objectives: At the end of this lesson you shall be able to
- **state the applications of stake joint**
- **state the types of stake joints.**

Stake joint

It is one of the folded joint and is used in light articles such as toys. It is also called as toy joint.

In this type of joint, clips are cut on one piece of metal and slots are cut on another piece to be jointed. Clips are inserted in slots and folded flat either in one direction or alternate clips are folded in opposite direction. (Fig 1)

Fig 1



Type of stake joint

A Straight stake joint B Zigzag stake joint

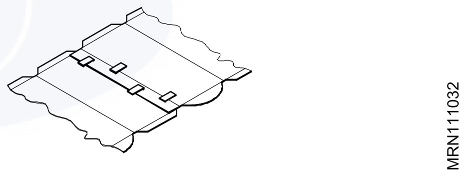
Straight stake joint

In this joint, clips and slots are in a line and the clips are inserted directly into the slots, folded and smashed in opposite direction. (Fig 1)

Zigzag stake joint

In this joint, clips are inserted in the slots, and alternate clips are folded in opposite direction. (Fig 2)

Fig 2



Folding tools

Objectives: At the end of this lesson you shall be able to
- **state the uses of different folding tools.**

The common tools used in the folding of sheet metal are:

– angle steel and folding bar

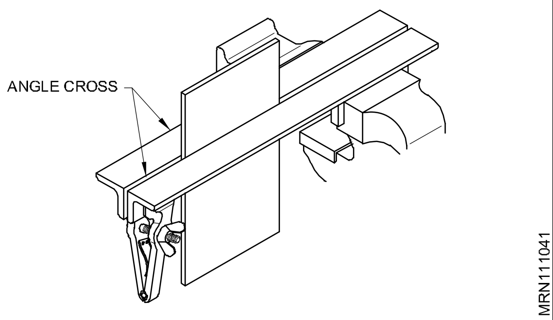
– C clamp

– stakes

– mallet.

Angle steel: Two pieces of angles are used for folding at 90^0. For longer sheets lengthy angles will be used along clamp (or) hand vice. (Fig 1)

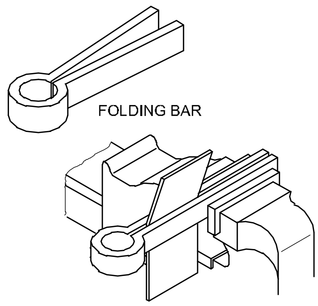
Fig 1



Folding bar: The sheet metal to be bent is clamped in the folding bars. The folding bars are clamped in the vice as shown in the figure. (Fig 2)

**`C' clamp:** The shape of the clamp is in the form of the letter `C'. `C' clamp is a holding device. This clamp is used when the piece has to be securely fixed to another piece. It is available in different sizes according to the opening the of jaws. (Fig 3)

Fig 2



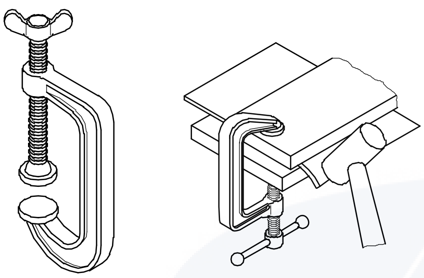
Stakes: Stakes are used for bending, seaming and forming of sheet metal that cannot be done on any regular machine. For the above purposes, different stakes are used. Stakes are made of forged steel or cast steel.

Types of stakes

– Hatchet stake

– Square stake

Fig 3



'C' CLAMP / 'G' CRAMP

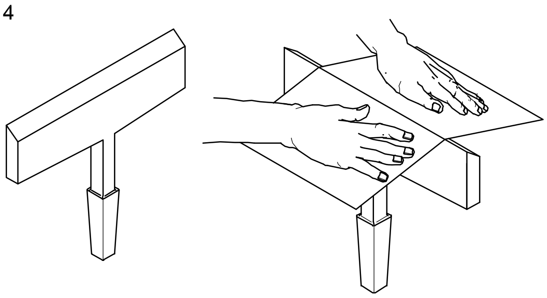
– Blow-horn square stake

– Bevel-edge square stake.

