Copper for Refrigeration Pipelines

Copper tube is used on refrigerating systems for the vapour and liquid circulation lines because of its chemical compatibility with refrigerants, (but not ammonia) its total impermeability and ease of jointing, bending and installation. Degreased tube complying with EN 12449 is used, either in soft coiled condition, (for small diameter lines) or half-hard condition in straight lengths. The copper used in tube for refrigerant lines is required to be oxygen-free or de-oxidised. The tube is supplied with its ends fitted with rubber caps to prevent moisture or other contaminants entering and these should be kept in place and used as a temporary seal during installation.

Pipe connections

EN 378 covers the safety and environmental aspects of the design, construction and installation of refrigeration systems. It requires that joints must not be damaged by the freezing of water on the outside. Soft soldered joints are not suitable for refrigeration pipework. Brazing, carried out to EN 14324 using copper-phosphorous (CP) filler metals complying with EN ISO 17672 is the preferred method for making non-detachable joints.

Brazing is necessary to provide strong joints that can withstand the vibration, temperature and thermal cycling stresses imposed. For copper to copper joints, use a low temperature CP brazing alloy. No flux is needed as the vaporised phosphorous will remove the copper oxide film.

Points to note on joint preparation:

- use a wheel cutter rather than a hacksaw, (to prevent swarf entering the tube) and remove internal burrs;
- clean all surfaces with an abrasive plastic scouring pad, (not steel wool as steel particles could enter the tube);
- make sure that the tube is properly supported and inserted to the fitting stop and that joint gaps are not too wide, a good close fit is required;
- purge the air out of the tube before brazing.

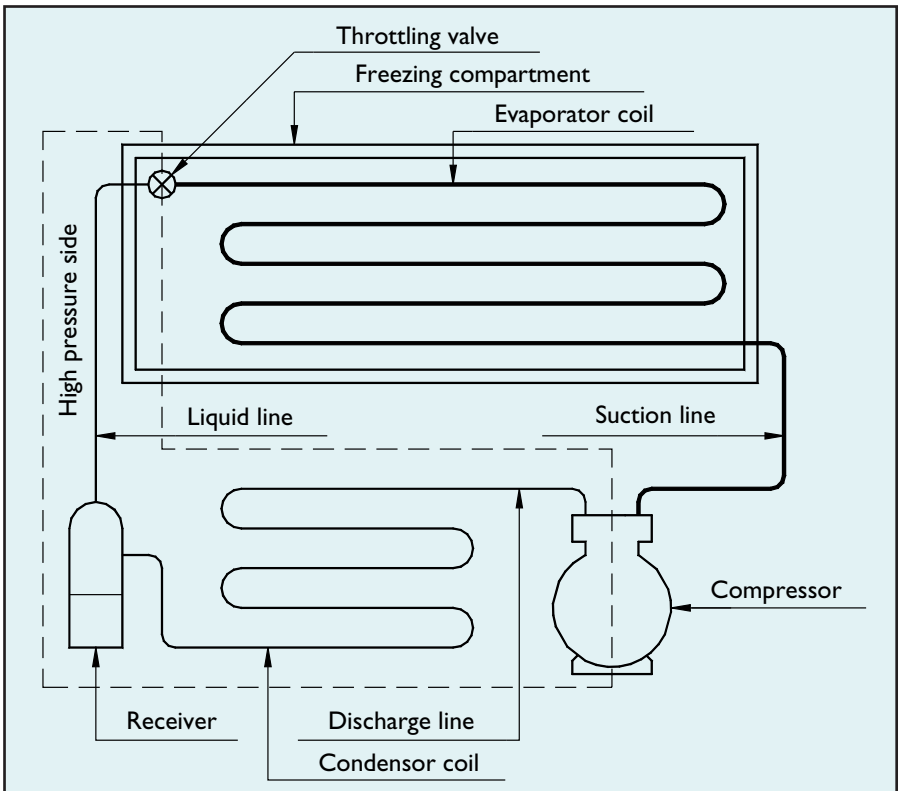


Figure 1

Brazing technique

When brazing it is important to heat the whole joint area evenly, so that the filler alloy melts and fills the capillary gap completely to bond the metal surfaces in the joint. Torches designed to burn LPG with air or oxygen are ideal because they give widespread flame. Where an oxy-acetylene torch is used, care must be taken to prevent localised overheating, so use a relatively large nozzle set to a soft neutral flame. Hold the torch away from the work so that the flame envelope heats the metal evenly keeping the torch moving constantly. This ensures an even heat-up so that when the brazing rod is applied it quickly melts and flows readily to fill the joint. Once the joint is filled remove the flame immediately, do not prolong the jointing operation.

