Safety precautions in sheet metal workshop

Objectives: At the end of this lesson you shall be able to
- **state various hazardous while working in a SMW shop**
- **state different precautions to be taken for safe working in a SMW shop.**

Whenever a work is done in a shop the following aspects may create an injury to the workman/trainee or to others working nearby.

1 Way of handling the materials, tools and machine.

2 Cleaning of the work area/shop floor.

3 Damaged/faulty tools, machines and safety appliances.

4 Carelessness and negligence of the workman/trainee.

5 Ignorance of general safety rules.

To avoid the accident/injuries taking place, while working it is very important to follow certain safety precautions. They are:

- Do not bend your whole body while lifting heavy loads. Instead use your thigh muscles for lifting.
- Use gloves while handling thin sheets.
- Use chipping screen during chiseling operation.
- Avoid using a mushroom head chisel.
- Arrange the tools properly over the work table so that the tools are not allowed to fall from the table on your foot.
- Wear proper size safety shoes.
- Remove burrs by filing from a plate or sheet after cutting them by chisel or hacksaw.
- Do not use a hammer with a broken or damaged handle.
- Fix the hammer head with the handle securely using a wedge.
- Do not wear loose garments/dress.
- Wear plain goggles/face shield while grinding.
- Do not grind materials which are 3mm or less in thickness and non-ferrous metals.
- Adjust the gap between the work rest and the grinding wheel to 1-2mm.
- Select and use the right kind of tool for the right job.
- Keep the floor on the work area neat and clean without any cut pieces of material, oil, etc.
- Keep a separate bin/basket for throwing cotton waste, metal chips etc.
- Always keep fire fighting equipment and the First Aid Box ready for use in case of any emergency.
- After completion of work keep the tools in the tool box.
- Wear helmet if anybody is working above your work place, either to repair at the roof or on a overhead crane.
- Use tongs while handling hot objects.
- Do not try to check the sharpness of any tool with bare fingers.
- Switch off the mains of a machine while leaving the machine after completion of work.
- Do not try to rectify any electrical fault by yourself. Call an electrician for doing any electrical repair work.
- Wherever and whenever possible avoid poluting the environment.
- If any other person is affected by electric shock, immediately switch off the mains or separate the person from the electrical contact using a wooden rod or any other insulating material.
- Always fix the job at a convenient height on the vice.
- Use sufficient leverage while tightening or loosening a nut or bolt.

General Workshop Rules

- Safety glasses must be worn.
- Safety footwear must be worn when working in the workshop.
- Ask workshop instructor before using equipment.
- Visitors must remain within marked walkways.
- Long hair must be tied back.
- Clean, equipment & machines after use.
- Take care when using compressed air.
- Hearing protection should be worn when using machinery.
- Working alone after hours is not permitted.

Metal sheets and their uses

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 their standard gauge numbers.

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

Black iron sheets: The cheapest sheet metal is the black iron, which is rolled to the desired thickness. The sheets are rolled in two conditions. When it is rolled in cold state, it is called cold rolled and when it is rolled in hot state, it is called hot rolled. Hot rolled sheets have a bluish black appearance, and are often referred to as uncoated sheets, since they are uncoated. They corrode rapidly.

Cold rolled sheets have plain silver whitish appearance and are uncoated. To decrease the work hardness, the cold ruled sheets are annealed in a closed atmosphere. These sheets are known as C.R.C.A (Cold rolled close annealed) sheets.

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

Galvanised iron sheets: Zinc coated iron is known as 'galvanised iron'. This soft iron sheet is popularly known as G.I. sheet. The zinc coating resist corrosion and improves the appearance of the metal and permit it to be soldered with greater ease. Because it is coated with zinc, galvanised iron sheet withstands contact with water and exposure to weather.

Articles such as pans, buckets, furnaces, heating ducts, cabinets, gutters etc. are made mainly from G.I. sheets.

Stainless sheets: 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 similar to galvanised iron sheets, but is tougher than G.I. sheets. The cost of stainless steel is very high.

Stainless steel is used in dairies, food processing, chemical plants, kitchenware etc.

Copper sheets: Copper sheets are available either as cold rolled or hot rolled. They have a very good resistance to corrosion and can be worked easily. They 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 sheets are used.

Aluminium sheets: Aluminium cannot be used in its pure form, but is mixed with very small amount of copper, silicon, manganese and iron. Aluminium sheets are whitish in colour and light in weight. They are highly resistant to corrosion and abrasion.

Aluminium 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 making roofs, food containers, dairy equipment, furnace fittings, cans and pans etc.

Lead sheets: Lead is very soft and heavy in weight.

Lead sheets are used for making the highly corrosive acid tanks.

When lead is coated on black iron sheets, they are called Terni sheets. They are highly anti-corrosive and commonly used in preservation of chemicals.

Indian Standard sheet sizes & strip sizes

Objectives: At the end of this lesson you shall be able to
- **specify the Indian Standard sheet sizes**
- **specify the Indian Standard strip sizes**
- **calculate the weight of the steel sheet, and the measure of the strip.**

Indian Standard sheet sizes & strip sizes

As per Indian Standard are designated as ISSH received by figures denoting length (mm) x width (mm) x thickness (mm) of the sheet as per IS 1730 : 1989.

Example

ISSH 3200 x 600 x 1.00

Where

3200 is the length of the sheet (mm)

600 is the width of the sheet (mm)

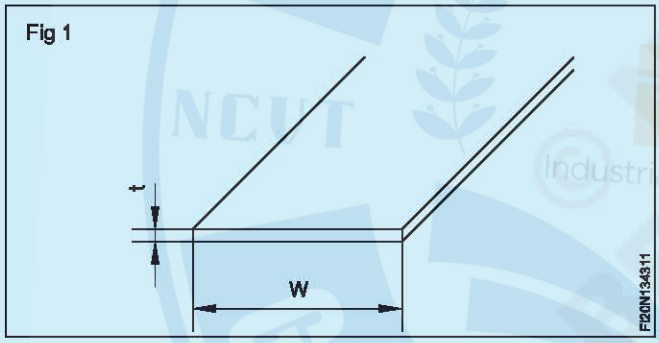
1.00 is the thickness of the sheet (mm)

Table 1 gives the weight of steel sheets of different standard sizes.

Indian Standard strip sizes

Indian Standard strips are designated as ISST followed by width (mm) x thickness (mm) of the strip as per IS 1730 - 1989. (Fig 1)

Fig 1



Example

ISST 1050 x 3.15: Where 1050 mm is the width of the strip and 3.15mm is the thickness.

Exercise

Calculate the weight of the steel sheet given below.

ISSH 1800x1200 x 1.40mm

Table 2 gives the weight in kg of a particular strip per metre length.

Exercise

Calculate the weight of a ISST 500 x 4 of 2 metres

Answer

TABLE 1

Standard Nominal Dimensions and Mass of Sheet

Size mm x mm	Standard Nominal Surface Area in m^2	Standard Nominal Thickness in mm												
		0.40	0.50	0.63	0.80	0.90	1.00	1.12	1.25	1.40	1.60	1.80	1.90	2.00
1800 x 600	1.08	3.39	4.24	5.34	6.78	7.65	8.47	9.50	10.6	11.9	13.6	5.3	16.1	17.0
750	1.35	4.24	5.30	6.67	8.48	9.54	10.6	11.9	13.2	14.8	17.0	19.1	20.1	21.2
900	1.62	5.09	6.35	8.01	10.2	11.4	12.7	14.2	15.9	17.8	20.3	22.9	24.2	25.4
950	1.71	5.37	6.71	8.45	10.7	12.1	13.4	15.0	16.8	18.8	21.5	24.2	25.5	26.8
1000	1.80	5.65	7.06	8.90	11.3	12.7	14.2	15.8	17.7	19.8	22.6	25.4	26.8	28.3
1100	1.98	6.22	7.77	9.79	12.4	14.0	15.6	17.4	19.4	21.8	24.9	28.0	29.5	31.1
1200	2.16	6.78	8.48	10.7	13.6	15.3	17.0	19.0	21.2	23.7	27.1	30.5	32.2	33.9
1250	2.25	7.07	8.83	11.1	14.1	15.9	17.6	19.8	22.1	24.7	28.3	31.8	33.6	35.3
1400	2.52	7.91	9.90	12.5	15.8	17.8	19.8	22.2	24.7	27.7	31.7	35.6	37.6	39.6
1500	2.70	8.48	10.6	13.4	17.0	19.1	21.2	23.8	26.5	29.7	33.9	38.2	40.2	42.4
2000 x 600	1.20	3.77	4.71	5.93	7.53	8.47	9.42	10.6	11.8	13.2	15.1	17.0	17.9	18.8
750	1.50	4.71	5.88	7.42	9.42	10.6	11.8	13.2	14.7	16.5	18.8	21.2	22.4	23.6
900	1.80	5.65	7.06	8.90	11.3	12.7	14.1	15.8	17.7	19.8	22.6	25.4	26.8	28.3
950	1.90	5.97	7.45	9.39	12.0	13.4	14.9	16.8	17.9	20.8	23.6	26.8	28.3	29.8
1000	2.00	6.28	7.85	9.89	12.6	14.1	15.7	17.6	19.6	22.0	25.1	28.3	29.8	31.4
1100	2.20	6.91	8.63	10.9	13.8	15.5	17.3	19.3	21.6	24.2	27.6	31.1	32.8	34.5
1200	2.40	7.53	9.42	11.9	15.1	17.0	18.8	21.1	23.6	26.4	30.1	33.9	35.8	37.7
1250	2.50	7.85	9.80	12.4	15.7	17.7	19.6	22.0	24.5	27.5	31.4	35.3	37.2	39.2
1400	2.80	8.79	11.0	13.8	17.6	19.8	22.0	24.6	27.5	30.8	35.2	39.6	41.8	44.0
2500	3.00	9.42	11.8	14.8	18.8	21.2	23.6	26.4	29.4	33.0	37.7	42.2	44.7	47.1
2200 x 600	1.32	4.14	5.18	6.52	8.28	9.32	10.4	11.6	13.0	14.5	16.6	18.7	19.7	20.7
750	1.65	5.18	6.47	8.16	10.4	11.7	13.0	14.5	16.2	18.1	20.7	23.3	24.6	25.9
900	1.98	6.22	7.77	9.78	12.4	14.0	15.5	17.4	19.4	21.8	24.9	28.0	29.5	31.1
950	2.09	6.56	8.20	10.3	13.1	14.8	16.4	18.4	20.5	23.0	26.2	29.5	31.2	32.8
1000	2.20	6.91	8.63	10.9	13.8	15.5	17.3	19.3	21.6	24.2	27.6	31.1	32.8	34.5
1100	2.42	7.60	9.50	12.0	15.2	17.1	19.0	21.3	23.7	26.6	30.4	34.2	36.1	38.0
1200	2.64	8.29	10.4	13.1	16.6	18.7	20.7	23.2	25.9	29.0	33.2	37.3	39.4	41.4
1250	2.75	8.63	10.8	13.6	17.3	19.4	21.6	24.2	27.9	30.2	34.5	38.9	41.0	43.2
1400	3.08	9.67	12.1	15.2	19.3	21.8	24.2	27.1	30.2	33.8	38.7	43.5	45.9	48.4
1500	3.30	10.4	13.0	16.3	20.7	23.3	25.9	29.0	32.4	36.3	41.4	46.6	49.2	51.8
2500 x 600	1.50	4.71	5.88	7.42	9.42	10.6	11.8	13.2	14.7	16.5	18.8	21.2	22.4	23.6
750	1.875	5.88	7.35	9.26	11.8	13.2	14.7	16.5	18.4	20.6	23.6	26.5	27.9	29.4
900	2.25	7.07	8.83	11.1	14.1	15.9	17.7	19.8	22.1	24.7	28.3	31.8	33.6	35.3
950	2.375	7.45	9.32	11.7	14.9	16.8	18.6	20.9	23.3	26.1	29.8	33.6	35.4	37.2
1000	2.50	7.85	9.80	12.4	15.7	17.7	19.6	22.0	24.5	27.5	31.4	35.3	37.2	39.2
1100	2.75	8.63	10.8	13.6	17.3	19.4	21.6	24.2	27.0	30.2	34.5	38.9	41.0	43.2
1200	3.00	9.42	11.8	14.8	18.8	21.2	23.6	26.4	29.4	33.0	37.7	42.4	44.7	47.1
1250	3.125	9.81	12.3	15.5	19.6	22.1	24.5	27.5	30.7	34.3	39.2	44.2	46.6	49.1
1400	3.50	11.0	13.7	17.3	22.0	24.7	27.5	30.8	34.3	38.5	44.0	49.5	52.2	55.0
1500	3.75	11.8	14.7	18.5	23.6	26.5	29.4	33.0	36.8	41.2	47.1	53.0	55.8	58.9

Based on the density of steel =7.85 g/cm2

For determining the mass of sheet above 2mm thickness refer to IS1730:1989

TABLE 2

Standard Nominal Dimensions and Mass of Strip

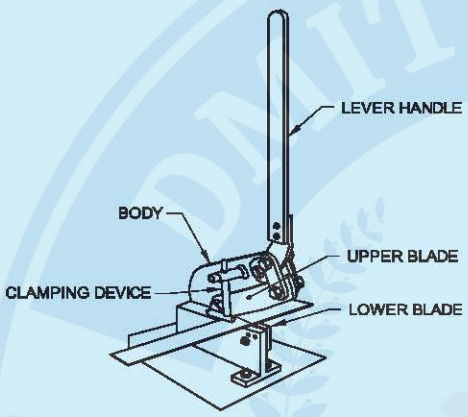
Width in mm	Thickness in mm													
	1.60	1.80	2.00	2.24	2.50	2.80	3.15	3.55	4.00	4.50	5.0	6.0	8.0	10.0
	Mass * kg/m													
100	1.25	1.41	1.57	1.76	1.96	2.20	2.47	2.79	3.14	3.53	3.92	4.71	6.28	7.85
125	1.57	1.77	1.96	2.20	2.45	2.74	3.08	3.48	3.92	4.41	4.90	5.88	7.85	9.81
160	2.01	2.26	2.51	2.81	3.14	3.52	3.95	4.46	5.02	5.65	6.28	7.53	10.0	12.6
200	2.51	2.82	3.14	3.52	3.92	4.39	4.94	5.58	6.28	7.06	7.84	9.42	12.6	15.7
250	3.14	3.53	3.92	4.40	4.90	5.49	6.17	6.97	7.85	8.83	9.80	11.8	15.7	16.6
320	4.02	4.52	5.02	5.62	6.28	7.05	7.90	8.92	10.0	11.3	12.5	15.1	20.0	25.1
400	5.02	5.65	6.28	7.04	7.85	8.78	9.88	11.1	12.6	14.1	15.7	18.8	25.1	31.4
500	6.28	7.05	7.85	8.79	9.51	11.0	12.4	13.9	15.7	17.7	19.6	23.6	31.4	39.2
650	8.16	9.17	10.2	11.4	12.7	14.3	16.1	18.1	20.4	23.0	25.5	30.6	40.8	51.0
800	10.0	11.3	12.6	14.1	15.7	17.6	19.8	22.3	25.1	28.3	31.4	37.7	50.2	62.8
950	-	13.4	14.9	16.7	18.6	20.8	23.5	26.5	29.8	33.6	27.3	44.7	59.7	74.6
1000	-	-	15.7	17.6	19.6	22.0	24.7	27.9	31.4	35.3	39.2	47.1	62.8	78.5
1050	-	-	16.5	18.5	20.6	23.3	26.0	29.2	33.0	37.1	41.2	49.5	65.9	82.4
1150	-	-	-	20.2	22.6	25.2	28.4	32.0	36.1	40.6	45.1	54.2	72.2	90.3
1250	-	-	-	-	24.5	27.5	30.9	34.8	39.2	44.2	49.1	58.9	78.5	98.1
1300	-	-	-	-	-	28.6	32.1	36.2	40.8	45.9	51.0	61.2	81.6	102
1450	-	-	-	-	-	-	35.8	40.4	45.5	51.2	56.9	68.3	91.1	114
1550	-	-	-	-	-	-	383	43.2	48.7	54.7	60.8	73	93.3	122

Hand lever shears

Objectives: At the end of this lesson you shall be able to
- **identify the hand lever shear**
- **state the principle of working**
- **state the constructional feature parts and their functions.**

Hand lever shear is a hand operated machine used to cut sheet metal upto a thickness of 3 mm (10 SWG). When the machine is mounted on the bench, it is called a hand lever bench shear. It may also be mounted on the floor, over a small platform. It is used for cutting along straight lines and convex cutting of sheet metal. (Fig.1)

Fig 1



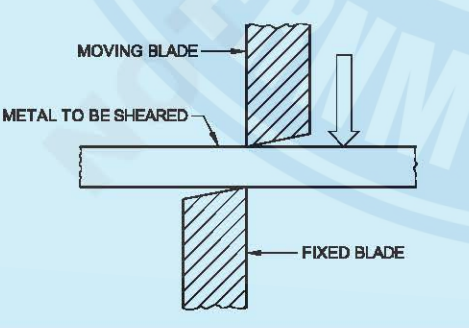
The lower blade of the hand lever shear is fixed (bottom blade) and the upper blade is pivoted at an angle.

The sheet being cut is prevented from tilting by a clamping device, which can be adjusted to the thickness of the sheet.

The knife cutting edge of the upper blade is curved so that the opening angle at the point of cut remains constant.

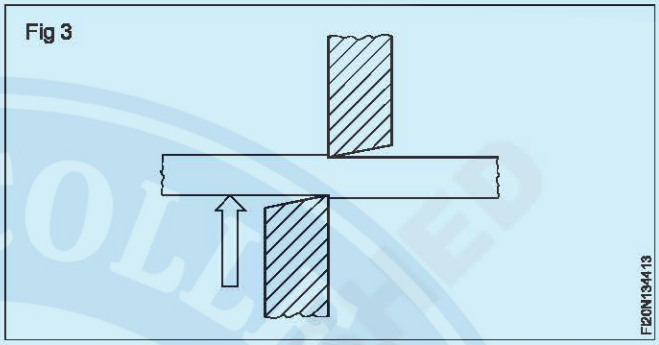
As the upper blade moves down on the sheet metal, the metal is subjected to shearing force, which causes deformation of the metal. (Fig 2 & 3) Increase in force causes plastic deformation of metal.

Fig 2



After a certain amount of plastic deformation, the cutting member begin to penetrate. The uncut metal work, harden at the edge (Fig 4).

Fig 3



Fracture begins to run into the work hardened metal from the point of contact of the cutting members. When these fractures meet, the cutting members penetrate the whole of the metal thickness. (Fig 5)

Fig 4

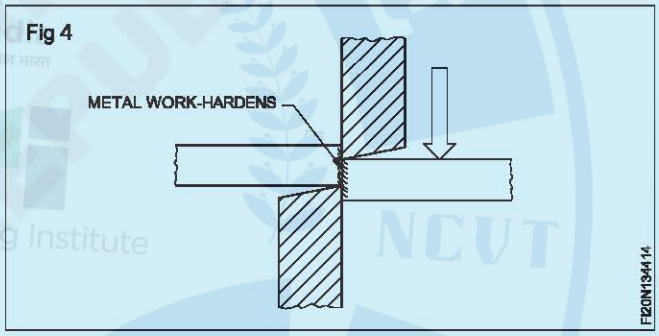
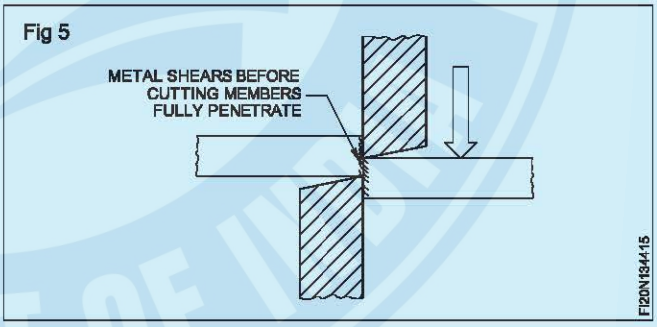


Fig 5



Blade clearance is very important and should not exceed 10 percent of the thickness to be cut and should suit the particular material.

Results of incorrect and correct setting of shear blade are as follows.

1 Excessive clearance causes a burr to form on the underside of the sheet as shown in the (Fig 6).

2 With no clearance, over strain is caused, the edge of the sheet becomes flattened on the under sides as shown in (Fig 7).

Fig 6

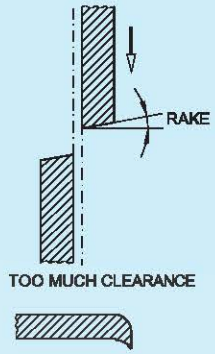
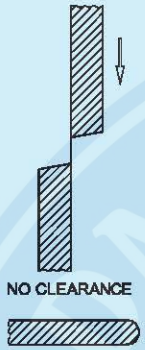
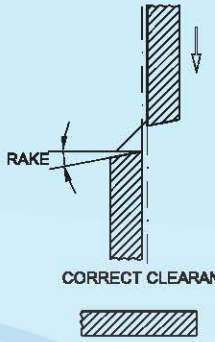


Fig 7



3 With the correct clearance, optimum shearing results are obtained as shown in (Fig 8).

Fig 8



Squaring shear

Objectives: At the end of this lesson you shall be able to
- **state the function of the squaring shear**
- **describe the adjustments on the machine to control the length of the cut**
- **state the capacity of the machine**
- **explain the safety precautions to be observed when working on squaring shears.**

Squaring shear

Cutting sheet metals is called shearing.

Squaring shears are used to cut large sheets into pieces to handle sheets easily.

Sheet metal can be cut by many simple machines.

Squaring shears, (Fig 1) operated by foot, are used to cut and trim large pieces of sheet metal. The size of the machine is specified by the length of the bed and maximum thickness of sheet it cuts. Front gauge and back gauge is provided to adjust the length of cut. A back gauge controls the length of the cut, when sheet is inserted from the front.

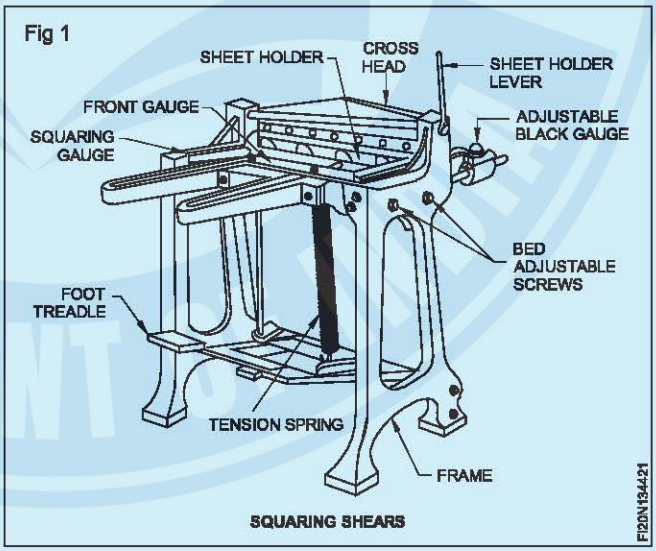
A front gauge cut the sheet which is inserted from the back.

Sheet holder is provided to hold the sheet firmly while it is being cut. It is operated by sheet holder lever.

The square gauge is adjustable and is kept at right angles to the cutting blade. 18 gauge sheets or lighter can usually be cut by squaring shear parts are as shown in Fig 1.

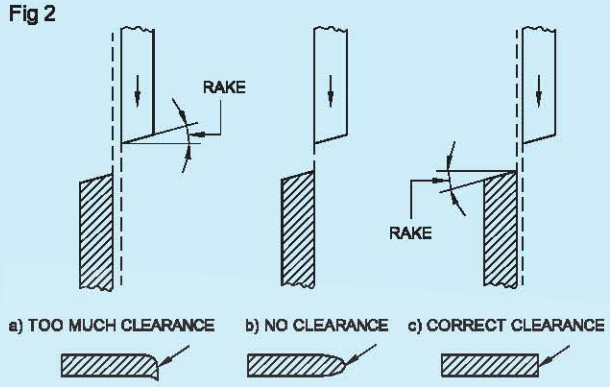
The clearance between the blades (Fig 2) can be adjusted by two adjusters. One adjuster shifts the table forward and other shifts the table backward. (Fig 3)

Fig 1



Too much clearance causes a burr to form on the underside of the sheet (Fig 2a) with no clearance overstrain is caused, the edges of the sheet becomes flattened on the underside (Fig 2b). With the correct clearance optimum shearing results are obtained (Fig 2c).

Fig 2

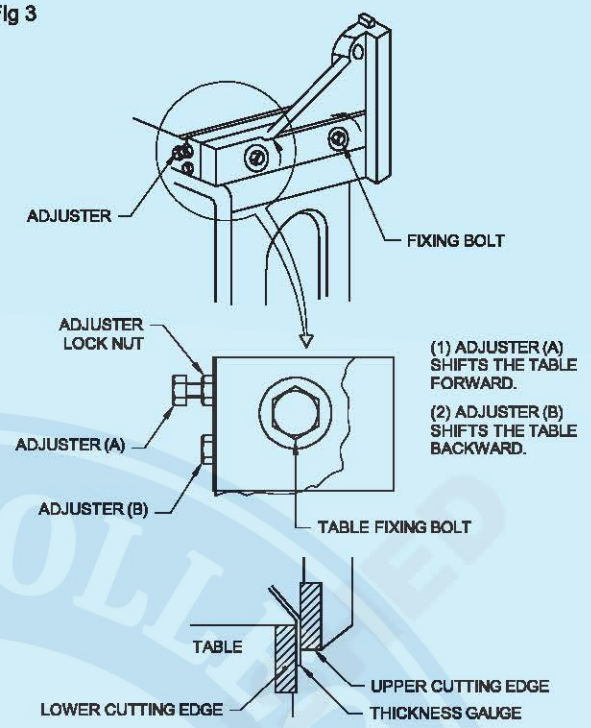


RESULTS OF INCORRECT AND CORRECT SETTING OF SHEAR BLADES

Safety

Keep your fingers away from the cutting blade at all times. Never attempt to cut bar iron, wire or any heavy metal on the squaring shears. This may nick the blade, which will then make a notch in every edge you cut. For better shearing results blade clearances and setting of blades are shown in Fig 2 & 3.

Fig 3



CLEARANCE ADJUSTMENT

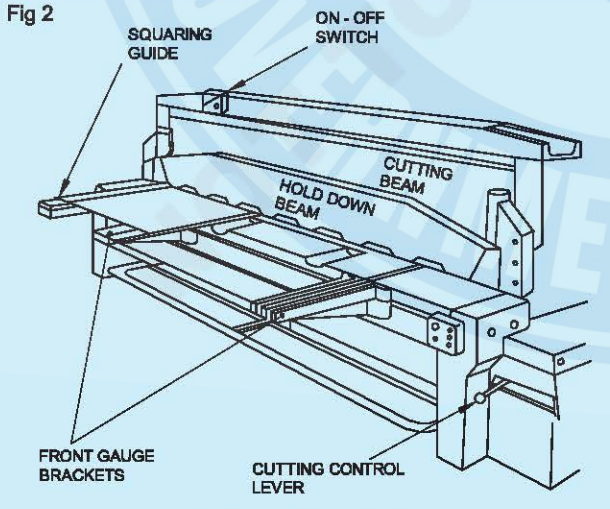
Guillotine shears

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

- **state the constructional features of guillotine shears**
- **explain working of guillotine shears**
- **explain setting procedures of squaring guide, front gauge and back gauge**
- **state the safety precautions to be followed while working on guillotine shears.**

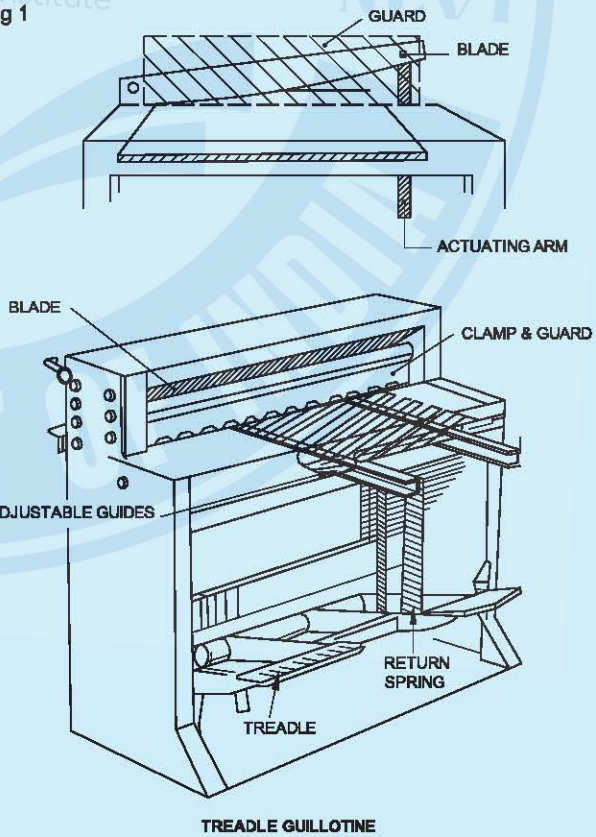
Guillotine shears: On a treadle, guillotine, the bottom cutting blade is fixed to the machine bed and the top blade is operated by the treadle. The material to be cut is kept on the bed and held in position by hand. The hold down clamp comes into operation when the treadle is depressed. Figs 1&2 shows the treadle guillotine.

Fig 2



POWER GUILLOTINE SHEAR

Fig 1



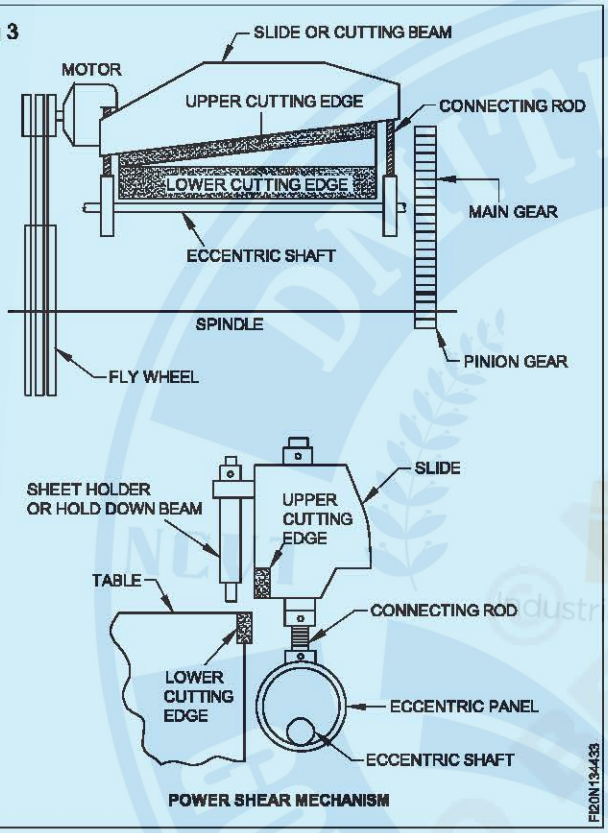
TREADLE GUILLOTINE

On some power operated guillotines, provision is given for a single or continuous cutting action. If there is any doubt in operating cutting control, check as follows.

