JOINTING OF COPPER TUBES

CAPILLARY JOINTS

The choice of jointing systems that are available to installers and specifiers of copper tube is truly wide. As well as the ubiquitous Capillary Soldered Joint, as illustrated in Figure 1, we have High Duty Fittings that can be silver-soldered or brazed. We can also form joints on the tube directly and use brazing or bronze welding techniques, as in Figures 2 and 3, or we can use copper or copper alloy brazing fittings. We also have a variety of Compression Fittings available and all of these jointing systems have been continuously evolved and improved for over fifty years to the point that they are, in the hands of the competent, professional installer, utterly reliable. Furthermore, the unique properties of copper tube and fittings combine to give a long, trouble-free, safe and cost-effective service life on gas, water, sanitation and heating services.

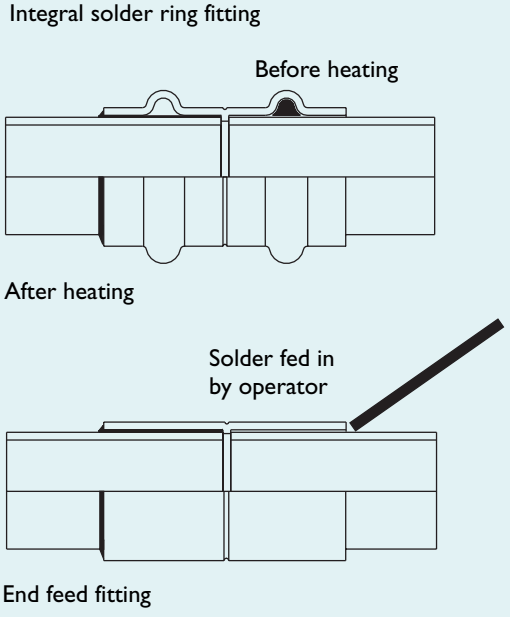

Figure 1 Capillary joints

Capillary attraction

Copper tube and capillary fittings are manufactured to close tolerances, so that a small even gap results on assembly. When a clean, fluxed copper tube is inserted into a clean, fluxed capillary fitting and heated to the melting temperature of the solder used, the forces of adhesion and cohesion cause liquid solder to flow into the capillary gap. Flux enables the solder to wet, adhere to and alloy with the surface of the copper and cohesion causes sufficient solder to be drawn in to completely fill the gap so a strong, watertight joint results.

Capillary jointing systems

Because there are a number of designs of capillary fittings and a wide variety of different fluxes, solders and brazing alloys available, reference should be made to manufacturers technical literature for advice on a particular jointing system. However, the methods of making capillary joints are similar, involving the following steps:

Measuring

Although measuring is not strictly a part of the jointing process it can have an effect on joint quality. If the tube is cut too short and does not reach the full depth of the socket a proper joint cannot be achieved. Also, if the tube is cut too long correct, alignment might not result and this can affect the capillary gap.

Cutting

Cut the tube square and de-burr inside, to enable full water flow, and outside to ease entry to the fitting. Use a junior hacksaw on 6 to 10mm soft tube and either a rotary tube cutter or a hacksaw with a minimum of 32 teeth per inch on larger sizes. When using a tube cutter be careful not to exert too much force when tightening the cutter on to the copper tube. This can result in 'nozzling' where the end of the tube is reduced in diameter. Nozzling makes the internal burrs more difficult to remove and can affect the capillary gap making it too wide at the base of the socket. Note, when using capillary joints on soft coiled copper it is good practice to re-round the tube end using a suitable tool so that the correct gap is maintained all round the joint.

Cleaning

Clean the tube and fitting. Fine sand paper and steel wool can be used but abrasive impregnated nylon scouring pads (washing-up 'greens') are very effective and no particles of steel can enter the system if they are used.

Fluxing and assembly

Once cleaned the tube should be fluxed immediately. Only apply sufficient flux to thinly coat the mating surfaces and assemble at once so that dust and dirt do not contaminate the capillary gap. Twist the fitting on to the tube to ensure an even coat of flux in the joint and make sure that the tube enters to the full depth of the socket. Wipe off any excess flux and the joint is ready for heating. Be sure to use a suitable type of flux for the solder used in the joint. For ordinary 'soft' soldered joints the commonly used fluxes are made from zinc and/or aluminium chlorides. Fluxes have to be corrosive to some extent to clean the copper and so any residues should be removed after soldering. So called 'self-cleaning' fluxes contain free hydrochloric acid. Whilst they can be excellent fluxes when used with extreme

