

Solderability of Lead Free Electrodeposits

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Introduction

Recent legislative efforts and customer requests have driven the need for development of lead free electrodeposits for electronic connectors. This report reviews solderability experiments performed on these new coatings.

Pure tin has been used as a solderable electrodeposit for more than 50 years. Tyco Electronics currently sells thousands of products that are pure tin plated, many off those for solderable applications. About 15 years ago, the MLCC (multilayer chip capacitor) industry introduced pure tin coatings for the solderable end caps of these products. Several billion of these products are successfully soldered in tin/lead solder processes each year.¹

The pure tin deposits now in use by Tyco Electronics are fully backward compatible with tin/lead solder processes. This report provides some support for that position. The pure tin coatings are also fully forward compatible with future lead free solder processes.² Experiments reported on here use a tin-silver-copper lead free solder, however the results are more broadly applicable to most tin based lead free solders.

Test Method

A variety of testing has been performed to look at solderability of these coatings. Table 1 summarizes the testing reported in this document.

Table 1. Summary of solderability test methods used for lead free contacts.

Test	Method or standard	Comments
Dip and look	IPC/JEDEC J-STD-002A	Tin/Lead solder – solder pot temperature = 240 C
Dip and look	IPC/JEDEC J-STD-002A	Tin/Silver/Copper solder – solder pot temperature = 260 C
Resistance to dissolution of metallization	IPC/JEDEC J-STD-002A	Tin/Lead solder – solder pot temperature = 260 C
Resistance to dissolution of metallization	IPC/JEDEC J-STD-002A	Tin/Silver/Copper solder – solder pot temperature = 280 C

Test Method: Dip and Look

Samples for these tests were evaluated in three conditions: as plated, after 8 hour steam age and after 16 hour heat age (155 C). We tested at least 10 samples in each condition. The flux used was Kester 145, which is a 25% solids non-activated rosin flux.

Test Method: Resistance to Dissolution of Metallization

¹ Brusse, J., Proceedings AESF SUR/FIN 2002, June 24-27, pp 45-58.

² Garner, C.M., et al, 2000 Electronics Packaging technology Conference, IEEE, pp 6-9.

Samples for these tests were evaluated in three conditions: as plated, after 8 hour steam age and after 16 hour heat age (155 C). We tested at least 10 samples in each condition. The flux used was Kester 145, which is a 25% solids non-activated rosin flux.

Materials and Samples

All samples examined in this work use pure tin as the lead free electrodeposit. Details of the coatings thickness, substrates and parts are provided below.

These studies were performed on Tyco Electronics product 2mm, HM, part number 646333-1. This product uses a phosphor bronze (C51100) substrate, which has been plated with 3 microns of lead free matte tin onto the non-press-fit portion of the contact. No nickel barrier was present for these samples. Two solders were used for this portion: eutectic tin/lead solder and SAC405.

Results:

The results for dip and look solderability testing are provided below in Tables 4 and 5. The test methodology for dip and look solderability testing has not yet been adopted as an industry test method. This is primarily due to differences in opinion about what the solder pot temperature should be and the inspection criteria for lead free solder. Lead free solders do not generate bright and lustrous solder joints the way tin/lead solder does. As a result, the inspection criteria used for lead free dip and look tests was 95% coverage only.

The products soldered well in all conditions. The tables below show the product test results, then beneath each row is a micrograph of the solder dipped parts. The centerline spacing of the contacts on the strip is 2mm with a gap of 1.54 mm between contacts. In some cases, the narrow gap between the contacts creates solder bridging between contacts. This is visible in some of the micrographs.

The testing here is on samplings from manufacturing processes. Provided in Annex 1 is a history of lead free production solderability testing from six of our plating lines. The testing was performed in accordance to IPC/JEDED J002A dip and look using as plated and heat aged samples. All samples have passed the solderability requirements.

Table 4. Results of dip and look solderability testing for tin/lead solder.

