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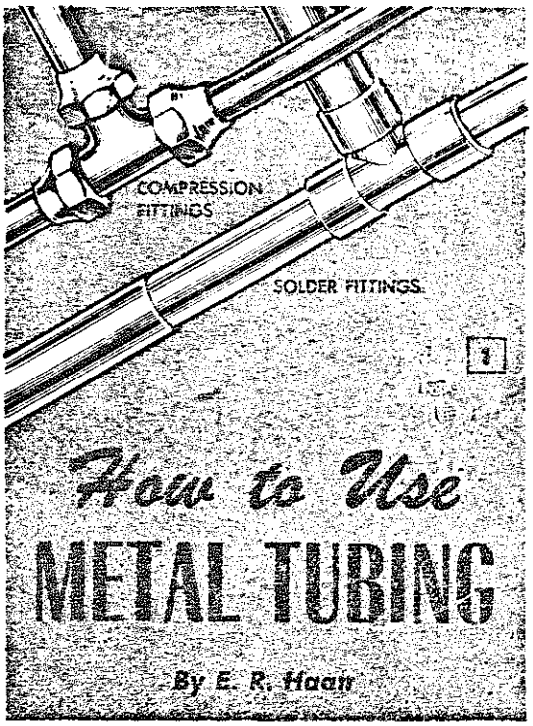


How to Use METAL TUBING

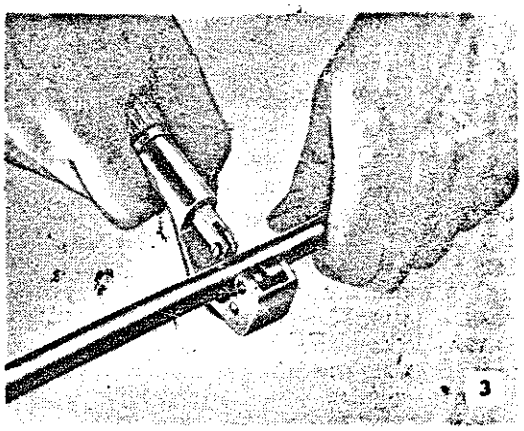
By E. R. Haan

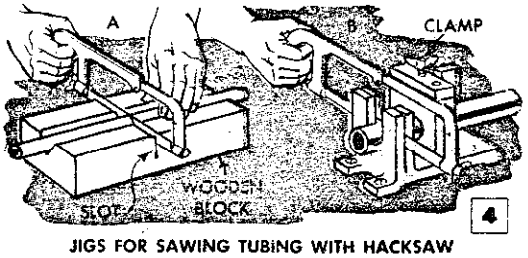
WHEN REPLACING WATER LINES, extending old ones or adding new ones in your home, the job may be simplified by using soft copper or aluminum tubing. It can be run around corners, over or under obstructions and "snaked" through partitions with ease. Besides being rustproof, soft tubing expands if water freezes in it and therefore can resist several successive freezings before rupturing.

Available in 60 and 100-ft. coils, tubing eliminates many pipe-cutting and threading operations and requires fewer fittings than does rigid pipe when used in continuous runs. The tubing generally used ranges from ¼ to 2 in. in diameter, and comes in hard as well as soft varieties. The former is made in straight lengths, while the latter is obtainable in coils.

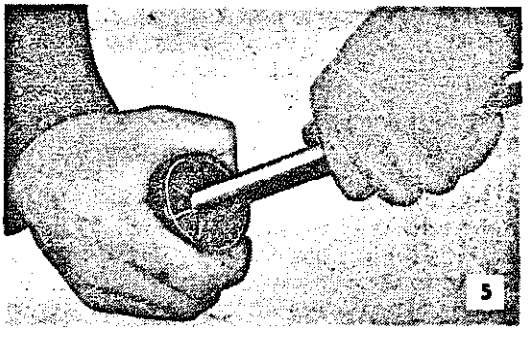
Two assembly methods: There are two methods of tubing assembly which differ in the kinds of fittings used, as shown in Fig. 1. Compression fittings are used with soft tubing, and solder fittings with both soft and hard tubing. The fittings include practically all the kinds used in regular pipe work plus adapters that connect tubing to threaded pipe. Copper, tinned-steel and brass tubing can be soldered readily. Aluminum tubing is assembled with compression fittings.

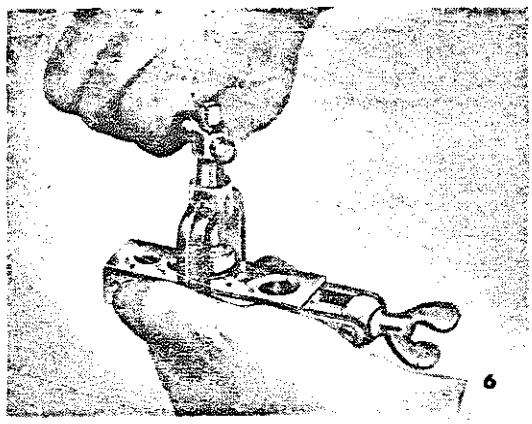
Straightening coiled tubing: To straighten coiled tubing, set the coil on edge on a flat surface and unroll it slowly while holding the straightened portion down as in Fig. 2.