Hatchet stake: A hatchet stake has a sharp straight edge bevelled on one side. It is used for making sharp bends, for bending edges and for folding sheet metal. (Fig 4)

Square stake: A square stake has a flat and square-shaped head with a long shank. It is used for general purposes. (Fig 5)

Fig 4



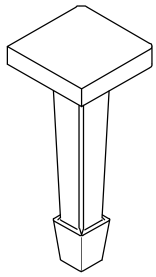
HATCHET STAKE

Blow-horn stake: It has a short tapered horn at one end, and a long tapered one at the other end. It is used in forming, riveting or seaming tapered, cone-shaped articles, such as funnels etc. (Fig 6)

Bevel-edged square stake: A bevel-edged square stake is used to form corners and edges.(Fig 7)

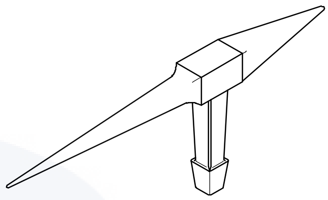
Mallet: A mallet is used for working on sheet metal. It will not damage the sheet surface while working. Mallets are made of wood, rubber, copper etc.(Fig 8)

Fig 5



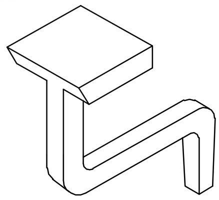
SQUARE STAKE

Fig 6



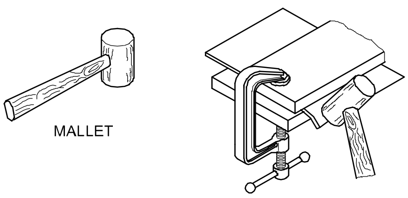
BLOW HORN STAKE

Fig 7



BEVEL-EDGED SQUARE STAKE

Fig 8

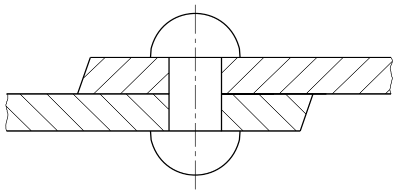


Securing metal sheets by rivetting

Objectives: At the end of this lesson you shall be able to
- **define riveting**
- **state the uses of rivets**
- **name the materials from which rivets are made**
- **identify the different types of rivets.**

Riveting: Riveting is one of the satisfactory methods of making permanent joints of two pieces - metal snips. (Fig 1)

Fig 1



It is customary to use rivets of the same metal as that of the parts that are being joined.

Uses: Rivets are used for joining metal sheets and plates in fabrication work, such as bridges, ships, cranes, structural steel work, boilers, aircraft and in various other works.

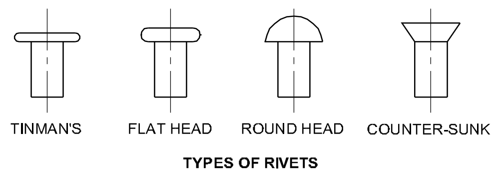
Material: In riveting, the rivets are secured by deforming the shank to form the head. These are made of ductile materials like low carbon steel, brass, copper and aluminium.

Types of rivets (Fig 2)

The four most common types of rivets are:

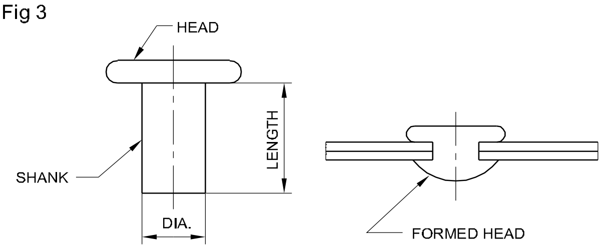
- tinmen's rivet
- flat head rivet
- round head rivet
- countersunk head rivet.

Fig 2



Each rivet consists of a head and a cylindrical body called as shank. (Fig 3)

Fig 3



Sizes of rivets: Sizes of rivets are determined by the diameter and length of the shank.

Selection of rivet size: The diameter of the rivet is calculated by using the formula

$$D = \left(\frac{21}{2} \text{ to } 3\right) \times T \text{ where T is total thickness.}$$

The shank length is given by

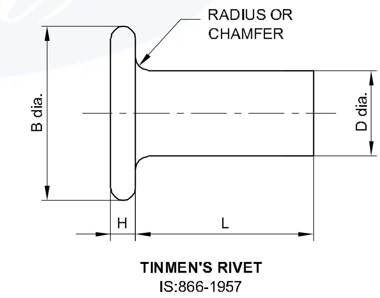
$$L = T + T + \left(\frac{11}{2}D\right)$$

where `T' is the sheet thickness and `D' is the diameter of the rivet.

Normally tinmen's rivets are designated by numbers.

The ISI table giving the dimension of the tinmen's rivets is given below. (Fig 4)

Fig 4



Method of riveting: Riveting may be done by hand or by machine.

While riveting by hand, it can be done with a hammer and a rivet set.