- Switch on guillotine
- Depress pedal
- If the control is set for single cutting the cutting beam is descent once for each depression of the pedal.
- If the controls are set for continuous cutting the beam will continue to raise and descend when pedal is depressed.

Power shear mechanism is shown in Fig 3.

Fig 3



POWER SHEAR MECHANISM

Safety

1 All guillotines are very dangerous.

2 Place the guard in position before operating.

3 Never work from the back of a guillotine.

4 Understand its safe operation fully, and the operation of emergency switches should be known perfectly.

5 Gauges, if not being used, should be clear of the material being cut.

Cutting procedure: When cutting, already marked line as shown in Fig 3.

- Switch on power guillotine
- Place the sheet on bed of machine and slide between blades
- Place the sheet on the bed of machine and slide between blades
- Align cutting mark to the edge of the bottom blade
- Depress pedal, ensuring that the other foot is away from pedal bar.

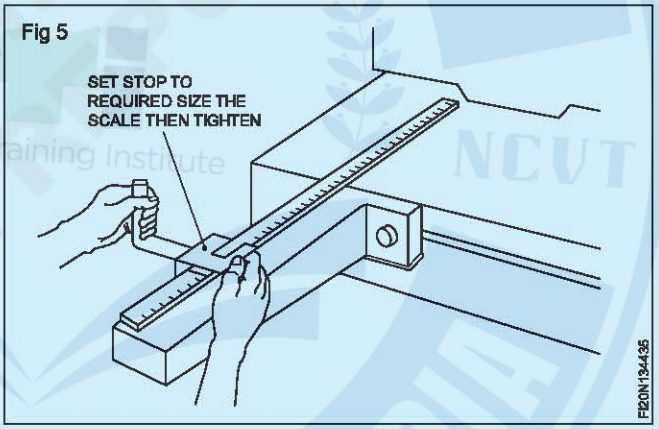
Use of the squaring guide: Guillotines are commonly fitted with a guide at one end of the bed, to enable sheets to be cut without marking on the sheet.

Where the guide is fitted with a scale, a stop is fitted to enable strips of a predetermined length to be cut accurately as shown in Fig 4.

Fig 4

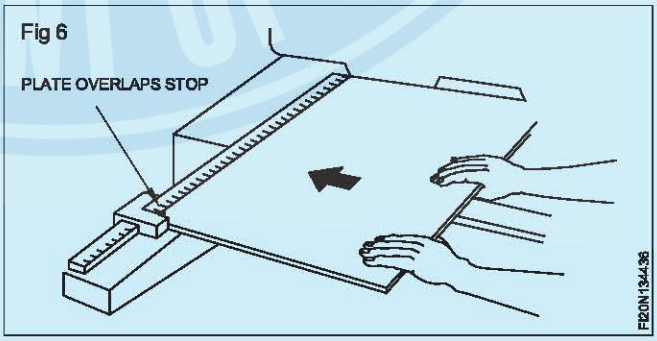
Position sheets against guide for squaring the other end over lap stops slightly as shown in Fig 5.

Fig 5



Safety: Wear protective gloves for handling sheet metal. Reverse sheet and reposition. Place same edge to guide. Pull sheet back against stop and depress pedal as shown in Fig 6.

Fig 6



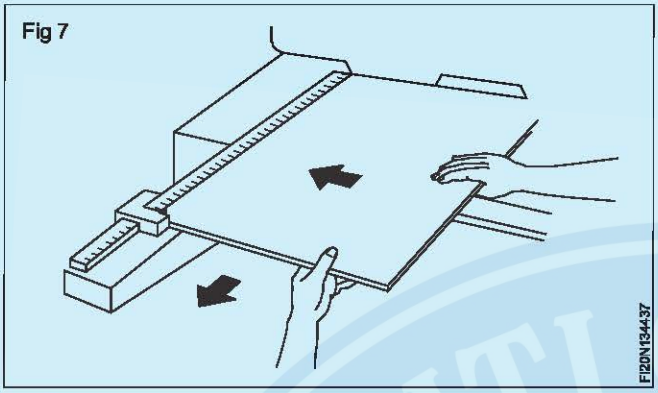
Parallel setting of front gauge: The front gauge is used when there is less overhang.

Before setting, check that the guillotine is switched off and separated. (Power machine only)

Keep wooden block under pedal as an added safe guard. Fit gauge bar by tee bolts of bar into slots in brackets.

Procedure for tape measure (Fig 7)

Fig 7

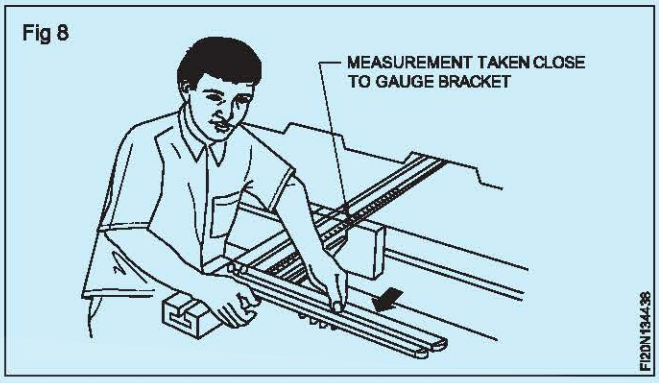


- Slide the tape end between blades
- Edge of the tape is hooked against bottom blade
- Position gauge bar, keeping the bar parallel to the blade
- Tighten securing nuts slightly
- Adjust the gauge to required position by tapping lightly by palm
- Adjust the gauge bar parallel to the blade and fully tighten the nuts.

When using a rule

- Place the rule between blades. Position required dimension on the edge of bottom blade.
- Place the gauge bar against end of the rule.
- Position the bar parallel. Slightly tighten the nut and adjust as shown in Fig 8.

Fig 8

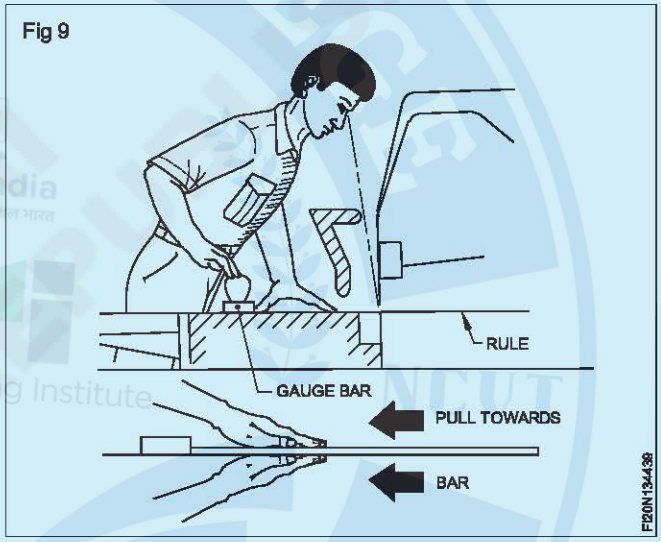


Using scale on gauge brackets: Where a machine is fitted with a graduated scale on the brackets, position gauge bar to the required dimension and fully tighten the nuts.

Keep place supported against gauge bar as shown in Fig 9.

Mark off plate to the size and shape. Set guide stop to give correct length.

Fig 9



Cut the sheet metal to the size and shape as per marking

Sheet Metal Tools

Objective: At the end of this lesson you shall be able to
• List out the measuring tools, marking tools and production tools used in the sheet metal work

Tools used in the sheet metal work are:

I Measuring tools

1 Steel rule
2 Outside micrometer
3 Vernier caliper
4 Combination set
5 Standard wire gauge
6 Radius gauge

II Marking tools

1 Tinman's square
2 Scratch owl
3 Straight scriber
4 Bend scriber
5 Punches
6 Try square
7 Wing compass
8 Trammel
9 Jenny caliper
10 Surface plate
11 Timper
12 Trammel
13 Marking table
14 Surface plate

III Production tools

1 Snips
2 Tin man's hammers
3 Mallet
4 Ball pane hammer
5 Straight edge
6 Templates
7 Soldering iron
8 Blow lamp
9 Hand grooves
10 Stakes
11 Surface plate
12 Riveting tools, dolly, staps etc.

Measuring Tools

Fig 1

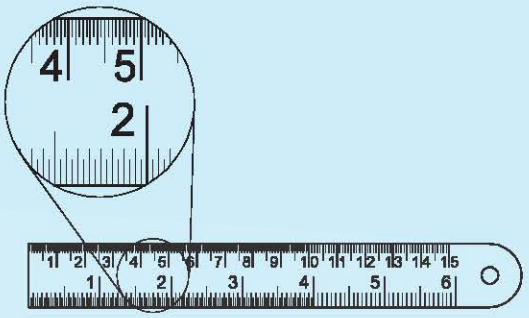


Fig 2

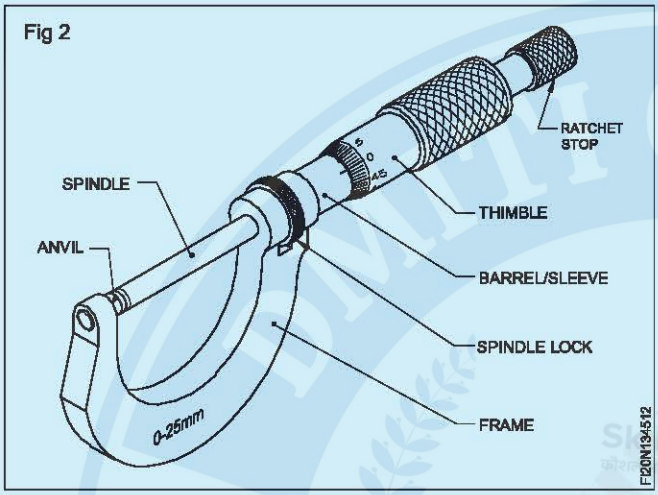


Fig 3

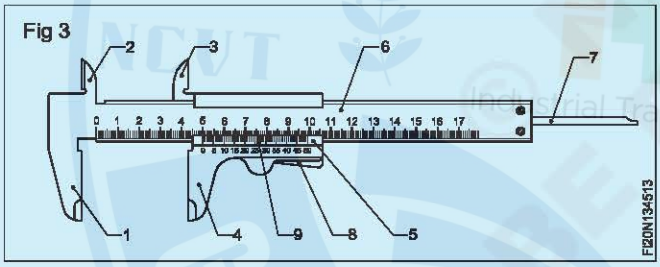


Fig 4

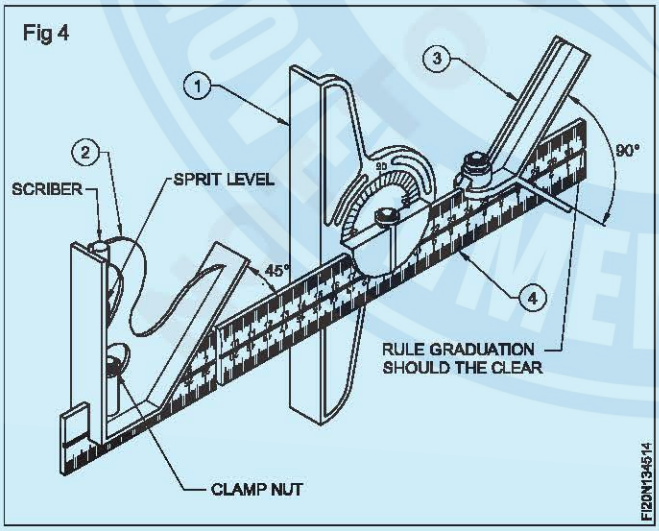


Fig 5

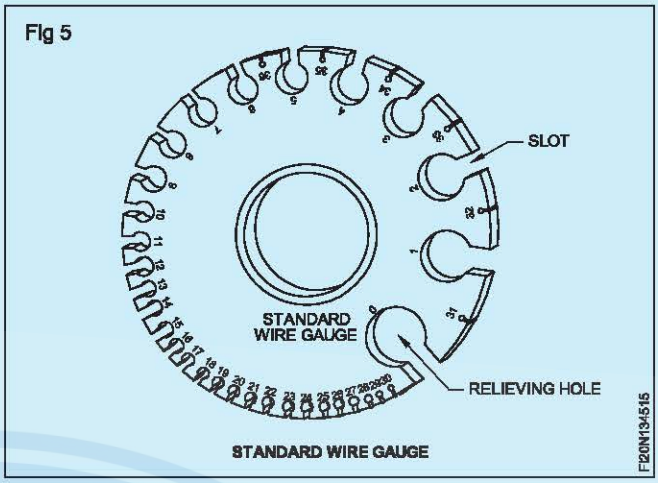
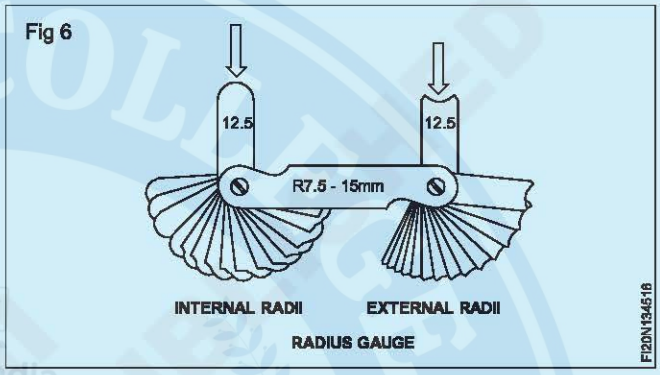


Fig 6



Marking Tools Sheet Metal Worker

Fig 7

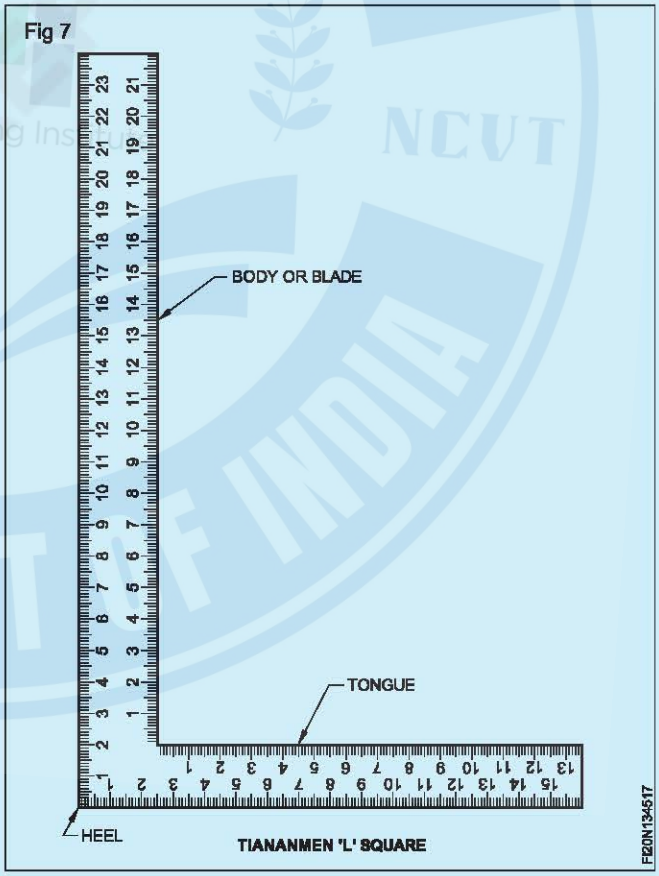
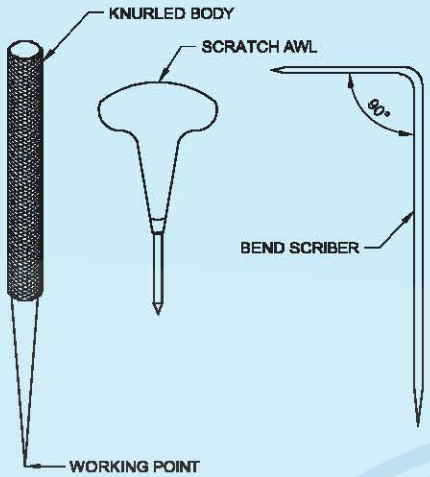


