Product Data Sheet

MCP 96/Metspec 203 Alloy

UPDATED ON 2012-07

TYPICAL USES

The uses of MCP 96 alloy more often depend on its low melting point than on other properties. It finds application in shielding during medical radiation treatments, in fusible core technology, as an anchoring material and as a support material in the formation of copper pipefittings.

Although not a true eutectic, MCP 96 is satisfactory for thermal protection devices designed to yield at 95^{0}C.

PHYSICAL PROPERTIES

MCP 96 is often known by the trivial name Rose's "A" alloy. Although it is often quoted as the eutectic of the Bismuth-Lead-Tin system, it is difficult to reconcile this with close observation of the liquidus surface (1), which has features suggesting different proportions with a eutectic of temperature of five or six degrees below the 99.5^{0}C most often reported.

In common with all alloys of low melting point, MCP 96 undergoes equilibration after solidification; melting behavior therefore depends on the age and thermal history of the alloy. The equilibration process, which appears extremely complex, gives rise to slow dimensional changes. These occur at rates dependant on the immediate post solidification treatment. Natural cooling is characterized by a sudden recalescence at 55-65^{0}C. Ingots tend to be brittle, breaking with a conchoidal fracture.

Characteristic	Typical Value
Density	9.85 g/cm^3
Brinell Hardness	13.5 -15.5
Melting Point	98°C
Specific heat at 25°C (solid)	0.151 J/g.°C
Specific heat at 120°C (liquid)	0.167 J/g.°C
Enthalpy of fusion	30.9 J/g
Electrical resistivity	71.4 mΩ.cm
Compressive Properties: Proof stress at 2 days and 70 days (0.2% set) (1.0% set)	 18.4 rising to 24.1 MPa 20.8 rising to 29.8 MPa
Tensile Properties: Data at 2 days and 70 days Proof stress 0.2% set Tensile Strength Elongation (% in 5.65√A)	 8.6 rising to 19.0 MPa 20.4 rising to 33.9 MPa 165 falling to 100

[1)] The analytical purity is determined by ICP (Inductively Coupled Plasma)

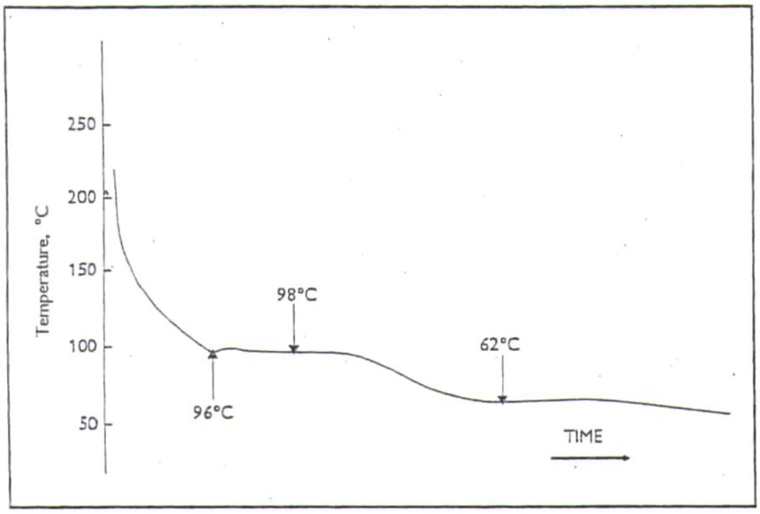

Fig. 1 SOLIDIFICATION

The trace obtained by solidification from a homogeneous melt of a sample of 300g indicates a reasonably precise final arrest at 98^{0}C, which follows a short supercooling.

The post solidification plateau is strong 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).