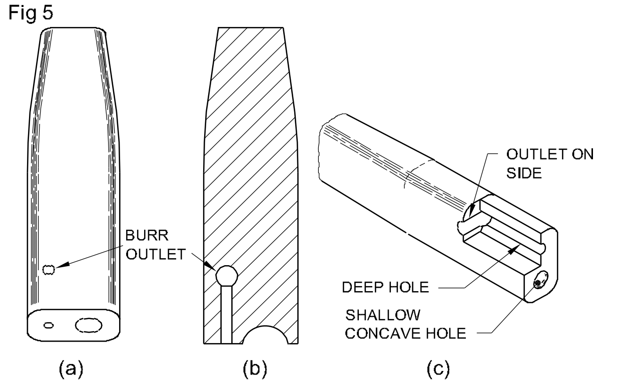
Rivet set: A cross-section of a rivet set is shown in the figure 5a, b and c. The shallow, cup-shaped hole is used to draw the sheet and the rivet together. The outlet on the side allows the slug to drop out.

The cup shape is used for forming the rivet head.

The rivet set selected should have a hole slightly larger than the diameter of the rivet.

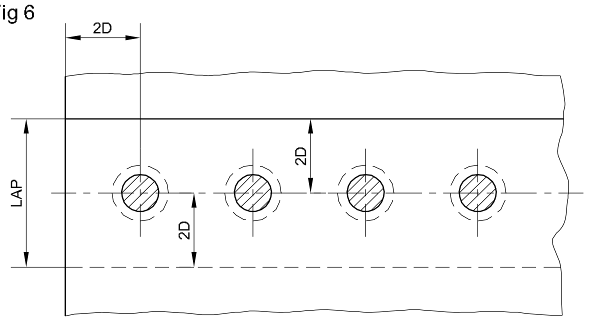
Spacing of rivets: The space or distance from the edge of the metal to the centre of any rivet should be atleast twice the diameter of the rivet to avoid tearing. The `Lap' distance (4D) is shown in Fig 6.

Fig 5



SECTION OF A RIVET

Fig 6

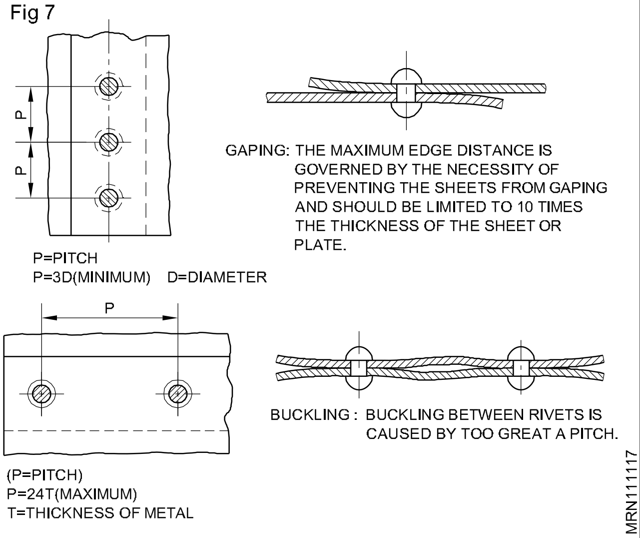


EDGE DISTANCE = TWICE THE DIAMETER OF RIVET (MINIMUM)
MINIMUM LAP = FOUR TIMES DIAMETER OF RIVET

The minimum distance between the rivets (pitch) should be sufficient to allow the rivets to be driven without interference. The distance should be atleast three times the thickness of the sheet or above.

The maximum distance should never exceed 24 times the thickness of the sheet. Otherwise buckling will take place as shown in Fig 7.

Fig 7



Soldering

Objectives: At the end of this lesson you shall be able to
- **state the process of soldering**
- **state the different types of solder and their application.**

There are different methods of joining metallic sheets. Soldering is one of them.

Soldering is the process by which metallic materials are joined with the help of another liquified metal (solder).

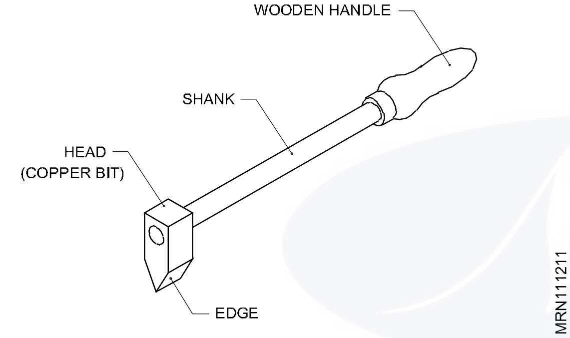
The melting point of the solder is lower than that of the materials being joined.

