복합재료(Composite+Peek) 물성 DB (200개)

ㅇ 시험 개요

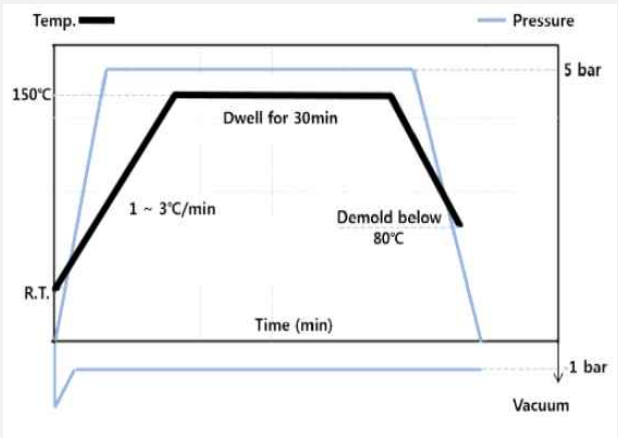
탄소섬유 강화 복합재료에 대한 시뮬레이션 물성 라이브러리를 구축하기 위해, 다양한 복합구조체의 섬유 방향과 적층수와 수지 종류에 따른 재료 물성 차이를 조사하고, 이에 따른 결과를 데이터 베이스(Data Base, DB) 구축하는 것이 목적임.

ㅇ 시험규격 (ASTM D3039, ASTM D695, ASTM D5379)

시험 장비는 20톤 용량의 Shimadzu사 만능재료시험기를 사용하여 재료 물성을 평가하였으며, 하중 변위 속도는 분당 2mm의 변위제어 속도로 최대 하중의 50% 하중 저하가 발생하면 자동으로 종료되도록 설정함.

ㅇ 성형 조건 및 시험 환경

시험환경은 대기온도 25℃, 습도 20%에서 시험.



<성형조건>

ㅇ 시험장비(만능재료시험기)

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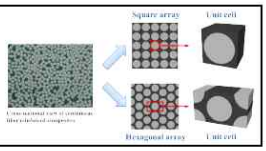
Data base report of material properties library for polymer composite engineering

■ Theory

Representative elementary volume (RVE) is the smallest volume over which a measurement can be made that will yield a value representative of the whole. In the case of periodic materials, one simply chooses a periodic unit cell (which, however, may be non-unique), but in random media, the situation is much more complicated.



■ Material properties

☐ Weave

Brand	SK Chemical
Pattern	Woven
Fiber material	Carbon
Lay up type	Multi layer

☐ Material properties

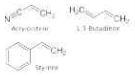
Property	Unit	Value
E-Modulus	GPa	116
Poisson's ratio	-	0.28
Density	g/mm³	1.84

☐ Resin

Type	Peek

☐ Material properties

Property	Unit	Value
E-Modulus	MPa	535
Poisson's ratio	-	0.29
Density	g/mm³	1.55



■ Property according to direction(XYZ)

No.	Symbol	Properties	Unit	Value	Notes
1	ρ	Density	g/mm³	2.087E-09	-
2	E_1	Young's Modulus X	MPa	163394	Longitudinal modulus
3	E_2	Young's Modulus Y	MPa	10439.24	Transverse Modulus
4	E_3	Young's Modulus Z	MPa	11256.224	-
5	ν_{12}	Poisson's ratio XY	MPa	0.4128075	-
6	ν_{13}	Poisson's ratio YZ	MPa	0.479643	-
7	ν_{23}	Poisson's ratio XZ	MPa	0.290232	-
8	G_{12}	Shear Modulus XY	MPa	4789.113	In-plane shear modulus
9	G_{13}	Shear Modulus YZ	MPa	3876.901	Out-of-plane shear modulus
10	G_{23}	Shear Modulus XZ	MPa	5489.555	Out-of-plane shear modulus
11	S_{1T}	Longitudinal Tensile strength	MPa	3606.339	Strain: 0.03%
12	S_{1C}	Longitudinal Compressive strength	MPa	-4341.612	Strain: 0.03%
13	S_{2T}	Transverse Tensile strength	MPa	3022.863	Strain: 0.03%
14	S_{2C}	Transverse compressive strength	MPa	-326.796	Strain: 0.03%
15	S_{3T}	Tensile strength	MPa	307.7329	Strain: 0.03%
16	S_{3C}	Compressive strength	MPa	-307.7329	Strain: 0.03%
17	S_{12}	Out-of-plane shear strength	MPa	134.0244	-
18	S_{23}	Shear strength	MPa	121.5306	-
19	k	Thermal conductivity	W/m·K	482.303	
20	C_p	Specific heat	kJ/kg·K	474.165	