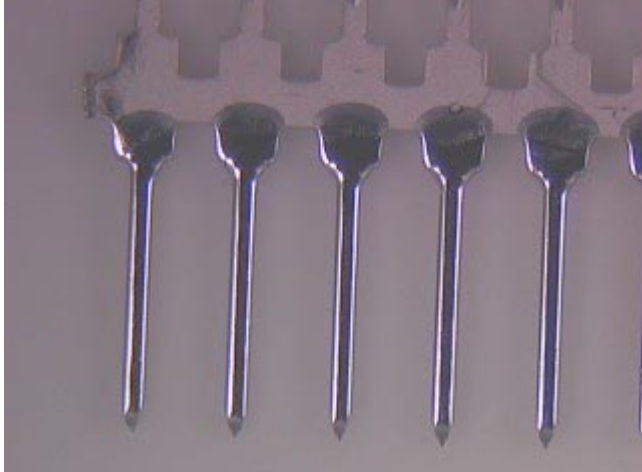
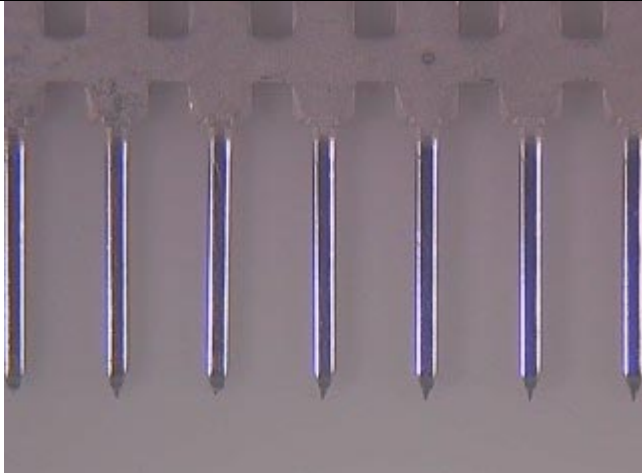
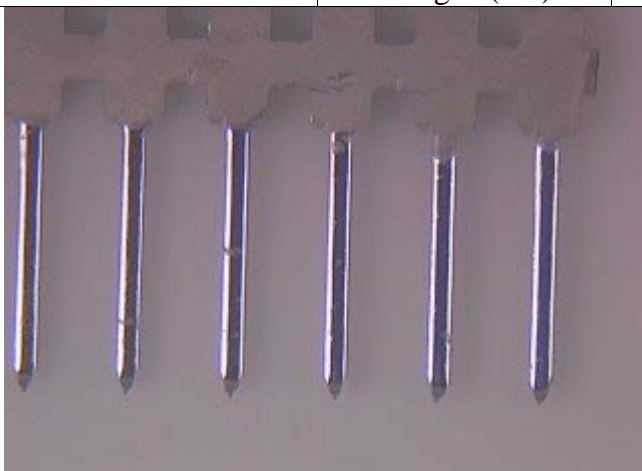
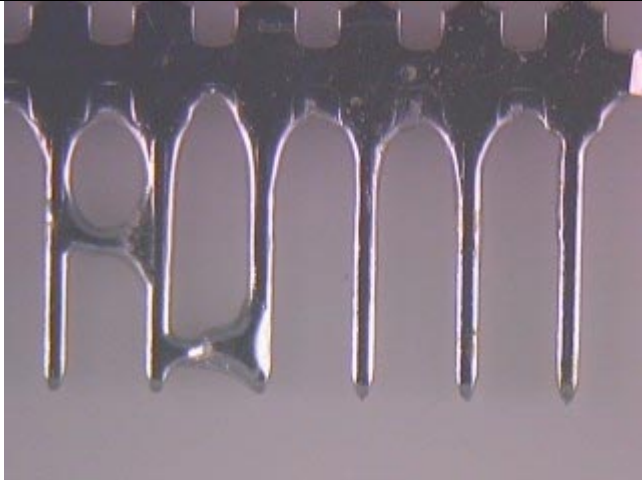
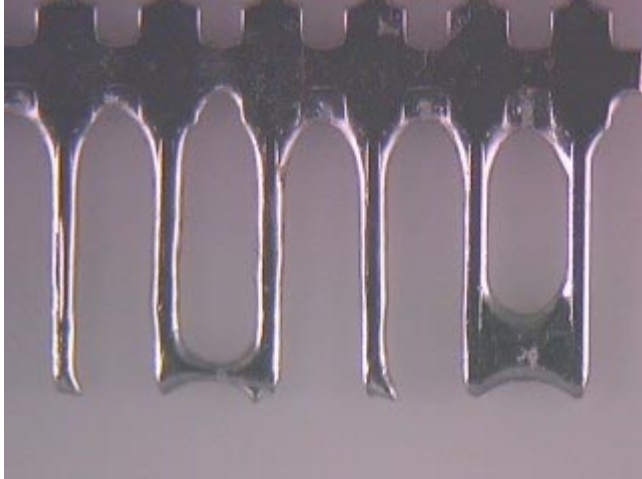
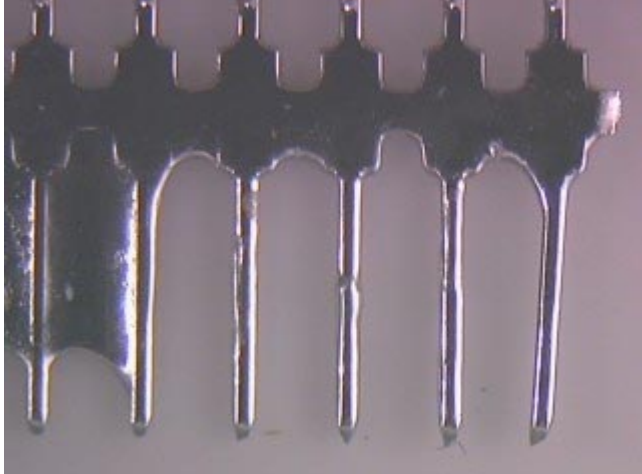
Coating	Conditioning	Solder	Results
Matte Tin	As plated	Tin/lead	Pass (10/10)
			
Matte Tin	Heat aged	Tin/Lead	Pass (10/10)
			
Matte Tin	Steam aged (8hr)	Tin/Lead	Pass (10/10)
			

Table 5. Results of dip and look solderability testing for lead free solders.

Coating	Conditioning	Solder	Results
Matte Tin	As plated	SAC405	Pass (10/10)
			
Matte Tin	Heat aged	SAC405	Pass (10/10)
			
Matte Tin	Steam aged (8hr)	SAC405	Pass (10/10)
			

Resistance to dissolution of metallization:

The results for resistance to dissolution of metallization testing are provided below in Tables 6 and 7. Similar to the dip and look test method, the inspection criteria used for lead free dip and tests was 95% coverage only.

Table 6. Results of resistance to dissolution of metallization testing for tin/lead solder.