The solder wets the base material without melting it.

Soldering iron (Fig 1)

The soldering iron is used to melt the solder and heat the metal that are to be joined together.

Fig 1



A soldering iron has the following parts.

- Head (copper bit)
- Shank
- Wooden handle
- Edge

Shape of head

The head of the iron is made of forged copper. This is because copper has a good heat conductivity and has a strong affinity for the solder so that the solder melts easily and sticks to the bit.

A Hatchet type soldering as in (Fig 1) has shank fitted at 90° to the head. The soldering edge is 'V' shaped.

This type is used for straight soldering joints.(Fig 2)

The other type is the square pointed soldering iron or a standard workshop pattern soldering iron. (Fig 3) For this type the edge is shaped to an angle on four sides to form a pyramid shape.

This is used for tacking and soldering of joining points. (Fig 3a and 3b)

Fig 2

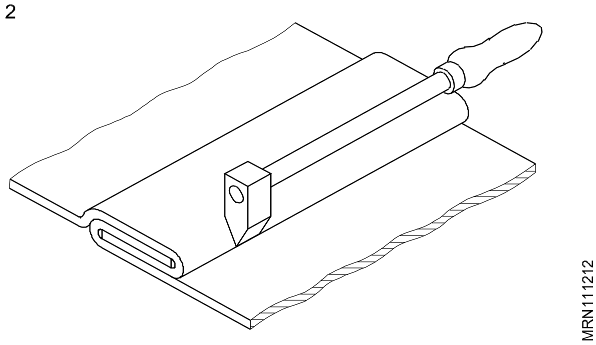


Fig 3

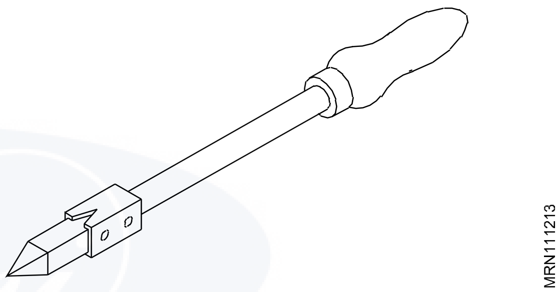


Fig 3a

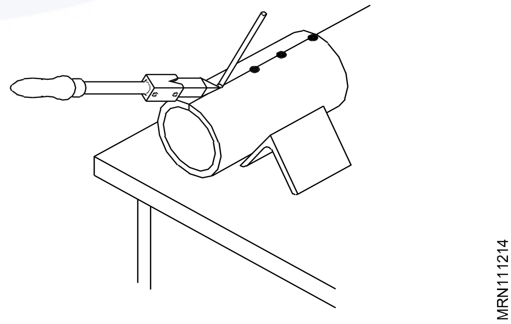
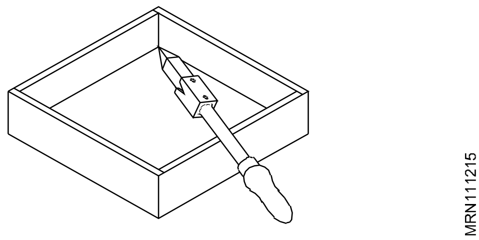


Fig 3b

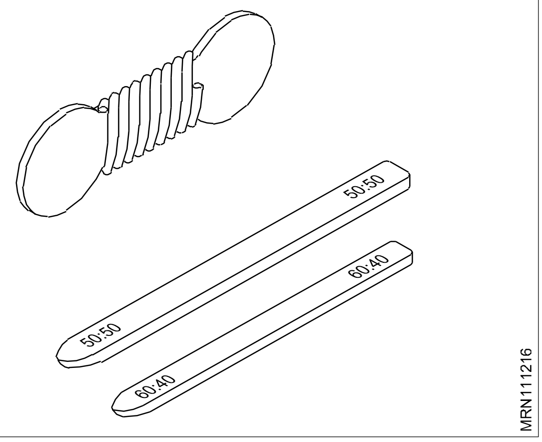


Solders

Pure metals or alloys are used for solders.

Solders are applied in the form of wires, sticks, ingots, rods, threads, tapes, formed sections, powder and pastes. (Fig 4)

Fig 4



Types of solders

There are two types of solders.

- Soft solder
- Hard solder

One distinguishes between soft solders whose melting points are below 450° C and hard solders whose melting points lie above 450° C.

