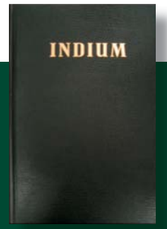
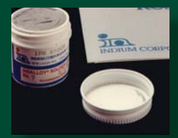
Solder Alloy Directory

INDIUM CORPORATION®

Innovation





The Indium Corporation enjoys a rich and productive history. Our roots go back to the 1800's when indium was first discovered by Reich and Richter and when applications for its use were being considered. These roots extend from developing metals purification technology to performing zero-gravity refining process research in outer space. Along the way we developed unique products that enabled our customers to reach their goals.

We are proud of the numerous awards and the recognition we have received for these efforts. We are prouder yet of the achievements that will shape the future.

1930s | 1940s | 1950s | 1960s | 1970s | 1980s | 1990s | 2000— present

1863	Indium is discovered by F. Reich and T. Richter in Germany.
1926	First indium processing patent is awarded to Dr. William S. Murray and Associates of Oneida Community, Ltd.
1934	Indium Corporation of America founded in Utica, New York, USA by Dr. William S. Murray.
1942	Indium Corporation awarded the prestigious Army Navy "E" Award for manufacturing excellence.
1943	Manufacturing facility established at Lincoln Avenue, Utica, NY, USA.
1952	Developed commercially-viable process for production of precision solder preforms.
1960-65	Indium Corporation of America develops indium inorganic chemicals, including: indium oxide, indium-tin oxide, indium chloride, and indium hydroxide.
1982	Developed manufacturing capabilities for spherical solder powder production.
1985	Established manufacturing facility at Robinson Road, Clinton, NY, USA.
1986	R&D Department for solder research is formed under the direction of Dr. Ning-Cheng Lee.
1988	Earned New York State Governor's Award for Achievement in Exporting.
1989	Performed Indium Float Zone Purification Experiment aboard NASA's Space Shuttle Mission STS-30, Atlantis.
1990	Indium Corporation of Europe (ICE) is founded.
1990	Performed Microgravity Disturbances Experiment aboard NASA's Space Shuttle Mission STS-32, Columbia.
1994	Established office in Turin, Italy to facilitate sales of metals & chemicals in Europe & Asia.

1995	Indium Corporation of America - Singapore (Asia-Pacific Operations) is founded.
1995	Website is launched: http://www.indium.com.
1998	Indium Corporation earns the Frost & Sullivan Market Engineering Customer Service Leadership Award for developments in the solder paste and adhesive markets.
2000	Indium Corporation earns the Frost & Sullivan Market Engineering Customer Service Leadership Award for developments in the solder paste and adhesive markets.
2003	Indium Corporation earns the Frost & Sullivan Product Innovation Award for the development of NC-SMQ230 Pb-Free solder paste.
2004	Indium Corporation honored with 2nd award for outstanding performance in quality and service for our work as a supplier to a major battery manufacturer.
2004	Indium Corporation (Suzhou) Co., LTD is founded.
2005	Greg Evans, Indium Corporation President, is honored with the SMTA Founder's Award.
2005-06	NF260 No-Flow Underfill wins the Global Technology Award, SMT Vision Award, and EM Asia Innovation Award.
2006	Indium Corporation earns the Frost & Sullivan Market Engineering Customer Service Leadership Award for developments in the solder paste and adhesive markets.
2006	Indium5.1AT No-Clean Pb-Free Solder Paste wins the Global Technology Award.

