Properties of Alloys of Multicore® Solder Wires

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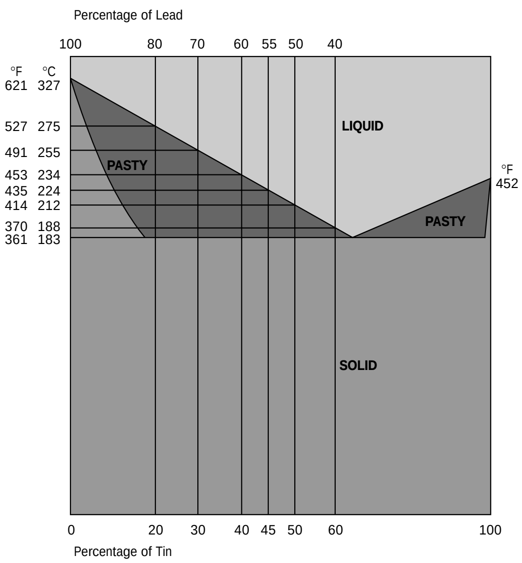
This data sheet lists the most popular solders supplied as flux-cored wire and can be used in addition to the separate Technical Data Sheets for Multicore cored solder wire fluxes.

TIN/LEAD ALLOYS
From the following diagram, it can be seen that most tin/lead solders have a plastic range, i.e. on heating they are pasty between the solid and liquid states. The solders are solid at 183°C (361°F).

According to the alloy composition they have different plastic ranges. 60/40 tin/lead alloy for example becomes liquid at 188°C (370°F) and therefore has a plastic range of 5°C (9°F), 40/60 tin/lead has a plastic range of 51°C (92°F).



For applications such as wave soldering of electronic assemblies, the requirement for a solder with a relatively low melting point in conjunction with a short freezing range leads to the choice of 63/37 or 60/40 Sn/Pb alloy. Although 63/37 is the eutectic alloy, 60/40 is often used in practice as the slightly higher 5°C freezing range of 60/40 is of no practical significance and 60/40 is a little cheaper than 63/37. Under conditions of slow cooling, 60/40 may give duller joints than 63/37 but this is a purely cosmetic effect.

Lowering the tin content increases the pasty range and raises the liquidus temperature whilst of course reducing the cost of the alloy. Wetting properties tend to fall off with the reduced tin content.

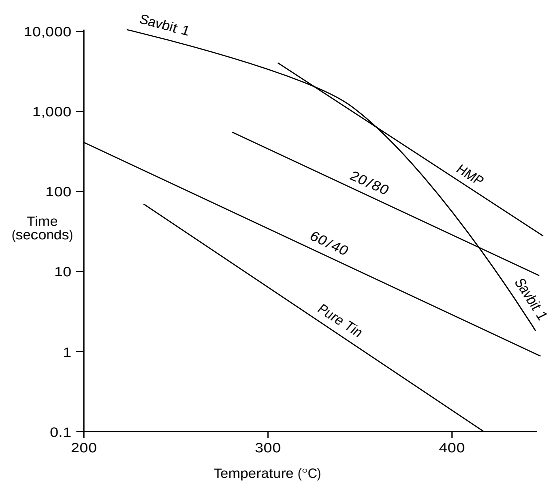
As far as obtaining a low melting point is concerned, there is no advantage in using a higher tin content than 63/37, since the higher tin content alloys have higher melting points and cost more.

MULTICORE SAVBIT ALLOY

- SAVES Copper and Iron-plated Soldering Iron Bits
- SAVES failure of soldered joints as Savbit prevents erosion of copper wires and copper plating
- SAVES costs and improves reliability

Multicore Savbit Solder is produced especially to overcome the problem of ordinary tin/lead solders dissolving copper. It is an alloy to which a precise amount of copper has been added so that no further copper absorption should take place during soldering.

The breakage time of 0.067mm copper wire in various solders as a function of temperature is shown below.