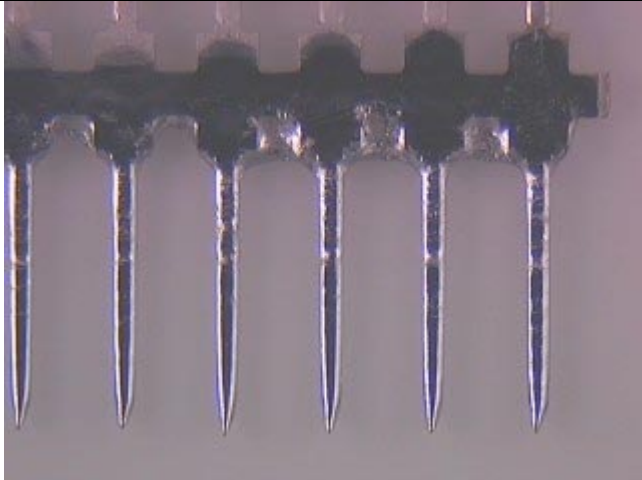
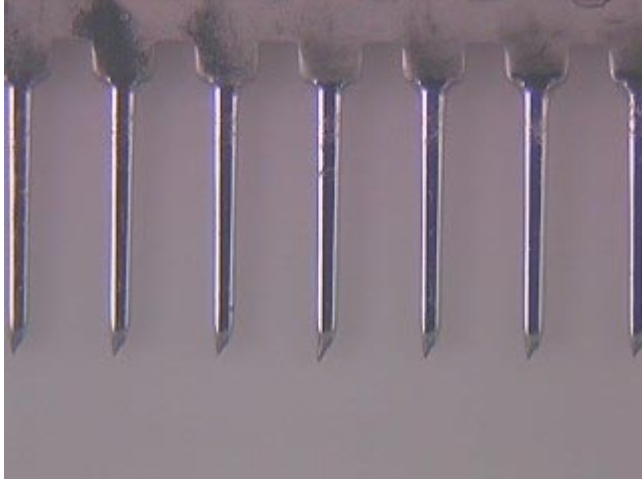
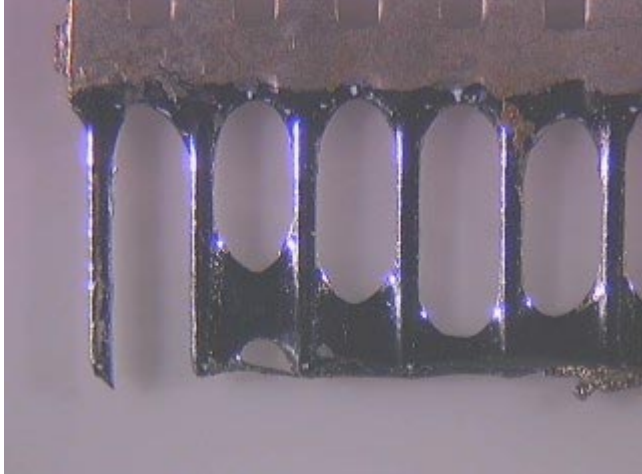
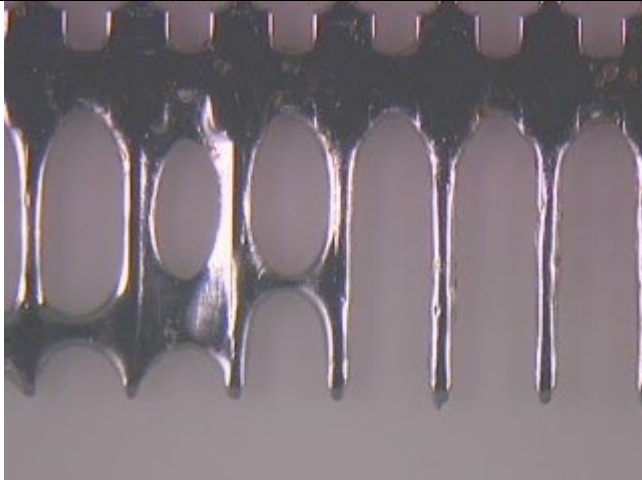
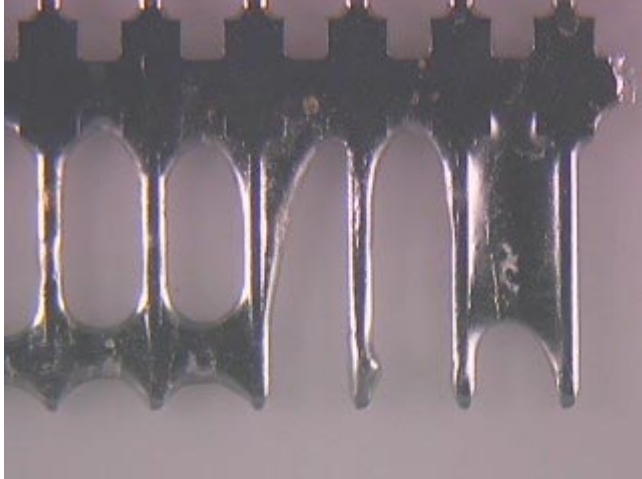
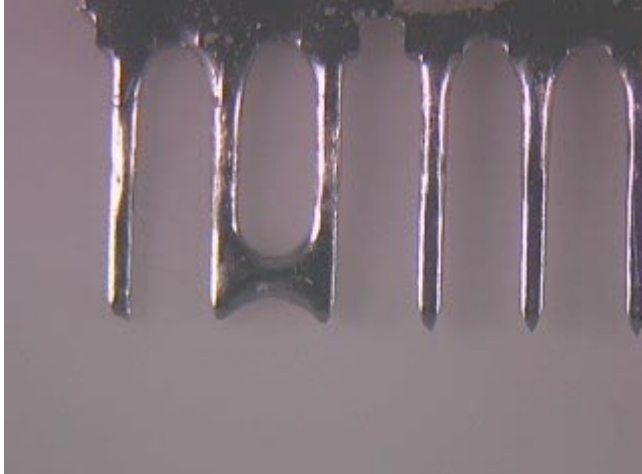
Coating	Conditioning	Solder	Results
Matte Tin	As plated	Tin/lead	Pass (10/10)
			