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Solder Alloys

Mechanical Properties

Alloy Properties

Indalloy Number	TEMP Liquidus (°C)	TEMP Solidus (°C)	Elemental Composition (% by Mass)	TEMP Liquidus (°F)	TEMP Solidus (°F)	Density (lb/in³)	Density (gm/cm³)	Electrical Conductivity (1.7μohms-cm (% of IACS)	Thermal Conductivity @ 85°C (W/cm-°C)	Thermal Coefficient Expansion @20°C (PPM/°C)	Tensile Strength (PSI)	Shear Strength (PSI)	Young's Modulus (PSI x 10^6)	Elongation (%)	Brinell Hardness	Latent Heat of Fusion (J/g)	Specific Heat Solid (J/g-°C)	Specific Heat Liquid (J/g-°C)	Application Notes
46L	8	7	61.0Ga 25.0In 13.0Sn 1.0Zn	46	44	0.2348	6.50												Liquid metal used as a replacement for mercury
51	11E	11	62.5Ga 21.5In 16.0Sn	51	51	0.2348	6.50												
60	16E	16	75.5Ga 24.5In	60	60	0.2294	6.35												
77	25	16	95.0Ga 5.0In	77	60	0.2222	6.15												
14	30MP		100.0Ga	86		0.2133	5.90												
15	43	38	42.9Bi 21.7Pb 18.3In 8.0Sn 5.1Cd 4.0Hg	109	100	0.3353	9.28												
117	47E	47	44.7Bi 22.6Pb 19.1In 8.3Sn 5.3Cd	117	117	0.3310	9.16	4.5	.15	25	5400			37.5 note 4	16.5 note1	36.8	0.163	0.197	See Table 1
16	52	47	44.7Bi 22.6Pb 16.1In 11.3Sn 5.3Cd	126	117	0.3310	9.16												
17	56	54	49.1Bi 20.9In 17.9Pb 11.6Sn 0.5Cd	133	129	0.3255	9.01												
136	58E	58	49.0B i21.0In 18.0Pb 12.0Sn	136	136	0.3255	9.01	2.43	.10	23	6300			20 note 4	16.5 note1	28.9	0.167	0.201	Poor wettability, but adequate for mechanical joining of metallic substrates when highly active flux is used. See Table 1
19	60E	60	51.0In 32.5Bi 16.5Sn	140	140	0.2847	7.88	3.3		22	4850				11				
18	62E	62	61.7In 30.8Bi 7.5Cd	143	143	0.2898	8.02												
140	65	57	47.5Bi 25.4Pb 12.6Sn 9.5Cd 5.0In	149	135	0.3422	9.47	3.5	.15		3725			77.5 note 4	14 note 1	36	0.159	0.188	
147	65	61	48.0Bi 25.6Pb 12.8Sn 9.6Cd 4.0In	149	142	0.3432	9.50												See Table 1
21	69	58	49.0Bi 18.0Pb 18.0In 15.0Sn	156	136	0.3252	9.00												
158	70E	70	50.0Bi 26.7Pb 13.3Sn 10.0Cd	158	158	0.3461	9.58	4	.18	22	5990	300		120 note 4	14.5 note 1	39.8	0.146	0.184	Good fusible alloy. Can be used for lens blocking. See Table 1
162	72E	72	66.3In 33.7Bi	162	162	0.2887	7.99												
22	73	70	50.5Bi 27.8Pb 12.4Sn 9.3Cd	163	158	0.3494	9.67												
23	73	70	50.0Bi 25.0Pb 12.5Sn 12.5Cd	163	158	0.3468	9.60	3.1			4550			30	25				Non-electrical solder for low-ambient temperature
24	73	70	50.0Bi 25.0Pb 12.5Sn 12.5Cd Dopant: 0.05 Ag	163	158	0.3465	9.59												
25	78E	78	48.5Bi 41.5In 10.0Cd	172	172	0.3067	8.49												
26	78	70	50.0Bi 34.5Pb 9.3Sn 6.2Cd	172	158	0.3573	9.89												
174	79E	79	57.0Bi 26.0In 17.0Sn	174	174	0.3086	8.54												
27	81E	81	54.0Bi 29.7In 16.3Sn	178	178	0.3060	8.47												
28	82	77	50.0Bi 39.0Pb 8.0Cd 3.0Sn	180	171	0.3660	10.13												
29	85	81	50.3Bi 39.2Pb 8.0Cd 1.5In 1.0Sn	185	178	0.3667	10.15												
160-190	88	71	42.5Bi 37.7Pb 11.3Sn 8.5Cd	190	160	0.3544	9.81	4.3			5400	300		135 note 4	15 note 1	34.3	0.146		See Table 1
31	89	80	50.3Bi 39.2Pb 8.0Cd	1.5	Sn	1.0	In				192	176	0.3667	10.15					
32	89	80	50.9Bi 31.1Pb 15.0Sn 2.0In 1.0Cd	192	176	0.3479	9.63												
33	91	87	51.1Bi 39.8Pb 8.1Cd 1.0In	196	189	0.3689	10.21												
34	92	83	52.0Bi 31.7Pb 15.3Sn 1.0Cd	198	181	0.3505	9.70												
197	92E	92	51.6Bi 40.2Pb 8.2Cd	198	198	0.3703	10.25												
35	93	73	50.0Bi 39.0Pb 7.0Cd 4.0Sn	199	163	0.3653	10.11												
36	93	87	51.4Bi 31.4Pb 15.2Sn 2.0In	199	189	0.3483	9.64												
8	93E	93	44.0In 42.0Sn 14.0Cd	199	199	0.2695	7.46		.36	24	2632				4.8 note 2				
37	94	90	52.0Bi 31.7Pb 15.3Sn 1.0In	201	194	0.3505	9.70												
38	95E	95	52.5Bi 32.0Pb 15.5Sn	203	203	0.3508	9.71												
257	96	95	52.0Bi 32.0Pb 16.0Sn	204	203	0.3501	9.69			24	5060	3800	2.08	148.6					
39	96E	96	52.0Bi 30.0Pb 18.0Sn	205	205	0.3468	9.60	2.3	.13		5200			100	15.5 note 1	34.7	0.151	0.167	
42	96E	96	46.0Bi 34.0Sn 20.0Pb	205	205	0.3248	8.99												Low-temperature eutectic solder. Can be used on the same metallization as SnPb based solders. Lowest temperature solder paste
40	99	93	50.0Bi 31.0Pb 19.0Sn	210	199	0.3461	9.58												
41	100E	100	50.0Bi 28.0Pb 22.0Sn	212	212	0.3411	9.44												

E = eutetic
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Notes
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note 2: Modified Brinell hardness, using 100-kg load, 1/2 min.
note 3: Dependds on specimen preparation
note 4: % elongation on 5.65 (sq. root Area) gauge length

Conversions
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ex: 1.72 x 100 / %IACS = micro ohm - cm