Soft solders

These are alloys of the metals- tin, lead, antinomy, copper, cadmium and zinc and are used for soldering heavy (thick) and light metals.

Hard solders

These are alloys of copper, tin, silver, zinc, cadmium and phosphorus, and are used for soldering heavy metals.

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 fluxes

1 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.

2 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.

3 Ammonium chloride

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

Ammonium chloride, dissolved in water, 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.

4 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.

5 Paste

This is a mixture of zinc chloride, resin, glycerine 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.

Development of surface

Objectives: At the end of this lesson you shall be able to
- **state what is a pattern, a layout and a stretch out**
- **state & notching and clipping the allowances for edges and seaming considered in pattern development**
- **state different methods of pattern layout development.**

Pattern: The pattern is a piece of material, which is cut to the exact size and shape, to form the desired object.

It is nothing but, a flat outline of an object, to be formed to its final shape.

The pattern may be drawn on a paper first, then transferred to the sheet metal. This makes possible the corrections if any, saving valuable material. Paper patterns are not suitable for repeated use.

However, experienced skilled sheet metal worker do pattern layouts directly on the sheet metal.

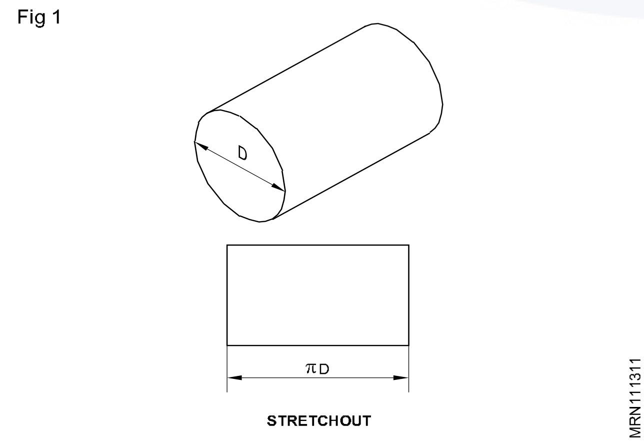
Layout: It is the method of developing the lines and curves which form the pattern.

Pattern layout is done by employing different geometrical constructions.

Different geometrical constructions are taught in the engineering drawing subject.

Stretchout: The term "stretchout" refers to the sizes of flat piece of metal before it is formed into shape. For example, the stretchout of a round pipe is the circumference of the pipe. (Fig 1)

Fig 1



Allowances for edges and seaming, considered in pattern layout development.

Allowances of edges: Different types of edges, are used to stiffen the edges of sheet metal articles and to eliminate sharp edges.

Edges are made either by bending or by wrapping the metal.

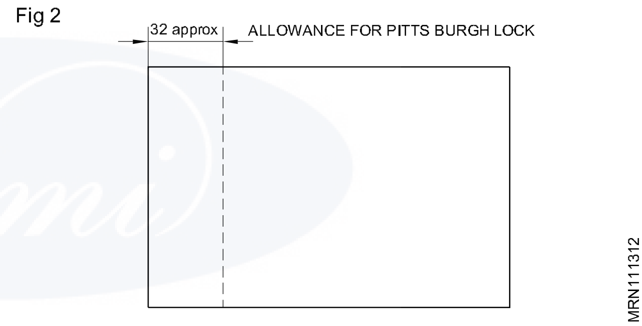
The amount of metal allowed for the edges is called allowance for edges.

The following table shows the allowance for different edge.

S.No	Type of edge	Allowance generally kept
1	Single hem	6 mm above 22 gauge sheet 8 mm below 22 gauge sheet
2	Double hem	Twice the hem size - 1.6 mm
3	Wired edge gauge sheet	2.5 x dia of wire - above 24G 2.5 x dia of wire + thickness of metal - below 24 gauge sheet

Allowances for seaming: Sheet metal parts are joined by various types of seams. The amount of metal allowed for seaming is called "Allowances for seaming". The following table shows the allowance for different seams. (Fig 2)

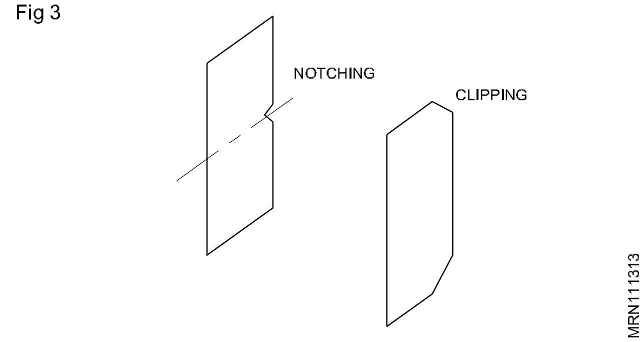
Fig 2



S.No	Type of edge	Allowance generally kept
1	Grooved seam	3 x width of lock above 24 gauge sheet 3 x width of lock + 5 thickness of metal-below 24 gauge sheet

Allowances for Notching & Clipping: Notching and clipping are used to cut away that portions of the metal to prevent overlapping and bulging on seams and edges. (Fig 3) For detail information, please refer next lesson.

