

LEAD-FREE SOLDER ALLOY USA PATENTS

	Patent Number	Assigned To	Metals Weight %							
			Sn	Ag	Cu	Bi	Sb	Zn	In	Other
1	3,607,253	International Business Machines Corp	89.4-95.1	3.0-3.8	-	-	0.2-0.5	-	-	Cd 0.7-1.3
2	4,042,725	Asahi Glass Company	2.0-85	0-5	-	-	-	15-98	-	Al 0.01-0.5
3	4,170,472	Motorola, Inc.	61-69	23-28	-	-	8.0-11	-	-	
4	4,667,871	GTE Products Corporation	35-95	0.5-70	0.5-20	-	-	-	-	Ti,V,Zr 0.1-4 Ni 0-5 Cr 0-2
5	4,670,217	JW Harris Company	90.0-98.5	0.5-2	-	-	0.5-4.0	0.5-4.0	-	
6	4,695,428	JW Harris Company	86.8-98.8	0.1-3.0	0.1-2.0	-	0.5-4.0	0.5-4.0	-	
6A	4,695,428	JW Harris Company	96.5	3	0.5	-	-	-	-	
7	4,758,407	JW Harris Company	87-92.9	0-0.5	3.0-5	-	4.0-6	-	-	Ni 0-2
8	4,758,407	JW Harris Company	92.5-96.9	0-5	3.0-5	-	-	-	-	Ni 0.1-2
9	4,778,733	Engelhard Corporation	92-99	0.05-3	0.7-6	-	-	-	-	
10	4,806,309	Willard Industries	90-95	0.1-0.5	-	1-4.5	3.0-5	-	-	
11	4,879,096	Oatey Company	88-99.35	0.05-3	0.5-6	0.1-3	-	-	-	
12	4,929,423	Cookson Group, PLC	Balance	0.01-1.5	0.02-1.5	0.08-20	-	-	-	P 0-.10 Rare Earth 0-0.2
13	5,094,813	Kale, Sadashiv S	95.68	0.08-0.16	2.8-3.5	-	-	0.2-0.5	-	Ni 0.08-0.16
14	5,102,748	Taracorp, Inc.	Balance	-	3.0-6	-	-	-	-	Se 0.1-1 Te 0.1-1
15	5,147,471	Kronberg, James W	50-70	-	-	-	-	25-40	-	Ge 0.1-10
16	5,242,658	The Indium Corporation of America	72.8-89.4	-	-	-	-	6.7-19.2	2.7-16.4	
17	5,256,370	The Indium Corporation of America	70-92	1.0-6	-	-	-	-	4.0-35	
18	5,316,205	Motorola, Inc.	Balance	-	-	30-70	-	-	-	gold bump
19	5,320,272	Motorola, Inc.	Balance	1.0-2.2	-	-	-	-	-	Au 1.0-2.2
20	5,328,660	International Business Machines Corp	78.4	2	-	9.8	-	-	9.8	
21	5,344,607	International Business Machines Corp	90	-	-	2	-	-	8	
22	5,352,407	Seelig, Karl F	93-98	1.5-3.5	0.2-2.0	-	0.2-2.0	-	-	
23	5,390,080	Motorola, Inc.	Balance	-	-	-	-	4.0-12	-	
24	5,393,489	International Business Machines Corp	93.5-94	2.5-3	1	1.0-2	1.0-2	-	-	
25	5,405,577	Seelig, Karl F	90.3-99.2	0.5-3.5	0.1-2.8	-	0.2-2.0	-	-	
26	5,411,703	International Business Machines Corp	93.0-94.0	-	1.0-2.0	1.5-2.5	2.5-3.5	-	-	
27	5,414,303	International Business Machines Corp	70-90	-	-	2.0-10	-	-	8.0-20	
28	5,429,689	Ford Motor Company	80	0.5	-	4.5-14.5	-	-	5-14.5	
29	5,435,968	Touchstone, Inc.	79-97	0-4.0	3.0-15.0	0.0-1.0	-	-	-	Se 0.0-1.0
30	5,439,639	Sandia Corporation	91-96	3.2-4.83	-	>3	-	-	-	

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			Sn	Ag	Cu	Bi	Sb	Zn	In	Other	
31	5,452,842	Motorola, Inc.	Balance	-	-	-	-	-	4.0-12	-	
32	5,455,004	The Indium Corporation of America	82-90	-	-	1.0-5	-	-	4.5-6	3.5-6	
33	5,527,628	USA Army	86-97	0.3-4.5	0.0-5	0.0-4.8	-	-	-	0.0-9.3	Intermetallic Filler
34	5,527,628	Iowa State University, Sandia	Balance	3.5-7.7	1.0-4.0	0.0-10.0	-	-	0.0-1.0	-	Si,Sb,Mg,Ca,rare earth, misc metal <1
35	5,538,686	AT&T Corporation	>70	<5	<5	<10	<5	<5	6.0-10	3.0-10	<5 Au
36	5,569,433	Lucent Technologies, Inc.	40-60	0.05-1	-	>40	-	-	-	-	
37	5,580,520	The Indium Corporation of America	71.5-91.9	2.6-3.3	-	-	-	-	-	4.8-25.9	
38	5,658,528	Mitsui Mining & Smelting Co. Ltd	Balance	1.0-4	-	See Other	-	-	-	See Other	(Ag+1.23Bi+0.52In)≥5
39	5,698,160	Lucent Technologies, Inc.	59-82	2.0-11	-	-	-	-	16-30	-	
40	5,728,868	Mitsui Mining & Smelting Co. Ltd	Balance	-	0.1-0.5	<3	-	-	7.0-9.0	-	
41	5,730,932	International Business Machines Corp	80-81	2.0-4	10.0-12	-	-	-	-	5.0-6	
42	5,733,501	Kabushiki Kaisha Toyota Chuo Kendyusho	Balance	0.8-5	-	>0.1	0.1-10	-	-	>0.1	In+Bi<17
43	5,755,896	Ford Motor Company	37-53	-	-	37-57	-	-	-	6.0-10	
44	5,762,866	Lucent Technologies, Inc.	Balance	1.0-6	-	0.2-0.6	-	-	0.2-0.6	0.2-0.6	
45	5,817,194	Fukuda Metal Foil & Powder Co. Ltd	Balance	≤10	≤3	-	-	-	-	-	P 0.05-1.5 Ni 0.05-1.5
46	5,837,191	Johnson Manufacturing Company	Balance	0.05-0.6	0.05-0.6	-	0.75-2	-	-	-	Ni 0.05-0.6
47	5,843,371	Samsung Electro-Mechanics Co. Ltd	Balance	3.0-4	-	6.0-14	-	-	-	2.0-5	
48	5,851,482	Korea Institute of Machinery & Metals	Balance	-	-	5.0-15	0.01-3	0.01-3	-	-	Mg 0.01-3 Al 0.01-3 Te 0.01-3
49	5,863,493	Ford Motor Company	91.5-96.5	2.0-5	0-2.9	-	-	-	-	-	Ni 0.1-3
50	5,874,043	International Business Machines Corp	70.5-73.5	6.5-7.5	-	-	-	-	-	Balance	
51	5,918,795	Matsushita Electric Industrial Co. Ltd	83-92	2.5-4	0.0-0.7	5.0-18	-	-	-	0.0-1.5	