Matte Tin	Heat aged	Tin/Lead	Pass (10/10)
			
Matte Tin	Steam aged (8hr)	Tin/Lead	Pass (10/10)
			

Table 7. Results of resistance to dissolution of metallization testing for lead free solders.

Coating	Conditioning	Solder	Results
Matte Tin	As plated	SAC405	Pass (10/10)
			
Matte Tin	Heat aged	SAC405	Pass (10/10)
			
Matte Tin	Steam aged (8hr)	SAC405	Pass (10/10)
			

Conclusions:

- 1) Pure tin plated components show excellent solderability.
- 2) All parts passed the solderability and resistance to dissolution of metallization tests for both tin-lead solder and tin-silver-copper solder.

- 3) Tin plating solderability is both backwards compatible to tin/lead solder processes and forwards compatible with tin-silver-copper solder processes.
- 4) Additional information on solderability can be obtained from our website at:
<http://www.tycoelectronics.com/leadfree>

Appendix 1. Table of solderability history from lead free production on 6 plating lines. Tests performed as per IPC/JEDEC J STD 002A in the as plated condition and after heat aging (16 hr at 155 C). Line = plating line; Prod Date = date of production; PN-Nr = part number; Fo-Nr = Factory order number; Reel/Nr = Reel number within the factory order; Base Material = base metal using ISO designations; underlayer = nil or nickel barrier; um = thickness of nickel of final plating layer as appropriate; Plating = final plating layer, which is matte tin for all of these tests; Solder test without aging = percent coverage after dip and look test; Solder test with aging 16h/155 C = percent coverage after heat age and dip and look test.

Line	Prod.date	PN-Nr	Fo-Nr.	Reel/ Nr	Base Material	Under- layer	µm	Plating	µm	Solder Test without aging	Solder Test with aging 16h/155°C
903	2/18/2003	0-0338750-2	465215	L 2 A	CuSn4	----		Sn matt	4,2µm	99%	99%
906	2/18/2003	5-0927949-2	463685	L 3 A	CuSn6	Ni	1,9µm	Sn matt	4,0µm	100%	99%
906	2/18/2003	5-0928838-3	462224	L 1 A	CuSn6	Ni	1,7µm	Sn matt	3,9µm	100%	100%
906	2/18/2003	5-0928865-9	462862	L 3 A	CuSn6	Ni	1,4µm	Sn matt	4,4µm	99%	98%
906	2/18/2003	5-0928865-9	462862	L 2 A	CuSn6	Ni	1,8µm	Sn matt	4,3µm	100%	99%
903	2/19/2003	0-0215461-2	465224	L 2 A	CuSn4	----		Sn matt	5,0µm	100%	100%
903	2/19/2003	0-0215461-2	465225	L 5 A	CuSn4	----		Sn matt	5,0µm	99%	99%
906	2/19/2003	5-0928838-1	458355	L 1 A	CuSn6	Ni	1,8µm	Sn matt	4,4µm	100%	100%
906	2/19/2003	5-0928838-1	458355	L 1 E	CuSn6	Ni	1,6µm	Sn matt	4,0µm	99%	99%
906	2/19/2003	8-0965981-7	458575	L 1 E	CuFe2	Ni	1,9µm	Sn matt	3,6µm	99%	99%
904	2/20/2003	1-0964159-4	469461	R 3 A	CuSn4	----		Sn matt	7,9µm	100%	100%
906	2/20/2003	1-1452090-3	444626	L 1 A	CuSn0,15	Ni	1,7µm	Sn matt	4,0µm	99%	99%
906	2/21/2003	1-1452090-2	444624	L 4 A	CuSn0,15	Ni	1,5µm	Sn matt	4,0µm	98%	98%
906	2/22/2003	1-1452090-1	444623	L 1 A	CuSn0,15	Ni	1,6µm	Sn matt	3,9µm	99%	99%
906	2/22/2003	2-0927949-9	475930	R 15A	CuSn6	Ni	1,6µm	Sn matt	3,7µm	100%	100%
###	2/24/2003	0-0962922-2	473479	R 1 A	CuSn4	----		Sn matt	6,2µm	100%	100%
904	2/24/2003	0-1418747-2	477854	R 1 A	CuSn4	----		Sn matt	7,0µm	100%	99%
904	2/24/2003	1-1452089-2	468170	L 2 A	CuSn0,15	----		Sn matt	5,8µm	100%	99%
904	2/24/2003	1-1534047-1	456581	L 1 A	CuSn4	----		Sn matt	5,0µm	99%	96%
904	2/25/2003	1-0965961-3	478956	R 1 A	CuSn6	----		Sn matt	5,9µm	100%	100%
904	2/25/2003	7-0968056-2	477694	R 1 A	CuSn0,15	----		Sn matt	6,5µm	99%	98%
906	2/25/2003	7-0928865-7	459076	L 2 A	CuZn30	Ni	1,7µm	Sn matt	4,3µm	99%	99%
906	2/25/2003	7-928865-7	459076	L 2 M	CuZn30	Ni	1,7µm	Sn matt	4,4µm	100%	98%
904	2/26/2003	0-0969106-3	478850	R 1 A	CuSn4	----		Sn matt	5,4µm	100%	100%
904	2/26/2003	2-1394228-2	473446	R 1 A	CuSn4	----		Sn matt	3,8µm	100%	99%

