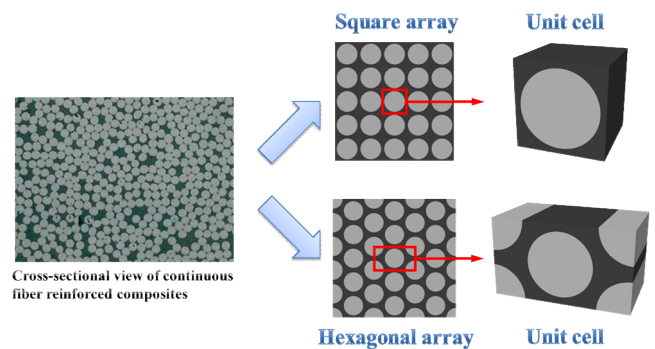


Theory

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.



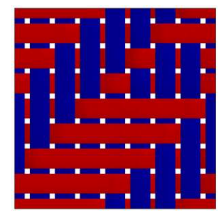
Material properties

Weave

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

Material properties

Property	Unit	Value
E-Modulus	GPa	126
Poisson's ratio	-	0.25
Density	g/mm ³	1.72



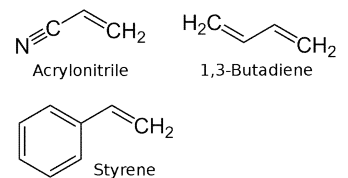
Resin

Type	ABS
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Material properties

Property	Unit	Value
E-Modulus	MPa	565
Poisson's ratio	-	0.29
Density	g/mm ³	1.59

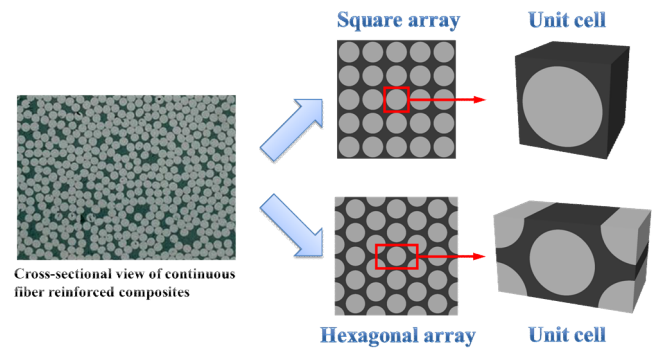


Property according to direction(XYZ)

No.	Symbol	Properties	Unit	Value	Notes
1	ρ	Density	g/mm ³	1.716E-09	-
2	E_1	Young's Modulus X	MPa	159892.7	Longitudinal modulus
3	E_2	Young's Modulus Y	MPa	12254.76	Transverse Modulus
4	E_3	Young's Modulus Z	MPa	12073.208	-
5	ν_{12}	Poisson's ratio XY	MPa	0.5464785	-
6	ν_{13}	Poisson's ratio YZ	MPa	0.401013	-
7	ν_{23}	Poisson's ratio XZ	MPa	0.3095808	-
8	G_{12}	Shear Modulus XY	MPa	3453.374	In-plane shear modulus
9	G_{13}	Shear Modulus YZ	MPa	3551.111	Out-of-plane shear modulus
10	G_{23}	Shear Modulus XZ	MPa	4467.362	Out-of-plane shear modulus
11	S_{11T}	Longitudinal Tensile strength	MPa	3501.3	Strain: 0.03%
12	S_{11C}	Longitudinal Compressive strength	MPa	-3711.378	Strain: 0.03%
13	S_{22T}	Transverse Tensile strength	MPa	3295.193	Strain: 0.03%
14	S_{22C}	Transverse compressive strength	MPa	-400.3251	Strain: 0.03%
15	S_{33T}	Tensile strength	MPa	403.0484	Strain: 0.03%
16	S_{33C}	Compressive strength	MPa	-321.3494	Strain: 0.03%
17	S_{12S}	Out-of-plane shear strength	MPa	157.8762	-
18	S_{23S}	Shear strength	MPa	144.2466	-
19	k	Thermal conductivity	W/m-K	400.787	
20	C_p	Specific heat	kJ/kg-K	451.035	

