복합재료(Composite + PP) 물성 DB (200개)

ㅇ 시험 개요

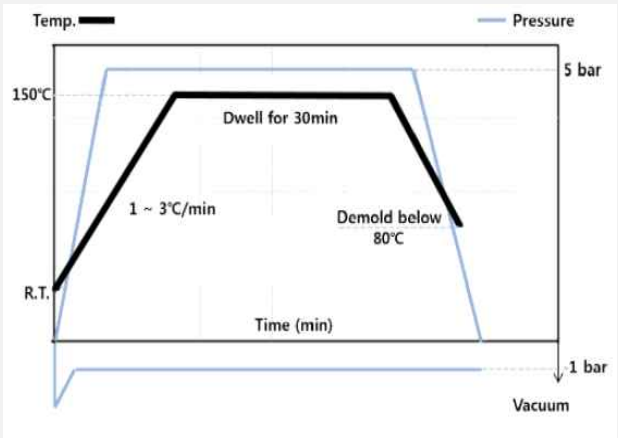
탄소섬유 강화 복합재료에 대한 시뮬레이션 물성 라이브러리를 구축하기 위해, 다양한 복합구조체의 섬유 방향과 적층수와 수지 종류에 따른 재료 물성 차이를 조사하고, 이에 따른 결과를 데이터 베이스(Data Base, DB) 구축하는 것이 목적임.

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

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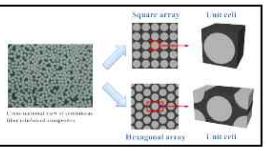


■ Material properties

☐ Weave

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

☐ Material properties

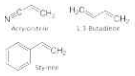
Property	Unit	Value
E-Modulus	GPa	126
Poisson's ratio	-	0.25
Density	g/mm³	1.89

☐ Resin

Type	PP

☐ Material properties

Property	Unit	Value
E-Modulus	MPa	420
Poisson's ratio	-	0.27
Density	g/mm³	1.62



■ 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	166895.3	Longitudinal modulus
3	E_2	Young's Modulus Y	MPa	9985.36	Transverse Modulus
4	E_3	Young's Modulus Z	MPa	10076.136	-
5	ν_{12}	Poisson's ratio XY	MPa	0.589725	-
6	ν_{13}	Poisson's ratio YZ	MPa	0.5857935	-
7	ν_{23}	Poisson's ratio XZ	MPa	0.3603714	-
8	G_{12}	Shear Modulus XY	MPa	4430.744	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	4921.67	Out-of-plane shear modulus
11	S_{1T}	Longitudinal Tensile strength	MPa	5041.872	Strain: 0.03%
12	S_{1C}	Longitudinal Compressive strength	MPa	-4726.755	Strain: 0.03%
13	S_{2T}	Transverse Tensile strength	MPa	2804.999	Strain: 0.03%
14	S_{2C}	Transverse compressive strength	MPa	-408.495	Strain: 0.03%
15	S_{3T}	Tensile strength	MPa	408.495	Strain: 0.03%
16	S_{3C}	Compressive strength	MPa	-351.3057	Strain: 0.03%
17	S_{12}	Out-of-plane shear strength	MPa	155.6046	-
18	S_{23}	Shear strength	MPa	168.0984	-
19	k	Thermal conductivity	W/m·K	366.822	
20	C_p	Specific heat	kJ/kg·K	404.775	

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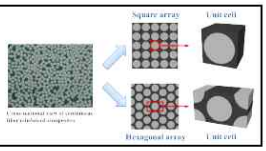


■ Material properties

☐ Weave

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

☐ Material properties

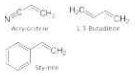
Property	Unit	Value
E-Modulus	GPa	103
Poisson's ratio	-	0.3
Density	g/mm³	1.75