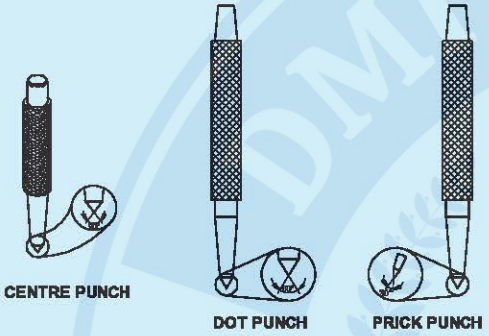
Fig 8



STRAIGHT SCRIBER

FI20N134518

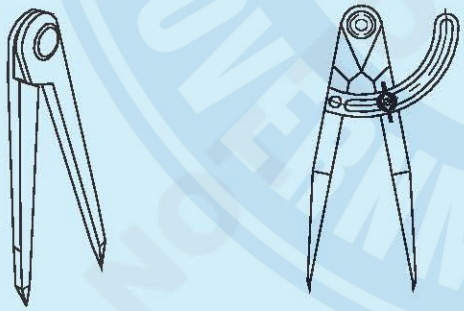
Fig 9



PUNCHES

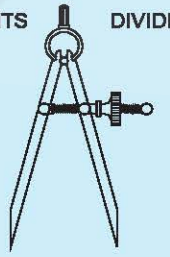
FI20N134519

Fig 10



DIVIDER FIRM JOINTS

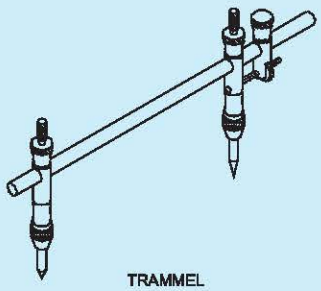
DIVIDER SQUARE TYPES



WING COMPASS

FI20N13451A

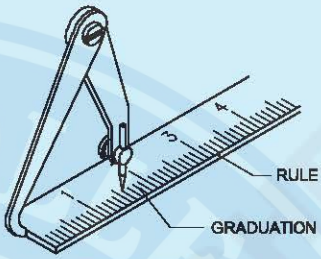
Fig 11



TRAMMEL

FI20N13451B

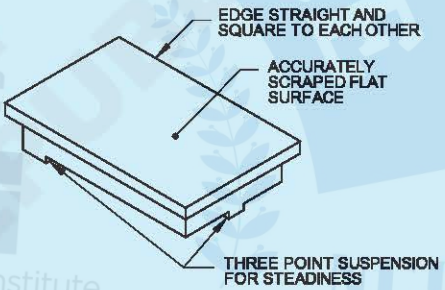
Fig 20



JENNY CALIPER

FI20N13451C

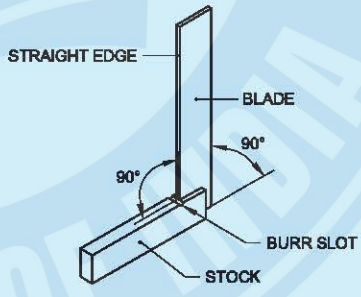
Fig 13



SURFACE PLATE

FI20N13451D

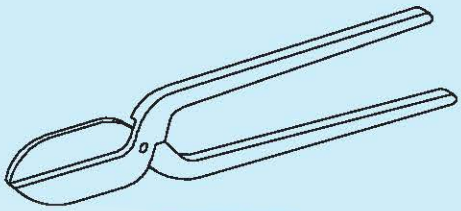
Fig 14



TRY SQUARE

FI20N13451E

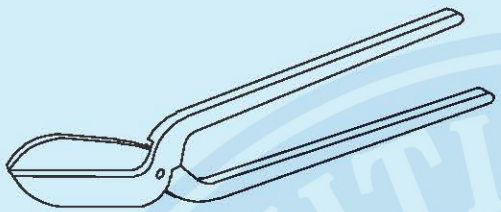
Fig 15



STRAIGHT SNIPS

FI20N13451F

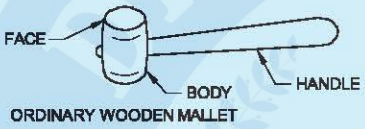
Fig 16



BEND SNIPS

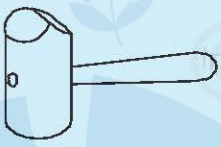
FI20N13451G

Fig 17

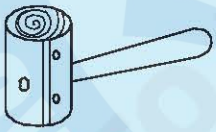


ORDINARY WOODEN MALLET

BOOSING MALLET



END - PACKED MALLET



RAWHIDE MALLET

SHEEL METAL MALLETS

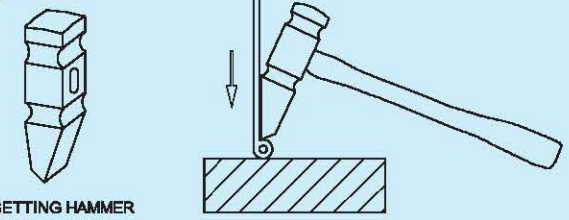
FI20N13451H

Fig 18

BALL PEEN CROSS PEEN STRAIGHT PEEN

FI20N13451I

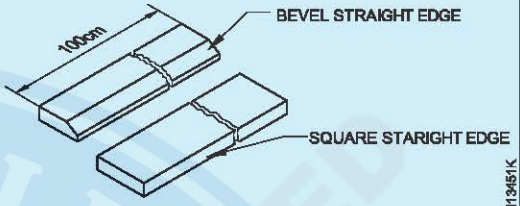
Fig 19



SETTING HAMMER

FI20N13451J

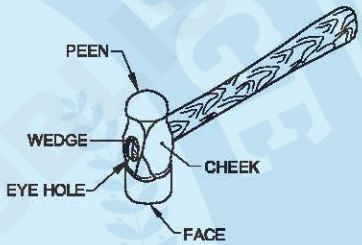
Fig 7



STRAIGHT EDGE

FI20N13451K

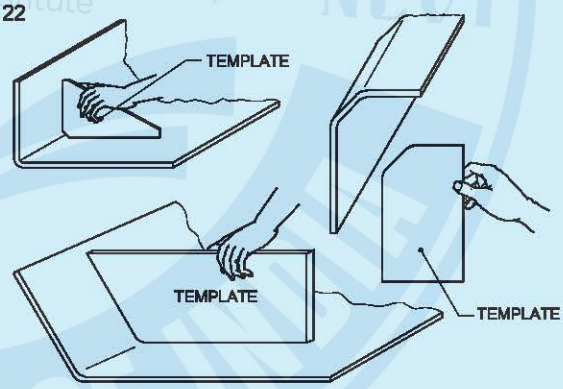
Fig 21



BALL PEEN HAMMER

FI20N13451L

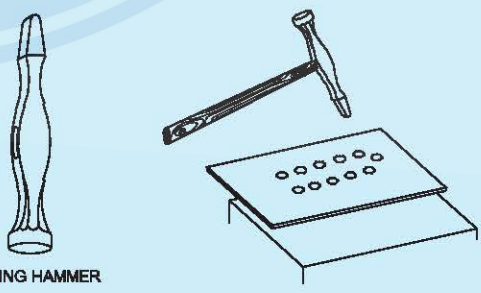
Fig 22



CHECKING ANGLES WITH A TEMPLATE

FI20N13451M

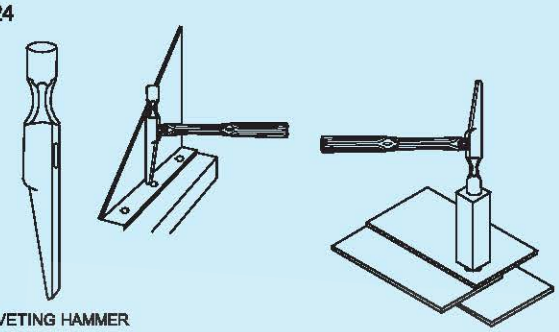
Fig 23



PEENING HAMMER

FI20N13451N

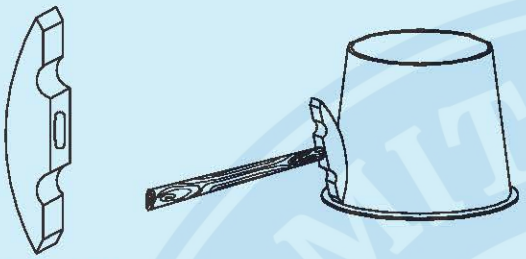
Fig 24



RIVETING HAMMER

FI20N13451O

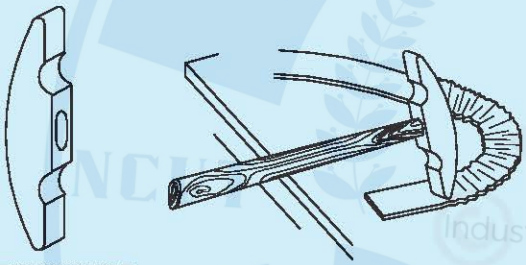
Fig 25



CREASING HAMMER

FI20N13451P

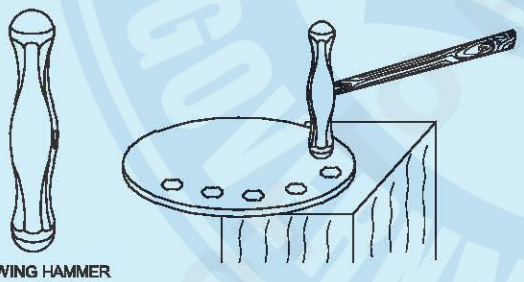
Fig 26



STRETCHING HAMMER

FI20N13451Q

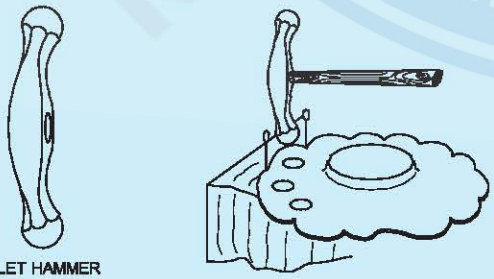
Fig 27



HOLLOWING HAMMER

FI20N13451R

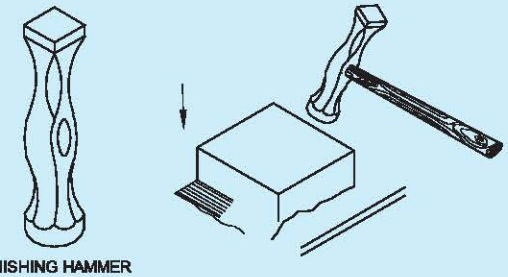
Fig 28



BULLET HAMMER

FI20N13451S

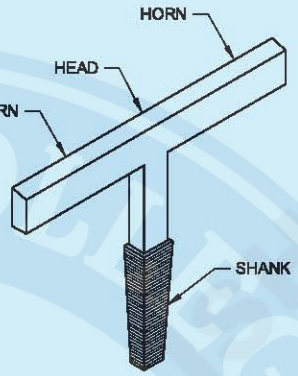
Fig 29



PLANISHING HAMMER

FI20N13451T

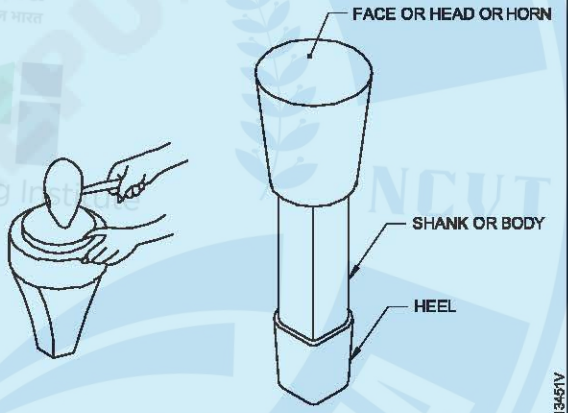
Fig 30



HATCHET STAKE

FI20N13451U

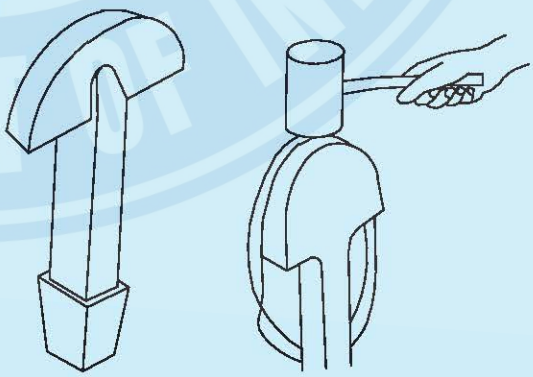
Fig 31



ROUND BOTTOM STAKE

FI20N13451V

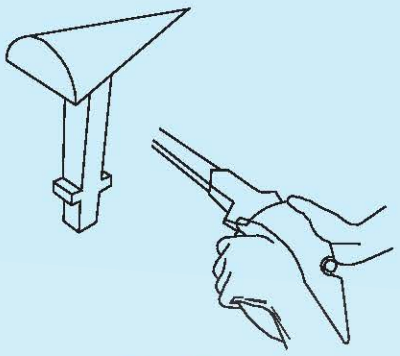
Fig 32



HALF MOON STAKE

FI20N13451W

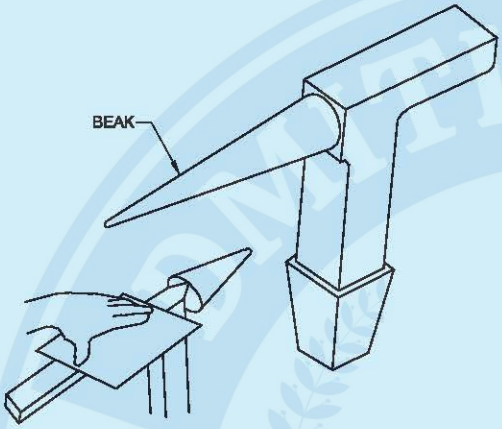
Fig 33



FUNNEL STAKE

FI20N134510

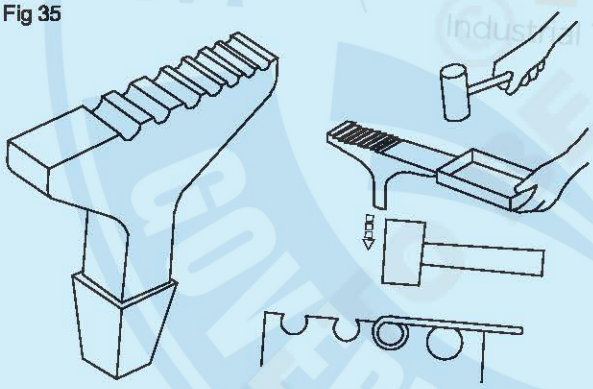
Fig 34



BEAK OR BICKIRON

FI20N134511

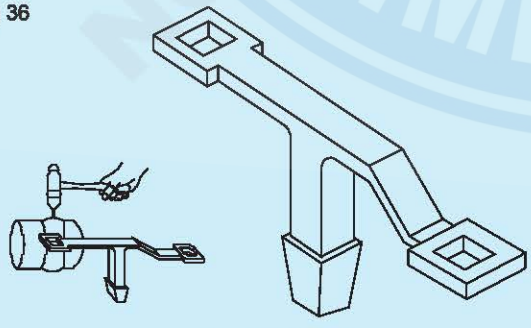
Fig 35



CREASING IRON

FI20N134512

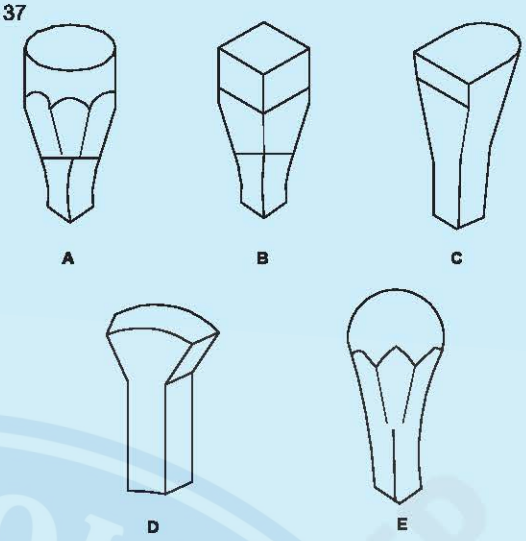
Fig 36



TINMAN'S HORSE

FI20N134512

Fig 37

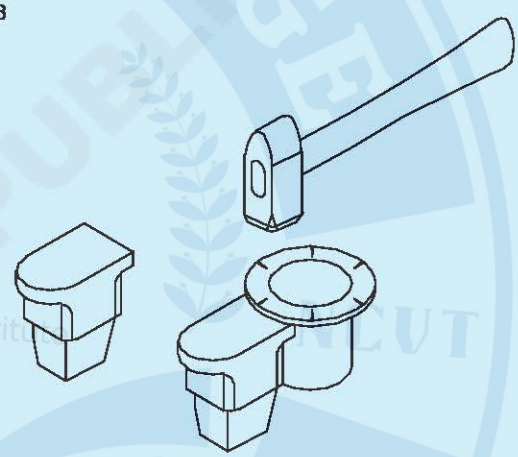


A - ROUND BOTTOM
B - ANVIL
C - ANVIL
D - HALF MOON
E - ROUND HEAD

HEADS

FI20N134512

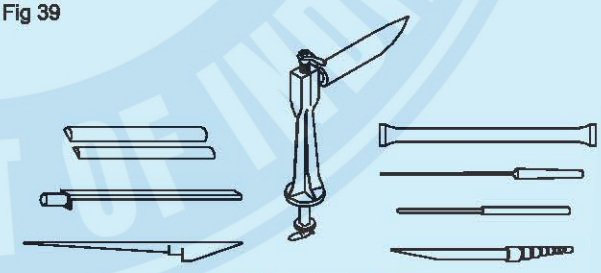
Fig 38



TINMAN'S ANVIL

FI20N134512

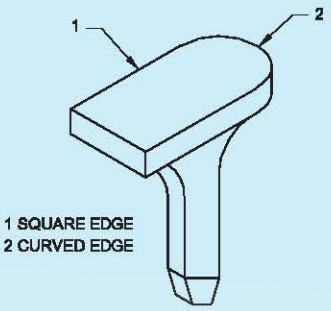
Fig 39



UNIVERSAL STAKE HOLDER

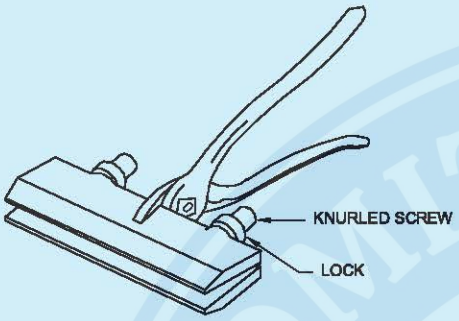
FI20N134512

Fig 40



FI20N134512S

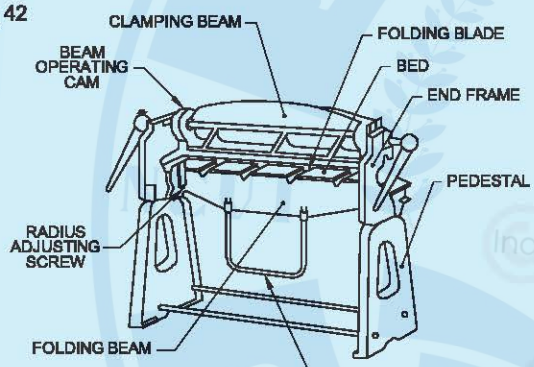
Fig 41



HAND SEAMER

FI20N134512B

Fig 42



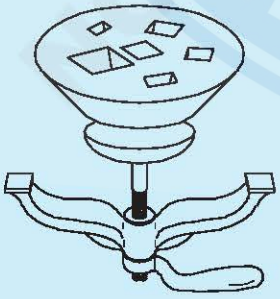
FI20N134512Z7

Fig 43

BENCH PLATE

FI20N134512B

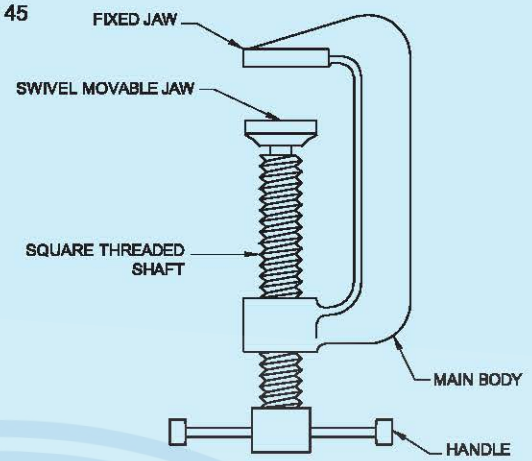
Fig 44



REVOLVING BENCH PLATE

FI20N134512Z9

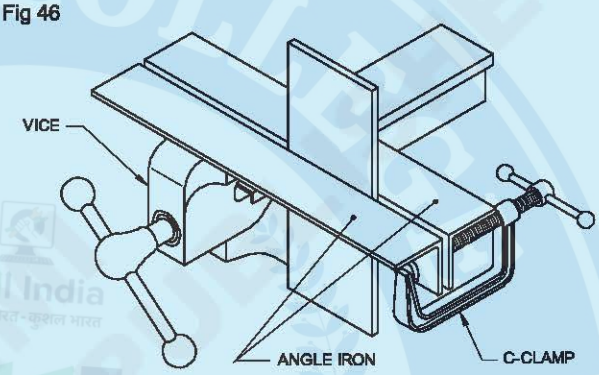
Fig 45



'C' CLAMP

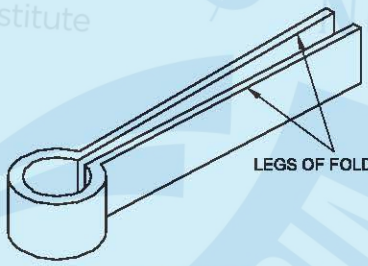
FI20N134512ZA

Fig 46



FI20N134512ZB

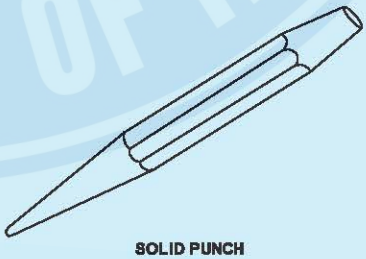
Fig 47



FOLDING BARS

FI20N134512ZC

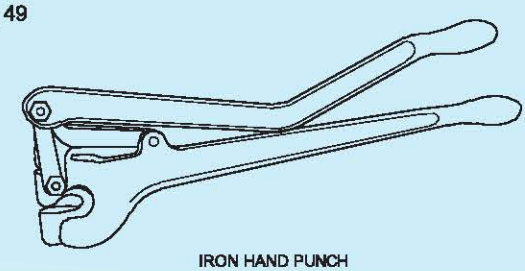
Fig 48



SOLID PUNCH

FI20N134512ZD

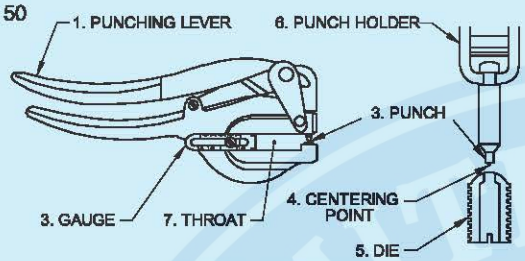
Fig 49



IRON HAND PUNCH

FI20N13451ZE

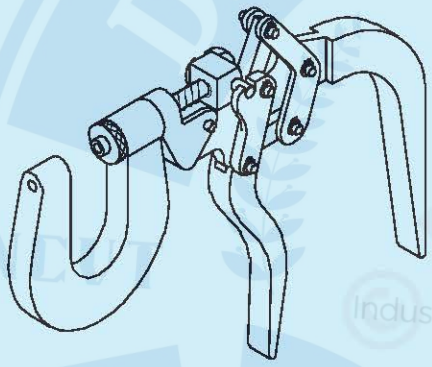
Fig 50



THE HAND LEVER PUNCH

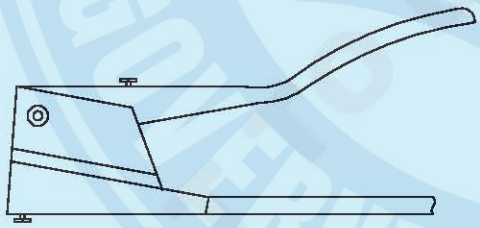
FI20N13451ZF

Fig 51



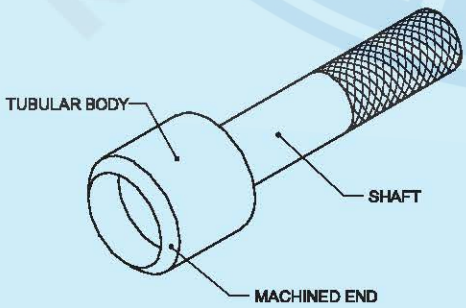
FI20N13451ZG

Fig 52



FI20N13451ZH

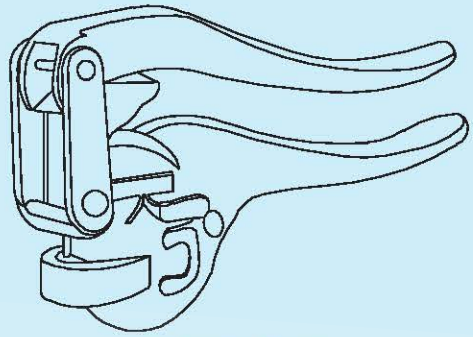
Fig 53



HOLLOW PUNCH

FI20N13451ZI

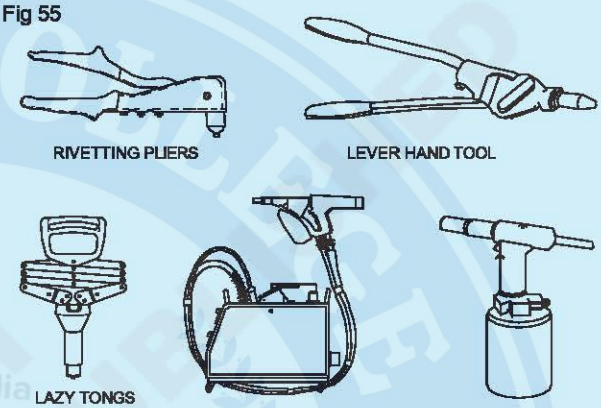
Fig 54



TINNER'S HAND PUNCH

FI20N13451ZJ

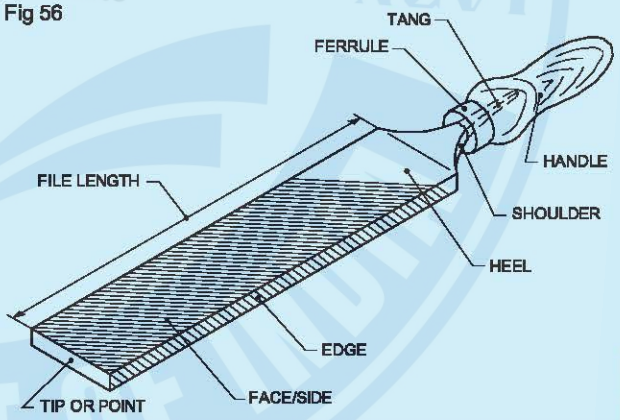
Fig 55



BLIND RIVETTING EQUIPMENT

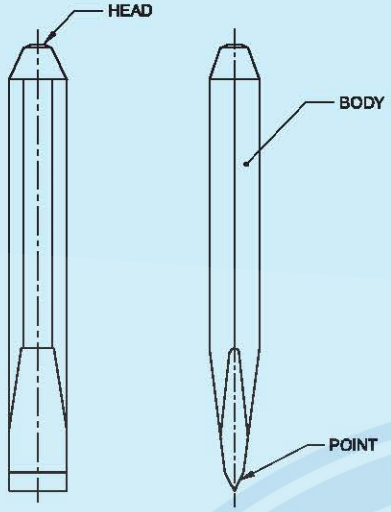
FI20N13451ZK

Fig 56



FI20N13451ZL

Fig 57

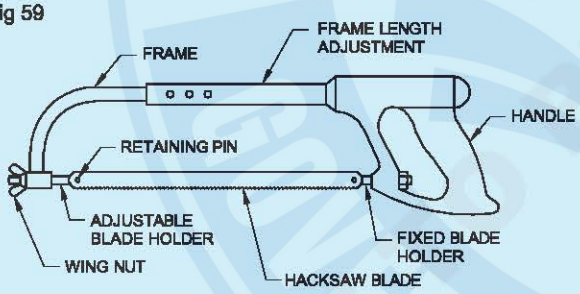


FI20N134512M

Fig 58

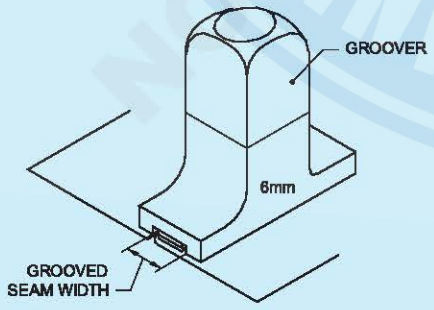
FI20N134512N

Fig 59



FI20N134512O

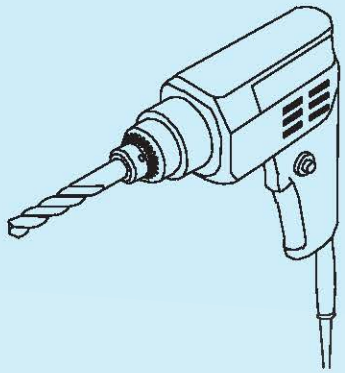
Fig 60



SIZE OF GROOVE & SEAM

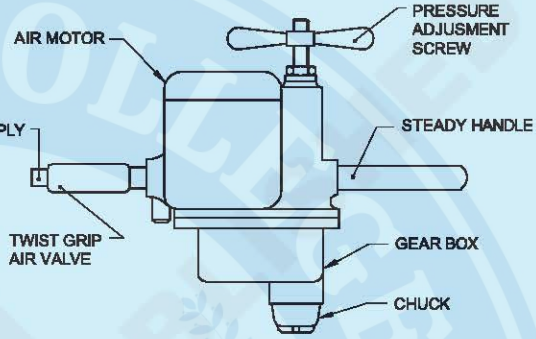
FI20N134512P

Fig 61



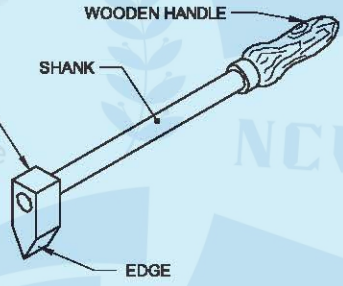
FI20N134512Q

Fig 62



FI20N134512R

Fig 63



SOLDERING IRON (HATCHET TYPE)

FI20N134512S

Fig 64

GAS HEATED SOLDERING COPPER BIT

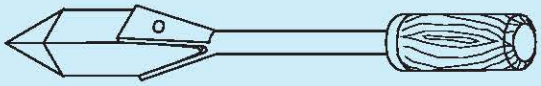
FI20N134512T

Fig 65

STRAIGHT SOLDERING COPPER WITH HANDLE

FI20N134512U

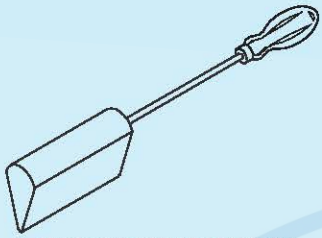
Fig 66



ADJUSTABLE SOLDERING BIT

FI20N134512V

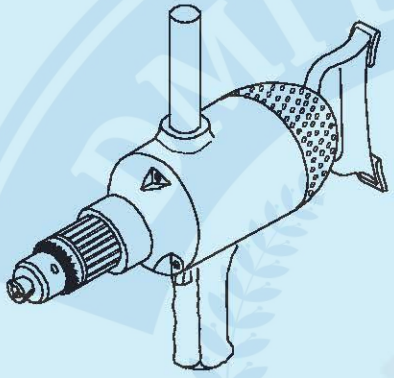
Fig 67



HANDY SOLDERING COPPER BIT

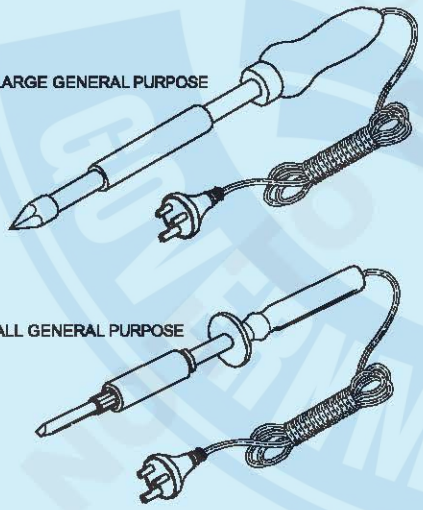
FI20N134512W

Fig 68



FI20N134512X

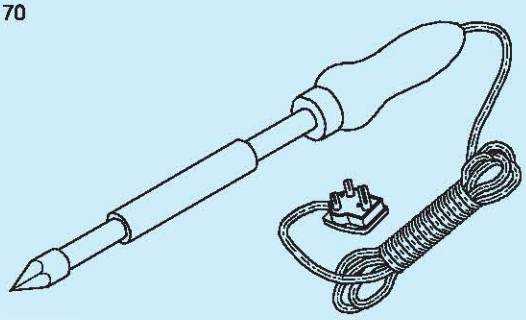
Fig 69



SELECT THE APPROPRIATE SOLDERING IRON

FI20N134512Y

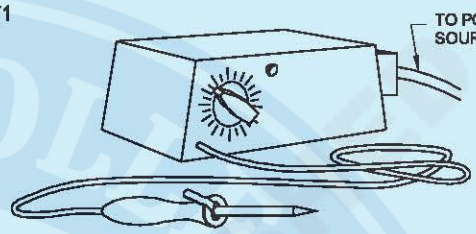
Fig 70



ELECTRIC COPPER SOLDERING

FI20N134512Z

Fig 71

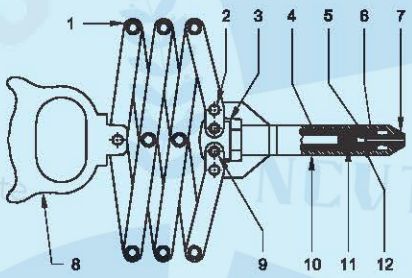


TRANSFORMER TYPE ELECTRIC SOLDERING IRON

FI20N134512Z1

Machines and appliances tools

Fig 72



PARTS LIST OF LAZY TONG

NO.	DESCRIPTION	QTY.
1	LINKAGES	1 SET
2	LOCK NUT	2
3	YOKE	1
4	POWER COUPLING	1
5	JAW CASE	1
6	JAWS	1 SET
7	NOSE PIECE	1
8	HANDLE	1
9	FULCRUM PINS	2
10	BODY	1
11	JAW PUSHER SPRING	1
12	JAW PUSHER	1

FI20N134512Z2

Fig 73

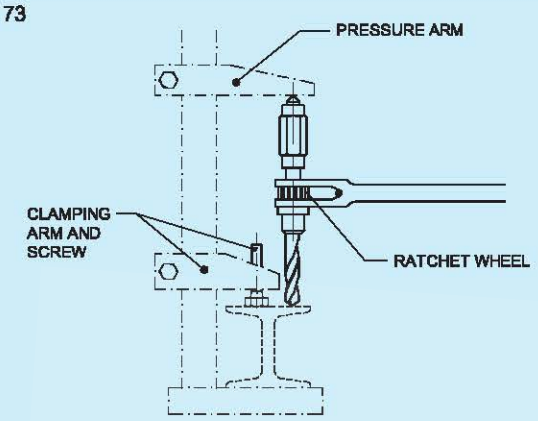
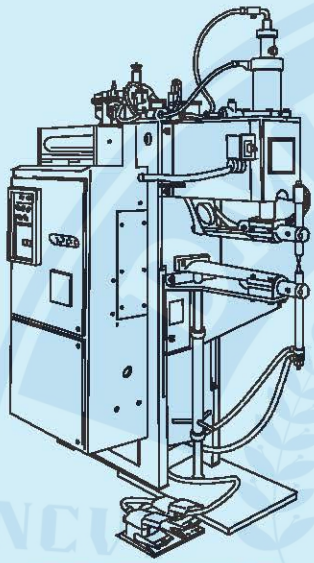
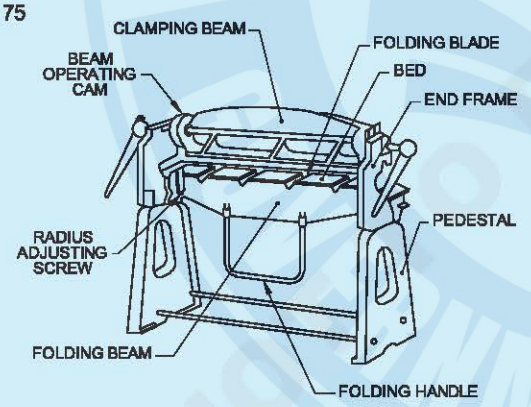


Fig 74



PEDESTAL TYPE SPOT WELDER

Fig 75



BAR FOLDER

Fig 76

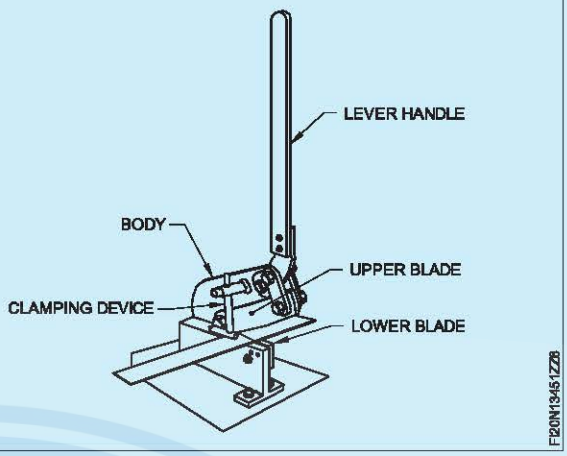


Fig 77

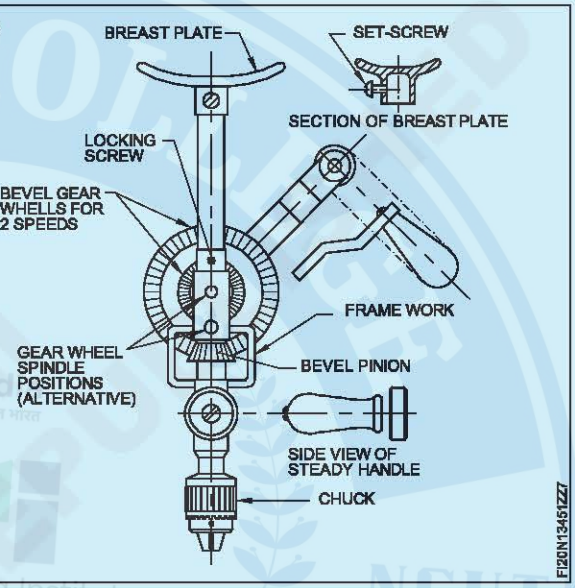
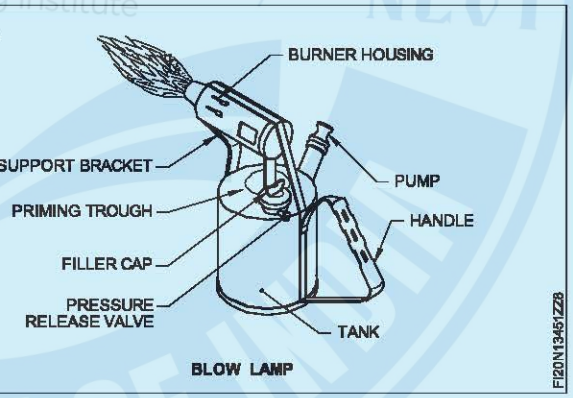
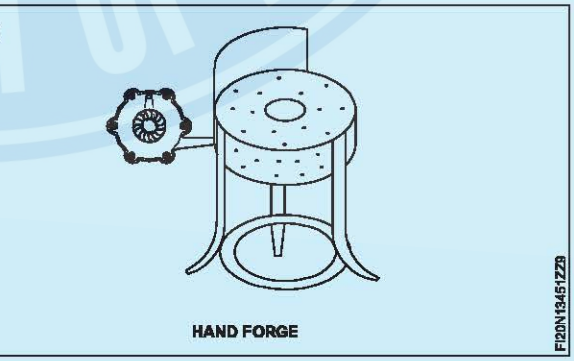


Fig 78



BLOW LAMP

Fig 79



HAND FORGE

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 indicate only gauge or thickness of the sheet 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.

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)

Fig 1

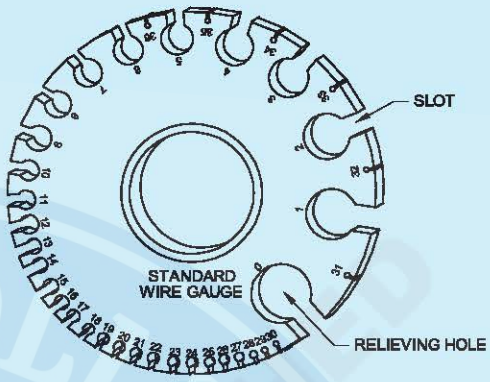
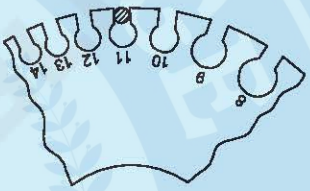


Fig 2



Tinman's "L" square

Objective : At the end of this lesson you shall be able to
- **state the use of the Tinman's "L" square.**

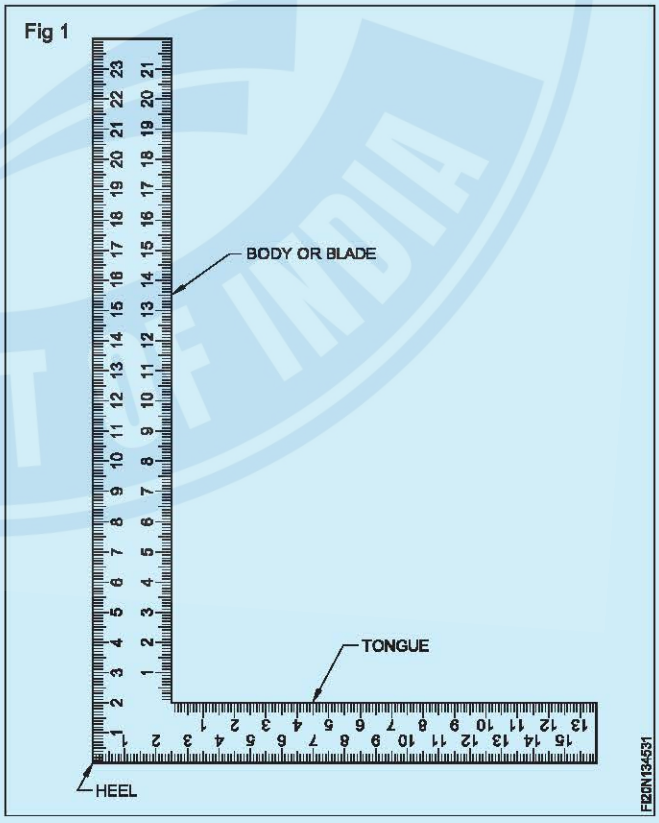
A Tinman's "L" square is an "L" shaped piece of hardened steel with graduation marks on the edges of the Tongue and Body or blade (Fig.1). It is used for marking in the perpendicular direction to any base line and to check the perpendicularity.

The short arm of the "L" square is called the tongue and the long arm is called the body or blade and the corner is called the heel. The angle between the tongue and the body of the "L" square is 90°.

The size of the "L" square is specified by the length of the body and the tongue.

It is also called as Tinman's square.

Fig 1



Straight edge

Objectives: At the end of this lesson you shall be able to
- **state the uses of straight edge**
- **list the types of straight edge.**

Straight edge: Straight edge is a flat bar of steel.

It is used to mark straight lines on a sheet metal surface.

Types (Fig 1)

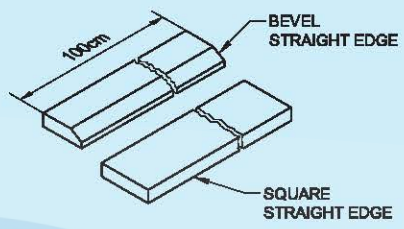
Straight edges are available in two types.

1 Square straight edges

2 Bevel straight edge.

Straight edges are available in 600 mm, 1 to 3 mtrs in length. While marking with the help of a straight edge, place the straight edge on the sheet and hold it by your left hand.

Fig 1



Scriber/Scratch awl

Objectives: At the end of this lesson you shall be able to
- **state the features of scribers**
- **list the types of scribers**
- **state the uses of a scriber.**

In layout work, it is necessary to scribe lines to indicate the dimensions of the workpiece to be cut or folded.

It is made out of high carbon steel about 3 to 5 mm dia. for drawing clear lines on sheet metal, working point is ground at one end angle of 10° to 20°. Scriber working point is hardened and tempered.

Scribers are available in different types and sizes.

Types of scribers (Fig 1)

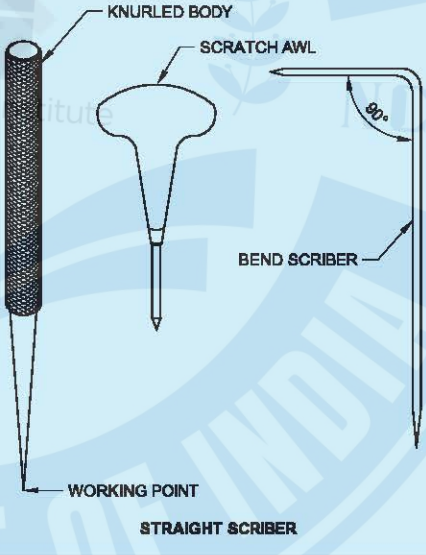
– Straight scriber

– Bend scriber

– Scratch AWL

Scriber points are very sharp and they are to be handled very carefully. Do not put the scriber in your pocket. Place a cork on the point, when not in use to prevent accidents.

