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The Fundamentals of Solder Joint of Solder Joint Design – Part 2 – Surface Mount Solder Joints

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SOLDER JOINT CRITERIA

Designed for:

- Electrical conductivity
- Mechanical stability
- Heat dissipation

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Review

- Solder joint design criteria
- Requirements of a solder joint
- Know the weaknesses of a solder joint
- What is takes to make a solder joint
- Defined wetting and non-wetting
- Defined the cohesive and adhesive forces

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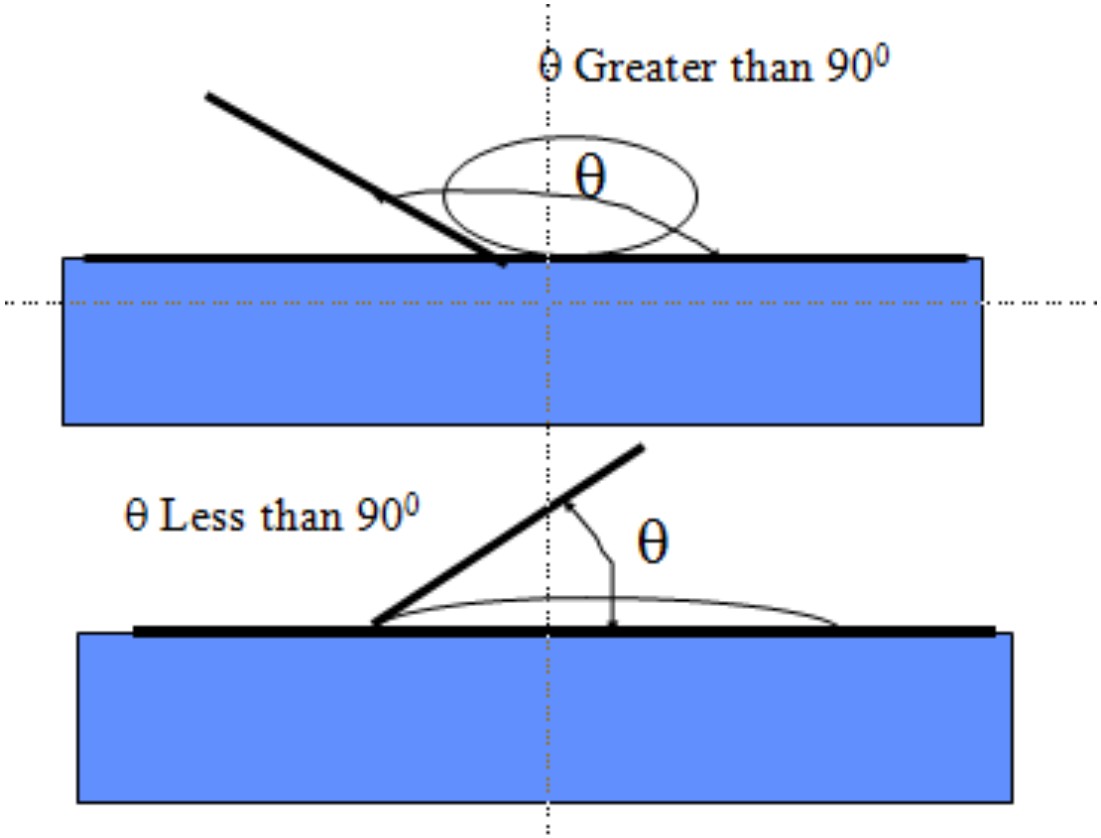
Wetting Angles



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Adhesive Liquid Forces

- Adhesive forces will allow the solder to wet the solid base metal.
- Will create the capillary action up the heel of the lead
- Will allow the solder to spread over the surfaces being soldered

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Plated Through Hole Pads

The design is a compromise:

- Board density and minimum electrical spacing require small pads
- Joint strength and reliability require as large a pad as possible

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Plated Through Hole Solder Joints

We saw a basic overdesign

- Solder joints had more strength than the board itself
- Double sided PTH joint strength is 8 to 13 times stronger than necessary

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Surface Mount Joints

The smt joint is vastly weaker

- Smaller in size
- Less solder in the joint

The SMT joint exhibits a shift from a large PTH to a smaller lap or butt joint, creating a change in the stress distribution as well as the ratio between component weight and solder support

