Welding of brass

Objectives: At the end of this lesson you shall be able to
- **state the composition of brass**
- **state the selection of nozzle, flame and flux**
- **explain the necessity of oxidising flame and welding technique.**

Composition of brass: Brass is an alloy of copper and zinc in various proportion, possibly with the addition of other elements in very less percentage.

The percentage of zinc various from 1 to 50% which makes available 15 individual commercial brasses. These brasses containing 20 to 40% zinc have a variety of uses.

Melting temperature of brass: The melting point of copper is 1083°C and that of zinc is 419°C. Brass melts at intermediate temperatures. The greater the amount of copper the higher the melting point. The melting point of brass is generally around 950°C.

Selection of nozzle, flame and flux: The main difficulty in welding of brass is the vapourisation of zinc, because the melting point of zinc is lower than that of brass. Due to the loss of zinc, below holes or porosity is produced in the weld and only copper is left over.

The strength is thereby reduced, and the weld gives a pitted appearance when polished.

Therefore excess burning of zinc should be controlled.

These 'zinc' problems are minimized by excess oxygen in the oxidising flame. The excess oxygen in the oxidising flame will convert zinc into zinc oxide whose melting point is more than that of zinc. So use of oxidising flame prevents evaporation of zinc. The flux helps to retain the zinc while solidification of weld metal occurs. The copper-zinc alloys, most of which are called BRASS, are more difficult to weld than copper. The zinc in the alloy produces irritating and destructive fumes or vapours during the welding process. Be sure to provide adequate ventilation and avoid inhaling zinc fumes.

For oxy-acetylene welding of brass, an oxidising flame is used and the nozzle is one size larger than the one used for welding mild steel plate of the same thickness. This will give a soft oxidising flame.

It is difficult to weld brass by electric arc process.

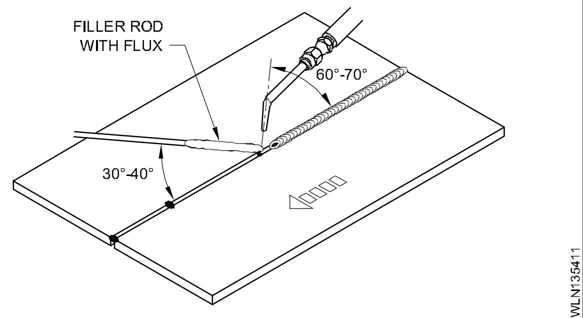
Flux is very important in welding brass. A fresh mixture of borax paste makes a good flux for brass welding.

The flux should be applied on the underside of the joint area and to the filler rod.

Edge preparation is as shown in Table 1.

Welding technique: Adopt leftward technique and keep the angle of the blowpipe at 60°-70° and the filler rod at 30°-40°. At the end of the joint reduce the blowpipe angle and withdraw entirely to reduce the heat input at the crater. (Fig 1)

Fig 1



Ensure complete removal of all traces of flux because the residual flux will react and reduce the strength of the joint.

Use a respirator and avoid inhaling zinc fumes during welding.

Table 1

Thickness	Preparation	Assembly	Pitch of tacks (mm)	Nozzle size	Filler rod
1 mm	Square edge	No gap	25	2	1.6 mm
1.2 mm	Square edge	0.8 mm gap	38	3	2 mm
1.5 mm	Square edge	0.8 mm gap	38	3	2 mm
3 mm	Single V	1.5 mm gap	75	5 to 7	3 mm

Copper-Properties-Types and Weldability

Objectives: At the end of this lesson you shall be able to
- **describe the various types of copper**
- **state the physical properties of copper**
- **explain the welding procedure.**

Electrolyte copper: This type contains 99.9% pure copper with 0.01 to 0.08% oxygen in the form of cuprous oxide. (Cu_2O). This type of copper is not weldable.

De-oxidized copper: In this type a small quantity of phosphorous, a de-oxidising element is added to the electrolyte copper. This type of copper is weldable.

Characteristics of copper

Reddish in colour.

High thermal and electrical conductivity.

Excellent resistance to corrosion.

Excellent workability in either hot or cold condition and in forming wires, sheets, rods, tubes and castings.

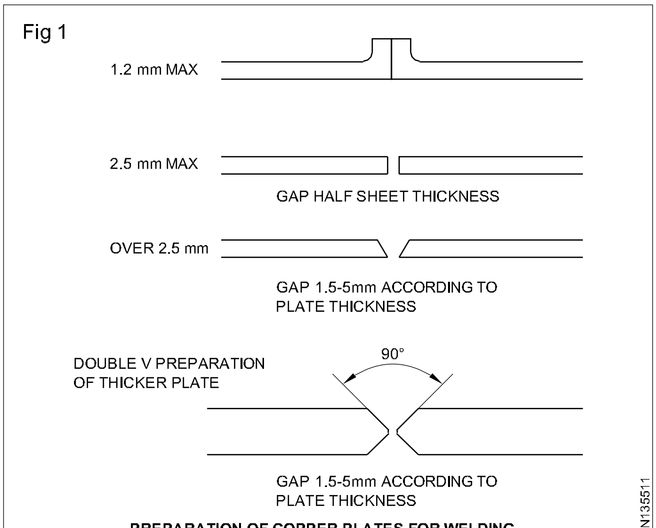
Melting point: 1083°C.

