

SECTION 4, CHAPTER 4

SOLDERING AND BRAZING

List of Contents

	<i>Para.</i>		<i>Para.</i>
SOFT SOLDERING		BRAZING	
Introduction	1	Introduction	27
Soldering Irons	3	Metals which can be Brazed	29
Soft Solders	7	Fluxes	30
Fluxes	9	Jointing Alloys	32
Brazing Lamp	14	Cleaning	35
Methods of Soft Soldering	18	Brazing Processes	36
Causes of Faulty Soldered Joints	25	Torch Brazing	37
Types of Soldered Joints	26	Making the Brazed Joint	40
		Cleaning after Brazing	41

List of Illustrations

	<i>Fig.</i>		<i>Fig.</i>
Common Soldering Irons	1	Melting Range of Brazing Alloys and Solders	8
Electric Soldering Irons	2	Types of Brazing Torch	9
Alumino-Thermic Iron	3	Use of Torch Flame	10
Test of Solders and Fluxes	4	Application of Heat to Dissimilar Metals	11
5-Pint Brazing Lamp	5	Application of Heat when Brazing Metals of Different Thicknesses	12
Soldering Nipple to Cable	6	Application of Heat to Joint during Brazing	13
Typical Soldered Joints	7		

SOFT SOLDERING

Introduction

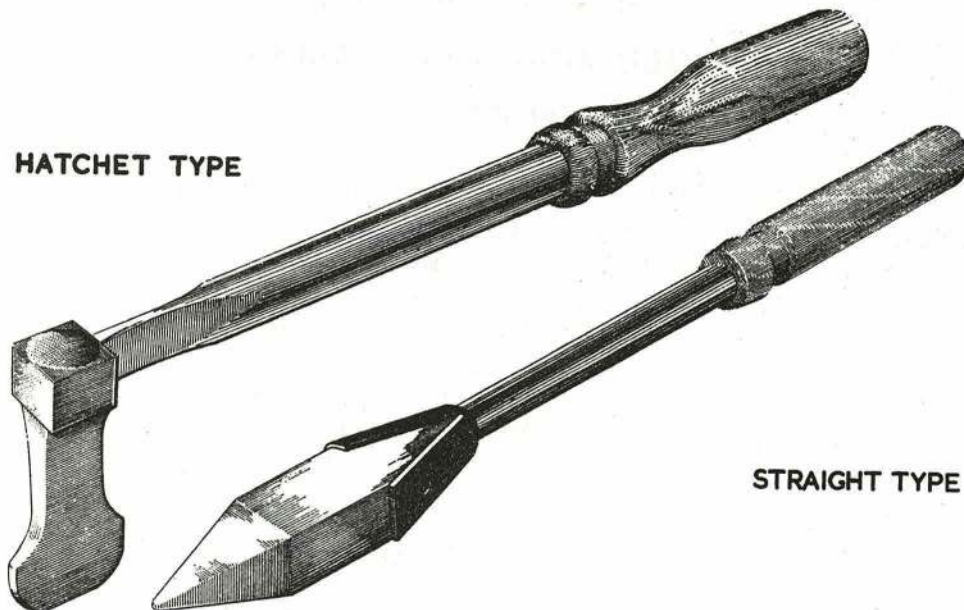
1. The process of soft soldering consists of joining metals (which may or may not be similar) by flowing a tin-lead or similar alloy, termed solder, between the surfaces to be joined, a flux being used to remove oxides and facilitate the flow and adhesion of the solder. It is essentially an alloying process in which the tin in the solder combines with the metal of the joint, and this will occur only when the metal and solder brought into contact are thoroughly clean. The comparatively low temperature required enables joining to be achieved without adverse effect upon the physical properties of the joined metals, and minimizes the damage to adjacent materials such as paint, insulation, etc.

2. Most metals can be soft soldered, but specialized knowledge or equipment is sometimes required. The basic equipment required for soft soldering consists of the soldering iron, solder, flux and a source of heat. More elaborate equipment is needed, however, for such special applications of the process as sweat soldering or dip soldering, a typical example being the method used in the manufacture of coolant radiators.

Soldering Irons

3. A soldering iron consists of a copper "bit" secured to a holder, to which is fitted a heat-resistant handle. The bit varies in size according to the nature of the work for which the iron is intended; because the bit is the heat reservoir of the tool, it must be large enough to heat the work adequately. The following types of soldering iron are available.

HATCHET TYPE



STRAIGHT TYPE

Fig. 1. COMMON SOLDERING IRONS

4. Common Soldering Iron. This type of iron is available in various shapes as well as weights, two typical forms being shown in Fig. 1. The bits, which are renewable, are heated by a fire or by the flame of a brazing lamp.

