

***MEC A/S***

Solderability Test

of

Multimec Switches for Through Hole Mount

**Title** **Solderability Test of Multimec Switches for Through Hole Mount**

**Project No.** 0511c Solderability Test of Multimec TH Switch

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## Report Concerning Project No.

### 0511c Solderability Test of Multimec TH Switch

#### 1. Problem Description

The scope of this report is to verify the solderability of a Lead-Free and RoHS compatible switch (Multimec).

For the purpose of reference a Tin/Lead (SnPb) plated switch has been tested in a conventional SnPb solderability test process.

For the purpose of verifying backward compatibility a lead-free component has been tested in a SnPb solderability test process.

The solderability test temperatures have been chosen according to EN/IEC 60068-2-54.



The Through Hole Components with Tin/Lead plated Terminations are tested with SnPb solder at 235°C. The Components with Lead-free Terminations are also tested with SnPb solder at 235°C, furthermore they have been tested with a Lead-free Solder at 265°C.

#### 2. Applicable Documents

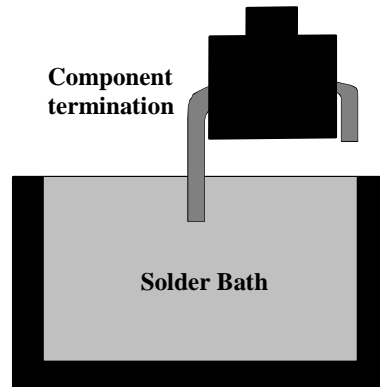
- EN/IEC 60068-2-54

#### 3. Test parameters for Multicore MUST II

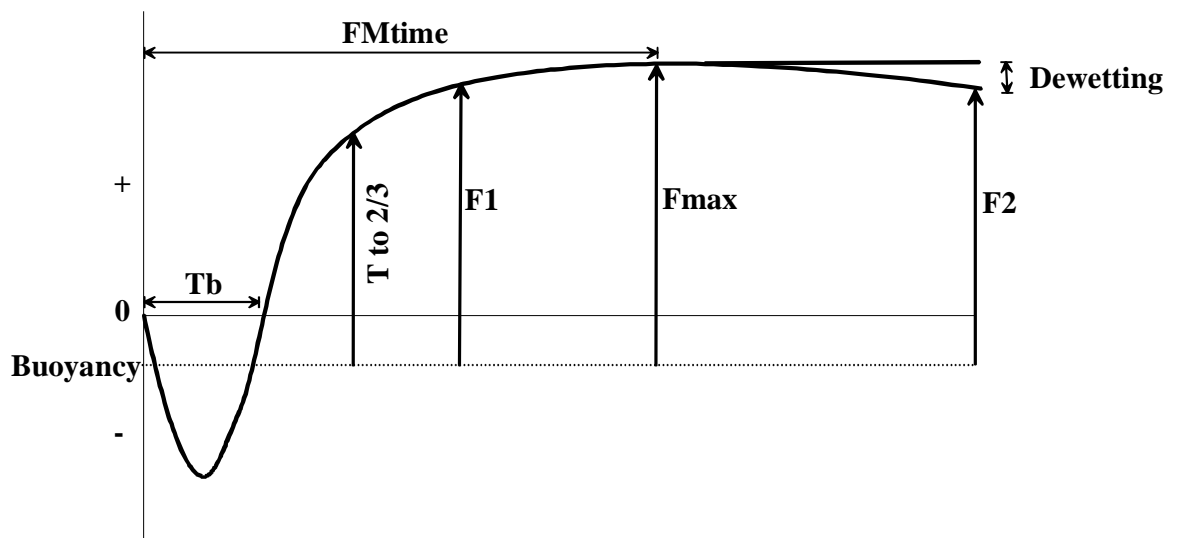
<b>Depth:</b> 1,77	<b>Durn:</b> 5	<b>Clips:</b> 1	<b>Recpt:</b> Bath
<b>Lead:</b> 1	<b>Space:</b> ----	<b>Temp:</b> se *	<b>Range:</b> +/-1mN
-----	----	<b>X-Section:</b> Rect	<b>Diam:</b> -----
<b>Width:</b> 0,80	<b>Thick:</b> 0,30	<b>TimeZero:</b> 5,0	<b>TimeBuoy:</b> 5,0
<b>Time 1:</b> 2,0	<b>Force 1:</b> 0,16	<b>Time 2:</b> 5,0	<b>Force 2:</b> 0,14
<b>Speed:</b> 20	<b>Solder:</b> se *	<b>T to 2/3 Fmax:</b> 5,0	<b>Flux:</b> Rosin SM/NA

