

JCAA/JGPP Lead-Free Solder Project

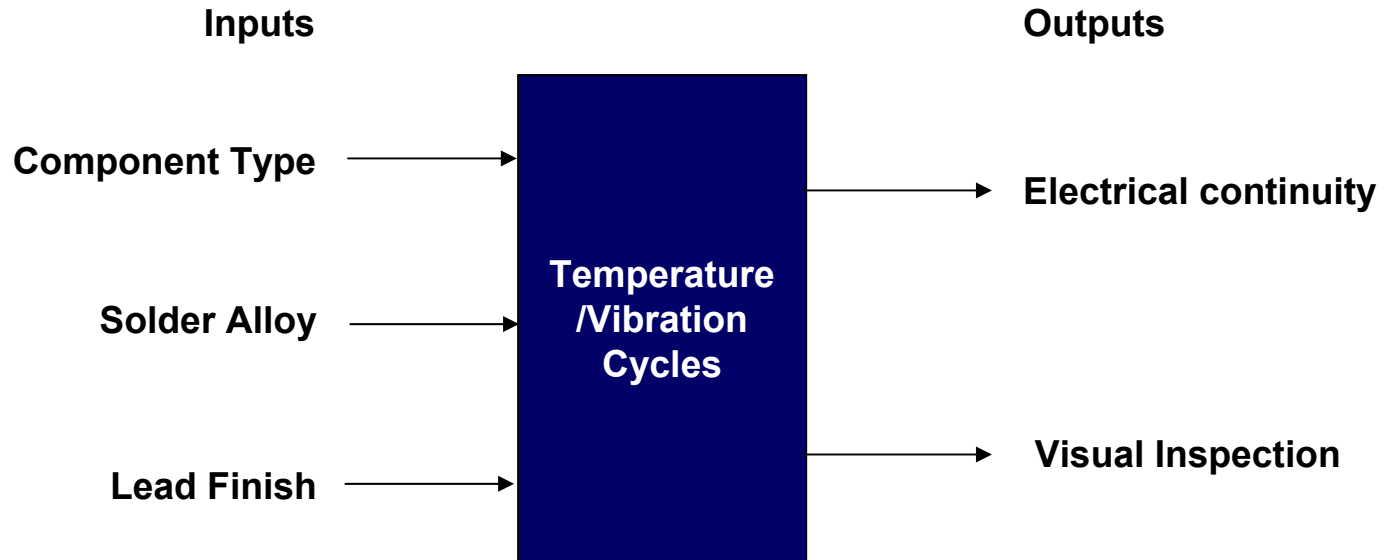
- **Scope**
- **Experimental variables**
- **Initial observations**
- **Weibull plots**
 - **Single combinations of solder alloy, lead finish and component type**
 - **Plots showing all solder alloys for a given combination of component type and lead finish**
- **Statistical tests - TBD**

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Scope

- **Status**
 - This is an interim analysis of the results from McKinney
 - Manufactured boards in chamber
- **Samples**
 - Manufactured boards after 366 cycles
 - Rework boards after 300 cycles
 - Samples failing the initial continuity check were removed from the analysis
- **Conditioning**
 - -55 to 125C temperature cycling with vibration at end of cycle
 - 10 grms; increased 5 g every 50 cycles
 - 300 cycles total or significant failures

Experimental Variables



Input Variable Levels

- **Component types**
 - BGA-225
 - CLCC-20
 - PDIP-20
 - PLCC-20
 - TQFP-144
 - TQFP-208
 - TSOP-50
- **Solder Alloys**
 - SAC
 - SACB
 - SnPb
 - SnCu
- **Lead Finishes**
 - AuPdNi
 - SAC
 - SACB
 - Sn
 - SnCu
 - SnPb

Manufactured Board Observations

- Too few joints have failed
 - In a reliability study we want lots of failures (all if possible)
 - 822 samples were tested, only 251 failures were noted after 366 cycles
 - Comparisons of failure rates are difficult to perform in some cases
- 31% (251) component failures @ 366 cycles
 - 67% of the failures (167 samples) occurred in only seven combinations of lead finish, component and solder paste:
 - 100% SnPb TSOP-50 on SACB paste (25 of 25)
 - 100% SAC CLCC-20 on SAC paste (25 of 25)
 - 100% SnPb CLCC-20 on SAC paste (25 of 25)
 - 78% SnPb CLCC-20 on SnPb paste (39 of 50)
 - 83% SnPb BGA-225 on SAC paste (20 of 24)
 - 68% SnPb BGA-225 on SACB paste (17 of 25)
 - 64% SAC BGA-225 on SAC paste (16 of 25)
- Boards manufactured with SnPb paste performed better overall (23% failures vs 42% for SAC and 27% for SACB)

Rework Board Observations

- Too few joints have failed after 300 cycles
- 192 failures of 821 samples @ 300 cycles
 - 155 of 702 unreworked components have failed (22%)
 - 84% SAC CLCC-20 (42 of 50)
 - 62% SACB CLCC-20 (31 of 50)
 - 74% SAC BGA-225 (59 of 80)
 - 28% SnPb BGA-225 (11 of 40)
 - 13% SnPb TSOP-50 (5 of 40)
 - 37 of 119 reworked components have failed (31%)
 - 100% SnCu TSOP-50 reworked with SACB (10 of 10)
 - 70% SnPb TSOP-50 reworked with SnPb (7 of 10)
 - 50% AuPdNi TQFP-208 reworked with SAC (5 of 10)
 - 50% AuPdNi TQFP-208 reworked with SACB (5 of 10)

Defect Map After 300 Cycles

Part	MFG SnPb					MFG SAC					MFG SACB					RWK SnPb					RWK SAC					RWK SACB										
	30	31	32	33	34	99	100	101	102	103	113	139	140	141	142	45	66	67	68	70	172	173	174	175	176	200	201	202	203	204						
U18																																				
U4									112									287		252			169												261	
U43		175																					267	264	202	212	267	198				207	BGA-225			
U55									222														280	255												
U6							112		100	162		164	137	188					247		126	216	130	148	128	231	152	135	198	229						
U2		210	260			297	270	258	126	218	298	291		223		197	193		276	219	151	240	224	190	133	272	63	5	193	155						
U21									50												290	97	167	148	160	118	163	258	196	176	272					
U44										213											298	168	263	193	255	215	256			274		BGA-225				
U5							30	264	52									261	259	238	107	202	240	107	119	100	129	88	158	42						
U56							96		38	0											285		270	217						255						
U10	279					254	203	256	191	201						274					202	186		236	285	247	241	254	235	198						
U14						275	206	256	168	198							300	233			263	262	260	255	237	271	256	252	253							
U17						277	226		171	256					1						291	299		276			277		255	250	CLCC-20					
U45						260	261		206	299											201	258	254			269	275		278							
U52						271	255	280	203												218	269	252	225	267		268									
U13		295	259		297	297			271	295						268					250	188	286	206	236	242	239	299	260	222						
U22						286		280	275												242	227	213	263	275		278	230								
U46									284												203	227		287			218		292		CLCC-20					
U53									299												258		258	245	257	291			293							
U9									230												201	224	252	236	273	229	250		252	257						
U23							0																													
U35																																				
U49					51																									0	AuPdNi PDIP-20					
U59					11											0																				
U8								0																		0										
U11																																				
U30																																				
U38																															Sn PDIP-20					
U51												51																								
U63																																				
U15																																				
U27																											0	211			Sn PLCC-20					
U28																																				
U47																																				
U54																																				
U1															29										287											
U20																																				
U41																																				
U58																																				
U7																															Sn TQFP-144					
U3																	206	155		148	52	137		96	107	19	2	14	42	5						
U31																																				
U34																																				
U48																															AuPdNi TQFP-208					
U57	51											221										256														
U12									221								193		261		202			156		69	288	219	244	254						
U25						298		291	293							186	210	249	258	300				256		22	201	228	153	263						
U29									299																						TSOP-50					
U39																																				
U61																																				
U16																																				
U24											71	92	51	112	133																					
U26											205	159	268	212	178																TSOP-50					
U40											103	156	126	131	202																					
U62											204	272	262	278																						
PTH											261		285	218	222																PTH					

= Indicates reworked components
 = SnPb
 = SACB
 = SAC
 = SnCu

Defect Map After 366 Cycles (RWK @ 300 Cycles)

Part	MFG SnPb					MFG SAC					MFG SACB					RWK SnPb					RWK SAC					RWK SACB						
	30	31	32	33	34	99	100	101	102	103	113	139	140	141	142	45	66	67	68	70	172	173	174	175	176	200	201	202	203	204		
U18			306						346	320			318	302																		
U4			311			327		317	112	334			341		346			287		252			169									
U43			175			334														267	264	202	212	267		198			207		BGA-225	
U55									222						1								280	255								
U6			316				112		100	162			164	137	188				247		126	216	130	148	128	231	152	135	198	229		
U2			210	260		297	270	258	126	218	298	291	301	223	311		197	193	276		219	151	240	224	190	133	272	63	5	193	155	
U21						323			50												290	97	167	148	160	118	163	258	196	176	272	
U44						349				213			330								298	168	263	193	255	215	256		274		BGA-225	
U5			303			336	30	264	52	330				287	301	311			261	259	238	107	202	240	107	119	100	129	88	158	42	
U56							96	317	38	0			349								285		270	217					255			
U10	279	328	306			254	203	256	191	201							274				202	186		236	285	247	241	254	235	198		
U14			330			275	206	256	168	198								300	233		263	262	260	255	237	271	256	252	253			
U17			326	324		277	226	303	171	256					1						291	299		276			277		255	250	CLCC-20	
U45			313			260	261	301	206	299											201	258	254			269	275		278			
U52						271	255	280	203	302											218	269	252	225	267		268					
U13	314	295	259	319	297	297	311	309	271	295			346		302		268				250	188	286	206	236	242	239	299	260	222		
U22			319			286		280	275	349											242	227	213	263	275		278		230			
U46			305	304				315	284												203	227		287			218		292		CLCC-20	
U53				330		325		312	299	304											258	258	245	257	291				293			
U9		302	350	305		309	347	332	230	307		316	348		338						201	224	252	236	273	229	250		252	257		
U23							0																									
U35															317																	
U49					51												0													0	AuPdNi PDIP-20	
U59					11				0																							
U8																																
U11																																
U30																																
U38																															Sn PDIP-20	
U51																																
U63												51																				
U15																												211				
U27																											0				Sn PLCC-20	
U28																																
U47																																
U54																																
U1				327					324						29									287								
U20																																
U41																															Sn TQFP-144	
U58																																
U7									308																							
U3																	206	155		148	52	137		96	107	19	2	14	42	5		
U31																																
U34																																
U48																															AuPdNi TQFP-208	
U57	51											221										256										
U12						315			221	311							193		261		202			156		69	288	219	244	254		
U25			350			298		291	293							186	210	249	258	300					256	22	201	228	153	263		
U29						304		347	299																						TSOP-50	
U39																																
U61																																
U16						323					71	92	51	112	133																	
U24						350	334		301		205	159	268	212	178																	
U26			347								103	156	126	131	202																TSOP-50	
U40											204	272	262	278	350																	
U62											261	312	285	218	222																	
PTH																															PTH	