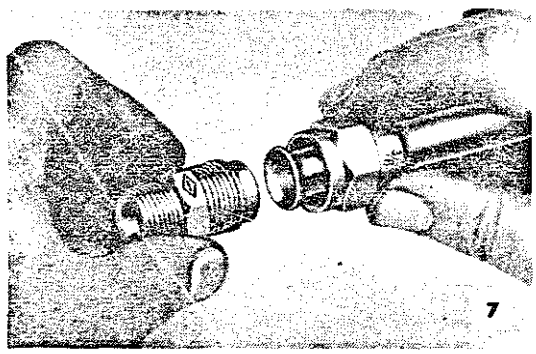


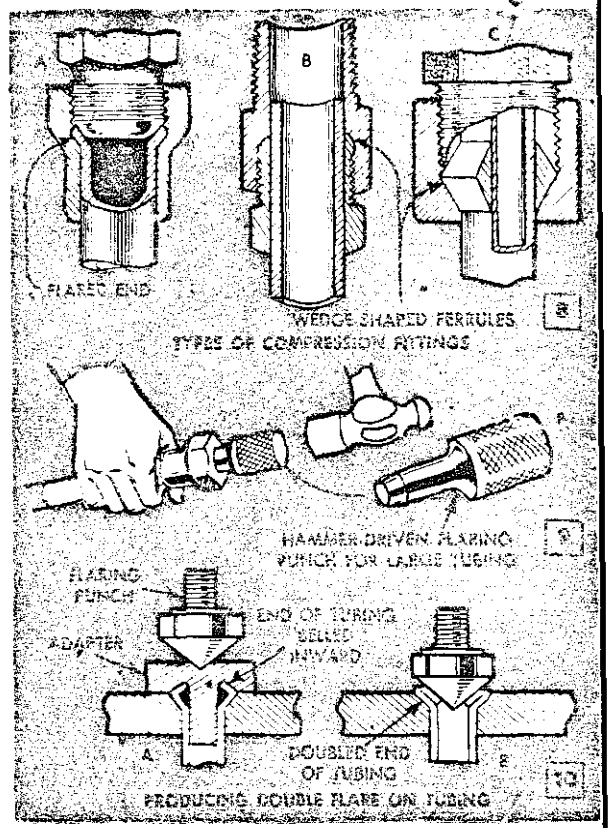


JIGS FOR SAWING TUBING WITH HACKSAW









How to cut tubing: For either method of assembly, the ends of the tubing must be cut off absolutely square. Cutting is best done by means of a regular tube cutter, Fig. 3. Cutting also can be done with a fine-tooth hacksaw—32 teeth per in. To assure square cuts when sawing the tubing it is held in a V-block which has a cross slot to guide the saw as in detail A, Fig. 4, or in a regular tube-cutting fixture as in detail B.

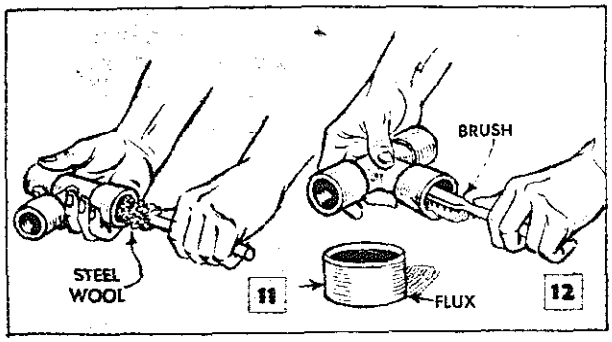
A cutter forms a burr on the inside of the tube and it is necessary to remove it by reaming lightly as in Fig. 5. Hacksawing produces burrs on both inside and outside. To remove them, use a reamer on the inside and a file on the outside. When reaming or filing, always hold the open end of the tubing downward so that the chips fall away from, rather than into, the tube.

Compression fittings: Fig. 8 shows three types of compression fittings. The kind shown in detail A requires flaring the ends of the tubing. Those shown in details B and C require merely pushing the tube into a fitting, then tightening the latter. This compresses a wedge-shaped ferrule or sleeve firmly on the tubing wall.

Flaring the ends of tubing: Flaring is done with a special tool as shown in Fig. 6. After slipping the compression nut of the fitting over the tubing, insert it in the block of the flaring tool so the end will project from $\frac{1}{16}$ to $\frac{1}{8}$ in. above the block. Tighten the block to grip the tubing securely, then screw down the threaded punch. Most flaring tools accommodate tubing from $\frac{1}{4}$ to $\frac{5}{8}$ in. in diameter, but larger ones are available. Also, for large tubing, a hammer-driven flaring punch of proper size often is used, as shown in Fig. 9.