\*Test Temp/Solder: 235°C with Sn60Pb40 and 265°C with Lead Free Sn99.3Cu0.7Ni (SN100C)

#### 4. Definition of Solderability Test



A Through Hole (TH) test object is dipped vertically into a solder Bath.  
The solderability can be defined from the wetting force according to EN/IEC 60068-2-54.



$F1$ : wetting force after 2 sec.

$F2$ : Wetting force at the end of test (5 sec.).

$T_b$ : Time to  $F=0$  (Test start).

$T_a$ : Time to Buoyancy (Contact angle  $90^\circ$ )

$F_{max}$ : Maximum wetting force.

$F_{Mtime}$ : Time t maximum wetting force.

T to 2/3: Time to 2/3 of maximum wetting force (MIL-STD)

Dewetting: EN/IEC 60068-2-54 allows 20% dewetting ( $F2$  20% <  $F1$ )

## 5. Work Description

For Verification of the Solderability the following has been carried out as reported in section 6:

### 6.1 Solderability Test according to EN/IEC 60068-2-54 of Components with **Tin/Lead** plated Terminations

*50 components have been tested at 235°C with Tin/Lead Solder in Bath (Sn60Pb40). See Appendix A.1*



### 6.2 Solderability Test according to EN/IEC 60068-2-54 of Components with **Lead-free** plated Terminations

*50 components have been tested at 235°C with Tin/Lead Solder in Bath (Sn60Pb40). See Appendix A.2*



### 6.3 Solderability Test according to EN/IEC 60068-2-54 of Components with **Lead-free** plated Terminations

*50 Components have been tested at 265°C with Lead-free Solder in Bath (Sn99.3Cu0.7Ni). See Appendix A.3*



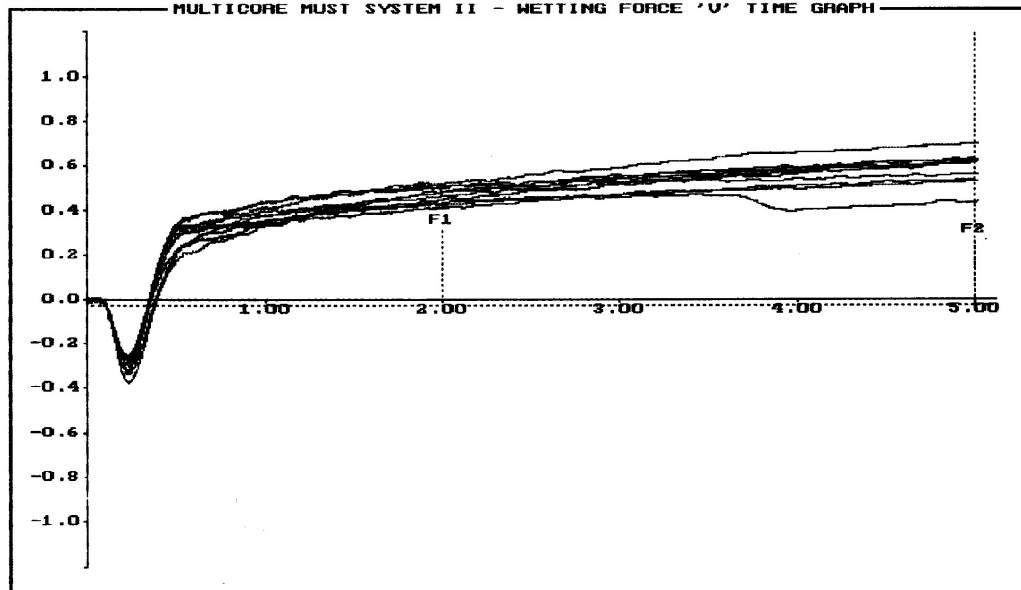
### 6.4 Comparison between three Types of Solderability Test

### 6.5 Summary Conclusion

6. Test results

6.1 Graphic Representation of 10 Tests of Through Hole Components with SnPb plated terminations. (Test Temperature 235°C)

Graphic Representation of 10 Tests selected from the Solderability Test.