= Indicates reworked components
 = SnPb
 = SACB
 = SAC
 = SnCu

MFG SnPb and SAC CLCC-20 With SAC Paste

Part	MFG SnPb					MFG SAC					MFG SACB					RWK SnPb					RWK SAC					RWK SACB						
	30	31	32	33	34	99	100	101	102	103	113	139	140	141	142	45	66	67	68	70	172	173	174	175	176	200	201	202	203	204		
U18			306						346	320			318	302																		
U4			311			327		317	112	334			341		346			287		252			169									
U43			175			334														267	264	202	212	267		198			207		BGA-225	
U55									222						1								280	255								
U6			316				112		100	162			164	137	188				247		126	216	130	148	128	231	152	135	198	229		
U2			210	260		297	270	258	126	218	298	291	301	223	311		197	193	276		219	151	240	224	190	272	63	5	193	155		
U21						323			50												290	97	167	148	160	118	163	258	196	176	272	
U44						349				213			330								298	168	263	193	255	215	256		274		BGA-225	
U5			303			336	30	264	52	330				287	301	311			261	259	238	107	202	240	107	119	100	129	88	158	42	
U56													349								285		270	217					255			
U10	279	328	306			254	203	256	191	201							274				202	186		236	285	247	241	254	235	198		
U14			330			275	206	256	168	198								300	233		263	262	260	255	237	271	256	252	253			
U17			326	324		277	226	303	171	256					1						291	299		276			277		255	250	CLCC-20	
U45			313			260	261	301	206	299											201	258	254			269	275		278			
U52						271	255	280	203	302											218	269	252	225	267		268					
U13	314	295	259	319	297	297	311	309	271	295			346		302		268				250	188	286	206	236	242	239	299	260	222		
U22			319			286		280	275	349											242	227	213	263	275		278		230			
U46			305	304				315	284												203	227		287			218		292		CLCC-20	
U53				330		325		312	299	304											258		258	245	257	291			293			
U9		302	350	305		309	347	332	230	307		316	348		338						201	224	252	236	273	229	250		252	257		
U23																																
U35															317																	
U49				51																										0	AuPdNi PDIP-20	
U59				11																												
U8																																
U11																																
U30																																
U38																															Sn PDIP-20	
U51																																
U63													51																			
U15																												211			Sn PLCC-20	
U27																																
U28																																
U47																																
U54																																
U1			32												29									287								
U20																																
U41																															Sn TQFP-144	
U58																																
U7																																
U3																	206	155		148	52	137		96	107	19	2	14	42	5		
U31																																
U34																															AuPdNi TQFP-208	
U48																																
U57	51																						256									
U12																	193		261		202			156		69	288	219	244	254		
U25			350													186	210	249	258	300					256	22	201	228	153	263	TSOP-50	
U29																																
U39																																
U61																																
U16														112	133																	
U24						350	334		301		205	159	268	212	178																	
U26			347								103	156	126	131	202																TSOP-50	
U40											204	272	262	278	350																	
U62											261	312	285	218	222																	
PTH																															PTH	

SAC and SnPb CLCC-20 with SAC paste appear less reliable than the other CLCC-20 combinations

= Indicates reworked components
 = SnPb
 = SACB
 = SAC
 = SnCu

SnPb TSOP-50 with SACB Paste

Part	MFG SnPb					MFG SAC					MFG SACB					RWK SnPb					RWK SAC					RWK SACB								
	30	31	32	33	34	99	100	101	102	103	113	139	140	141	142	45	66	67	68	70	172	173	174	175	176	200	201	202	203	204				
U18			306						346	320			318	302																	BGA-225			
U4			311			327		317	112	334			341		346			287		252			169								BGA-225			
U43			175																		267	264	202	212	267	198			207		BGA-225			
U55									222						1								280	255							BGA-225			
U6			316				112		100	162			164	127	188				247		126	216	130	148	128	231	152	135	198	229	BGA-225			
U2			210	260		297	270	258	126	218	298	291	301	223	311	197	193	276			219	151	240	224	190	272	63	5	193	155	BGA-225			
U21									50												290	97	167	148	160	118	163	258	196	176	BGA-225			
U44										213			330								298	168	263	193	255	215	256		274		BGA-225			
U5			303			336	30	264	52	330			287	301	311			261	259	238	107	202	240	107	119	100	129	88	158	42	BGA-225			
U56							96	317	38	0			349								285		270	217							BGA-225			
U10	279	328	306			254	203	256	191	201						274					202	186		236	285	247	241	254	235	198	BGA-225			
U14			330			275	206	256	168	198								300	233		263	262	260	255	237	271	256	252	253		BGA-225			
U17			326	324		277	226	303	171	256					1						291	299		276			277		255	250	CLCC-20			
U45			313			260	261	301	206	299											201	258	254			269	275		278		CLCC-20			
U52						271	255	280	203	302											218	269	252	225	267		268				CLCC-20			
U13	314	295	259	319	297	297	311	309	271	295			346		302			268			250	188	286	206	236	242	239	299	260	222	CLCC-20			
U22			319			286		280	275	349											242	227	213	263	275		278		230		CLCC-20			
U46			305	304				315	284												203	227		287			218		292		CLCC-20			
U53						325		312	299	304											258		258	245	257	291			293		CLCC-20			
U9			302	350	305	309	347	332	230	307			316	348	338						20	224	252	236	273	229	250		252	257	CLCC-20			
U23							0																								CLCC-20			
U35										317																					CLCC-20			
U49					51																										AuPdNi PDIP-20			
U59					11																										AuPdNi PDIP-20			
U8																															AuPdNi PDIP-20			
U11																															AuPdNi PDIP-20			
U30																															AuPdNi PDIP-20			
U38																															AuPdNi PDIP-20			
U51																															AuPdNi PDIP-20			
U63																															AuPdNi PDIP-20			
U15																															AuPdNi PDIP-20			
U27																															AuPdNi PDIP-20			
U28																															AuPdNi PDIP-20			
U47																															AuPdNi PDIP-20			
U54																															AuPdNi PDIP-20			
U1			327																												AuPdNi PDIP-20			
U20																															AuPdNi PDIP-20			
U41																															AuPdNi PDIP-20			
U58																															AuPdNi PDIP-20			
U7									308																						AuPdNi PDIP-20			
U3																															AuPdNi PDIP-20			
U31																															AuPdNi PDIP-20			
U34																															AuPdNi PDIP-20			
U48																															AuPdNi PDIP-20			
U57			51										221										256								AuPdNi PDIP-20			
U12						315			221	311												193		261		202		156	69	288	219	244	254	AuPdNi PDIP-20
U25			350			298		291	293							186	210	249	258	300					256		22	201	228	153	263		AuPdNi PDIP-20	
U29						304		347	299																								AuPdNi PDIP-20	
U39																																	AuPdNi PDIP-20	
U61																																	AuPdNi PDIP-20	
U16						323							71	92	51	112	133								286								TSOP-50	
U24						350	334		301				205	159	268	212	178								254								TSOP-50	
U26			347										103	156	126	131	202								288								TSOP-50	
U40													204	272	262	278	350																TSOP-50	
U62													261	312	285	218	222								254								TSOP-50	
PTH																																	PTH	

SnPb TSOP-50 with SACB paste appears less reliable

Not seeing this effect on SnPb CLCC-20 with SACB paste or SnPb BGA-225 with SACB paste

= Indicates reworked components
 = SnPb
 = SACB
 = SAC
 = SnCu

SAC & SACB Finished Components and SnPb Paste

Part	MFG SnPb					MFG SAC					MFG SACB					RWK SnPb					RWK SAC					RWK SACB											
	30	31	32	33	34	99	100	101	102	103	113	139	140	141	142	45	66	67	68	70	172	173	174	175	176	200	201	202	203	204							
U18																																					
U4									112									287		252			169												261		
U43		175																																		BGA-225	
U55									222						1																						
U6							112		100	162		164	137	188					247		126	216	130	148	128	231	152	135	198	229							
U2		210	260			297	270	258	126	218	298	291		223		197	193		276	219	151	240	224	190	133	272	63	5	193	155							
U21									50											290	97	167	148	160	118	163	258	196	176	272							
U44										213										298	168	263	193	255	215	256			274							BGA-225	
U5							30	264	52									261	259	238	107	202	240	107	119	100	129	88	158	42							
U56							96		38	0											285			270	217					255							
U10	279					254	203	256	191	201						274					202	186		236	285	247	241	254	235	198							
U14						275	206	256	168	198							300	233			263	262	260	255	237	271	256	252	253								
U17						277	226		171	256					1						291	299		276			277		255	250						CLCC-20	
U45						260	261		206	299											201	258	254			269	275		278								
U52						271	255	280	203												218	269	252	225	267		268										
U13	295	259			297	297			271	295						268					250	188	286	206	236	242	239	299	260	222							
U22						286		280	275												242	227	213	263	275		278	230									
U46									284												203	227		287			218	292								CLCC-20	
U53									299												258		258	245	257	291			293								
U9									230												201	224	252	236	273	229	250	252	257								
U23																																					
U35																																					
U49																																					
U59																																			0	AuPdNi PDIP-20	
U6																																					
U11																																					
U30																																					
U38																																				Sn PDIP-20	
U51																																					
U63																																					
U15																																					
U27																											211									Sn PLCC-20	
U28																																					
U47																																					
U54																																					
U1																									287												
U20																																					
U41																																				Sn TQFP-144	
U58																																					
U7																																					
U3																																					
U31																																					
U34																																					
U48																																					
U57	51													221																							
U12									221																												
U25						298		291	293												186	210	249	258	300				254								
U29									299																											TSOP-50	
U39																																					
U61																																					
U16												71	92	51	112	133																					
U24												205	159	268	212	178																					
U26												103	156	126	131	202																					TSOP-50
U40												204	272	262	278																						
U62																																					
PTH												261		285	218	222																					PTH

Interaction of SAC and SACB finished components and SnPb paste due to SnPb reflow profile

Reworked BGA-225s are better

= Indicates reworked components
 = SnPb
 = SACB
 = SAC
 = SnCu

Reworked Leaded SMT Components

Part	MFG SnPb					MFG SAC					MFG SACB					RWK SnPb					RWK SAC					RWK SACB						
	30	31	32	33	34	99	100	101	102	103	113	139	140	141	142	45	66	67	68	70	172	173	174	175	176	200	201	202	203	204		
U18																																
U4									112									287		252			169							261		
U43			175																				267	264	202	212	267	198			207	BGA-225
U55									222														280	255								
U6									112	100	162		164	137	188				247		126	216	130	148	128	231	152	135	198	229		
U2			210	260		297	270	258	126	218	298	291				197	193	276	219	151	240	224	190	133	272	63	5	193	155			
U21									50												290	97	167	148	160	118	163	258	196	176	272	
U44										213											298	168	263	193	255	215	256			274	BGA-225	
U5							30	264	52									261	259	238	107	202	240	107	119	100	129	88	158	42		
U56							96		38	0											285		270	217					255			
U10	279					254	203	256	191	201						274					202	186		236	285	247	241	254	235	198		
U14						275	206	256	168	198							300	233			263	262	260	255	237	271	256	252	253			
U17						277	226		171	256					1						291	299		276			277		255	250	CLCC-20	
U45						260	261		206	299											201	258	254			269	275		278			
U52						271	255	280	203												218	269	252	225	267		268					
U13		295	259		297	297			271	295						268					250	188	286	206	236	242	239	299	260	222		
U22						286		280	275												242	227	213	263	275		278	230				
U46									284												203	227		287			218	292			CLCC-20	
U53									288												258		258	245	257	291			293			
U9																					201	224	252	236	273	229	250	252	257			
U23																																
U35																																
U49																																
U59																0														0	AuPdNi PDIP-20	
U8																																
U11																																
U30																																
U38																															Sn PDIP-20	
U51																																
U63																																
U15																																
U27																											211				Sn PLCC-20	
U28																																
U47																																
U54																																
U1																																
U20																																
U41																																
U58																																
U7																																
U3																																
U31																																
U34																																
U48																																
U57	51																															
U12									221																							
U25						298			291	293						186	210	249	258	300						69	288	219	244	254		
U29										299																						
U39																																
U61																																
U16																																
U24											71	92	51	112	133																	
U26											205	159	268	212	178																	
U40											103	156	126	131	202																TSOP-50	
U62											204	272	262	278																		
PTH											261		285	218	222																PTH	