Savbit solder has been used by leading electronics manufacturers throughout the world for over forty years. Savbit was originally used to increase the life of copper soldering iron bits. Soldering speed and efficiency are increased by keeping the iron in good condition. Iron-plated bits having a longer life than plain copper tips are now commonly used but they also fail eventually (usually by cracking of the plating) and then erode rapidly unless Savbit solder is used.

It has also been proved that the use of Savbit alloy can improve the strength and reliability of soldered joints very considerably. This is because ordinary tin/lead alloys can erode thin copper wires (as used for leads of electronic components) and thin copper films (as used on printed circuit boards.) This erosion is between 50 and 100 times slower at normal soldering temperatures when Savbit alloy is used.

HMP SOLDER

The presence of 1.5% silver substantially improves strength and wetting power compared to 5/95 Sn/Pb solder.

Applications

Making nearby soldered joints: A useful application of a high melting point alloy is the soldering of joints close to each other in such a way that the first joint is not re-melted while the later joint, or joints, are being made. The first joint is made with HMP alloy (296-301°C) and the further joints are made with successively lower melting point alloys, for example - 60/40 tin/lead alloy (183-188°C) and good control of soldering temperatures.

Service at high temperatures: The maximum safe service temperature for any solder alloy subjected to stress is about 40°C below the solidus melting temperature, HMP alloy can therefore be relied upon in service up to about 255°C compared with about 145°C for the common tin/lead alloys. HMP alloy is consequently particularly suitable for soldering electric motors, car radiators, high temperature lamps and other products which are likely to meet relatively high temperatures during their working life.

If HMP is used to solder tin/lead coated components, the resulting soldered joint will be a new alloy with a lower melting point than HMP alloy. This will depend on the thickness and composition of the coating. The coating itself could therefore be HMP alloy if necessary.

Service at very low temperatures: Tin/Lead alloys containing more than 20% of tin become brittle at temperatures below about -70°C. The HMP alloy containing 5% of tin remains ductile (non-brittle) down to below -200°C. Multicore HMP alloy is also recommended therefore for service in extremely cold conditions.

Creep strength of HMP alloy: From information supplied, it is clear that an outstanding feature is its very great improvement in resistance to creep by comparison with the tin/lead solders, both at normal and at elevated temperatures. At 150°C for example, a 50/50 tin/lead solder will fail under a load of 0.7 N mm-2 in approximately 10 hours. The following results were obtained with HMP alloy at the same temperature.

Load (N mm-2)	Time to failure
3.4	150 hours
1.7	about 1 year
0.7	no creep

LEAD FREE ALLOYS

Lead-free soldering is now EU law. The WEEE and RoHS Directives were published by the EC in 2003 for implementation by July 2006. All EU countries will have, with few exempted electronics applications, to comply with the elimination of lead in their production.

Multicore 96SC (SAC387) and 97SC (SAC305): Since Multicore 96SC and 97SC are the universally accepted lead-free alloys for SMT reflow, it is obvious that 96SC/97SC alloys ensure perfect compatibility when re-working SMT assemblies originally soldered with these alloys. These alloys perform the closest to traditional Sn/Pb alloys.

Multicore 99C: This is the standard lead-free alloy for hand soldering and rework: Due to the fact that temperature dynamics of rework can be less controlled than reflow processes, it is safe to use 99C alloy for all lead-free hand soldering and rework applications. There is a considerable cost advantage also. 99C has superior wetting and capillary filling characteristics and is also used for plumbing applications.

Multicore 96S: This alloy is the pure tin/silver eutectic alloy; like pure tin, it is bright, hardly tarnishes, is lead-free and non-toxic, but unlike pure tin it is relatively strong.

It has higher electrical conductivity than other soft solders and a melting point approximately 40°C higher than either 60/40, 63/37 or LMP alloys. For one or more of these reasons it finds uses, despite its higher cost, in the form of Multicore Solder Wire usually in Electronics applications. The alloy itself is however used more extensively for non-electrical applications in the form of Multicore ARAX Acid-cored Solder, particularly for soldering stainless steel.

96S has better wetting power on stainless steel than other solders. Note the silver in 96S does not suppress absorption of silver from silver plated surfaces or metallisations into the solder, so 96S is not suitable for soldering to such surfaces.