Ta = 5.0  
 Tb = 5.0  
 Test Limits  
 F1 = 0.352 mN at 2.0s  
 F2 = 0.308 mN at 5.0s  
 5.0s to 2/3 FMax  
 Buoyancy = -0.03

Test No	Ta	Tb	F1	F2	T to 2/3	Dewetting	Result
14	0.345	0.353	0.55	0.73	1.353	0	PASS
20	0.344	0.352	0.46	0.56	0.908	1	PASS
26	0.342	0.351	0.53	0.59	0.621	0	PASS
32	0.335	0.345	0.49	0.64	1.274	0	PASS
39	0.342	0.352	0.44	0.46	0.881	6	PASS
45	0.331	0.341	0.53	0.65	0.879	0	PASS
51	0.337	0.349	0.45	0.56	1.004	0	PASS
57	0.365	0.380	0.48	0.65	1.571	0	PASS
60	0.365	0.382	0.51	0.66	1.328	0	PASS
69	0.375	0.388	0.51	0.66	1.465	0	PASS

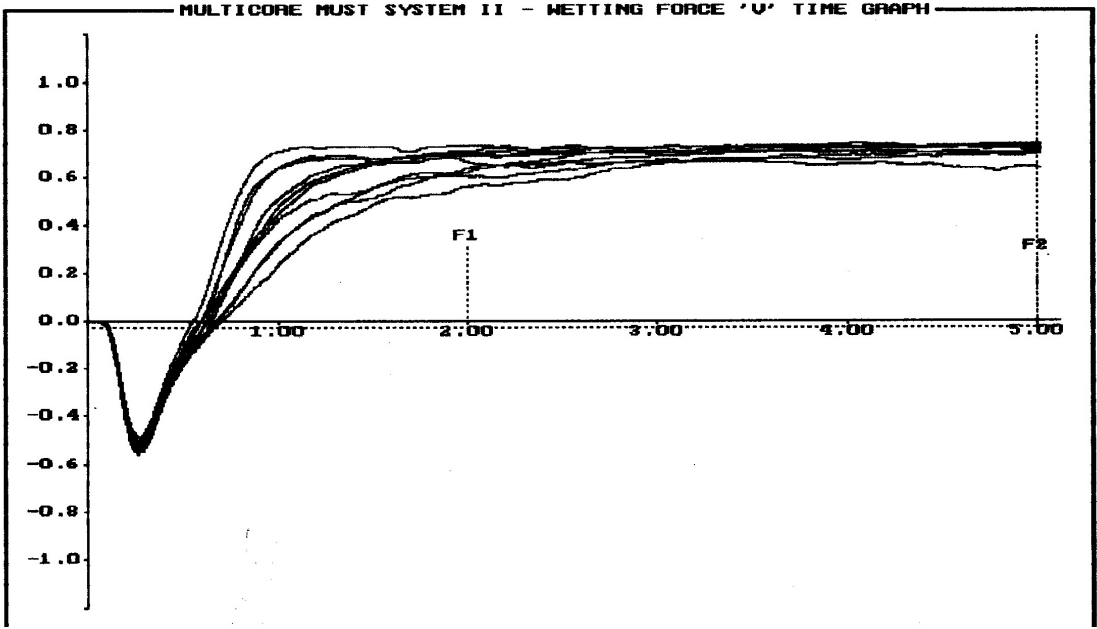
Test parameters

Component Type (Termination finish)	Graph No.	Test No.	Test Solder Bath	Test Temp. Bath
SnPb	1	26, 32, 45	Sn60Pb40	235°C

**6.2 Graphic Representation of 10 Tests of Through Hole Components with Sn plated terminations.**

(Test Temperature 235°C)

Graphic Representation of 10 Tests selected from the Solderability Test.