Fig 1



Types of marking punches

Objectives: At the end of this lesson you shall be able to
- **state the different punches used in marking**
- **state the feature of each punch and its uses.**

Punches are used in order to make certain dimensional features of the layout permanent. There are three types of punches. They are

– Centre punch

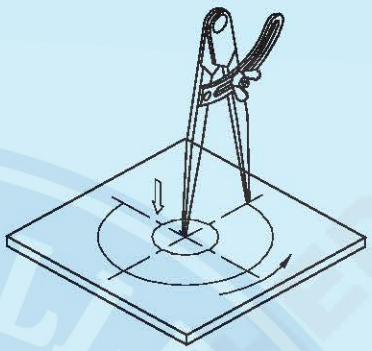
– Prick punch

– Dot punch.

Centre punch: The angle of the point is 90^0 in a centre punch. The punch mark made by this is wide and not very deep. This punch is used for locating holes. The wide punch mark gives a good seating for starting the drill. (Fig 1)

Prick punch: The angle of the prick punch is 30^0. This punch is used for making light punch marks needed to position dividers and trammels. The divider leg will get a proper seating in the punch mark. (Fig 2)

Fig 1



Dot punch: The angle of punch is 60°. It is also known as prick punch. This punch is used for witness marking.

Wing compass

Objectives: At the end of this lesson you shall be able to
- **Name the parts of a wing compass**
- **state the uses of the wing compass**
- **state the specification of the wing compass**
- **state some important hints on the wing compass**
- **state the uses of a trammel beam.**

Wing compass is used for scribing circles, arcs and for transforming and stepping off distances. (Fig 1,2 and 3)

Compasses are available with (A) Firm joints (B) Wing (C) Spring joints and (D) Beam Compass or Trammel. (Fig 4)

The measurements are set on the wing compass with a steel rule.

The sizes of a wing compass range between 50 mm to 200 mm. The distance from the point to the centre of the rivet is the size of the wing compass. (Fig 5)

For the correct location and seating of the wing compass legs, 60^0 dot punch mark is indented. (Fig 6)

The beam compass (or) Trammel is used to scribe a circle or an arc with a large diameter which cannot be scribed by a wing compass. (Fig 7)

Fig 2

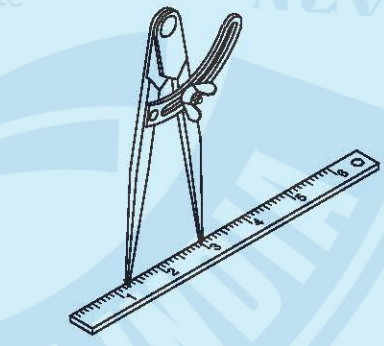


Fig 3

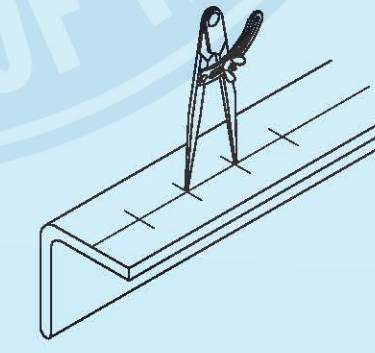


Fig 1

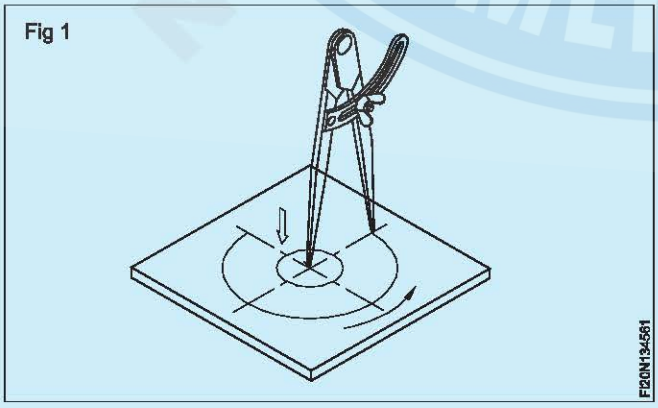


Fig 4

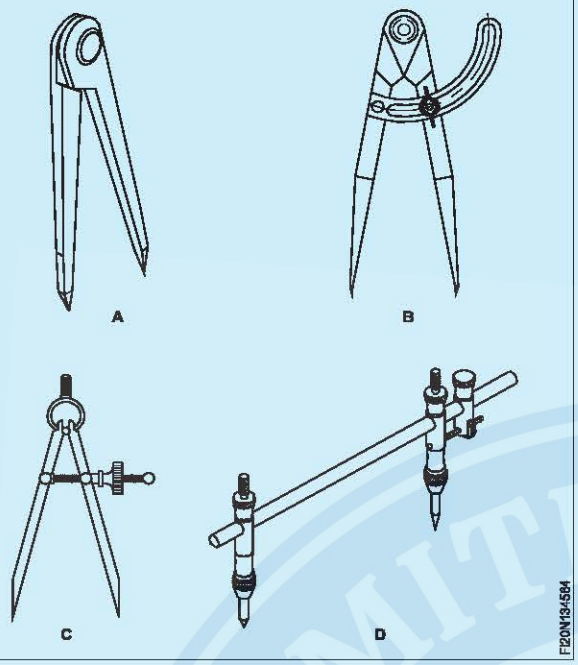


Fig 5

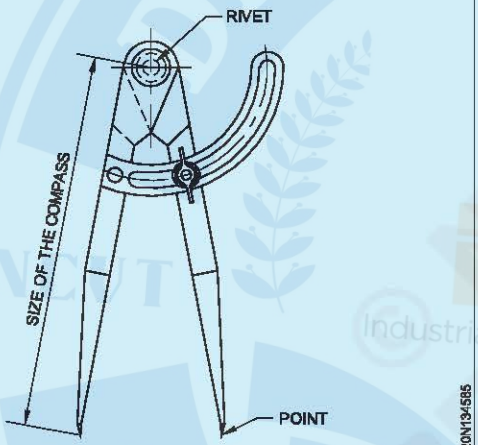


Fig 6

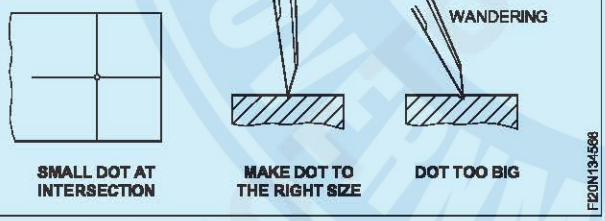
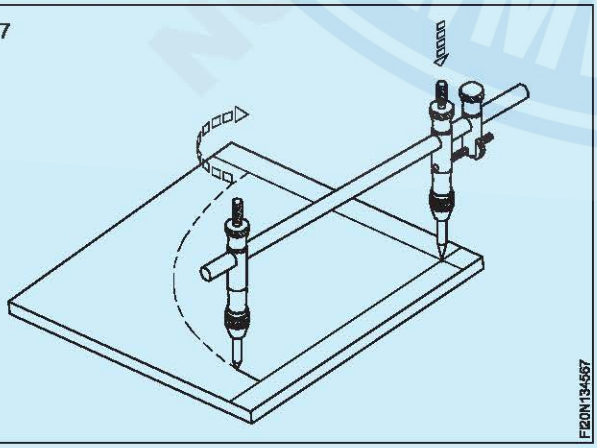


Fig 7



Parts of the wing compass are shown in Fig 8.

The two legs of the compass should always be equal in length. (Fig 9)

Compass are specified by the type of the joints and length. When using spring type wing compass the measurement once taken will not vary while marking.

The compass point should be kept sharp, in order to produce fine lines. Frequent sharpening with an oilstone is better than sharpening by grinding. (Fig 10) Sharpening by grinding will make the points soft.

Fig 8

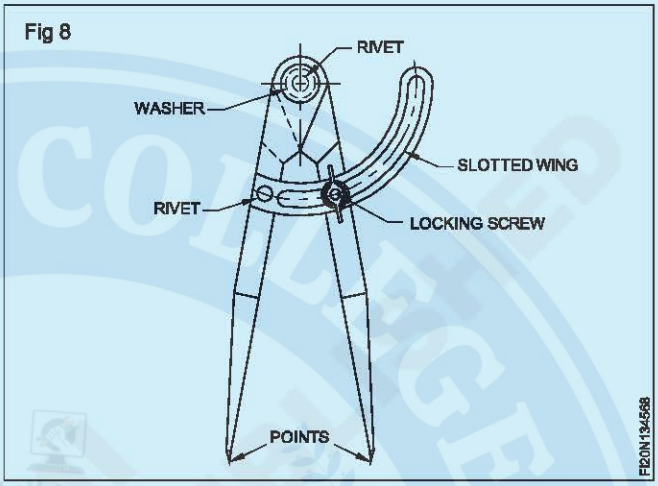


Fig 9

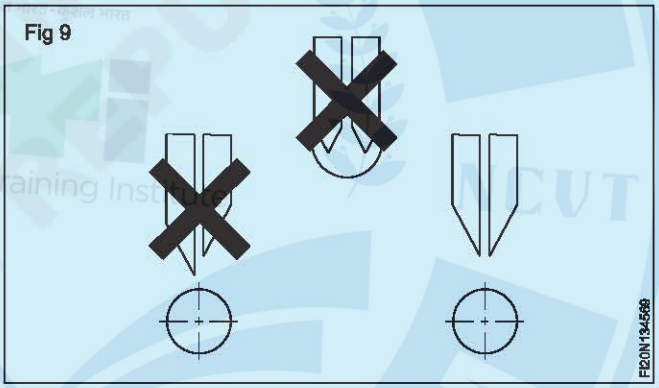
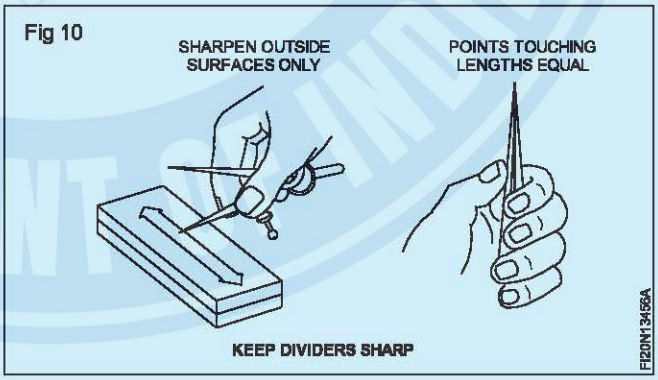


Fig 10



Straight snips

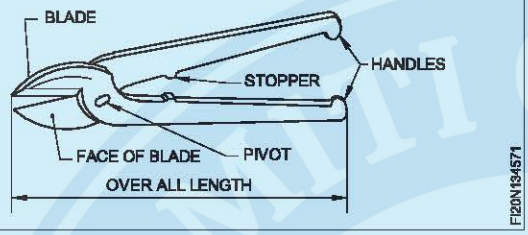
Objectives: At the end of this lesson you shall be able to
- **state the uses of straight snips**
- **state the parts of straight snips**
- **state care and maintenance.**

A snip is also called a hand shear. It is used like a pair of scissors to cut thin soft metal sheets. Snips are used to cut sheet metal upto 20 S.W.G.

Uses of straight snips: The straight snips are used to cut sheet metal along straight lines and outer sides of curves.

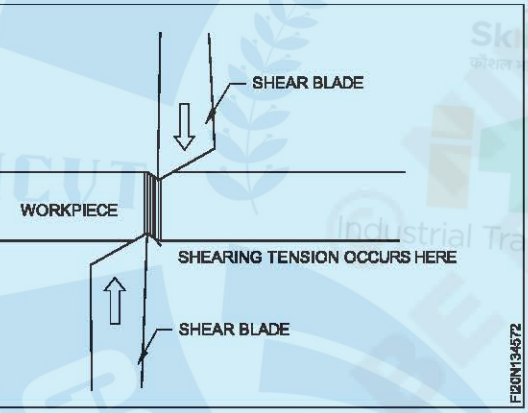
Parts of straight snips are shown in Fig 1.

Fig 1



While cutting a sheet metal, blades are pressed against the sheet, which causes shearing tension from both sides as shown in Fig 2 and the cutting action takes place.

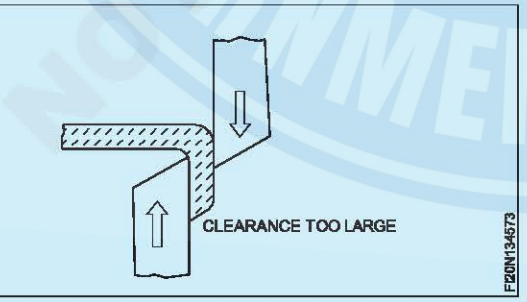
Fig 2



Cutting edge of the blade and clearance: Clearance between the blades should be free but without gap. For straight snips, cutting angle is 87°.

If the clearance is too large it cause unclean cut, chamfered and jamming of workpiece as shown in Fig 3.

Fig 3



Types: There are two types of snips

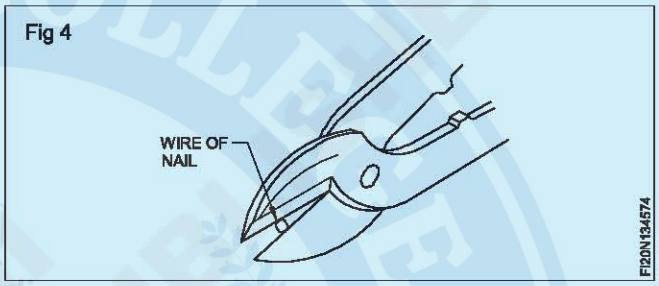
1 Straight snip

2 Bent snip

Specification: Snips are specified by its overall length and the shape of the blade. (snips are available in 150 mm, 200mm, 300 and 400 mm overall length) Ex.200 mm, straight snips.

Safety: Avoid cutting wires and nails, if so the cutting edge of the blade becomes damaged (Fig 4).

Fig 4



Avoid cutting hard sheet metal, if so the blade becomes blunt.

Due to wear and tear, the cutting edge of the blades becomes blunt. To resharpen the blade, the cutting angle alone should be ground to an angle of 87° (Fig 5) and should not grind the face of the cutting side of the blade. (Fig 6)

Fig 5

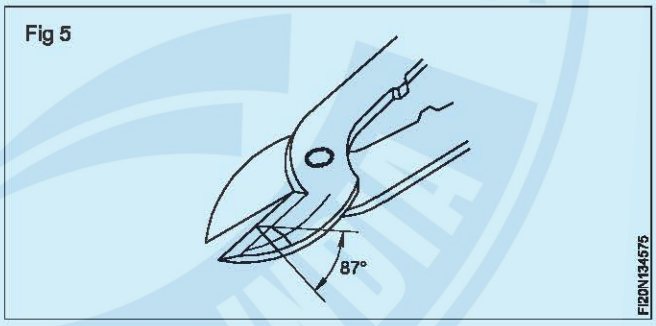
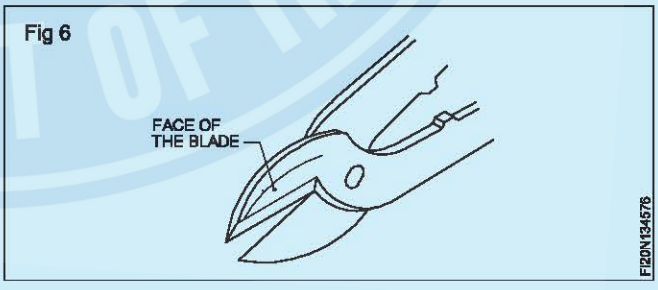


Fig 6

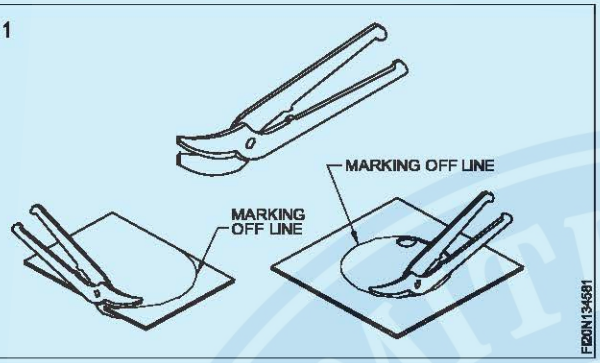


Bend snips

Objectives: At the end of this lesson you shall be able to
- **state the use of the bend snips**
- **state the parts of the bend snips**
- **state the specification of the bend snips**
- **state types of shears and their application.**

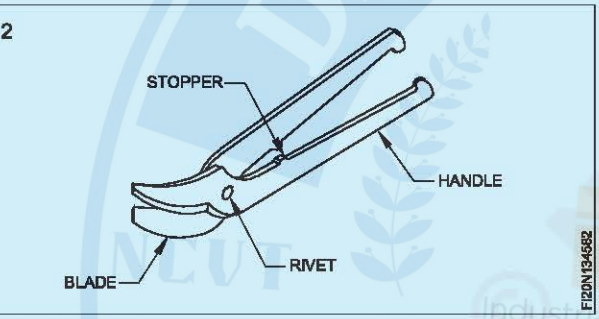
The bend snips are used to cut the inside curved lines and for trimming curved edges as shown in (Fig 1).

Fig 1



Parts of the bend snips are shown in fig 2. The blades of the bend snips are curved. (Fig 2)

Fig 2



Specification: Bend snips are specified by their overall length. Bend snips are available in 150, 200, 300 and 400 mm length.

Type of shears

1 Tinman's shears is sometimes called straight shears.

2 Universal combination shears or Gilbow shears.

3 Pipe shears

4 Scotch shears

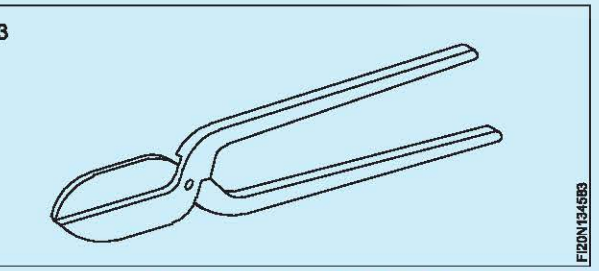
5 Block shears

6 Rhodes shears

Uses

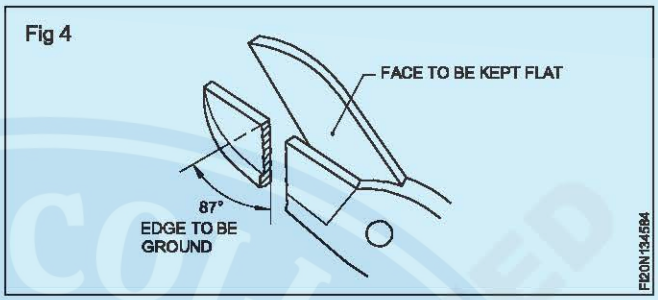
Tinman's shears (Fig.3): It is used for making straight cuts and large external curves upto the thickness of 18 SWG. Cutting angle of a shears is 87°. The cross sectional view of the cutting blades is shown in Fig 3. Never grind the face of the blade.

Fig 3



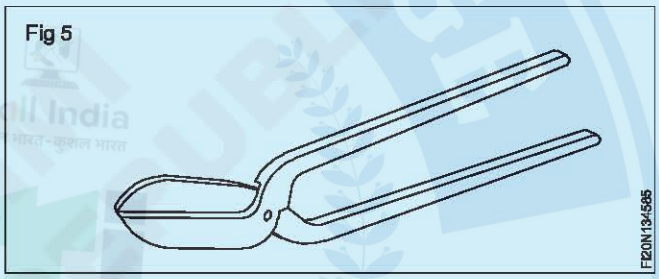
Universal combination shears or Gilbow shears (Fig 4)

Fig 4



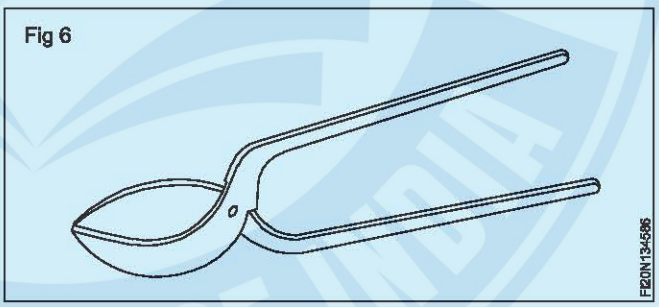
Its blades are designed for universal cutting, straight line or internal and external cutting of curves may be right hand or left hand, easily identifiable as the top blade is either on the right or the left. (Fig 5)

Fig 5



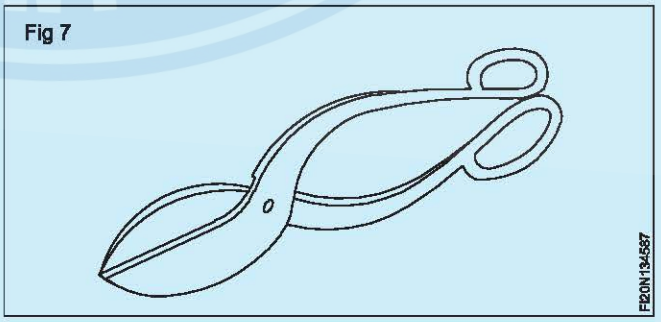
Pipe shears (Fig.6): It is applied as bend shears in all cases. Particularly it is used to time the edges of the pipes.

Fig 6



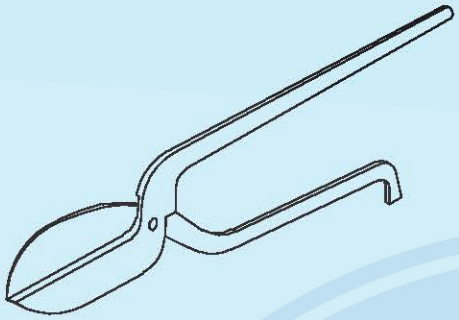
Scotch shears (Fig.7): It is a shape as shown in the fig.9 its handles are formed as eye holes to give extra grip to the hands. It is also used as Tinman's shears.

Fig 7



Block shears (Fig.8): One of the handle of the shear is bent downwards as shown in the figure. The bending portion should be fixed on the iron plates hole and the upper handle will be held by the worker. It is used in mass production purposes.

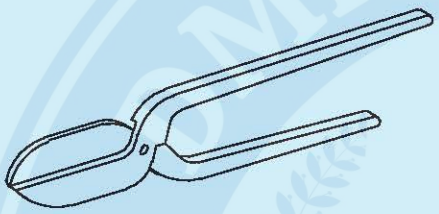
Fig 8



FI20N134566

Rohdes shears: Its one handle is shorter in length as compared with the other handle as shown in Fig.9.

Fig 9



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The short handle is to be pressed by the right leg of the worker and the other handle should be held by the right hand. It is used to cut lengthy sheets.

Shearing force: To produce the maximum cutting force, the hand must be kept far from the rivet and the metal being cut must be kept close to the rivet.

Hawk billed shears (Fig.10)**:** It is used for the inside cutting of an intricate work. The snips have narrow curved blades that allow you to make sharp turns without bending the metal.

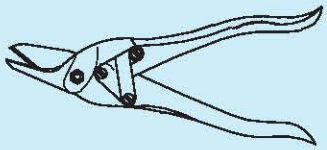
Fig 10

HAWK-BILLED SHEAR

FI20N134569A

Aviation shears (Fig.11)**:** It can be used for all kinds of cutting. These are made with left, right or universal cutting blades.

Fig 11



AVIATION SHEAR

FI20N134569B

Bench shears (Fig.12)**:** These are designed to have one handle held in a vice or bench plate, while the other handle is moved up and down.

They can cut 16 gauge to 18 gauge thickness sheet metal.

Fig 12

BENCH SHEAR

FI20N134568C

Double cutting shears (Fig.13)**:** These shears have three blades used to cut around cylindrical objects, such as cans and pipes. A single blade is pushed through the metal to sheet to cut.

Fig 13

DOUBLE CUTTING SHEAR

FI20N134568D

Electric portable shear (Fig.14)**:** Electric shears are used to cut corrugated metal sheets or a sheet metal of 18 gauge thickness or lighter sheet metals.

The shear point can be inserted with a light hammer blow. Successive blows will drive the shear on a scribed line for almost any shape like inner circles, zig zag, curvature line easily. A strip of metal about 3"/32 (2.5 mm) wide is removed in this shearing operations.

Fig 14

FI20N134568E

Sheet metal mallets & hammers

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

- **state the different types of mallets**
- **state the uses of mallets**
- **state the care and maintenance.**

Mallet is a shaping tool used for general purpose work like flattening, bending and forming to required shape of sheet metal.

These are made of hard wood

When using any metal hammer for flattening the sheet metal, the face of the hammer may damage or leave impression on the sheet more than what is required for the job. To avoid such damage and a impression, mallets are used.

Types (Fig 1)

– Ordinary mallet

– Bossing mallet

– End-faked mallet

– Raw hide mallet.

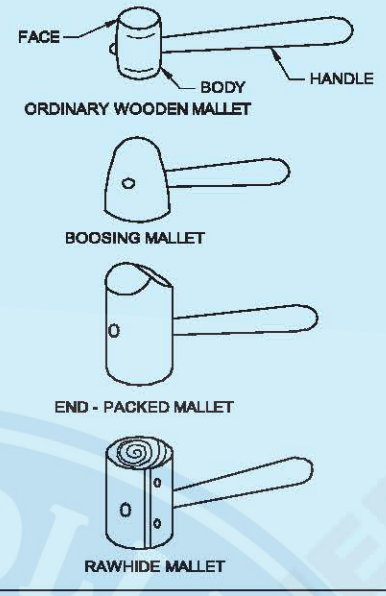
Ordinary mallet: Both the faces of the mallets are provided the little convexity. If the face is not in convex shape the edges of the mallet face will get frozen while beating the job.

Mallets are specified by the dia and the shape of the face. Mallets are available in 50 mm, 75 mm and 100 mm dia.

Avoid using the mallet as hammer for doing chipping and to drive nails and work on the sharp corners.

If so the face will get damaged and the mallet is liable to break.

Fig 1



Sheet metal hammers

Objectives: At the end of this lesson you shall be able to
- **state the names of sheet metal hammers**
- **state the constructional features of sheet metal hammers**
- **state the uses of sheet metal hammers**
- **specify the sheet metal hammers**
- **state safety precautions while using the hammers.**

In the previous lessons, you learned about the Engineering hammers such as Ball pane hammer, cross pane hammer and straight pane hammer. Apart from these, there are some special type of hammers used in sheet metal trade, which are called sheet metal hammers.

They are

1 Setting hammer

2 Riveting hammer

3 Creasing hammer

4 Stretching hammer

5 Hollowing hammer

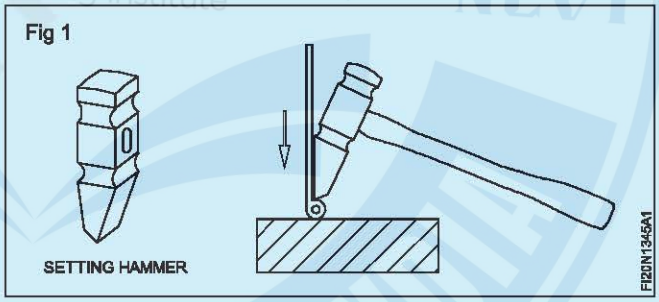
6 Bullet hammer

7 Plaiting hammer

8 Peening hammer

Setting hammer: Its face is either round or square in shape. Its pane is tapered from the eye hole and the other side is straight to the handle. The tip of the pane is rectangular in shape, and slightly convexed. It is used to set up the seams, flaring the edge of the cylindrical jobs and to set up the long channel also. Its face is used for general purposes. (Fig 1)

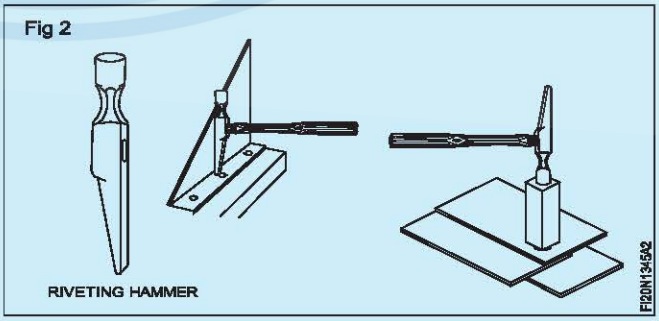
Fig 1



Riveting hammer: Riveting hammer's face is round in shape and the face is slightly convex. Its pane is long tapered and straight to the handle vertically. The tip of the pane is blended.

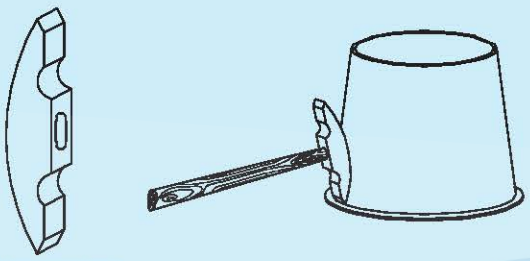
Riveting hammer is used to jump the rivet shanks and finish the rivet heads. (Fig 2)

Fig 2



Creasing hammer: Its both ends are sharpened and cross to the handle. It is used to finish the wired edges, false wiring edge and make corners of the sheet with the help of a creasing stake. (Fig 3)

Fig 3



CREASING HAMMER

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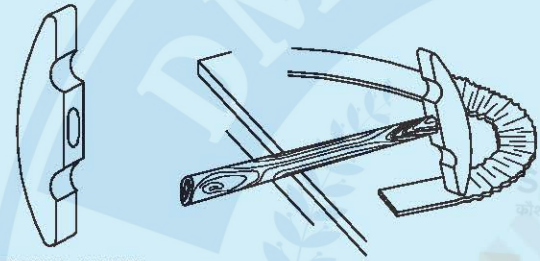
Stretching hammer: Its shape is like a creasing hammer but its pane ends are blended.

It is used to stretch the sheets to increase the length of the sheet. It is mostly used in raising operation. (Fig 4)

Fig 4



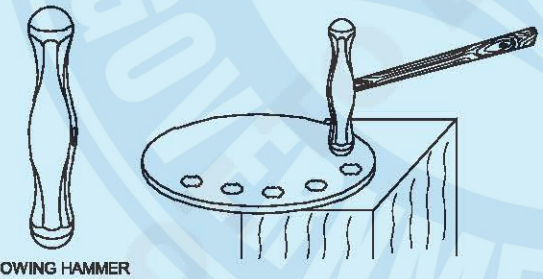
STRETCHING HAMMER

FI20N13454

Hollowing hammer: Its both ends are shaped like ball and well polished.