5. Electric Soldering Iron. This type of iron is also available in various shapes and sizes, being heated by elements suitable for most supply voltages. Fig. 2 shows two typical examples of electric soldering irons;

one is intended for light work such as soldering small electrical connections, while the other is suitable for general workshop use. The light type may weigh only a few ounces and have a pointed cylindrical bit of $\frac{1}{8}$ in. or $\frac{1}{16}$ in. diameter, with a heater element rated at as little as 10 watts for use on a 6-volt supply; other heaters are suitable for use on normal mains-supply voltages (200-250 volts). The larger types are effective tools for general soldering work, with substantial bits and heaters rated at up to 250

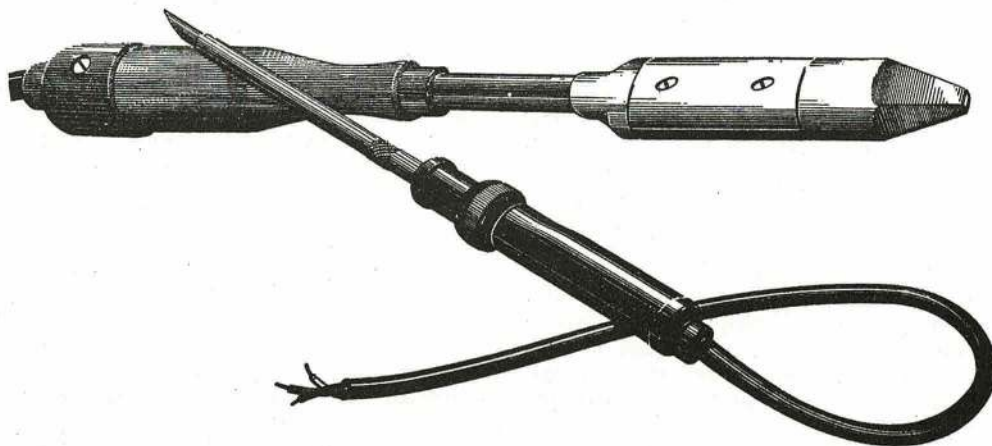


Fig. 2. ELECTRIC SOLDERING IRONS

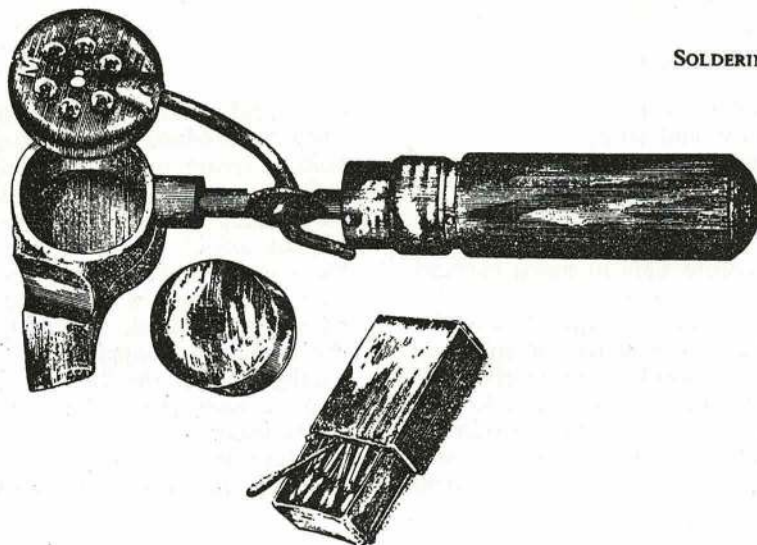


Fig. 3. ALUMINO-THERMIC IRON

watts; these irons are, as a rule, only available for use on normal mains-supply. Temperature control of electric soldering irons is made possible by the incorporation of heater switches; these are usually fitted in the flexible cable of the tool, but many of the light types, which attain soldering heat very rapidly, have thumb-type switches in the handle to ensure that the iron is automatically switched off when not actually in use.

6. Aluminothermic Soldering Iron. This type of iron (Fig. 3) was introduced for use where neither electric power nor other heating medium is available. The copper bit has a circular cavity in which is placed a "Mox" (magnesium and aluminium oxide) tablet. The tablet is lit by a special match (fusee) and in burning it heats the bit; the residue must be shaken out of the cavity before using the iron. These irons are now rarely used, and, in any case, must not be used near aircraft, M.T., or inflammable stores while the tablet is still burning.

Soft Solders

7. Soft solders are mainly alloys of tin and lead, a small percentage of antimony being normally added to give a harder and stronger joint. Some of the standard grades of soft solder and their uses are as follows:—

(a) **Tinman's (30B/1214).** This is a solder composed of 58% lead, 40% tin, and

2% antimony; it is supplied in stick form. Tinman's solder liquefies at 227°C., and sets solid at 185°C.; it is used for fine and general work.

(b) **Electrician's (30B/1601).** This solder is composed of 40% lead and 60% tin; it is supplied in the form of resin-cored wire to eliminate the danger of corrosive fluxes being used. It is mainly intended for instrument, wireless and electrical work, its melting and solidifying points approximating to those of tinman's solder.

(c) **Lead/Silver (30B/1298).** This is an alloy of lead (97.5%) and silver (2.5%), which melts at 304°C. and solidifies at 183°C. It retains its strength to a considerably higher temperature than does lead/tin solder.

8. Solder should always be used in the most economical form or shape for the particular work to be done. In the Service, solder is normally provided in the ordinary tinman's stick and cored wire forms, the latter type being supplied in S.W.G. sizes and wound in coils or on reels. Wire or cored solder should be used in place of stick solder whenever it will reduce waste. The following is a list of various forms in which solder is manufactured:—

Tinman's sticks,
Ingots, nuggets or blocks,
Thin blowpipe strips,
Solid solder wire,

Cored solder wire,
Solder tape and strip,
Solder washers,
Solder paints.