Double flaring, Fig. 10, is recommended for steel tubing, which is especially likely to crack when only a single flaring is used. Double flaring also is advised for copper and aluminum tubing when extra-strong joints are desired, or where they must be frequently disconnected and reconnected. The inside bend is made by using an adapter on the flare block as in detail A, Fig. 10, after which the flaring proceeds as in detail B. A little oil on the end of a flaring tool reduces friction and helps to prevent scoring the metal. Avoid using excessive pressure when flaring tubing, since pressure hardens it and makes it more likely to crack from strain or vibration. After flaring, assemble the fitting as in Fig. 7.

Solder fittings: With solder fittings you merely insert the tubing in a fitting and sweat-solder the two together. If there is any distortion caused by soldering heat, the tubing must be shaped to perfect roundness by means of a sizing tool, Fig. 17. The surfaces to be soldered together (the outside of the tubing and the inside



of the fitting) must be cleaned thoroughly with fine steel wool or emery cloth, rubbing the metal as in Fig. 11 until it is bright. Wipe the tubing clean, then apply a thin film of soldering flux, Fig. 12. Push the tubing into the fitting as far as it will go, then rotate it a few times to assure even distribution of the flux.

Preheating and soldering: Preheating the joint comes next, using any suitable kind of torch. Play the flame over the fitting, not concentrating it too long at any one point. As most torches produce a flame that has a temperature considerably higher than the melting point of copper (1900 deg. F.), care must be taken to prevent burning a hole.

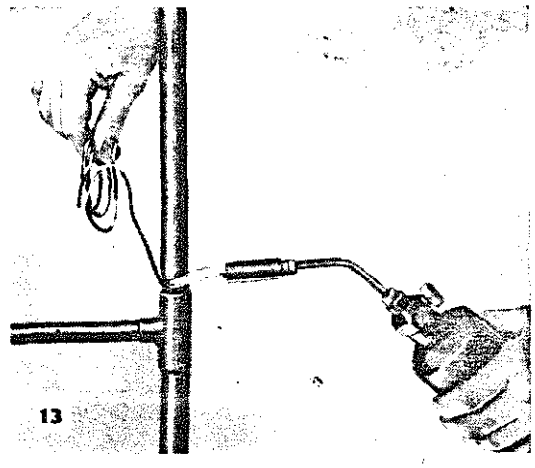
While heating, touch the end of a piece of wire solder to the edge of the fitting occasionally—outside the flame—to check for correct soldering temperature. This is reached when the solder liquefies immediately when touched to the fitting. Do not heat the metal above this temperature.

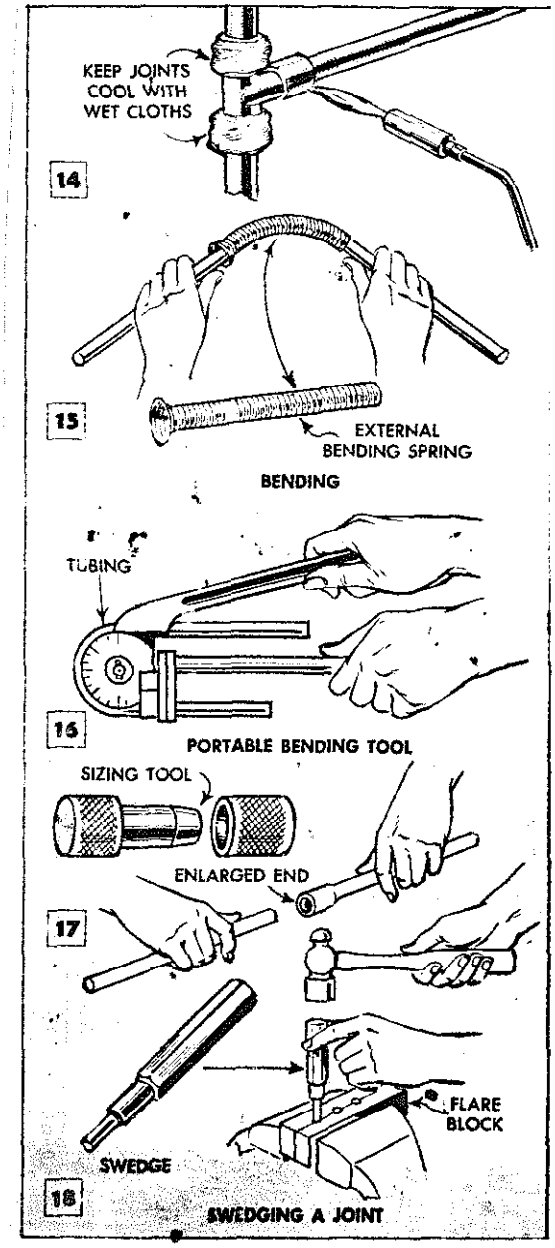
Next, feed the solder along the edge of the fitting, Fig. 13, while keeping the fitting hot. The solder is drawn between the contacting surfaces by capillary attraction no matter at what angle the fitting is held. Generally, the correct amount of ⅛-in. wire solder to use per joint is a length equal to the diameter of the tubing.

