Product Data Sheet

MCP 79/Metspec 174 Alloy

UPDATED ON 2012-07

TYPICAL USES

MCP 79 alloy contains neither Lead nor Cadmium and may be preferred to other compositions equally suited to an application on grounds of health and safety, or for environmental reasons.

MCP 79 appears to be a good approximation to a eutectic in the Bismuth-Tin-Indium system and is satisfactory for thermal protection devices designed to yield at ~79^{0}C. Other uses include tube and section bending, proof casting, low temperature soldering and jointing.

PHYSICAL PROPERTIES

MCP 79 appears as a ternary eutectic E_1 in the Bismuth-Tin-Indium system.

In common with all alloys of low melting point , MCP 79 undergoes equilibration after solidification. The equilibration process gives rise to slow dimensional changes, which occur at rates dependant on both the immediate post solidification treatment and the size and shape of the piece. Melting behavior, dependent *inter alia* on the age and thermal history (and thus the degree of equilibration) of the alloy, is only slightly altered after long periods of equilibration.

A diagram of the liquidus surface appears at the bottom of this Technical Information Sheet for MCP 79 alloy.

Characteristic	Typical Value
Density	9.23 g/cm^3
Brinell Hardness	11.5 -12.5
Melting Point	79°C
Specific heat at 25°C	0.169 J/g.°C
Enthalpy of fusion	36.3 J/g
Electrical resistivity	65 mΩ.cm

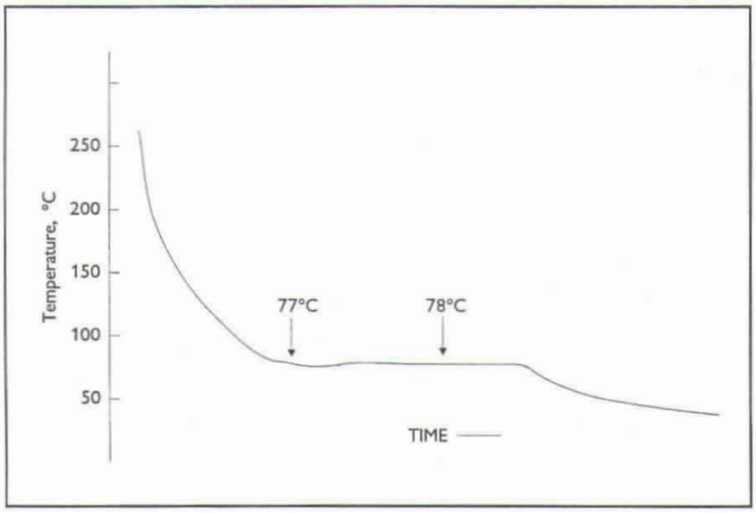

Fig. 1 SOLIDIFICATION

The trace obtained by solidification from a homogeneous melt of a sample of 300g indicates a reasonably precise final arrest at 77-79^{0}C, although this is preceded by slow variation that suggests that the composition is not accurately eutectic.

A short post solidification arrest (not visible on this diagram) at about 75^{0}C is evidence of further reaction in the solid state. This may be compared with the behavior in melting of newly solidified and mature samples (fig.2).