###	2/26/2003	7-0927989-2	475666	L 2 A	CuZn30	Ni	1,7µm	Sn matt	3,6µm	100%	99%
906	2/26/2003	8-0968455-6	463514	L 1 A	CuFe2	Ni	1,7µm	Sn matt	3,9µm	100%	100%
904	2/27/2003	0-1394460-2	476270	R 11A	CuSn4	----		Sn matt	5,4µm	100%	99%
###	2/27/2003	0-0969109-2	473152	R 1 A	StahIST2K40	Ni	1,9µm	Sn matt	4,3µm	100%	100%
904	2/28/2003	0-0964040-2	476269	R 2 A	CuSn4	----		Sn matt	3,5µm	100%	100%
903	3/3/2003	0-0215461-2	477646	L 15A	CuSn4	----		Sn matt	5,7µm	99%	98%
904	3/3/2003	1-0962847-3	476273	R 3 A	CuZn30	Ni	1,2µm	Sn matt	7,8µm	100%	100%
904	3/3/2003	1-0968945-2	462138	R 21E	CuZn30	Ni	1,8µm	Sn matt	6,1µm	100%	98%
906	3/3/2003	0-1394281-2	459105	R 38A	X12CrNi177	----		Sn matt	5,4µm	100%	99%
903	3/4/2003	0-0100564-2	465207	L 1 A	CuSn4	----		Sn matt	3,7µm	100%	100%
903	3/4/2003	0-0215461-2	477645	L 3 A	CuSn4	----		Sn matt	6,0µm	100%	100%
904	3/4/2003	1-0965942-4	475202	R 8 A	CuZn30	Ni	1,8µm	Sn matt	5,5µm	100%	100%
904	3/4/2003	1-0965954-4	464774	R 6 A	CuSn4	----		Sn matt	3,9µm	100%	100%
904	3/4/2003	1-0969200-2	480484	R 4 A	CuNiSi	----		Sn matt	6,3µm	100%	99%
903	3/5/2003	0-0100565-2	477625	L 1 A	CuSn4	----		Sn matt	4,4µm	99%	98%
903	3/5/2003	0-0100565-2	477627	L 7 A	CuSn4	----		Sn matt	4,8µm	100%	99%
903	3/6/2003	0-0338750-2	477589	L 1 A	CuSn4	----		Sn matt	5,0µm	98%	99%
903	3/6/2003	0-1377267-1	483904	L 4 A	CuSn4	----		Sn matt	4,7µm	100%	99%
903	3/7/2003	0-0100565-2	477629	L 2 A	CuSn4	----		Sn matt	5,2µm	99%	99%
906	3/7/2003	7-0927989-2	480330	L 6 E	CuZn30	Ni	1,7µm	Sn matt	4,5µm	98%	100%
906	3/8/2003	9-0927949-5	483328	L 3 M	CuSn6	Ni	1,5µm	Sn matt	3,9µm	100%	100%
906	3/9/2003	8-0965981-9	472964	R 13A	CuFe2	Ni	1,6µm	Sn matt	3,4µm	100%	98%
904	3/10/2003	1-0965988-2	480406	L 2 A	CuSn4	----		Sn matt	7,9µm	100%	99%
906	3/10/2003	5-0965981-4	456879	R 11E	CuSn6	Ni	1,6µm	Sn matt	3,7µm	99%	100%
906	3/10/2003	9-0928865-1	459005	L 2 A	CuFe2	Ni	1,8µm	Sn matt	3,4µm	99%	99%
904	3/11/2003	1-0968057-2	480409	R 15A	CuSn0,15	----		Sn matt	4,9µm	99%	95%
906	3/11/2003	1-0966895-2	481635	L116A	CuZn30	----		Sn matt	3,9µm	100%	100%
906	3/11/2003	9-0928865-1	459007	L 2 A	CuFe2	Ni	1,6µm	Sn matt	3,2µm	100%	99%
904	3/12/2003	0-0962922-2	486332	R 1 A	CuSn4	----		Sn matt	8,0µm	99%	98%
904	3/12/2003	0-1534800-2	464706	R 4 E	CuSn4	----		Sn matt	5,7µm	100%	99%
904	3/12/2003	1-0965964-5	477958	R 1 A	CuSn4	----		Sn matt	7,6µm	100%	95%
904	3/12/2003	1-1452051-2	480902	R 1 A	CuSn0,15	----		Sn matt	7,6µm	99%	95%
904	3/12/2003	1-1534049-1	479664	L 1 A	CuSn4	----		Sn matt	5,9µm	100%	96%
903	3/13/2003	0-0100564-2	465208	L 3 A	CuSn4	----		Sn matt	5,8µm	100%	99%
904	3/13/2003	0-0969188-2	486906	R110A	CuSn6	----		Sn matt	5,6µm	100%	100%
903	3/14/2003	0-0215461-2	477647	L 1 A	CuSn4	----		Sn matt	3,6µm	100%	99%
903	3/14/2003	0-0215461-2	477648	L 6 A	CuSn4	----		Sn matt	5,0µm	100%	100%
904	3/14/2003	3-0964160-5	487617	R 1 A	CuSn0,15	----		Sn matt	8,4µm	100%	98%
###	3/14/2003	0-0100565-2	477632	L 5 A	CuSn4	----		Sn matt	5,0µm	99%	99%
903	3/15/2003	0-0188277-2	477609	L 6 A	CuSn4	----		Sn matt	5,5µm	99%	98%
903	3/15/2003	0-0338750-2	488550	L 4 A	CuSn4	----		Sn matt	5,1µm	100%	100%
###	3/15/2003	1-0964160-3	477284	R 1 A	CuSn4	----		Sn matt	7,5µm	100%	100%