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43	102	70	40.5Bi 27.8Pb 22.4Sn 9.3Cd	216	158	0.3367	9.32												
45	103	102	54.0Bi 26.0Sn 20.0Cd	217	216	0.3172	8.78												
46	104	95	56.0Bi 22.0Pb 22.0Sn	219	203	0.3385	9.37												
57	104	95	50.0Bi 30.0Pb 20.0Sn	219	203	0.3443	9.53												
47	105	70	35.3Bi35.1Pb20.1Sn9.5Cd	221	158	0.3425	9.48												
48	105	98	52.2Bi 37.8Pb 10.0Sn	221	208	0.3602	9.97												
49	107	96	45.0Bi 35.0Pb 20.0Sn	225	205	0.3468	9.60												
50	108	95	46.0Bi 34.0Pb 20.0Sn	226	203	0.3465	9.59												
52	108	102	54.5Bi 39.5Pb 6.0Sn	226	216	0.3664	10.14												
224	108E	108	52.2In 46.0Sn 1.8Zn	226	226	0.2627	7.27												
53	109E	109	67.0Bi 33.0In	228	228	0.3183	8.81												
54	112	98	51.6Bi 41.4Pb 7.0Sn	234	208	0.3660	10.13												
55	113	72	40.0Bi 33.4Pb 13.3Sn 13.3Cd	235	162	0.3479	9.63												
56	113	104	54.4Bi 43.6Pb 1.0Sn 1.0Cd	235	219	0.3750	10.38												
44	115	95	50.0Bi 25.0Pb 25.0Sn	239	203	0.3367	9.32												
58	117	103	53.0Bi 42.5Pb 4.5Sn	243	217	0.3700	10.24												
59	118	75	38.2Bi 31.7Sn 26.4Pb 2.6Cd 1.1Sb Dopant: 0.06Cu	244	167	0.3273	9.06												
1E	118E	118	52.0In 48.0Sn	244	244	0.2637	7.30	11.7	.34	20	1720	1630		83	4.5 note 2				Fair wettability on glass, quartz, and many ceramics. Good low-temperature malleability. Compensates for some CTE mismatch. Low vapor pressure.
61	119	108	53.7Bi 43.1Pb 3.2Sn	246	226	0.3721	10.30												
62	120	117	55.0Bi 44.0Pb 1.0Sn	248	243	0.3754	10.39												
63	121	92	56.8Bi 41.2Pb 2.0Cd	250	198	0.3743	10.36												
64	121	120	55.0Bi 44.0Pb 1.0In	250	248	0.3754	10.39												
65	123	70	46.0Pb 30.7Bi 18.2Sn 5.1Cd	253	158	0.3519	9.74							46					
253	123E123		74.0In 26.0Cd	253	253	0.2753	7.62												
255	124E	124	55.5Bi 44.5Pb	255	255	0.3772	10.44	4	.04		6400			37.5	15	20.9	0.126	0.155	Good fusible alloy. Poor solderability. See table 1
1	125	118	50.0In 50.0Sn	257	244	0.2637	7.30	11.7	.34	20	1720	1630		83	4.5 note 2				Fair wettability on glass, quartz, and many ceramics. Good low-temperature malle ability. Compensates for some CTE mismatch. Low vapor pressure.
13	125MP		70.0In 15.0Sn 9.6Pb 5.4Cd	257		0.2757	7.63		.39	27	1476	2000			4				
67	126	124	58.0Bi 42.0Pb	259	255	0.3758	10.40												
68	127	93	38.0Pb 37.0Bi 25.0Sn	261	199	0.3425	9.48												
69	129	95	51.6Bi 37.4Sn 6.0In 5.0Pb	264	203	0.3100	8.58												
70	130	121	40.0In 40.0Sn 20.0Pb	266	250	0.2840	7.86												
71	131	118	52.0Sn 48.0In	268	244	0.2637	7.30												
72	133	96	34.0Pb 34.0Sn 32.0Bi	271	205	0.3306	9.15												
73	133	128	56.8Bi 41.2Sn 2.0Pb	271	262	0.3107	8.60												
74	135	96	38.4Bi 30.8Pb 30.8Sn Dopant: 0.05 Ag	275	205	0.3328	9.21												
75	135E	135	57.4Bi 41.6Sn 1.0Pb	275	275	0.3100	8.58												
76	136	95	36.0Bi 32.0Pb 31.0Sn 1.0Ag	277	203	0.3331	9.22												
78	136	95	36.7Bi 31.8Pb 31.5Sn Dopant: 0.25 Cd & 0.05 Ag	277	203	0.3324	9.20												
79	136	121	55.1Bi 39.9Sn 5.0Pb	277	250	0.3132	8.67												
80	137	95	36.4Bi 31.8Pb 31.8Sn	279	203	0.3320	9.19												
81	137	96	43.0Pb 28.5Bi 28.5Sn	279	205	0.3407	9.43												

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Notes
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note 2: Modified Brinell hardness, using 100-kg load, 1/2 min.
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Alloy Properties