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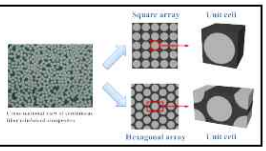


■ Material properties

☐ Weave

Brand	SK Chemical
Pattern	Woven
Fiber material	Carbon
Lay up type	Multi layer

☐ Material properties

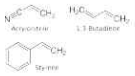
Property	Unit	Value
E-Modulus	GPa	125
Poisson's ratio	-	0.27
Density	g/mm³	1.5

☐ Resin

Type	Peek

☐ Material properties

Property	Unit	Value
E-Modulus	GPa	362
Poisson's ratio	-	0.29
Density	g/mm³	1.53



■ Property according to direction(XYZ)

No.	Symbol	Properties	Unit	Value	Notes
1	ρ	Density	g/mm³	2.030E-09	-
2	E_1	Young's Modulus X	MPa	158725.6	Longitudinal modulus
3	E_2	Young's Modulus Y	MPa	12708.64	Transverse Modulus
4	E_3	Young's Modulus Z	MPa	11347	-
5	ν_{12}	Poisson's ratio XY	MPa	0.581862	-
6	ν_{13}	Poisson's ratio YZ	MPa	0.4521225	-
7	ν_{23}	Poisson's ratio XZ	MPa	0.2466972	-
8	G_{12}	Shear Modulus XY	MPa	4398.165	In-plane shear modulus
9	G_{13}	Shear Modulus YZ	MPa	3257.9	Out-of-plane shear modulus
10	G_{23}	Shear Modulus XZ	MPa	4921.67	Out-of-plane shear modulus
11	S_{1T}	Longitudinal Tensile strength	MPa	4096.521	Strain: 0.03%
12	S_{1C}	Longitudinal Compressive strength	MPa	-4166.547	Strain: 0.03%
13	S_{2T}	Transverse Tensile strength	MPa	3186.261	Strain: 0.03%
14	S_{2C}	Transverse compressive strength	MPa	-403.0484	Strain: 0.03%
15	S_{3T}	Tensile strength	MPa	378.5387	Strain: 0.03%
16	S_{3C}	Compressive strength	MPa	-343.1358	Strain: 0.03%
17	S_{12}	Out-of-plane shear strength	MPa	138.5676	-
18	S_{23}	Shear strength	MPa	139.7034	-
19	k	Thermal conductivity	W/m·K	458.5275	
20	C_p	Specific heat	kJ/kg·K	516.57	

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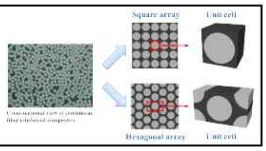


■ Material properties

☐ Weave

Brand	SK Chemical
Pattern	Woven
Fiber material	Carbon
Lay up type	Multi layer

☐ Material properties

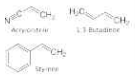
Property	Unit	Value
E-Modulus	GPa	102
Poisson's ratio	-	0.3
Density	g/mm³	1.76

☐ Resin

Type	Peek

☐ Material properties

Property	Unit	Value
E-Modulus	MPa	541
Poisson's ratio	-	0.29
Density	g/mm³	1.53



■ Property according to direction(XYZ)

No.	Symbol	Properties	Unit	Value	Notes
1	ρ	Density	g/mm³	2.073E-09	-
2	E_1	Young's Modulus X	MPa	136550.7	Longitudinal modulus
3	E_2	Young's Modulus Y	MPa	12254.76	Transverse Modulus
4	E_3	Young's Modulus Z	MPa	13616.4	-
5	ν_{12}	Poisson's ratio XY	MPa	0.4678485	-
6	ν_{13}	Poisson's ratio YZ	MPa	0.5150265	-
7	ν_{23}	Poisson's ratio XZ	MPa	0.2733018	-
8	G_{12}	Shear Modulus XY	MPa	3714.006	In-plane shear modulus
9	G_{13}	Shear Modulus YZ	MPa	4072.375	Out-of-plane shear modulus
10	G_{23}	Shear Modulus XZ	MPa	5300.26	Out-of-plane shear modulus
11	S_{1T}	Longitudinal Tensile strength	MPa	4621.716	Strain: 0.03%
12	S_{1C}	Longitudinal Compressive strength	MPa	-3571.326	Strain: 0.03%
13	S_{2T}	Transverse Tensile strength	MPa	2777.766	Strain: 0.03%
14	S_{2C}	Transverse compressive strength	MPa	-400.3251	Strain: 0.03%
15	S_{3T}	Tensile strength	MPa	294.1164	Strain: 0.03%
16	S_{3C}	Compressive strength	MPa	-315.9028	Strain: 0.03%
17	S_{12}	Out-of-plane shear strength	MPa	155.6046	-
18	S_{23}	Shear strength	MPa	157.8762	-
19	k	Thermal conductivity	W/m·K	482.303	
20	C_p	Specific heat	kJ/kg·K	385.5	