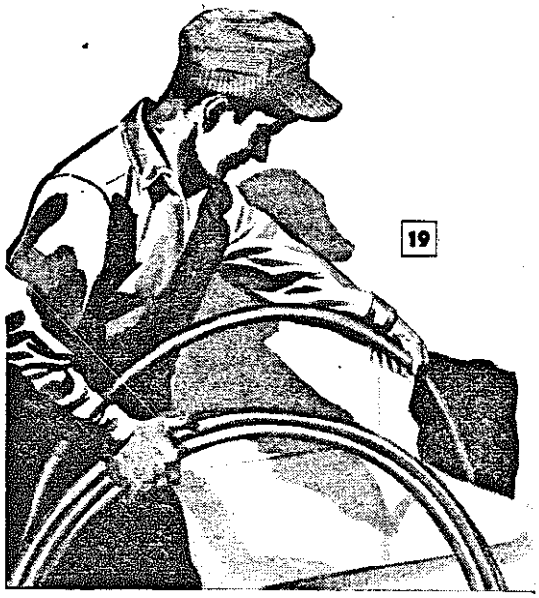
Avoid getting solder all over the work. You can wipe off excess solder while it is still liquid with a moistened cloth but do not remove the bead from the chamfered ends of the fitting. Avoid movement of the tube or fitting until after the solder has "set" or hardened, since any disturbance before this time weakens the joint. To protect wood or other combustible material in the vicinity of the flame when soldering a joint, use a sheet of asbestos board or asbestos paper.

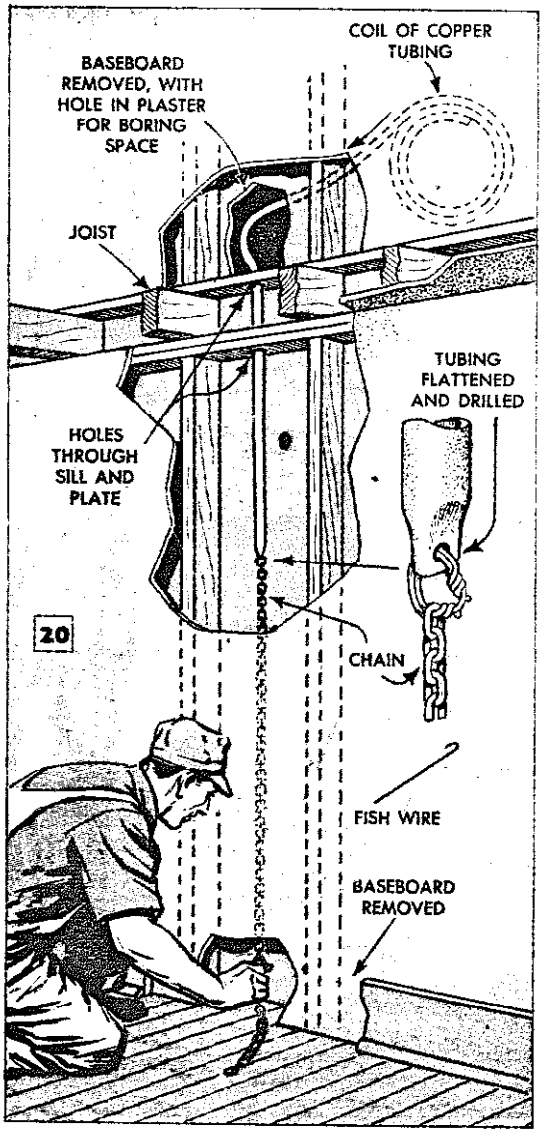
Whenever soldering tubing into a fitting which has other outlets already soldered into it, prevent the latter from melting loose by wrapping wet cloths around the joints to be protected as in Fig. 14.

Solder to use: Ordinary "soft" solder is









satisfactory where joints are not subject to much strain or vibration and are not heated to temperatures above 250 deg. F. For producing stronger joints, use "hard" or brazing solder which flows at temperatures of 1300 and 1400 deg. F.

How to bend tubing: You can bend soft copper tubing by hand as in Fig. 15, using spring-steel bending coils. Bending coils come in various sizes, for either inside or outside application. For accurate, small-radii bends, use a bending fixture, Fig. 16.

When copper tubing is bent or otherwise worked, it becomes hard and brittle. Therefore, before rebending copper tubing, anneal it by heating to a dull cherry-red color, then quench it in water. Aluminum is annealed in the same manner.

Swedged joints: Lengths of tubing can be spliced together by swedging, thus eliminating the need for a coupling. A swedging tool of the proper size, Fig. 18, increases the diameter of tubing a short distance from its end so it can be fitted over the end of another length. The joint is finished and soldered in the manner already described.

"Snaking" tubing through partitions: Copper tubing usually can be snaked through partitions as shown in Figs. 19 and 20. Two workers are required for this job. Holes are bored through the top and sole plates of the partition, a length of chain is lowered from the upper to the lower opening and it is pulled through the lower opening by means of a piece of wire with a hook bent in the end. This arrangement permits the worker below to pull the tubing through the partition by pulling on the chain while the worker above feeds the tubing into the partition. If any cross-pieces or fire stops are encountered, it is necessary to open the wall at this point and notch the obstruction.