Ta = 5.0	Test Limits	5.0s to 2/3 FMax
Tb = 5.0	F1 = 0.352 mN at 2.0s	Buoyancy= -0.03
	F2 = 0.308 mN at 5.0s	

Test No	Ta	Tb	F1	F2	T to 2/3	Dewetting	Result
70	0.605	0.620	0.72	0.73	0.817	1	PASS
74	0.529	0.551	0.76	0.75	0.773	2	PASS
80	0.605	0.630	0.70	0.76	1.072	1	PASS
87	0.558	0.592	0.74	0.74	1.007	1	PASS
93	0.630	0.651	0.73	0.77	0.978	0	PASS
99	0.653	0.682	0.66	0.67	1.203	5	PASS
105	0.598	0.625	0.63	0.73	1.086	0	PASS
111	0.574	0.592	0.72	0.75	0.842	0	PASS
117	0.660	0.703	0.59	0.73	1.469	0	PASS
128	0.635	0.672	0.65	0.76	1.312	0	PASS

Test parameters

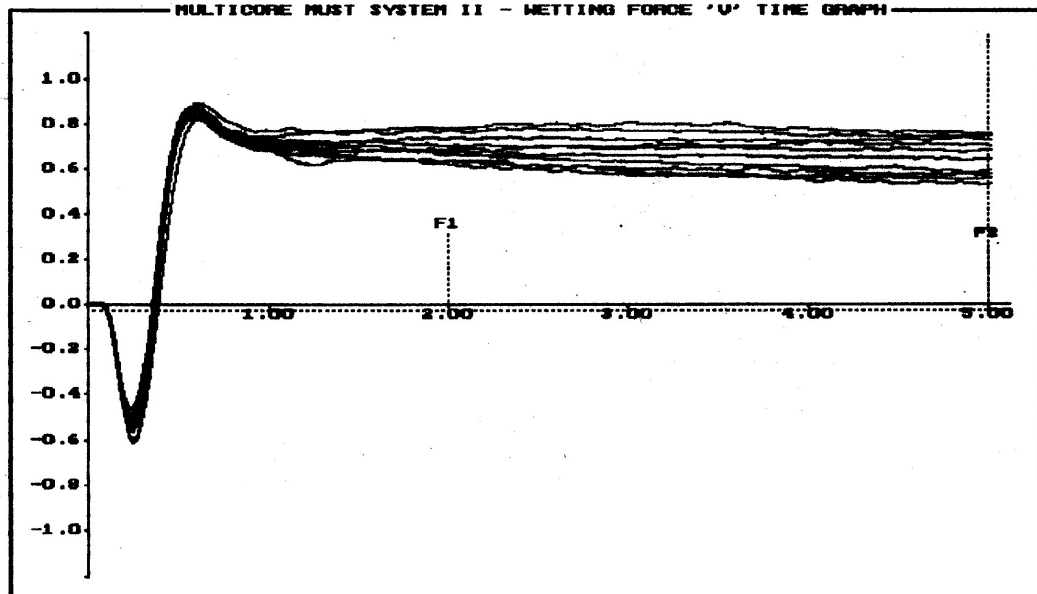
Component Type (Termination finish)	Graph No.	Test No.	Test Solder Bath	Test Temp. Bath
Sn (Lead-Free)	2	70, 74, 80	Sn60Pb40	235°C



**6.3 Graphic Representation of 10 Tests of Through Hole Components with Sn plated terminations.**

(Test Temperature 265°C)

Graphic Representation of 10 Tests selected from the Solderability Test.



Ta = 5.0	Test Limits	
Tb = 5.0	F1 = 0.352 mN at 2.0s	5.0s to 2/3 FMax
	F2 = 0.308 mN at 5.0s	Buoyancy= -0.03

