Material Cleanliness

To create a strong solder joint, the surfaces being joined must be clean and ready to accept the solder. Selecting the proper flux is essential to the process. The choice is based on the metal base, the liquidus temperature of the solder, and the application.

Material Compatibility in Soldering

Base Metal	Recommended Indalloy® Flux	Recommended Solder Indalloy® # (Alloy)	Incompatible Solders
Gold (Au) (See note 1) #5R Silver (Ag) (See note 2) Palladium (Pd) Platinum (Pt)	#5R, #5RMA, #5RMA-RC	#4 (100%In) #2 (80.0In/15.0Pb/5.0Ag) #164 (92.5Pb/5.0In/2.5Ag) #182 (80.0Au/20.0Sn) InPb alloys #290 (97.0In/3.0Ag)	Sn SnPb InSn SnPbIn SnPbBi (See note 5)
Clean Copper (Cu)	#5R, #5RMA, #5RMA-RC	#42 (46.0Bi/34.0Sn/20.0Pb) Sn62 (62.5Sn/36.1Pb/1.4Ag) Sn63 (63.0Sn/37.0Pb) #121 (96.5Sn/3.5Ag) #133 (95.0Sn/5.0Sb) #151 (92.5Pb/5.0Sn/2.5Ag) #282 (57.0Bi/42.0Sn/1.0Ag) SnAgCu alloys	In InPb InSn InPbAg (See note 4)
Tin (Sn) Solder Plate (SnPb)	#5R, #5RMA, #5RMA-RC	#1E (52.0In/48.0Sn) #106 (63.0Sn/37.0Pb) #121 (96.5Sn/3.5Ag) #282 (57.0Bi/42.0Sn/1.0Ag) SnAgCu alloys	(See note 3)
Oxidized Cu Cu Alloys (Brass, Bronze)	#4, #5RA, #5RA-RC	63.0Sn/37.0Pb 62.0Sn/36.0Pb/2.0Ag SnAgCu alloys	In-containing alloys (See note 4)
Nickel (Ni) Lead (Pb)	#4, #5RA, #5RA-RC	#106 (63.0Sn/37.0Pb) #1E (52.0In/48.0Sn) InPb alloys SnAgCu alloys	(See note 5)
Aluminum (Al)	#3	#201 (91.0Sn/9.0Zn)	SnPb has poor corrosion resistance
Stainless Steel	#2	#1E (52.0In/48.0Sn) #106 (63.0Sn/37.0Pb) #121 (96.5Sn/3.5Ag)	Avoid Pb and Cd for food applications
Steel	#1	#106 (63.0Sn/37.0Pb) #121 (96.5Sn/3.5Ag)	Compatible with most solders

Note 1: Indium-containing solder is good for operating temperatures less than 125°C. For applications above 125°C, choose Indalloy® 182 (80.0Au/20.0Sn).

Note 2: When soldering to silver (Ag), it is recommended that the solder also contain some Ag, such as Sn62 (62.5Sn/36.1Pb/1.4Ag), Indalloy® 121 (96.5Sn/3.5Ag), Indalloy® 151 (92.5Pb/5.0Sn/2.5Ag).

Note 3: Avoid solders that contain indium when soldering to Sn or SnPb. It is possible for localized pockets of the InSn eutectic to form, which melts at 118°C.

Note 4: Avoid solders that contain indium when soldering to Cu. Indium and copper diffuse into one another forming a brittle inter-metallic.

Note 5: InPb alloys have a wide temperature range from 156.6°C to 327.5°C (Indalloy® numbers 7, 10, 11, 150, 204, 205, and 206).

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Bonding to Non-Metallics

A unique property of indium is that it will wet and bond to certain non-metallics such as glass, glazed ceramics, mica, quartz, and various metallic oxides. The bond is formed by the adhesion of the indium suboxide to the non-metallic and, in turn, the metallic indium to its oxide. Since presence of the oxide is necessary for adhesion, no fluxes can be used since they would reduce the suboxide.

Recommended solders include Indalloy® numbers 1E, 3, 4, and 290. Indalloy® numbers 1E and 4 exhibit the best wetting, while numbers 3 and 290 exhibit higher strength due to the hardening effect of the silver, although they do result in slightly decreased wettability. For non-metallic bonding, an indium applicator is recommended. An information booklet, included with the kit, describes how to use this applicator to create the indium suboxide layer required for bonding, as well as when to use flux and when to avoid it.

In most cases, ultrasonic energy, like that generated by an ultrasonic soldering iron or pot, is effective in promoting wetting of the surface. Bond strengths of 400-700psi are typical of this bonding technique.

Procedures

Before Bonding
- Thoroughly clean the non-metallic substrate with a strong alkaline cleaner.
- Rinse the substrate with distilled water.
- Rinse the substrate with electronics-grade acetone or alcohol.

Pre-Tinning
- In case of glass, quartz, or glazed ceramics, adhesion is enhanced by heating the material to about 350°C (to drive off any moisture that is present), then cooling it to about 200°C. At this temperature, rub indium into the heated non-metallic using an indium applicator to form the indium suboxide.
- Once the suboxide is formed, continue rubbing either indium or a high indium-containing alloy until the required amount is bonded to the suboxide.

