COINING™ / AMETEK® SPECIALTY METAL PRODUCTS



A GUIDE TO OUR ALLOYS

Alloying is a process in which two or more metals are melted together in a precise combination to form a specific alloy. Alloying is done in either an induction furnace or a casting operation, depending on the alloy. While the combining of metal elements into an alloy may seem simple, the process requires close control to avoid contaminates and oxidation.

Yes we can...

Respond to your needs – quickly, precisely and efficiently. At COINING, the fabrication of high-quality precision metal stampings and preforms for the electronic industry is our primary business.

Our commitment is to provide the parts and services that allow you to meet your production and quality goals. To us, this is more than a job: This is a matter of attitude. COINING has several distinct areas of experience. All are specially equipped and staffed to work with maximum efficiency.

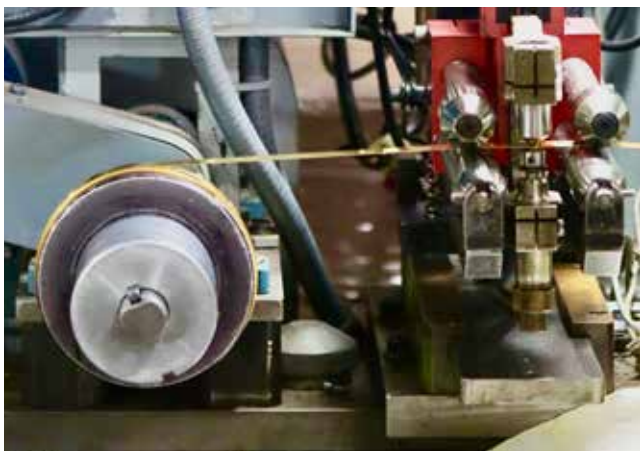
Typically, we respond to a request for quotation within one to two business days. Samples of standard shapes or those from our open tooling list can be in your hands within two weeks and, not uncommonly, we ship within a few days. Prototypes of custom shapes involving special tooling take a little longer if the application is particularly challenging.

With our specialized staff and friendly customer service, we are dedicated to filling your order on time. And to satisfy all your production needs, we have these capabilities in-house:

- Extrusion and Continuous Casting
- Rolling
- Tool and Die Making
- Stamping
- Deburring