Fluxes

9. Solder will adhere only to metal surfaces that are clean and free from oxidation, these conditions being normally obtained by the use of a flux. The action of soldering fluxes is therefore twofold; first, to clean the surfaces to be joined, and secondly, to protect the cleaned surfaces from oxidation when heat is applied. Soft soldering fluxes belong to one or the other of two main categories, viz.:—

(a) Active or chloride fluxes.

(b) Safety or protective fluxes.

10. **Active or Chloride Fluxes.** These fluxes are made in various forms as paste, salt or fluid, and are used for many soldering duties. They are capable of removing considerable amounts of oxide, rust or grease from the base metal, but the residue of such a flux may cause corrosion. "Killed spirits" is very corrosive and tends to leave a sticky residue on the joint itself. A joint must be carefully washed or wiped with a damp rag immediately the soldering operation is completed. If the completed article has any crevices where flux residue may lodge, the soldered assembly must first be immersed in a solution of 1-2 per cent. hydrochloric acid in water, and then rinsed carefully in running water. The corrosive action of these fluxes on copper is excessive and is, moreover, extremely difficult to neutralize; they are not, therefore, suitable for general electrical work.

11. **Safety or Protective Fluxes.** These fluxes are used on work where complete freedom

from acid or corrosive action is desirable. They are produced in four forms; as a paste, fluid, or cream, or in cored solder wire. Safety fluxes are not as rapid in action as chloride fluxes and are less effective in removing surface oxide; therefore, it is essential that the work to be soldered is clean. The resin-base fluxes form a protective film over the parts to be joined, preventing oxidation at the soldering temperature. An added advantage is that the flux residue sets rapidly into a hard dry material, whereas most fluxes leave a sticky residue which absorbs moisture or traps dust or metal filings, thus lowering the insulation resistance of the joint.

12. **Flux Testing.** It is sometimes necessary to test the efficiency of a flux. A useful method is to coat pieces of copper, brass, or whatever metal is to be soldered, with the flux under test. On the centre of these pieces place pellets of solder of equal weight and shape and heat to the soldering temperature. The area covered and the angle the solder makes with the parent metal (Fig. 4) are the measure of the efficiency of the flux. This test may be followed by prolonged flux corrosion tests.

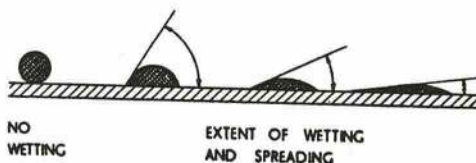


Fig. 4. TEST OF SOLDERS AND FLUXES

13. The following fluxes are approved for Service use:—

Type of Flux	Active or Safety	Uses
Flux, soldering, "Jaydalene"	Active Safety	For soldering stainless steel conductors of ignition cables only.
Paste, soldering	Safety	All metals except stainless steel, where non-corrosive jointing is required.
Solution, soldering ..	Active	General purpose flux.
Flux, non-corrosive ..	Safety	For use in soldering identification labels to steel tubing.
Sal-ammoniac	Active	For tinning large surfaces.
Ortho-phosphoric acid	Active	For stainless steel pipes.

Brazing Lamp

14. The brazing lamp (or blow lamp, as it is more generally called) is the most commonly used method of heating a common soldering iron. They are available in two sizes, viz. with containers of one pint and five pints capacity respectively. Both sizes of lamp operate on similar principles, although the five-pint version is of rather more elaborate construction than the one-pint type, and the fuel used in both types is kerosine (paraffin).

15. Construction and Operating Principle.

The main constructional features are shown in Fig. 5. Kerosine from the container is forced under pressure through the vaporizer to the jet; on leaving the jet the fuel vapour mixes with air in the burner chamber and the resulting mixture, when ignited, burns with a blue flame of fairly high temperature. The burner is so constructed that the flame also heats the vaporizer. Pressure is applied to the container by means of a hand-operated pump embodying a non-return valve. An air release valve is fitted to the container and, in addition, the larger type of lamp is equipped with a pressure gauge and a flame regulator valve. The normal working pressure is between 20 and 30 lb. per sq. in.; the pressure must never be higher than that indicated by a red warning mark on the dial of the pressure gauge.

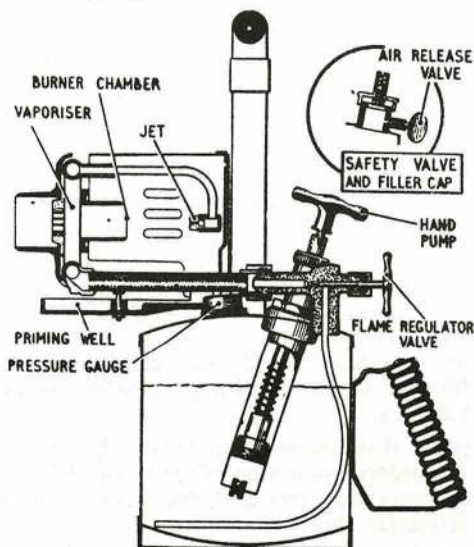


Fig. 5. 5-PINT BRAZING LAMP

16. **Using the Brazing Lamp.** To obtain the best results from a brazing lamp it must always be maintained in a clean and serviceable condition. The method of preparing and lighting the 5-pint lamp is as follows:—