Horizontal lengths of tubing must be supported adequately with suitable hangers to prevent sagging at any point. The hard variety of tubing generally is used for long horizontal lengths.

Buried copper tubing: Copper tubing buried underground should never be run through cinder fill, especially where the ground is wet. The sulphur in the cinders attacks copper. Where such a condition exists, damage to the tubing can be prevented by wrapping it with canvas liberally coated with an asphalt compound such as roofing cement or roofing paint. The covered pipe then is surrounded for a distance of 1 ft. with a layer of sand mixed with lime or broken plaster in equal proportions. Compression fittings are preferred for underground work and should be tack-soldered for added security against loosening. ★ ★ ★

How to work with copper piping

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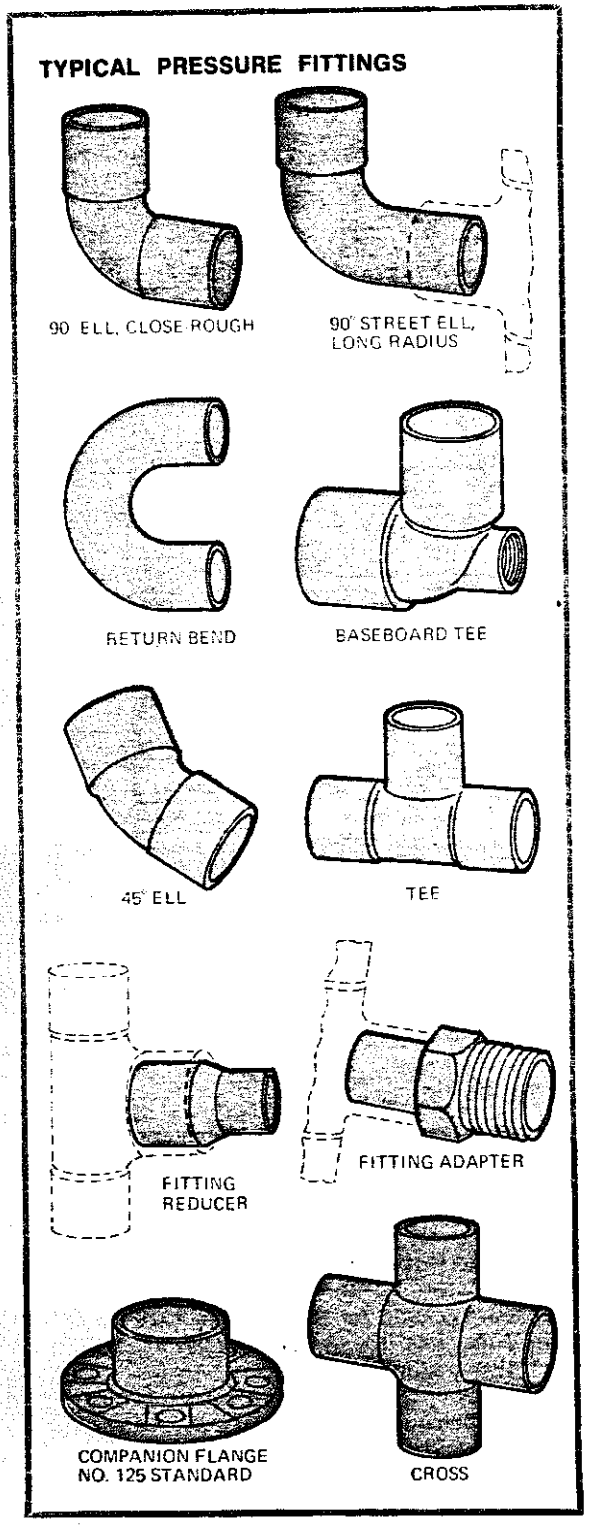
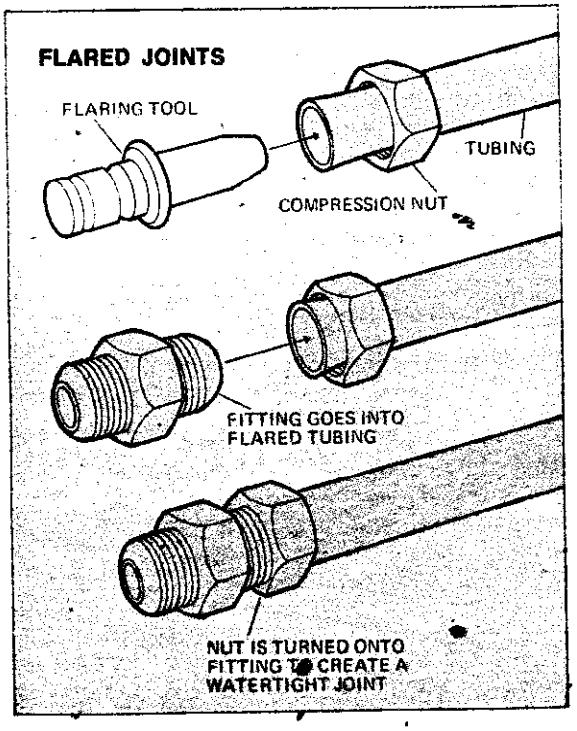


Copper piping is light and extremely durable, requires no threading of the ends to join it, comes in varying diameters, wall thicknesses and degrees of hardness, and is suitable for both hot and cold-water systems. To join copper piping, there are many types of fittings to cover every part of the plumbing layout. A number of common fittings are shown at the left.