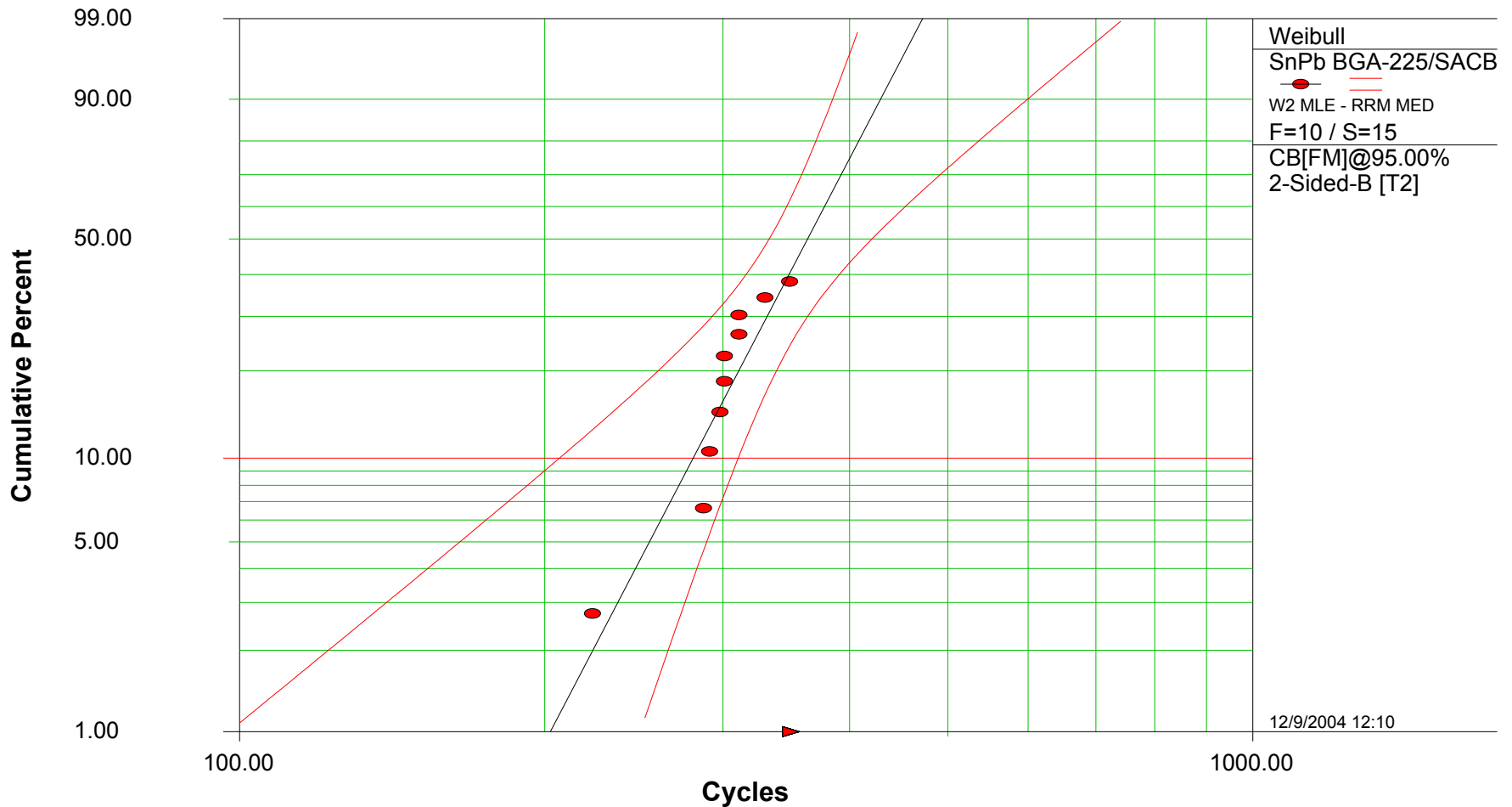
Reworked TQFP-208 and TSOP-50 are failing with little to none of the unreworked components failing. Definite problem with U3.

JCAA/JGPP Lead-Free Solder Project

- **Weibull plots**
 - **Single combinations of solder alloy, lead finish and component type**
 - **Shows 95% confidence limits of the fitted line**