95A - Lead-free high temperature solder: 95A is a high melting point solder suitable for general purpose soldering where a lead-free alloy is require

Sn62 SOLDERS

Applications

Soldering silver-plated surfaces: The presence of the 2% silver in Sn62 alloys suppresses absorption of silver from silver-plated surfaces into the solder. A good joint is thus obtained. If an ordinary tin/lead alloy is used on silver-plated surfaces, the silver can be lifted from the surface and dissolved into the solder so that a good joint is unlikely. The attachment of terminations in the manufacture of silver ceramic capacitors is a typical application.

NOMINAL COMPOSITIONS AND SPECIFICATIONS OF STANDARD MULTICORE ALLOYS

Alloy	Tin	Lead	Antimony	Copper	Silver	Melting Point/Range	
Sn63, 63/37 & 63EN	63	37	-	-	-	183	standard electronics rework
Sn60, 60/40 & 60EN	60	40	-	-	-	183-188	standard electronics rework
50/50 & 50EN	50	50	-	-	-	183-212	electrical/industrial soldering
45/55 & 45EN	45	55	-	-	-	183-224	electrical/industrial soldering
40/60 & 40EN	40	60	-	-	-	183-234	electrical/industrial soldering
30/70 & 30EN	30	70	-	-	-	183-255	electrical/industrial soldering
20/80 & 31D	20	80	-	-	-	183-275	electrical/industrial soldering
15/85 & 4D	15	85	-	-	-	227-288	electrical/industrial soldering
45D	18	80	-	-	2	178-270	Aluminium soldering
95A	95	-	5	-	-	236-243	high temp. lead free alloy
96S & Sn96	96.3	-	-	-	3.7	221	possible lead free option
96SC (SAC387)	95.5	-	-	0.7	3.8	217	common lead free alloy
97SC (SAC305)	96.5	-	-	0.5	3	217	common lead free alloy
97Cu3	97	-	-	3	-	230-250	high temp. lead free alloy
99C	99.3	-	-	0.7	-	227	common lead free alloy
HMP	5	93.5	-	-	1.5	296-301	high temp. standard alloy
Savbit1	50	48.5	-	1.5	-	183-215	thin copper wire soldering
Savbit6	60	38	-	2	-	183-190	thin copper wire soldering
Sn62 or LMP	62	36	-	-	2	179	low melting point alloy

Note: All alloys comply with EN 29453 and J-STD-006 or BS219 as appropriate
Other alloys can be made available subject to demand

TENSILE STRENGTHS, DENSITY AND ELECTRICAL CONDUCTIVITY

Alloy	Ultimate Tensile Strength		Density	Electrical conductivity (% IACS)
	(N mm-2)	(tons in-2)	(g cc-1)	
Sn63	67	4.3	8.4	11.9
Sn60, 60/40, 60EN	48	3.1	8.5	11.5
50EN	47	3.1	8.9	10.9
45EN	47	3.1	9.1	10.5
40EN	47	3.1	9.3	10.1
30EN	49	3.2	9.7	9.3
20/80	51	3.3	10.0	8.7
15/85	49	3.2	10.2	8.5
95A	31	2.0	7.2	10.8
96SC/97SC	48	3.1	7.5	13
96S	54	3.5	7.5	13.9
HMP	36	2.3	11.1	8.0
Sav1	55	3.5	8.9	10.9
Sn50	45	2.9	8.9	10.9
Sn62	90	5.9	8.5	11.5

The UTS listed above refers to the bulk solder. The values give a guide to the relative strengths at room temperature of identical joints made with different solder alloys, but should not be used to calculate absolute joint strengths, which depend primarily on the conditions of test; thanks are due to the International Tin Research Institute for their co-operation in arriving at values all determined under the same conditions, viz specimens freshly cast at 50°C above liquidus, unmachined, tested at 20°C at 1/16in. per minute strain rate. 1N mm-2 = 145 psi = 0.102 kg mm-2 = 0.065 tons in-2.

GENERAL INFORMATION
For safe handling information of this product, consult the Material Safety Data Sheet, (MSDS).

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