Indalloy Number	TEMP Liquidus (°C)	TEMP Solidus (°C)	Elemental Composition (% by Mass)	TEMP Liquidus (°F)	TEMP Solidus (°F)	Density (lb/in³)	Density (gm/cm³)	Electrical Conductivity (1.7μohms-cm (% of IACS)	Thermal Conductivity @ 85°C (W/cm-°C)	Thermal Coefficient Expansion @20°C (PPM/°C)	Tensile Strength (PSI)	Shear Strength (PSI)	Young's Modulus (PSI x 10^6)	Elongation (%)	Brinell Hardness	Latent Heat of Fusion (J/g)	Specific Heat Solid (J/g-°C)	Specific Heat Liquid (J/g-°C)	Application Notes
281	138E	138	58.0Bi 42.0Sn	281	281	0.3093	8.56	4.5	.19	15	8000	500		55 note 4	23 note 1	44.8	0.167	0.201	Makes a good low-temperature solder paste for electronics assembly.Can be used where Cd and Pb should be avoided. Also good for thermo-electric applications. See Table 1
83	139	96	38.4Pb 30.8Bi 30.8Sn	282	205	0.3360	9.30												
84	139	132	45.0Sn 32.0Pb 18.0Cd 5.0Bi	282	270	0.3118	8.63												
282	140	139	57.0Bi 42.0Sn 1.0Ag	284	282	0.3098	8.57												More malleable and ductile than #281
85	143	96	33.4Bi 33.3Pb 33.3Sn	289	205	0.3310	9.16												
290	143E	143	97.0In 3.0Ag	290	290	0.2666	7.38	23	.73	22	800				2				Has nearly the wettability, thermal conductivity, and low-temperature malleability of indium. Solders silver, fired glass, and ceramics. Good for thermal interfaces requiring more creep resistance than pure indium
86	144E	144	60.0Bi40.0Cd	291	291	0.3364	9.31												
87	145	118	58.0Sn 42.0In	293	244	0.2637	7.30												
181	145E	145	51.2Sn 30.6Pb 18.2Cd	293	293	0.3053	8.45		.35	24	6263								
203	150	125	95.0In 5.0Bi	302	257	0.2675	7.40												
88	150MP		99.3In 0.7Ga	302		0.2641	7.31												
225	151	143	90.0In 10.0Sn	304	289	0.2641	7.31												
89	152	120	42.0Pb 37.0Sn 21.0Bi	306	248	0.3310	9.16												
230	152	140	54.0Sn 26.0Pb 20.0In Dopant: 0.12 - 0.16Cu	306	284	0.2912	8.06												Also known as 532
90	152MP		99.4In 0.6Ga	306		0.2641	7.31												
91	153MP		99.6In 0.4Ga	307		0.2641	7.31												
2	154	149	80.0In 15.0Pb 5.0Ag	309	300	0.2836	7.85	13	.43	28	2550	2150		58	5.2 note 2				Especially useful for soldering to gold because it minimizes leaching. Good thermal fatigue properties
92	154MP		99.5In 0.5Ga	309		0.2641	7.31												
4	157MP		100.0In	314		0.2641	7.31	24	.86	29	273	890	1.57	22 to 41	0.9	28.47	0.243		Soft, ductile metal has good wettability on many surfaces, including glazed ceramics, certain metallic oxides, glass, and quartz. Deforms indefinitely under load and has no tendency to become brittle, making it valuable for cryogenic applications. Bonds to non-metallic. Volume change on freezing -2.5%
93	160	122	54.5Pb 45.5Bi	320	252	0.3826	10.59												
94	160	145	50.0Sn 25.0Cd 25.0Pb	320	293	0.3020	8.36												
95	162	140	48.0Sn 36.0Pb 16.0Bi	324	284	0.3172	8.78												
97	163	144	43.0Sn 43.0Pb 14.0Bi	325	291	0.3259	9.02			24	6400		3.56	41					Good general purpose step-soldering alloy
98	167	120	50.0Sn 40.0Pb 10.0Bi	333	248	0.3169	8.77												
9	167	154	70.0Sn 18.0Pb 12.0In	333	309	0.2815	7.79	12.2	.45	24	5320	4190		135.5	12 note 2				General purpose solder with good physical properties
99	170	131	51.5Pb 27.0Sn 21.5Bi	338	268	0.3461	9.58												
281-338	170	138	60.0Sn 40.0Bi	338	280	0.2934	8.12	5	.30		7500			35	23.5 note 1	44.4	0.18	0.213	See table 1
234	172	166	49.7Sn 41.8Pb 8.0Bi0.5Ag	342	331	0.3187	8.82												
101	173	130	50.0Pb 30.0Sn 20.0Bi	343	266	0.3422	9.47												
240	173	160	46.0Sn 46.0Pb 8.0Bi	343	320	0.3241	8.97			22	6000		5.28	48					
204	175	165	70.0In 30.0Pb	347	329	0.2959	8.19	8.8	.38	28	3450								Minimizes gold leaching characteristics. Good thermal fatigue properties
102	176	146	47.5Pb 39.9Sn 12.6Bi	349	295	0.3299	9.13												
103	177E	177	67.8Sn 32.2Cd	351	351	0.2775	7.68												
104	179E	179	62.5Sn 36.1Pb 1.4Ag	354	354	0.3039	8.41	11.9	.50	27	7000	7540					0.167		Widely used electronic solder. Good for silver metallization. Has improved strength and fatigue properties
105	180	96	60.0Sn 25.5Bi 14.5Pb								356	205	0.2981	8.25					