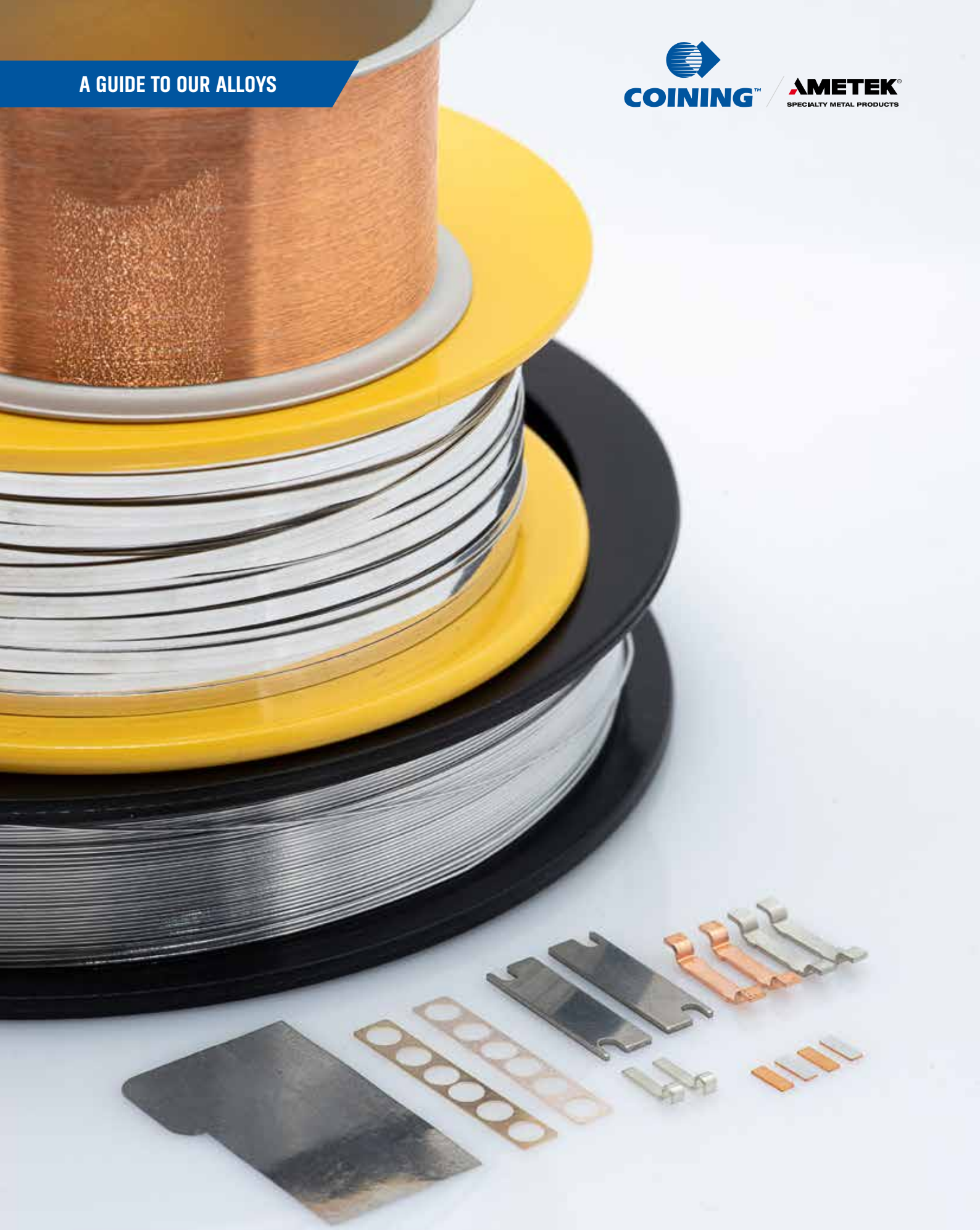


Casting process: molten material being poured into a mould cavity.



Au strip going through one of our stamping presses.

COINING™ / AMETEK® SPECIALTY METAL PRODUCTS



COINING's high precision bonding wire, ribbon, solder preforms, bond pads, and microstampings.

Casting and Rolling

With our melting and casting capabilities, strip is made daily. We stock many alloys with base metals of gold, silver, lead, and tin in strip form. We have the ability to roll as thin as 0.0003" (7.5 µ). Our typical tolerance on many gauges is ±0.0002" (5 µ). Our standard alloys are always ready to be punched for delivery.

Cladding and Plating

We stock a wide variety of Copper, Molybdenum and Kovar multilayered cladded materials. Cladding is a process by which different layers of metals are bonded without adhesives or filler materials. COINING specializes in supplying stamped and plated Kovar and Molybdenum tabs, covers, terminals and heatsinks. Shapes as small as 0.010" (ten thousandths or 254 µ) are routinely plated. We can supply parts stamped from plated strips as an alternative if required.

Alloys

We can work with a wide variety of brazing and soldering alloys. We typically fabricate alloys of gold, silver, lead, tin, antimony, copper, indium, palladium, and nickel. We are also quite comfortable with special alloys such as those including germanium, silicon and phosphorus. Our expertise also includes exotic metals and alloys, including molybdenum, tungsten, titanium, aluminum, and Kovar. We are always willing to work with a new alloy, even if a limited quantity is needed.