It is used to make hollowing operation on the metal sheet and to remove the dents from the hollowed articles. This hammer is mostly used for panel beating work. (Fig 5)

Fig 5



HOLLOWING HAMMER

FI20N13455

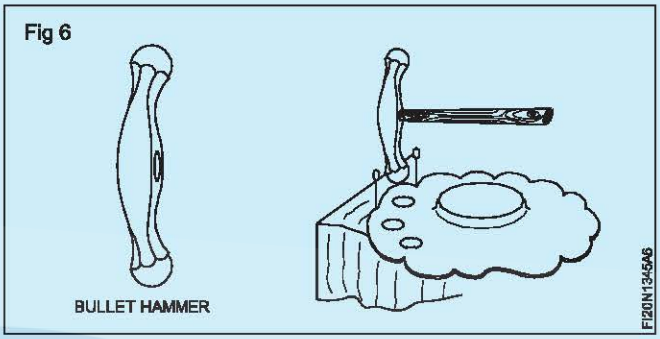
Bullet hammer: Its panes look like the hollowing hammer but the body is longer than the hollowing hammer and slightly bent. The pane ends are well polished and suitable to work on deep portion.

It is used to draw deep hollowing where the hollowing hammer cannot be used and also it is used to remove the dents from the deep hollow portion. (Fig 6)

Planishing hammer: It's one face is square and other is round in shape and well polished. Its pane is slightly convex. This hammer is heavy in weight.

It is used to give smooth surface finish to the jobs which are hollowed and raised, and to planish the surface of the plain sheets. (Fig 7)

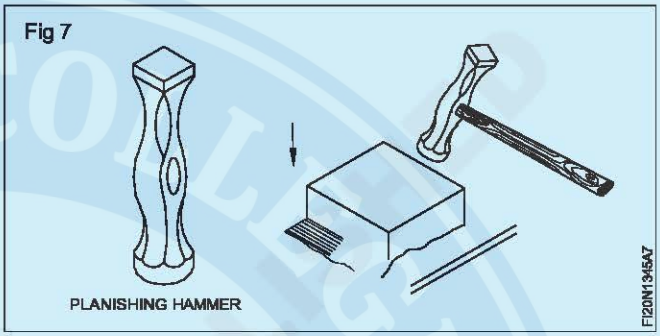
Fig 6



BULLET HAMMER

FI20N13456

Fig 7

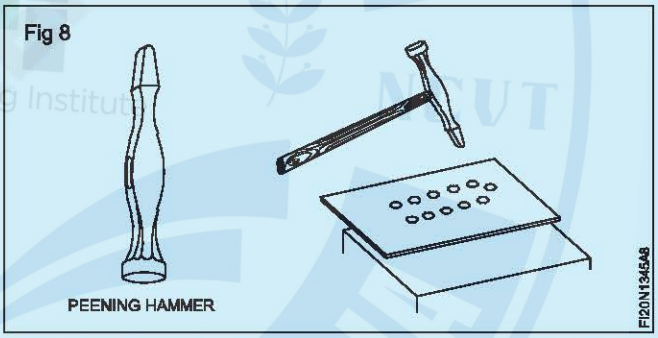


PLANISHING HAMMER

FI20N13457

Peening hammer: It's face is round and slightly convex and a pane is just like stretching hammer. This hammer is used to peen polished impressions on the spinned aluminium job and hollowed copper, brass house hold vessels. (Fig 8)

Fig 8



PEENING HAMMER

FI20N13458

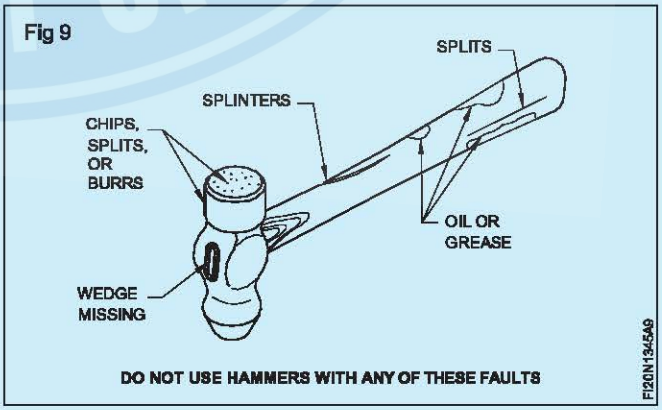
Specification: The sheet metal hammers are specified by the Type of pane and the weight of the hammer.

Example

1 Planishing hammer

Safety precautions (Fig 9)

Fig 9



FI20N13459

– Always handle and face of the hammers should be free from oil and grease.

– Face of the hammers should be free from scratches, dents, splits, burrs, chips etc.

– The handle should be securely fitted to the head. The wedge should be tight. (Fig 10)

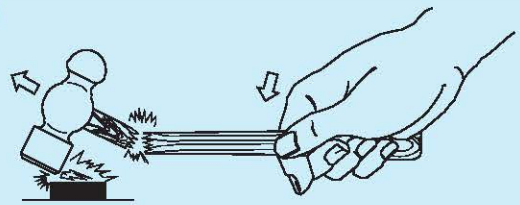
Fig 10

SAFETY CHECK

FI20N13454A

– Hammers fitted with broken, cracked, splinted handles should not be used. Replace the handles immediately. (Fig 11)

Fig 11



FLYING HEADS ARE DANGEROUS

FI20N13454B

– Heads flying from poorly fitted or broken handle can cause serious injuries.

– Always use a piece of soft metal between the hammer and the hard steel.

– Never hit two hammer faces together because the faces would split and the chips would fly dangerously.

– Select the right hammer for that particular job.

Soldering iron (soldering bit)

Objectives: At the end of this lesson you shall be able to
- **state the purpose of soldering iron**
- **describe constructional features of soldering iron**
- **state different types of copper bits and their uses.**

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

Soldering irons are normally made of copper or copper alloys. So they are also called as copper bits.

Copper is the preferred material for soldering bit because

– it is a very good conductor of heat

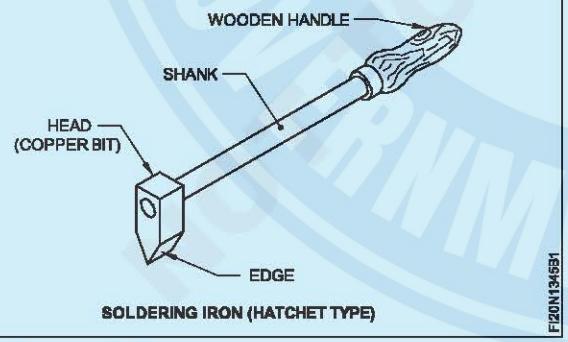
– it has affinity for tin lead alloy

– it is easy to maintain in serviceable condition

– it can be easily forged to the required shape.

A soldering iron has the following parts. (Fig 1)

Fig 1



SOLDERING IRON (HATCHET TYPE)

FI20N13459I

– Head (copper bit)

– Shank

– Wooden handle

– Edge

SOLDERING COPPER BIT

Types of soldering copper bits: There are 7 types of soldering copper bits in general use,

They are

– The pointed soldering copper bit.

– The electric soldering copper bit.

– The gas heated soldering copper bit.

– Straight soldering copper bit.

– Hatchet soldering copper bit.

– Adjustable copper bit.

– Handy soldering copper bit.

The bits of soldering irons are made in various shapes and sizes to suit the particular job. They should be large enough to carry adequate heat to avoid too frequent reheating and not too heavy to be awkward to manipulate.

Soldering bits are specified by the weight of the copper head. For general soldering process, the shape of the head is a square pyramid but for repetition, or awkward placed joints, other shapes are designated.

Point soldering copper bit: This is also called a square pointed soldering iron. The edge is shaped to an angle on four sides to form a pyramid. This is used for tacking and soldering. (Fig 2)

Electric soldering copper bit: The bit of the electric soldering iron is heated by an element. This type is preferred, if current is available because it maintains uniform heat. Electric soldering irons are available for different voltages and are usually supplied with a number of interchangeable tips. They can be made quite small and are generally used on electrical or radio assembly work. (Fig 3)

Fig 2

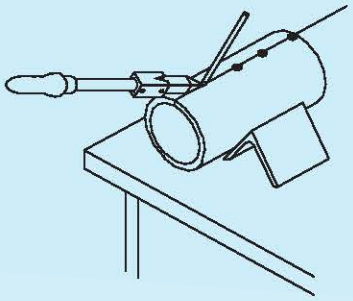


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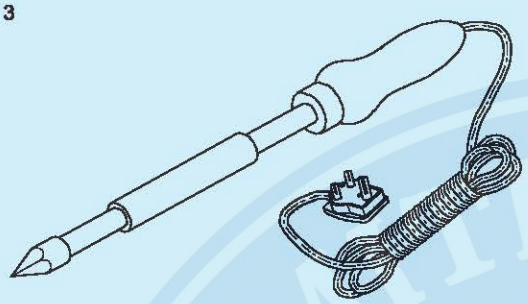
Fig 3



ELECTRIC COPPER SOLDERING

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Gas heated soldering copper bit: A gas heated soldering copper bit is heated by a gas flame which impinges on the back of the head. High pressure gas is used and the bits is large enough to have a good heat storage capacity. Liquified petroleum gas (LPG) flame is used extensively for this purpose. Soldering kit normally includes many sizes and shapes of bits which can be used to make most kinds of soldering connections. (Fig 4)

Fig 4

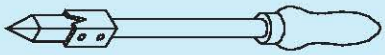
GAS HEATED SOLDERING COPPER BIT

F120N134584

Straight soldering copper bit: This type of soldering iron is suitable for soldering the inside bottom of a round job. (Fig 5)

Hatchet soldering copper bit: This type of soldering iron is very much suitable for soldering on flat position lap or grooved joint outside round or square bottom. (Fig 6)

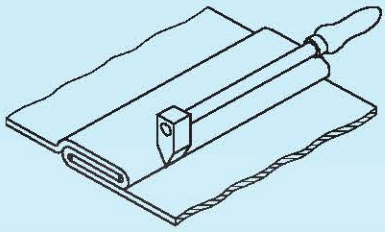
Fig 5



STRAIGHT SOLDERING COPPER WITH HANDLE

F120N134585

Fig 6



F120N134586

Adjustable soldering copper bit: This type of soldering iron is used for soldering where straight or hatchet bit cannot be used for soldering. Adjustable soldering bit can be adjusted in any position for soldering. (Fig 7)

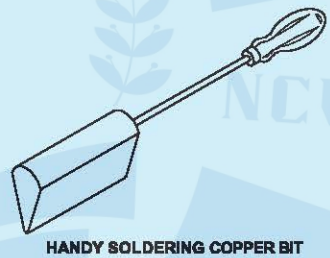
Fig 7

ADJUSTABLE SOLDERING BIT

F120N134587

Handy soldering copper bit: It is like a hatchet type but bigger in size than the hatchet. It is used for soldering heavy gauge of metal. It should not be used for soldering on light gauges of metal because additional heat will cause the metal to buckle. (Fig 8)

Fig 8



HANDY SOLDERING COPPER BIT

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Trammels

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

- **state the uses of Trammels.**

Beam Trammels and taper measures: Trammel set is used for striking lines at 90° to each other, and also for measuring the distances accurately. It is a usual practice for the craftsman to use a pair of trammel heads or 'trams' and any convenient beam such as a length of wooden batten. The arrangement of the trammel for fine adjustment for accurate marking out is shown in Fig 1.

The 90^0 angle lines i.e lines square with each other, may be set out, with the aid of the beam trammel set or steel tape as shown in Fig 2.

Fig 1

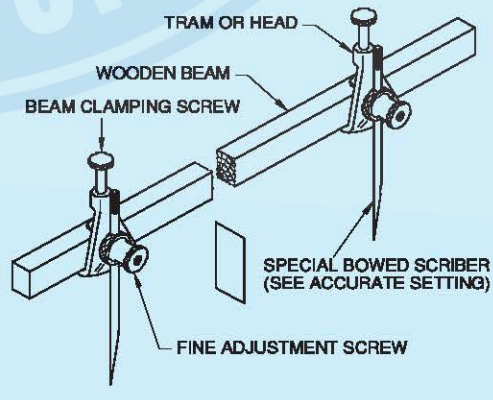

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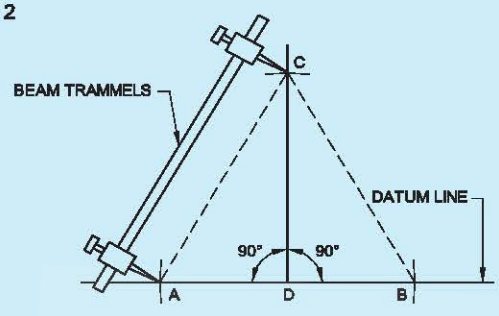
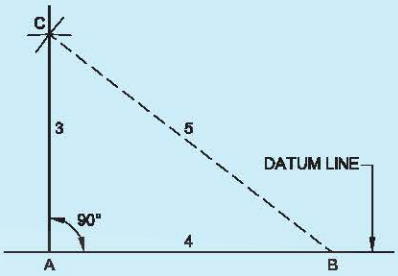
Fig 2



USE OF TRAMMELS TO CONSTRUCT A RIGHT ANGLE

The normal accuracy obtainable when marking out with the dividers, and the trammels is within 0.15 mm of the true dimension. Fig 3 show how the properties of a right angled triangle can be used to set out a perpendicular line by using trammel set.

Fig 3



USE OF TRAMMELS AND STEEL TAPE TO CONSTRUCT A RIGHT ANGLE.

APPLICATIONS OF BEAM TRAMMELS AND STEEL TAPE (MAKING OUT)

Groovers

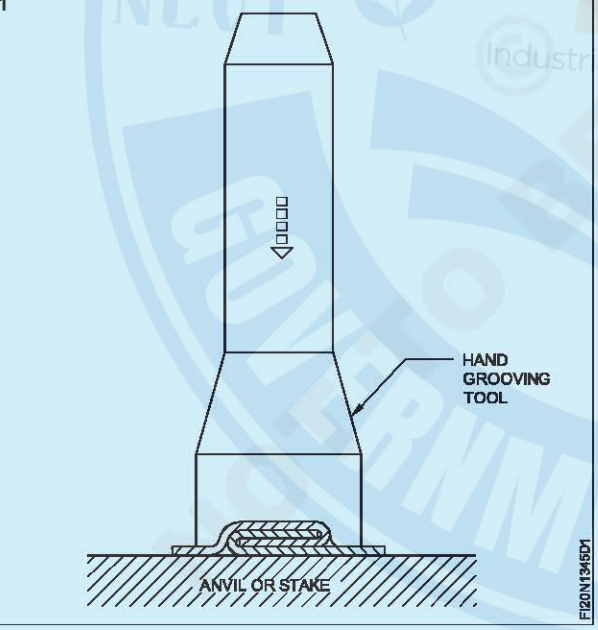
Objectives: At the end of this exercise you shall be able to
- **state what is groover**
- **state the size of the groovers**
- **state the uses and applications of groovers.**

Any seam in sheetmetal should be locked or closed property for effective functioning. Otherwise the joint will be a failure.

What is a groover?

A groover is hand tool used for closing and locking of seams in sheetmetal work. (Fig 1)

Fig 1



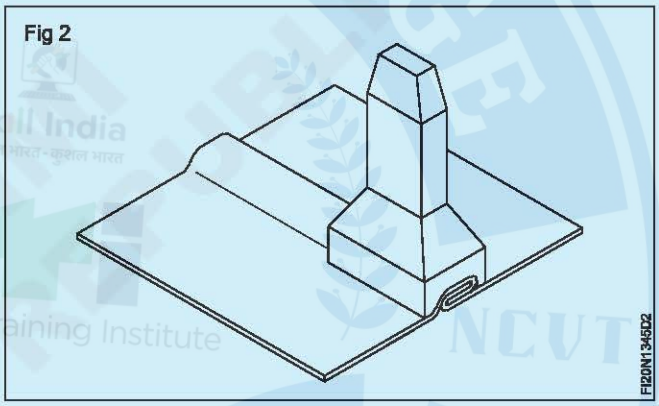
The end of the tool is recessed to fit over the lock making the grooved seams. (Fig 2)

Sizes

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

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

Fig 2



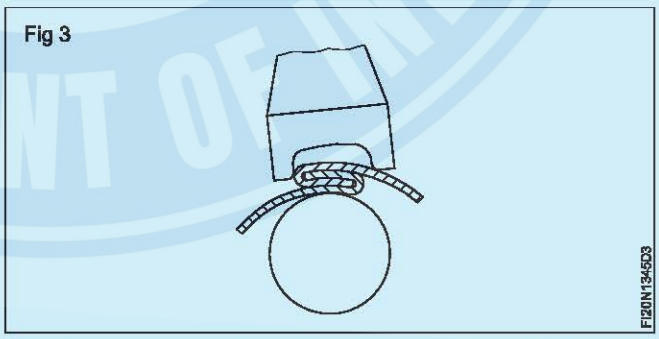
For thicker materials, a groover 3mm larger than the width of the fold is used.

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

Closing and locking

First the joint is held in position and then it is closed with a mallet. (Fig 3)

Fig 3



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 position the groover.

The grooving operations are repeated for the other end of the joint. (Fig 4 and 5).

Fig 4

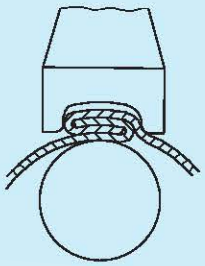


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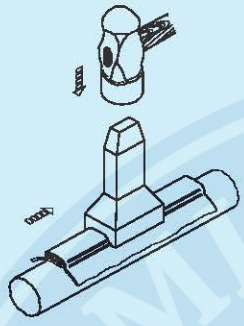
Fig 5



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The joint is locked working along the joint in stages.

The seam is tighter 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 a groover will mark the metal and prevent locking.

Stakes and their uses

Objectives: At the end of this lesson you shall be able to
- **state what is a stake**
- **state the different types of stakes and their uses.**

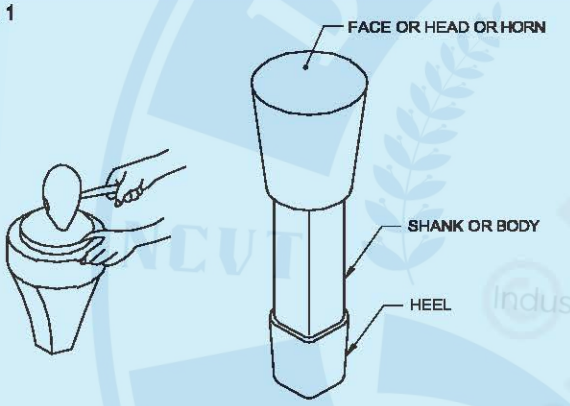
Stakes are the sheet metal workers anvils used for bending, seaming or forming. They actually work as supporting tools as well as forming tools.

Stakes are made in different shapes and sizes to suit the types of operations for which machines are not readily available or readily adaptable.

Some stakes are made of forged mild steel, faced with cast steel. The better class stakes are made either of forged steel or of cast steel.

A stake used in sheet metal working consists of a head (or) a horn. (shank or body and heel) The shanks are designed to fit into a tapered bench socket. (Fig 1)

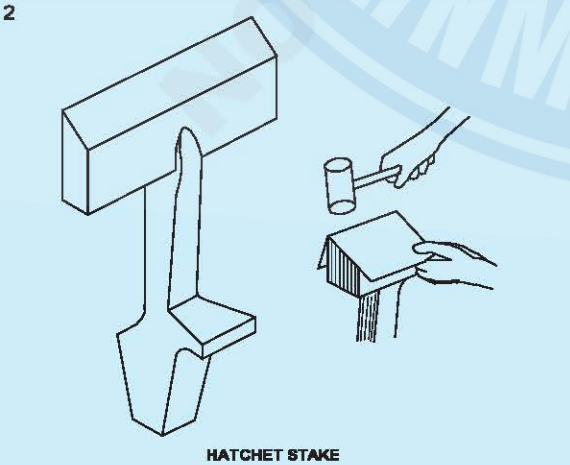
Fig 1



Round bottom stake (Fig 1): It has a round and a concave face head. It is used for hollowing the sheet.

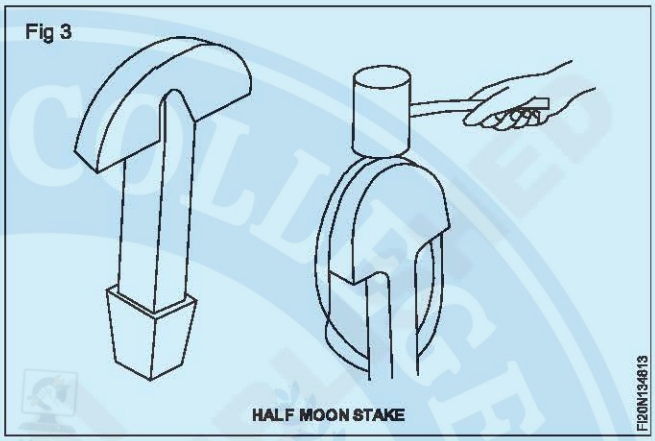
Hatchet stake (Fig 2): The hatchet stake has a sharp, straight edge, beveled along one side. It is very useful for making sharp bends, folding the edges of sheet metal, forming boxes and pans by hand.

Fig 2



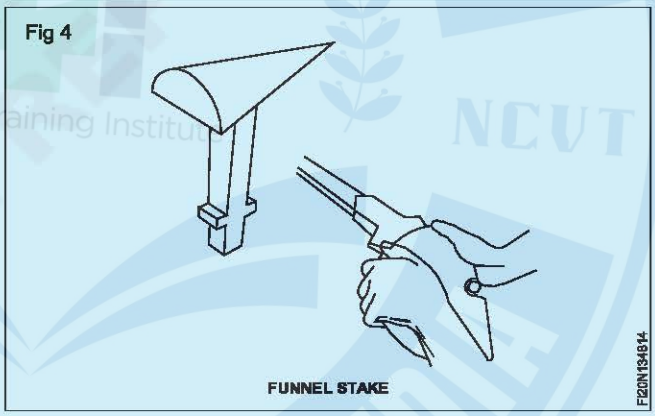
Half moon stake (Fig 3): This stake has a sharp head in the form of an arc of a circle, beveled along one side. It is used for turning up flanges on metal discs.

Fig 3



Funnel stake (Fig 4): This stake is used when shaping and seaming funnels and tapered articles.

Fig 4

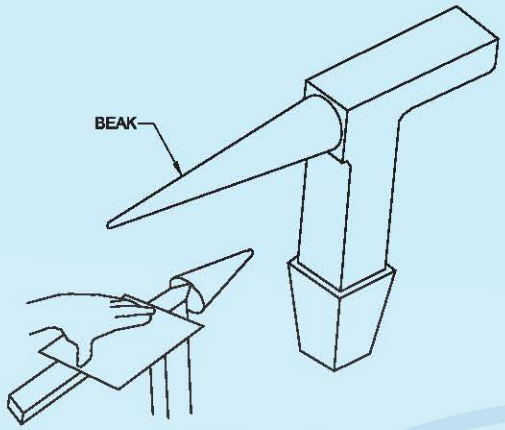


Beak or Bick Iron stake (Fig 5): This stake has two horns, one of which is tapered the other is a rectangular shaped anvil. The thick tapered horn or beak is used when making spouts and sharp tapered articles. The anvil may be used for squaring corners, seaming and light riveting.

Creasing Iron (Fig 6): This stake has two rectangular shaped horns, one of which is plain. The other horn contains a series of grooving slots of various sizes. The grooves are used when 'Sinking' a bead on a straight edge of a flat sheet. This is also used when making small diameter tubes with thin gauge metal.

Pipe stake or Square edge stake (Fig 7): This stake has the horn and the shank. The horn is available in two types. one is with flat face as shown in (Fig 7A). Other one is with curved face as shown in (Fig 7B) Flat face horn stake is used to fold the edges, and to turn up straight edges. The

Fig 5



BEAK OR BICKIRON

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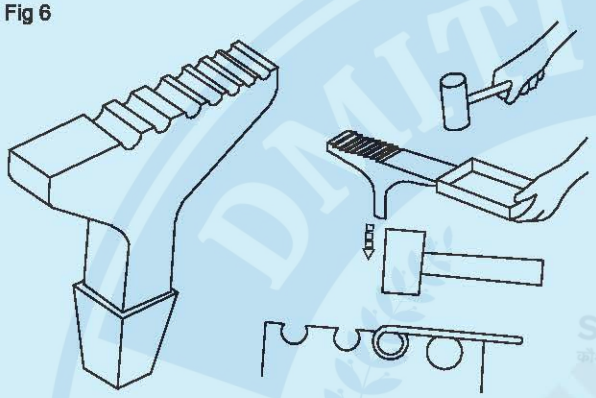
Fig 6



CREASING IRON

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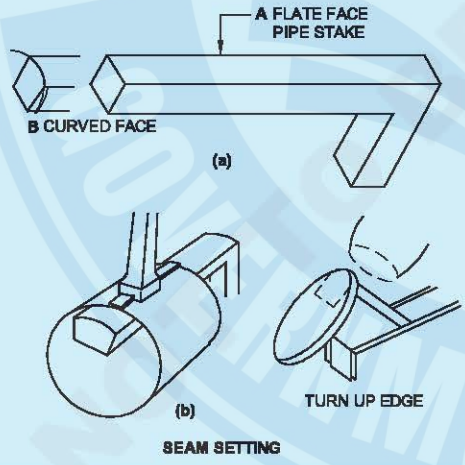
curved face horn stake is used to turn circular disc or curved edges and to make knocked up joints.

Fig 7



SEAM SETTING

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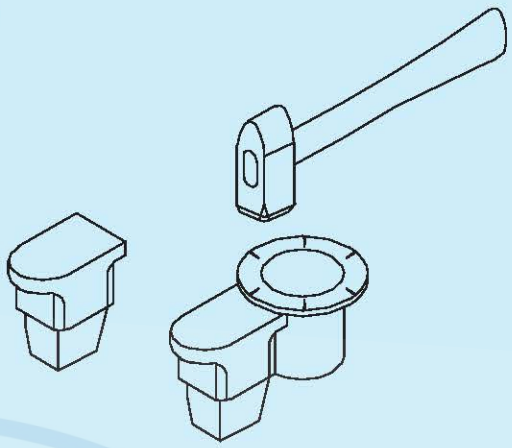
Tinman's Anvil (Fig 8): It is used for planishing all types of flat shaped works. It is highly polished on its working surface.

Tinman's Horse (Fig 9): This stake has two arms at its both ends, one of which is usually cranked downwards for clearance purpose. There is a square hole for the reception of a wide variety of heads. (Fig 10)

Fig 8



TINMAN'S ANVIL

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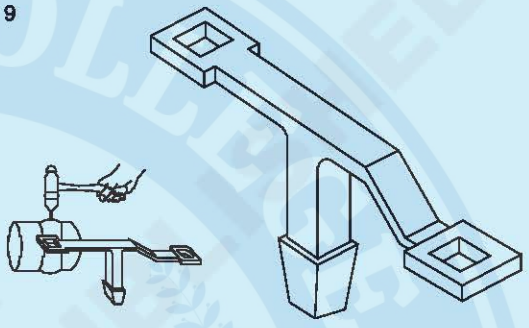
Fig 9



TINMAN'S HORSE

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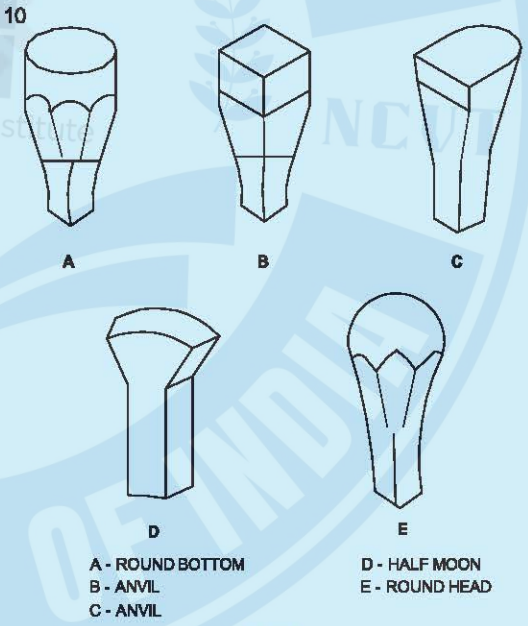
Fig 10



HEADS

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The surface of the stake is important for the workmanship of the finished article. Therefore, care must be taken to avoid any damage to the surface of the stake when centre punching or cutting with a cold chisel.

Apart from these stakes, special types of stakes are also available to suit different types of jobs.

Copper smith stake

Objectives: At the end of this lesson you shall be able to
- **identify a copper smith stake**
- **state the constructional features of a copper smith stake**
- **state the uses of a copper smith stake**
- **state safety, care and maintenance while using a copper smith stake.**

It is not economical to have too many stakes for simple operations in a sheet metal shop.

Hence, an economical way of tooling is adopted and designed by combining two edges of different cross sections on a common head as in Fig 1. This stake is called a copper smith stake or tinman's anvil. It is a very useful stake used in sheet metal work, due to its constructional features.

This stake is used for flattening the surfaces of the sheet metal, bending, flanging, finishing wired edges on both straight and curved edges.

These stakes are made of medium carbon steel and case hardened.

Safety care and maintenance

1 Fix the stake firmly in the bench plate or stake holder to avoid slipping and causing accidents.

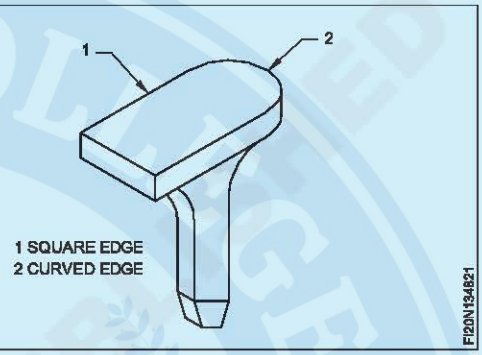
2 Do not use it for heavy work.

3 Do not spoil the surface of the stake by chiseling and punching.

4 Do not spoil the edges by cutting wire or nails on the edges of the stake.

5 Remove and keep it in its place after use.

Fig 1



Bottom round stake

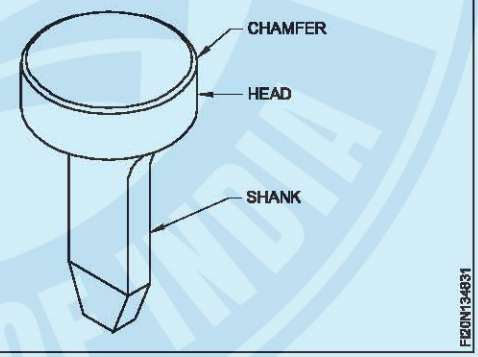
Objectives: At the end of this lesson you shall be able to
- **identify the Round Bottom Stake**
- **state the constructional features of this stake**
- **state the uses of this stake.**

Bottom round stake: This is a very common stake used in a sheet metal shop. This stake is round in shape with a flat face, slightly chamfered to avoid the cracking or tearing of sheets while using it.

It is used for turning edge on circular discs, seaming and fixing bottom to cylindrical parts, making a paned down joint at the bottom of the cylindrical parts. The tail is designed to fit in the square slot made in the work bench or stake holder.