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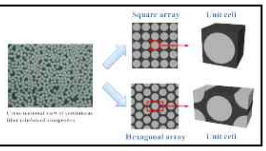


■ Material properties

☐ Weave

Brand	SK Chemical
Pattern	Woven
Fiber material	Carbon
Lay up type	Multi layer

☐ Material properties

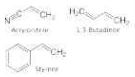
Property	Unit	Value
E-Modulus	GPa	116
Poisson's ratio	-	0.26
Density	g/mm³	1.52

☐ Resin

Type	Peek

☐ Material properties

Property	Unit	Value
E-Modulus	GPa	458
Poisson's ratio	-	0.28
Density	g/mm³	1.89



■ Property according to direction(XYZ)

No.	Symbol	Properties	Unit	Value	Notes
1	ρ	Density	g/mm³	1.987E-09	-
2	E_1	Young's Modulus X	MPa	165728.2	Longitudinal modulus
3	E_2	Young's Modulus Y	MPa	10983.896	Transverse Modulus
4	E_3	Young's Modulus Z	MPa	13616.4	-
5	ν_{12}	Poisson's ratio XY	MPa	0.5543415	-
6	ν_{13}	Poisson's ratio YZ	MPa	0.5150265	-
7	ν_{23}	Poisson's ratio XZ	MPa	0.3579528	-
8	G_{12}	Shear Modulus XY	MPa	3779.164	In-plane shear modulus
9	G_{13}	Shear Modulus YZ	MPa	4626.218	Out-of-plane shear modulus
10	G_{23}	Shear Modulus XZ	MPa	4656.657	Out-of-plane shear modulus
11	S_{1T}	Longitudinal Tensile strength	MPa	4061.508	Strain: 0.03%
12	S_{1C}	Longitudinal Compressive strength	MPa	-4796.781	Strain: 0.03%
13	S_{2T}	Transverse Tensile strength	MPa	3431.358	Strain: 0.03%
14	S_{2C}	Transverse compressive strength	MPa	-345.8591	Strain: 0.03%
15	S_{3T}	Tensile strength	MPa	294.1164	Strain: 0.03%
16	S_{3C}	Compressive strength	MPa	-373.0921	Strain: 0.03%
17	S_{12}	Out-of-plane shear strength	MPa	156.7404	-
18	S_{23}	Shear strength	MPa	152.1972	-
19	k	Thermal conductivity	W/m·K	400.787	
20	C_p	Specific heat	kJ/kg·K	458.745	

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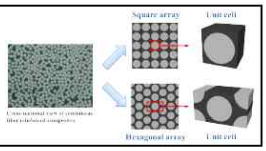


■ Material properties

☐ Weave

Brand	SK Chemical
Pattern	Woven
Fiber material	Carbon
Lay up type	Multi layer

☐ Material properties

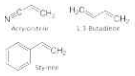
Property	Unit	Value
E-Modulus	GPa	128
Poisson's ratio	-	0.3
Density	g/mm³	1.71

☐ Resin

Type	Peek

☐ Material properties

Property	Unit	Value
E-Modulus	MPa	367
Poisson's ratio	-	0.3
Density	g/mm³	1.52



■ Property according to direction(XYZ)