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Rigid Lap Joint

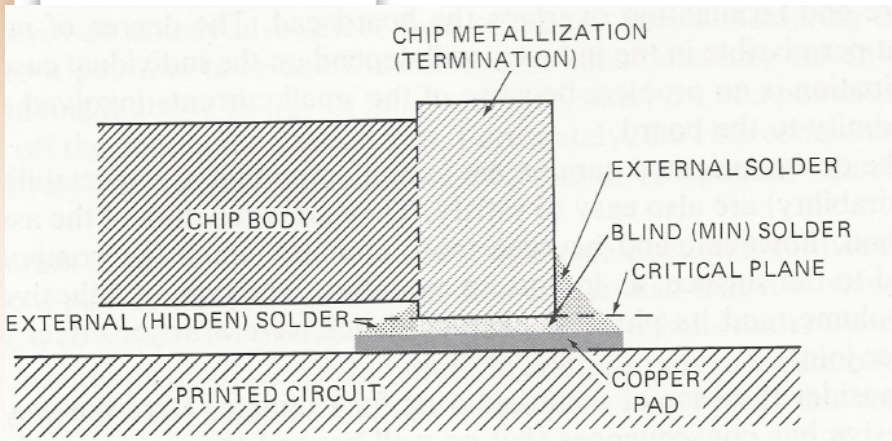

Fig. 1-8. Diagram of a rigid lap joint.

Table 1-7. Comparison Table: Chip Lap vs Pth.

SOLDER JOINT TYPICAL	CHIP LAP. MINIMUM	CHIP LAP. AVG.	PTH & WIRE .032 IN. DIA
Length, in.	.015	.03	.082
Width, in.	.04	.05	.1
Area, in.^{2}	.0006	.0015	.0082
% of PTH	7.32	18.29	100.00
Shear Sn63, lb	3.48	8.7	47.56
Tensile, lb	4.62	11.55	63.14
Pad peel, lb	.4	.5	3.14

Adapted from Soldering Handbook for Printed Circuits and Surface Mounting, by Howard H. Manko, Van Nostrand Reinhold, Section 1-13

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Rigid Lad Leadless Chip Carrier

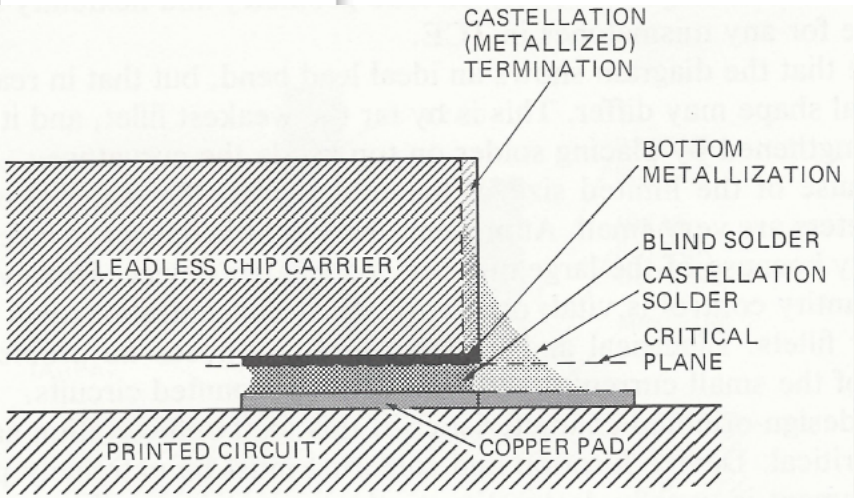

Fig. 1-14. Diagram of the rigid lap joint on an LCC.

Table 1-10. Comparison Table: LCC Lap vs Pth.

SOLDER JOINT TYPICAL	LCC LAP BLIND	LCC LAP CASTELLATION	PTH & WIRE .032 IN. DIA
Length, in.	.04	.04	.082
Width, in.	.02	.04	.1
Area, in.^{2}	.0008	.0016	.0082
% of PTH	9.76	19.51	100.00
Shear Sn63, lb	4.64	9.28	47.56
Tensile, lb	6.16	12.32	63.14
Pad peel, lb	.2	.4	3.14

Adapted from Soldering Handbook for Printed Circuits and Surface Mounting, by Howard H. Manko, Van Nostrand Reinhold, Section 1-16

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Compliant Lap Joint Gull Wing

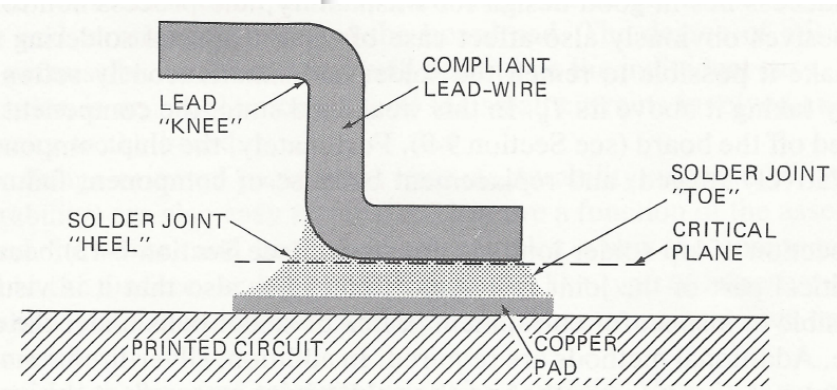

Fig. 1-10. Diagram of the SO lap cross section.