MFG SAC BGA-225/SACB Paste

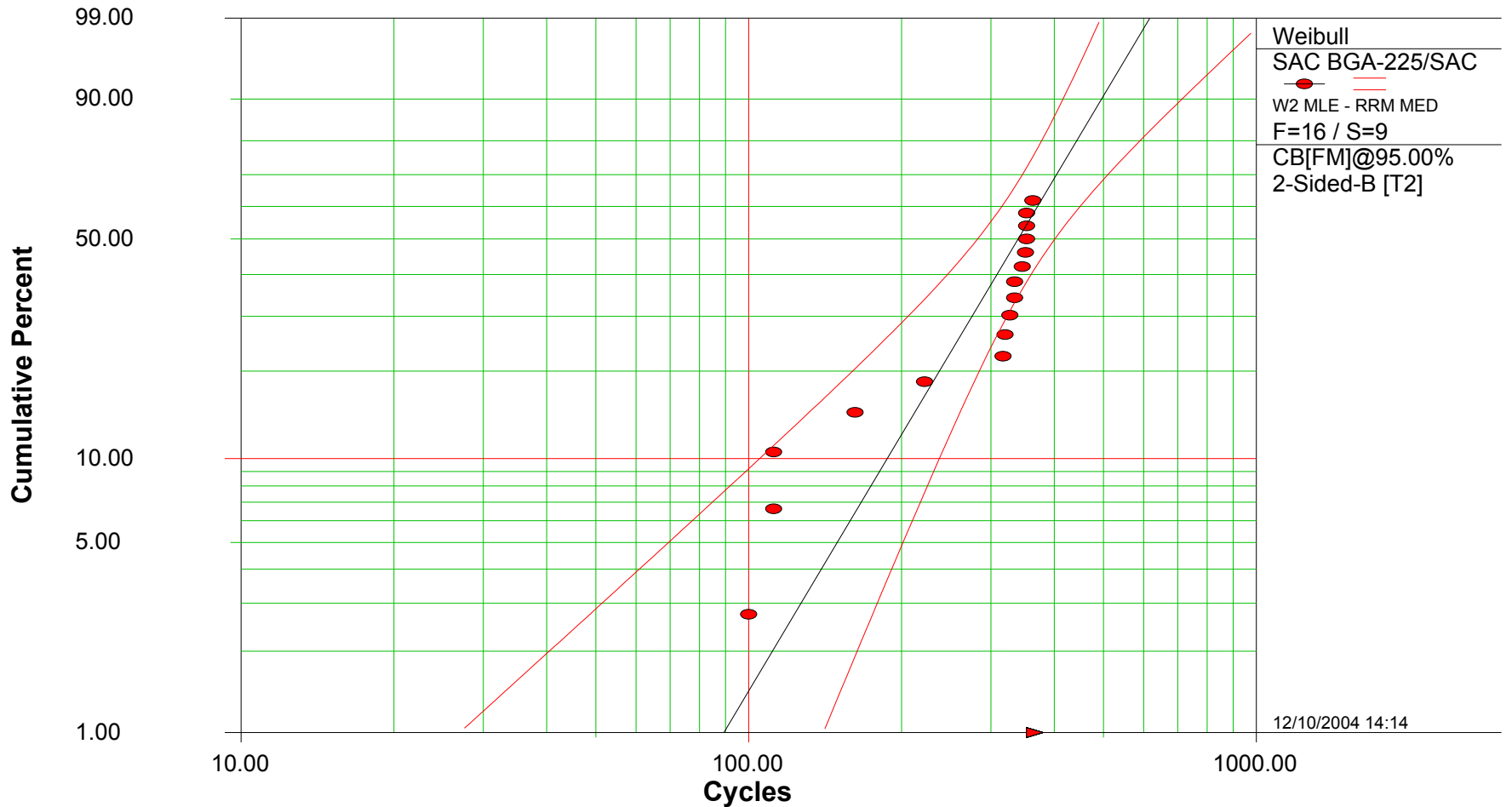
Weibull Plot



$\beta=7.2427, \eta=382.4436$

MFG SAC BGA-225/SAC Paste

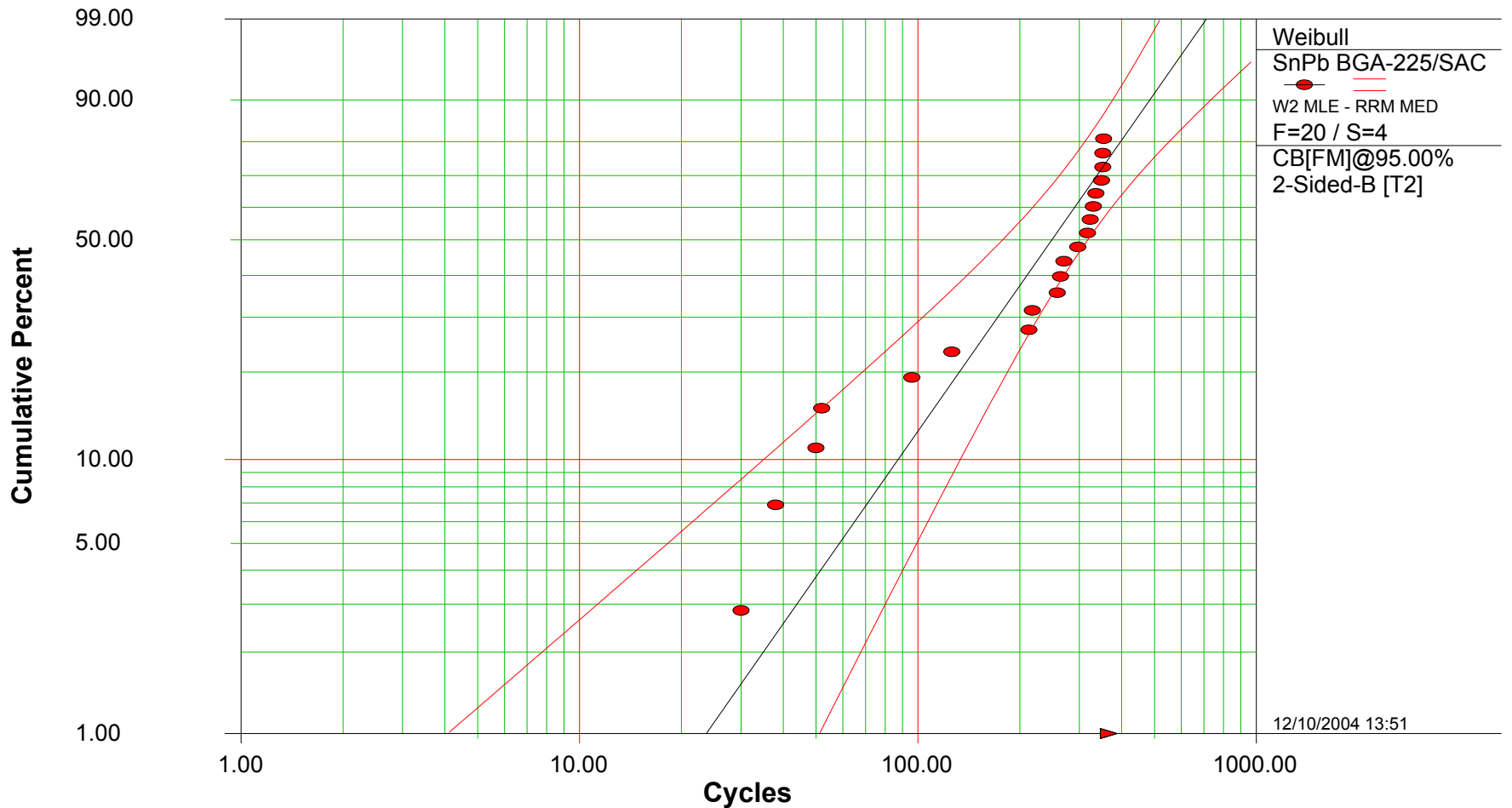
Weibull Plot



$\beta=3.1715, \eta=381.0932$

MFG SnPb BGA-225/SAC Paste

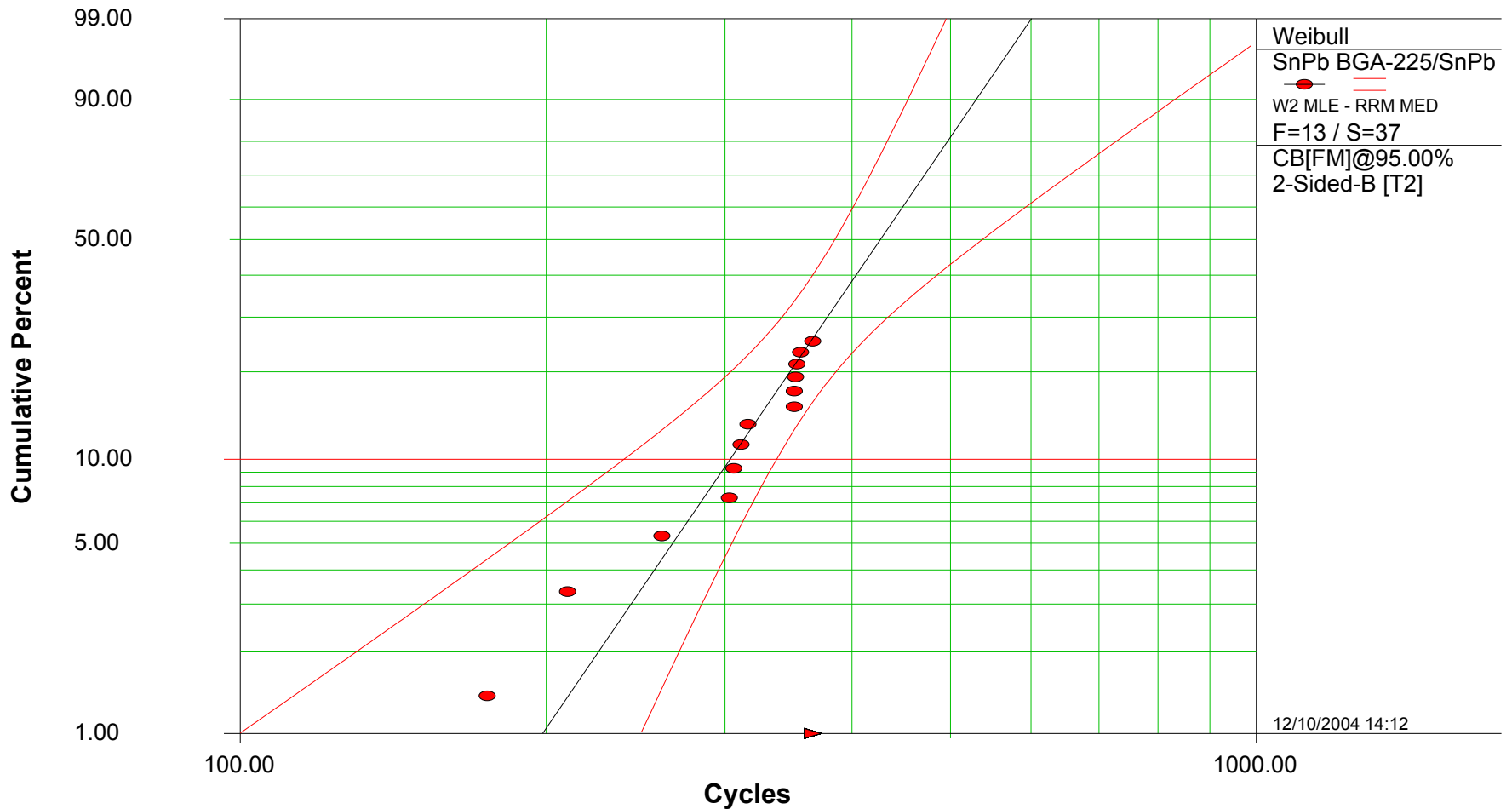
Weibull Plot



$\beta=1.8002, \eta=305.2807$

MFG SnPb BGA-225/SnPb Paste

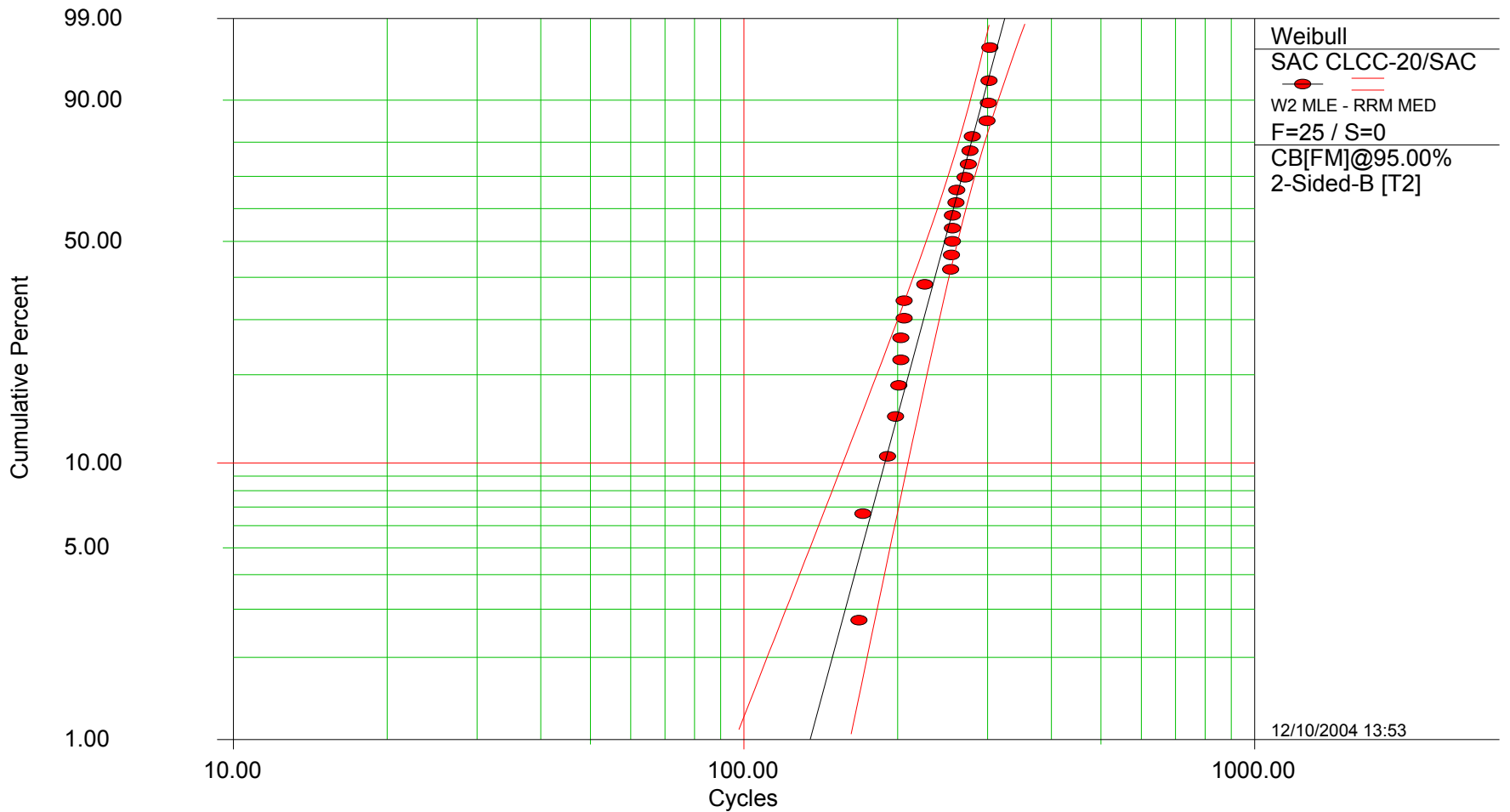
Weibull Plot



$\beta=5.5323, \eta=455.9695$

MFG SAC CLCC-20/SAC Paste

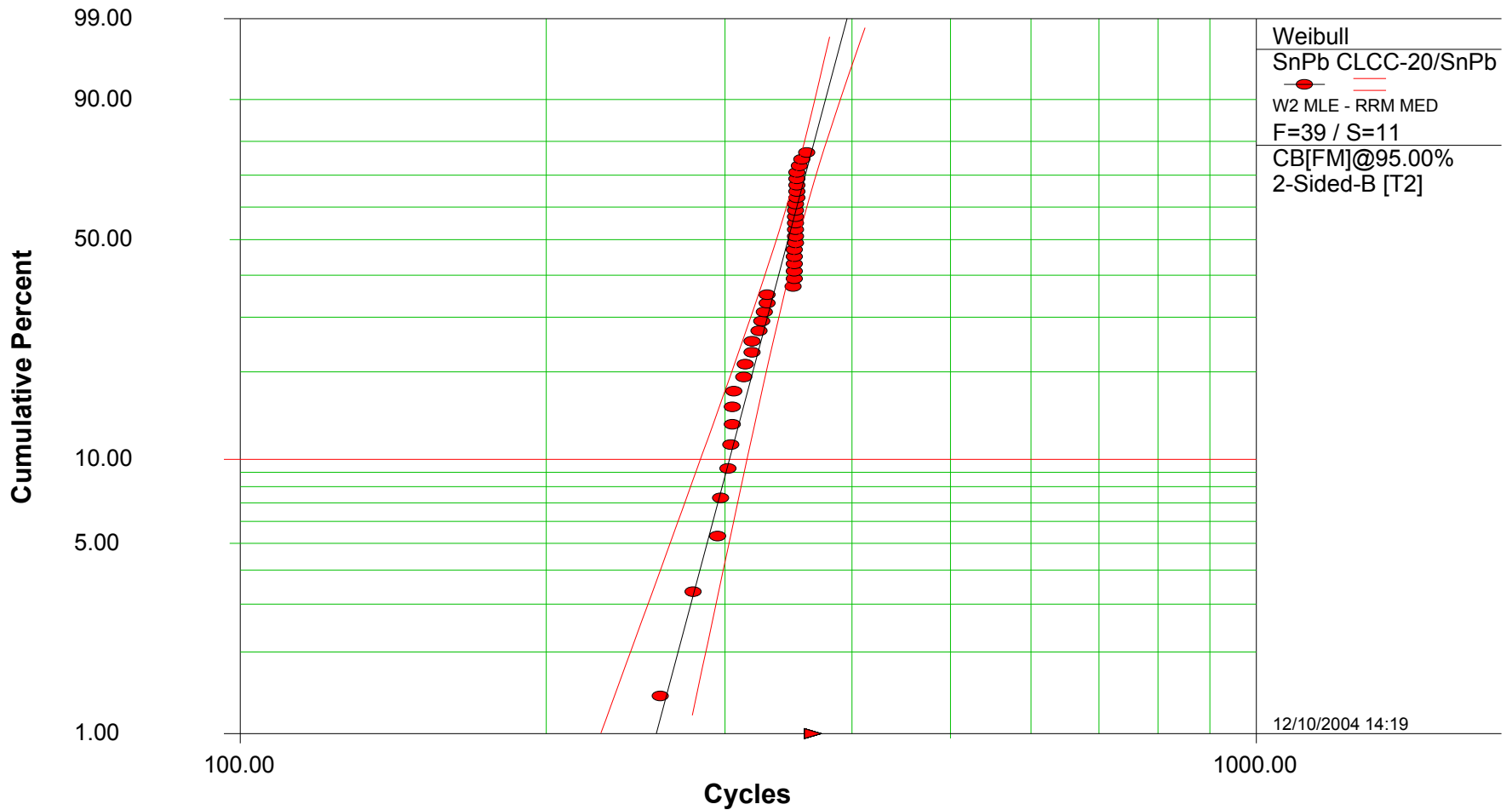
Weibull Plot



$\beta=6.9865, \eta=260.5094$