☐ Resin

Type	PP

☐ Material properties

Property	Unit	Value
E-Modulus	MPa	360
Poisson's ratio	-	0.29
Density	g/mm³	1.8



■ 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	129548.1	Longitudinal modulus
3	E_2	Young's Modulus Y	MPa	9349.928	Transverse Modulus
4	E_3	Young's Modulus Z	MPa	10620.792	-
5	ν_{12}	Poisson's ratio XY	MPa	0.518958	-
6	ν_{13}	Poisson's ratio YZ	MPa	0.416739	-
7	ν_{23}	Poisson's ratio XZ	MPa	0.3071622	-
8	G_{12}	Shear Modulus XY	MPa	4723.955	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	5640.991	Out-of-plane shear modulus
11	S_{1T}	Longitudinal Tensile strength	MPa	3781.404	Strain: 0.03%
12	S_{1C}	Longitudinal Compressive strength	MPa	-3676.365	Strain: 0.03%
13	S_{2T}	Transverse Tensile strength	MPa	3159.028	Strain: 0.03%
14	S_{2C}	Transverse compressive strength	MPa	-280.4999	Strain: 0.03%
15	S_{3T}	Tensile strength	MPa	337.6892	Strain: 0.03%
16	S_{3C}	Compressive strength	MPa	-348.5824	Strain: 0.03%
17	S_{12}	Out-of-plane shear strength	MPa	164.691	-
18	S_{23}	Shear strength	MPa	143.1108	-
19	k	Thermal conductivity	W/m·K	356.6325	
20	C_p	Specific heat	kJ/kg·K	505.005	

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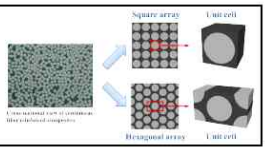


■ Material properties

☐ Weave

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

☐ Material properties

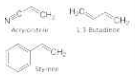
Property	Unit	Value
E-Modulus	GPa	107
Poisson's ratio	-	0.28
Density	g/mm³	1.72

☐ Resin

Type	PP

☐ Material properties

Property	Unit	Value
E-Modulus	MPa	589
Poisson's ratio	-	0.3
Density	g/mm³	1.69



■ 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	133049.4	Longitudinal modulus
3	E_2	Young's Modulus Y	MPa	9803.808	Transverse Modulus
4	E_3	Young's Modulus Z	MPa	13616.4	-
5	ν_{12}	Poisson's ratio XY	MPa	0.518958	-
6	ν_{13}	Poisson's ratio YZ	MPa	0.5307525	-
7	ν_{23}	Poisson's ratio XZ	MPa	0.3555342	-
8	G_{12}	Shear Modulus XY	MPa	3355.637	In-plane shear modulus
9	G_{13}	Shear Modulus YZ	MPa	3811.743	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	3991.482	Strain: 0.03%
12	S_{1C}	Longitudinal Compressive strength	MPa	-4761.768	Strain: 0.03%
13	S_{2T}	Transverse Tensile strength	MPa	3921.552	Strain: 0.03%
14	S_{2C}	Transverse compressive strength	MPa	-291.3931	Strain: 0.03%
15	S_{3T}	Tensile strength	MPa	283.2232	Strain: 0.03%
16	S_{3C}	Compressive strength	MPa	-291.3931	Strain: 0.03%
17	S_{12}	Out-of-plane shear strength	MPa	131.7528	-
18	S_{23}	Shear strength	MPa	168.0984	-
19	k	Thermal conductivity	W/m·K	444.9415	
20	C_p	Specific heat	kJ/kg·K	408.63	

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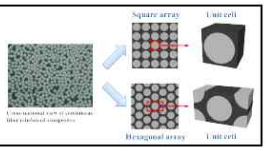


■ Material properties

☐ Weave

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

☐ Material properties

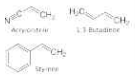
Property	Unit	Value
E-Modulus	GPa	100
Poisson's ratio	-	0.27
Density	g/mm³	1.51

☐ Resin

Type	PP

☐ Material properties

Property	Unit	Value
E-Modulus	MPa	388
Poisson's ratio	-	0.3
Density	g/mm³	1.53



■ Property according to direction(XYZ)

No.	Symbol	Properties	Unit	Value	Notes
1	ρ	Density	g/mm³	2.002E-09	-
2	E_1	Young's Modulus X	MPa	142386.2	Longitudinal modulus
3	E_2	Young's Modulus Y	MPa	10076.136	Transverse Modulus
4	E_3	Young's Modulus Z	MPa	12708.64	-
5	ν_{12}	Poisson's ratio XY	MPa	0.5857935	-
6	ν_{13}	Poisson's ratio YZ	MPa	0.4914375	-
7	ν_{23}	Poisson's ratio XZ	MPa	0.2587902	-
8	G_{12}	Shear Modulus XY	MPa	3453.374	In-plane shear modulus
9	G_{13}	Shear Modulus YZ	MPa	3453.374	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	-4796.781	Strain: 0.03%
13	S_{2T}	Transverse Tensile strength	MPa	2995.63	Strain: 0.03%
14	S_{2C}	Transverse compressive strength	MPa	-359.4756	Strain: 0.03%
15	S_{3T}	Tensile strength	MPa	383.9853	Strain: 0.03%
16	S_{3C}	Compressive strength	MPa	-348.5824	Strain: 0.03%
17	S_{12}	Out-of-plane shear strength	MPa	122.6664	-
18	S_{23}	Shear strength	MPa	152.1972	-
19	k	Thermal conductivity	W/m·K	397.3905	
20	C_p	Specific heat	kJ/kg·K	505.005	