Copper pipe can be joined using either soldered (also called capillary or "sweat" joints) or screwed (compression fitting) joints. Compression joints are of two types. With the first, called a "bead" fitting, the tubing is pushed into the fitting, a bead of jointing paste is applied around the tubing in front of a compression nut, and the compression nut is tightened onto the fitting. The result is a watertight fit. The second type is called a "flare" fitting because the end of the tubing is funnel-shaped with a special flaring tool (below). This shaped end receives the male end of the fitting; the compression nut is then tightened to finish the connection.

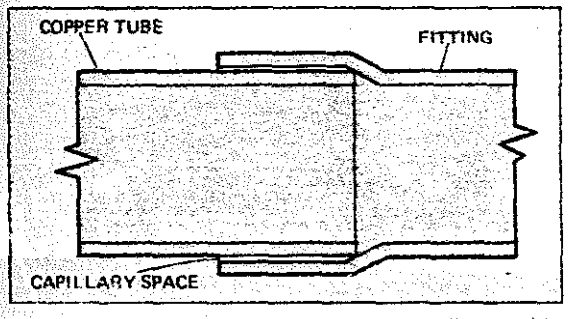


Types of copper piping

Type	Temper
K	Hard (rigid) or soft (flexible)
L	Hard or soft
M	Hard only

To be sure the type of copper piping that you use for a specific application complies with local plumbing code, always check with your local building department. In general, Type L can be used below ground, Type M above ground. For a superior installation, use Type K below ground and Type L above ground.

Capillary or 'sweat' joints



Properly prepared, a sweated joint will provide many years of troublefree (nonleaking) service. Although your joint may leak the first couple of times you attempt to sweat pipe, you'll soon be sweating copper pipe just like a pro by getting a little practice under your belt and by following the rules outlined on these pages.

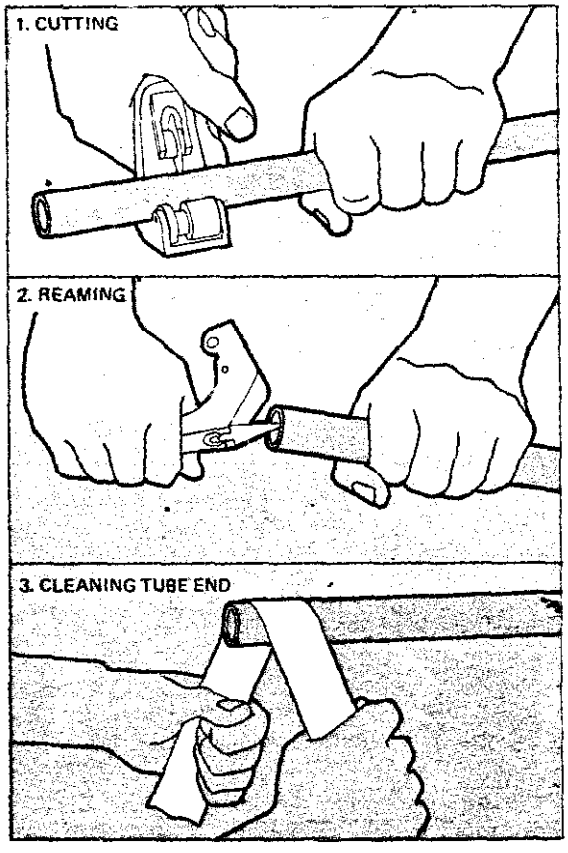
To understand the principles of sweating pipe, you should understand how capillary action works. When the end of a copper pipe is inserted as far as possible into a fitting, a small amount of space will remain between the inside wall of the fitting and the outside wall of the pipe. When the fitting is heated with a propane torch and solder is applied around the pipe at the outer edges of the fitting, the solder will be drawn into this space by capillary action, bonding the pipe and fitting together securely. Such action will be the result regardless of whether the piping will be running horizontally or vertically.

If you're repairing or adding to an existing copper piping system, remember that all parts to be joined first must be completely dry. After the soldering is done and the joint cooled to room temperature, test the work for possible leaks.