- (a) With the filler cap removed and using a funnel with a fine gauze strainer, pour clean kerosine into the container until it is not more than three-quarters full; replace and tighten the cap. If any kerosine is spilt, wipe it up with old rag; ensure that the outside of the lamp is dry.
- (b) Clean the jet with the correct cleaning needle or pricker.
- (c) Open the air release valve and close the flame regulator valve.
- (d) Fill the priming well with methylated spirit; ignite the spirit for the purpose of heating the vaporizing tube. The capacity of the priming well is such that when practically all the spirit has been burnt the vaporizer should be hot enough to function correctly.
- (e) Close the air release valve, open the flame regulator valve one turn and operate the pump. If the vaporizer is not hot enough, liquid kerosine will be ejected through the jet or the lamp will burn with a yellow flame. If this occurs, the air release valve must be opened and the lamp allowed to cool; the procedure from (c) onwards should then be repeated.

A sudden reduction in the size of the flame when the lamp is in use is an indication of a partly blocked jet; this can usually be rectified, without extinguishing the lamp, by careful use of the cleaning needle or pricker. The lamp can be extinguished at any time by opening the air release valve.

17. **Precautions.** In view of the highly inflammable nature of the fuel and the fact that it is burning under pressure, the following precautions must be strictly observed when using brazing lamps:—

- (a) Pyrene or tetrachloride extinguishers must be instantly available in case of accidents—under no circumstances should water be applied to a kerosine fire.
- (b) Lighted brazing lamps must not be taken within 50 ft. of aircraft, mechanical transport, or inflammable stores.

(c) Lamps must not be used in conditions of excessive heat, e.g., near furnaces.

(d) Lighted lamps must be placed on incombustible surfaces only; they must never be placed on wooden benches or floors.

(e) The flame of the lamp, when not being used for heating, must always be directed towards a brick hearth; if this is not available, a shield of sheet asbestos or thick metal sheet should be used to screen the flame.

Methods of Soft Soldering

18. Tinning the Iron. Before an iron can be used for soldering, the contact surfaces must be given a coating of tin or solder; this is known as "tinning" the iron, and is done as follows:—

(a) Apply a file to the faces on the end of the copper bit until all dirt, oxide and roughness are removed.

(b) Heat the bit (not the tip) until it will just melt solder.

(c) Apply flux to the hot bit and then rub the bit against some solder; the tin or solder will adhere to and leave a smooth coating over the faces forming the point of the bit.

19. Precautions. The following precautions should be observed when using soldering irons:—

(a) The ideal working temperature of the iron is just high enough to melt the solder easily: over-heating causes chalkiness in the solder resulting in unsatisfactory joints, and it also encourages the formation of oxide on the bit, thus necessitating repeated cleaning and re-tinning. Systematic use of the heater switch enables an electric iron to be kept at optimum temperature, while frequent slight re-heating of a common iron is always preferable to less frequent but more protracted re-heating.

(b) When heating a common iron, always direct the flame of the brazing lamp towards the base of the bit, not at the point.

(c) Avoid excessive use of soldering fluid or flux; too much flux tends to lower the temperature of the iron and also promotes corrosion of the bit.

20. Cleaning. All metal surfaces or joints to be soft soldered must be thoroughly clean to obtain perfect adhesion and pressure-tight joints. Methods of cleaning are filing, scraping, grinding, machining, and polishing. In some cases dirty or rusty metal surfaces can be cleaned by the use of chemicals, such as hydrochloric or nitric acid.

21. Making the Joint. When making a soldered joint between two metal faces, having thoroughly cleaned the surfaces and tinned the iron, proceed as follows:—

(a) Apply flux to the joint surfaces and place them in the required position. Do not use an excessive amount of flux.

(b) Use the heated iron to apply solder and heat simultaneously to the joint. Ensure good penetration of the solder between the joint faces.

(c) Press the surfaces together if the design of the joint will allow this, and remove the iron.

(d) Allow to cool. Remove all flux residue (para. 10) and dry thoroughly. Apply anti-corrosive treatment if necessary.

22. Soldering is not a difficult operation, and good results can be obtained by exercising care and paying attention to the following points:—

(a) Ensure that the solder and flux chosen for the work in hand is of the correct type, and that the flux is clean.

(b) Be meticulously careful over the cleaning of surfaces prior to tinning; thorough cleaning is always important, but it is absolutely vital when a safety flux is being used.

(c) Molten solder will not adhere properly to cold metal, and it may be found necessary to pre-heat work of large dimensions. In this case avoid excessive pre-heating as this may cause the formation of a film of oxide on the previously cleaned surfaces.

(d) If it is necessary to secure the work to be soldered in a vice, place wooden blocks between the jaws and the work so as to minimize the loss of heat.

(e) Use the minimum amount of solder between the joint faces, but make certain that it is evenly distributed. Solder has

little strength and the strongest joint is produced by a thin film adhering perfectly to the joint surfaces.

(f) Throughout the operation, keep the soldering iron well tinned and at the correct temperature to facilitate the flow of solder.