Fig 3



Four methods are commonly used for pattern development.

1 Parallel line development method

2 Radial line development method

3 Triangulation development method

4 Geometric construction method.

Parallel line development method

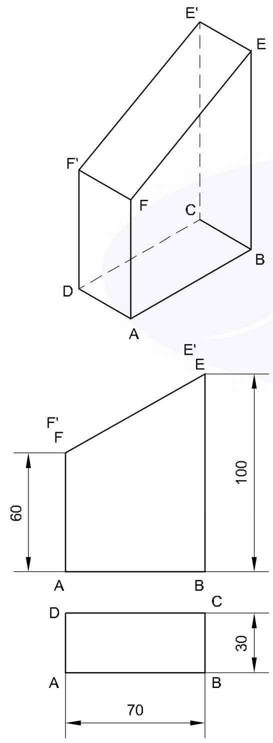
Objectives: At the end of this lesson you shall be able to
- **state what is parallel line development method**
- **layout patterns for simple objects by parallel line development method.**

Parallel line development method: Parallel line development method is used for pattern development of the objects whose sides run parallel to one another as in ducts, elbows and T joints.

In developing any pattern by parallel line development method, following procedure is followed (for illustration refer object shown in Fig 1).

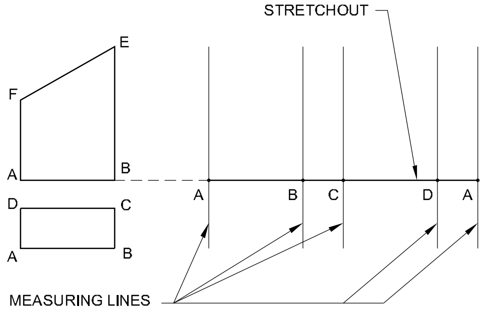
1 Draw the elevation and plan of the object with dimensions (Fig 1)

Fig 1



2 Draw the stretchout of the pattern (Fig 2).

Fig 2

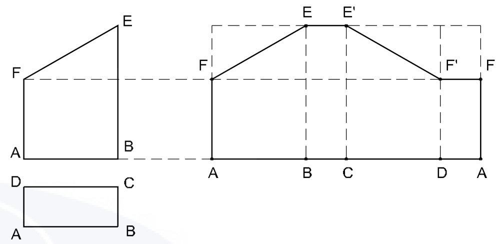


3 Locate measuring lines from elevation or plan on the pattern stretch out. While locating measuring lines, these lines should be in proper distance apart and in proper order.(Fig 3)

4 Transfer the lengths of the measuring lines from elevation to the same lines on the pattern.(Fig 3)

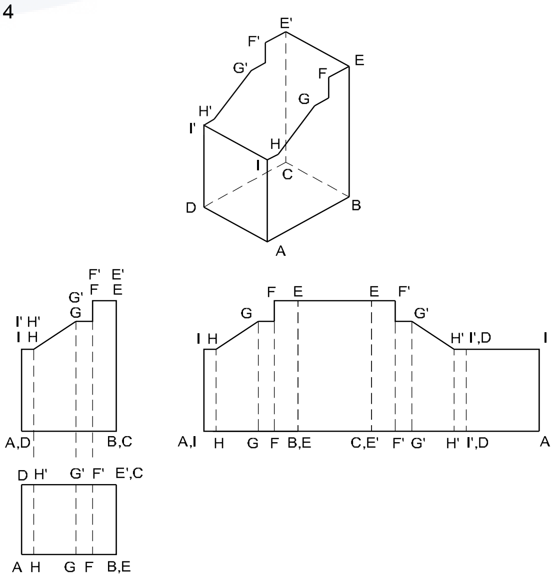
5 Connect the points located on the measuring lines. (Fig 3)

Fig 3



By this method, the pattern layout of the following object is shown for better understanding of parallel line development method. (Fig 4)

