

Prepreg Selection: Individual Dielectric Space

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Background

Almost every Printed Circuit Board (PCB) fabricator uses a slightly different method of selecting prepreg to achieve specific thickness and fill requirements. Many of the methods are based on historical data, as documented data points are easier to begin with, rather than starting from scratch.

Working from history can be a safe method to get close to where you need to be and worked well when the industry norm was long running jobs with fairly wide thickness tolerances allowed for adjustments to be made over time. Today, the industry is focused on short-run, tight-tolerance work, with a very short life cycle until a new design is rolled out. These industry conditions put a premium on getting it right the first time.

Recognizing the need for more accurate methods to determine constructions, without benefit of historical data, Isola has developed “thickness calculators” to look at a variety of factors and determine a specific construction that will achieve accurate individual dielectric space requirements, as well as overall board thickness.

The basic tools needed to determine a construction to yield a specific nominal thickness is a list of available prepreg styles, the glass thickness of each and the Overall thickness “as delivered”. With that information, you can very accurately predict any given construction relative to thickness, Fill and any potential for problems associated with inadequate resin volume.

The following is a listing of Prepreg Styles and Thickness:

Prepreg Style	Resin Content	Glass	O/A	Delta	Unsupported Resin Volume
106	75%	0.0014	0.0023	0.0009	–
1080	65%	0.0025	0.003	0.0005	Very Low
2113	56%	0.0029	0.0039	0.001	–
2116	57%	0.0038	0.0051	0.0013	–
2116	62%	0.0038	0.0061	0.0023	Very High
1652	50%	0.0045	0.0057	0.0012	–
7628	42%	0.0065	0.0069	0.0004	Very Low
7628	50%	0.0065	0.0085	0.002	Very High

With the information above you can put together any combination and determine what your thickness starting point is going to be by adding together the overall thickness of each selected ply. You will also get the total amount of “unsupported resin volume” that will be available for fill and bond for each individual dielectric space, that value will be important in the next step.

The final step to accurately calculate any individual Dielectric Space is to determine how much of the available unsupported resin volume is going to be needed to fill and bond any etched layers. The simplest way to get that value is to multiply the percentage of etched area by the thickness of the copper foil on each layer and add those values together to determine the total value and subtract that from the initial Overall thickness determined in the first step. That is the calculated Dielectric Space – Copper Surface to Copper Surface. It is important to note that if the total calculated Dielectric Thickness Value is the same as or less than the total “Glass” thickness of all plies you may have a construction that does not provide adequate Resin Volume for the application.

As an example – if you have 2ea 1oz Signal Layers you need to bond together and you have determined that 75% of the copper has been removed from each layer this is what happens.

Nominal Copper Thickness of $0.0014 \times 75\% = 0.00105$ X 2 layers = 0.0021 Thickness reduction for resin volume needed to Fill

2 X 106 Prepreg will equal $0.0023 \text{ O/A} \times 2 = 0.0046$ - 0.0021 required for fill = 0.0025 space

The thickness of Glass Fabric in each ply is $0.0014 \times 2 = 0.0028$ so you can expect some glass fabric compression to take place to get the amount of resin you need to fill the etched areas.

If you used this same construction in an outer layer of a Foil Laminated board filling only a 1 oz Ground Layer this is what you would get:

Nominal Copper Thickness of $0.0014 \times 20\% \text{ etched area} = 0.00028$ Thickness reduction for resin volume to Fill

2 X 106 Prepreg will equal $0.0023 \text{ O/A} \times 2 = 0.0046$ - $0.00028 = 0.00432$ space, in this case you have plenty of resin for the application as the total Glass Thickness is 0.0028 and the calculated thickness after fill is 0.00432.

This is really intended to provide a basic understanding of how it works, and like any tool it has limitations – very large unsupported resin volumes tend to flow quite a bit and can result in lower thickness values, the actual copper thickness at the point of lamination is often lower than nominal because of cleaning and microetch processes, etc. but the process is very accurate if you input accurate values. Isola has thickness calculators available that will make this process very simple.