MFG SnPb CLCC-20/SnPb Paste

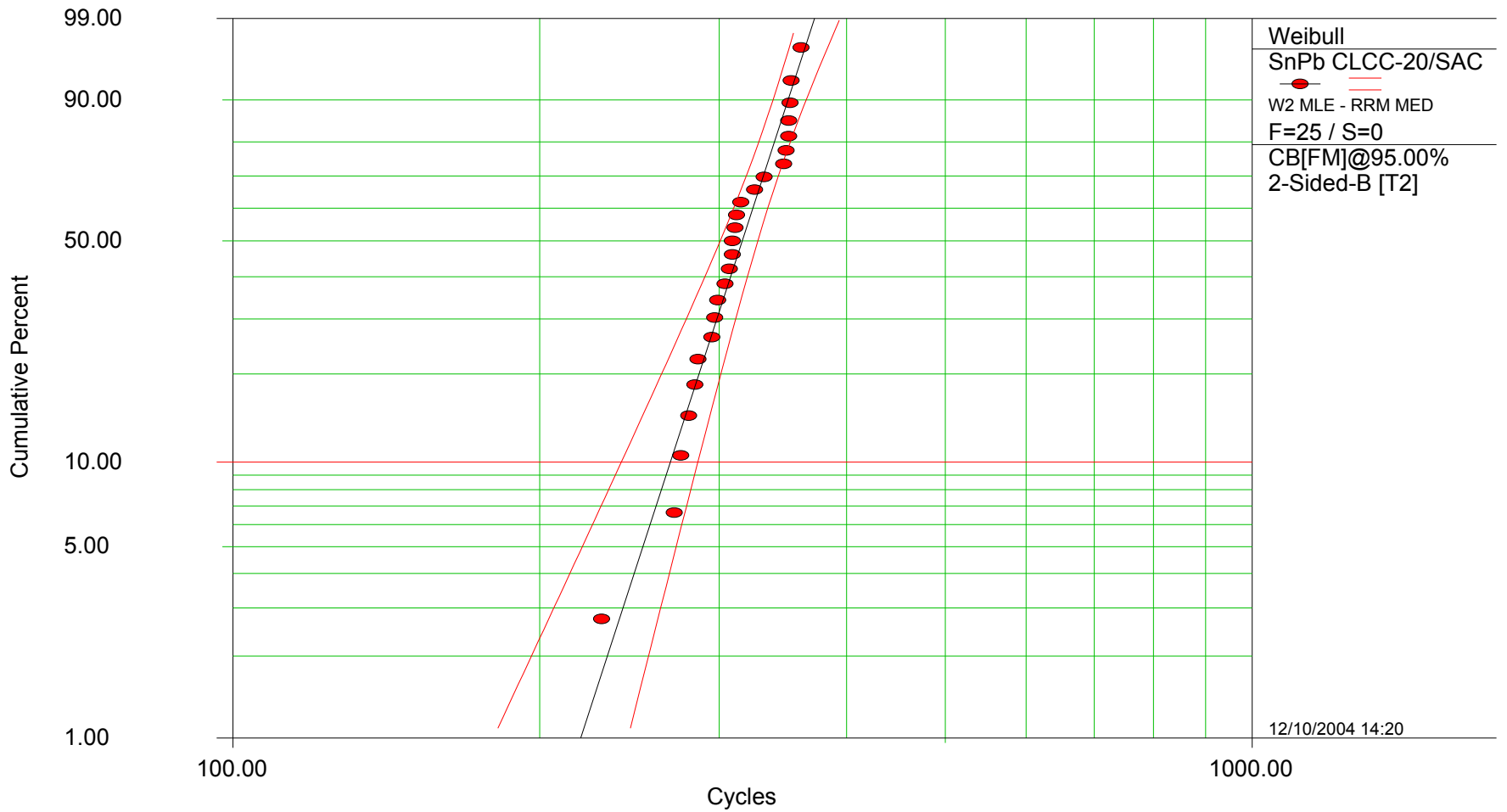
Weibull Plot



$\beta=14.1778, \eta=355.2280$

MFG SnPb CLCC-20/SAC Paste

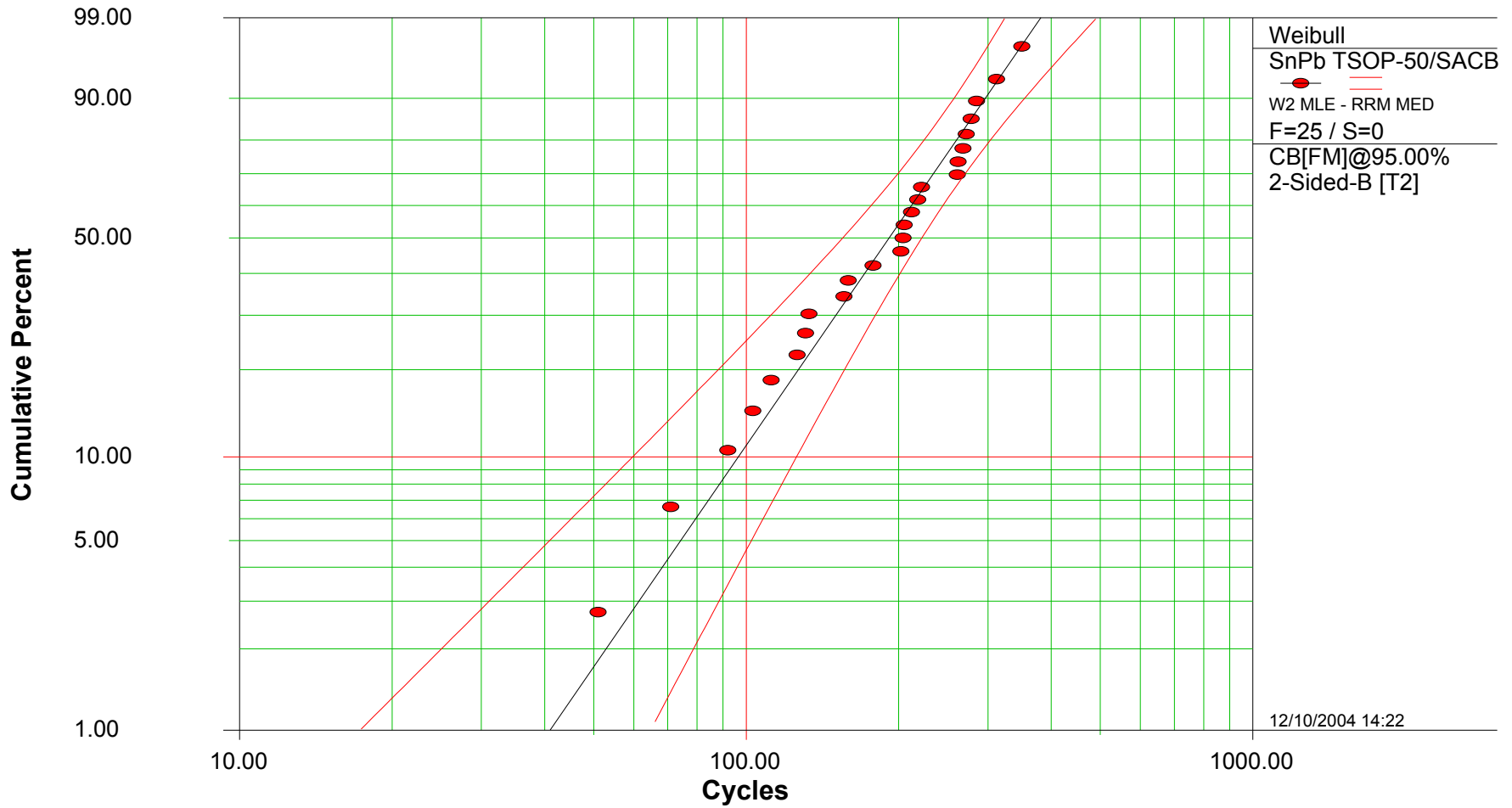
Weibull Plot



$\beta=11.6105, \eta=326.1821$

MFG SnPb TSOP-50/SACB Paste

Weibull Plot



Weibull
SnPb TSOP-50/SACB
W2 MLE - RRM MED
F=25 / S=0
CB[FM]@95.00%
2-Sided-B [T2]

12/10/2004 14:22

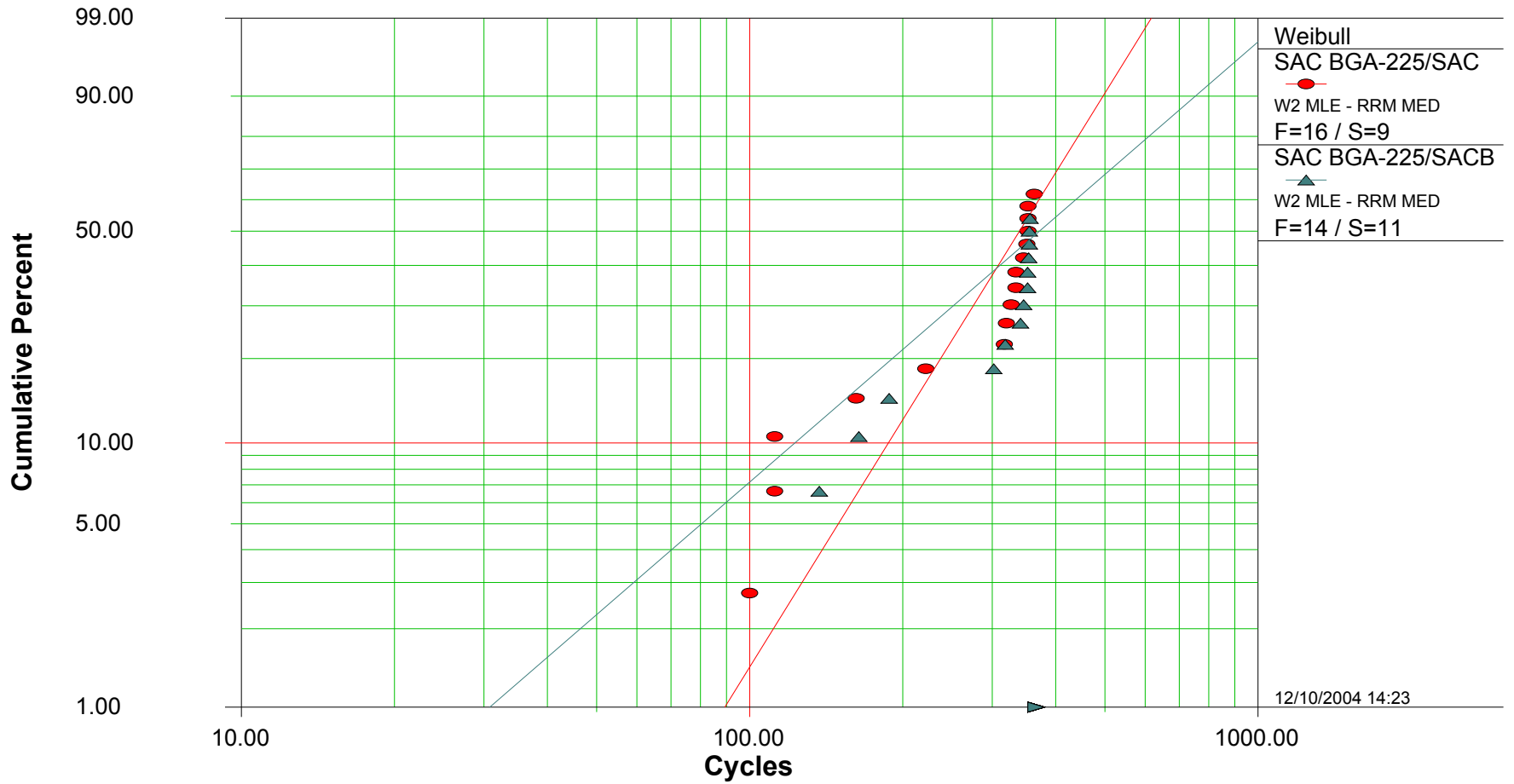
$\beta=2.7476, \eta=218.9992$

JCAA/JGPP Lead-Free Solder Project

- **Weibull plots**
 - **Plots showing all solder alloys for a given combination of component type and lead finish**