Fig 4

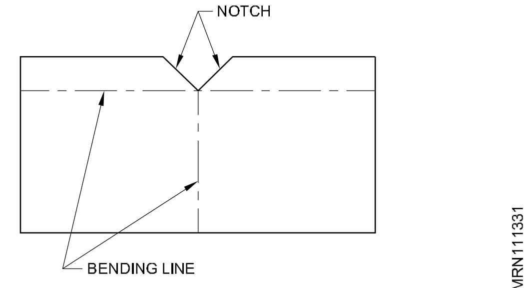


Notches in sheet metal

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 and state the uses of each.**

Notches: Notches are the spaces provided for joining the edges when sheet metals are cut from the layout. (Fig 1)

Fig 1



Purpose of notches

Notches help to :

– to prevent surplus material from overlapping and causing a bulge at the seam and edges

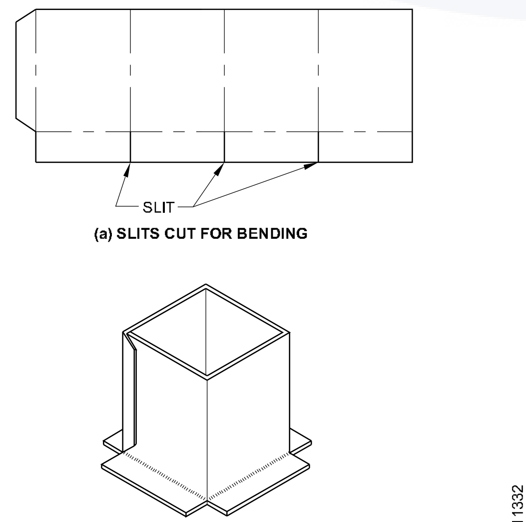
– to allow the work to be formed to the required size and shape

– to allow the work to assemble better.

Types of notches

Straight notch or slit: Straight cuts made from the edge of the sheet to a distance where it is to be bent is known as a straight notch. (Figs.2a and 2b)

Fig 2

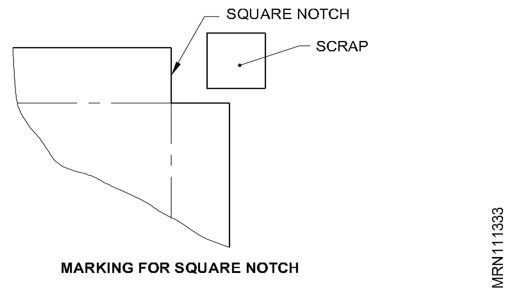


(a) SLITS CUT FOR BENDING

(b) SHEET BENT TO SHAPE USING NOTCH

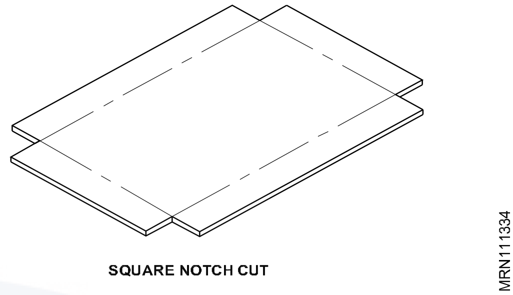
Square notch: A square notch is used when forming a square or rectangular box. (Figs.3,4 and 5)

Fig 3



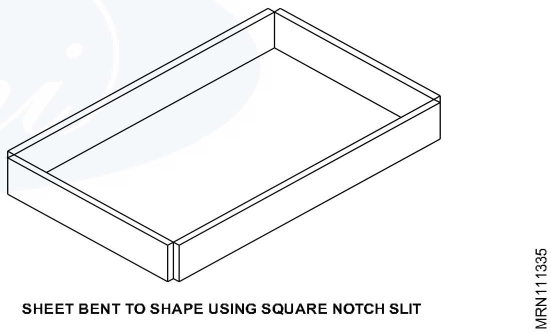
MARKING FOR SQUARE NOTCH

Fig 4



SQUARE NOTCH CUT

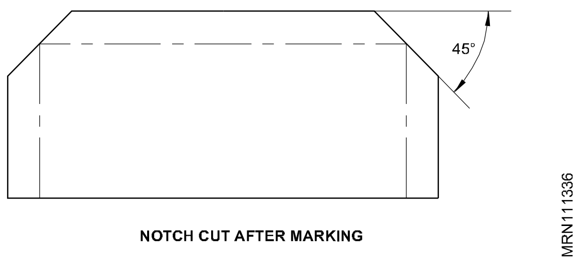
Fig 5



SHEET BENT TO SHAPE USING SQUARE NOTCH SLIT

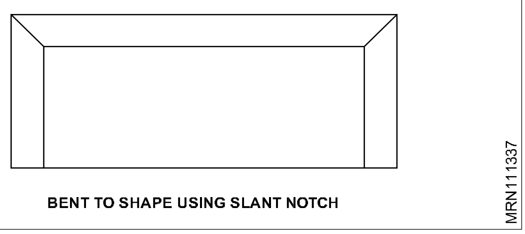
Slant notch: This notch is cut at an angle of 45^0 to the corner of the sheet. It is used when a single hem meets at right angles. (Figs.6 & 7)