Equipment needed

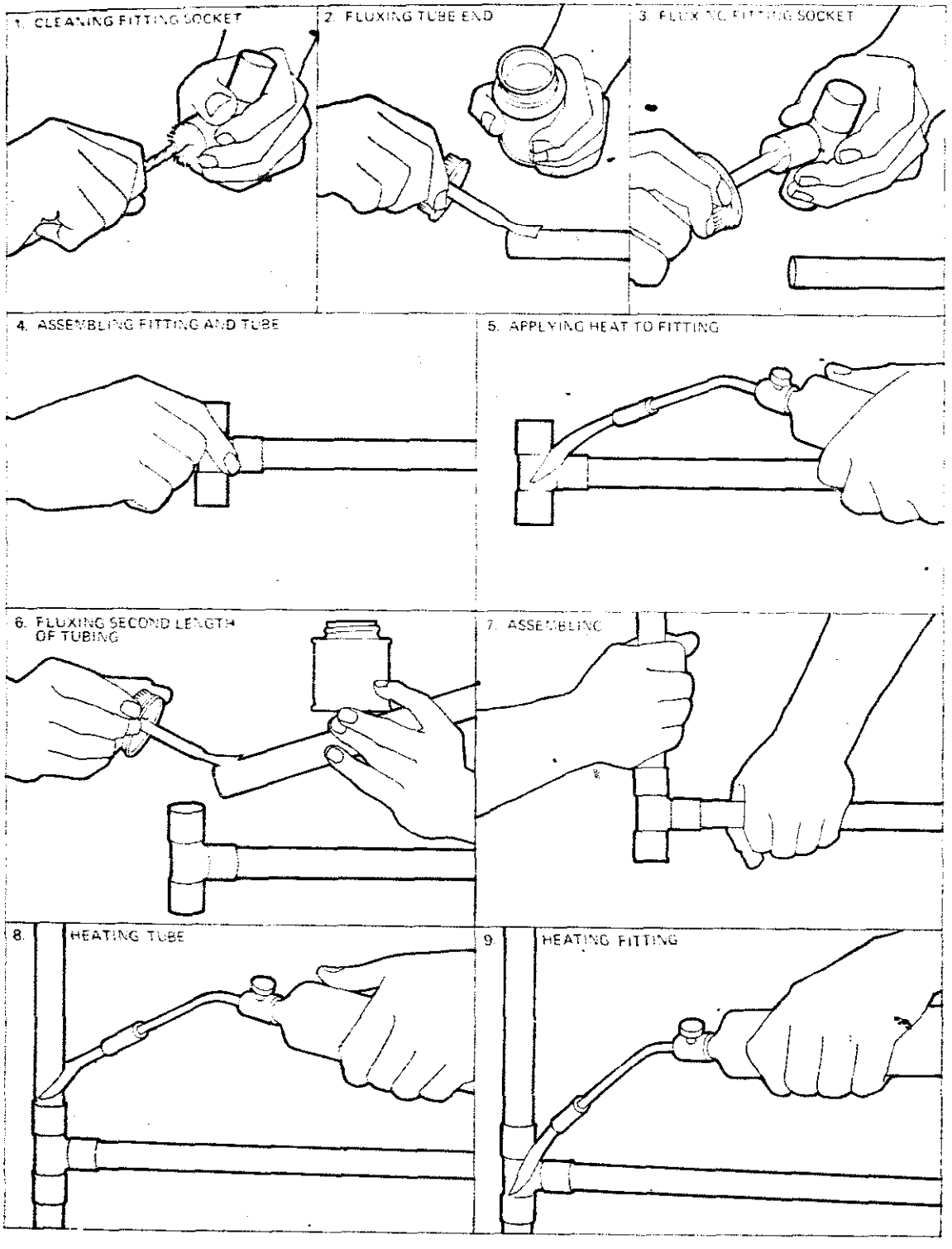
Propane torch
Hacksaw
Smooth file
Tubing bender (also known as a "hickey")
Tubing cutter with reamer
Sandpaper or fine steel wool
Solder
Flux

Cutting and cleaning

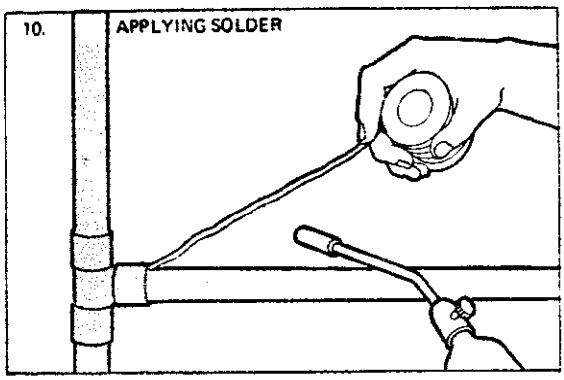


Cut pipe to length using a tubing-cutter (1) or a fine hacksaw blade. Make sure the cut is square and the pipe remains round and true. Cutting with a hacksaw blade leaves rough edges on the inside and outside of the pipe, while a tubing cutter leaves rough edges on the inside of the pipe. Remove burrs on the outside of the pipe with a smooth file or sandpaper and on inside with a reamer (2) or rattail file. Clean the end of pipe with steel wool or a strip of sandpaper (3).