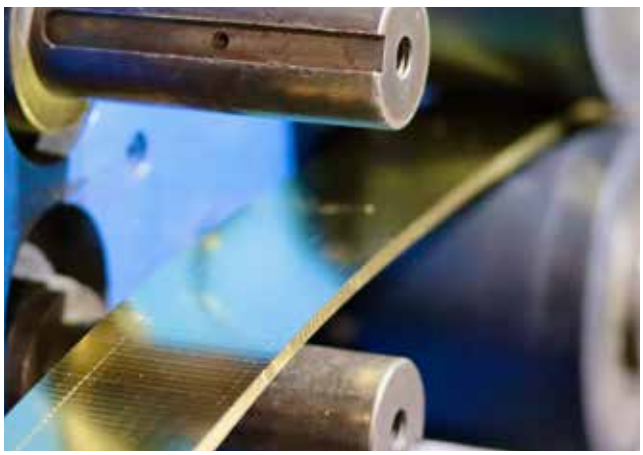
Tooling

We can make your custom part design a reality. Our fully equipped tool and die department with wire EDM capability brings craftmanship and modern technology together to satisfy your every need. All dies are made in house. Delivery with a new tool is generally two to six weeks depending on the complexity of the part.

Our standard tooling list is available upon request.



One of our custom designed tools optimized for custom-made products.



Au strip going through our rolling machine.



COINING can roll material as thin as 0.0003 inch (0.0076 mm).

Stamping

We can produce standard, custom, and complex shapes quickly and efficiently. All stamping is done in-house in our highly integrated production facility. All jobs, no matter the size, have lot numbers and quality control documents accompanying them throughout our process. In-process inspection is done on a routine basis. Our standard tooling list (discs, frames, rectangles, squares and washers) is among the most extensive in the industry – with sizes ranging from a 0.0035" (90 µ) square to shapes over 6" (15 cm). Our custom fabrication capabilities are limited only by the physical constraints of the materials at hand. Essentially, if a shape is possible, it is almost certain that COINING can fabricate it - quickly, precisely and efficiently.

Quality

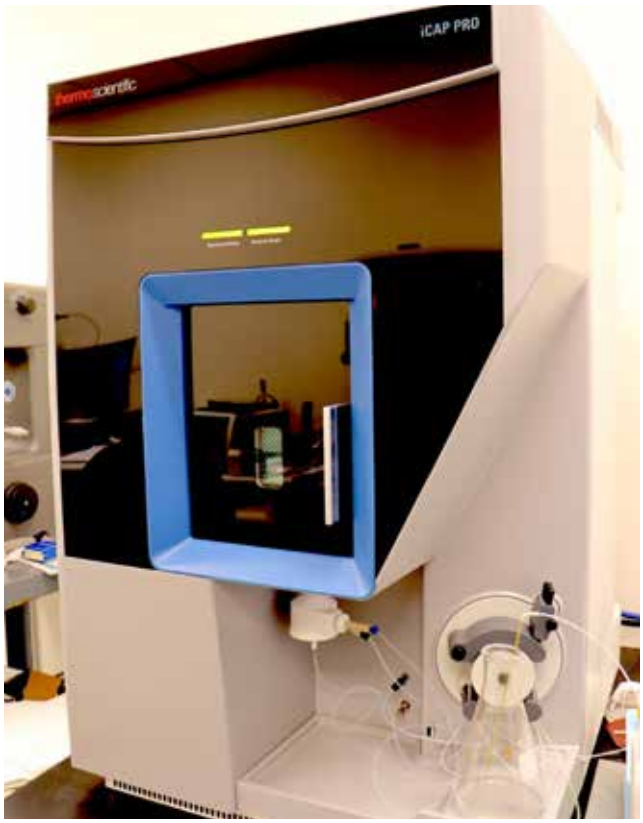
Our fully staffed and highly trained quality control department is always striving to ensure that you receive the finest part. Our tight in-process controls allow us to consistently strive for zero defects. Special packaging requests such as waffle packs, tape and reel, argon-filled jars are available upon request.

We purchase only from those suppliers with the proven capability of providing quality product on time. Incoming inspection is done on all raw materials – and analyticals are required and available to you upon request.

Our quality policy is "COINING will produce and deliver quality products on time and provide service which meets or exceeds our customers' expectations."

In-House Lab and Analytical Services

Our industry leading analytical laboratory is staffed with experienced and metallurgists. Our lab is equipped with the latest generation of instruments to measure bulk compositions, trace impurities, and bulk physical characteristics. All our testing methods meet or exceed ISO17025 requirements for testing laboratories, ensuring the accuracy and achieved integrity of test analyses. COINING has completed A2LA accreditation and offers analytical laboratory and failure analysis services.