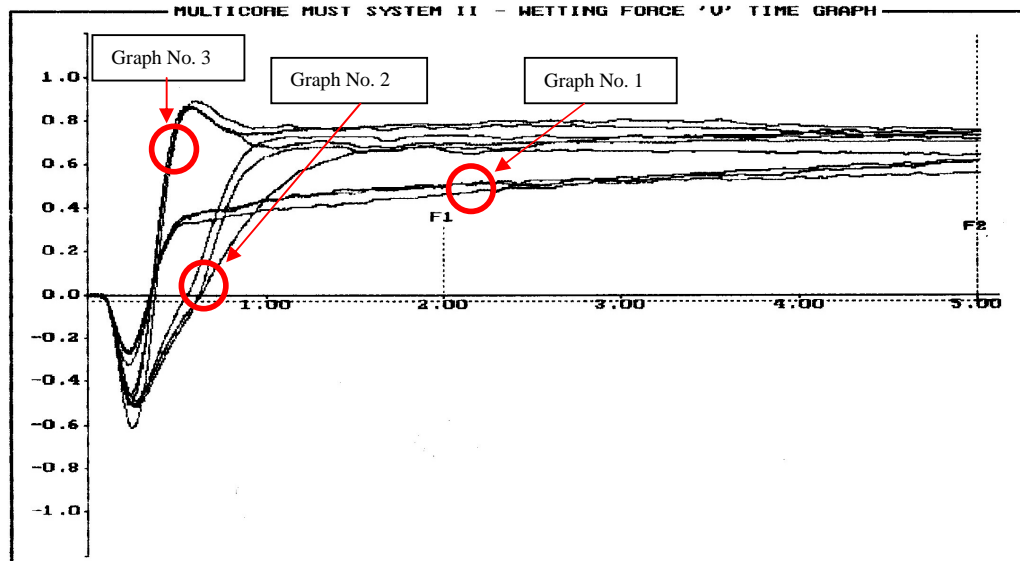
Test No	Ta	Tb	F1	F2	T to 2/3	Dewetting	Result
131	0.368	0.373	0.81	0.79	0.456	12	PASS
137	0.347	0.352	0.80	0.78	0.449	15	PASS
143	0.349	0.355	0.72	0.76	0.443	12	PASS
149	0.354	0.358	0.69	0.63	0.447	28	PASS
154	0.347	0.351	0.76	0.74	0.439	19	PASS
156	0.345	0.349	0.70	0.67	0.437	26	PASS
163	0.382	0.388	0.65	0.59	0.480	32	PASS
169	0.356	0.362	0.66	0.60	0.451	32	PASS
175	0.360	0.365	0.66	0.56	0.452	37	PASS
186	0.354	0.359	0.74	0.71	0.438	20	PASS

Test parameters

Component Type (Termination finish)	Graph No.	Test No.	Test Solder Bath	Test Temp. Bath
Sn (Lead-Free)	3	131, 137, 156	Sn99.3Cu0.7Ni	265°C

### 6.4 Comparison between three types of Solderability Tests

The following Graphic Representations illustrate three Tests from each type of Solderability Test.



Ta = 5.0                      Test Limits  
 Tb = 5.0                      F1 = 0.352 mN at 2.0s                      5.0s to 2/3 FMax  
    F2 = 0.308 mN at 5.0s                      Buoyancy= -0.03

Test No	Ta	Tb	F1	F2	T to 2/3	Dewetting	Result	
1	26	0.342	0.351	0.53	0.59	0.621	0	PASS
	32	0.335	0.345	0.49	0.64	1.274	0	PASS
	45	0.331	0.341	0.53	0.65	0.879	0	PASS
2	70	0.605	0.620	0.72	0.73	0.817	1	PASS
	74	0.529	0.551	0.76	0.75	0.773	2	PASS
	80	0.605	0.630	0.70	0.76	1.072	1	PASS
3	131	0.368	0.373	0.81	0.79	0.456	12	PASS
	137	0.347	0.352	0.80	0.78	0.449	15	PASS
	156	0.345	0.349	0.70	0.67	0.437	26	PASS

Test parameters

Component Type (Termination finish)	Graph No.	Test No.	Test Solder Bath	Test Temp. Bath
SnPb	1	26, 32, 45	Sn60Pb40	235°C
Sn (Lead-Free)	2	70, 74, 80	Sn60Pb40	235°C
Sn (Lead-Free)	3	131, 137, 156	Sn99.3Cu0.7Ni	265°C

## 6.5 Summary Conclusion

The test has been conducted with a non-activated flux (SM/NA) and all the tested Through Hole components show acceptable wetting according to EN/IEC 60068-2-54. The solderability on the Lead-Free plating has been verified to a level comparable with the conventional tin-lead plating in a conventional tin-lead solderability process.