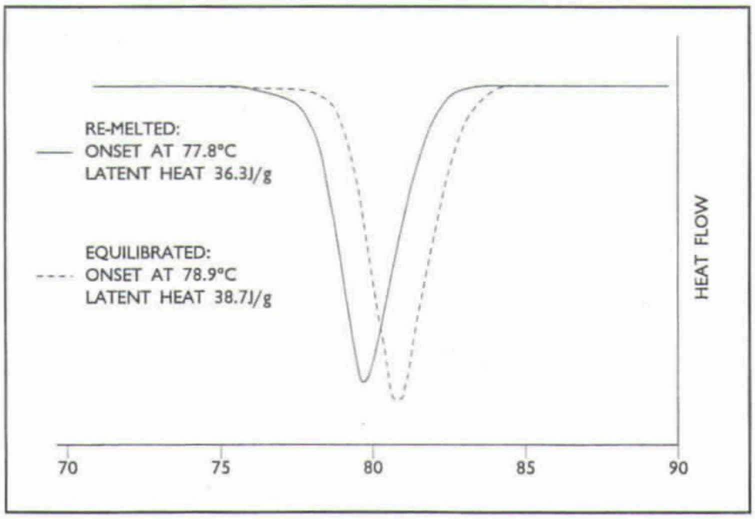

Fig. 2 MELTING

The structural changes that take place after solidification are made apparent by the technique of differential scanning calorimetry (DSC). The behaviour of matured alloy is here compared with that of a newly solidified specimen.

While the curves for these extremes are reproducible, there are differences in melting behaviour between specimens of different ages (or which have had different thermal conditioning). The curve remains stable after the specimen has reached the “equilibrated” condition. The onset temperature for melting, like the latent heat of fusion, is found to have increased in very old specimens. The change by 1^{0}C suggests that mature alloy is needed in thermal protection devices.

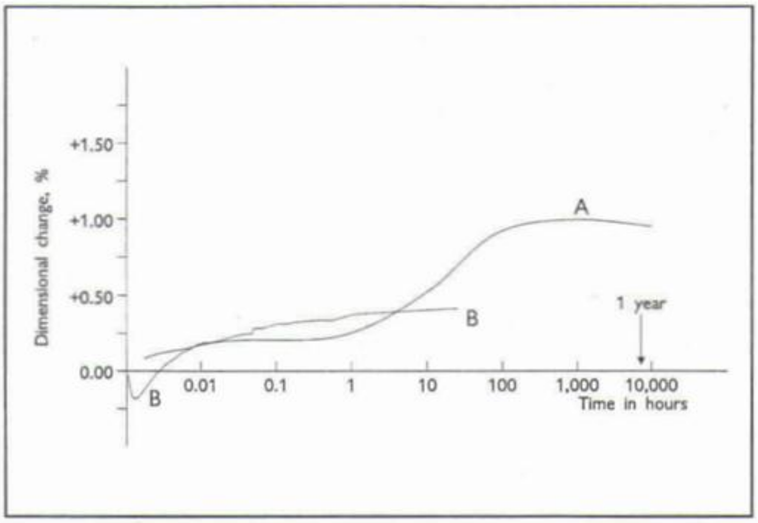

Fig. 3 GROWTH & SHRINKAGE

The linear dimensional changes after casting are sensitive to the size and shape of the specimen, which affect the rate of cooling after solidification and thus, equilibration of the internal structure. Differences are barely apparent after about 12 months, by which time the process of stabilization is virtually complete.

Curve ‘A’ is for a 10mm square bar, 250mm in length, promptly quenched after solidification. Curve “B” is for a much smaller, faster quenched specimen of about 5 x 5 x 2mm.

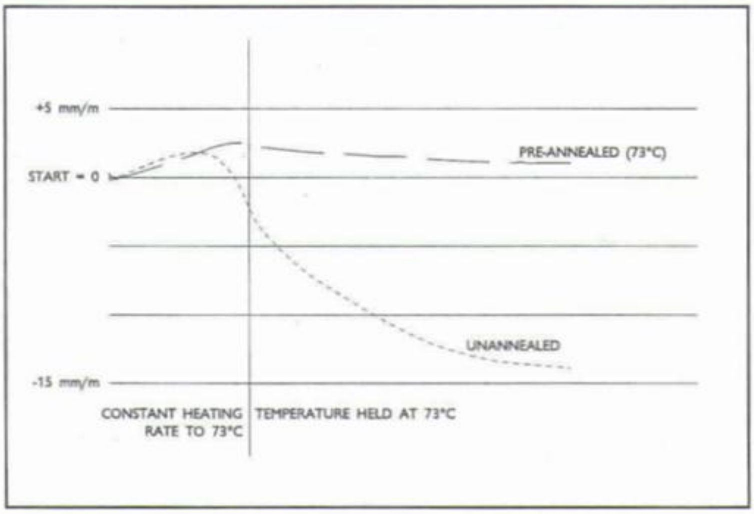

Fig. 4 THERMAL EXPANSION

Thermal expansion is dependent on the extent of equilibrium attained by the specimen.