904	3/17/2003	0-0969105-3	483073	R 4 A	CuSn4	----		Sn matt	4,7µm	100%	100%
904	3/18/2003	0-0929900-5	478872	R 1 A	CuSn6	----		Sn matt	5,5µm	100%	98%
###	3/18/2003	0-1355187-2	487879	R 1 A	CuSn0,15	----		Sn matt	6,6µm	100%	100%
904	3/18/2003	0-1534688-2	476650	R 4 A	CuFe2	Ni	1,7µm	Sn matt	4,1µm	99%	99%
904	3/18/2003	1-1355187-2	487880	L 3 A	CuSn0,15	----		Sn matt	6,8µm	99%	99%
904	3/19/2003	0-1452231-2	474091	R 1 A	CuZn30	Ni	1,7µm	Sn matt	4,8µm	100%	97%
904	3/19/2003	1-0965942-4	479109	R 7 A	CuZn30	Ni	1,7µm	Sn matt	5,7µm	100%	98%
901	3/20/2003	0-0969108-2	487925	R 6 A	CuZn30	Ni	1,7µm	Sn matt	3,8µm	99%	98%
904	3/20/2003	0-1418748-2	485823	R 1 E	CuSn4	Ni	1,5µm	Sn matt	4,5µm	100%	98%
904	3/20/2003	0-1418749-2	489289	R 1 A	CuSn4	Ni	1,3µm	Sn matt	4,7µm	98%	97%
901	3/21/2003	0-0969197-2	487316	R 5 E	CuMg	Ni	1,9µm	Sn matt	4,4µm	100%	98%
906	3/21/2003	5-927954-8	481573	R 4 E	CuSn6	Ni	1,8µm	Sn matt	4,2µm	98%	98%
906	3/21/2003	8-0965981-7	487470	L 2 E	CuFe2	Ni	1,7µm	Sn matt	3,9µm	99%	99%
906	3/21/2003	9-0927949-1	490954	L 2 E	CuSn6	Ni	1,6µm	Sn matt	3,5µm	100%	99%
906	3/22/2003	7-0927989-2	491469	L 2 E	CuZn37	Ni	1,8µm	Sn matt	4,4µm	99%	99%
906	3/22/2003	9-927949-4	487452	L 1 A	CuSn6	Ni	1,8µm	Sn matt	3,5µm	100%	100%
901	3/24/2003	0-0215284-2	485540	L 6 A	CuSn4	Ni	1,8µm	Sn matt	4,5µm	99%	96%
901	3/26/2003	0-0968429-2	491343	R 15A	CuNiSi	Ni	1,6µm	Sn matt	3,5µm	100%	100%
903	3/26/2003	0-0100564-2	477657	L 6 A	CuSn4	----		Sn matt	4,6µm	100%	99%
903	3/28/2003	0-0100564-2	477658	L 10A	CuSn4	----		Sn matt	4,9µm	100%	100%
903	3/28/2003	0-0100565-2	477633	L 1 A	CuSn4	----		Sn matt	5,5µm	99%	95%
903	3/29/2003	0-0338750-2	488552	L 10A	CuSn4	----		Sn matt	4,3µm	100%	100%
903	3/31/2003	0-0188277-2	477613	L 4 A	CuSn4	----		Sn matt	5,0µm	100%	100%
903	3/31/2003	0-0338750-2	477594	L 28A	CuSn4	----		Sn matt	5,3µm	100%	98%
904	3/31/2003	1-0964160-3	491644	L 7 A	CuSn4	----		Sn matt	7,7µm	100%	97%
904	3/31/2003	1-0968411-2	490990	L 5 A	CuSn4	----		Sn matt	6,6µm	99%	99%
903	4/1/2003	0-0100564-2	477659	L 5 A	CuSn4	----		Sn matt	5,2µm	100%	100%
903	4/1/2003	0-0100565-2	477634	L 9 A	CuSn4	----		Sn matt	5,4µm	100%	99%
904	4/1/2003	1-0968412-2	487876	L 3 A	CuSn4	----		Sn matt	6,7µm	100%	100%
904	4/2/2003	0-0969065-2	494982	L 1 A	CuSn4	----		Sn matt	7,1µm	99%	98%
906	4/2/2003	5-0927949-1	496907	L 3 A	CuSn6	Ni	1,6µm	Sn matt	3,9µm	100%	99%
906	4/2/2003	6-0927949-1	491657	L 1 A	CuSn6	Ni	1,6µm	Sn matt	4,0µm	100%	100%
901	4/3/2003	0-0969197-2	490933	R 3 A	CuMg	Ni	2,0µm	Sn matt	3,9µm	100%	100%
904	4/3/2003	3-0968056-2	486256	L 1 A	CuSn0,15	----		Sn matt	6,2µm	100%	100%
906	4/3/2003	6-0928865-2	491658	L 1 A	CuSn6	Ni	1,7µm	Sn matt	4,5µm	100%	99%
906	4/3/2003	7-0927949-4	491648	L 1 A	CuSn6	Ni	1,6µm	Sn matt	3,3µm	100%	100%
901	4/4/2003	0-0215284-2	489220	L 14A	CuSn4	Ni	1,5µm	Sn matt	3,5µm	98%	99%
###	4/4/2003	0-0968273-2	487023	R 1 A	CuSn4	----		Sn matt	7,0µm	99%	99%
904	4/4/2003	0-0969064-2	494978	R 1 A	CuSn6	----		Sn matt	7,8µm	100%	100%
904	4/4/2003	0-1355784-2	493613	R 1 A	CuSn0,15	----		Sn matt	6,6µm	100%	100%
904	4/4/2003	1-1534048-1	487898	L 1 A	CuSn4	----		Sn matt	6,5µm	100%	98%
904	4/4/2003	1-1534048-2	487899	L 2 A	CuSn4	----		Sn matt	6,1µm	99%	99%