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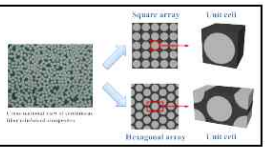


■ Material properties

☐ Weave

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

☐ Material properties

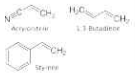
Property	Unit	Value
E-Modulus	GPa	129
Poisson's ratio	-	0.3
Density	g/mm³	1.75

☐ Resin

Type	PP

☐ Material properties

Property	Unit	Value
E-Modulus	MPa	387
Poisson's ratio	-	0.29
Density	g/mm³	1.7



■ Property according to direction(XYZ)

No.	Symbol	Properties	Unit	Value	Notes
1	ρ	Density	g/mm³	1.944E-09	-
2	E_1	Young's Modulus X	MPa	169229.5	Longitudinal modulus
3	E_2	Young's Modulus Y	MPa	11256.224	Transverse Modulus
4	E_3	Young's Modulus Z	MPa	9349.928	-
5	ν_{12}	Poisson's ratio XY	MPa	0.5464785	-
6	ν_{13}	Poisson's ratio YZ	MPa	0.518958	-
7	ν_{23}	Poisson's ratio XZ	MPa	0.3168366	-
8	G_{12}	Shear Modulus XY	MPa	4398.165	In-plane shear modulus
9	G_{13}	Shear Modulus YZ	MPa	4658.797	Out-of-plane shear modulus
10	G_{23}	Shear Modulus XZ	MPa	5527.414	Out-of-plane shear modulus
11	S_{1T}	Longitudinal Tensile strength	MPa	4446.651	Strain: 0.03%
12	S_{1C}	Longitudinal Compressive strength	MPa	-4516.677	Strain: 0.03%
13	S_{2T}	Transverse Tensile strength	MPa	2995.63	Strain: 0.03%
14	S_{2C}	Transverse compressive strength	MPa	-394.8785	Strain: 0.03%
15	S_{3T}	Tensile strength	MPa	321.3494	Strain: 0.03%
16	S_{3C}	Compressive strength	MPa	-356.7523	Strain: 0.03%
17	S_{12}	Out-of-plane shear strength	MPa	119.259	-
18	S_{23}	Shear strength	MPa	148.7898	-
19	k	Thermal conductivity	W/m·K	489.096	
20	C_p	Specific heat	kJ/kg·K	520.425	

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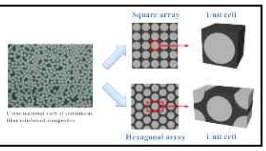


■ Material properties

☐ Weave

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

☐ Material properties

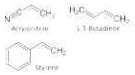
Property	Unit	Value
E-Modulus	GPa	110
Poisson's ratio	-	0.28
Density	g/mm³	1.61

☐ Resin

Type	PP

☐ Material properties

Property	Unit	Value
E-Modulus	MPa	406
Poisson's ratio	-	0.25
Density	g/mm³	1.62



■ 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	136550.7	Longitudinal modulus
3	E_2	Young's Modulus Y	MPa	10711.568	Transverse Modulus
4	E_3	Young's Modulus Z	MPa	10893.12	-
5	ν_{12}	Poisson's ratio XY	MPa	0.408876	-
6	ν_{13}	Poisson's ratio YZ	MPa	0.424602	-
7	ν_{23}	Poisson's ratio XZ	MPa	0.2442786	-
8	G_{12}	Shear Modulus XY	MPa	4626.218	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	4391.644	Out-of-plane shear modulus
11	S_{1T}	Longitudinal Tensile strength	MPa	4971.846	Strain: 0.03%
12	S_{1C}	Longitudinal Compressive strength	MPa	-3606.339	Strain: 0.03%
13	S_{2T}	Transverse Tensile strength	MPa	3349.659	Strain: 0.03%
14	S_{2C}	Transverse compressive strength	MPa	-356.7523	Strain: 0.03%
15	S_{3T}	Tensile strength	MPa	359.4756	Strain: 0.03%
16	S_{3C}	Compressive strength	MPa	-332.2426	Strain: 0.03%
17	S_{12}	Out-of-plane shear strength	MPa	145.3824	-
18	S_{23}	Shear strength	MPa	134.0244	-
19	k	Thermal conductivity	W/m·K	414.373	
20	C_p	Specific heat	kJ/kg·K	547.41	