MFG SAC BGA-225

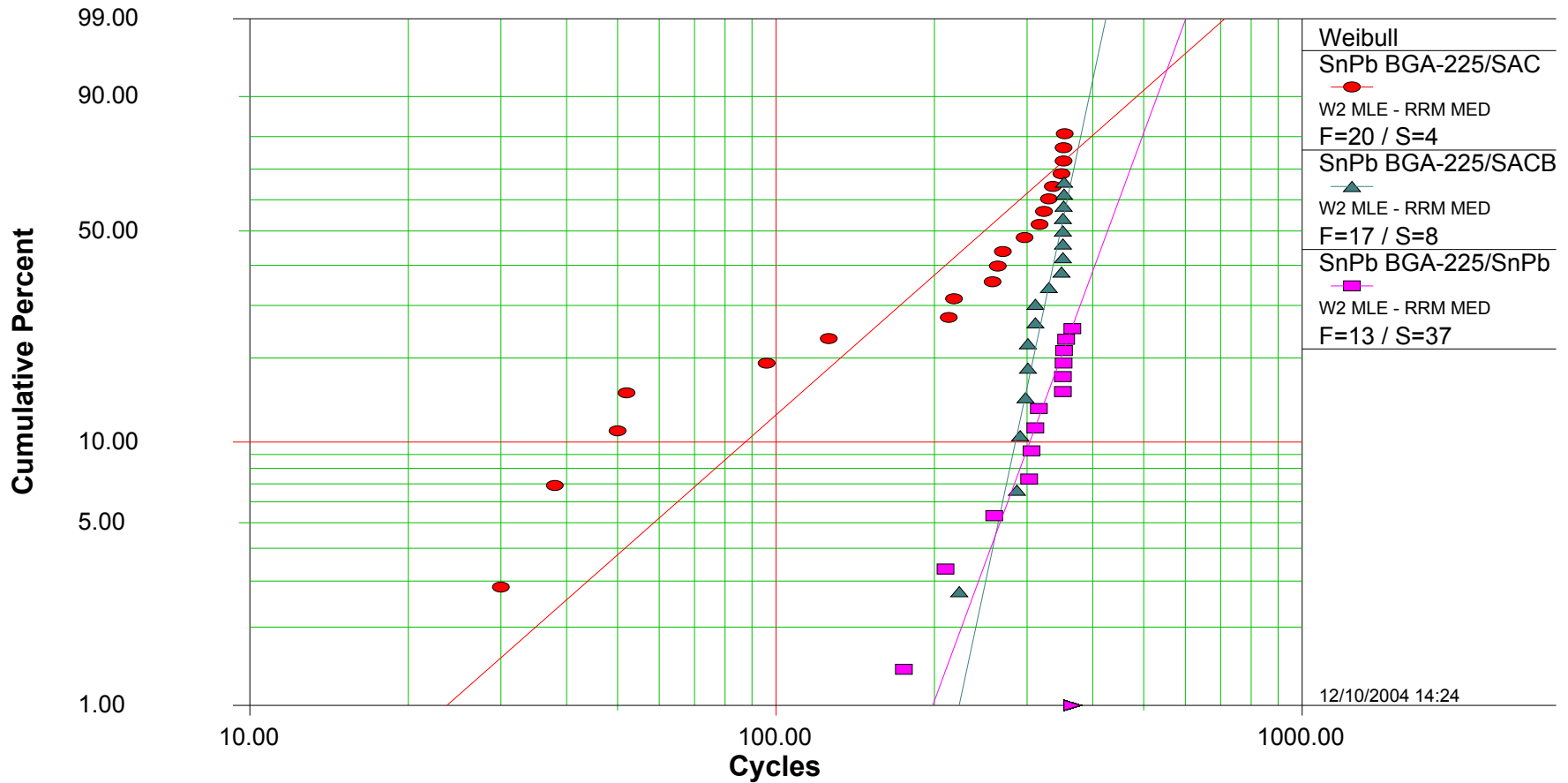
Weibull Plot



$\beta_1=3.1715, \eta_1=381.0932$
 $\beta_2=1.7004, \eta_2=461.1552$

MFG SnPb BGA-225

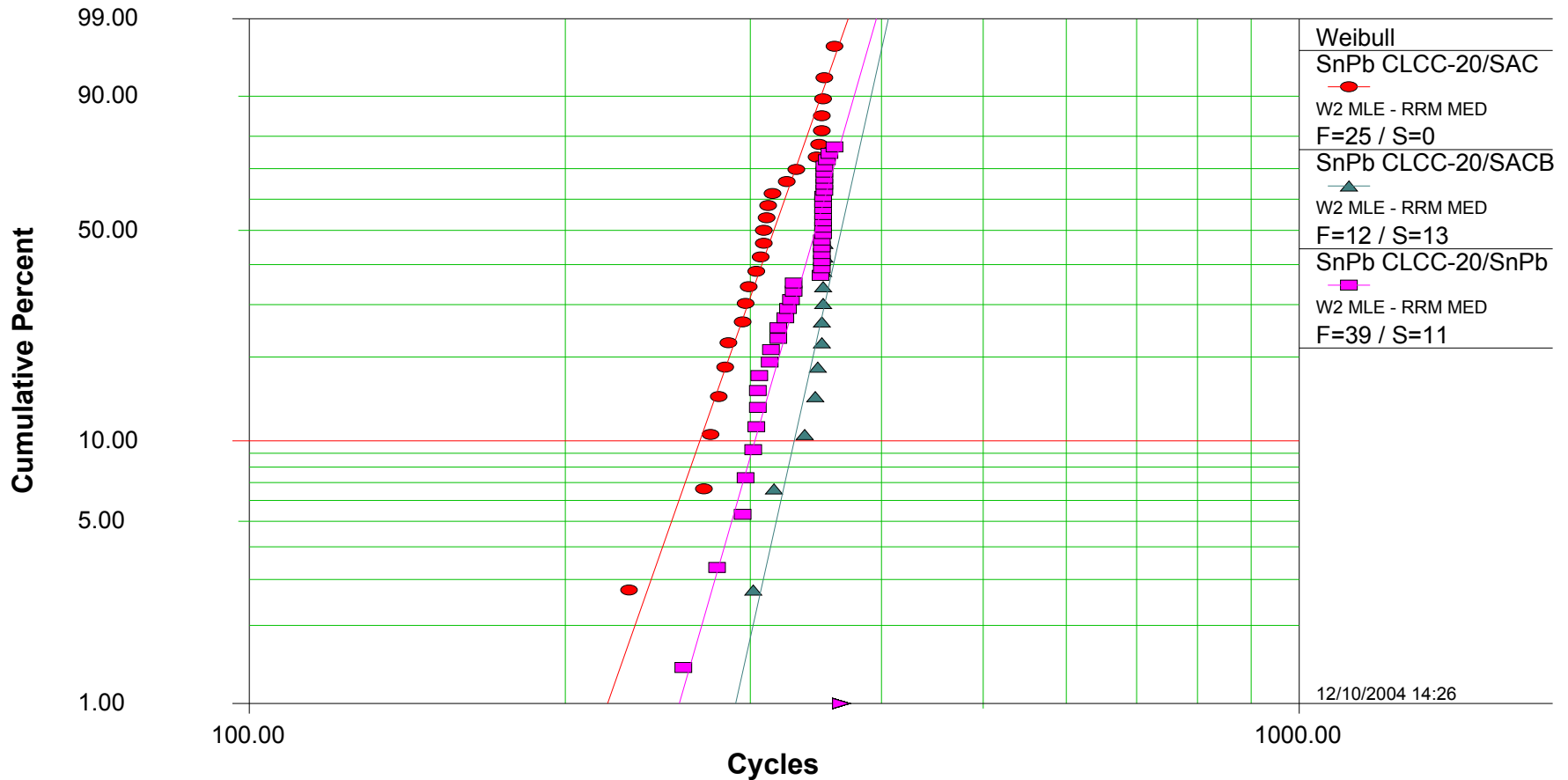
Weibull Plot



$\beta_1=1.8002, \eta_1=305.2807$
 $\beta_2=9.5414, \eta_2=360.9488$
 $\beta_3=5.5323, \eta_3=455.9695$