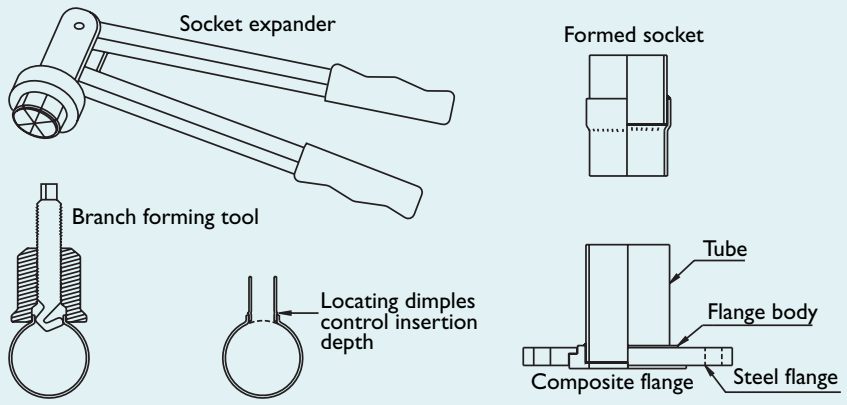

Figure 2 Socket and branch forming tools and brazing joints

care, they are not recommended for general use because of their corrosive nature. If the capillary joint is to be made with 'high duty' silver solder or brazing alloy the flux used is made from borax. The flux powder should be mixed with water to a thin creamy consistency before application.

Heating

Heat is usually applied with an LPG blow-torch. Keep the flame moving until a complete ring of solder shows at the mouth of the joint on Integral Ring fittings. When making End Feed fittings the solder should melt when it is brought into contact with the tube. The flame should then be moved away. If the solder does not melt continue to heat and then try again. Keep the flame moving, this is to prevent localised overheating which can char the flux before the solder is applied. Only add sufficient solder to fill the capillary gap all round the tube. Any extra will simply form a bead at the bottom of the joint or possibly run inside the tube. As a guide on small tube diameters when using solder wire, a length of solder approximately equal to the tube diameter should be enough to fill the joint. Don't add extra solder to Integral Ring fittings. The manufacturers have gone to great lengths to ensure that the correct amount of solder is already in the joint so adding extra to a properly prepared joint is simply unnecessary and wasteful. When using oxy/acetylene equipment to make large diameter joints or for brazing use a large, soft flame set to neutral.

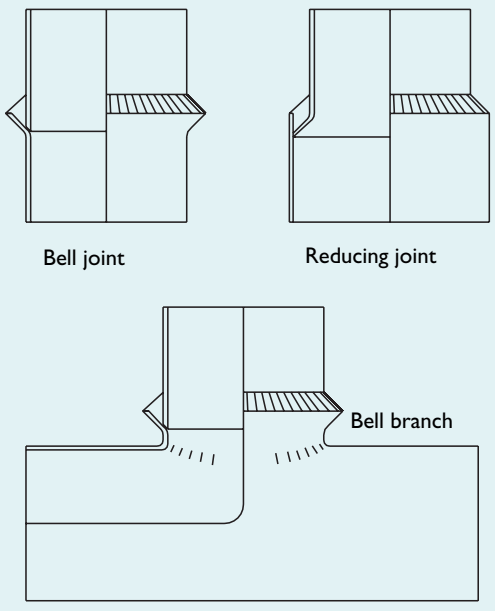

Figure 3 Bronze welded joints

Alternatives to the blow-torch

In situations where the use of a blow-torch might result in damage to the building fabric you could consider alternative methods of heating for small diameter joints. One alternative to consider is an electric hot air gun, especially if an attachment is used which directs the flow of hot air around the tube. This has the result of both protecting the building fabric and also speeding up the heating process. Another method is to use an electric resistance soldering tool. This consists of a pair of heating elements fitted with interchangeable heads which are shaped to fit the tube. These are clipped around the joint to be made and heat travels into the tube and fitting by conduction.

Finishing off

Once the joint has been made it is important to allow it to cool so that the solder has solidified before any disturbance. It is also important to remove any residue of flux from the outside of the tube by wiping with a wet cloth and warm water. The pipeline should also be flushed with warm water as soon as practicable to wash out flux residues from the bore. This is especially important on heating systems, if flux is allowed to remain in the system it can set up localised corrosion cells in the bottom of heat emitters.

Slip fittings

Where it is necessary to break into an existing installation for repair or to insert a new branch 'slip', couplings and tees are available. They have no tube stop and make the job much easier without disturbing the rest of the installation. It is a good idea to mark the tube so that the fitting can be correctly positioned to ensure a full capillary contact at both ends.

Site formed joints for brazing

The force of capillary attraction depends on having an even controlled gap. Because of this it is necessary to use special forming tools, see Figure 2, to prepare site formed sockets and branches directly on copper tube for brazing. Because brazing requires the copper to be heated to a dull red heat it is important to consider the effect on the tensile strength of the tube. Localised softening can result and so the maximum working pressure will be reduced.