Do not cut wires or nails on the edge of the stake. This will spoil the edge and the same impression will be formed on the sheet or the part formed on it.

Fig 1



Stake holders

Objectives: At the end of this lesson you shall be able to
- **name the different types of stake holders**
- **state the constructional features of stake holders**
- **state the uses of stake holders**
- **state safety, care and maintenance when using stake holders.**

There are three types of stake holders

1 Bench plate

2 Revolving bench plate

3 Universal stake holder

Bench plate: Stakes are held in position while using them by means of a plate which is fastened to the work bench with bolts and nuts. These plates are called bench plates or stake holders.

These bench plates are made of cast iron and are rectangular in shape as in Fig 1. The tapered holes are conveniently arranged so that the shanks of the stakes may be fixed and used in any convenient position. The smaller holes are used to support the bench shears.

Fig 1

BENCH PLATE

FI20N134841

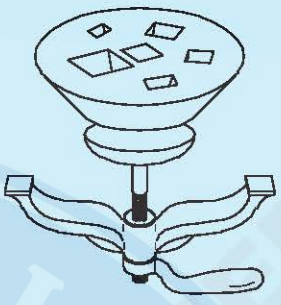
Revolving bench plate: Revolving bench plate consists of a revolving plate with tapered holes to support the shanks of the stakes while using them.

This revolving bench plate can be held in any convenient position by clamping it on to the work bench, with the clamping provision provided on it as in Fig 2.

Universal stake holder: Universal stake holder can be clamped to any desired position on the work bench. So it is preferred by most of the mechanics.

This stake holder is designed with a set of stakes which can be easily fixed on to the stake holder and hence it is termed as universal stake holder set as shown in Fig 3. One stake may be replaced by another very quickly by simply turning the swivel handle and replacing the stake.

Fig 2



REVOLVING BENCH PLATE

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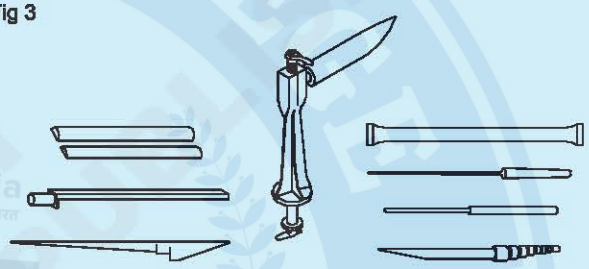
Fig 3



UNIVERSAL STAKE HOLDER

FI20N134843

When placing an order to purchase this type of stake holder set, we should specify clearly the type of stakes to be supplied along with the stake holder.

Safety, care and maintenance:

- Fix the stake holder firmly on to the work bench.
- Do not use it for very heavy work.
- Do not overtighten the locking arrangements which may spoil the threads on the device.
- Do not place the unnecessary accessories on the work table. Place only the required ones.
- Avoid chiseling or punching on this stake holder.
- Remove and keep it in its place after use.

Sheet metal seams

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

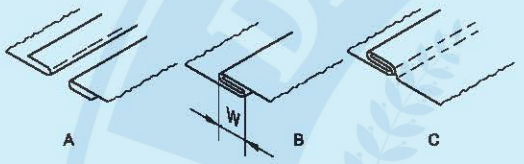
Introduction

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.

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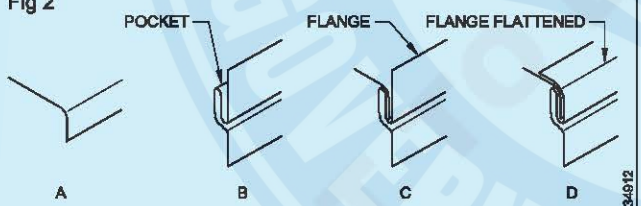
2 **Pittsburgh seam:** This seam is also called hammer lock or hobo lock. This seam is used as a longitudinal corner seam for various types of pipes such as duct work. The single lock is placed in a pocket lock and then the flange is hammered over, step by step as shown in Fig 2.

Fig 2



STEPS IN FORMING THE PITTSBURGH SEAM.

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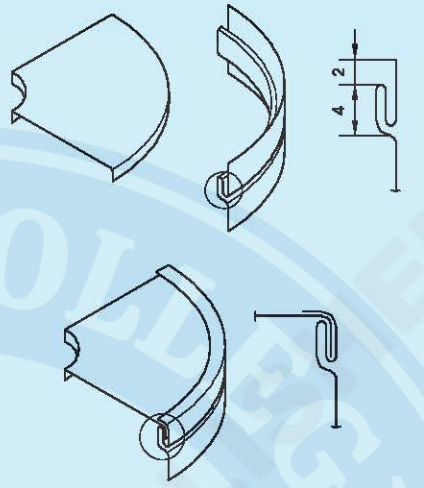
The advantage of the Pittsburgh seam is that the single lock can be turned on a curve and the pocket lock can be formed on a flat sheet and rolled to fit the curve as shown in Fig 3. If roll forming machine is not available in shop, Pittsburgh seam is formed on the brake.

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.

Fig 3



PITTSBURGH SEAMS CAN BE FORMED ON CURVES.

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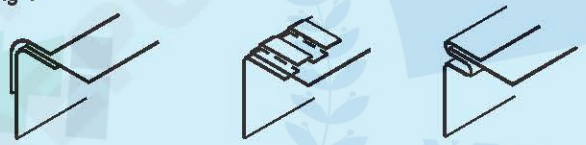
Fig 4

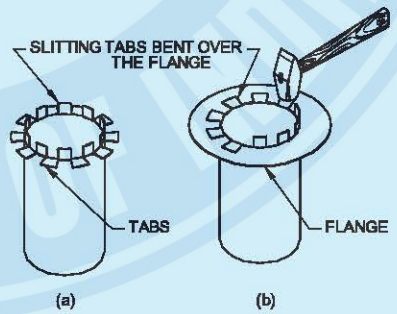


FLANGE DOVETAIL SEAM
PLAIN DOVETAIL SEAM
BEADED DOVETAIL SEAM

F12DN134914

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

Fig 5



PLAIN DOVETAIL SEAM.

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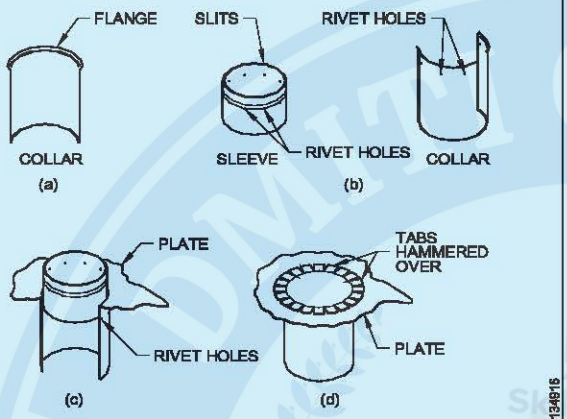
The straight tabs are bent over the part to be joined and the bent tabs act as stops. This seam may be made water tight by soldering around the joint.

(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 interval sat 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.

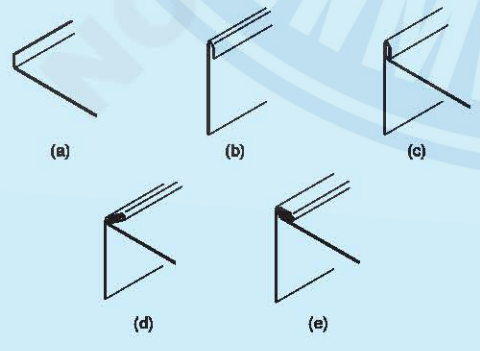
(C) Beaded dovetail seam

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.

Fig 7

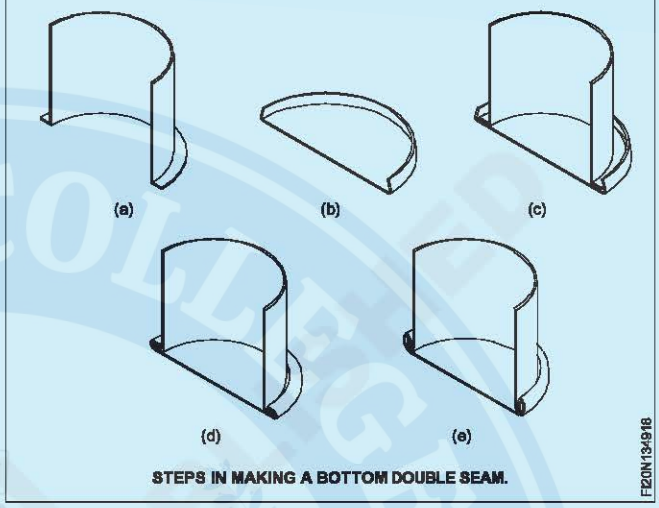


MAKING A DOUBLE SEAM.

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

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.

Fig 8



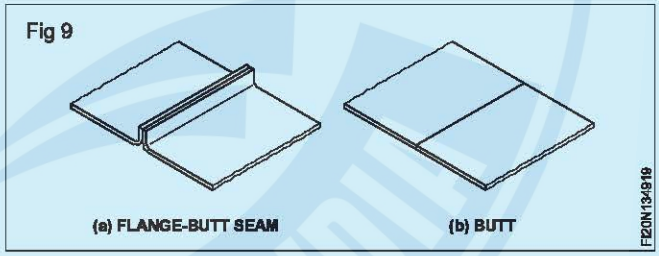
STEPS IN MAKING A BOTTOM DOUBLE SEAM.

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

7 Slip joint seam

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

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.

Fig 10

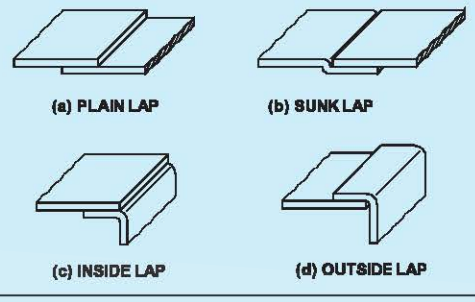
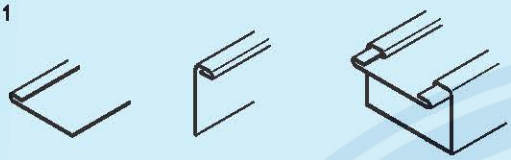


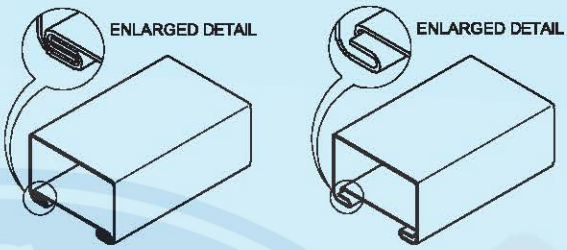
Fig 11



SLIP JOINT 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

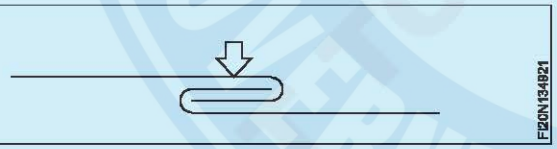
Objectives: At the end of this lesson you shall be able to
- **state the purpose of a joint**
- **state the use of the groover**
- **determine the allowance for the locked grooved joint**

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 workpieces to be joined are made in the form of a hook, inserted and locked using a groover.

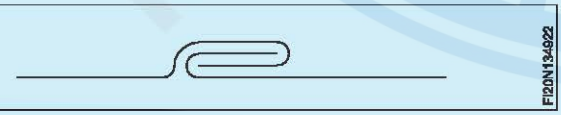
When they are interlocked and tightened only then it is called a "grooved joint" (Fig 1).

Fig 1



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

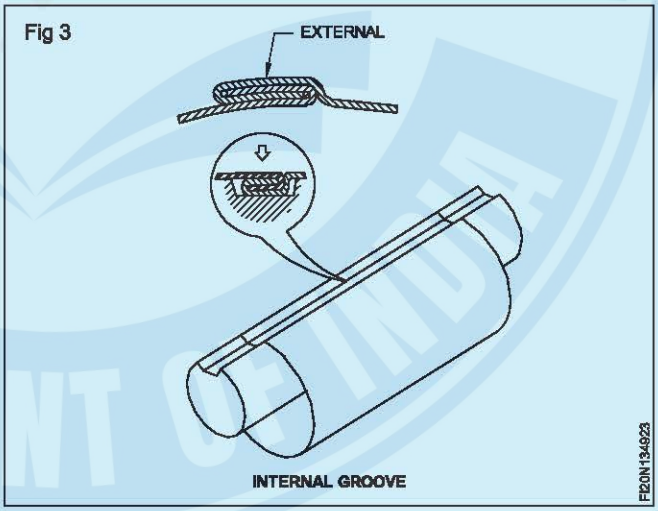
Fig 2



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)

Fig 3

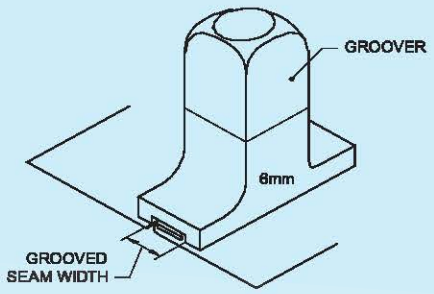


Hand Groover: The hand groover is made up of cast steel and is used to make external locked grooved joint.

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 4

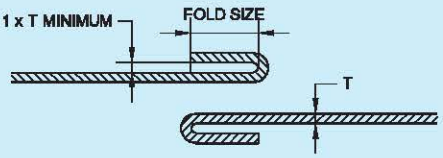


The hand groover is specified according to the size of the groove of the groover.

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)

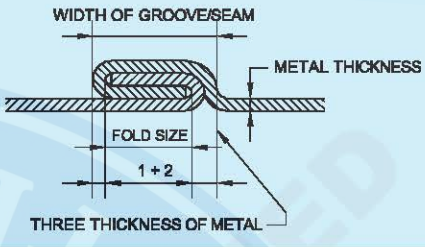
For example, the width of the groover is 6 mm and the sheet thickness is 0.5 mm,

Fig 5



Then the width of the fold
= 6 - (3 x 0.5)
= 4.5 mm (See Fig 6).

Fig 6



Stake joint

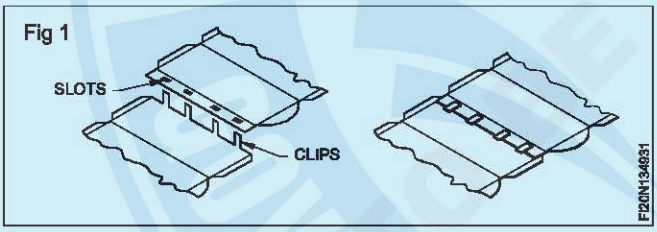
Objectives: At the end of this exercise you shall be able to
- **state the applications of stake joint**
- **state the types of stake joints.**

Stake joint

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

In this type of joint, clips are cut on one pieces 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



Types of stake joint

i Straight stake joint

ii Zigzag stake joint

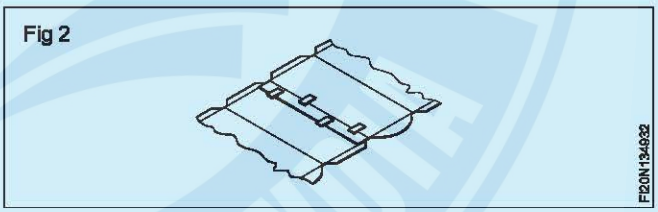
Straight stake joint

In this joint, clips and slots are in a line an 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 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**
- **calculate the allowances for grooved joints**
- **calculate the allowances for dovetail joints**
- **calculate the allowances for paned down and knocked up joints.**

When making self secured joints or seams, it is necessary to provide material for the preparation of the edges and seams, the extra material is called an allowance.

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

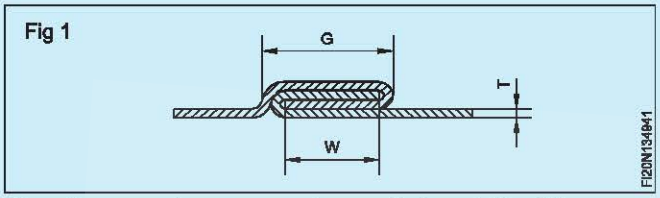
Allowance is also necessary for avoiding cracking or warping, and for obtaining the required finish.

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

You may neglect the thickness of the metal for thinner sheet 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 seen that the final width of the groove will have a minimum value of W+ 3T, where T represents the metal thickness.

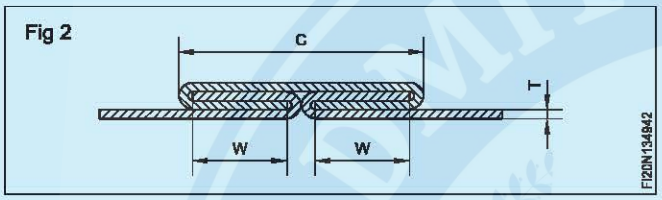
Fig 1



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

Allowance for double grooved seam/joint: It will be seen from Fig.2 that the width of the capping strip is equivalent of two times the width of the folded edge plus four times the thickness of the metal size.

Fig 2



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.

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 (Fig 3) and 'K' represents the size of the knocked-up joint. (Fig 4)

Allowance for P = 2W + 2T

Allowance for K = 2W + 3T

Fig 3

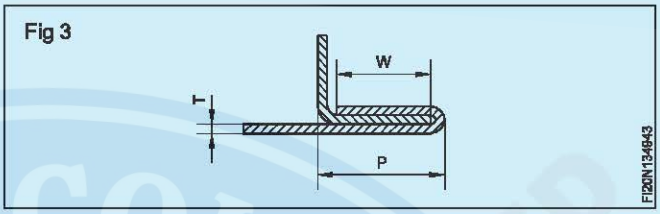
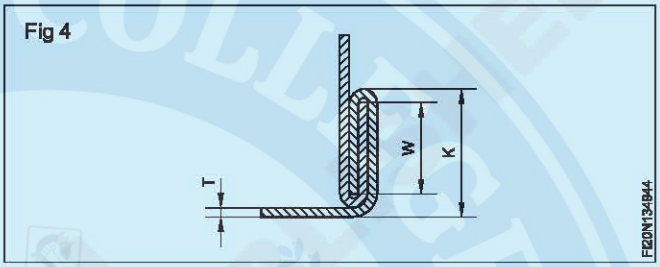


Fig 4



Edge stiffening by wiring

Objective: At the end of this lesson you shall be able to
- **state what is edge stiffening**
- **state what is the purpose of edge stiffening**
- **state methods of edge stiffening by wiring.**

Edge stiffening: Edge stiffening is the process by which edges of the sheets are made stronger and rigid.

Edge stiffening is done by

1 Wiring
2 Hemming
3 Flanging
4 Curling
5 Beading
6 Gutting
7 Ribbing

Purpose of edge stiffening

1 To give extra strength and rigidity to edges, to prevent it from bending/buckling, damage during handling etc.

2 To avoid sharp edges for safe handling.

3 In addition, this adds to decorative appearance of the sheet metal articles.

Methods of edge stiffening by wiring

1 Solid wiring

2 False wiring

In solid wiring, sheet metal edges are wrapped around the wire and wires are kept permanent in place. This is generally called simple "Wiring".

In false wiring, sheet metal edges are wrapped around the wire, after forming final shape, the wire is removed from the edge to retain it hollow.

If the edge of the sheet metal is straight, the edge formed is called "straight wired edge".

If the edge of the sheet metal is curved, the edge formed is called "curved wired edge".

False wiring cannot be done on curved edges

Wiring allowance

Objectives: At the end of this lesson you shall be able to
- **state what is wiring allowance**
- **determine the wiring allowance.**

Wiring allowance is nothing but the amount of additional length provided on sheet metal to wrap around the wire to make a wired edge.

Wiring allowance is determined by the following formula.

Wiring allowance = 2.5 x d+t

where

d=dia of wire

t=thickness of sheet metal

If wiring allowance provided is more, then the correct shape of the wire is not formed. If wiring allowance provided is less, the gap is found at the inner side of the edge and the wire can be seen.

Generally, the length of the wire provided is slightly more than the length of the edge. This is required to hold the wire at ends, while forming the edge of the sheet metal around the wire.

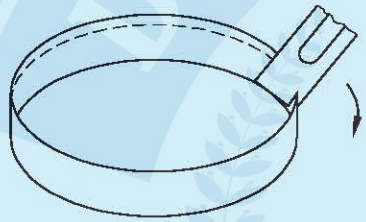
Surplus wire is cut after the wired edge is finished.

Making wired edge along a curved surface by hand process

Objectives: This shall help you to
- **mark the wiring allowance at the curved edge**
- **make a wired edge along a curved surface by hand process**

Mark the wiring allowance at the curved edge to be wired using a gauge with sheet metal as shown in Fig 1.

Fig 1



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Flange the edge to be wired using a hatchet stake and a setting hammer, step by step upto 90°. (Fig 2) Then upset the flange to its half the width and make curve on the flange for wiring. (Fig 3)

Make a round ring from the given G.I.wire to the required dia. (Fig 3)

The joint of the wire should be opposite to the locked grooved joint.

Place the G.I. Wire ring on the flange. (Fig 4)

Fig 2

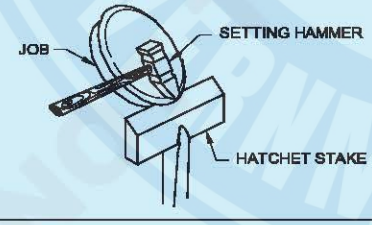

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Fig 3

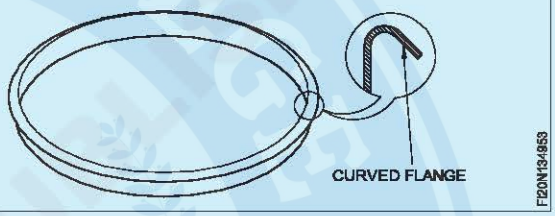

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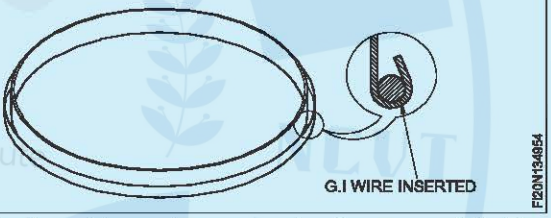
Fig 4



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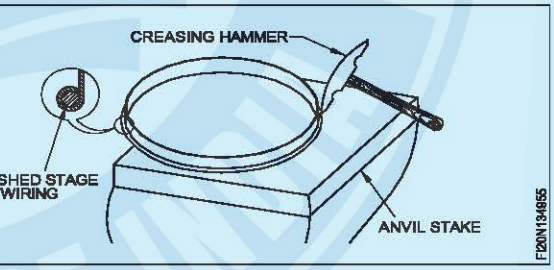
Complete the wiring using a creasing hammer. (Fig 5)

Fig 5



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Dress the wiring by using a half moon stake and a mallet.

Redress the trueness of the cylindrical shape by a round mandrel and a mallet.

False wiring

Objectives: At the end of this lesson you shall be able to
- **state what is false wiring**
- **state advantages of false wiring**

False wiring is one of the methods of edge stiffening in which wired edge is formed and fially wire is removed from the edge, to make the edge hollow.

Advantages of false wiring: In addition to advantages by wiring, false wiring gives following advantages.

1 Cost of the article is reduced.

2 Weight of the article is also reduced.

In sheet metal articles like trunks, boxes etc,. wiring is done only at the corners of the adjacent sides and the remaining portion of the wired edge is kept hollow.

This helps to maintain the sides in position.

Hemming

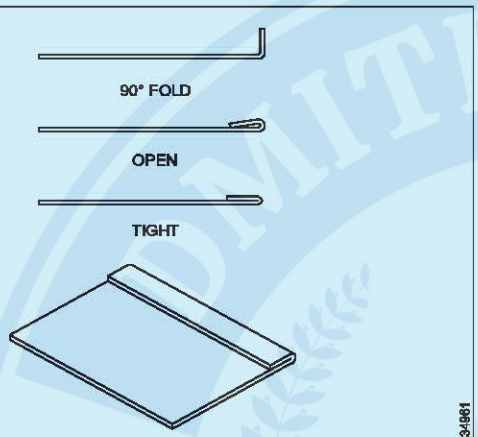
Objectives : At the end of this lesson you shall be able to

- **state the importance of hemming**
- **determine the hemming allowance.**

The sheet metal edges being thin are very unsafe while we handle. They are like knife edge and can cause injuries. Therefore the edges should be made blunt by way of making the edge folded to 180°. Also since the sheet metal is very thin the edges will deflect due to low strength without stiffness.

For the above reasons the edges are hemmed (Fig 1) which will ensure safety, retaining of shape, owning to the stiffness and also enhance good appearance.

Fig 1



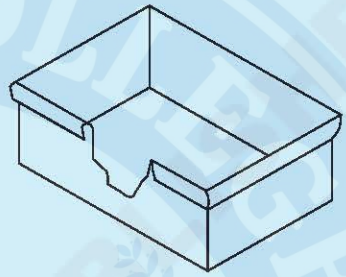
The folded edge will be more strong if it is not completely flattened and a hollow channel is made.

Usually the hemming allowance will be 3 to 4 times the thickness of the sheet to be hemmed, subject to a minimum of 4 M M.

If the hemming width is more, wrinkles are formed at the hemmed edges.

A hemmed box is shown in Fig 2 gives good appearance, safe and strong edge.

Fig 2



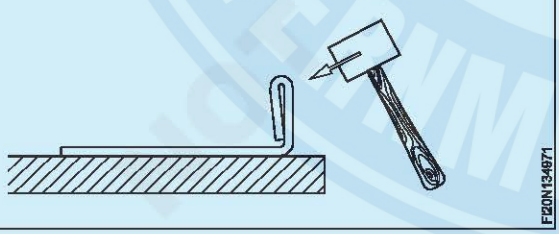
Double hemming by Hand Process

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

- **state the purpose of double hemming**
- **give the hemming allowance for the first and second folds.**

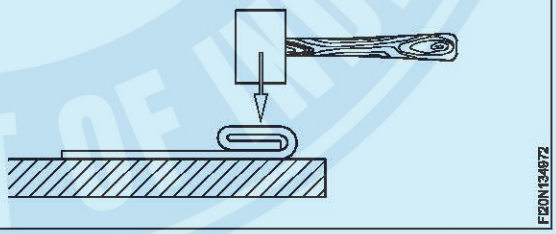
Double hemming is done by folding twice. This give more strength, when compared to single hemming. This is done on various sheet metal articles which in square, rectangular objects like trays. (Fig1 & Fig 2)

Fig 1



While doing double hemming, care must be taken making second fold. Angle of folding should be grade increased throughout the length of the fold.

Fig 2



Edge Stiffening

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

- **make a single hemming on a curved edge using anvil stake and setting hammer.**

Mark the hemming allowance on the formed body using a marking template.

Fix the anvil stake on to the vice or bench plate.

Hold the workpiece such that the marked line coincides with the edge of the stake approximately inclined an angle of 10° as shown in Fig 1.

Strike and rotate the workpiece gradually along the marked line to form a small flange using a setting hammer. (Fig 2)

Fig 1

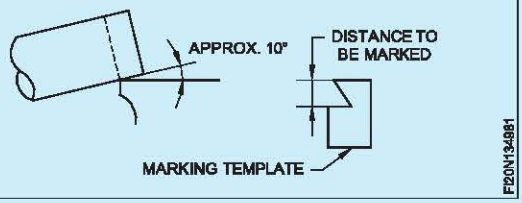
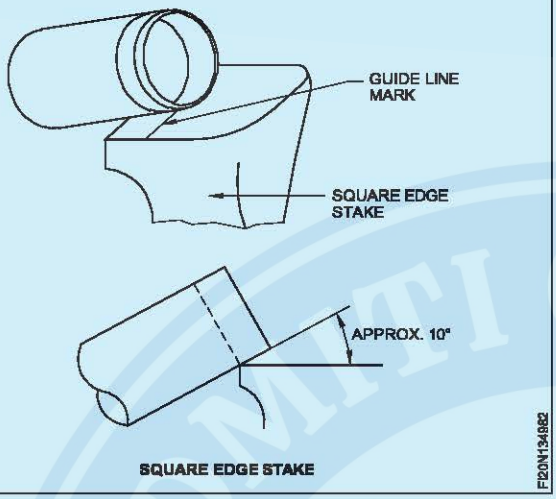
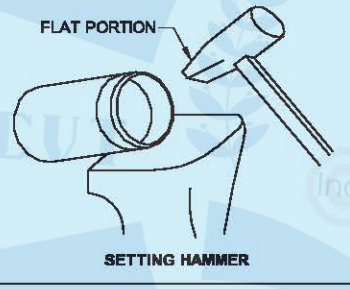


Fig 2



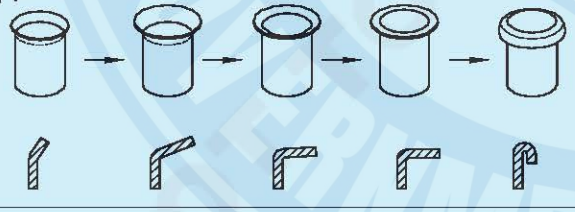
Gradually increase the angle of inclination while forming range as shown in Fig 3.

Fig 3



Finish the hemmed edge on a round mandrel stake by a let (Fig 4)

Fig 4



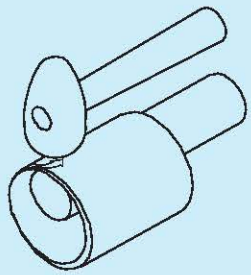
Press the disturbed body of the cyclinder to a round shape using round mandrel stake and a mallet

Check the cylindrical body for roundness and the marketing allowance for flanging.

Fix the copper smith stake in the benchvice or bench plate firmly.

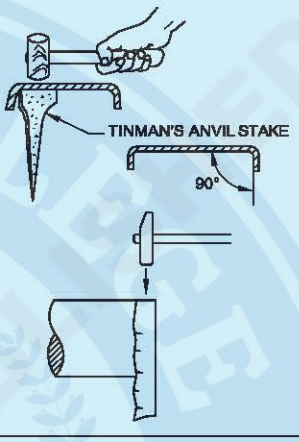
Mark the flanging allowance as guideline on the stake as in Fig 5

Fig 5



Hold the cylinder such that the marked line on the cylinder for flanging, coincides with the straight edge of the stake. (Fig 6)

Fig 6

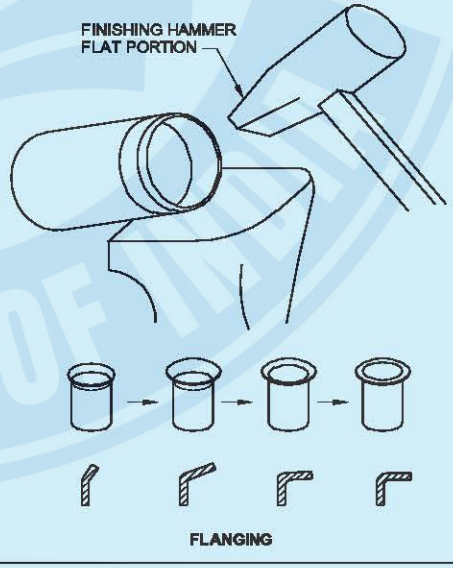


Position the cylinder as in Figure 1 and strike the metal using the flat face of the finishing hammer.