Ten steps for assembling copper piping



Clean the inside of the fitting with a wire brush. A thorough cleaning is absolutely necessary because a "sweat" joint relies on capillary action and any dirt, grease or surface oxidation on the pipe or the fitting will hinder the joining action. Because the pipe should fit tightly into the fitting, do not remove too much metal when sanding or the capillary space will be enlarged and the joint weakened.



Assembling copper system

After you have thoroughly cleaned the inside of the fitting socket (Step 1, left), apply a thin coat of flux to the end of the pipe (Step 2) and the inside of the fitting (Step 3) with a small, clean brush. Then push the tubing tightly into the fitting (Step 4) and twist the pieces slightly in order to distribute the flux evenly. Wipe off any excess flux that remains and apply heat with a propane torch to the fitting (Step 5).

In the same manner, apply flux to the second length of tubing (Step 6), insert in the fitting (Step 7) and apply a flame to both the tubing (Step 8) and fitting (Step 9). Melt the solder from a spool of soldering wire around the tubing-fitting joint (Step 10, above).

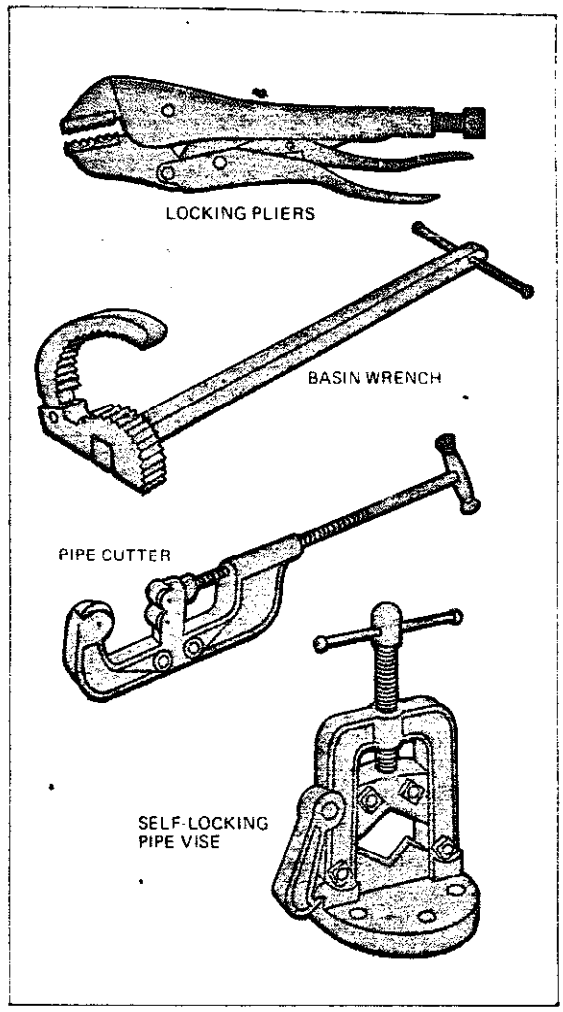
Flux for soldering is mildly corrosive. It contains zinc and ammonium chlorides in a petroleum base, and is used as a protective coating on the metal and as an agent to help the solder flow. Always stir flux before you use it.

The cardinal rule in choosing a solder is to buy a quality solder. Most solders for household plumbing jobs are composed of 50 percent tin and 50 percent lead. If the joint requires a solder of greater strength, use one comprising 95 percent tin and 5 percent antimony.

Do not clean, flux and assemble more copper piping than you can solder in about two hours.

Soldering tips

Remember to align joints with adequate support before soldering, and to place no strain on them. When soldering, use torch with sweeping motion—tubing and fitting should be at same temperature for best flow of solder into joint. If solder forms lumps, joint is not hot enough. If there is no question that the joint is hot enough but solder still does not flow freely, overheating resulting in burned flux is likely, and the joint must be started again from Step 1. As soon as solder has set, use a wet brush or rag to crack and remove flux (remove it from inside of pipes by flushing with water); remove all flux before pressure-testing the joint—if necessary use a wire brush. If you have to redo a joint, reflux the entire joint area before applying heat to unsolder.



Toolbox additions

If you plan on doing most of your own plumbing jobs, the four tools shown above can be valuable additions to your toolbox. The two pictured at the top are available at most hardware stores, while you may have to visit a plumbers' supply house to find the lower two.

Vise-grip pliers, with serrated jaws and locking nut, are especially useful when working with small-diameter pipes. A basin wrench, whose gripping head is adjustable, will save you many bumps and knocks on head and hands when you are installing a basin where there is little room for swinging ordinary wrenches.

A pipe cutter, which is faster and more accurate than a hacksaw when cutting iron or galvanized pipe, is operated simply by starting the cutter over the pipe, and, as it is revolved, tightening the handle gradually to deepen the cut. Thread-cutting oil should be applied to both the cutter and the pipe.

A self-locking pipe vise has V-shaped jaws that grip the pipe from both top and bottom. It eliminates the need for a helper to hold the pipe while you do the cutting. ★★★