To bond two non-metallic substrates
- Pre-tin each surface with indium or a high indium-containing alloy (as described above).
- Bring the two pre-tinned substrates in contact with each other and reflow at 20-40°C over the liquidus temperature of the solder used to pre-tin.

To bond a non-metallic substrate to a metallic substrate
- Pre-tin the non-metallic surface with indium or a high indium-containing alloy (as described above).
- Using an appropriate flux, pre-tin only the metallic surface with the same indium or high indium-containing alloy as used on the non-metallic surface.
- After this pre-tinning, completely remove the flux residue.
- Bring the two cleaned, pre-tinned surfaces in contact with each other and reflow at 20-40°C above the liquidus temperature of the pre-tinning solder.

When you have completed your evaluation of the alloys, contact us for assistance in helping you select the form that will work best in your application.

Form No. 97699 R5

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Solder Research Kit Information

Wire and Flux Kit

Ribbon and Flux Kit

Paste Kit

Solder Research Kit

At Indium Corporation, we have created a strong research and development team that has made us one of the top solder manufacturers in the world, so we understand the challenges of developing viable products for today's marketplace.

One of the key hurdles in product development is being able to test a variety of options at a reasonable cost. With our Solder Research Kit, you can select various assembly solders to experiment with, then choose the one that works best in your application.

Solder selection depends on many factors, including:

- Maximum soldering temperature
- Maximum and minimum operating temperature
- Lead content/Pb-free composition
- Base metal compatibility
- Tensile strength
- Corrosion resistance
- Electrical/thermal conductivity
- Thermal coefficient of expansion
- Physical appearance
- Available solder forms

Safety Considerations

When using fluxes and solders, be careful to avoid unsafe conditions. Always make sure your soldering equipment is in good working order and your area is well ventilated. To ensure safe working conditions, refer to the safety data sheets (SDS), available online at www.indium.com/sds.

Reflow Temperature

When you selected the solders for your kit, you may have used the Alloy Properties Chart to determine the proper melting temperature and other characteristics, based on your soldering application.

When soldering, you will need to heat the solder to a temperature that is about 20-40°C above its liquidus temperature.

Liquid Fluxes

Indalloy® Flux	Effective Temperature Range	Clean Residue in	Metal to be Soldered	J-STD 004
1	100-338°C	Warm water with mechanical scrubbing	Iconel/Monel/Zn/Mild Steel	NA
2	100-371°C	Warm water with mechanical scrubbing	Stainless Steel/High Chrome Super Steel/Nitinol	NA
3	96-343°C	Warm water with mechanical scrubbing	Aluminum	NA
40A	100-250°C	Warm water with detergent	SnNi electrodeposit/Kovar/ Pb/Oxidized Cu/Brass/Bronze/ BeCu/Rh/Cd/Ni	ORH1
5RA	125-350°C	Commercial rosin flux remover	Solder/Cu/Sn/Ag/Au/Ni/ Brass/Bronze	ROM1
5RA-RC	125-350°C	Solvent-based or semi-aqueous cleaners	BeCu/Brass/Bronze/Cd/Pb/Ni/ Oxidized Cu/Rh	ROH1
5RMA	125-350°C	IPA	Solder Plate/Sn/Clean Cu/Pt/ Pd/Ag/Au	ROL1
5RMA-RC	125-350°C	IPA or Commercial rosin flux remover	Solder/Clean Cu/Sn/Ag/Au	ROL1
5R	125-350°C	IPA	Clean Cu/Pt/Pd/Ag/Au	ROL0

NA = *Flux not for use in electronic applications*

TACFluxes®

TACFluxes®	Typical Tackiness (grams)	Typical Viscosity (kcps)	Max Temp (°C)	J-STD 004	Reliability J-STD 004	Halide-Containing	Cleaning Method	Compatible Alloys
007	190	570	310	ROL1	pass	Y	No-Clean/Semi-Aqueous Solution	SnPb, SnPbAg, AuSn, PbSn, and PbSnAg
010	232	67	450	ORL0	pass	N	No-Clean/Semi-Aqueous Solution	PbSn, PbSnAg, PbSnSb
012	140	220	250	ROL0	pass	N	No-Clean/Semi-Aqueous Solution	Indium-containing alloys
020B	250	800	230	ROL0	pass	N	No-Clean/Semi-Aqueous Solution	SnPb, SnPbAg, SnAgCu, SnAg
021	225	365	230	ROL0	pass	N	No-Clean/Semi-Aqueous Solution	Bismuth-containing alloys
023	225	410	300	ROL1	pass	Y	No-Clean/Semi-Aqueous Solution	SnAgCu, SnAg
025	550	850	370	ORM0	pass	N	Water	SnPb, SnAgCu, PbSn

Solder Selection Chart

These alloys are the most popular of our over 200 choices.
These selections have been proven in many applications.