Our ICP instrument provides optimum testing capabilities.



Metal stamping and punching machinery

We offer the following analytical services:

- Bulk composition and trace impurity analysis of pure metals and alloys. Accuracy to ppb levels
- Carbon and Sulfur conte analysis in metals. Minimum detection 0.5 ppm
- Oxygen and nitrogen content in metals minimum detection 0.5 ppm
- Qualitative surface chemistry and analysis
- Low temperature (<500 °C) material melting points with accuracy to 0.5°C
- Knoop and Vickers hardness testing per ASTM E92
- Grain determination up to 1000x capability

Lead-Free Alloys

With its extensive experience and expertise in lead-free technology, COINING can provide a comprehensive array of lead-free alloys and preforms. COINING advantages include:

- Over 100 hundred lead-free alloys with melting points (both eutectic and non-eutectic) ranging from 90°C to 1,100°C. Typically your requirements can be met with one of these alloys.
- Precision stamping capabilities supported by an extensive inventory of standard tools including discs, frames, rectangles, squares, and washers. COINING's in-house ability to rapidly build complex dies from micro to macro scale enables expeditious delivery of standard, custom, and complex shapes in sizes ranging from 0.0035" (0.09mm) to over 6" (15cm), and as thin as .0002" (5 microns).
- An experienced staff of R&D metallurgists to work with you to develop a custom alloy if an existing alloy does not meet your lead-free needs.
- Completely integrated manufacturing capability which enables COINING to efficiently move from the creation of an alloy to the completion of a finished part.

There is no single "magic" lead-free alloy that can be universally substituted for the existing lead-based soldering alloys. Your specific needs will define the best lead-free substitute. COINING's expertise will ensure that you receive a high-quality product quickly and efficiently.

Lead is a known environmentally toxic element, with significant adverse effects on human health. As such, it has become the focus of worldwide governmental efforts to eliminate its use wherever possible. Europe has enacted the EC directives (WEEE/RoHS) banning lead in many applications. Japan has banned lead from most industrial uses, and the Americas are moving in this direction as well. Companies that fail to heed these regulations or warning signs to eliminate lead usage wherever possible, face dire consequences ranging from loss of customers and applications to outright prohibition from participating in certain markets. Regardless of regulation, intelligent manufacturers and consumers will increasingly demand lead-free products.

What Is Affected?

- Large household appliances
- Small household appliances
- IT & Telecommunication equipment
- Consumer equipment
- Lighting equipment
- Electrical and electronic tools
- Medical equipment systems
- Monitoring and control instruments
- Automatic dispensers
- Automotive electronics

COINING uses a variety of elements to manufacture a broad range of compositions of lead-free soldering and brazing alloys. This combined with an extensive tool list and precision stamping capability expedites the completion of your order. When necessary, COINING's in-house metallurgists will work with you to provide a customized solution to your alloy needs.

To learn more about our alloys please go to **www.ametek-coining.com/knowledge/alloy-list**, or contact Sales or Customer Service for a complete list of lead-free alloys.

COINING...the capability of working from raw material to finished product within our own facility.