Density: 8.98 g/cm^3

Coefficient of linear expansion (ic): 0.000017 mm/mm/°C

Edges preparation (Fig 1)

Fig 1



PREPARATION OF COPPER PLATES FOR WELDING

Up to 1.2 mm - edge or flange point.

Over 1.5 mm up to 2.5 mm - square butt with 50% of sheet thickness as root gap.

2.5 mm to 16 mm - a angle 'V' of 80°-90°.

Over 16 mm - Double 'V' preparation of 90°.

Types of cleaning

Mechanical cleaning is done to remove dirt and any other foreign material. Chemical cleaning is done by applying solutions to remove oil, grease, paint etc.

Filler rod and flux: A completely de-oxidized copper rod (copper-silver alloy filler rod) having a lower melting point than the base metal is used.

Flux: Copper-silver alloy flux is applied on the edges to be joined in paste form.

Nozzle size: Use a nozzle which is one size larger than that used for mild steel.

Flame: Adjust a strictly neutral flame.

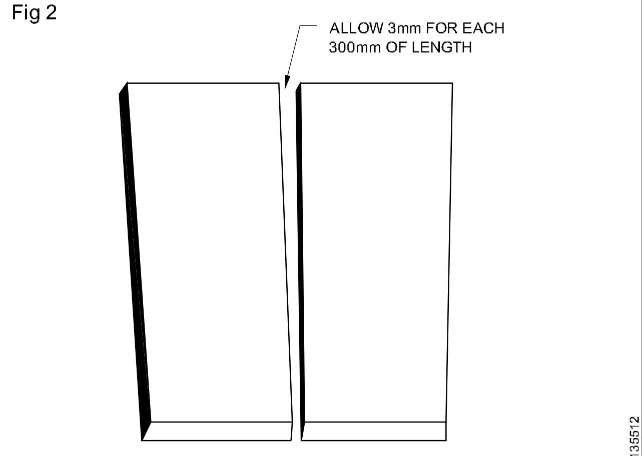
Effects of setting 'carburizing' or 'oxidising' flame

Too much oxygen will cause the formation of copper oxide and the weld will be brittle.

Too much acetylene will cause steam to form a porous weld.

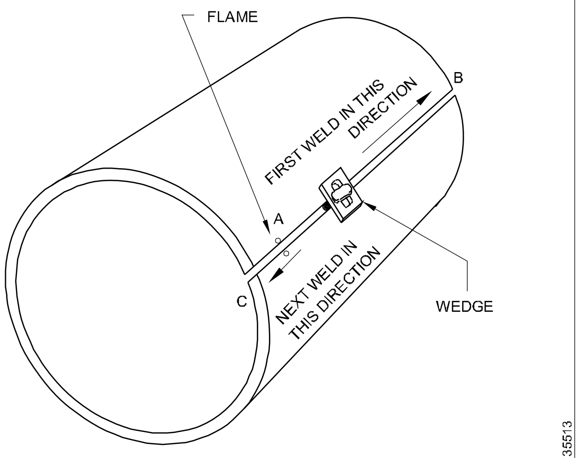
Setting: 1.6 mm root gap between the sheets with a divergence allowance at the rate of 3-4 mm per 300 mm run. (Fig 2) Use wedge for welding long seam in copper. (Fig 3) No tacking is done.

Fig 2



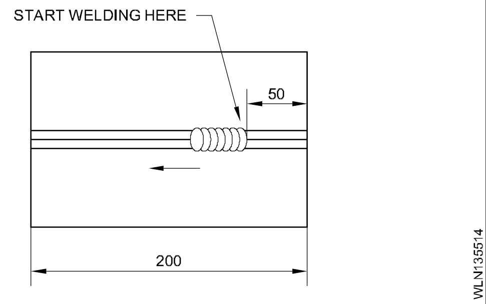
DIVERGENCE ALLOWANCE

Fig 3



WELDING LONG SEAM IN COPPER

Fig 4



Preheat: Surface of the base metal is raised to a fairly high temperature 750°C (peacock neck blue colour) before the actual welding is started.

Welding technique: Adopt leftward technique up to 3.5 mm thickness and rightward technique for 4 mm thickness and above. Usually the welding starts from a point 40 to 50 mm away from the right end of the job and after welding till the left end turn the job by 180° and weld the balance non-welded portion. Always welding is done towards the open end of the joint. (Fig 4)

Control of distortion

Divergence allowance (as already stated in job setting) acts as an effective controlling distortion.

