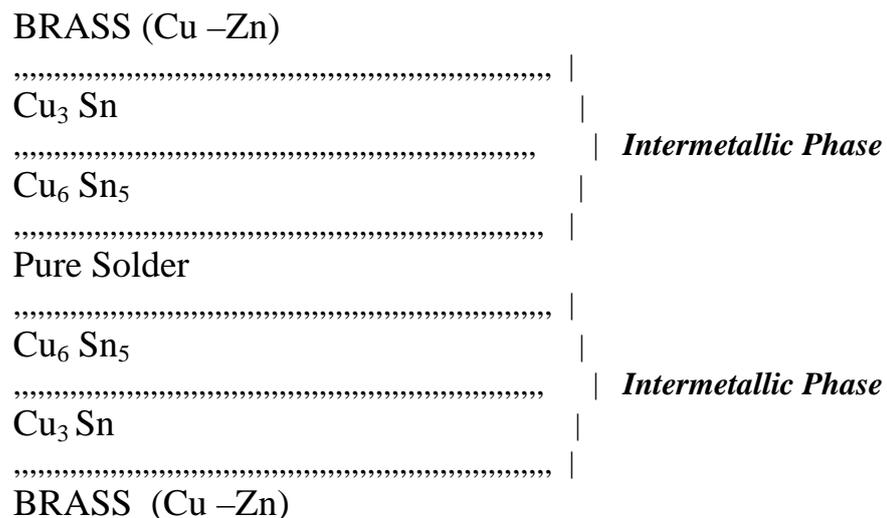


## The Chemistry of Soldering. *Bob Alderman © 2002*

The soldered joint was developed to join items of lead pipework together. Plumbing derives its name for the use of lead (plumbum, chemical symbol Pb) in the architectural context. Lead has long been used for water pipes (the Romans) and roofing including the drain hoppers and down pipes. The rapid expansion of domestic plumbing in the late 19<sup>th</sup> century resulted in improved means of jointing the water pipes. Wiping molten lead onto the joint areas to join and seal them created early joints. These can still be observed in the older toilet where they show as a bulge in the pipes. The addition of tin to strengthen the joint and other alloying materials like bismuth and cadmium to change the melting point and a burgeoning electronics industry has resulted in many specialist solders with properties tuned to particular applications.

When a joint is made the solder alloys on the surface of the metal it is on. This is the physical and chemical attachment of the solder to the metal. In the modelling situation we are generally using brass in one of its several alloy forms. Nickel silver is a brass; there is no silver in it, just a small percentage of nickel in addition to the copper and zinc.

The working part of the joint is the chemical combination of the tin in the solder with the copper in the brass. If a joint is examined under high magnification there are zones of alloys through the joint. The Intermetallic zones are only microns thick. These can be illustrated thus:



Cu = Copper, Sn = Tin, Zn = Zinc

The copper in the brass is used to create a new alloy with the tin in the solder.

It can be seen that there is still a component of the joint that is pure solder. The thinner this can be made will generally mean the stronger the joint is.

How to make the joint:

The basic ingredients are heat and flux. The heat melts the solder and provides the energy to create the chemical bonds. The flux is used to chemically clean the surface and prevent oxidation of the metal to be joined under the heating.

***It is at this point where modellers seem to get in a mess!***