Rotate the body of the cylinder by one hand.

Strike with finishing hammer to increase the angle of bending gradually as in (Fig 7) till the flange is bent to 90°

Fig 7



Solders

Objectives: At the end of this lesson you shall be able to
- **define a solder**
- **state the types of solders**
- **state the constituents of soft and hard solders.**

Solder is a bonding filler metal used in soldering process.

Pure metals or alloys are used as solders. Solders are applied in the form of wires, sticks ingots, rods, threads, tapes, formed sections, powder, pastes etc.

Types of solders

There are two types of solders.

– Soft solder

– Hard solder

Soft solders: Soft solders are alloys of tin and lead in varying proportions. They are called soft solders because of their comparatively low melting point. One distinguishes between soft solder whose melting points are 450°C and hard solders whose melting points lie above 450°C. These are alloys of the materials tin, lead, antimony, copper, cadmium and zinc and are used for soldering heavy (thick) and light metals. Table shows different compositions of solder and their application.

In the composition of soft solder, tin is always stated first.

WARNING

For cooking utensils, do not use solder containing lead. This could cause poisoning. Use pure tin only.

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

Table 1

Sl.No.	Types of solder	Tin	Lead	Application
1	Common solder	50	50	General sheet metal applications
2	Fine solder	60	40	Because of quick setting properties and higher strength,
3	Fine solder	70	30	they are used for copper water tanks, heaters and general electrical work.
4	Coarse solder	40	60	Used on galvanised iron sheets
5	Extra fine solder	66	34	Soldering brass, copper and jewellery
6	Eutectic alloy	63	37	Similar to fine solder

Soldering flux

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

All metal rust to some extent, when exposed to the atmosphere because of oxidation. The layer of the rust must be removed before soldering. For this, a chemical compound applied to the joint is called flux.

Functions of the fluxes

1 Flues removes oxides from the soldering surface it prevents corrosion

2 It forms a liquid cover over the workpiece and prevents further oxidation.

3 It helps molten solder to flow easily in the required place by lowering the surface tension of the molten solder.

Selection of flux: The following criteria's are important for selecting a flux.

- Working temperature of the solder
- Soldering process
- Material to be joined

Different types of fluxes: Flux can be classified as (1) Inorganic or Corrosive (Active) & (2) Organic or non-corrosive (Passive).

Inorganic fluxes are acidic and chemically active and remove oxides by chemically dissolving them. They are applied by brush directly on to the surface to be soldered and should be washed immediately after the soldering operation is completed.

Organic fluxes are chemically inactive. These fluxes coat the surface of the metals to be joined and exclude the air from the surface, to avoid further oxidation. They are applied only to the metal surfaces which have been previously cleaned, by mechanical abrasion. They are in the form of lump, powder, paste or liquid.

Different types of fluxes

(A) Inorganic 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. This is also known as muriatic acid.

2 **Zinc chloride:** Zinc chloride is produced by adding small pieces of clean zinc to hydrochloric acid. It gives off hydrogen gas and heat after a vigorous bubbling action, thus producing zinc chloride. The zinc chloride is prepared in heat resisting glass beakers in small quantities. (Fig 1)

Zinc chlorides are known as killed spirits. It is mainly used for soldering copper, brass and tin sheets.

3 **Ammonium chloride or Sal-Ammoniac:** It is a solid white crystalline substance used when soldering copper, brass, iron and steel. It is used in the form of powder or mixed with water. It is also used as a cleaning agent in dipping solution.

4 **Phosphoric acid:** It is mainly used as flux for stainless steel. It is extremely reactive. It is stored in plastic containers because it attacks glass.

(B) Organic fluxes

1 **Resin:** It is an amber coloured substance extracted from pine tree sap. It is available in paste or powder form.

Resin is used for soldering copper, brass, bronze, tin plate, cadmium, nickel, silver and some alloys of these metals. This is used extensively for electrical soldering work.

2 **Tallow:** It is a form of animal fat. It is used when soldering lead, brass and pewter.

Table 1

The following Table shows the nature and type of flux used in soldering.

Metal to be soldered	Inorganic flux	Organic flux	Remarks
Aluminium Aluminium-bronze			Commercially prepared flux and solder required
Brass	Killed spirits Sal-ammoniac	Resin Tallow	Commercial flux available
Cadmium	Killed spirits	Resin	Commercial flux available
Copper	Killed spirits Sal-ammoniac	Resin	Commercial flux available
Gold		Resin	
Lead	Killed spirits	Tallow Resin	

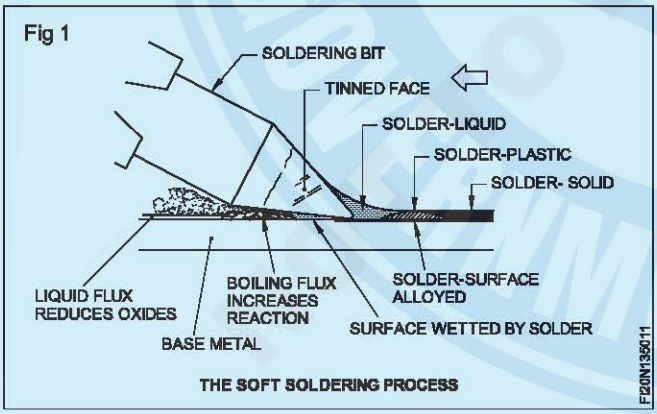
Monel			Commercial flux required
Nickel	Killed spirits	Resin	Commercial flux available
Silver		Resin	
Stainless steel	Phosphoric acid		Commercial flux available
Steel	Killed spirits		
Tin	Killed spirits		Commercial flux available
Tin-bronze	Killed spirits	Resin	
Tin-lead			
Tin-zinc	Killed spirits	Resin	
Zinc	Muriatic acid		

Soft soldering

Objectives: At the end of this lesson you shall be able to
- **explain soft soldering process**
- **state the melting characteristics of soft solders**
- **state the essential features of the soldering technique**
- **explain the importance of the attitude of the bit**
- **state the importance of movement of the bit in soldering**
- **state the characteristics of the soldered seams to be observed while inspection.**

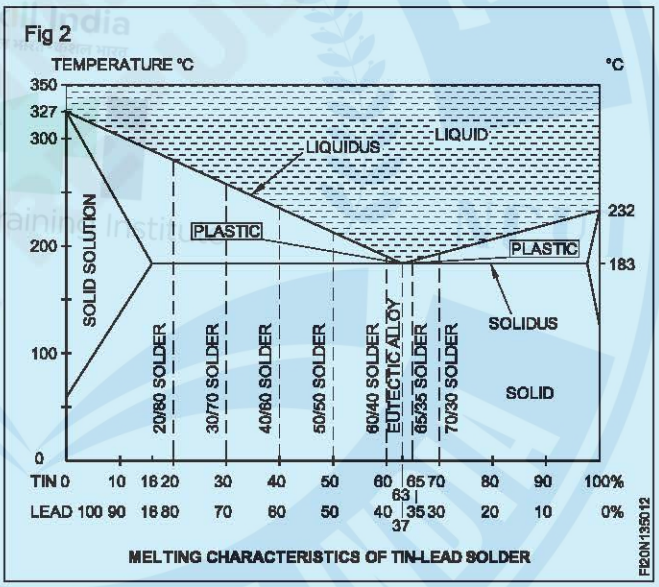
Soft soldering involves the process
- preparing the workpiece.
- select the correct soft solder.
- preparing the soldering iron.
- select and apply suitable flux.
- heat the soldering iron bit and the workpiece to the correct temperature.
- manipulating the soldering iron on the workpiece skillfully as shown in Fig 1.
- complete the job to a satisfactory standard.

Fig 1



Melting characteristics of soft solders: The eutectic alloy of tin lead solder is a mixture of 63% tin and 37% lead. 63/37 solder melts at 183°C and is the lowest melting point of all combinations in the alloy series as shown in Fig 2.

Fig 2

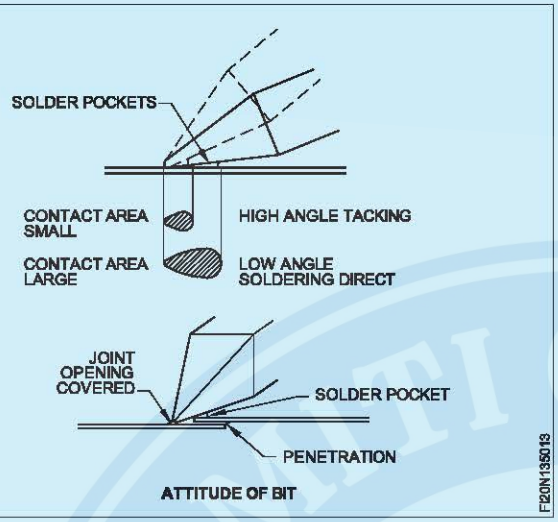


Soldering Techniques: The following features are essential to do soldering.
- Correct joint design
- Preparation of the joint
- Selection of the solder
- Selection and preparation of the soldering iron.
- Copper bit heating
- Soldering bit manipulation
- Cleaning after soldering
- Inspection of the seam.

Attitude of the bit: The soldering iron bit should be placed in a position that enables sufficient heat and solder to flow into the joint.

The angle between a working face of the bit and the joint surface should be filled with a pocket of solder. (Fig 3)

Fig 3

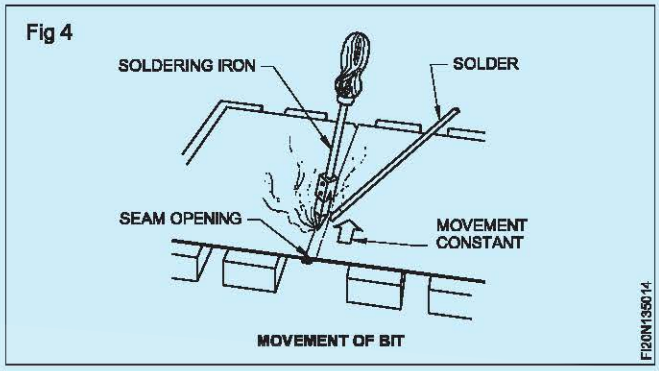


Any variation of this angle will control the amount of heat and solder which is transferred onto the lapped surfaces.

Contact between the molten solder and the joint opening is essential for the penetration of the solder into the joint as shown in figure.

The pattern of the bit movement ensures successful heating of the solder deposited, when the point of the bit covering the joint opening penetrate through the lap as shown in Fig 4

Fig 4



Flux residues and stains should be removed from the seam, to keep clean dry surfaces for paint finishes.

Inspection of the seam: A soldered seam should have the following characteristics.

- The solder has penetrated the lapped surfaces.
- The joint gap is sealed with a neat smooth fillet of the solder.
- The upper surfaces of the seam must be smooth, thin coating of solder, with tidy solder margins with uniform width.

Visual inspection is good to rectify the faults of the solder. However, physical testing for air or water tight seams is specified often. Leaks, detected by the tests are corrected by re-cleaning, re-fluxing and re-soldering of the faulty area in the soldered seam.

Process of soft soldering and hard soldering

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

- **define 'soldering'**
- **state the different types of soldering processes**
- **state the different types of solder and their applications**
- **state the different types of soldering bits and their uses.**

Soldering method: 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 should not be done on joints subjected to heat and vibrations and where more strength is required.

Soldering can be classed as soft soldering and hard soldering.

The process of joining metals using tin lead solders which melt below 420°C is known as soft soldering.

The process of joining metals using hard solders consisting of copper, zinc, cadmium and silver which melt above 600° is known as hard soldering

Brazing is a hard soldering process used to join copper brass and most ferrous metals.

The bonding filler metal usually consists of copper and zinc alloys. Silver brazing or silver soldering is a process used to join steel, copper, bronze and brass and precious metals like gold and silver.

The bonding filler metal consists of silver, copper and zinc tin alloys.

Factors considered while soldering

Objectives: At the end of this exercise you shall be able to
- **follow the conditions for proper define 'soldering'**
- **state the different types of soldering processes.**

Soldering is joining two metal parts with a solder, i.e. a third metal that has a lower melting point.

Before soldering the following conditions must be met.

1 The metal must be clean

2 The correct soldering device must be used and it must be in good condition

3 The correct solder and flux or soldering agent must be chosen.

4 Proper amount of heat must be applied. If you folds these conditions, you could get a good solder joint.

Cleanliness: Solder will never stick to a dirty, oil or exide coated surface. Begineers often ignore this simple point the metal is dirty. Clean it with a liquid cleaner. If it is a annealed sheet remove the oxide with an abrasive and clean it until the surface is bright.

A bright metal, such as copper, can be coated with even though you cannot see it. This oxide can be removed with any fine abrasive.

Successful soldering

Objective : At the end of this lesson you shall be able to
- **follow the hints for successful soldering.**

Hints for successful soldering

You should always wear safety glasses to avoid possible injury to the eyes.

Sheet metal must be cleaned with a file, wire brush, steel wool strip, or emery cloth.

Be sure that the pieces to be soldered fit closely together, for a strong joint.

Soldering flux must be applied by a swab or brush only to the surfaces on which molten solder is to be applied.

Hold the pieces to be soldered firmly to prevent their movement.

Hold the soldering iron in one hand, placing its widest tinned face flat against the surface to be soldered.

When soldering iron is held incorrectly, the point of the soldering iron touches only a portion of the area to be soldered, this is referred to as "skimming" the joint and results in a weak joint.

Apply the wire solder beneath the edge of the iron and nearest to the work. Move the soldering iron slowly along the work making sure that the solder melts, spreads and penetrates properly.

Solder as much surfaces as possible without re-heating the soldering iron or changing to another iron.

A temperature capable of merely melting the solder is not sufficient enough, heat must be transmitted by the soldering iron to the workpiece to quickly raise the temperature of the metals to the solder melting temperature.

It is this step in soldering that beginners often fail to understand and remember.

A soldering iron that is too small, often causes difficulty.

Do not breathe any smoke from the sal ammoniac block as it is a toxic gas and is dangerous.

Sweating of sweat soldering

Objective : At the end of this lesson you shall be able to
- **explain the process of sweating.**

Sweating or Sweat soldering is a process, in which two or more surfaces are soldered one on the top of the other without allowing the solder to be seen after assembly.

In sweating, metal surfaces to be joined are tinned first, then placed on above the other and heated together. While heating, the solder melts and flows to join the overlapped surfaces.

Sweating process is applied in body repairing works in which the damaged surface is sweat soldered with a piece of metal called patch. This process is also applied in rectifying leakages of water tanks and fuel tanks.

Soldered Joint

Objectives: At the end of this lesson you shall be able to
- **state the types of the soldered joints**
- **state the points to be considered for correct joint design.**

Types of soldered joints: Sheet metal components are joined together by soldered joints. In many cases, the edges are joined by sheet metal mechanical joints and then soldered to make the joint stronger and leak proof.

Fig 1 shows soldered lap joints.

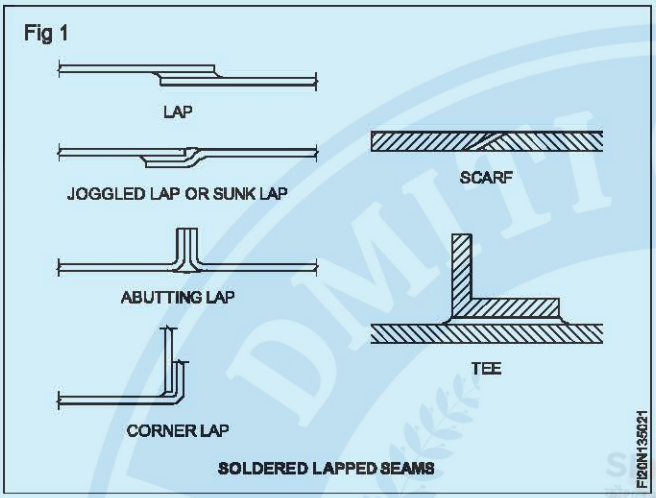


Fig 2 shows soldered seams.

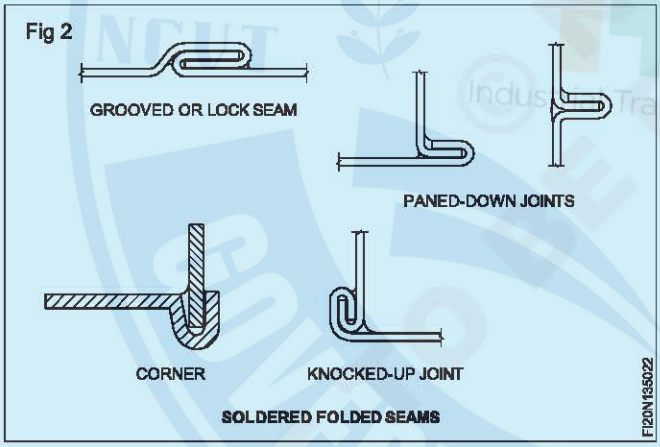
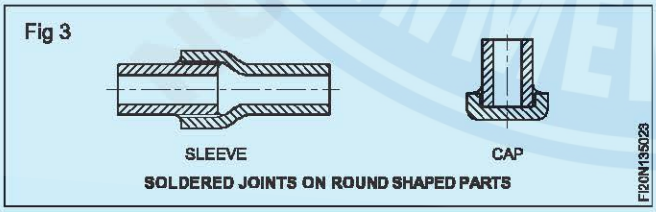
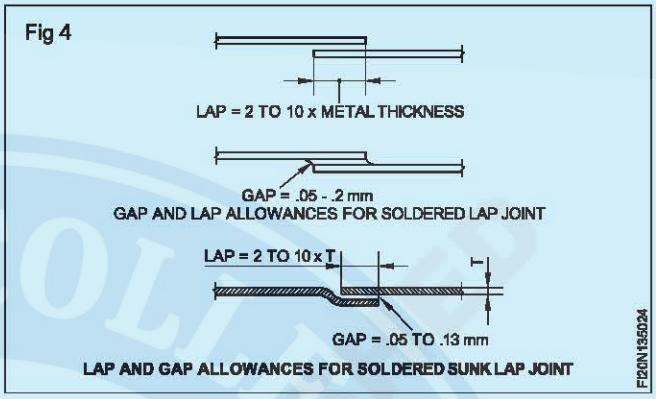


Fig 3 shows soldered joint on round shaped parts.



Sheet metal joints both lapped and folded, are suitable for silver soldering application as shown in Fig.4



Silver solder effects the union of lapped joints and seals the beam openings of the interlocking folded joints.

Correct joint design: Sheet metal joints with overlapping surfaces are ideal for joining or sealing with solder. Close fitting of lapped surfaces are essential for the flow of molten solder into the joint by capillary action.

Joint design suitable for silver brazing or soldering mainly depends on the type of assembly and its intended use.

Maximum strength can be achieved by observing the following conditions.

– A suitable filler alloy must be used.

  Component metal is of major consideration.

– Joint clearances should be minimum.

  Close fitting surfaces helps capillary flow and gaps between 0.05 and 0.13 mm should be used.

– The solder must contact lapped surface sufficiently.

  Lap width is commonly made 2 to 10 times the component metal thickness. In case of unequal thickness, the lap size is based on the thinner materials.

– Workpieces must be firmly supported.

  It is essential to prevent the movement for the control of the solder application, alignment and accuracy of the component assembly.

Dipping solution

Objectives: At the end of this lesson you shall be able to
- **state the use of the dipping solution**
- **state the constituents of the dipping solution.**

It is used to dissolve oxides from solder coated faces of the copper bit before applying it to the workpiece.

It is made of

1 Dissolving sal-ammoniac powder in water.

2 Dilute zinc-chloride with water.

3 Adding commercial flux with zinc chloride or ammonium chloride as active ingredients to water.

A mixture of approximately one part of active component and four parts of water is satisfactory as the acidity of the solution should not be strong.

Safety precautions in soldering

Objective : At the end of this lesson you shall be able to
- **follow safety precautions in soldering to avoid injuries/accidents.**

Safety precautions followed while soldering

1 Wear safety glasses to protect your eyes from solder splattering and flux.

2 Be careful while storing hot soldering irons after use to avoid burns.

3 Wash your hands thoroughly after using soft solder because it is poisonous.

4 Tin the soldering iron in a well ventilated area to exhaust fumes coming out while soldering.

5 Wear safety goggles when using acids for cleaning.

6 When making acid solution, always pour acid into water slowly.

7 Never pour water into the acid.

8 All inorganic fluxes are poisonous.

9 Wear goggles and gloves while handling corrosive flux.

Fluxes types and description

Objectives : At the end of this lesson you shall be able to
- **explain flux and its function**
- **describe the types of fluxes and their storage.**

Flux is a fusible (easily melted) chemical compound to be applied before and during welding to prevent unwanted chemical action during welding and thus making the welding operation easier.

The functions of fluxes : To dissolve oxides and to prevent impurities and other inclusions that could affect the weld quality.

Fluxes help the flow of filler metal into very small gap between the metals being joined.

Fluxes act as cleaning agents to dissolve and remove and clean the metal for welding from dirt and other impurities.

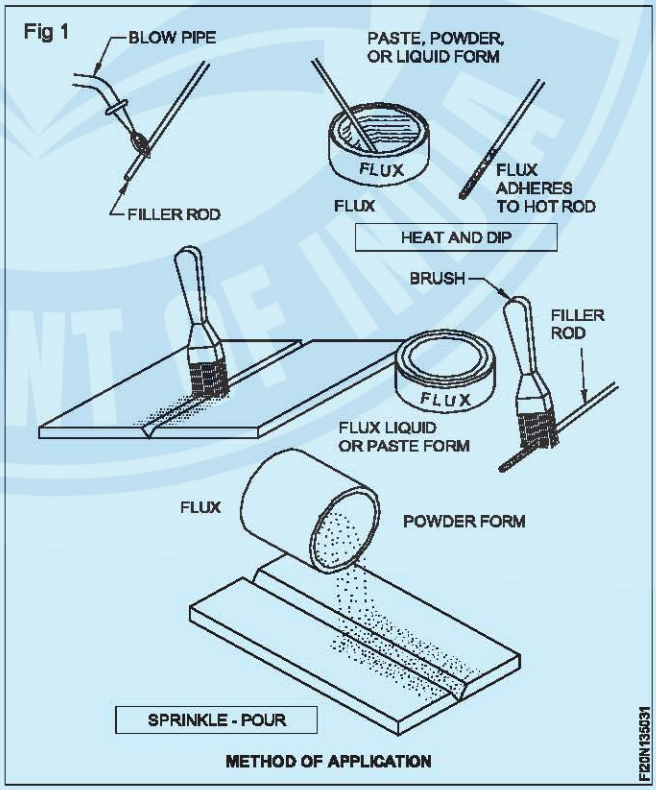
Fluxes are available in the form of paste, powder and liquid.

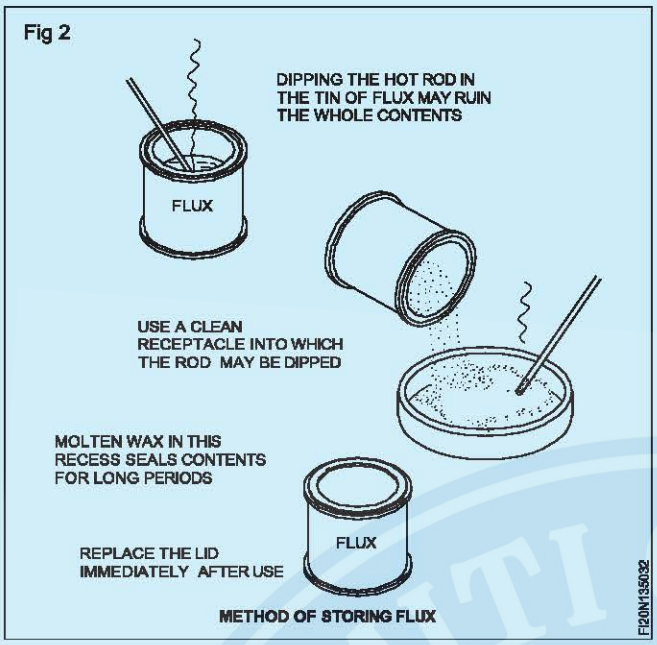
The method of application of flux is shown in Fig. 1

Storing of fluxes; where the flux is in the form of a coating on the filler rod, protect carefully at all times against damage and dampness. Fig 2.

Seal flux tin lids when storing especially for long periods (Fig 2)

Fig 1





Though the inner reducing envelope of an oxy-acetylene flame offers protection to the weld metal, it is necessary to use a flux in most cases. Fluxes used during welding not protect the weldment from oxidation but also from a slag which floats up and allows clean weld metal, to be deposited. After the completion of welding, flux residues should be cleaned.

Removal of flux residues: After welding or brazing is over, it is essential to remove the flux residues. Fluxes in general are chemically active. Therefore, flux residues, if not properly removed, may lead to corrosion of parent metal and weld deposit.

Some hints for removal of flux residues are given below:

- **Aluminium and aluminium alloys**- As soon as possible after welding, wash the joints in warm water and brush vigorously. when conditions allow, follow up by a rapid dip in a 5 percent solution of nitric acid; wash again, using hot water to assist drying.
- When containers, such as fuel tanks, have been welded and parts are inaccessible for the hot water scrubbing method, use a solution of nitric and hydrofluoric acids. To each 5.0 litres of water add 400 ml of nitric acid (specific gravity 1.42) followed by 33ml of hydrofluoric acid (40 percent strength). The solution used at room temperature will generally completely remove the flux residue in 10 minutes, producing a clean uniformly etched surface, free from stains. Following this treatment the parts should be rinsed with cold water and finished with a hot water rinse. The time of immersion in hot water should not exceed three minutes, otherwise staining may result; after this washing with hot water the parts should be dried. It is essential when using this treatment that rubber gloves be worn by the operator and the acid solution should preferably be contained in an aluminium vessel.
- **Magnesium alloys**-Wash in water followed quickly by standard chromating. Acid chromate bath is recommended.
- **Copper and brass**- Wash in boiling water followed by brushing. Where possible, a 2 percent solution of nitric or sulphuric acid is preferred to help in removing the glassy slag, followed by a hot water wash.
- **Stainless steel**- Treat in boiling 5 percent caustic soda soultion, followed by washing in hot water. Alternatively, use a de-scaling solution of equal volume of hydrochloric acid and water to which is added 5 percent of the total volume of nitric acid with 0.2 percent of total volume of a suitable restrainer.
- **Cast iron**- Residues may be removed easily by a chipping hammer or wire brush.
- **Silver brazing** -The flux residue can be easily removed by soaking brazed components in hot water, followed by wire brushing. In difficult cases the work piece should be immersed in 5 to 10 percent sulphuric acid solution for a period of 2 to 5 minutes, followed by hot water rinsing and wire brushing.

Types of spelters and fluxes used in brazing

Objectives: At the end of this lesson you shall be able to
- **state the types of spelter and flux used in brazing**
- **state the composition of spelter and its melting point.**

Brazing is essentially similar to soldering but it gives a much stronger joint than soldering. The principal differences is the use of a harder filler material, commercially known as spelter which fuses at temperature above red heat, but below the melting temperature of the parts to be joined. Filler materials used in this process may be divided into two classes. Copper base alloys and silver base alloys. There are a number of different alloys in each class, but brass (Copper and Zinc) sometimes with upto 20% tin are mostly used mainly for brazing the ferrous metals. Silver alloys (Silver and Copper or Silver and Copper and Zinc) having a melting point range of 600 to 850^{0}C are suitable for brazing any metals capable of being brazed. They are giving a clean finish and a strong ductile joint. Spelters are commonly made according to the thickness of sheets.

After brazing, the joint must be hammered to check the leakages and to remove flux. Mostly and commonly used flux is "Borax" for ferrous and non-ferrous metals. It removes rust and prevents atmospheric effect, when brazing operation is going on.

COMPOSITION OF SPELTER AND MELTING POINTS

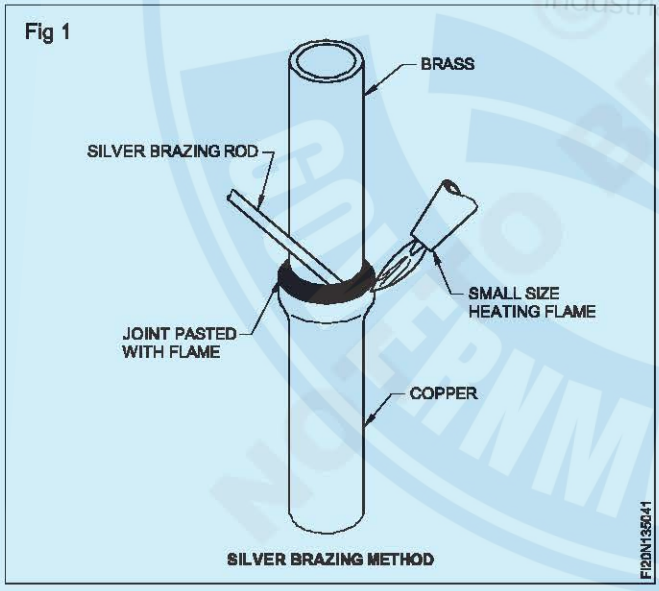
Sl. No.	Types of spelters	Common metals	Copper %	Zinc %	Silver %	Melting temperatures	Uses
1	Copper + Zinc Base spelter	Common	60	40	NIL	850°C	Hard brazing on copper sheets and non-ferrous
2	-do-	Ferrous metals	80	20	NIL	600°C	Brass sheet thick
3	-do-	brass	30	70	NIL	400°C	Brass sheet thin
4	Silver solder	Gold	10	10	80%	350°C	It is used for gold ornaments brazing

Silver brazing of copper pipes by gas

Objectives: At the end of this lesson you shall be able to
- **explain the term silver brazing**
- **state the various applications of silver brazing.**

Silver brazing (Fig 1)

Fig 1



A low temperature brazing method.

Also called by other names such as:- Silver soldering, Hard soldering.

Its temperature range is 600°C to 850°C.

Silver-brazing filler rods are composed of copper and silver with a small percentage of Zinc, Cadmium and Nickel.

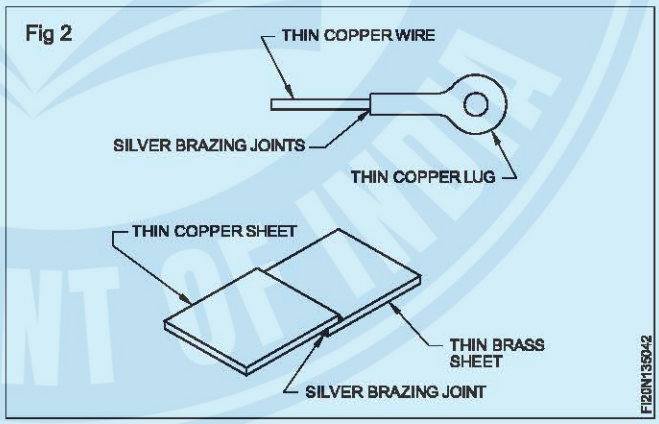
Silver content may vary from 40 to 60%.

