AGC
Your Dreams, Our Challenge

TACONIC

TLY Family of Low Loss Laminates

TLY laminates are manufactured with very lightweight woven fiberglass and are much more dimensionally stable than chopped fiber reinforced PTFE composites. The woven matrix in the TLY material yields a more mechanically stable laminate that is suitable for high volume manufacturing. The low dissipation factor enables successful deployment for automotive radar applications designed at 77 GHz as well as other antennas in millimeter wave frequencies.

Comparative OEM testing at 77 GHz of lightly reinforced TLY-5 vs. its closest chopped fiber reinforced competitor has shown "drop in"/equivalent insertion losses/dielectric properties. The primary benefit is much higher manufacturing yields.

The dielectric constant range is 2.17 to 2.40. For most thicknesses, the dielectric constant can be specified anywhere within this range with a tolerance of +/- .02. In the low dielectric constant range, the dissipation factor is approximately 0.0009 at 10 GHz.

Typical applications include satellite communications, automotive radar, filters, couplers, avionics and phased array antennas.

TLY products with enhanced flexibility have been designed for fabrication of antennas that have some curvature (TLY-3FF).

Benefits & Applications:

- Dimensionally Stable
- Lowest Df
- High Peel Strength
- Low Moisture Absorption
- Uniform, Consistent Dk
- Laser Ablatable

- Automotive Radar
- Satellite/Cellular Communications
- Power Amplifiers
- LNBs, LNAs, LNCs
- Aerospace
- Ka, E and W band Applications

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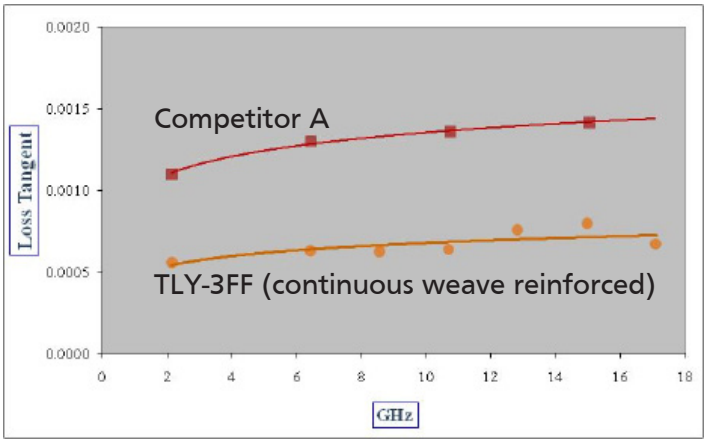
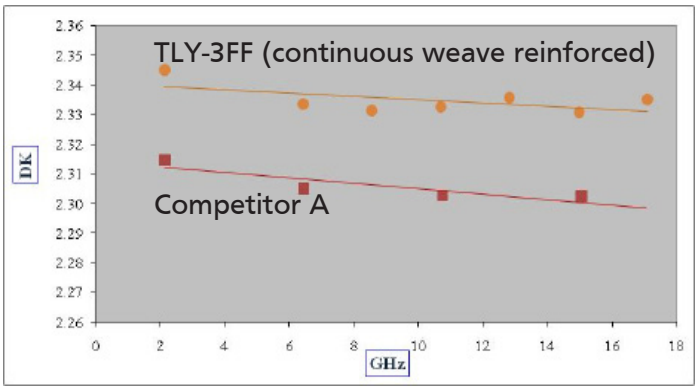
Flexible Laminates

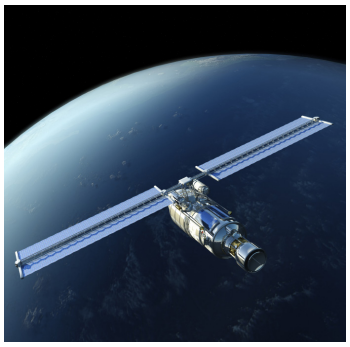




TLY-3FF is a new highly flexible laminate designed for applications that require laminates with some bend radius. TLY-3FF is much more flexible than standard TLY fiberglass reinforced substrates. The flexibility of TLY-3FF is comparable to chopped fiber reinforced PTFE laminates yet it has a loss tangent that is lower than traditional chopped fiber reinforced laminates.