906	4/4/2003	8-0927989-2	491668	L 1 E	CuZn30	Ni	1,5µm	Sn matt	3,8µm	100%	98%
904	4/7/2003	0-0969188-2	494996	R 66A	CuSn6	----		Sn matt	4,8µm	100%	100%
904	4/8/2003	0-1418516-2	498603	L 1 A	CuSn0,15	----		Sn matt	6,5µm	100%	99%
904	4/8/2003	0-1418531-2	489384	L 2 E	CuSn0,15	----		Sn matt	6,6µm	100%	98%
904	4/8/2003	1-0965953-4	488881	R 1 A	CuSn4	----		Sn matt	4,5µm	100%	100%
904	4/8/2003	1-1452061-5	498683	L 1 A	CuSn4	----		Sn matt	7,5µm	99%	99%
906	4/8/2003	5-0928865-9	476677	L 1 A	CuSn6	Ni	1,6µm	Sn matt	3,8µm	100%	100%
906	4/8/2003	6-0928865-3	480203	L 1 A	CuSn6	Ni	1,7µm	Sn matt	3,8µm	100%	99%
906	4/8/2003	7-0928865-7	477724	L 1 M	CuZn30	Ni	1,7µm	Sn matt	3,6µm	99%	99%
904	4/9/2003	1-0964159-4	488734	R 1 A	CuSn4	----		Sn matt	7,6µm	100%	100%
906	4/9/2003	6-0927949-1	499177	L 3 A	CuSn6	Ni	1,7µm	Sn matt	3,6µm	99%	97%
906	4/9/2003	6-0928865-6	494960	L 1 A	CuSn6	Ni	1,6µm	Sn matt	3,6µm	100%	100%
904	4/10/2003	1-0965942-4	495264	R 3 A	CuZn30	Ni	1,8µm	Sn matt	6,1µm	99%	98%
904	4/10/2003	1-965954-4	488854	T 11E	CuSn4	----		Sn matt	4,0µm	99%	99%
903	4/14/2003	0-0100565-2	489273	L 1 A	CuSn4	----		Sn matt	4,6µm	100%	96%
904	4/14/2003	1-0968945-2	499156	R 18A	CuZn30	Ni	1,2µm	Sn matt	4,6µm	100%	99%
904	4/14/2003	1-1534320-2	497289	R 5 A	CuZn30	NI	1,4µm	Sn matt	3,5µm	100%	100%
906	4/14/2003	7-0928865-6	492485	L 2 E	CuSn30	Ni	1,7µm	Sn matt	3,8µm	99%	100%
906	4/14/2003	8-0927949-9	497509	R 8 E	CuSn6	Ni	1,7µm	Sn matt	3,7µm	99%	100%
903	4/15/2003	0-0188277-2	482096	L 1 A	CuSn4	----		Sn matt	4,8µm	100%	100%
903	4/15/2003	0-0338750-2	489228	L 1 A	CuSn4	----		Sn matt	5,2µm	100%	100%
903	4/15/2003	0-0338750-2	499696	L 1 A	CuSn4	----		Sn matt	4,6µm	100%	99%
904	4/15/2003	0-1418747-2	330094	R 14E	CuSn4	----		Sn matt	5,3µm	99%	100%
904	4/15/2003	0-1418752-2	498007	L 2 E	CuSn0,15	Ni	1,5µm	Sn matt	4,7µm	100%	100%
906	4/15/2003	8-965981-7	477686	L 1 A	CuFe2	Ni	1,8µm	Sn matt	3,6µm	100%	100%
903	4/16/2003	0-0100564-2	491586	L 1 A	CuSn4	----		Sn matt	5,1µm	100%	100%
903	4/16/2003	0-0215461-2	489298	L 1 A	CuSn4	----		Sn matt	4,8µm	100%	98%
904	4/16/2003	0-1241489-2	332763	R 13A	CuSn4	----		Sn matt	6,9µm	98%	96%
904	4/16/2003	1-0968056-2	334251	R 1 A	CuSn0,15	----		Sn matt	4,5µm	100%	100%
906	4/16/2003	6-1452061-8	497969	L 1 A	CuSn6	Ni	1,3µm	Sn matt	3,5µm	100%	100%
906	4/16/2003	6-1452061-9	497971	L 1 A	CuSn6	Ni	1,6µm	Sn matt	4,4µm	100%	99%
903	4/21/2003	0-0100564-2	491587	L 1 A	CuSn4	----		Sn matt	4,7µm	100%	99%
904	4/21/2003	0-0968274-2	493139	R 7 A	CuSn4	----		Sn matt	6,5µm	99%	98%
903	4/22/2003	0-0188277-2	489249	L 1 A	CuSn4	----		Sn matt	4,9µm	99%	99%
904	4/22/2003	3-0964159-6	336205	R 1 A	CuSn4	----		Sn matt	6,4µm	99%	99%
901	4/23/2003	0-0969108-2	498453	R 1 A	CuZn30	NI	1,6µm	Sn matt	3,9µm	100%	100%
904	4/23/2003	1-0964159-3	333060	R 24A	CuSn4	----		Sn matt	7,4µm	99%	99%
904	4/24/2003	1-0964158-3	333059	R 1 A	CuSn4	----		Sn matt	7,6µm	99%	100%
904	4/24/2003	7-0968455-9	333106	R 1 A	CuMg	----		Sn matt	5,2µm	100%	99%
904	4/24/2003	7-968455-9	333106	R 3 E	CuMg	----		Sn matt	5,1µm	99%	99%
906	4/24/2003	5-0927949-2	492912	L 1 A	CuSn6	Ni	1,6µm	Sn matt	4,0µm	100%	99%
906	4/24/2003	6-0927949-1	338520	L 3 A	CuSn6	Ni	1,6µm	Sn matt	3,8µm	100%	100%