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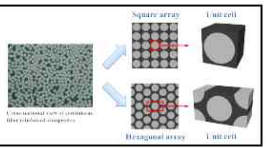


■ Material properties

☐ Weave

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

☐ Material properties

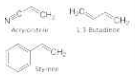
Property	Unit	Value
E-Modulus	GPa	119
Poisson's ratio	-	0.29
Density	g/mm³	1.74

☐ Resin

Type	PP

☐ Material properties

Property	Unit	Value
E-Modulus	MPa	429
Poisson's ratio	-	0.27
Density	g/mm³	1.88



■ Property according to direction(XYZ)

No.	Symbol	Properties	Unit	Value	Notes
1	ρ	Density	g/mm³	1.816E-09	-
2	E_1	Young's Modulus X	MPa	131882.3	Longitudinal modulus
3	E_2	Young's Modulus Y	MPa	9622.256	Transverse Modulus
4	E_3	Young's Modulus Z	MPa	12163.984	-
5	ν_{12}	Poisson's ratio XY	MPa	0.511095	-
6	ν_{13}	Poisson's ratio YZ	MPa	0.5857935	-
7	ν_{23}	Poisson's ratio XZ	MPa	0.3071622	-
8	G_{12}	Shear Modulus XY	MPa	4593.639	In-plane shear modulus
9	G_{13}	Shear Modulus YZ	MPa	4789.113	Out-of-plane shear modulus
10	G_{23}	Shear Modulus XZ	MPa	5186.683	Out-of-plane shear modulus
11	S_{1T}	Longitudinal Tensile strength	MPa	3606.339	Strain: 0.03%
12	S_{1C}	Longitudinal Compressive strength	MPa	-3921.456	Strain: 0.03%
13	S_{2T}	Transverse Tensile strength	MPa	3104.562	Strain: 0.03%
14	S_{2C}	Transverse compressive strength	MPa	-359.4756	Strain: 0.03%
15	S_{3T}	Tensile strength	MPa	408.495	Strain: 0.03%
16	S_{3C}	Compressive strength	MPa	-400.3251	Strain: 0.03%
17	S_{12}	Out-of-plane shear strength	MPa	129.4812	-
18	S_{23}	Shear strength	MPa	114.7158	-
19	k	Thermal conductivity	W/m·K	509.475	
20	C_p	Specific heat	kJ/kg·K	416.34	

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■ Theory

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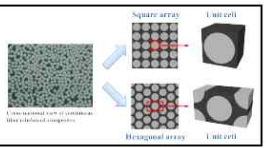


■ Material properties

☐ Weave

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

☐ Material properties

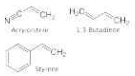
Property	Unit	Value
E-Modulus	GPa	126
Poisson's ratio	-	0.29
Density	g/mm³	1.7

☐ Resin

Type	PP

☐ Material properties

Property	Unit	Value
E-Modulus	MPa	383
Poisson's ratio	-	0.26
Density	g/mm³	1.65



■ Property according to direction(XYZ)

No.	Symbol	Properties	Unit	Value	Notes
1	ρ	Density	g/mm³	1.630E-09	-
2	E_1	Young's Modulus X	MPa	163394	Longitudinal modulus
3	E_2	Young's Modulus Y	MPa	13434.848	Transverse Modulus
4	E_3	Young's Modulus Z	MPa	9349.928	-
5	ν_{12}	Poisson's ratio XY	MPa	0.518958	-
6	ν_{13}	Poisson's ratio YZ	MPa	0.440328	-
7	ν_{23}	Poisson's ratio XZ	MPa	0.290232	-
8	G_{12}	Shear Modulus XY	MPa	4300.428	In-plane shear modulus
9	G_{13}	Shear Modulus YZ	MPa	4886.85	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	3991.482	Strain: 0.03%
12	S_{1C}	Longitudinal Compressive strength	MPa	-4656.729	Strain: 0.03%
13	S_{2T}	Transverse Tensile strength	MPa	3948.785	Strain: 0.03%
14	S_{2C}	Transverse compressive strength	MPa	-310.4562	Strain: 0.03%
15	S_{3T}	Tensile strength	MPa	337.6892	Strain: 0.03%
16	S_{3C}	Compressive strength	MPa	-288.6698	Strain: 0.03%
17	S_{12}	Out-of-plane shear strength	MPa	113.58	-
18	S_{23}	Shear strength	MPa	143.1108	-
19	k	Thermal conductivity	W/m·K	366.822	
20	C_p	Specific heat	kJ/kg·K	416.34	