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5	181	134	37.5Pb 37.5Sn 25.0In	358	273	0.3042	8.42	7.8	.23	23	5260	4300		101	10.2 note 2				Very good resistance to alkaline corrosion
205	181	173	60.0In 40.0Pb	358	343	0.3078	8.52	7	.29	27	4150								Minimizes gold leaching characteristics. Good thermal fatigue properties
100	182	178	62.6Sn 37.0Pb 0.4Ag	361	352	0.3035	8.40												
106	183E	183	63.0Sn 37.0Pb	361	361	0.3035	8.40	11.5	.50	25	7500	6200	4.35	37	17		0.167		Most widely used SnPb electronic solder. Not recommended for soldering to gold thicker than 0.5 microns (20 micro inches)
213	183	183	62.0Sn 38.0Pb	362	361	0.3046	8.43						4.35						
107	184	183	65.0Sn 35.0Pb	363	361	0.3010	8.33												
231	186	174	86.5Sn 5.5Zn 4.5In3.5Bi	367	345	0.2659	7.36												Zinc causes high dross
108	186	183	70.0Sn 30.0Pb	367	361	0.2948	8.16	12.5		22	7800	5200	5.08	30	17				Good pre-tinning alloy
227	187	175	77.2Sn 20.0In 2.8Ag	369	347	0.2619	7.25	9.8	.54	28	6800	4800	5.6	47	17				Can be used as a lead-free replacement for Sn63, Sn62, Sn60 because it has a similar melting point as well as equal, or superior, physical and mechanical properties. Not for use over 100°C due to Sn/In eutectic. U.S. Patent #5,256,370; covers 70-92%4Sn 1-6%Ag 4-35%In; temperature range Liquidus: 179-213°C; Solidus: 167-212°C.
226	187	181	83.6Sn 8.8In 7.6Zn	369	358	0.2627	7.27				6600		4	85.5					Zinc causes high dross. U.S. Patent #5,242,658; covers 72.8-89.4Sn 6.7-19.2Zn 2.7-16.4In; temperature range Liquidus: 176-193°C; Solidus: 166-191.4°C
137	189	179	61.5Sn 35.5Pb 3.0Ag	372	354	0.3046	8.43												
109	191	183	60.0Sn 40.0Pb	376	361	0.3071	8.50	11.5	.49	25	7600	5600	4.35	40	16				Good electrical grade solder
110	192	183	75.0Sn 25.0Pb	378	361	0.2890	8.00												
235	195	165	58.0In 39.0Pb 3.0Ag	383	329	0.3104	8.59												
111	197	170	55.5Pb 40.5Sn 4.0Bi	387	338	0.3328	9.21												
112	199	183	80.0Sn 20.0Pb	390	361	0.2836	7.85												
201	199E	199	91.0Sn 9.0Zn	390	390	0.2627	7.27	15	.61		7940			32.5	21.5 note 1	71.2	0.239	0.272	Recommended for soldering to aluminum using flux #3
113	200	183	55.0Sn 45.0Pb	392	361	0.3136	8.68												
114	205	183	85.0Sn 15.0Pb	401	361	0.2782	7.70												
254	205	204	86.9Sn 10.0In 3.1Ag	401	399	0.2663	7.37												Lead-free U.S. Patent #5,256,370; covers 70-92%Sn 1-6%Ag 4-35%In; tempperture range Liquidus: 179-213°C; Solidus: 167-212°C
115	210	177	55.0Pb 44.0Sn 1.0Ag	410	351	0.3291	9.11												
7	210	184	50.0In 50.0Pb	410	363	0.3201	8.86	6	.22	27	4670	2680		55	9.6 note 2				Minimizes gold leaching characteristics. Good thermal fatigue properties. Very good resistance to alkaline corrosion
116	212	183	50.0Sn 50.0Pb	414	361	0.3205	8.87	10.9	.48	23	6000	5200		35	14				General purpose solde
118	213	183	90.0Sn 10.0Pb	415	361	0.2728	7.55												
249	213	211	91.8Sn 4.8Bi 3.4Ag	415	412	0.2688	7.44												
119	216	183	50.0Sn 49.5Pb 0.5Sb	421	361	0.3198	8.85												
238	217E	217	90.0Sn 10.0Au	423	423	0.2811	7.78				7280			1.1					
120	218	183	52.0Pb 48.0Sn	424	361	0.3234	8.95												
241	220	217	95.5Sn 3.8Ag 0.7Cu	428	423	0.2674	7.40	13.2			6962	3916		36.5	15				Lead-free alloy, no Patent
252	220	217	95.5Sn 3.9Ag 0.6Cu	428	423	0.2674	7.40												Lead-free alloy, no Patent. Alloy of choice for general SMT assembly. See Indalloy
256	220	217	96.5Sn 3.0Ag 0.5Cu	428	423	0.2674	7.40				7200		2.41	19.3					Lead-free alloy, no Patent. Preferred alloy to recommend
121	221E	221	96.5Sn 3.5Ag	430	430	0.2710	7.50	16	.33	30	5800	2700		73	40				Lead-free high-temperature solder. Excellent thermal fatigue properties. Not recommended for soldering to gold thicker than 0.5microns (20 micro inches)
122	222	183	95.0Sn 5.0Pb	432	361	0.2681	7.42												
246	225	217	95.5Sn 4.0Ag 0.5Cu	437	423	0.2674	7.40				7470		2.6	17.3					Lead-free alloy, no Patent. See Indalloy 256
251	225	217	96.2Sn 2.5Ag 0.8Cu 0.5Sb	437	423	0.2663	7.37												Castin-Patented alloy

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ex: 1.72 x 100 / %IACS = micro ohm - cm

