IM600/133 Material Data

Table 1 - Temperature dependent material properties

Temperature dependent material properties				
		Thermal Conductivity (W/mm.K)		
Temperature (°C)	Specific Heat (J/kg°C)	Fibre	Transverse	Through-Thickness
25	1065	0.008	0.00067	0.00067
500	2100	0.004390	0.000342	0.000342
800	2100	0.002608	0.00018	0.00018
1000	2171	0.001736	0.0001	0.0001
3316	2500	0.001736	0.0001	0.0001
3334*	5875	0.001736	0.0001	0.0001
3335*	5875	0.0005	0.0005	0.0005
7000*	5875	0.001015	0.001015	0.001015
Temperature dependent material properties				
		Electrical Conductivity (1/ Ω.mm)		
Temperature (°C)	Density (kg/mm^3)	Fibre	Transverse	Through-Thickness
25	$1.52x10^{-6}$	35.97	0.001145	$1.79x10^{-6}$
500	$1.52x10^{-6}$	35.97	0.001145	$1.79x10^{-6}$
800	$1.10x10^{-6}$	35.97	0.001145	$1.79x10^{-6}$
3316	$1.10x10^{-6}$	35.97	0.001145	$1.79x10^{-6}$
3334*	$1.11x10^{-9}$	35.97	2	$1x10^{6}$
3335*	$1.11x10^{-9}$	0.2	0.2	$1x10^{6}$
7000*	$1.11x10^{-9}$	1.5	1.5	$1x10^{6}$
* - Gas				

	Temperature Range (°C)	Energy Released (J)
Resin Decomposition	500-800	$4.8x10^{6}$
Fibre Ablation	3316-3334	$43x10^{6}$

Interlaminar Thermal Conductivity	500 W/m^{2}°C
Interlaminar Electrical Conductivity	$1x10^{5}$ 1/Ω.mm

Table 2 - Temperature dependent mechanical properties [1].

Temperature (^oC)	E_1 (MPa)	$E_2=E_3$ (MPa)	$G_{12}=G_{13}$ (MPa)	G_{23} (MPa)	$\nu_{12}=\nu_{13}$	ν_{23}	α11 ($x10^{-8}$)	α22= α33 ($x10^{-5}$)
25	137,000	8200	4360	3000	0.3	0.45	1.80	2.16
200	137,000	6560	3488	2400	0.3	0.45	5.40	3.78
260	137,000	82	34.88	24	0.3	0.45	5.40	3.78
600	137,000	4.1	1.744	1.2	0.3	0.45	5.40	3.78
3316	137,000	4.1	1.744	1.2	0.3	0.45	5.40	3.78
>3316	1370	0.41	0.1744	0.12	0.3	0.45	5.40	3.78

Table 3 - Strain rate effects on intralaminar strength and fracture toughness [2]

	Xt (MPa)	Xc (MPa)	Yt (MPa)	Yc (MPa)	$S_{12}=S_{13}=S_{23}$ (MPa)	Γ_{11}^C (N/mm)	Γ_{11}^T (N/mm)	Γ_{22}^C (N/mm)	Γ_{22}^T (N/mm)
QS	1708	1281	34	192	128	10	133	1.6	0.5
HR	2357	1781	47	263	177	16	164	2.0	0.6

*QS refers to quasi-static and HR refers to high strain rate conditions

Table 4 - Traction and fracture toughness properties [3].

Temperature (^oC)	σ_{max} (MPa)	τ_{max} (MPa)	G_{IC} (J/m^2)	$G_{IIC}=G_{IIIC}$ (J/m^2)
25	65.0	100.0	435	1855
300	$1x10^{-4}$	$1x10^{-5}$	$1x10^{-6}$	$1x10^{-7}$
3000	$1x10^{-4}$	$1x10^{-5}$	$1x10^{-6}$	$1x10^{-7}$

References

[1] H. Chen, F. S. Wang, X. T. Ma, and Z. F. Yue, ‘The coupling mechanism and damage prediction of carbon fiber/epoxy composites exposed to lightning current’, *Compos. Struct.*, vol. 203, pp. 436–445, 2018, doi: 10.1016/j.compstruct.2018.07.017.

[2] F. S. Wang, N. Ding, Z. Q. Liu, Y. Y. Ji, and Z. F. Yue, ‘Ablation damage characteristic and residual strength prediction of carbon fiber/epoxy composite suffered from lightning strike’, *Compos. Struct.*, vol. 117, no. 1, pp. 222–233, 2014, doi: 10.1016/j.compstruct.2014.06.029.

[3] S. Kamiyama, Y. Hirano, and T. Ogasawara, ‘Delamination analysis of CFRP laminates exposed to lightning strike considering cooling process’, *Compos. Struct.*, vol. 196, pp. 55–62, 2018, doi: 10.1016/j.compstruct.2018.05.003.