Purging refrigerant pipelines whilst brazing

When heat is applied to copper in the presence of air, oxides form on the surfaces of the tube. Normally this is not harmful, but oxide scale on the inside of refrigerant pipelines can lead to problems once the refrigerant is circulating in the system. Refrigerants have a scouring effect that will lift the scale from the tubing and this can be

carried through the system and help to decompose the compressor lubricating oil and refrigerant - with the result that sludge can form. The formation of oxides when brazing is easily prevented, this is achieved by slowly passing nitrogen through the pipework whilst the heat is being applied.

The procedure can be as follows:

- connect a nitrogen cylinder to one end of the pipework to be jointed using a regulator set to a low pressure, the far end of the pipework to be open to atmosphere;
- turn on the gas and regulate the flow to about 1 to 2 litres per minute, (this flow rate can easily be felt on the back of a moistened hand). The nitrogen should be allowed to flow without building up a pressure in the pipeline. On larger diameter lines a cardboard disk with a small hole punched in it can be fitted into the far end of the line to reduce the volume of gas required;
- continue the flow until the joints have cooled.

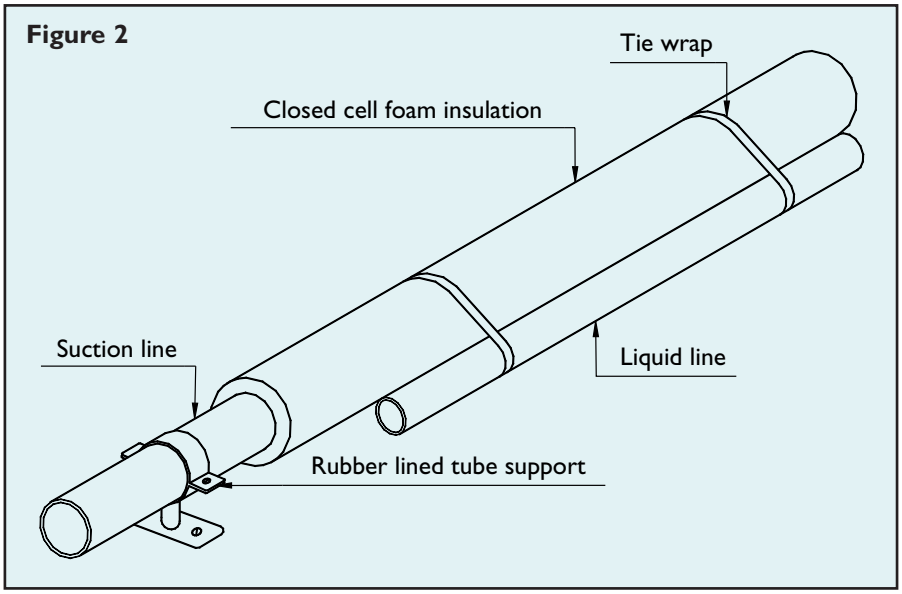
Table 1 Recommended maximum spacing for single copper tube supports

Tube diameter (mm) and condition	Spacing (m)
15 & 22 soft (R220)	1
22 to 54 half-hard (R250)	2
54 to 67 half-hard (R250)	3

Detachable joints

Where detachable joints are used, EN 378 recommends the use of flanges, or non-manipulative compression fittings for tube up to 50mm outside diameter. The Standard suggests that flared, manipulative joints be avoided where reasonably practicable. They are restricted to use on soft condition, annealed tube of a minimum of 9 and a maximum of 19mm outside diameter. Even on tubes in this range they must not be used to connect to expansion valves, (see Figure 1). When tightening any detachable joint make sure that the torque used is correct. It should be sufficient to compress the ring on to the tube to make a leak-proof seal without too much tube deformation.

Figure 2



Screwed joints

The use of other screwed joints is restricted to a maximum of 32mm inside diameter for liquid lines and 40mm inside diameter for vapour lines, PTFE tape can be used to form the seal on the thread.

Tube supports

All tube needs to be adequately supported, preferably using rubber lined clips to prevent noise and vibration transmission. The maximum recommended spacing for single tubes is shown in table 1. Where small diameter liquid lines are strapped to vapour lines, (see Figure 2) consider reducing the spacings for tube supports.

Strength Pressure Testing

Once the refrigeration system installation work is complete EN 378 requires it to be tested for mechanical strength. This can be by means of hydrostatic pressure to between 1 and 1.3 times the system design pressure. Water could be used, but this is not normally desirable and an inert gas such as nitrogen can be employed. Test certificates should be prepared and witnessed by the responsible person.

Note: do not use compressed air as oil/air mixtures are extremely dangerous, there will be oil in the compressor crankcase. Refer to the Health and Safety Guidance Note GS4 Safety in Pressure Testing for more detail if necessary.

Joint Inspection and Leak Pressure Testing

All brazed joints need to be inspected and a leak pressure test has to be carried out using an inert gas to pressurise the system. If the system has only a relatively small number of joints a bubble test on each joint using leak detecting fluid is easy to carry out. If a pressure gauge is used on a large system then sufficient time, (24 hours would not be excessive) must be allowed to enable tiny leaks to show on the gauge.