Applications

This low temperature brazing alloy is suitable for the following.

Joining electrical parts requiring high electrical conductivity. (Fig 2)

Fig 2



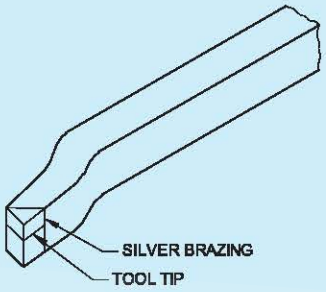
Food handling and processing equipment. (Stainless steel).

Economy in brazing operation requiring a low temperature, thin layer, quick and complete penetration.

Joining of thin sheets and close fitted joints in steel, copper, brass, bronze, nickel alloys and nickel-silver alloys.

Brazing tungsten carbide tips to ROCK DRILLS, MILLING CUTTERS, CUTTING and SHAPING TOOLS. (Fig 3)

Fig 3



Joining dissimilar metals and jewellery making works.

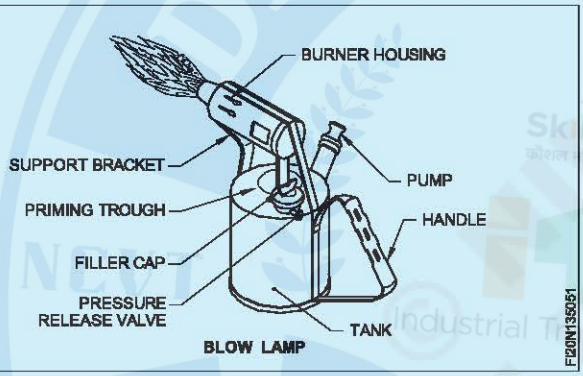
There is economy in the brazing operation as it requires only low temperature and a thin layer of deposition. There is quick and complete penetration in this method of joining.

Blow lamp

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

In 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



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 methylated spirit for lighting the blow lamp. Set of nozzle is provided to direct the kerosene vapour 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.

Portable hand forge with blower

Objectives: At the end of this lesson you shall be able to
- **state the purpsoe of hand forge**
- **describe the constructional feature of hand forge**
- **state the fuel used in hand forge.**

Hand forge: It is used for heating the soldering bit.

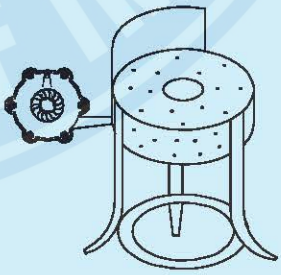
It is made of mild steel plates and angles. It is generally round in shape. the hand blower is attached to it for air supply.

A pefforated plate is fixed at the bottom to remove burnt residuals.

The fuel zone is built up with fire bricks and coated with the mixture of clay and sand, providing space at the centre for fuel. (Fig 1)

The fuel used for firing is mainly charcoal. The charcoal is prepared from hard wood.

Fig 1



Rivet and riveting

Objectives: At the end of this lesson you shall be able to
- **state what is rivet and riveting**
- **list the part of rivet**
- **explain the type of rivet.**

Rivet

A rivet is a permanent mechanical fastener consisting of a head at one end and a cylindrical stem at the other end (called the tail) which has the appearance of a metal pin.

Rivets are used to in structures, bridges, sheet metal operations, ships, and in many industries.

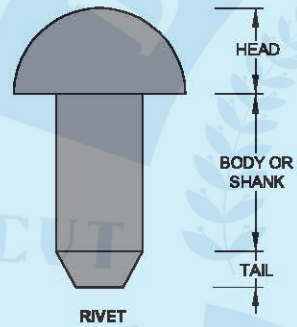
Riveting

Riveting is one of the methods of making permanent joint

Parts of a Rivet

Following are the parts of a Rivet (Fig 1)

Fig 1



1 Head 2 Shank or Body 3 Tail

Head : The upper-most part of rivet is called "head". These are made of different type according to different jobs.

Shank or Body: The part below rivet is called shank or body. This is round in shape.

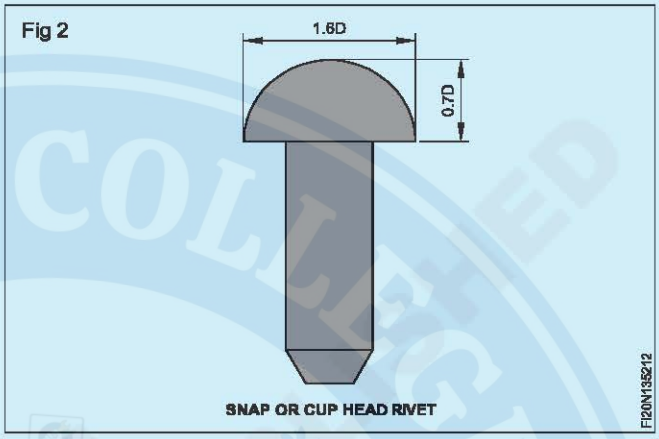
Tail: Part below its centre is called tail. It is somewhat tapered. It is inserted into holes of two plates and head is made by beating their tail. The length of tail is ¼ D. A rivet is known by its roundness, length and shape of head.

Type of rivet

1 Snap head or cup head rivets
2 Pan head rivets
3 Conical head rivets
4 Countersunk head rivets
5 Flat head rivets
6 Bifurcated head rivet
7 Hollow head rivets.
8 Tinman's rivet
9 Flush rivet

Snap head or cup head rivets (Fig 2)

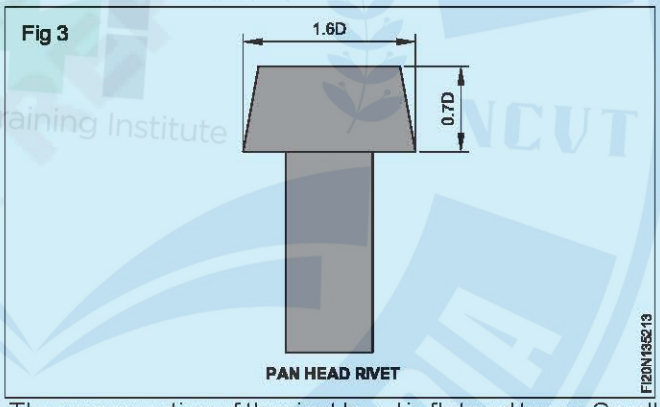
Fig 2



The head is of a semi-circle in shape.. The joints of this rivet are very strong. It is widely used in bridges made of iron material.

Pan head rivets (Fig 3)

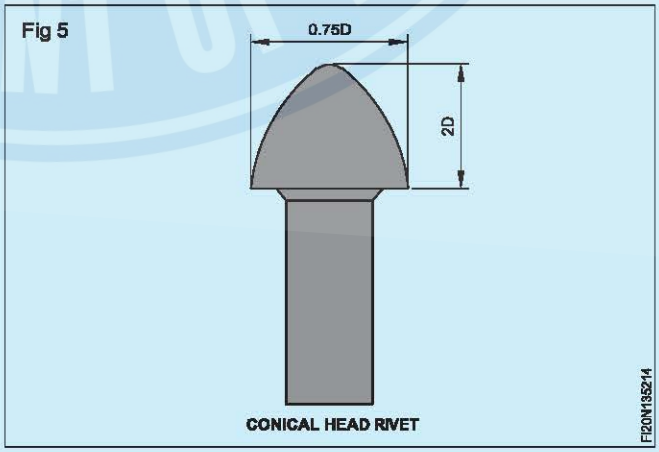
Fig 3



The upper portion of the rivet head is flat and taper. Small diameter of the head is equal to the diameter of the rivet. In heavy engineering, pan head rivets are used.

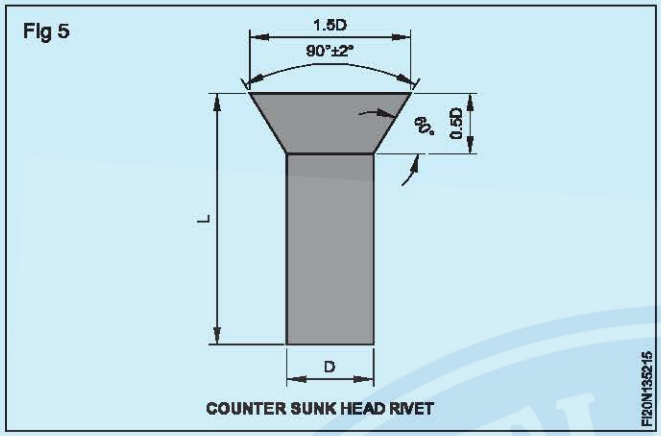
Conical Head Rivet (Fig 4)

Fig 5



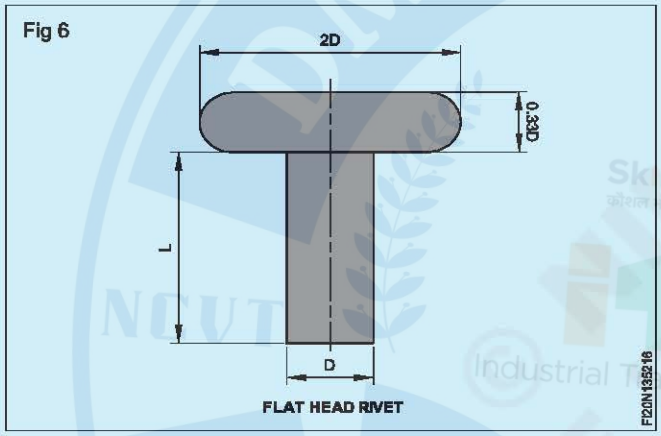
The conical shape is given is used for light jobs. A conical shape is given to the head by a hammer.

Counter Sunk Head Rivet (Fig 5)



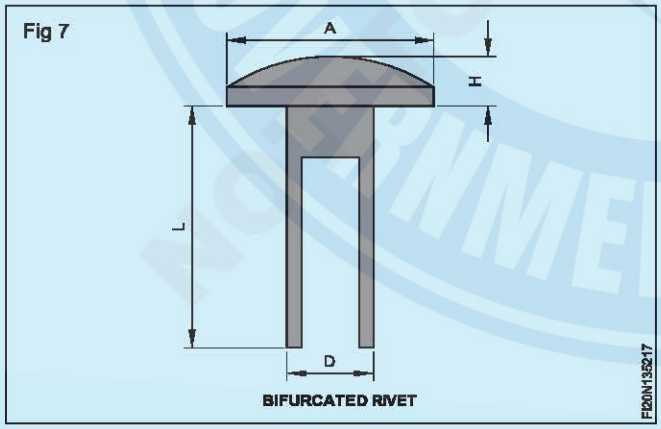
At places where it is necessary to keep the surface plane even after fixing a rivet, this type of rivets is used.

Flat Head Rivet (Fig 6)



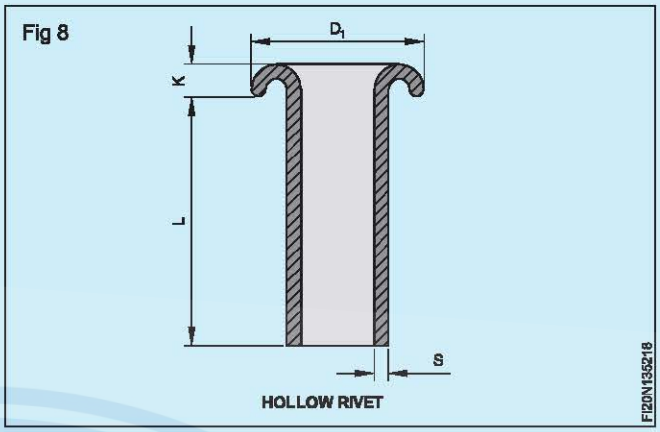
For small and light jobs of sheet metal, flat head rivets are used. These are generally used in non-ferrous metals and thin sheets. Its head is flat.

Bifurcated rivet (Fig 7)



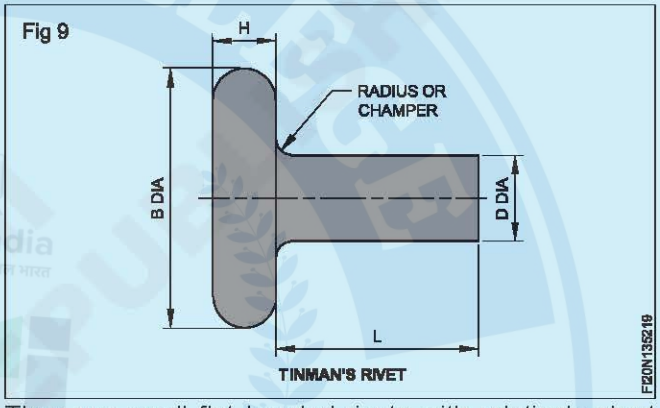
These types of rivets are different from other rivets. These are used for joining chains etc. in place of pins.

Hollow Rivet (Fig 8)



Hollow rivets used where a part of the machine moves and it is also necessary to keep this part attached to the machine.

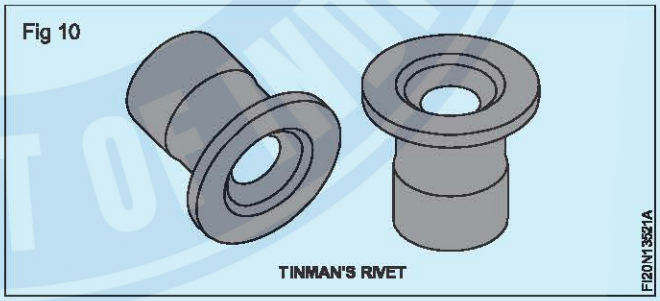
Tinman's Rivets (Fig 9)



They are small flat headed rivets with relatively short lengths. The size number of tin man's rivets are determined by the approximate weight per thousand rivets. Each weight of rivet has a definite diameter and length. (Table 1)

Tinmen's rivets are commonly used in light sheet metal work, such as the manufacture of buckets, steel trunks and fabrication of air-conditioning ducts.

Flush rivet (Fig 10)



Flush riveting is a method of connecting two pieces of sheet metal together, using rivets whose heads do not protrude above the surface of the metal. In aircraft construction, a flush rivet reduces drag, thus increasing aircraft performance

A flush rivet takes advantage of a countersink hole; they are also commonly referred to as countersunk rivets

Table 1 Dimensions of tinmen's riverts (Clause 4.1 and Fig 1)						
Rivet	Lencth	Shank	Head Dia		Head Thickness	
Size	(L)	Dia	(B)		(H)	
Designating Number			max	min	max	min
(1)	(2) mm	(3) mm	(4) mm	(5) mm	(6) mm	(7) mm
2	4-0	2-1	4-2	4-0	0-6	0-5
4	4-8	2-4	4-8	4-6	0-6	0-5
6	5-2	2-7	5-6	5-3	0-8	0-6
8	6-0	3-1	6-4	6-0	0-9	0-7
10	6-8	3-8	7-8	7-4	1-1	0-9
12	8-3	4-2	8-5	8-1	1-1	0-9
14	9-1	5-2	10-7	10-2	1-4	1-1
16	11-5	5-6	11-4	10-8	1-5	1-2
18	12-7	6-4	13-0	12-3	1-7	1-4
20	14-3	7-0	14-3	13-6	1-9	1-6

Types of riveted joints

Objectives: At the end of this lesson you shall be able to
- **brief the different types of riveted joints**
- **state the sizes of rivets, lapping allowance pitch and length of rivets**
- **layout the spacing of rivets in chain and zig zag riveting**
- **determine the pitch of the riveting**
- **compare hot and cold riveting.**

In construction and fabrication work different types of riveted joints are made. The commonly used joints are:

– single riveted lap joint

– double riveted lap joint

– single strap butt joint

– double strap butt joint

Single riveted lap joint: This is the simplest and most commonly used type of joint. This joint is useful for joining both thick and thin plates. In this, the plates to be joined are overlapped at the ends and single row of rivets is placed in the middle of the lap. (Fig 1)

Double riveted lap joint: This type of joint will have two rows of rivets. The overlap is large enough to accommodate two rows of rivets. (Fig 2)

Double riveted (Zigzag) lap joint: This provides a stronger joint than a single lap joint. The rivets are placed either in a square formation or in a triangular formation. The square formation of rivet placement is called CHAIN riveting. The triangular formation of rivet placement is called zigzag riveting. (Fig 3)

Single strap butt joint: This method is used in situations where the edges of the components are to be joined by riveting. (Fig 4)

Fig 1

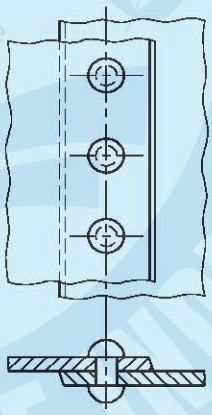


Fig 2

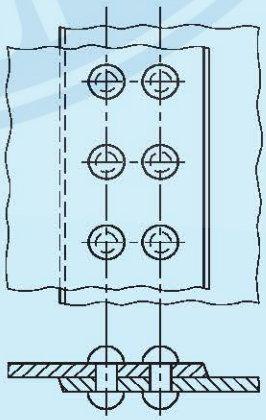


Fig 3

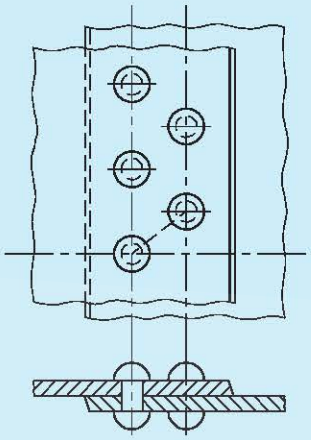


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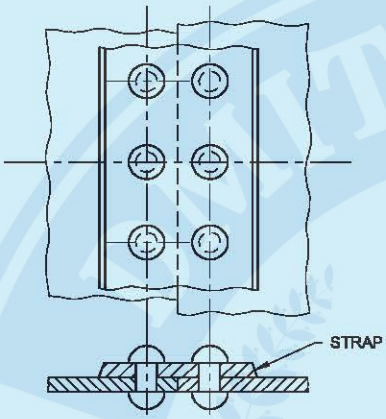
Fig 4



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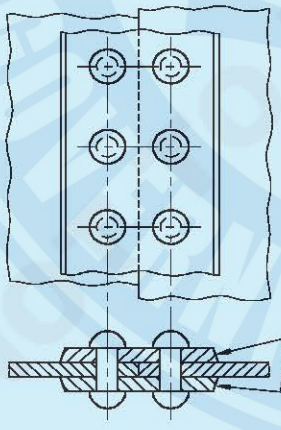
A separate piece of metal called STRAP is used to hold the edges of the components together.

This joint is also used for joining the edges of components together. This is stronger than the single strap butt joint. This joint has two cover plates placed on either side of the components to be assembled. (Fig 5)

Fig 5



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When single or double straps are used for riveted butt joints, the arrangement of rivets may be:

- Single riveted i.e one row on either side of the butt.
- double or triple riveted with chain or zigzag formation. (Fig 6)

Layout the spacing of rivet holes in chain riveting

Fig 7 shows the layout of the spacing of rivets holes in chain riveting

Fig 6

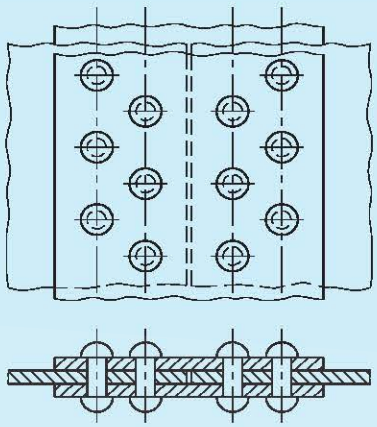

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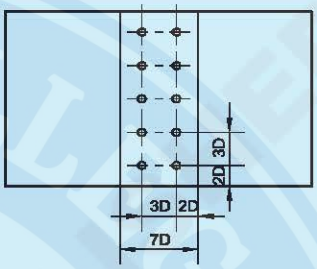
Fig 7



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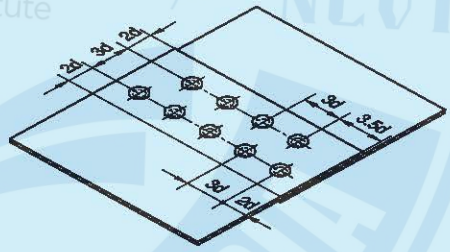
In chain riveting, square formation of rivets is formed in placement of rivets.

Zig Zag Riveting: Zig zag riveting is one type of layout of rivet spacing in veted joint

Zig zag riveting, triangular formation of rivets is formed in placement of rivets.

Layout of spacing for zigzag riveting is shown in Fig 8.

Fig 8



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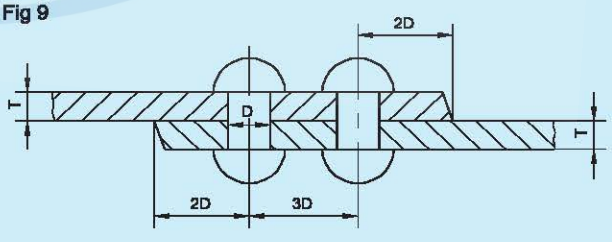
Spacing of rivets in joints: The spacing of the rivet holes depends upon the job. Given below is a general approach in determining this.

Distance from the edge to the centre of the rivet. (Fig 9)

Fig 9



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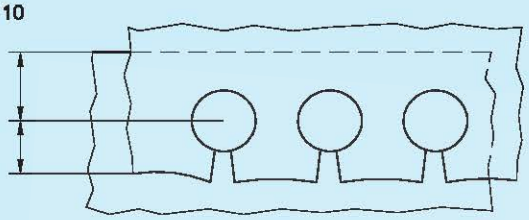
The space or distance from the edge of the metal to the centre of any rivet should be atleast twice the diameter of the rivet.

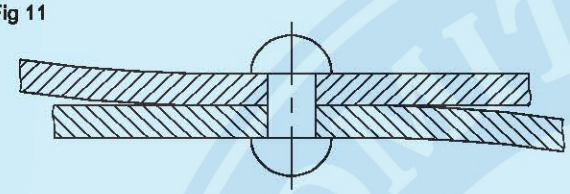
The purpose of this is to prevent the splitting of the edges. The maximum distance from the edge should not be more than ten times the thickness of the plate. (Fig 10)

Fig 10



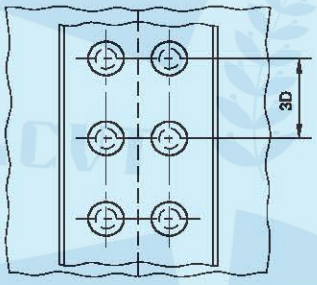
Too much distance from the edge will lead to GAPING. (Fig 11)

Fig 11



Pitch of rivet: The minimum distance between rivets should be three times the diameter of the rivet. (3D) (Fig 12)

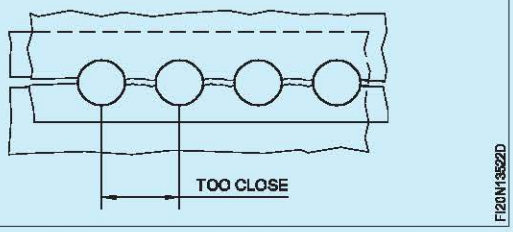
Fig 12



The distance will help to drive the rivets without interference. (Fig 13)

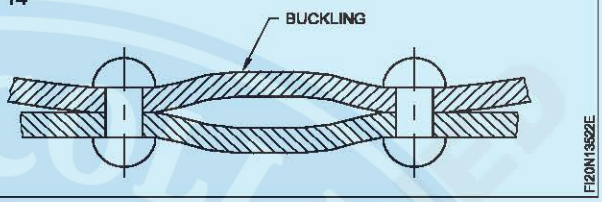
Too closely spaced rivets will tear the metal along the centre line of the rivets.

Fig 13



The maximum distance between the rivets should exceed twenty four times the thickness of the metal. (Fig 14)

Fig 14



Too far a pitch will allow the sheet/plate to buckle between the rivets.

Each rivet consists of a heated cylindrical body.

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

Selection of rivet size: The meter of the rivet is calculated by using the formula (2 1/2 to 3) x T where T is total thickness.

Lapping allowance: Normally sheet metal trade we will use the following formula it is three times of the dia of rivet +2 times the sheet thickness on thin sheets.

Pitch allowance: Three of fourness the diameter of rivet +sheet thickness 1 time.

The shank length is given by

Length: L=T=D where T is sheet thickness and D is the diameter of the rivet.

Comparison of hot and cold riveting

Hot Riveting	Cold Rivetting
End of the rivet shank is heated to an elevated temperature prior to up setting	No such heating is carried out up setting is performed at room temperature
Lower pressure is required to apply on die	More pressure is required to apply on the die
External heat source is required	No such heat source is required
Since heating process requires time, so hot riveting is a time consuming process	Cold riveting is time efficient as no heating is carried out
It is suitable when rivet material is ferrous and rivet diameter is about 10mm	For small diameter non-ferrous rivet (like aluminium, brass) cold riveting is suitable

Hand-riveting tools

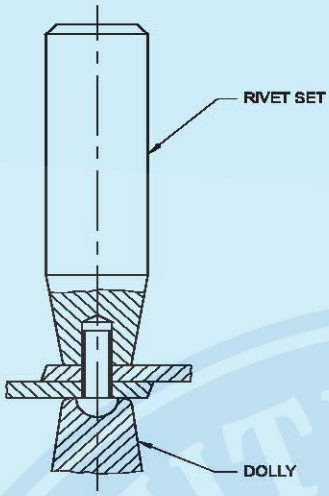
Objectives: At the end of this exercise you shall be able to
- **name the different hand-riveting tools**
- **state the uses of different hand -riveting tools**

Rivet set: It is used for bringing the sheet metal closely together after inserting the rivet in the hole

This is required while riveting thin plates or sheet with small rivets (Fig 1)

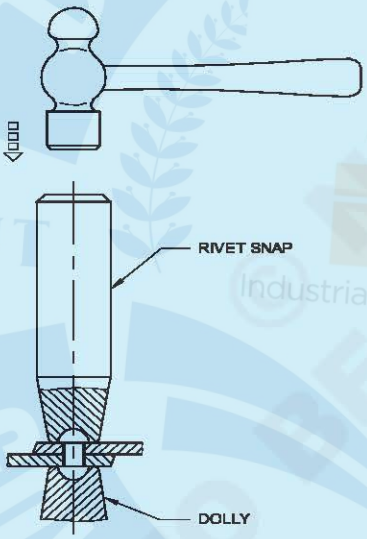
Dolly: It is used to support the head of the rivet which is already formed and also to prevent damage to the shape of the rivet head (Fig 1)

Fig 1



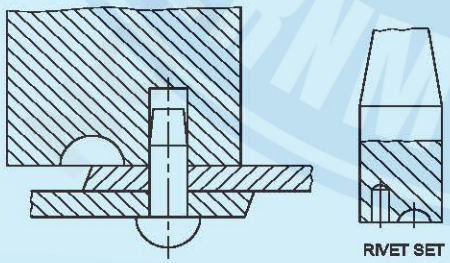
Rivet snap: It is used to form the final shape of the rivet during riveting. Rivet snaps are available to match the different shapes of rivet heads (Fig 2)

Fig 2



Combined rivet set: This is a tool which can be used for setting and forming the head (Fig 3)

Fig 3



Hand riveter: This has a lever mechanism which exerts pressure between the jaws when the handle is pressed.

This is useful for riveting copper or aluminium rivets. Interchangeable anvils can be provided.(Fig 4)

Pop riveter: This is used for riveting pop rivets by hand. The trigger mechanism squeezes the rivet and separates the mandrel of the rivet. In this method as the mandrel is being separated from the rivet, the head is formed on the other end (Fig 5)

Fig 4

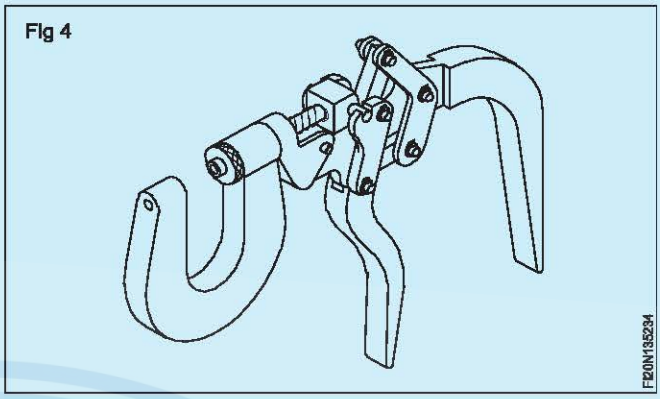
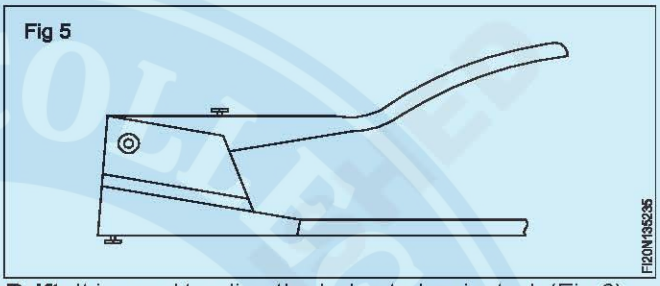
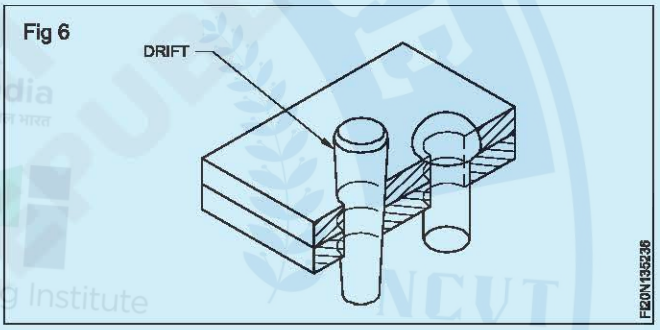


Fig 5



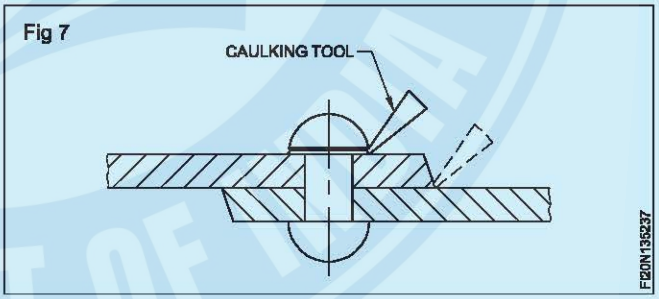
Drift: It is used to align the holes to be riveted. (Fig 6)

Fig 6



Caulking tool: It is used for closing down the edges of the plates and heads of the rivets to form a metal-to-metal joint (Fig 7)

Fig 7



Fullering tool: It is used for pressing the surface of the edge of the plate (Fig 8) Fullering helps to make fluid-tight joints.

Fig 8