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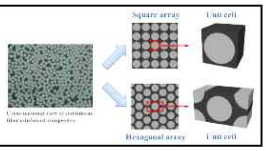


■ Material properties

☐ Weave

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

☐ Material properties

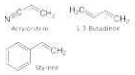
Property	Unit	Value
E-Modulus	GPa	110
Poisson's ratio	-	0.26
Density	g/mm³	1.83

☐ Resin

Type	PP

☐ Material properties

Property	Unit	Value
E-Modulus	MPa	342
Poisson's ratio	-	0.26
Density	g/mm³	1.81



■ Property according to direction(XYZ)

No.	Symbol	Properties	Unit	Value	Notes
1	ρ	Density	g/mm³	1.930E-09	-
2	E_1	Young's Modulus X	MPa	138884.9	Longitudinal modulus
3	E_2	Young's Modulus Y	MPa	12617.864	Transverse Modulus
4	E_3	Young's Modulus Z	MPa	12436.312	-
5	ν_{12}	Poisson's ratio XY	MPa	0.5307525	-
6	ν_{13}	Poisson's ratio YZ	MPa	0.432465	-
7	ν_{23}	Poisson's ratio XZ	MPa	0.3434412	-
8	G_{12}	Shear Modulus XY	MPa	4300.428	In-plane shear modulus
9	G_{13}	Shear Modulus YZ	MPa	4854.271	Out-of-plane shear modulus
10	G_{23}	Shear Modulus XZ	MPa	5640.991	Out-of-plane shear modulus
11	S_{1T}	Longitudinal Tensile strength	MPa	3851.43	Strain: 0.03%
12	S_{1C}	Longitudinal Compressive strength	MPa	-3816.417	Strain: 0.03%
13	S_{2T}	Transverse Tensile strength	MPa	2968.397	Strain: 0.03%
14	S_{2C}	Transverse compressive strength	MPa	-381.262	Strain: 0.03%
15	S_{3T}	Tensile strength	MPa	277.7766	Strain: 0.03%
16	S_{3C}	Compressive strength	MPa	-324.0727	Strain: 0.03%
17	S_{12}	Out-of-plane shear strength	MPa	146.5182	-
18	S_{23}	Shear strength	MPa	147.654	-
19	k	Thermal conductivity	W/m·K	417.7695	
20	C_p	Specific heat	kJ/kg·K	439.47	

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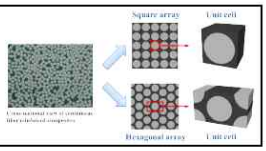


■ Material properties

☐ Weave

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

☐ Material properties

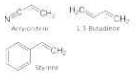
Property	Unit	Value
E-Modulus	GPa	103
Poisson's ratio	-	0.27
Density	g/mm³	1.55

☐ Resin

Type	PP

☐ Material properties

Property	Unit	Value
E-Modulus	MPa	454
Poisson's ratio	-	0.3
Density	g/mm³	1.87



■ Property according to direction(XYZ)

No.	Symbol	Properties	Unit	Value	Notes
1	ρ	Density	g/mm³	1.43E-09	-
2	E_1	Young's Modulus X	MPa	116710	Longitudinal modulus
3	E_2	Young's Modulus Y	MPa	9803.808	Transverse Modulus
4	E_3	Young's Modulus Z	MPa	9894.584	-
5	ν_{12}	Poisson's ratio XY	MPa	0.47178	-
6	ν_{13}	Poisson's ratio YZ	MPa	0.55041	-
7	ν_{23}	Poisson's ratio XZ	MPa	0.350697	-
8	G_{12}	Shear Modulus XY	MPa	4007.217	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	4013.054	Out-of-plane shear modulus
11	S_{1T}	Longitudinal Tensile strength	MPa	3711.378	Strain: 0.03%
12	S_{1C}	Longitudinal Compressive strength	MPa	-4201.56	Strain: 0.03%
13	S_{2T}	Transverse Tensile strength	MPa	3104.562	Strain: 0.03%
14	S_{2C}	Transverse compressive strength	MPa	-386.7086	Strain: 0.03%
15	S_{3T}	Tensile strength	MPa	310.4562	Strain: 0.03%
16	S_{3C}	Compressive strength	MPa	-275.0533	Strain: 0.03%
17	S_{12}	Out-of-plane shear strength	MPa	119.259	-
18	S_{23}	Shear strength	MPa	139.7034	-
19	k	Thermal conductivity	W/m·K	495.889	
20	C_p	Specific heat	kJ/kg·K	470.31	