

Trade of Plumbing

Module 2: Domestic Hot and Cold Water Service

Unit 4: Spring Bending Copper Pipe

Phase 2

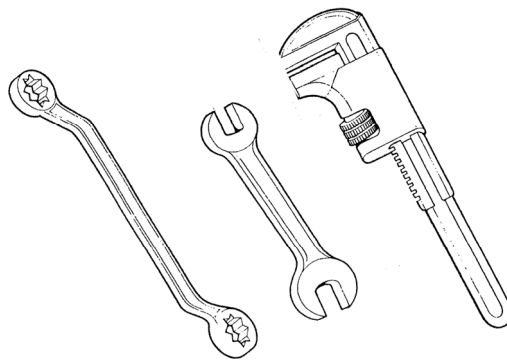


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Document Release History

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June 2006	V.1.0	
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Module 2 – Domestic Hot and Cold Water Service

Unit 4 – Spring Bending Copper Pipe

Duration – 22 Hours

Learning Outcome:

By the end of this unit each apprentice will be able to:

- Form 90° square bends, offset bends and crossovers on copper pipe using bending springs.
- Assemble copper pipe spring bending projects.

Key Learning Points

Sk RK	Identification of bending springs.
Sk Sc	Annealing copper pipe.
H	Use of gas torches.
Sk H	Cooling copper pipe.
M Sk	Manufacture and use of templates.
Sk M	Angles and use of set squares.
M	Calculation of length of heat bend.
Sk	Spring bending 90° bends and double bends.
Sk	Spring bending offsets and crossovers.
Sk	Removing bending springs.
P	Working independently.
Sk	Measurements, tolerances.
Sk	Alignment of bends.
Sk	Interpretation of drawings.
Sk	Preparation of materials list.
P	Planning, communication.
Sk	Assembly of spring bending projects.
Sk	Bracketing and levelling pipework

P	Good working practice.
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Training Resources

- Classroom facilities.
- Workshop facilities, sample bending springs.

Exercise

Construct copper pipe spring bending projects, as in exercise 2.2.4a in the curriculum documents.

Key Learning Points Code

M = Maths **D** = Drawing **RK** = Related Knowledge **Sc** = Science
P = Personal Skills **Sk** = Skill **H** = Hazards

Spring Bending Copper Pipe

The wall of copper tubing is so weak and thin that it must be supported during bending. When using a machine to do the bending the pipe wall is supported externally by both the former and guide. When the pipe is being bent by spring the wall is supported internally.

Copper pipe 19mm diameter and larger must first be annealed before bending by springs. This means the pipe must be heated until it is red and then quenched in water. Copper has the ability to retain its softness after it has been cooled. It is often necessary to heat the pipe several times because it becomes “work-hardened” during the bending process. “Work-hardened” means the copper is returning to its original hardness. Remember never to have the bending spring in the pipe when it is being heated. When bending 13mm pipe to a large radius it is not necessary to heat it, but if the bend radius is less than 10mm heating is recommended.

The best method for applying heat is the oxy-acetylene equipment, but great care must be taken not to melt the pipe. If using LPG (Liquid Petroleum Gas) the quality of heat is less intense and may take longer and have to be applied more frequently.

Before heating the pipe always ensure the spring will go inside it. If a pipe cutter had been used the internal burr must be removed. Many people find it easier and quicker and easier to use a hacksaw for pipe cutting when spring bending.

Always take your time when bending copper by spring. Pull the bend gently – no jerking movement. If any ripples appear they must be tapped out before the spring is removed. Always overpull the bend a little and then return it to the correct angle. This will allow the spring to be removed from the pipe easily. When both putting the spring into the pipe and taking it out, it should be turned in an anti-clockwise direction

To form a spring bend on a copper tube. First mark on the tube the centre of the bend then mark off the beginning and the end of the bend. This distance can be obtained from the formula

$$\frac{\pi D}{4} \quad \text{for} \quad 90^\circ \text{ bends}$$

The total bend area is then annealed by heating to a dull red and then quenching with water. This makes the tube easier to bend. Tubes over 19mm diameter must be annealed.

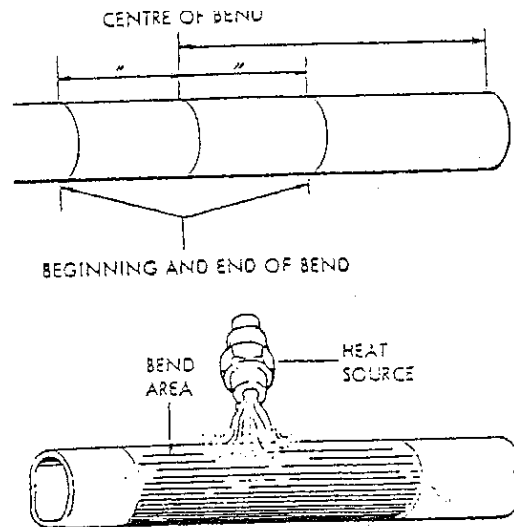


Figure 1. Spring Bending Copper Tube

Select the correct size copper bending spring and insert it into the tube until it overlaps the bend lines. Copper tube bending springs are available in all sizes from 13 to 50mm. The spring may have to be pushed completely into the tube to reach the bend area. To remove the spring a hooked extension rod must be connected to it. Using the centre bend like as a fulcrum point, bend the tube around the knee.