Table 1-8. Comparison Table: So Lap vs Pth.

SOLDER JOINT TYPICAL	SO LAP MIN	SO LAP AVG.	PTH/WIRE .032 IN. DIA
Length, in.	.03	.04	.082
Width, in.	.02	.025	.1
Area, in.^{2}	.0006	.001	.0082
% of PTH	F 7.32	12.20	100.00
Shear Sn63, lb	3.48	5.8	47.56
Tensile, lb	4.62	7.7	63.14
Pad peel, lb	.2	.25	3.14

Adapted from Soldering Handbook for Printed Circuits and Surface Mounting, by Howard H. Manko, Van Nostrand Reinhold, Section 1-14

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Compliant Butt Joint "J" Lead

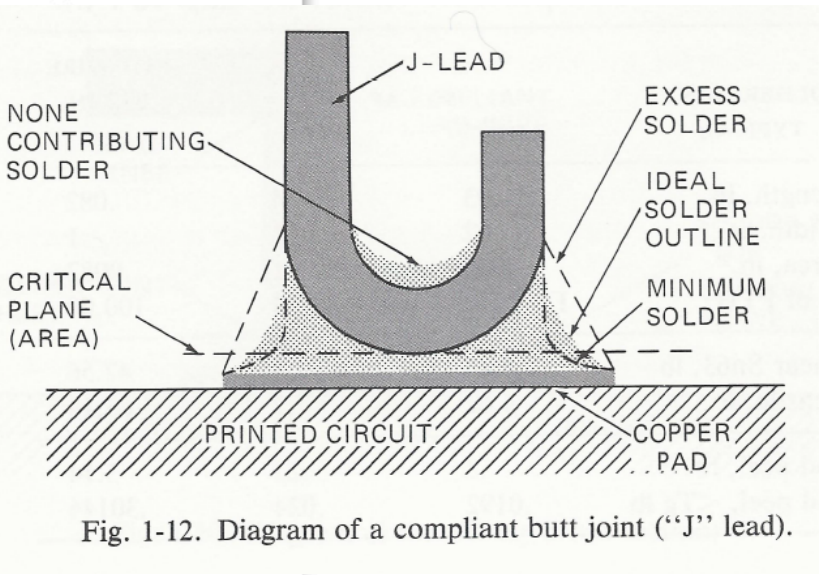

Fig. 1-12. Diagram of a compliant butt joint ("J" lead).

Table 1-9. Comparison Table: J Lead vs Pth.

SOLDER JOINT TYPICAL	J-LEAD MIN	J-LEAD AVG.	PTH/WIRE .032 IN. DIA
Length, in.	.025	.04	.082
Width, in.	.01	.015	.1
Area, in.^{2}	.00025	.0006	.0082
% of PTH	3.05	7.32	100.00
Shear Sn63, lb	1.45	3.48	47.56
Tensile, lb	1.925	4.62	63.14
Pad peel, lb	.1	.15	3.14

Adapted from Soldering Handbook for Printed Circuits and Surface Mounting, by Howard H. Manko, Van Nostrand Reinhold, Section 1-15

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SMT Pad Design

Must take into consideration

- Amount of solder applied to each pad.
- Pad sizes to maintain consistency
- Prevent the application of vias in the areas of the pad
- Recommend review of IPC – 7351 *Generic Requirements for Surface Mount Design and Land Pattern Standard*

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Comparison of Zones

	Range of Shear strength of solder joint, psi	Range of Tensile strength of solder joint, psi	Peel strength of the 1 oz. foil, 1oz = 10psi on FR-4
Rigid Lap	3.48 – 8.7	4.62 – 11.55	.4 - .5
LCC	4.64 – 9.28	6.16 – 12.32	.2 - .4
Gull Wing	3.48 – 5.8	4.62 – 7.7	.2 - .25
"J" Lead	1.45 – 3.48	1.9 – 4.6	.1 .15

Adapted from Soldering Handbook for Printed Circuits and Surface Mounting, by Howard H. Manko, Van Nostrand Reinhold

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Thank You

Questions?

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Further Information

Our Next session will discuss questions and answers we've provided, it should be interesting and we're looking forward to your comments.

For questions regarding this webinar, please contact Leo Lambert at leo@eptac.com or call at 800-643-7822 ext 215

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