Solder Alloys

Mechanical Properties

Alloy Properties

Indalloy Number	TEMP Liquidus (°C)	TEMP Solidus (°C)	Elemental Composition (% by Mass)	TEMP Liquidus (°F)	TEMP Solidus (°F)	Density (lb/in³)	Density (gm/cm³)	Electrical Conductivity (1.7μohms-cm (% of IACS)	Thermal Conductivity @ 85°C (W/cm-°C)	Thermal Coefficient Expansion @20°C (PPM/°C)	Tensile Strength (PSI)	Shear Strength (PSI)	Young's Modulus (PSI x 10^6)	Elongation (%)	Brinell Hardness	Latent Heat of Fusion (J/g)	Specific Heat Solid (J/g-°C)	Specific Heat Liquid (J/g-°C)	Application Notes
123	226	221	97.5Sn 2.5Ag	439	430	0.2652	7.34												
217-440	227	103	48.0Bi 28.5Pb 14.5Sn 9.0Sb	441	217	0.3360	9.30	3			13000				19		0.167		See Table 1
125	227	183	55.0Pb 45.0Sn	441	361	0.3277	9.07												
258	227	215	98.5Sn 1.0Ag 0.5Cu	441	419	0.2645	7.32				5640		2.15	13.4					
243	227E	227	99.0Sn 1.0Cu	441	441	0.2641	7.31												Lead-free alloy, no Patent
244	227E	227	99.3Sn 0.7Cu	441	441	0.2641	7.31												Lead-free alloy, no Patent
126	231	185	58.0Pb 40.0Sn 2.0Sb	448	365	0.3313	9.17												
206	231	197	60.0Pb 40.0In	448	387	0.3360	9.30	5.2	.19	26	5000								Minimizes gold leaching characteristics. Good thermal fatigue properties
127	232	179	60.0Pb 37.0Sn 3.0Ag	450	354	0.3393	9.39												
128	232MP		100.0Sn	450		0.2630	7.28	15.6	.73	24	1900		6.1				0.222		
209	233MP		65.0Sn 25.0Ag 10.0Sb	451		0.2818	7.80			36	17000								
129	235MP		99.0Sn 1.0Sb	455		0.2627	7.27												
3	237	143	90.0In 10.0Ag	459	289	0.2724	7.54	22.1	.67	15	1650	1600		61	2.7 note 2				Has nearly the wettability and low-temperature malleability of Indium. Solders silver, fired glass, and ceramics. Large plastic range
130	238	183	60.0Pb 40.0Sn	460	361	0.3353	9.28	10.1	.44	25	5400	4600	3.34	25	12				Inexpensive utility solder
131	238	232	97.0Sn 3.0Sb	460	450	0.2623	7.26				1400								
132	240	221	95.0Sn 5.0Ag	464	430	0.2670	7.39	12.6		23	8000	3540		30	13.7		0.23		High-temperature electrical solder
133	240	235	95.0Sn 5.0Sb	464	455	0.2619	7.25	11.9	.28	31	5900	6000		38	13.3				Lead-free, used in food equipment, potable water systems, and refrigeration tubing. Good wettability and creep resistance
134	243	185	63.2Pb 35.0Sn 1.8Sb	469	365	0.3393	9.39												
135	247	183	65.0Pb 35.0Sn	477	361	0.3432	9.50												
236	247	237	83.0Pb 10.0Sb 5.0Sn 2.0Ag	477	459	0.3739	10.35												
138	250	185	68.4Pb 30.0Sn 1.6Sb	482	365	0.3479	9.63												
139	251	134	95.0Bi 5.0Sn	484	273	0.3483	9.64												
210	253	179	70.0Pb 27.0Sn 3.0Ag	487	354	0.3555	9.84												
233	255	245	85.0Pb 10.0Sb 5.0Sn	491	473	0.3743	10.36	6			5570			3.5		0.9	0.15		
141	257	183	70.0Pb 30.0Sn	495	361	0.3512	9.72	9.3	.41	26	5000	4000	3.05	18	12				
142	260	179	50.0Sn 47.0Pb 3.0Ag	500	354	0.3201	8.86												
10	260	240	75.0Pb 25.0In	500	464	0.3602	9.97	4.6	.18	26	5450	3520		47.5	10.2 note 2				Minimizes gold leaching characteristics. Good thermal fatigue properties. Very good resistance to alkaline corrosion
143	260	252	90.0Pb 10.0Sb	500	486	0.3830	10.60												
144	263	184	73.7Pb 25.0Sn 1.3Sb	505	363	0.3570	9.88												
202	266E	266	82.6Cd 17.4Zn	511	511	0.3017	8.35												Limited productio
145	268	183	75.0Pb 25.0Sn	514	361	0.3599	9.96				3426			53					
146	270	184	79.0Pb 20.0In 1.0Sb	518	363	0.3671	10.16												
148	271MP		100.0Bi	520		0.3541	9.80												
150	275	260	81.0Pb 19.0In	527	500	0.3711	10.27	4.5	.17	27	5550								Minimizes gold leaching characteristics. Good thermal fatigue properties. Very good resistance to alkaline corrosion
149	280	183	80.0Pb 20.0Sn	536	361	0.3689	10.21	8.7	.37	27	4800	3000	2.9	20	11				
182	280E	280	80.0Au 20.0Sn	536	536	0.5242	14.51		.57	16	40000	40000	8.57	2			0.15		Very strong solder with excellent thermal fatigue resistance. Excellent solder to use when soldering to gold. High thermal conductivity
152	285	239	92.0Pb 5.0Sn 3.0Sb	545	462	0.3909	10.82												
153	288	183	85.0Pb 15.0Sn	550	361	0.3866	10.70				4700	4470							
154	289	179	57.0Pb 40.0Sn 3.0Ag	552	354	0.3346	9.26												