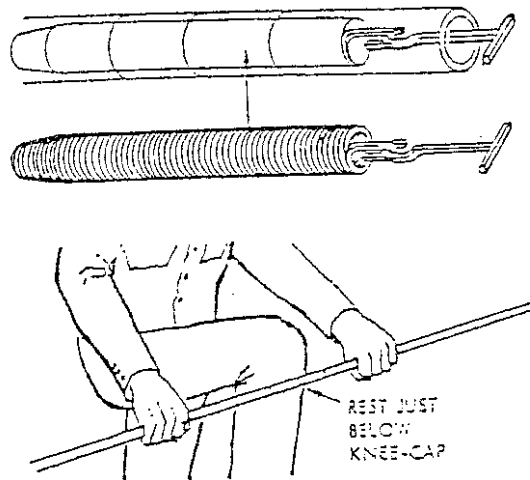


Figure 2. Spring Bending Copper Tube

When using bending springs always overbend slightly then straighten back to the final angle, this makes it easier to remove the bending spring. After bending and checking the final bend angle, remove the bending spring by twisting in the direction of the spiral and pull it free.

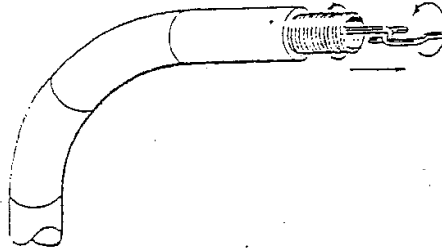
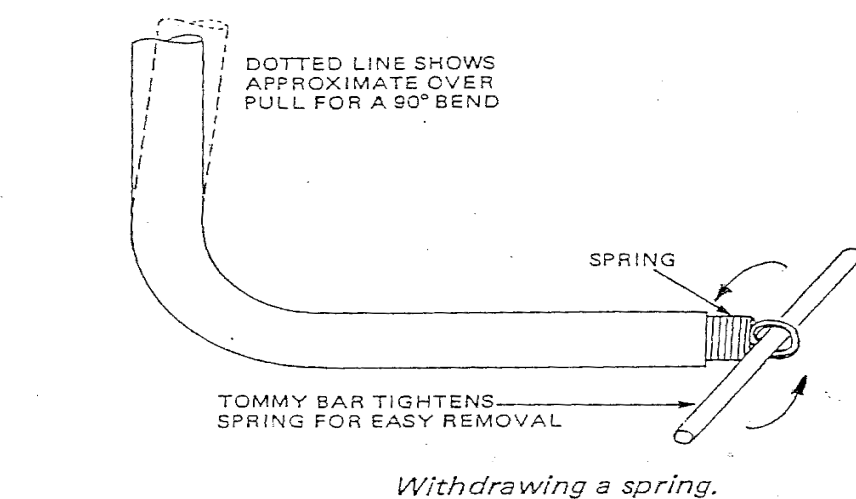
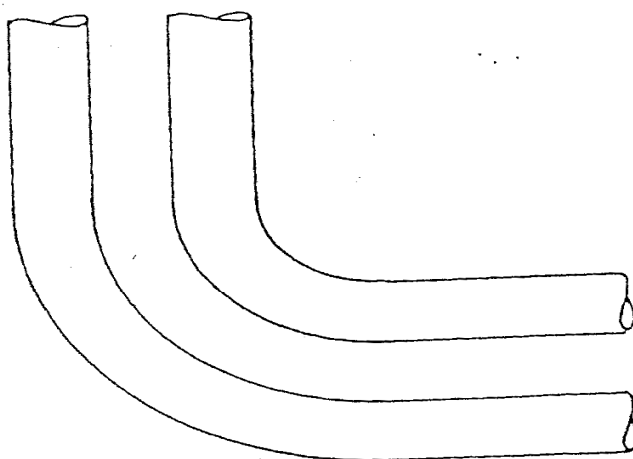


Figure 3. Spring Bending Copper Tube



Completed bend.



THE RADIUS OF EACH BEND IS DIFFERENT, SO THE BENDS ARE SPACED EVENLY APART. IF ONE BEND IS MADE BY MACHINE THE OTHER MUST BE MADE BY HAND SO THAT IT FOLLOWS THE CURVE

Matching bends made by hand.