7. Appendix A

Appendix A.1

Test Data for Through Hole Components with SnPb plated terminations. (Test Temperature 235°C)

Ta = 5.0	F1 = 0.352 mN at 2.0s	5.0s to 2/3 FMax
Tb = 5.0	F2 = 0.308 mN at 5.0s	Buoyancy= -0.03

Test No	Ta	Tb	F1	F2	T to 2/3	Dewetting	Result
14	0.345	0.353	0.55	0.73	1.353	0	PASS
15	0.347	0.359	0.51	0.58	0.835	0	PASS
16	0.349	0.371	0.44	0.51	0.903	0	PASS
17	0.347	0.357	0.46	0.55	0.955	0	PASS
18	0.349	0.367	0.61	0.73	1.132	0	PASS
19	0.328	0.340	0.54	0.67	0.948	0	PASS
20	0.344	0.352	0.46	0.56	0.908	1	PASS
21	0.356	0.371	0.45	0.55	1.232	0	PASS
22	0.351	0.367	0.54	0.68	1.255	0	PASS
23	0.354	0.370	0.49	0.63	1.370	0	PASS
24	0.344	0.358	0.48	0.62	1.229	0	PASS
25	0.354	0.368	0.47	0.58	0.997	0	PASS
26	0.342	0.351	0.53	0.59	0.621	0	PASS
27	0.331	0.340	0.51	0.65	0.905	0	PASS
28	0.340	0.349	0.49	0.62	0.813	0	PASS
29	0.335	0.345	0.48	0.61	0.982	0	PASS
30	0.344	0.354	0.44	0.49	0.816	0	PASS
31	0.328	0.337	0.55	0.68	0.911	0	PASS
32	0.335	0.345	0.49	0.64	1.274	0	PASS
33	0.347	0.356	0.54	0.68	1.390	0	PASS
34	0.333	0.341	0.52	0.62	0.813	0	PASS
35	0.335	0.346	0.47	0.58	0.976	0	PASS
36	0.324	0.332	0.52	0.64	0.883	0	PASS
37	0.347	0.354	0.50	0.61	0.949	0	PASS
39	0.342	0.352	0.44	0.46	0.881	6	PASS
40	0.342	0.349	0.45	0.57	0.674	0	PASS
41	0.342	0.352	0.54	0.66	0.929	0	PASS
42	0.342	0.352	0.54	0.64	0.935	0	PASS
43	0.337	0.346	0.51	0.63	1.065	0	PASS
44	0.352	0.364	0.50	0.68	1.592	0	PASS
45	0.331	0.341	0.53	0.65	0.879	0	PASS
46	0.337	0.344	0.50	0.63	1.106	0	PASS
47	0.365	0.379	0.47	0.60	1.413	1	PASS
48	0.356	0.370	0.47	0.65	1.555	0	PASS
49	0.360	0.369	0.53	0.68	1.394	0	PASS
50	0.347	0.363	0.44	0.54	1.046	0	PASS
51	0.337	0.349	0.45	0.56	1.004	0	PASS
52	0.358	0.368	0.49	0.59	1.042	1	PASS
53	0.354	0.361	0.49	0.64	1.123	0	PASS
54	0.368	0.380	0.49	0.67	1.675	0	PASS
55	0.349	0.358	0.42	0.54	0.847	0	PASS
56	0.363	0.377	0.52	0.68	1.436	0	PASS
57	0.365	0.380	0.48	0.65	1.571	0	PASS
58	0.358	0.369	0.50	0.62	0.971	0	PASS
60	0.365	0.382	0.51	0.66	1.328	0	PASS
61	0.351	0.362	0.46	0.58	1.229	0	PASS
62	0.363	0.374	0.48	0.60	1.185	0	PASS
65	0.368	0.381	0.47	0.54	1.115	1	PASS
67	0.356	0.370	0.46	0.58	1.352	0	PASS
69	0.375	0.388	0.51	0.66	1.465	0	PASS

Test parameters

Component Type (Termination finish)	Graph No.	Test No.	Test Solder Bath	Test Temp. Bath
SnPb	-----	-----	Sn60Pb40	235°C