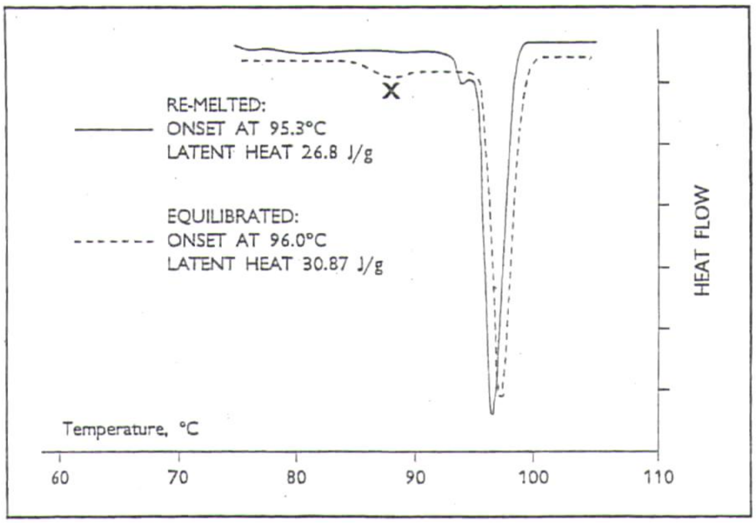

Fig. 2 MELTING

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.

The onset temperature for melting, like the latent heat of fusion, is found to be much altered in very old specimens, suggesting that mature alloy is needed in thermal protection devices. The change indicated at 'X' on the curve for equilibrated alloy occurs in the solid state, before melting.

While the curves for these extremes of treatment are reproducible, there are substantial 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.

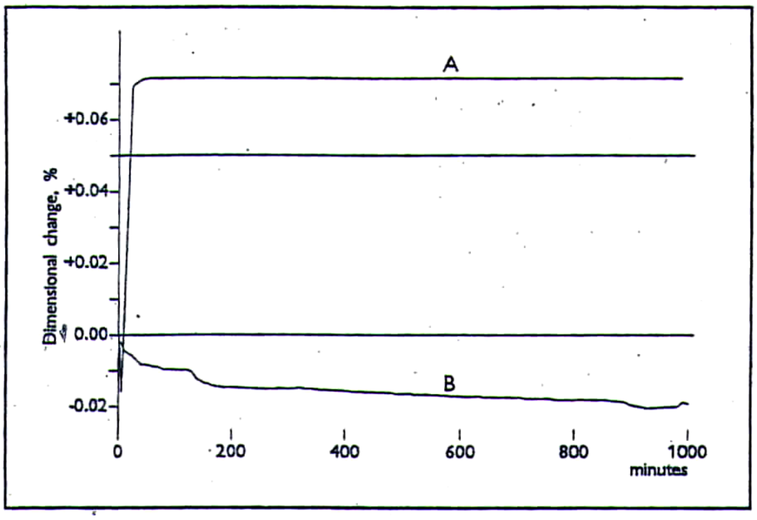

Fig. 3 GROWTH & SHRINKAGE

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 6 months, with growth ceasing at +0.08%. Curve A is for a 10mm square bar, 250mm in length, promptly quenched after solidification. It shows a rapid net shrinkage of 0.016% reversing immediately into growth to a fairly steady value after 24 hours. The lower curve B is for a faster quenched, small specimen of 5 x 5 x 2mm.

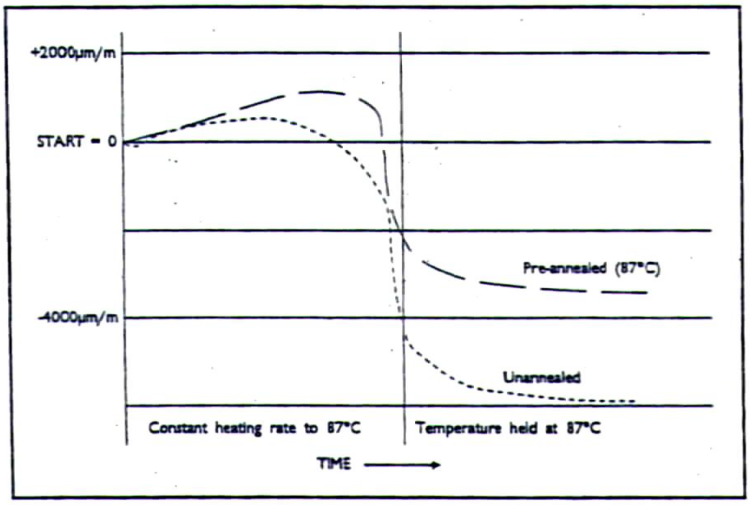

Fig. 4 THERMAL EXPANSION

The structural changes that occur in equilibrating solid alloys influence the thermal expansion. The coefficient of thermal expansion of MCP 96 is constant for almost any specimen only to about 50^0C, the actual value (17 – 25 x 10^{-6}) rising slightly to an extent depending on the degree of equilibration. Above the temperature, structural change predominates over simple thermal expansion and meaningful values cannot be obtained.