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Notes
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Resistivity of IACS / Elec. conductivity %IACS = Resistivity of alloy
ex: 1.72 x 100 / %IACS = micro ohm - cm

Solder Alloys

Mechanical Properties

Alloy Properties

Indalloy Number	TEMP Liquidus (°C)	TEMP Solidus (°C)	Elemental Composition (% by Mass)	TEMP Liquidus (°F)	TEMP Solidus (°F)	Density (lb/in³)	Density (gm/cm³)	Electrical Conductivity (1.7μohms-cm (% of IACS)	Thermal Conductivity @ 85°C (W/cm-°C)	Thermal Coefficient Expansion @20°C (PPM/°C)	Tensile Strength (PSI)	Shear Strength (PSI)	Young's Modulus (PSI x 10^6)	Elongation (%)	Brinell Hardness	Latent Heat of Fusion (J/g)	Specific Heat Solid (J/g-°C)	Specific Heat Liquid (J/g-°C)	Application Notes
228	290	267	88.0Pb 10.0Sn 2.0Ag	554	513	0.3884	10.75	8.5	.27	29	3260			42			0.143		(Sn10) Not recommended for applications above 120°C due to formation of eutectic
155	292MP		90.0Pb 5.0Ag 5.0Sn	558		0.3974	11.00		.25	27									
156	295	221	90.0Sn 10.0Ag	563	430	0.2713	7.51												
157	295	252	95.0Pb 5.0Sb	563	486	0.3960	10.96												
151	296	287	92.5Pb 5.0Sn 2.5Ag	565	549	0.3982	11.02	8.6		29	4210	2240	2				0.13		
160	300	227	97.0Sn 3.0Cu	572	441	0.2645	7.32												
159	302	275	90.0Pb 10.0Sn	576	527	0.3884	10.75	8.9	.25	29	4400	2400	2.76	30	10				
242	302	275	89.5Pb 10.5Sn	576	527	0.3884	10.75	8.9	.25	29	4400	2400	2.76	30	10				
161	303E	303	97.5Pb 2.5Ag	577	577	0.4094	11.33	8.6			4400	2900		42					Torch solder, poor corrosion resistance
163	304	299	95.5Pb 2.5Ag 2.0Sn	579	570	0.4047	11.20												
237	304MP		93.0Pb 3.0Sn 2.0In 2.0Ag	579		0.4000	11.07												
165	309E	309	97.5Pb 1.5Ag 1.0Sn	588	588	0.4075	11.28	6	.23	30	4420			23	9.5				High-temperature solder, frequently used in semiconductor assembly. Often used in reducing atmospheres such as 88% nitrogen 12% hydrogen. Slightly better corrosion resistance than #101
12	310	290	90.0Pb 5.0In 5.0Ag	590	554	0.3974	11.00	5.6	.25	27	5730	3180		23	9 note 2				Tin-free indium solder
164	310	300	92.5Pb 5.0In 2.5Ag	590	572	0.3982	11.02	5.5	.25	25	4560	2830							Good thermal fatigue. Minimal gold leaching properties of indium-lead alloys. Often used in reducing atmospheres such as 88% nitrogen 12% hydrogen
171	312	308	95.0Pb 5.0Sn	594	586	0.3996	11.06	8.8	.23	30	4000	2100		45	8 note 2				High-temperature SnPb alloy
11	313	300	95.0Pb 5.0In	595	572	0.3996	11.06	5.1	.21	29	4330	3220		52	6 note 2				
239	313E	313	91.0Pb 4.0Sn 4.0Ag 1.0In	595	595	0.3992	11.05												
167	315MP		98.0Pb 1.2Sb 0.8Ga	599		0.4047	11.20												
168	320	300	98.0Pb 2.0Sb	608	572	0.4043	11.19												
169	322	310	98.5Pb 1.5Sb	612	590	0.4057	11.23												
170	327MP		100.0Pb	621		0.4101	11.35	7.9	.35	29	1800	1800	2.61	55	4				
172	330	231	98.0Sn 2.0As	626	448	0.2616	7.24												
173	345	232	99.0Sn 1.0Ge	653	450	0.2623	7.26												
183	356E	356	88.0Au 12.0Ge	673	673	0.5300	14.67		.44	13	26835	26825	10.55						
184	363E	363	96.8Au 3.2Si	685	685	0.5564	15.40		.27	12	36975	31900	12.04						
175	364	305	95.0Pb 5.0Ag	687	581	0.4083	11.30												
229	365	304	94.5Pb 5.5Ag	689	579	0.4101	11.35	6	.23	30	4420								
176	382E	382	95.0Zn 5.0Al	720	720	0.2385	6.60												
185	395	340	95.0Cd 5.0Ag	743	644	0.3154	8.73												
186	424E	424	55.0Ge 45.0Al	795	795	0.1340	3.71												
177	465	451	75.0Au 25.0In	869	844	0.4950	13.70												Extremely hard, high-temperature alloy. Limited production
178	485	451	82.0Au 18.0In	905	844	0.5383	14.90												Extremely hard, high-temperature alloy. Limited production
187	525E	525	45.0Ag 38.0Au 17.0Ge	977	977	0.3823	10.58												
188	577E	577	88.3Al 11.7Si	1,071	1,071	0.0961	2.66												
189	585	521	86.0Al 10.0Si 4.0Cu	1,085	970	0.0994	2.75												
190	610	577	92.5Al 7.5Si	1,130	1,071	0.0968	2.68												
215	620	605	45.0Ag 24.0Cd 16.0Zn 15.0Cu	1,148	1,121	0.3291	9.11												
191	630	577	95.0Al 5.0Si	1,166	1,071	0.0972	2.69												
216	635	625	50.0Ag 18.0Cd 16.5Zn 15.5Cu	1,175	1,157	0.3320	9.19												
217	650	620	56.0Ag 22.0Cu 17.0Zn 5.0Sn	1,202	1,148	0.3328	9.21												
192	660MP		100.0Al	1,220		0.0976	2.70												