## Appendix A.2

### Test Data for Through Hole Components with Sn plated terminations.

(Test Temperature 235°C)

Ta = 5.0	F1 = 0.352 mN at 2.0s	5.0s to 2/3 FMax
Tb = 5.0	F2 = 0.308 mN at 5.0s	Buoyancy= -0.03

Test No	Ta	Tb	F1	F2	T to 2/3	Dewetting	Result
70	0.605	0.620	0.72	0.73	0.817	1	PASS
71	0.572	0.595	0.69	0.68	0.892	6	PASS
72	0.614	0.640	0.71	0.71	0.998	1	PASS
74	0.529	0.551	0.76	0.75	0.773	2	PASS
78	0.555	0.578	0.77	0.75	0.802	3	PASS
79	0.584	0.609	0.73	0.79	0.953	0	PASS
80	0.605	0.630	0.70	0.76	1.072	1	PASS
81	0.638	0.670	0.67	0.72	1.469	3	PASS
82	0.587	0.613	0.70	0.77	1.025	0	PASS
83	0.547	0.567	0.75	0.74	0.787	4	PASS
84	0.656	0.688	0.57	0.68	1.243	4	PASS
85	0.575	0.601	0.74	0.75	0.965	3	PASS
87	0.558	0.592	0.74	0.74	1.007	1	PASS
88	0.638	0.672	0.65	0.76	1.365	0	PASS
89	0.514	0.538	0.71	0.73	1.071	2	PASS
93	0.630	0.651	0.73	0.77	0.978	0	PASS
94	0.563	0.590	0.73	0.72	0.944	3	PASS
95	0.578	0.599	0.74	0.72	0.834	4	PASS
96	0.550	0.569	0.78	0.79	0.765	0	PASS
97	0.717	0.763	0.51	0.62	1.528	6	PASS
98	0.646	0.695	0.54	0.67	1.683	2	PASS
99	0.653	0.682	0.66	0.67	1.203	5	PASS
100	0.649	0.678	0.65	0.63	1.183	6	PASS
101	0.620	0.649	0.55	0.69	1.619	0	PASS
102	0.648	0.691	0.60	0.71	1.415	0	PASS
103	0.635	0.666	0.69	0.68	1.065	5	PASS
104	0.505	0.532	0.57	0.63	1.244	3	PASS
105	0.598	0.625	0.63	0.73	1.086	0	PASS
106	0.629	0.654	0.67	0.73	1.114	1	PASS
107	0.643	0.688	0.53	0.63	1.473	1	PASS
108	0.625	0.653	0.68	0.74	1.135	0	PASS
109	0.559	0.582	0.75	0.77	0.876	1	PASS
110	0.556	0.576	0.74	0.77	0.862	0	PASS
111	0.574	0.592	0.72	0.75	0.842	0	PASS
112	0.657	0.704	0.62	0.67	1.462	7	PASS
114	0.694	0.724	0.56	0.62	1.230	2	PASS
115	0.578	0.604	0.70	0.74	1.206	1	PASS
116	0.611	0.643	0.64	0.75	1.485	0	PASS
117	0.660	0.703	0.59	0.73	1.469	0	PASS
118	0.787	0.826	0.52	0.57	1.437	6	PASS
119	0.574	0.622	0.58	0.63	1.516	8	PASS
121	0.731	0.770	0.56	0.64	1.301	0	PASS
122	0.565	0.594	0.71	0.69	0.979	5	PASS
123	0.647	0.689	0.50	0.65	1.513	3	PASS
124	0.624	0.673	0.51	0.65	1.671	1	PASS
125	0.649	0.699	0.53	0.62	1.522	9	PASS
126	0.679	0.720	0.60	0.73	1.506	2	PASS
127	0.684	0.727	0.54	0.73	1.746	0	PASS
128	0.635	0.672	0.65	0.76	1.312	0	PASS
129	0.665	0.700	0.64	0.75	1.428	0	PASS

#### Test parameters

Component Type (Termination finish)	Graph No.	Test No.	Test Solder Bath	Test Temp. Bath
Sn (Lead-Free)	-----	-----	Sn60Pb40	235°C