23. Bowden Cable Nipples. Make sure that the cable and nipple are clean and free from oil or grease. To prevent the strands of a new cable from unravelling, apply flux and solder to the cable before cutting it to length. To solder the nipple to the cable proceed as follows:—

- (a) Slide the nipple on to the cable.
- (b) Apply flux to the end of the cable, and thoroughly tin over a length at least $1\frac{1}{2}$ times that of the nipple.
- (c) Apply flux to the nipple and slide it to the tinned end of the cable.
- (d) Heat the nipple with a hot soldering iron and slide the nipple over the tinned cable, leaving about $\frac{1}{8}$ in. of cable protruding beyond the end of the nipple.
- (e) Hold the soldered nipple in a vice or a pair of pliers, and, using a small ball peen hammer spread the protruding strands of the cable (Fig. 6). Apply a blob of solder over the end of the cable, so that the countersink in the nipple is filled with solder.
- (f) Wash the soldered joint thoroughly in hot water, ensuring that all flux residue is removed. Dry the joint and apply a coating of rust preventive.

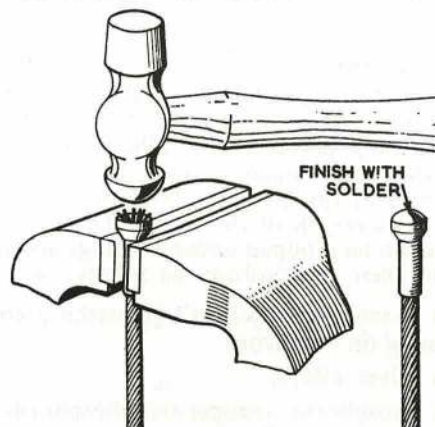


Fig. 6. SOLDERING NIPPLE TO CABLE

24. Sweating. This metal joining process is a form of soldering and is carried out by first cleaning, fluxing, and tinning or applying a thin coating of solder to the surfaces of the joint. The surfaces should be lightly coated with flux and placed in position for joining. Heat should then be applied to the parts by gas flame, muffle, or soldering iron, sufficiently to melt the solder. When this occurs the source of heat is removed, the work allowed to cool and the joint to set. Finally, all flux residue should be removed by washing. In the more up-to-date methods of sweating, solder creams and solder paints, which contain flux and solder, are used. The cream or paint is applied, before assembly, with a brush or by dipping. The parts should fit closely and should be of such form that they remain in position during heating, or be held together in a jig.

Causes of Faulty Soldered Joints

25. Dirty, greasy or corroded joining surfaces prevent good adhesion. Badly fitting surfaces result in areas of joint surfaces not being united by the solder. If the wrong type of flux is used, oxidation may occur and the surfaces of the joint may not be effectively cleaned. If the wrong type of solder is used, the joint may have low strength if solder with too low a melting point is used, or damage to the surrounding area of repair may occur with the use of a high melting point solder. Over-heating, or application of heat for unduly long periods will cause increased oxidation resulting in poor adhesion or the formation of a brittle compound in the joint, which reduces its strength. Insufficient heat will cause sluggish flow of the solder, and penetration into the joint will be incomplete.

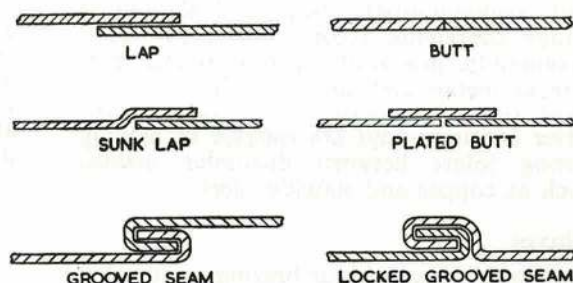


Fig. 7. TYPICAL SOLDERED JOINTS

Types of Soldered Joints

26. Solders are weak metals in comparison with steel, copper and brass, upon which they are much used. A soldered joint should, therefore, be designed to avoid, as far as is practicable, dependence on the strength of the solder. Fig. 7 shows some of the types of joint that may be used, the grooved seam and the locked grooved seam being typical examples of strong design.

BRAZING

Introduction

27. Brazing and soldering processes differ from welding in that the metals to be joined are not normally heated to a temperature approaching their melting points, the jointing material is not necessarily of similar constitution to that of the metals to be joined, and its melting point is usually considerably lower than that of these metals. Also, the two metals to be united may not be alike.

28. Soft soldering should not be used where much strength is required or where the joint will be subjected to vibration or heat. When a strong joint is needed and the work cannot be welded, brazing (which employs a higher melting point jointing alloy than is required for soft soldering) can be used to advantage. Hard soldering and silver soldering are alternative terms to brazing, but they specifically imply the use of filler materials containing silver, which have lower melting points, greater ductility and often greater strength than brazing brasses.

Metals which can be Brazed

29. With the exception of zinc-, tin-, lead-, and magnesium-base alloys, and aluminium alloys containing more than 2 per cent. magnesium, practically all ferrous and non-ferrous metals and alloys can be brazed or hard soldered satisfactorily. Some of the silver brazing alloys are capable of making strong joints between dissimilar metals, such as copper and stainless steel.

Fluxes

30. Fluxes necessary for brazing are divided into two classes, the borax type for working temperatures above 750°C., and the fluoride type for working temperatures of 600° to

750°C. The flux has several functions. It serves:—

- (a) To protect the work and the brazing alloy from oxidation during heating.
- (b) To dissolve such metallic oxides as are already present or are produced unintentionally.
- (c) To reduce the surface tension of the molten brazing alloy in relation to the metal on which it flows, enabling the molten metal to "wet" the surfaces to be joined.