The lower curve from a test beginning with newly cast and quenched (i.e. unannealed) alloy, shows a fairly steady thermal expansion being eclipsed by the structural changes, which accelerate as the temperature rises; the continuing shrinkage due to the changes can be seen as the temperature is held at 63^{0}C.

The upper curve repeats the measurements on the same specimen, which has by now been annealed during the first test. The structural changes continue, but are now largely complete. The underlying coefficient of thermal expansion is about 40 x 10^{-6}. ^{0}C^{-1} in the range 20 – 63^{0}C.

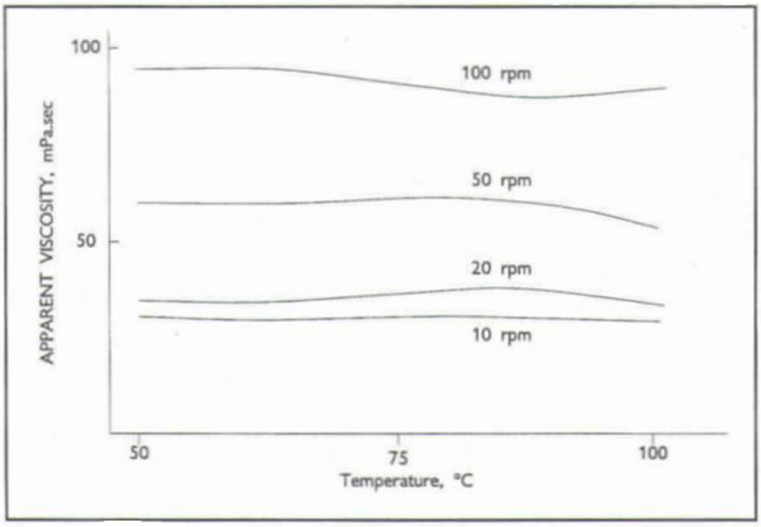

Fig. 5 VISCOSITY

Like that of most fusible alloys, the viscosity of MCP 79 is quite low, at a few mPa.s. High surface tension may cause practical measurements to suggest non-Newtonian behavior.

The values indicated in the diagram were obtained by means of a Brookfield RVT viscometer, using 3 litres of liquid alloy in a cylindrical container with alloy depth being roughly equal to the diameter. The figure illustrates changes apparent under conditions such as might be encountered in practical use. Viscosity is, in fact, so low that it is rarely a serious consideration in designing systems in which large quantities of alloy are circulated.

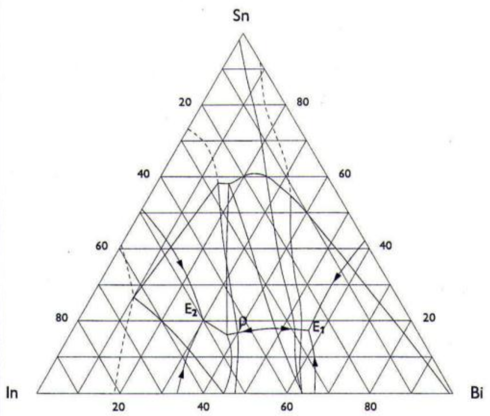

Fig. 4 THE Bi-Sn-In PHASE DIAGRAM
- liquidus surface
- constituents shown as % by weight.

MCP-61 (Bi 32.5, In 51.0, Sn 16.5%) is close to the ternary eutectic E_2.

The composition corresponding to E_1 is supplied as MCP-79 alloy.

STORAGE AND USE

Store products in their original packaging.
Wear protective equipment recommended by the Safety Data Sheet.