### Appendix A.3

#### Test Data for Through Hole Components with Sn plated terminations. (Test Temperature 265°C)

Ta = 5.0                      F1 = 0.352 mN at 2.0s                      5.0s to 2/3 FMax  
 Tb = 5.0                      F2 = 0.308 mN at 5.0s                      Buoyancy= -0.03

Test No	Ta	Tb	F1	F2	T to 2/3	Dewetting	Result
130	0.379	0.384	0.79	0.72	0.465	21	PASS
131	0.368	0.373	0.81	0.79	0.456	12	PASS
132	0.354	0.358	0.87	0.87	0.437	4	PASS
133	0.377	0.381	0.65	0.51	0.469	37	PASS
134	0.351	0.355	0.78	0.72	0.441	21	PASS
135	0.340	0.345	0.73	0.67	0.436	29	PASS
136	0.354	0.360	0.64	0.56	0.445	34	PASS
137	0.347	0.352	0.80	0.78	0.449	15	PASS
138	0.351	0.356	0.83	0.78	0.441	15	PASS
139	0.352	0.358	0.75	0.73	0.450	18	PASS
140	0.351	0.357	0.79	0.74	0.445	20	PASS
141	0.363	0.368	0.68	0.64	0.456	22	PASS
142	0.330	0.334	0.77	0.76	0.422	19	PASS
143	0.349	0.355	0.72	0.76	0.443	12	PASS
145	0.379	0.385	0.82	0.71	0.493	21	PASS
147	0.351	0.356	0.69	0.67	0.444	26	PASS
148	0.352	0.357	0.71	0.69	0.444	20	PASS
149	0.354	0.358	0.69	0.63	0.447	28	PASS
150	0.349	0.355	0.66	0.62	0.442	28	PASS
151	0.358	0.363	0.75	0.73	0.447	20	PASS
152	0.363	0.366	0.78	0.77	0.459	15	PASS
153	0.354	0.359	0.72	0.68	0.444	24	PASS
154	0.347	0.351	0.76	0.74	0.439	19	PASS
156	0.345	0.349	0.70	0.67	0.437	26	PASS
157	0.352	0.357	0.76	0.76	0.446	13	PASS
158	0.351	0.356	0.73	0.72	0.441	18	PASS
160	0.363	0.369	0.65	0.61	0.464	29	PASS
163	0.382	0.388	0.65	0.59	0.480	32	PASS
164	0.356	0.361	0.75	0.73	0.450	19	PASS
165	0.349	0.354	0.69	0.66	0.440	26	PASS
166	0.354	0.360	0.71	0.69	0.443	17	PASS
169	0.356	0.362	0.66	0.60	0.451	32	PASS
170	0.352	0.358	0.72	0.71	0.444	18	PASS
172	0.368	0.372	0.80	0.78	0.455	15	PASS
173	0.368	0.374	0.66	0.62	0.461	21	PASS
174	0.351	0.356	0.69	0.69	0.440	21	PASS
175	0.360	0.365	0.66	0.56	0.452	37	PASS
176	0.358	0.363	0.77	0.74	0.447	16	PASS
178	0.360	0.365	0.73	0.70	0.443	22	PASS
179	0.363	0.368	0.66	0.59	0.458	33	PASS
180	0.356	0.362	0.78	0.76	0.444	17	PASS
181	0.347	0.352	0.72	0.68	0.435	20	PASS
182	0.363	0.369	0.67	0.63	0.450	25	PASS
183	0.351	0.356	0.75	0.70	0.440	23	PASS
184	0.352	0.357	0.68	0.62	0.443	31	PASS
185	0.344	0.349	0.79	0.71	0.432	22	PASS
186	0.354	0.359	0.74	0.71	0.438	20	PASS
187	0.349	0.353	0.75	0.74	0.434	16	PASS
188	0.349	0.354	0.68	0.62	0.443	30	PASS
189	0.367	0.371	0.69	0.61	0.458	27	PASS

Test parameters

Component Type (Termination finish)	Graph No.	Test No.	Test Solder Bath	Test Temp. Bath
Sn (Lead-Free)	-----	-----	Sn99.3Cu0.7Ni	265°C