31. The type of flux to be used is determined by the brazing temperature and, to some extent, by the nature of the metal to be brazed. In most cases, it is best for the flux to be made up into a smooth paste with clean water and applied to the work with a brush. This is more economical than using dry powder and permits of more positive placing of the flux. Small parts can often be completely immersed in flux paste before being made up into an assembly for brazing. This ensures adequate fluxing and non-scaling of the parts. Fluxes are nearly always essential but under certain conditions the use of a flux during brazing is unnecessary. Examples are:—

- (a) Copper brazing of mild steel components in controlled atmosphere furnaces.
- (b) The joining of copper components using a phosphorus-bearing brazing alloy.
- (c) Some resistance brazing operations where a jet of hydrogen is played on the joint for the brief period during which fusion of the brazing alloy takes place.

Jointing Alloys

32. A wide range of jointing alloys is available for use when brazing. The composition and melting points of the alloys vary considerably, the choice of alloy being largely governed by the metals to be joined and the required strength of the joint. The jointing alloys can be grouped under headings according to their composition as follows:—

- (a) Brasses or "spelters" (sometimes containing tin or silicon).
- (b) Silver alloys.
- (c) Phosphorus—copper and phosphorus—silver—copper alloys.
- (d) Copper.

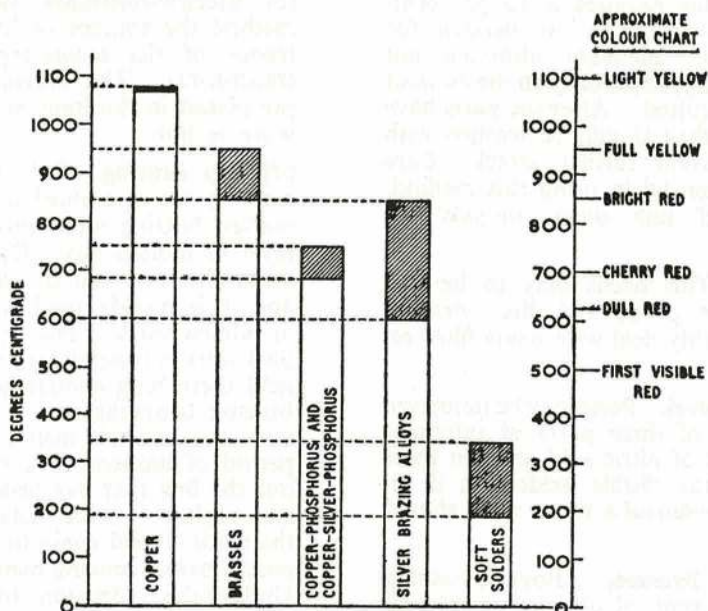


Fig. 8. MELTING RANGE OF BRAZING ALLOYS AND SOLDERS

A chart showing the melting ranges of these groups and an approximate colour guide to the temperatures is shown in Fig. 8.

33. Brazing brasses or spelters are alloys of copper and zinc, often containing a little silicon as a de-oxidant and occasionally a little tin. Melting points for brasses lie between about 850°C. and 950°C., the lowest melting points being associated with the highest zinc content and, consequently, the lowest ductility. High-zinc spelters are available only in granular form or hot-rolled "slittings" owing to their poor workability, but alloys of 40 per cent. zinc content or less are available as rod or strip.

34. Silver brazing alloys (formerly called silver solders) were originally alloys of silver, copper and zinc. Alloys of this type still have their applications but more general use is now made of alloys of the silver, copper, zinc, cadmium system, alloys of the silver, copper, phosphorus type and, for specialized applications, complex alloys which may contain (in addition to all or some of the aforementioned constituents) nickel, tin and manganese. Their melting temperatures range between 600°C. and 850°C. They are produced as rod, wire, strip, foil, filings,

powder, and as special inserts, such as rings, pellets and stampings for preplacement in brazed assemblies, which are produced in large numbers. An oxy-acetylene or coal gas and compressed air torch is required for normal working, but in emergency a blowlamp can be used on small work.

Cleaning

35. **General.** All metal surfaces or joints to be brazed must be thoroughly cleaned. Mechanical cleaning methods are filing, scraping, grinding, polishing and sand-blasting. After they are cleaned, the parts where the joint is to be made should not be handled. With alloys on which oxide films grow rapidly, the joint should be made as soon as possible after cleaning. Components should also be degreased before they are brazed. Methods of cleaning some metals are detailed below:—

(a) **Steel and Iron.** Oxide or scale can be removed by dipping the metal part in a hot solution of 5 to 10 per cent. sulphuric acid. It is advantageous to add an inhibitor to prevent excessive attack on the metal itself.

(b) **Brass.** This requires a 10 per cent. sulphuric acid solution. Immersion for 10 minutes is adequate although not always necessary, depending on the amount of cleaning required. After the parts have been pickled they should be washed with water to prevent further attack. Care should be taken when using this method, particularly if fine screw threads are involved.

(c) **Copper.** This needs only to be free from excessive grease and dirt. Brazing fluxes will readily deal with oxide films on copper.