Fig 6



NOTCH CUT AFTER MARKING

Fig 7

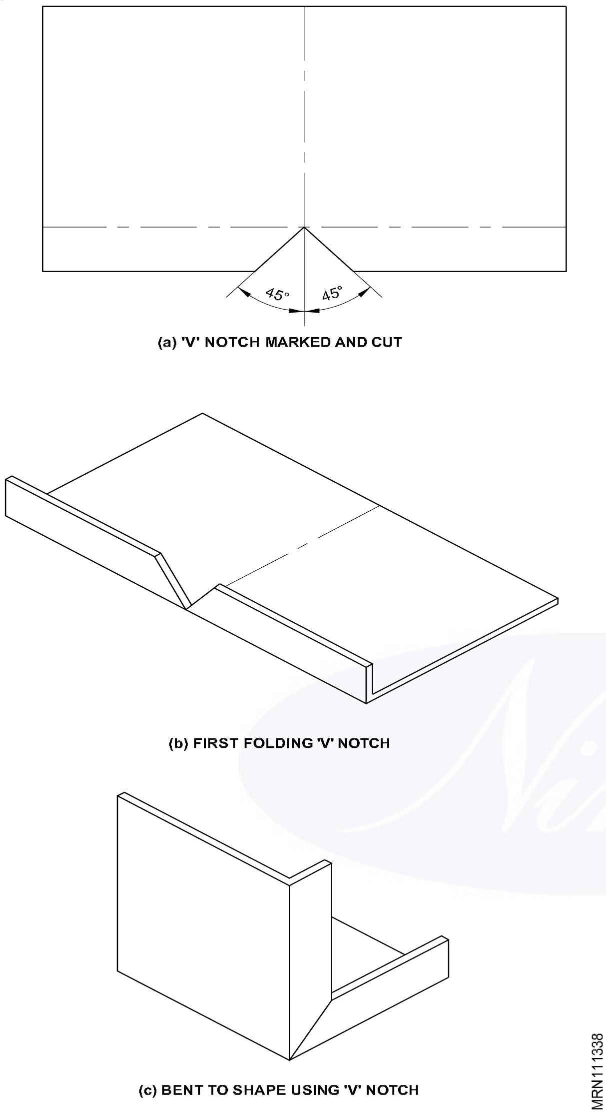


BENT TO SHAPE USING SLANT NOTCH

V' Notch: 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. (Figs.8, 9 and 10)

Fig 8

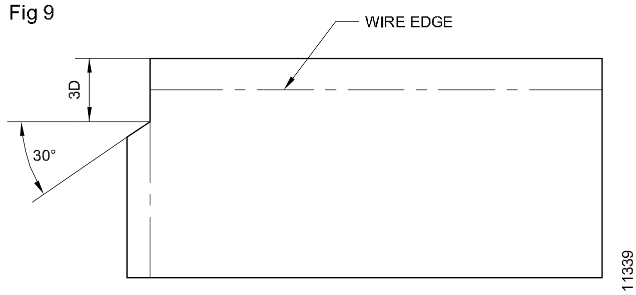


(a) 'V' NOTCH MARKED AND CUT

(b) FIRST FOLDING 'V' NOTCH

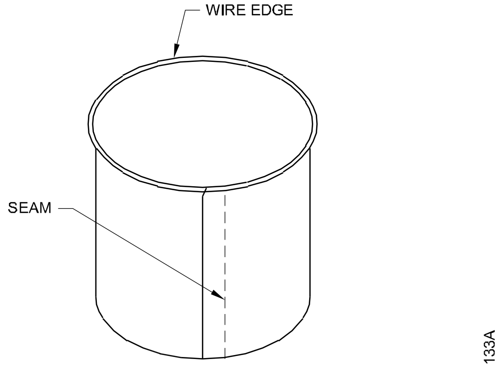
(c) BENT TO SHAPE USING 'V' NOTCH

Fig 9



WIRE NOTCH MARKED CUT

Fig 10



AN EDGE WIRED USING WIRE NOTCHES