No.	Symbol	Properties	Unit	Value	Notes
1	ρ	Density	g/mm³	2.102E-09	-
2	E_1	Young's Modulus X	MPa	123712.6	Longitudinal modulus
3	E_2	Young's Modulus Y	MPa	13616.4	Transverse Modulus
4	E_3	Young's Modulus Z	MPa	9531.48	-
5	ν_{12}	Poisson's ratio XY	MPa	0.5543415	-
6	ν_{13}	Poisson's ratio YZ	MPa	0.5857935	-
7	ν_{23}	Poisson's ratio XZ	MPa	0.253953	-
8	G_{12}	Shear Modulus XY	MPa	4365.586	In-plane shear modulus
9	G_{13}	Shear Modulus YZ	MPa	4593.639	Out-of-plane shear modulus
10	G_{23}	Shear Modulus XZ	MPa	5678.85	Out-of-plane shear modulus
11	S_{1T}	Longitudinal Tensile strength	MPa	4761.768	Strain: 0.03%
12	S_{1C}	Longitudinal Compressive strength	MPa	-4621.716	Strain: 0.03%
13	S_{2T}	Transverse Tensile strength	MPa	3758.154	Strain: 0.03%
14	S_{2C}	Transverse compressive strength	MPa	-288.6698	Strain: 0.03%
15	S_{3T}	Tensile strength	MPa	386.7086	Strain: 0.03%
16	S_{3C}	Compressive strength	MPa	-277.7766	Strain: 0.03%
17	S_{12}	Out-of-plane shear strength	MPa	130.617	-
18	S_{23}	Shear strength	MPa	159.012	-
19	k	Thermal conductivity	W/m·K	461.924	
20	C_p	Specific heat	kJ/kg·K	427.905	

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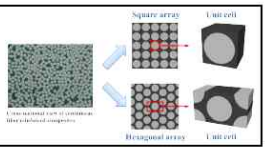


■ Material properties

☐ Weave

Brand	SK Chemical
Pattern	Woven
Fiber material	Carbon
Lay up type	Multi layer

☐ Material properties

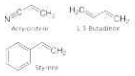
Property	Unit	Value
E-Modulus	GPa	117
Poisson's ratio	-	0.28
Density	g/mm³	1.74

☐ Resin

Type	Peek

☐ Material properties

Property	Unit	Value
E-Modulus	MPa	458
Poisson's ratio	-	0.29
Density	g/mm³	1.57



■ Property according to direction(XYZ)

No.	Symbol	Properties	Unit	Value	Notes
1	ρ	Density	g/mm³	1.801E-09	-
2	E_1	Young's Modulus X	MPa	116710	Longitudinal modulus
3	E_2	Young's Modulus Y	MPa	11891.656	Transverse Modulus
4	E_3	Young's Modulus Z	MPa	9531.48	-
5	ν_{12}	Poisson's ratio XY	MPa	0.4363965	-
6	ν_{13}	Poisson's ratio YZ	MPa	0.581862	-
7	ν_{23}	Poisson's ratio XZ	MPa	0.3434412	-
8	G_{12}	Shear Modulus XY	MPa	4723.955	In-plane shear modulus
9	G_{13}	Shear Modulus YZ	MPa	4561.06	Out-of-plane shear modulus
10	G_{23}	Shear Modulus XZ	MPa	3785.9	Out-of-plane shear modulus
11	S_{1T}	Longitudinal Tensile strength	MPa	4271.586	Strain: 0.03%
12	S_{1C}	Longitudinal Compressive strength	MPa	-4306.599	Strain: 0.03%
13	S_{2T}	Transverse Tensile strength	MPa	3458.591	Strain: 0.03%
14	S_{2C}	Transverse compressive strength	MPa	-373.0921	Strain: 0.03%
15	S_{3T}	Tensile strength	MPa	299.563	Strain: 0.03%
16	S_{3C}	Compressive strength	MPa	-375.8154	Strain: 0.03%
17	S_{12}	Out-of-plane shear strength	MPa	164.691	-
18	S_{23}	Shear strength	MPa	146.5182	-
19	k	Thermal conductivity	W/m·K	410.9765	
20	C_p	Specific heat	kJ/kg·K	462.6	

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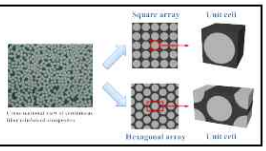


■ Material properties

☐ Weave

Brand	SK Chemical
Pattern	Woven
Fiber material	Carbon
Lay up type	Multi layer

☐ Material properties

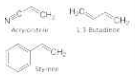
Property	Unit	Value
E-Modulus	GPa	119
Poisson's ratio	-	0.26
Density	g/mm³	1.86

☐ Resin

Type	Peek

☐ Material properties

Property	Unit	Value
E-Modulus	MPa	553
Poisson's ratio	-	0.25
Density	g/mm³	1.86



■ Property according to direction(XYZ)