(d) **Stainless Steel.** Parts may be immersed in a mixture of three parts of sulphuric acid, one part of nitric acid and ten parts water, until any visible oxide film is removed. On removal a water wash should be used.

(e) **Aluminium Bronzes.** Alloys containing up to 10 per cent. of aluminium are best cleaned by filing or the use of emery cloth. Brazing should take place as soon as possible after cleaning, before a new skin of oxide is able to form.

(f) **Tungsten Carbide Cutting Tool Tips.** The surfaces to be brazed should be lightly ground.

Brazing Processes

36. The scope of the term "brazing processes" has widened in recent years and now includes the following methods:—

(a) **Torch Brazing.** This method is used very widely and is detailed in paras. 37 to 40.

(b) **Furnace Brazing.** This method is often used for large scale production, the brazing alloy being pre-placed. The type of furnace used depends upon the characteristics of the work. Broadly speaking, controlled atmosphere furnaces are used for brazing ferrous assemblies with copper and silver-bearing brazing alloys without a flux, and for non-ferrous assemblies joined with a silver-copper eutectic. Open furnaces are used for miscellaneous silver-alloy brazing with flux, and for the flux-free brazing of copper assemblies with silver-phosphorus-copper brazing alloys.

(c) **Electric-resistance Brazing.** In this method the sources of heat are the electrodes of the secondary winding of a transformer. The brazing alloy may be pre-placed in the joint or added when the work is hot.

(d) **Dip Brazing.** This is done by immersing the assembled joint in a bath of molten brazing alloy protected by a top layer of molten flux. Only ferrous metal assemblies are well suited to dip brazing, and it is mainly used for making joints in tubular work. The cleaned and assembled work is lowered into the flux layer and held there long enough to bring it up to brazing temperature. It is then lowered into the molten metal, where a short period of immersion is sufficient to flush out the flux that has penetrated the joint, and replace it with metal. On removal, the work is held again in the flux layer to permit excess brazing metal to drain away. Undesirable adhesion of brazing metal to immersed parts can be prevented by painting such parts with a "stopper", ordinary whitewash being an example which is quite effective.

(e) **Salt Bath Brazing.** With this method, the work is heated by immersion in a salt bath. The fused salt used is one which, in addition to being the heating medium must also act as a brazing flux and thus protect the work and the brazing alloy from oxidation. Assemblies produced by this method must be such that pre-placement of the brazing alloy is practicable.

(f) **Forge Brazing.** This is the oldest of all brazing processes and is similar to torch brazing, the only essential difference being that the source of heat is a blacksmith's forge or brazing hearth instead of a torch. The forge is a useful means of heating large components such as castings, where local heating is liable to cause cracking or distortion.

(g) **Blowlamp Brazing.** This is the method most commonly used in the Services, particularly at Units where more up-to-date equipment is not available. The actual operating technique is similar to that for torch brazing.

(h) **Induction Brazing.** In this method the source of heat is a high-frequency coil which surrounds the joint locality of the work.

Torch Brazing

37. Hand torch brazing involves the use of a type of gas blowpipe (Fig. 9) fitted with a combination air and gas regulator by means of which both the size and nature of the flame can be adjusted to suit the work. Use may be made of coal-gas and compressed air, coal-gas and oxygen, hydrogen and oxygen, and oxy-acetylene. Very often an ordinary oxy-acetylene welding torch is used instead of a brazing torch. An air compressor or low pressure blower of suitable capacity is required when a coal-gas and compressed air mixture is employed.

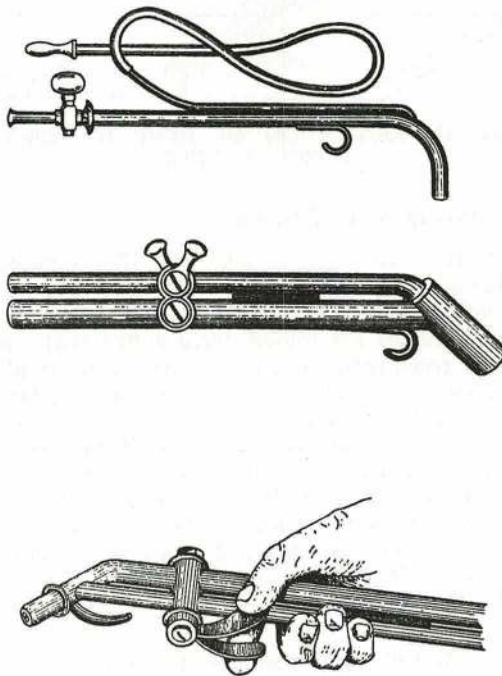


Fig. 9. TYPES OF BRAZING TORCH

38. The type and size of the torch used are decided by the gas mixture selected and the size of the parts to be heated. The gas mixture best suited to any given job in torch brazing is determined by considering:—

- (a) Whether the heat is to be general or fairly local.
- (b) The heating power required to raise the work to brazing temperature.
- (c) The thermal conductivity of the metal to be brazed.

(d) The peculiarities (if any) of the brazing alloy to be used.

39. When brazing, the envelope of the flame (not the cone as in welding) is used (Fig. 10), and the torch has usually to be kept in motion to achieve a general heat all over the work, rather than a local heat.