COINING™ / AMETEK® SPECIALTY METAL PRODUCTS

Partial List of Lead-Free Alloys

Solidus °C	Liquidus °C	E = Eutectic	Solidus °F	Liquidus °F	Alloy#	Element 1 and Wt %		Element 2 and Wt %		Element 3 and Wt %		Element 4 and Wt %		Density Gr/cc
93	93	E			3024	In	44	Sn	42	Cd	14			7.96
95	95	E			3033	In	51.5	Bi	32	Sn	16.5			7.31
120	122				3003	In	52	Sn	48					7.30
138	140		280	284	361	Bi	57	Sn	42	Ag	1			8.59
139	139	E			349	Bi	57	Sn	43					8.59
144	144	E	291	291	3006	In	97	Ag	3					7.38
156	156	E	313	313	3000	In	100							7.31
195	201				2147	Sn	88.5	In	8	Ag	3	Cu	0.5	7.43
199	199	E			2165	Sn	91.2	Zn	8.8					7.28
200	225				340	Sn	93.5	Bi	5	Ag	1.5			7.29
209	212				2155	Sn	93.3	Ag	3.1	Bi	3.1	Cu	0.5	7.43
210	215				2156	Sn	92	Bi	4.7	Ag	3.3			7.46
210	216				2128	Sn	96.3	Ag	2.5	Cu	0.7	Sb	0.5	7.38
215	222		419	432	2010	Sn	95	In	5					7.29
217	218				2136	Sn	96.5	Ag	3	Cu	0.5			7.37
217	218				2138	Sn	95.5	Ag	3.9	Cu	0.6			7.39
217	218				2133	Sn	96	Ag	3.5	Cu	0.5			7.38
221	221	E	430	430	2005	Sn	96.5	Ag	3.5					7.37
221	240				2009	Sn	95	Ag	5					7.40
227	227	E			2112	Sn	99.3	Cu	0.7					7.31
227	300		441	572	2061	Sn	97	Cu	3					7.33
232	232	E	450	450	2000	Sn	100							7.30
232	240		450	464	2067	Sn	97	Sb	3					7.28
233	233	E			2024	Sn	65	Ag	25	Sb	10			7.81
278	278	E	532	532	10004	Au	80	Sn	20					14.52
278	290				10121	Au	79	Sn	21					14.34
280	303		536	577	10013	Au	78	Sn	22					14.18
356	356	E	673	673	10003	Au	88	Ge	12					14.67

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Available Alloys

Solidus °C	Eutectic °C	Liquidus °C	Alloy Number #	Alloy Name	Density gr/cc	Solidus °F	Eutectic °F	Liquidus °F
	73		3035	In66.3Bi33.7	8		163	
73		75	3037	In66Bi34	8	163		167
	79		342	Bi57In26Sn17	8.54		174	
	96		150	Bi52Pb30Sn18	9.6		205	
	100		347	Bi46Sn32Pb20	8.99		212	
117		120	353	Bi55Pb44Sn1	10.39	243		248
	120		40490	In50.9Sn49.1	7.31		248	
120		122	3003	In52Sn48	7.3	248		252
120		123	2059	In50Sn50	7.3	248		253
	124		345	Bi55.5Pb44.5	10.43		255	
134		181	1059	Sn37.5Pb37.5In25	8.42	273		358
136		152	2126	Sn54Pb26In20	8.05	277		306
138		140	361	Bi57Sn42Ag1	8.57	280		284
	139		349	Bi57Sn43	8.54		282	
139		141	339	Bi58Sn42	8.57	282		286
	144		3006	In97Ag3	7.38		291	
144		163	1058	Sn43Pb43Bi14	8.99	291		325
149		150	3002	In80Pb15Ag5	7.85	300		302
150		168	2129	Sn53Pb37Bi10	8.65	302		334
153		163	2021	Sn70Pb18In12	7.79	307		325
	156		3000	In100	7.31		313	
160		174	3008	In70Pb30	8.18	320		345
160		224	1114	Pb62Sn25Bi10Ag3	9.82	320		435
174		185	3004	In60Pb40	8.52	345		365
175		187	2137	Sn77.2In20Ag2.8	7.36	347		369
175		248	2023	Sn65Pb30Ag5	8.31	347		478
176		189	2035	Sn60Pb38Ag2	10.71	349		372
177		188	2028	Sn62.2Pb36.4Ag1.4	8.42	351		370
177		189	2026	Sn62.5Pb36Ag1.5	8.41	351		372
	179		2031	Sn62Pb36Ag2	8.42		354	
	179		2027	Sn62.5Pb36.1Ag1.4	8.41		354	
179		232	1054	Pb60Sn37Ag3	9.39	354		450
179		232	2036	Sn60Pb37Ag3	8.49	354		450
179		242	2037	Sn60Pb36Ag4	8.48	354		468
179		312	1047	Pb70Sn27Ag3	9.84	354		594
180		209	3005	In50Pb50	8.89	356		408
	183		2030	Sn62Pb38	8.37		361	
183		185	2044	Sn63Pb37	8.4	361		365