No.	Symbol	Properties	Unit	Value	Notes
1	ρ	Density	g/mm³	1.573E-09	-
2	E_1	Young's Modulus X	MPa	117877.1	Longitudinal modulus
3	E_2	Young's Modulus Y	MPa	12163.984	Transverse Modulus
4	E_3	Young's Modulus Z	MPa	13344.072	-
5	ν_{12}	Poisson's ratio XY	MPa	0.4206705	-
6	ν_{13}	Poisson's ratio YZ	MPa	0.4285335	-
7	ν_{23}	Poisson's ratio XZ	MPa	0.2829762	-
8	G_{12}	Shear Modulus XY	MPa	3714.006	In-plane shear modulus
9	G_{13}	Shear Modulus YZ	MPa	4626.218	Out-of-plane shear modulus
10	G_{23}	Shear Modulus XZ	MPa	5375.978	Out-of-plane shear modulus
11	S_{1T}	Longitudinal Tensile strength	MPa	4621.716	Strain: 0.03%
12	S_{1C}	Longitudinal Compressive strength	MPa	-4971.846	Strain: 0.03%
13	S_{2T}	Transverse Tensile strength	MPa	3458.591	Strain: 0.03%
14	S_{2C}	Transverse compressive strength	MPa	-275.0533	Strain: 0.03%
15	S_{3T}	Tensile strength	MPa	326.796	Strain: 0.03%
16	S_{3C}	Compressive strength	MPa	-337.6892	Strain: 0.03%
17	S_{12}	Out-of-plane shear strength	MPa	145.3824	-
18	S_{23}	Shear strength	MPa	137.4318	-
19	k	Thermal conductivity	W/m·K	349.8395	
20	C_p	Specific heat	kJ/kg·K	562.83	

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■ Theory

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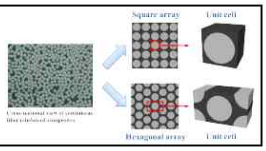


■ Material properties

☐ Weave

Brand	SK Chemical
Pattern	Woven
Fiber material	Carbon
Lay up type	Multi layer

☐ Material properties

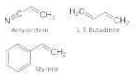
Property	Unit	Value
E-Modulus	GPa	101
Poisson's ratio	-	0.26
Density	g/mm³	1.76

☐ Resin

Type	Peek

☐ Material properties

Property	Unit	Value
E-Modulus	MPa	599
Poisson's ratio	-	0.25
Density	g/mm³	1.6



■ Property according to direction(XYZ)

No.	Symbol	Properties	Unit	Value	Notes
1	ρ	Density	g/mm³	1.959E-09	-
2	E_1	Young's Modulus X	MPa	149388.8	Longitudinal modulus
3	E_2	Young's Modulus Y	MPa	9894.584	Transverse Modulus
4	E_3	Young's Modulus Z	MPa	12254.76	-
5	ν_{12}	Poisson's ratio XY	MPa	0.518958	-
6	ν_{13}	Poisson's ratio YZ	MPa	0.424602	-
7	ν_{23}	Poisson's ratio XZ	MPa	0.3361854	-
8	G_{12}	Shear Modulus XY	MPa	4137.533	In-plane shear modulus
9	G_{13}	Shear Modulus YZ	MPa	4756.534	Out-of-plane shear modulus
10	G_{23}	Shear Modulus XZ	MPa	4997.388	Out-of-plane shear modulus
11	S_{1T}	Longitudinal Tensile strength	MPa	4691.742	Strain: 0.03%
12	S_{1C}	Longitudinal Compressive strength	MPa	-4131.534	Strain: 0.03%
13	S_{2T}	Transverse Tensile strength	MPa	2804.999	Strain: 0.03%
14	S_{2C}	Transverse compressive strength	MPa	-294.1164	Strain: 0.03%
15	S_{3T}	Tensile strength	MPa	397.6018	Strain: 0.03%
16	S_{3C}	Compressive strength	MPa	-356.7523	Strain: 0.03%
17	S_{12}	Out-of-plane shear strength	MPa	162.4194	-
18	S_{23}	Shear strength	MPa	145.3824	-
19	k	Thermal conductivity	W/m·K	417.7695	
20	C_p	Specific heat	kJ/kg·K	555.12	

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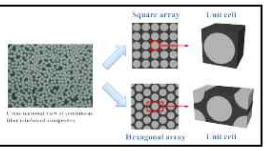


■ Material properties

☐ Weave

Brand	SK Chemical
Pattern	Woven
Fiber material	Carbon
Lay up type	Multi layer

☐ Material properties

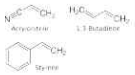
Property	Unit	Value
E-Modulus	GPa	102
Poisson's ratio	-	0.28
Density	g/mm³	1.6