Figure 4. Pipework Working Progress

Capillary Joint

A joint used extensively on copper and stainless steel tubing; the joint is made by melting solder which fills up into the fitting by *capillary attraction*. There are two types of *capillary attraction*. There are two types of capillary joints, those which are *soft soldered* and those which are *hard soldered*.

If capillary joints are used on mains supply the solder used must be lead free. The method of making a soft soldered joint is to first thoroughly clean the pipe end and internal surface of the fitting with wire wool; emery paper should not be used as this leaves a dirty film on the surface unseen to the human eye.

Once cleaned apply smear of flux to the pipe and joint; then assemble. Now heat up the joint with a blowlamp until solder which is applied melts and runs round and fills the socket. Do not melt on too much solder as it flows into the pipe possibly blocking it, remove the heat and allow the joint to cool. Upon completion flush out the pipeline and clean the external surface of the pipe of excessive flux.

Soft Soldering

Soft soldering is a means of jointing pipe using traditional plumbers solder which is a mixture of tin and lead. A comprehensive range of fittings are available and the solder is usually incorporated into each one in the form of an integral ring. Fitting without this ring of solder are also available but are not as popular as the first type.

Soft Soldering does not require as much heat as silver soldering and a standard butane plumber's blowtorch or blowlamp is used. In fact too much heat is almost as bad as too little where soft soldering is concerned.

Because of the low temperature being used great care must be taken when preparing the joint. Both the outside of the pipe and the inside of the fitting must be thoroughly cleaned with steel wool or emery paper. Flux is then applied to both surfaces and the joint is then pushed together. All parts of the fitting must be prepared and jointed at the same time. Always try and do the lower joint first. When the heat is applied look for a small ring of solder which will appear at the face of the fitting. This is an indication that the solder is melting. Most plumbers like to add a small amount of solder to the joint to make sure the joint is sound. If too much solder is used the excess can be wiped off with a piece of rag or brown paper smeared with a small amount of flux.

Flux is applied to help clean the joint and should never be applied with the fingers or allowed come into contact with the skin as it is very corrosive. It should always be applied with a brush. When soft solder jointing is used in plumbing and heating systems, always ensure the system is flushed out thoroughly to remove any excess or residue flux.

Soft soldering is a lot cheaper than using compression fittings but care must be taken when using this method as leaking joints are quite common.

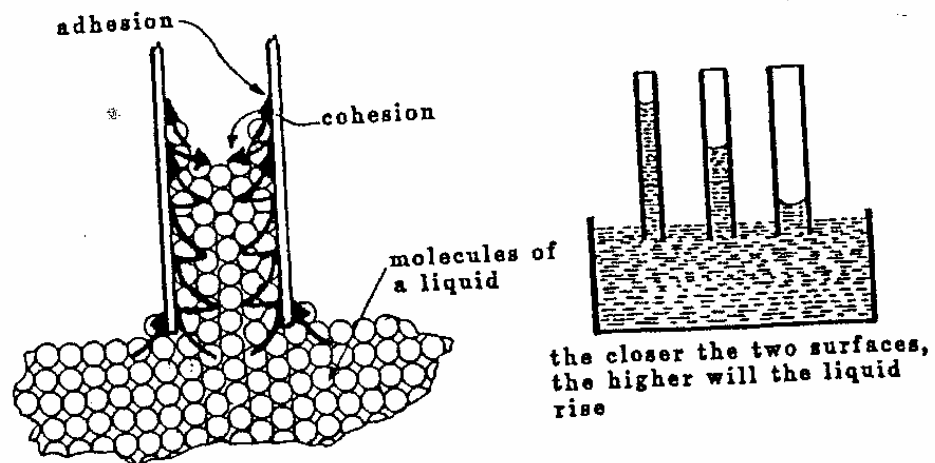


Figure 5. Soft Soldering

Capillary Attraction (Capillarity)

A well known phenomenon, which many people find hard to believe, in which liquids can rise upwards between two surfaces. To demonstrate this phenomenon put a clear drinking straw into a glass of water; if the straw is squeezed together the water will rise even higher.

Capillary attraction is caused by the liquid adhering to the side walls of the straw and then, due to *cohesion* of the water molecules (the need to hold together), pulling itself up to the level of adherence, the water then adheres again to the sides of the straw and again the water pulls itself up to the level of adherence. This process continues until the weight of the water molecules is too great and pulling itself up the level of adhesion proves too much.

Thus it can be stated that capillary attraction is caused by the adhesion and cohesion qualities of liquids. The closer two surfaces are together, the higher the liquid will rise. Also should the surface be greasy or oily liquid will not readily adhere.

Capillary attraction can be put to use in plumbing works, such as with capillary solder joints, hence the need for cleanliness, to get good adhesion. But it can also cause problems and damage such as water passing between the laps in sheet weathering material.

Self Assessment

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