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Available Alloys

Solidus °C	Eutectic °C	Liquidus °C	Alloy Number #	Alloy Name	Density gr/cc	Solidus °F	Eutectic °F	Liquidus °F
183		185	2044	Sn63Pb37	8.4	361		365
183		186	2092	Sn62.5Pb37.5	8.43	361		367
183		188	2032	Sn60Pb40	8.51	361		370
183		192	2020	Sn70Pb30	8.16	361		378
183		200	2048	Sn55Pb45	8.69	361		392
183		205	2057	Sn80Pb20	7.85	361		401
183		212	2039	Sn50Pb50	8.87	361		414
183		212	2018	Sn85Pb15	7.7	361		414
183		218	2017	Sn90Pb10	7.56	361		424
183		220	2045	Sn93Pb7	7.48	361		428
183		222	2012	Sn95Pb5	7.42	361		432
183		227	1056	Pb55Sn45	9.07	361		441
183		228	2008	Sn96Pb4	7.4	361		442
183		232	2145	Sn89Pb7Ag4	7.58	361		450
183		238	1053	Pb60Sn40	9.28	361		460
183		241	1051	Pb62Sn38	9.36	361		466
183		257	1045	Pb70Sn30	9.72	361		495
183		260	2148	Sn60Pb38.5Cu1.5	8.48	361		500
183		271	1062	Pb75Sn25	9.96	361		520
183		282	1040	Pb80Sn20	10.21	361		540
193		199	2153	Sn85.2In8Ag4.1Bi2.2Cu0.5	7.43	379		390
195		225	1052	Pb60In40	9.29	383		437
200		225	340	Sn93.5Bi5Ag1.5	7.43	392		437
208		213	2154	Sn91.5In4Ag3.5Bi1	7.39	406		415
209		212	2155	Sn93.3Ag3.1Bi3.1Cu0.5	7.43	408		414
210		215	2156	Sn92Bi4.7Ag3.3	7.45	410		419
215		222	2010	Sn95In5	7.29	419		432
216		217	2158	Sn95.4Ag3.1Cu1.5	7.38	421		423
	217		10008	Sn90Au10	7.77		423	
217		218	2136	Sn96.5Ag3Cu0.5	7.37	423		424
217		218	2138	Sn95.5Ag3.9Cu0.6	7.39	423		424
217		218	2133	Sn96Ag3.5Cu0.5	7.38	423		424
217		230	10035	Sn98Sb1Au1	7.34	423		446
	221		2005	Sn96.5Ag3.5	7.37		430	
221		226	2007	Sn96Ag4	7.38	430		439
221		226	2004	Sn97Ag3	7.36	430		439
221		227	2122	Sn96.5Ag2.5Cu1	7.37	430		441