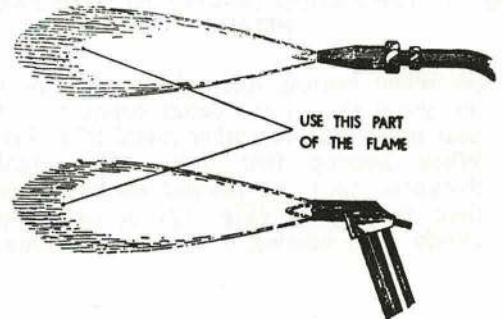


Fig. 10. USE OF TORCH FLAME

Making the Brazed Joint

40. When using a torch or a brazing lamp to make a brazed joint, the procedure, which also applies to hard soldering, is as follows:—

(a) Thoroughly clean the joint surfaces and, where one part fits over another, ensure that there is just sufficient clearance to allow a film of molten brazing alloy to find its way between the surfaces. Position the work so that it needs to be moved as little as possible during brazing.

(b) If fluxing before assembly of the parts has not been necessary, apply flux paste at and in the region of the joint. Areas requiring protection from oxidation should also be coated with flux.

(c) Warm the brazing alloy or rod in the flame and coat it with flux paste. If additional flux is required during the operation, this should be applied with the end of the brazing metal after dipping it into the container of dry flux.

(d) Heat the work with a flame which is kept in motion, until all the part of the joint to be brazed without re-positioning the work attains a temperature slightly in excess of the melting point of the brazing alloy. If the melting point of the flux is known, the fusion of the flux

will be a useful guide to the temperature of the work.

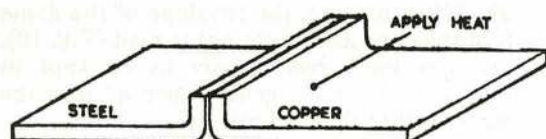


Fig. 11. APPLICATION OF HEAT TO DISSIMILAR METALS

(e) When heating dissimilar metals, heat the metal that is the better conductor of heat more than the other metal (Fig. 11). When heating two parts of unequal thickness, heat the heavier section more than the lighter (Fig. 12) in order to obtain even heating of the joint locality.

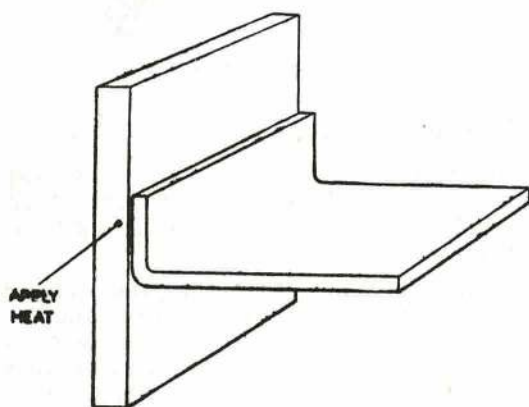


Fig. 12. APPLICATION OF HEAT WHEN BRAZING METALS OF DIFFERENT THICKNESSES

(f) Melt the brazing alloy by applying the end of the rod or strip to the heated edge of the joint. Do not melt the alloy in the flame and try to drop the molten metal on to the joint. Play the flame on that part of the joint to which the brazing alloy is required to flow, i.e. away from the point at which the brazing alloy has been applied. The molten brazing alloy is attracted by the hottest part of the metal on which it flows; thus heating ahead of the alloy facilitates brazing (Fig. 13).

(g) Continue feeding-in the brazing alloy until the joint is filled, but do not attempt to build up a fillet by this method. The work should then be allowed to cool until the brazing alloy has solidified.

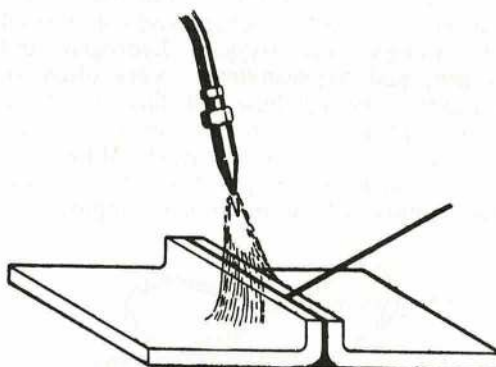


Fig. 13. APPLICATION OF HEAT TO JOINT DURING BRAZING

Cleaning after Brazing

41. It is most important that all traces of flux are removed from the work after brazing. The conditions vary with the type of work; after metals are joined using a flux with an acid constituent, corrosion will occur if all traces of the flux are not removed. After electrical or radar equipment is brazed, serious consequences can arise if the parts are not cleaned of flux residue; corrosion, electrical shorts and the collection of dirt in vital equipment may occur. Further, in oxygen and other gas equipment, explosions may result from the action of the gases on the flux residue.

42. Fluoride flux residues are removed by using a wire brush to scrub the parts in water or by leaving the parts immersed in hot water. Borax type flux residues can be removed by a dilute sulphuric acid pickle followed by a clean water rinse. Non-ferrous metals may, in most cases, be quenched in water, as soon as the brazing alloy has set, without harmful results; if a borax type flux has been used, the sudden contraction caused by this quench assists in cracking off some of the glass-like residue.

This file was downloaded
from the RTFM Library.

Link: www.scottbouch.com/rtfm

Please see site for usage terms,
and more aircraft documents.