MFG SnPb CLCC-20

Weibull Plot

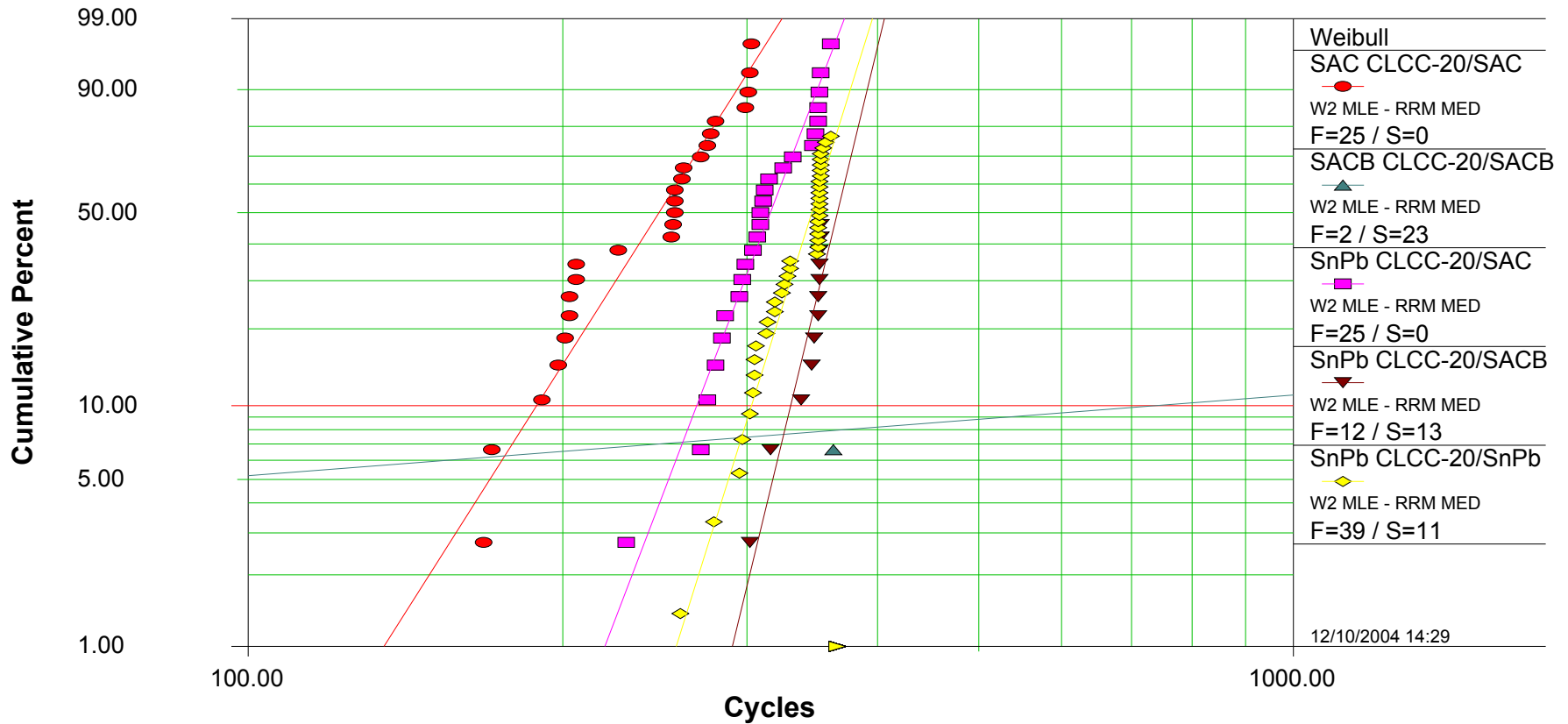


12/10/2004 14:26

$\beta_1=11.6105, \eta_1=326.1821$
 $\beta_2=18.2961, \eta_2=373.6465$
 $\beta_3=14.1778, \eta_3=355.2280$

MFG CLCC-20

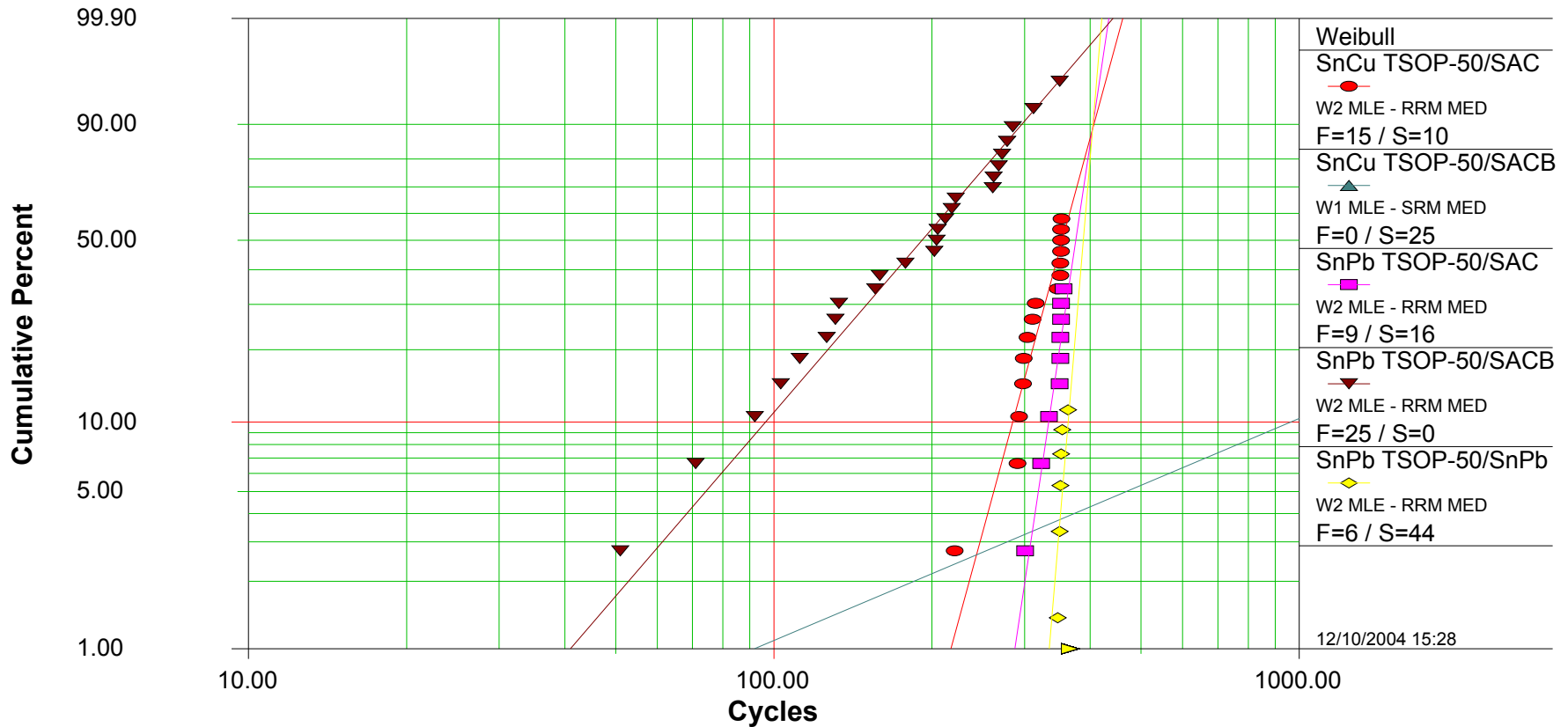
Weibull Plot



$\beta_1=6.9865, \eta_1=260.5094$
 $\beta_2=0.3422, \eta_2=5.2948E+5$
 $\beta_3=11.6105, \eta_3=326.1821$
 $\beta_4=18.2961, \eta_4=373.6465$
 $\beta_5=14.1778, \eta_5=355.2280$

MFG TSOP-50

Weibull Plot

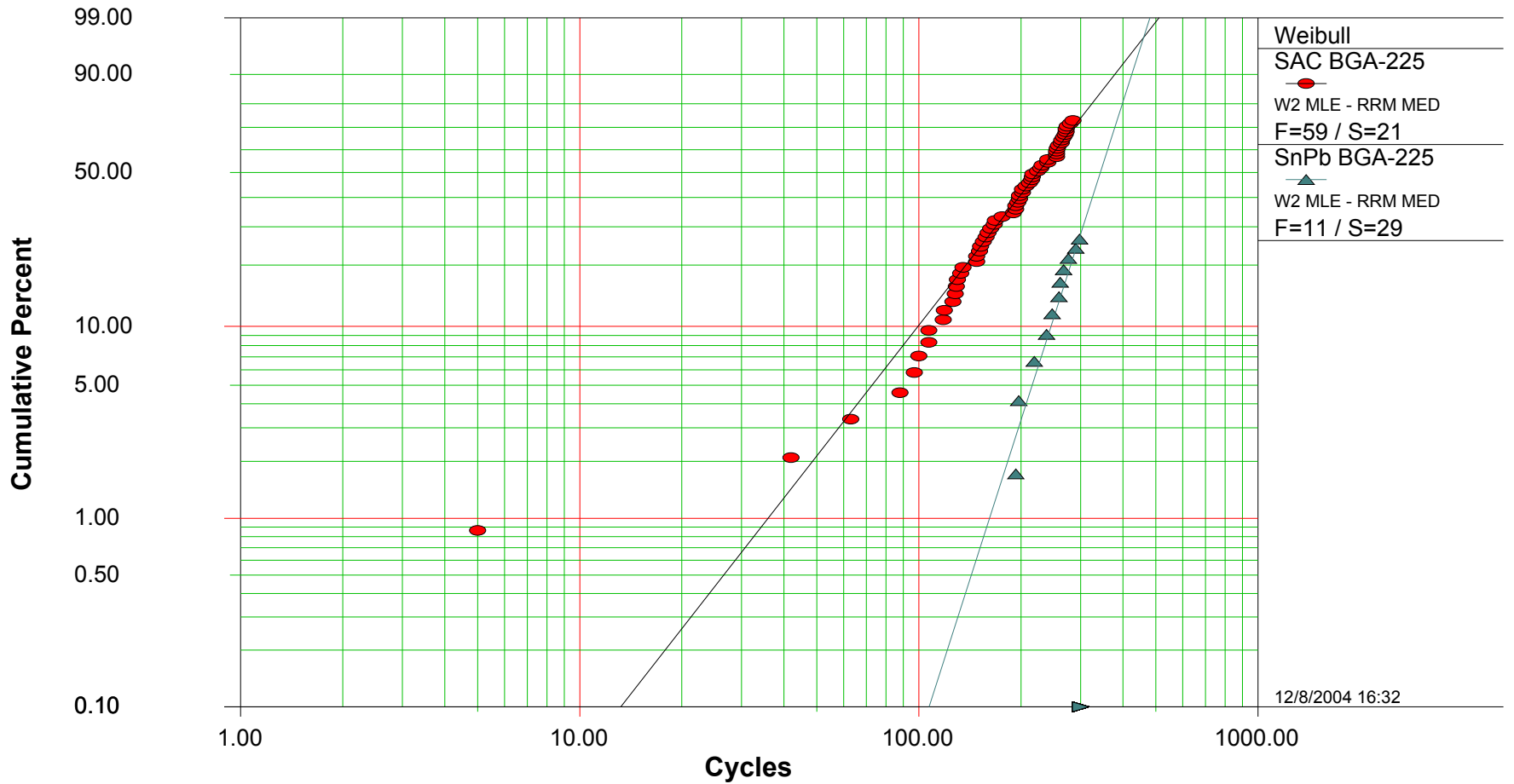


Weibull
 SnCu TSOP-50/SAC
 ● W2 MLE - RRM MED
 F=15 / S=10
 SnCu TSOP-50/SACB
 ▲ W1 MLE - SRM MED
 F=0 / S=25
 SnPb TSOP-50/SAC
 ■ W2 MLE - RRM MED
 F=9 / S=16
 SnPb TSOP-50/SACB
 ▼ W2 MLE - RRM MED
 F=25 / S=0
 SnPb TSOP-50/SnPb
 ◆ W2 MLE - RRM MED
 F=6 / S=44
 12/10/2004 15:28

$\beta_1=8.6755, \eta_1=369.3698$
 $\beta_2=1.0000, \eta_2=9152.9991$
 $\beta_3=15.8675, \eta_3=384.4736$
 $\beta_4=2.7476, \eta_4=218.9992$
 $\beta_5=28.3781, \eta_5=393.3312$