The fiberglass reinforced TLY-3FF has been engineered to provide the dimensional stability typical of the standard fiberglass reinforced TLY Series yet offers the mechanical flexibility of chopped fiber reinforced laminates.

TLY-3FF has also been designed for improved laser via formation relative to traditional TLY glass reinforced laminates.



The suggestion that chopped fiber reinforced 2.2 laminates is truly random is optimistic and perhaps misleading. Visual observation of a 5 mil chopped fiber 2.2 laminate shows a non homogeneous appearance with dark and light colored areas (Figure A). To determine the uniformity of the chopped fiber reinforcement, X-Ray Fluorescence was used. The chemical composition of fiberglass is dominated by silicon oxide (SiO_2), followed by CaO_2, Al_2O3, MgO and B_2O_3. XRF is more sensitive to the heavier elements than carbon or fluorine. For this reason, XRF was used to trace the relative compositions of the heavy Si and Ca in the light and dark regions. The first observation was that the dark and light regions had different densities (surface analysis not shown). The intensity of the scattering is proportional to the concentration of light vs. heavy elements. A more detailed analysis would be necessary to yield quantitative information on the difference in densities between the two regions. It is well known that the Dk of PTFE is dependent on the amount of air that is compressed out of a PTFE composite during high temperature densification. Figure B shows an overlap of the XRF scattering intensities for the light and dark colored regions (subsurface bulk anaylsis). The dark region shows 2.35 times the amount of silicon and 1.34 times the amount of calcium in the dark regions. Silicon oxide (silica) has a Dk of 3.28 and is appreciably higher than the 2.1 Dk of PTFE. The nonuniform distribution of the silicon and calcium suggests that the manufacturing process is prone to producing non homogeneous dielectric materials. It is unknown at this time which material is more homogeneous - chopped fiber or continuous weave reinforced 2.2 Dk PTFE composites. Though it must be stated that the domain sizes of the light and dark regions are very large and visible to the naked eye on the chopped fiber laminate and certainly on par with woven fiberglass PTFE laminates (TLY-5). Truly random chopped fiber reinforced laminates would have equal x, y and z CTE values. The large domain sizes of light and dark colored areas with different Si and Ca concentrations would suggest that there are probably different domains within the laminate of fluctuating CTE values.

TLY Typical Values					
Property	Test Method	Unit	Value	Unit	Value
Dk @ 10 GHz	IPC-650 2.5.5.5		2.20		2.20
Df @ 10 GHz	IPC-650 2.5.5.5		0.0009		0.0009
Moisture Absorption	IPC-650 2.6.2.1	%	0.02	%	0.02
Dielectric Breakdown	IPC-650 2.5.6	kV	>45	kV	>45
Dielectric Strength	ASTM D149	V/mil	2,693	V/mm	106,023
Volume Resistivity	IPC-650 2.5.17.1 (after elevated temp.)	Mohms/cm	10^{10}	Mohms/cm	10^{10}
Volume Resistivity	IPC-650 2.5.17.1 (after humidity)	Mohms/cm	10^{10}	Mohms/cm	10^{9}
Surface Resistivity	IPC-650 2.5.17.1 (after elevated temp.)	Mohms	10^{8}	Mohms	10^{8}
Surface Resistivity	IPC-650 2.5.17.1 (after humidity)	Mohms	10^{8}	Mohms	10^{8}
Flex Strength (MD)	IPC-650 2.4.4	psi	14,057	N/mm^2	96.91
Flex Strength (CD)	IPC-650 2.4.4	psi	12,955	N/mm^2	89.32
Peel Strength (1/2 oz. ED copper)	IPC-650 2.4.8	lbs/in	11	N/mm	1.96
Peel Strength (1 oz. CL1 copper)	IPC-650 2.4.8	lbs/in	16	N/mm	2.86
Peel Strength (1 oz. C1 copper)	IPC-650 2.4.8	lbs/in	17	N/mm	3.04
Peel Strength	IPC-650 2.4.8 (at elevated temp.)	lbs/in	13	N/mm	2.32
Young's Modulus (MD)	ASTM D 3039/IPC-650 2.4.19	psi	1.4×10^{6}	N/mm^2	9.65×10^{3}
Poisson's Ratio (MD)	ASTM D 3039/IPC-650 2.4.19		0.21		0.21
Thermal Conductivity	ASTM F 433	W/M*K	0.22	W/M*K	0.22
Dimensional Stability (MD, 10 mil)	IPC-650 2.4.39 (avg. after bake & thermal stress)	mils/in	-0.038	mm/M	-0.038
Dimensional Stability (CD, 10 mil)	IPC-650 2.4.39 (avg. after bake & thermal stress)	mils/in	-0.031	mm/M	-0.031
Density (Specific Gravity)	ASTM D 792	g/cm^3	2.19	g/cm^3	2.19
CTE (x) (25 - 260°C)	ASTM D 3386 (TMA)	ppm/°C	26	ppm/°C	26
CTE (y) (25 - 260°C)	ASTM D 3386 (TMA)	ppm/°C	15	ppm/°C	15
CTE (z) (25 - 260°C)	ASTM D 3386 (TMA)	ppm/°C	217	ppm/°C	217
NASA Outgassing (% TML)			0.01		0.01
NASA Outgassing (% CVCM)			0.01		0.01
NASA Outgassing (% WVR)			0.00		0.00
UL-94 Flammability Rating	UL-94		V-0		V-0

