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Design Strategies to Improve Flex Bend Radius Part I

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Application: Design guidelines to improve the flexibility and reliability of flexible circuits.

Many of the issues that arise when using a flex circuit come from a lack of knowledge about how to properly design one, especially when the circuit is required to bend. Many novices will design a circuit that calls for bending the flex in too tight of a bend radius, which can cause damage to the circuit and lower the reliability of the end product. This series of articles will focus on the seven key aspects to consider when designing for maximum durability and maximum “flexibility”. It is important to know that because flexibility is a relative term this study will instead use the term reducing bend radius. Below are two of the seven design strategies, please see Part I and Part III for more tips!

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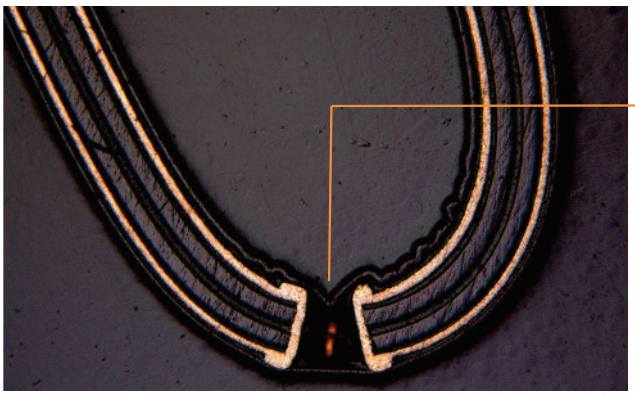
Reduce overall Thickness:
IPC guidelines typically list minimum bend radius of 6X the circuit thickness for single sided flex, 10X for double sided flex, and 20X for multiple layer flex. The area of focus is the thickness where flexing or bending will occur; which should be only in a location with conductors and not plated through-holes. Thickness can best be reduced by:

- *Using thinner copper*
- *Using adhesive-less base materials*
- *Stagger conductors*
- *Specifying button plating or pads only plating*

Any flex circuit with plated through-holes will need to be either panel plated or button plated. Button plating is preferred because it only plates the vias and leaves the conductors un-plated and which does not increase the thickness.

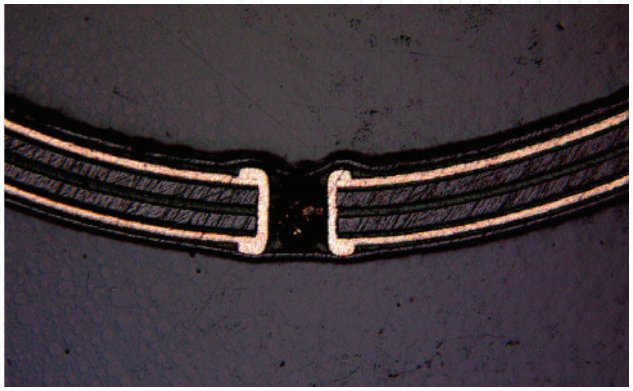
Use only Rolled Annealed (RA) Copper:
There are 2 common types of copper; Rolled Annealed (RA) and Electro Deposited (ED) copper.

- *Rolled Annealed copper is best for achieving a tighter bend radius.*
- *It is also important for you to put on your drawings the direction of the grain in relation to where the tight bending will occur*



Example of a "tight" bend in a flex circuit.

There is an extreme amount of pressure on the button plated through-hole, creating a stress point, this could cause a break or short of the circuit.



Example of a "gradual" bend in a flex circuit.

This bend reduces the stress put on the over all circuit and the weak spot of the button plated through-hole.

Disclaimer: Data presented for informational purposes only. Actual values and/or usage is for reference.

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Do not allow electroless copper as a seed layer prior to plating vias.

Also an area to be concerned about is the type of plating your vendor uses. Some copper plating requires a seed layer of electroless copper, this seed layer becomes an ED copper layer and can lead to conductor cracking. For a tight bend radius direct metallization is the preferred plating method.

Use only Polyimide covers in the flexing area.

There are two options for applying dielectric material over copper:

Polyimide cover material: This is the preferred material in areas where parts will be bent. As a general rule, you will want to specify a dielectric thickness and adhesive thickness separately. A rule of thumb is that for every 1 ounce of copper thickness there is 1 mil of adhesive thickness.

Flexible Solder Mask: Flexible solder mask has a minimum bend radius of 0.4” and is not recommended for any dynamic flexing application or application where the bend radius will be tighter than 0.4”

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