Chill plates or backing bar also prevents distortion.

After treatment

Peening is done in order to reduce the grain size and the locked up stresses. This is done when the metal is in hot condition.

Bronze welding of copper

Objectives: At the end of this lesson you shall be able to
- **explain the principle of bronze welding of copper**
- **describe the welding technique**
- **explain the advantages of bronze welding of copper**
- **describe the brazing problems and their remedies.**

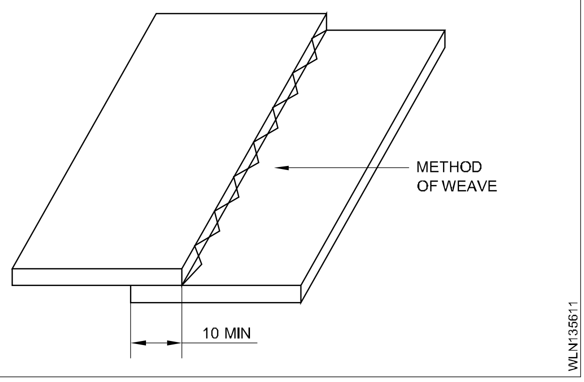
Principle of bronze welding of copper: Brazing is also a process of joining of similar or dissimilar metals together in a solid state by means of alloys (hard solder) which have a lower melting point than the metals to be joined. This process is used at a temperature above 452°C to 800°C depending upon the type of metal.

In bronze welding the base metal are not melted. Instead, they have been raised to a point which is above the melting point of the hard solder. The molten filler wets the surfaces to be joined, spreads over them, and solidifies, thereby forming the joint.

Technique: After the joint surfaces are perfectly cleaned the members of the joint should be clamped in a jig or in a fixture giving easy access for brazing the joint from all sides. The clearance should be set in advance.

Heating: Set a suitable oxidising flame. Heating should be done with the broad part of the flame. (Fig 1) When joining unequal sections of unequal thickness, the flame should be made to play on the thicker section.

Fig 1



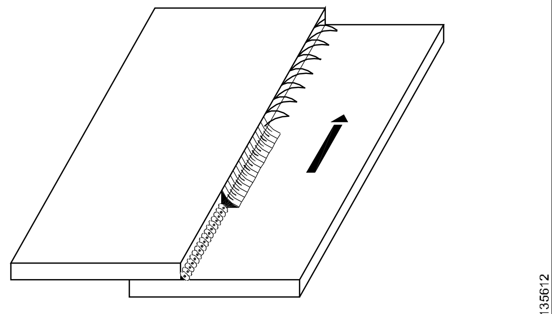
Flux: Brazing flux should be applied to the heated joint surfaces just before brazing. Some flux should also be applied to the filler rod which should be slightly heated.

Filler rod: The silicon-bronze filler rod should be melted by the heated members, as the filler rod is made to touch the edge of the member, and never melted directly by the flame. The method of depositing multiple pass on a fillet lap weld is shown in Fig 2. After the joint is completed, the bronze weld and the base metal should be allowed to cool slowly. Non-ferrous metals may be cooled in water also.

Advantages

Dissimilar metals can be joined.

Fig 2



MAKING A MULTIPLE PASS FILLET WELD ON A LAP JOINT

Assemblies can be 'bronzed' in a stress-free condition.

Complex assemblies can be bronzed in several steps by using filler metals at progressively lower melting temperatures.

Materials of different thickness can be joined.

Cast and wrought metals can be joined.

Metallurgical properties of the base materials are not seriously disturbed.

Brazed joints require little or no finishing.

Brazing problems and remedies

Problem	Remedy
The filler metal 'balls up' does not melt and flow into the joint.	Add more flux. Ensure pickling or additional mechanical cleaning to remove oxides, oils, or other surface coatings. Use fresh flux. Also check for contaminated pickling acid of 'dirty' grinder wheels that could spread impurities instead of removing them.
The filler metal melts but does not flow completely through the joint.	Increase the preheating period. The base metal may not be hot enough. Ensure thorough cleaning. Try a wider or narrower joint gap. Joint must not be too tight or too loose. Also check for gaps or spaces where capillarity is interrupted. Apply more flux to both filler rod and base metal. If not successful use a different flux compound. Improper flux may be breaking down due to too much heat.
The filler metal runs out instead of into the joint.	Reposition (tilt) the joint, so that gravity helps the filler joint. Make a small reservoir in the joint to start the capillary action. Feed the filler metal into the joint from above rather than horizontally or from below.
The filler metal melts but does not flow.	Ensure additional cleaning of the filler metal to remove the oxides. Use more flux on both the filler rod and the base metals.