Rework BGA-225

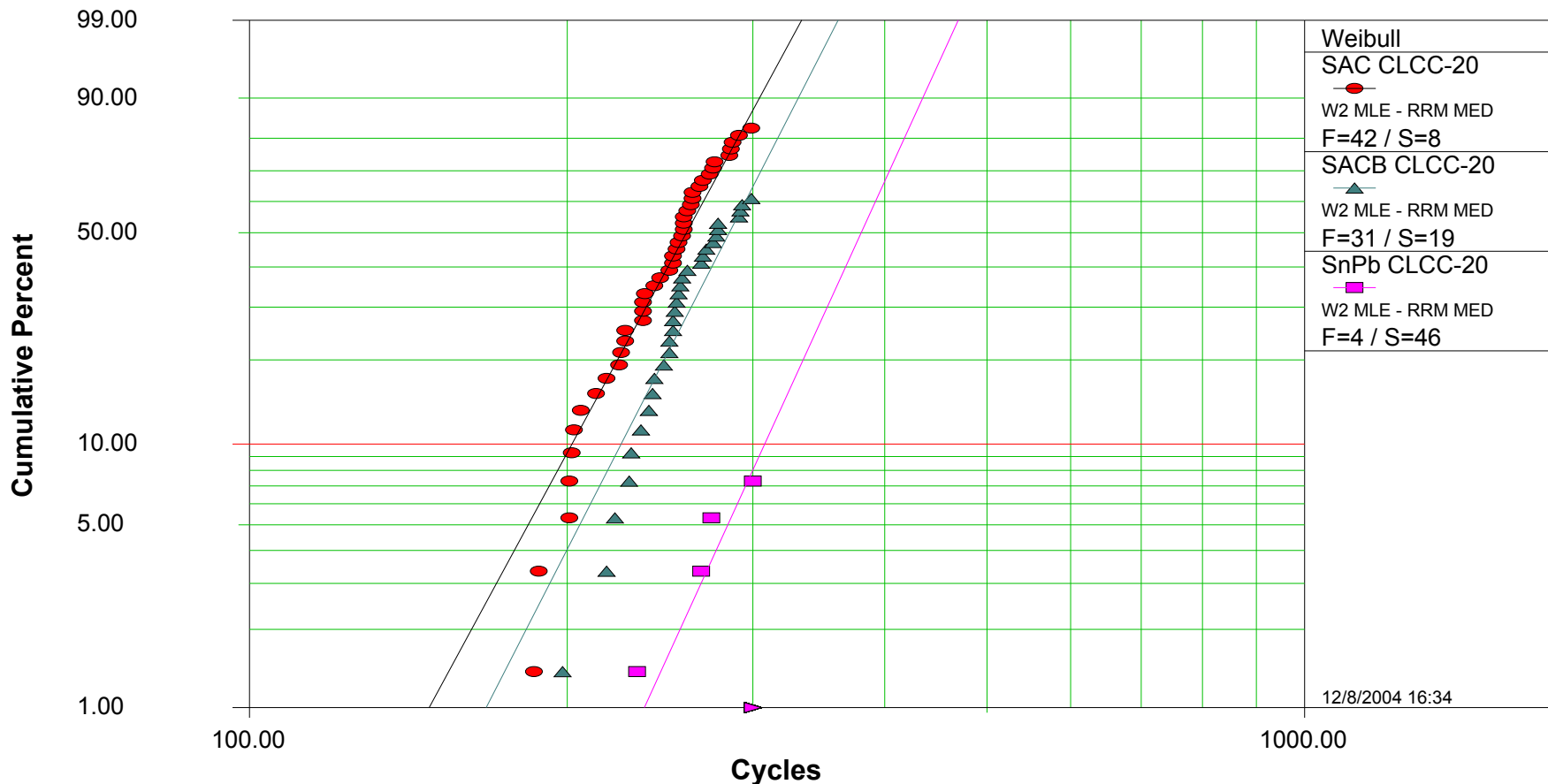
Weibull Plot



$\beta_1=2.3072, \eta_1=263.6944$
 $\beta_2=5.6253, \eta_2=366.2268$

Rework CLCC-20

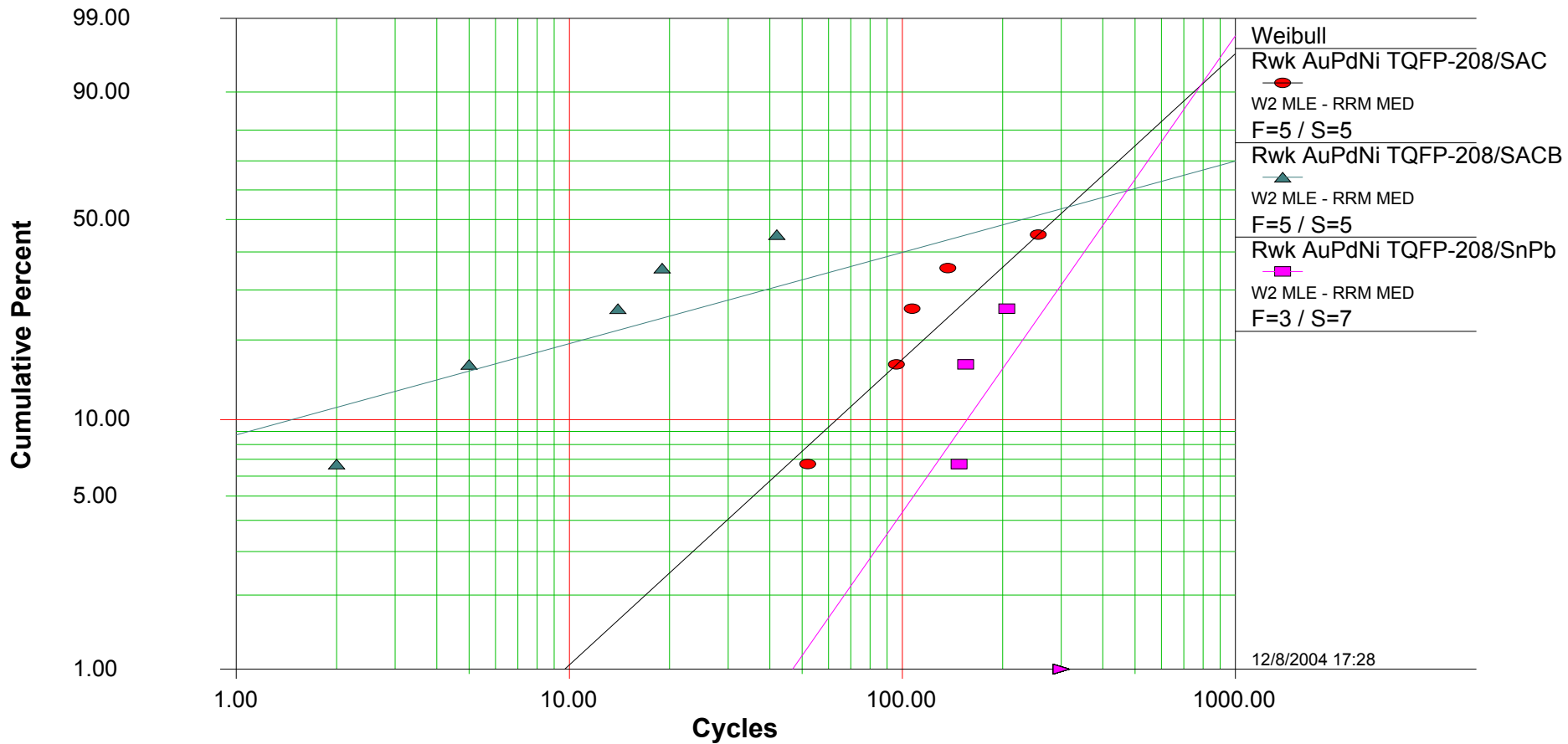
Weibull Plot



$\beta_1=7.5362, \eta_1=272.5469$
 $\beta_2=7.9779, \eta_2=298.4513$
 $\beta_3=8.9446, \eta_3=395.9904$

Reworked TQFP-208

Weibull Plot

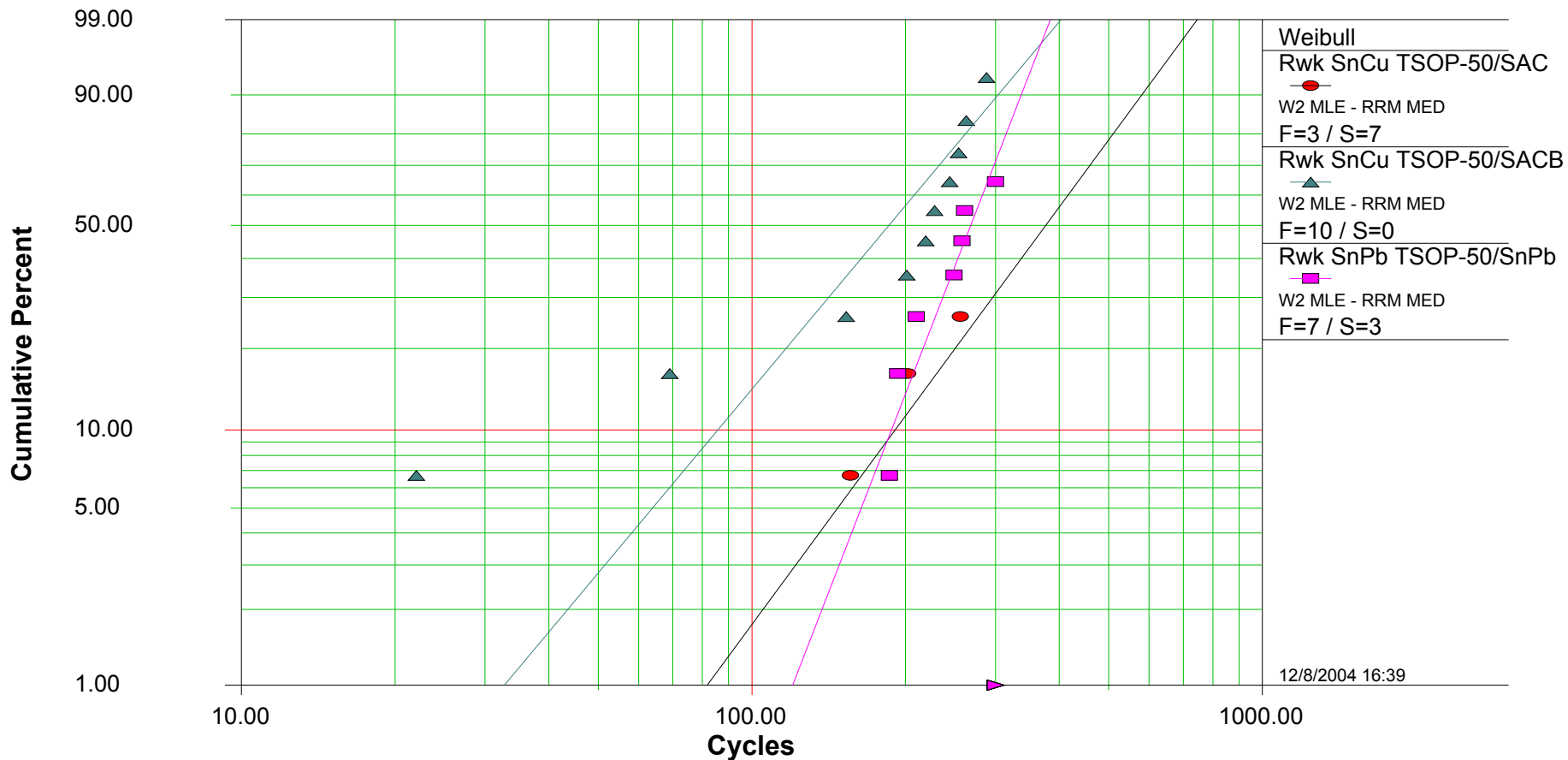


12/8/2004 17:28

$\beta_1=1.2496, \eta_1=384.7808$
 $\beta_2=0.3731, \eta_2=612.8314$
 $\beta_3=1.9481, \eta_3=496.6414$

Reworked TSOP-50

Weibull Plot



12/8/2004 16:39

$\beta_1=2.7717, \eta_1=430.0873$
 $\beta_2=2.4394, \eta_2=215.7865$
 $\beta_3=5.2679, \eta_3=287.9267$

Summary

- **Too few failures**
- **Manufactured boards**
 - **SAC and SnPb CLCC-20 with SAC paste appear less reliable**
 - **SnPb TSOP-50 with SACB paste appears less reliable**
- **Rework boards**
 - **Interaction of SAC and SACB finished components and SnPb paste due to SnPb reflow profile used**
 - **Possible rework issue with leaded SMT components?**
- **Plan to continue test as budget and Anatech event detector availability allow**