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ex: 1.72 x 100 / %IACS = micro ohm - cm

Solder Alloys						Mechanical Properties												Alloy Properties
Indalloy Number	TEMP		Elemental Composition (% by Mass)	TEMP		Density		Electrical Conductivity (1.7μohms-cm (% of IACS)	Thermal Conductivity @ 85°C (W/cm-°C)	Thermal Coefficient Expansion @20°C (PPM/°C)	Tensile Strength (PSI)	Shear Strength (PSI)	Young's Modulus (PSI x 10^6)	Elongation (%)	Brinell Hardness	Latent Heat of Fusion (J/g)	Specific Heat		Application Notes
	Liquidus (°C)	Solidus (°C)		Liquidus (°F)	Solidus (°F)	(lb/in^3)	(gm/cm^3)										Solid (J/g-°C)	Liquid (J/g-°C)	
218	690	630	50.0Ag 16.0Cd 15.5Cu 15.5Zn 3.0Ni	1,274	1,166	0.3328	9.21												
219	700	605	35.0Ag 26.0Cu 21.0Zn 18.0Cd	1,292	1,121	0.3208	8.88												
179	705	603	61.0Ag 24.0Cu 15.0In	1,301	1,117	0.3425	9.48												
211	705	640	80.0Cu 15.0Ag 5.0P	1,301	1,184	0.2753	7.62												
212	710	605	30.0Ag 27.0Cu 23.0Zn 20.0Cd	1,310	1,121	0.3169	8.77												
214	720	600	60.0Ag 30.0Cu 10.0Sn	1,328	1,112	0.3461	9.58												
193	780E	780	72.0Ag 28.0Cu	1,436	1,436	0.3617	10.01												
220	785	775	71.5Ag 28.0Cu 0.5Ni	1,445	1,427	0.3617	10.01												
194	800	370	98.0Au 2.0Si	1,472	698	0.6113	16.92												
221	800	690	63.0Ag 28.5Cu 6.0Sn 2.5Ni	1,472	1,274	0.3508	9.71												
195	890E	890	80.0Au 20.0Cu	1,634	1,634	0.5662	15.67												
196	950E	950	82.0Au 18.0Ni	1,742	1,742	0.5752	15.92												
207	961MP		100.0Ag	1,762		0.3794	10.50												
208	985	665	85.0Cu 8.0Sn 7.0Ag	1,805	1,229	0.3205	8.87												
198	1020	1000	50.0Au 50.0Ag	1,868	1,832	0.4914	13.60												
199	1030	360	99.4Au 0.6Sb	1,886	680	0.6894	19.08												
222	1030	1025	99.0Au1.0Ga	1,886	1,877	0.6818	18.87												
223	1063MP		99.8Au 0.2P	1,945		0.6843	18.94												
200	1064MP		100.0Au	1,948		0.6973	19.30	73.4	3.18	14	20000		11.2	39 to 45(2in)			0.13		
532	see Indalloy #230																		

Table 1

Certain alloys will grow or shrink after casting. This chart shows the cumulative effects over time.

Cumulative Growth and Shrinkage

Time after casting	Indalloy #117	Indalloy #136	Indalloy #147	Indalloy #158	Indalloy #160-190	Indalloy #217-440	Indalloy #255	Indalloy #281	Indalloy #281-338
2 min	+0.0005	+0.0003	+0.0020	+0.0025	-0.0004	+0.0008	-0.0008	+0.0007	-0.0001
6 min	+0.0002	+0.0002	+0.0022	+0.0027	-0.0007	+0.0014	-0.0011	+0.0007	-0.0001
30 min	0.0000	+0.0001	+0.0040	+0.0045	-0.0009	+0.0047	-0.0010	+0.0006	-0.0001
1 hour	-0.0001	0.0000	+0.0046	+0.0051	0.0000	+0.0048	-0.0008	+0.0006	-0.0001
2 hour	-0.0002	-0.0001	+0.0046	+0.0051	+0.0016	+0.0048	-0.0004	+0.0006	-0.0001
5 hour	-0.0002	-0.0002	+0.0046	+0.0051	+0.0018	+0.0049	0.0000	+0.0005	-0.0001
500 hour	-0.0002	-0.0002	+0.0052	+0.0057	+0.0025	+0.0061	+0.0022	+0.0005	-0.0001

Measurements are in inches per minute as compared to cold mold dimentions.
Test bar measures ½" x 10" weighing approximately one pound.
All data represents predictable characteristics and can abe relied on only as a guide.

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Locations Worldwide

Clinton, NY USA

Utica, NY USA

Clinton, NY USA

Chicago, IL USA


Milton Keynes, UK

Singapore


Suzhou, PRC


Shenzhen, PRC

Liuzhou, PRC

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