906	4/24/2003	8-0968455-9	495521	L 1 A	CuMg	Ni	1,9µm	Sn matt	3,0µm	99%	98%
906	4/24/2003	9-0927949-0	492434	L 1 E	CuSn6	Ni	1,6µm	Sn matt	3,6µm	100%	98%
906	4/24/2003	9-0927949-0	493756	L 5 E	CuSn6	Ni	1,7µm	Sn matt	3,5µm	100%	100%
906	4/24/2003	9-0927949-1	337259	L 1 A	CuSn6	Ni	1,6µm	Sn matt	4,1µm	100%	100%
904	4/25/2003	0-0969064-2	337104	R 1 A	CuSn6	----		Sn matt	5,7µm	100%	100%
904	4/25/2003	1-1534047-1	330022	L 2 A	CuSn4	----		Sn matt	5,8µm	100%	100%
904	4/25/2003	1-1534047-2	487983	L 1 A	CuSn4	----		Sn matt	5,4µm	100%	99%
904	4/25/2003	3-0929992-2	336647	R 1 A	CuSn4	----		Sn matt	6,9µm	100%	99%
906	4/25/2003	5-0927949-8	336888	L 1 A	CuSn6	Ni	1,7µm	Sn matt	4,5µm	99%	99%
904	4/26/2003	0-0969065-2	337101	R 14A	CuSn6	----		Sn matt	4,9µm	100%	99%
906	4/26/2003	6-0928865-1	337829	L 1 A	CuSn6	Ni	1,5µm	Sn matt	3,4µm	100%	99%
906	4/26/2003	6-0928865-1	337830	L 2 A	CuSn6	Ni	1,5µm	Sn matt	3,6µm	100%	100%
906	4/26/2003	7-0927989-2	490009	L 3 A	CuZn37	Ni	1,6µm	Sn matt	3,8µm	100%	99%
906	4/26/2003	7-0927989-2	490011	L 4 A	CuZn37	Ni	1,6µm	Sn matt	3,8µm	100%	100%
906	4/27/2003	8-0968455-5	496486	L 1 A	CuMg	Ni	2,1µm	Sn matt	4,4µm	100%	99%
906	4/27/2003	9-0927949-5	495582	L 1 A	CuSn6	Ni	1,7µm	Sn matt	3,8µm	99%	99%
901	4/28/2003	0-0968429-2	336622	R 1 A	CuNiSi	Ni	1,8µm	Sn matt	3,9µm	100%	99%
901	4/28/2003	0-0968429-2	336622	R 26A	CuNiSi	Ni	1,6µm	Sn matt	3,6µm	100%	98%
904	4/28/2003	0-0969188-2	337097	R 41A	CuSn6	----		Sn matt	5,1µm	100%	99%
904	4/30/2003	2-0962826-1	339710	R 1 A	CuSn4	----		Sn matt	7,1µm	99%	96%
904	4/30/2003	3-0968056-2	333386	L 19A	CuSn0,15	----		Sn matt	7,0µm	100%	100%
906	4/30/2003	8-0927954-3	340550	L 1 A	CuSn6	Ni	1,8µm	Sn matt	4,3µm	100%	100%
904	5/1/2003	1-1452089-2	337108	L 3 A	CuSn0,15	----		Sn matt	5,2µm	100%	100%
906	5/1/2003	4-1394551-4	336694	L 1 A	CuNiSi	----		Sn matt	3,8µm	99%	99%
906	01.05.03	6-0927949-8	498776	L 1 A	CuSn6	Ni	1,6µm	Sn matt	3,7µm	98%	99%