5N PLUS

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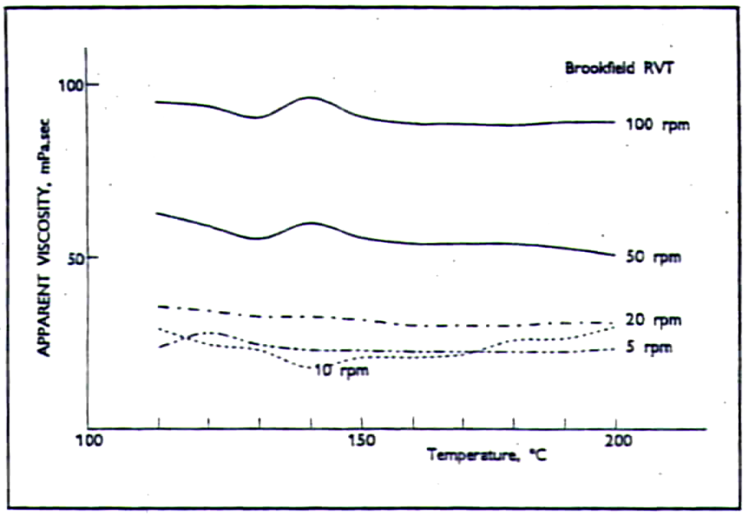


Fig. 5 VISCOSITY

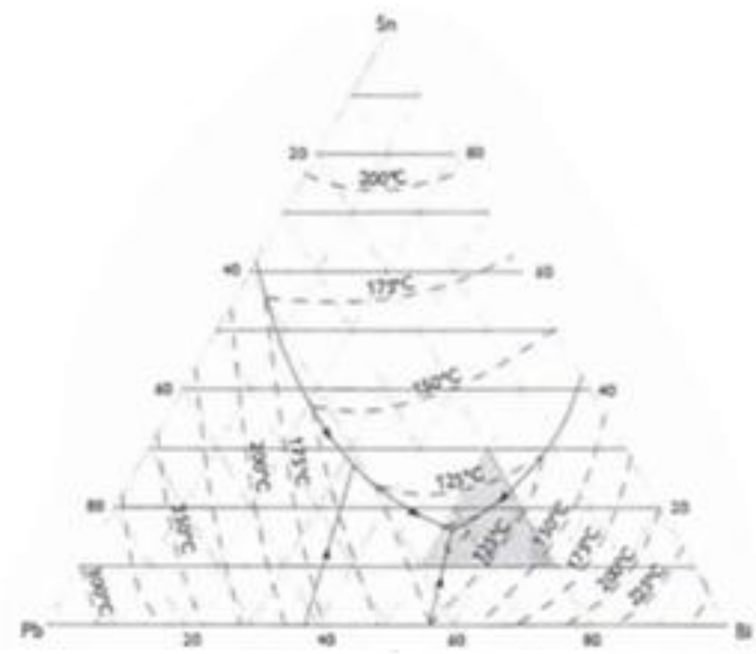
Like that of most fusible alloys, the viscosity of MCP 96 is quite low. Slightly above the melting point (say below 100^{0}C), it is of the order of 1 mPa.s. However, the high surface tension within this range causes practical measurements to suggest non-Newtonian behavior.

The values indicated in the diagram were obtained by means of a Brookfield RVT viscometer using 3 liters 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. 6 THE Bi-Pb-Sn PHASE DIAGRAM

The diagram shows the liquidus surface as proposed by The-Hsuan Ho et al, Z. Metallkunde 1953, 44, 127. MCP 110 (Bi 50, Pb 25, Sn 25%), also known as D'Arcet's alloy, is an arbitrary composition not chosen for any special feature of physical metallurgy.

A single ternary eutectic appears at Bi 52.5, Pb 32.0, Sn 15.5% (99.5^{0}C), a composition long known as Rose's A alloy and offered as MCP 96. Although it is widely reported as such, it is doubtful that this composition is really eutectic; the shaded grey triangle overlies an area of apparent complexity, in which liquidus points as low as 92^{0}C have been observed. The centre of the triangle (Bi 54, Pb 28, Sn 18) is probably close to the true system eutectic.



Constituents shown as % by weight

STORAGE AND USE

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