Phase Diagrams

Silver/Copper Phase Diagram

A phase diagram is a graphic representation of the effects of heat on alloys of various proportions. The diagram shown here is for all possible mixtures of silver and copper. Phase diagrams for just about any alloy you can imagine are available in reference books.

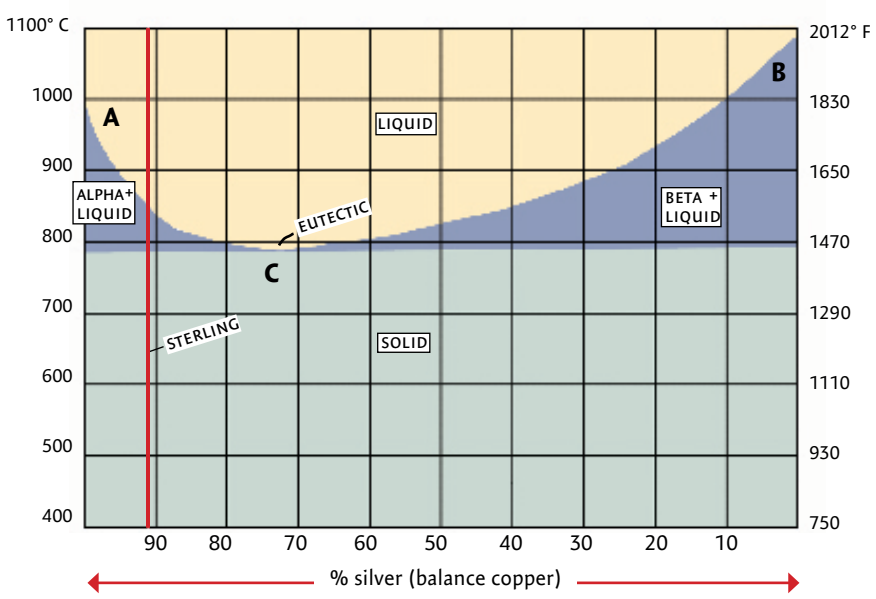

Diagram by Joanne L. Murray; Used with permission.

The left edge represents 100% silver. The point marked **A** indicates its melting point as being 1761° F (960.5° C). The right edge represents 100% copper, whose melting point is shown at **B**. Reading across the graph, the percentage of copper is increased as the silver is decreased. Halfway across is an alloy of equal parts of the two metals. The bottom edge of the graph is the lowest temperature shown, in this case 400° C. Each phase diagram will use different temperature ranges, choosing the range that is pertinent to the alloy being displayed.

To fill in the graph, laboratory tests are made for many alloys, first a mixture of 99 parts silver to 1 part copper, then 98:2, 97:3 and so forth. These tests determine the temperature at which the alloy is no longer solid (the *solidus*) and the temperature at which it is total liquid (the *liquidus*). These are plotted on the graph and yield the freezing curve, shown here as the boundary between yellow and blue regions, dipping down to nothing at the point marked **C** . At this temperature, called the *eutectic*, the metal passes directly from solid to liquid. This tells us that of all possible mixtures of these two metals, a combination of 71.9% silver and 28.1% copper has the lowest freezing point (1438° F, 781° C). Sterling, an alloy of 7.5% copper and 92.5% silver, is indicated on the diagram by the vertical red line near the left edge: the graph shows that its melting point is 1640° F (893° C).

Alloys in the yellow zone at the top of the diagram are totally liquid, in the blue areas they are in a semi-solid or slushy state and in the rest of the diagram, shown here in green, they are completely solid. Alloys that are semi-solid over a wide range of temperatures lend themselves to casting.