All reported values are typical and should not be used for specification purposes. In all instances, the user shall determine suitability in any given application.

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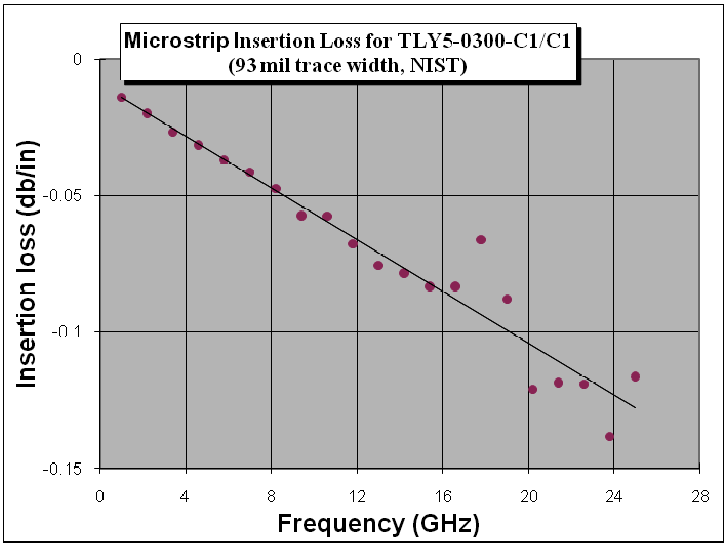

Designation	Dk
TLY-5A	2.17
TLY-5	2.20
TLY-3	2.33
TLY-3FF	2.33

Typical Thicknesses[1]	
Inches	mm
0.0035	0.09
0.0050	0.13
0.0075	0.19
0.0100	0.25
0.0200	0.51
0.0300	0.76
0.0600	1.52

Available Sheet Sizes	
Inches	mm
12 x 18	305 x 457
16 x 18	406 x 457
18 x 24	457 x 610
16 x 36	406 x 914
24 x 36	610 x 914
18 x 48	457 x 1220

[1]Other thicknesses may be available. Please call for information.
[2]Our standard sheet size is 36" x 48" (914 mm x 1220 mm). Please contact our customer service department for availability of other sizes.

Please see our Product Selector Guide for Information on available copper cladding.

Ohmega Ply®, Ticer® and other resistive films are available upon request. Heavy metal claddings (aluminum, brass & copper) may also be available upon request. Please contact AGC for availability.

TLY part #s under 15 mils in thickness laminated with rolled copper cladding are available on a case by case basis as agreed between customer and supplier.

An example of our part number is:
TLY-5-0050-CH/CH - 18" x 24" (457 mm x 610 mm)

CE

Rev. 8/20