*** Entries indicate lead-free alloys**

Indalloy® Number	Composition (%)	Liquidus (°C)	Solidus (°C)	Electrical Conductivity (% of IACS)	Thermal Conductivity (W/cm°C@85°C)	Thermal Coefficient of Expansion (PPM/°C @ 20°C)	Tensile Strength (PSI)	APPLICATION NOTES
136	49.0Bi/21.0In/18.0Pb/12.0Sn	58E	58	2.43	0.10	23	6300	Poor wettability, but adequate for mechanical joining of metallic substrates if corrosive type flux is used.
42	46.0Bi/34.0Sn/20.0Pb	96E	96	-	-	-	-	Can be used on the same metallizations as SnPb-based solder.
1E	52.0In/48.0Sn*	118E	118	11.70	0.34	20	1720	Fair wettability on glass, quartz, and many ceramics. Good low-temperature malleability. Compensates for some difference in CTE.
281	58.0Bi/42.0Sn*	138E	138	4.50	0.19	15	8000	Good low-melting point solder for electronics assembly or for applications where Cd and Pb are to be avoided. Also good for thermo-electric applications.
282	57.0Bi/42.0Sn/1.0Ag *	140	139	-	-	-	-	Similar to Indalloy® 281 but not as brittle. Used in low-temperature, Pb-free applications.
290	97.0In/3.0Ag*	143	143	23.00	0.73	22	800	Silver added to improve strength. Has nearly the wettability and low-temperature malleability of indium.
2	80.0In/15.0Pb/5.0Ag	154	149	13.00	0.43	28	2550	Especially useful for soldering against gold because it minimizes leaching. Good thermal fatigue.
4	100In*	157	MP	24.00	0.86	29	273	Pure indium. Soft, ductile metal. Good wettability on many surfaces including glazed ceramics, certain metallic oxides, glass, and quartz. Deforms indefinitely under load. Has no tendency to become brittle, making it valuable for cryogenic application. Bonds to non-metallic.
97	43.0Pb/42.0Sn/14.0Bi	163	144	-	-	24	6400	Good general purpose step soldering alloy.
9	70.0Sn/18.0Pb/12.0In	167	154	12.20	0.45	24	5320	General purpose solder with good physical properties.
204	70.0In/30.0Pb	175	165	8.80	0.38	28	3450	Minimizes gold leaching characteristics. Good thermal fatigue properties.
Sn62	62.0Sn/37.0Pb/2.0Ag	179E	179	11.90	0.50	27	7000	Good general purpose solder. Can be used on silver-metallized surfaces to reduce scavenging.
205	60.0In/40.0Pb	181	173	7.00	0.29	27	4150	Minimizes gold leaching characteristics. Good thermal fatigue properties.
Sn63	63.0Sn/37.0Pb	183	183	11.50	0.50	25	7500	Standard eutectic tin-lead solder with wide application. Not recommended for use against silver or gold.
201	91.0Sn/9.0Zn*	199	199	15.00	0.61	-	7940	Recommended for soldering to aluminum using Flux #3.
7	50.0In/50.0Pb	210	184	6.00	0.22	27	4670	Minimizes gold leaching characteristics. Good thermal fatigue properties. Very good resistance to alkaline corrosion.
241	95.5Sn/3.8Ag/0.7Cu*	220	217	13.20	-	-	6962	Pb-free alloy slated to replace SnPb in consumer electronic applications.
121	96.5Sn/3.5Ag*	221E	221	16.00	0.33	30	5800	Use when lead-based solders do not meet temperature, strength, or safety requirements. Not recommended against gold-plated surfaces.
206	60.0Pb/40.0In	231	197	5.20	0.19	-26	5000	Minimizes gold leaching. Good thermal fatigue properties.
3	90.0In/10.0Ag*	237	143	22.10	0.67	15	1650	Silver added to improve strength. Has nearly the wettability and low-temperature malleability of indium.
133	95.0Sn/5.0Sb*	240	235	11.90	0.28	31	5900	Used to join copper tubing for refrigeration and potable water systems. Good wettability with good creep resistance at elevated temperatures.
150	81.0Pb/19.0In	275	260	4.50	0.17	27	5550	Minimizes gold leaching. Good thermal fatigue properties.
182	80.0Au/20.0Sn*	280	280	-	0.57	16	40000	Strong solder with excellent thermal fatigue resistance. Can be soldered to gold surfaces without flux in inert atmosphere.
151	92.5Pb/5.0Sn/2.5Ag	296	287	8.60	-	29	4210	Wide application in semiconductor assembly. Often used in reducing atmospheres, such as 88% nitrogen, 12% hydrogen.
164	92.5Pb/5.0In/2.5Ag	310	300	5.50	0.25	25	4560	Particularly good thermal fatigue. Minimal gold leaching properties of indium-lead alloys. Often used in reducing atmospheres such as hydrogen.
244	99.3Sn/0.7Cu*	227	227	-	-	-	-	Candidate for certain Pb-free applications. Better than SAC alloys for CTE mismatch.
246	95.5Sn/4.0Ag/0.5Cu*	225	217	-	-	-	7476	Candidate for certain Pb-free applications.
256	95.5Sn/4.0Ag/0.5Cu*	220	217	-	-	-	7200	Candidate for certain Pb-free applications.

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