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Solidus °C	Eutectic °C	Liquidus °C	Alloy Number #	Alloy Name	Density gr/cc	Solidus °F	Eutectic °F	Liquidus °F
221		227	2003	Sn97.5Ag2.5	7.35	430		441
221		240	2009	Sn95Ag5	7.4	430		464
221		270	2014	Sn93Ag7	7.45	430		518
221		275	2058	Sn92Ag8	7.47	430		527
221		295	2015	Sn90Ag10	7.52	430		563
	227		2112	Sn99.3Cu0.7	7.26		441	
227		300	2061	Sn97Cu3	7.33	441		572
230		294	1036	Pb85Sn15	10.47	446		561
	232		2000	Sn100	7.31		450	
232		237	2144	Sn97.5Sb2.5	7.27	450		459
232		240	2067	Sn97Sb3	7.28	450		464
	233		2024	Sn65Ag25Sb10	7.81		451	
233		235	2001	Sn99.5Sb0.5	7.29	451		455
234		236	2002	Sn99Sb1	7.28	453		457
235		240	2011	Sn95Sb5	7.25	455		464
238		253	1044	Pb70In30	9.74	460		487
239		285	1022	Pb92Sn5Sb3	10.81	462		545
240		250	2016	Sn90Sb10	7.22	464		482
245		255	1037	Pb85Sb10Sn5	10.32	473		491
250		264	1042	Pb75In25	9.97	482		507
250		272	1124	Pb75Sb15Sn10	9.75	482		522
251		295	1068	Pb92.5Sn4Ag3.5	11.08	484		563
	252		1031	Pb89Sb11	10.51		486	
252		260	1026	Pb90Sb10	10.58	486		500
252		265	1023	Pb91Sb9	10.66	486		509
252		286	1015	Pb94Sb6	10.87	486		547
268		290	1033	Pb88Sn10Ag2	10.73	514		554
270		280	1038	Pb81In19	10.27	518		536
271		300	1073	Pb89.5Sn10.5	10.79	520		572
275		302	1027	Pb90Sn10	10.74	527		576
	278		10004	Au80Sn20	14.52		532	
278		280	1072	Pb93Sn5Ag2	10.9	532		536
278		290	10121	Au79Sn21	14.34	532		554
280		290	1125	Pb91.8Sn5Ag3Ni0.2	11.02	536		554
280		303	10013	Au78Sn22	14.18	536		577
280		475	10043	Au60Ag20Sn20	12.89	536		887

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Available Alloys

Solidus °C	Eutectic °C	Liquidus °C	Alloy Number #	Alloy Name	Density gr/cc	Solidus °F	Eutectic °F	Liquidus °F
285		310	1020	Pb93Sn7	10.94	545		590
287		296	1019	Pb92.5Sn5Ag2.5	11.01	549		565
290		310	1028	Pb90In5Ag5	10.99	554		590
	292		1029	Pb90Sn5Ag5	10.99		558	
292		314	1010	Pb95In5	11.04	558		597
296		301	1017	Pb93.5Sn5Ag1.5	11.02	565		574
298		305	1117	Pb94.5Sn4.5Ag1	11.05	568		581
299		303	1013	Pb95Ag2.5Sn2.5	11.16	570		577
299		303	1066	Pb95.5Ag3Sn1.5	11.22	570		577
299		304	1009	Pb95.5Ag2.5Sn2	11.19	570		579
300		304	1012	Pb95Sn3.5Ag1.5	11.11	572		579
	304		1004	Pb97.5Ag2.5	11.32		579	
304		327	1008	Pb96Ag4	11.3	579		621
304		950	20243	Ag97Pb3	11.33	579		1742
305		314	1011	Pb95Sn5	11.03	581		597
305		364	1014	Pb95Ag5	11.29	581		687
	307		1018	Pb92.5In5Ag2.5	11.01		585	
	309		1006	Pb97.2Ag1.75Sn1.05	11.26		588	
	309		1005	Pb97.5Ag1.5Sn1	11.26		588	
309		310	1071	Pb97.5Sn1.5Ag1	11.24	588		590
310		320	1007	Pb97Sn3	11.15	590		608
317		322	1003	Pb98Sn2	11.22	603		612
321		325	1001	Pb99Sn1	11.28	610		617
322		325	1069	Pb99Sb1	11.26	612		617
	327		1000	Pb100	11.34		621	
	356		10003	Au88Ge12	14.67		673	
	363		10088	Au96.85Si3.15	15.7		685	
363		800	10002	Au98Si2	16.85	685		1472
475		487	10111	Au80In20	14.54	887		909
488		530	10027	Au82In18	14.9	910		986
	525		10055	Ag45Au38Ge17	10.58		977	
600		720	20211	Ag60Cu30Sn10	9.57	1112		1328
607		618	20221	Ag45Au38Ge17	9.1	1125		1144
630		705	20225	Ag61Cu24In15	9.48	1166		1301
630		705	20205	Ag61.5Cu24In14.5	9.5	1166		1301
643		802	20308	Cu80Ag15P5	8.42	1189		1476