☐ Resin

Type	Peek

☐ Material properties

Property	Unit	Value
E-Modulus	MPa	466
Poisson's ratio	-	0.3
Density	g/mm³	1.75



■ Property according to direction(XYZ)

No.	Symbol	Properties	Unit	Value	Notes
1	ρ	Density	g/mm³	1.844E-09	-
2	E_1	Young's Modulus X	MPa	163394	Longitudinal modulus
3	E_2	Young's Modulus Y	MPa	12073.208	Transverse Modulus
4	E_3	Young's Modulus Z	MPa	9077.6	-
5	ν_{12}	Poisson's ratio XY	MPa	0.440328	-
6	ν_{13}	Poisson's ratio YZ	MPa	0.408876	-
7	ν_{23}	Poisson's ratio XZ	MPa	0.2636274	-
8	G_{12}	Shear Modulus XY	MPa	4333.007	In-plane shear modulus
9	G_{13}	Shear Modulus YZ	MPa	4333.007	Out-of-plane shear modulus
10	G_{23}	Shear Modulus XZ	MPa	4278.067	Out-of-plane shear modulus
11	S_{1T}	Longitudinal Tensile strength	MPa	4131.534	Strain: 0.03%
12	S_{1C}	Longitudinal Compressive strength	MPa	-3501.3	Strain: 0.03%
13	S_{2T}	Transverse Tensile strength	MPa	3404.125	Strain: 0.03%
14	S_{2C}	Transverse compressive strength	MPa	-291.3931	Strain: 0.03%
15	S_{3T}	Tensile strength	MPa	389.4319	Strain: 0.03%
16	S_{3C}	Compressive strength	MPa	-302.2863	Strain: 0.03%
17	S_{12}	Out-of-plane shear strength	MPa	169.2342	-
18	S_{23}	Shear strength	MPa	157.8762	-
19	k	Thermal conductivity	W/m·K	502.682	
20	C_p	Specific heat	kJ/kg·K	466.455	

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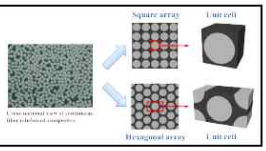


■ Material properties

☐ Weave

Brand	SK Chemical
Pattern	Woven
Fiber material	Carbon
Lay up type	Multi layer

☐ Material properties

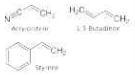
Property	Unit	Value
E-Modulus	GPa	120
Poisson's ratio	-	0.28
Density	g/mm³	1.58

☐ Resin

Type	Peek

☐ Material properties

Property	Unit	Value
E-Modulus	MPa	548
Poisson's ratio	-	0.29
Density	g/mm³	1.82



■ Property according to direction(XYZ)

No.	Symbol	Properties	Unit	Value	Notes
1	ρ	Density	g/mm³	1.558E-09	-
2	E_1	Young's Modulus X	MPa	134216.5	Longitudinal modulus
3	E_2	Young's Modulus Y	MPa	9803.808	Transverse Modulus
4	E_3	Young's Modulus Z	MPa	12890.192	-
5	ν_{12}	Poisson's ratio XY	MPa	0.4285335	-
6	ν_{13}	Poisson's ratio YZ	MPa	0.526821	-
7	ν_{23}	Poisson's ratio XZ	MPa	0.2612088	-
8	G_{12}	Shear Modulus XY	MPa	4691.376	In-plane shear modulus
9	G_{13}	Shear Modulus YZ	MPa	4626.218	Out-of-plane shear modulus
10	G_{23}	Shear Modulus XZ	MPa	4429.503	Out-of-plane shear modulus
11	S_{1T}	Longitudinal Tensile strength	MPa	4551.69	Strain: 0.03%
12	S_{1C}	Longitudinal Compressive strength	MPa	-4131.534	Strain: 0.03%
13	S_{2T}	Transverse Tensile strength	MPa	3050.096	Strain: 0.03%
14	S_{2C}	Transverse compressive strength	MPa	-294.1164	Strain: 0.03%
15	S_{3T}	Tensile strength	MPa	299.563	Strain: 0.03%
16	S_{3C}	Compressive strength	MPa	-408.495	Strain: 0.03%
17	S_{12}	Out-of-plane shear strength	MPa	168.0984	-
18	S_{23}	Shear strength	MPa	163.5552	-
19	k	Thermal conductivity	W/m·K	475.51	
20	C_p	Specific heat	kJ/kg·K	524.28	