

Calculated Thickness vs Measured Thickness  
Application Notes  
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Overall Thickness measurements of Laminated Multilayer panels often read differently than what was expected, assuming the calculations were initially performed correctly most of that difference can be attributed to Micrometer or Cross Section readings looking at one specific spot (usually a coupon) as opposed to looking at the entire panel.

Panels are never entirely flat and consistent across the entire panel surface. Almost always panels are thicker in the center and taper to the thinnest spots near the corners of the panels – often described as the “Football” shape of a panel. Average readings don’t work well because each segment of any panel is representative of a different Area total relative to the entire panel area.

In any given Square or Rectangle panel shape the actual flow dynamic taking place is more like a series of concentric circles over laying the panel. The Bulls Eye is in the center and each Circle outside and concentric to that Center point will be either equal to or more likely less than the thickness of that center point. What you will most often see in thickness distribution over a panel surface is the Thickest point in the center – Thinnest in each of the corners and next thinnest along the center of each edge, the degree of Taper is dependent on the interaction between the construction and the Lamination Process. Micrometer readings are usually taken near the panel edge so it is not unusual to get lab reports showing panels to be thinner than might be expected.

Taper will be worse with Lower Pressures, Higher unsupported Resin Volume, Lower Rate of Rise and can also be significantly influenced by Warped Tooling Plates where the edges of those tooling plates make contact first and result in reduced pressure and thermal transfer near the center of the panel.

Taper can be reduced by Increasing Pressure to a “Threshold” level where Warp is taken out of tooling plates, effective thermal and pressure transfer is in place – Increasing the Rate of Rise to a point (appropriate to the selected PSI range) to increase flow from the center of the panel and in rare cases reducing the total unsupported resin volume present in a construction.

It is possible to achieve flatter panels (less taper) by using smaller sheets of Kraft Paper in the center of the Book, usually 1 pc about 33% smaller than the panel size and a 2<sup>nd</sup> pc about 66% smaller. The effect is to slightly increase the pressure in the center of the panel to encourage flow from the center where almost no actual flow takes place toward the outer edges of the panel where the most flow takes place.

Without regard to the Lamination Process, Construction or methods used to reduce Taper you are still likely to see some Taper and it will be important to understand what thickness you have achieved relative to the thickness you calculated you would achieve. The only accurate method to compare Micrometer Thickness to Calculated Thickness is to Measure thickness across the Diagonal of a panel and Normalize those thickness readings to compensate for the total panel area each of those Micrometer Readings represents.

If you measure across the Diagonal of any panel and identify a spot to get an accurate Micrometer reading in the center and three spots each side of that center you can take those Seven readings and enter the Data into the attached “Normalization” spreadsheet and get results showing a “Normalized Thickness” with a “Plot” showing the actual profile of thickness variation.

This tool can help you understand better how to achieve the Overall thickness you need to be at as well as monitor response to process changes intended to give you panels with less taper.