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Solidus °C	Eutectic °C	Liquidus °C	Alloy Number #	Alloy Name	Density gr/cc	Solidus °F	Eutectic °F	Liquidus °F
646		677	20232	Ag45Cu27Zn25Sn3	8.91	1195		1251
660		750	20215	Ag50Zn28Cu20Ni2	8.97	1220		1382
665		682	20274	Ag60Cu25Zn15	9.42	1229		1260
665		985	40417	Cu85Sn8Ag7	8.87	1229		1805
671		718	20256	Ag65Cu20Zn15	9.49	1240		1324
691		800	20245	Ag63Cu28.5Sn6Ni2.5	9.71	1276		1472
714		905	40489	Cu95P5	7.5	1317		1661
718		857	20276	Ag54Cu40Zn5Ni1	9.69	1324		1575
750		850	20244	Ag65Cu28Mn5Ni2	9.78	1382		1562
	766		20246	Ag71.7Cu28Li0.3	9.5		1411	
770		895	20218	Ag56Cu42Ni2	9.75	1418		1643
775		785	20213	Ag71.5Cu28Ni0.5	10	1427		1445
	779		20204	Ag72Cu28	10.01		1434	
779		815	20234	Ag80Cu20	10.14	1434		1499
779		840	20202	Ag85Cu15	10.23	1434		1544
779		870	20292	Ag50Cu50	9.67	1434		1598
779		873	20203	Ag90Cu10	10.31	1434		1603
779		945	20311	Cu70Ag30	9.35	1434		1733
780		795	20249	Ag71.15Cu28.1Ni0.75	9.99	1436		1463
780		824	20263	Ag68.5Cu26.8Pd4.7	10.09	1436		1515
794		815	20214	Ag68Cu27Pd5	10.09	1461		1499
795		888	20210	Ag92Cu8	10.35	1463		1630
800		858	20271	Ag58.5Cu31.5Pd10	10.08	1472		1576
812		893	20235	Ag92.8Cu7.2	10.36	1494		1639
824		852	20239	Ag92.8Cu7.2	10.06	1515		1566
835		845	10042	Au60Ag20Cu20	13.79	1535		1553
850		900	20240	Ag65Cu20Pd15	10.33	1562		1652
862		910	20253	Ag95Cu5	10.4	1584		1670
885		895	10039	Au75Cu20Ag5	15.15	1625		1643
885		920	20316	Ag96Cu4	10.42	1625		1688
900		950	20208	Ag54Pd24Cu22	10.41	1652		1742
905		920	10009	Au65Cu35	13.76	1661		1688
	910		10041	Au80Cu20	15.67		1670	
910		925	10014	Au81.5Cu16.5Ni2	15.89	1670		1697
910		930	10076	Au62.5Cu37.5	13.48	1670		1706
912		930	10074	Au87.5Cu12.5	16.88	1674		1706
	955		10018	Au82Ni18	15.95		17.51	

Available Alloys

Solidus °C	Eutectic °C	Liquidus °C	Alloy Number #	Alloy Name	Density gr/cc	Solidus °F	Eutectic °F	Liquidus °F
955		970	10007	Au50Cu50	12.22	1751		
	961		20200	Ag100	10.49		1762	
962		983	20254	Ag54Pd25Cu21	10.44	1764		1801
975		1005	10006	Au95Cu5	18.27	1787		1841
980		1010	10011	Cu65Au35	11.01	1796		1850
1000		1020	10010	Ag50Au50	13.59	1832		1868
1000		1030	10038	Cu62Au35Ni3	11.01	1832		1886
1004		1038	10059	Au70Ni22Pd8	14.79	1839		1900
1025		1050	10017	Cu73Au27	10.46	1877		1922
1030		1050	10033	Cu75Au25	10.35	1886		1922
	1063		10023	Au99.94P0.06	19.21		1945	
	1063		10016	Au99.98P0.02	19.29		1945	
	1063		10001	Au100	19.3		1945	
1063			10070	Cu90Au10	9.45	1945		1972
	1083		40400	Cu100	8.96		1981	



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