Theory

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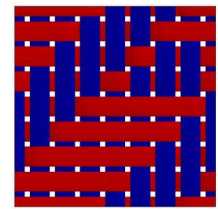
Material properties

☐ Weave

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

☐ Material properties

Property	Unit	Value
E-Modulus	GPa	130
Poisson's ratio	-	0.26
Density	g/mm ³	1.71



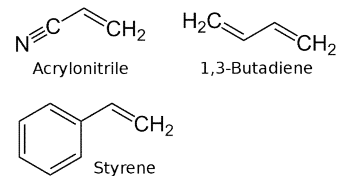
☐ Resin

Type	ABS
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☐ Material properties

Property	Unit	Value
E-Modulus	MPa	454
Poisson's ratio	-	0.27
Density	g/mm ³	1.67

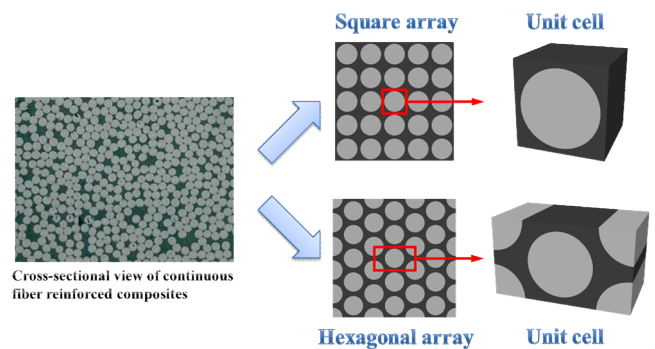


Property according to direction(XYZ)

No.	Symbol	Properties	Unit	Value	Notes
1	ρ	Density	g/mm ³	2.073E-09	-
2	E_1	Young's Modulus X	MPa	152890.1	Longitudinal modulus
3	E_2	Young's Modulus Y	MPa	11347	Transverse Modulus
4	E_3	Young's Modulus Z	MPa	11347	-
5	ν_{12}	Poisson's ratio XY	MPa	0.542547	-
6	ν_{13}	Poisson's ratio YZ	MPa	0.416739	-
7	ν_{23}	Poisson's ratio XZ	MPa	0.3458598	-
8	G_{12}	Shear Modulus XY	MPa	3290.479	In-plane shear modulus
9	G_{13}	Shear Modulus YZ	MPa	3714.006	Out-of-plane shear modulus
10	G_{23}	Shear Modulus XZ	MPa	4921.67	Out-of-plane shear modulus
11	S_{11T}	Longitudinal Tensile strength	MPa	5251.95	Strain: 0.03%
12	S_{11C}	Longitudinal Compressive strength	MPa	-5251.95	Strain: 0.03%
13	S_{22T}	Transverse Tensile strength	MPa	3458.591	Strain: 0.03%
14	S_{22C}	Transverse compressive strength	MPa	-370.3688	Strain: 0.03%
15	S_{33T}	Tensile strength	MPa	392.1552	Strain: 0.03%
16	S_{33C}	Compressive strength	MPa	-362.1989	Strain: 0.03%
17	S_{12S}	Out-of-plane shear strength	MPa	123.8022	-
18	S_{23S}	Shear strength	MPa	170.37	-
19	k	Thermal conductivity	W/m-K	393.994	
20	C_p	Specific heat	kJ/kg-K	462.6	

Theory

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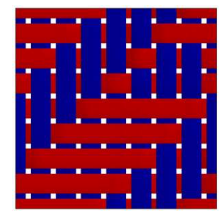
Material properties

☐ 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	-	0.28
Density	g/mm ³	1.85



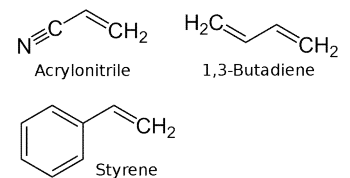
☐ Resin

Type	ABS
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☐ Material properties

Property	Unit	Value
E-Modulus	MPa	598
Poisson's ratio	-	0.25
Density	g/mm ³	1.7

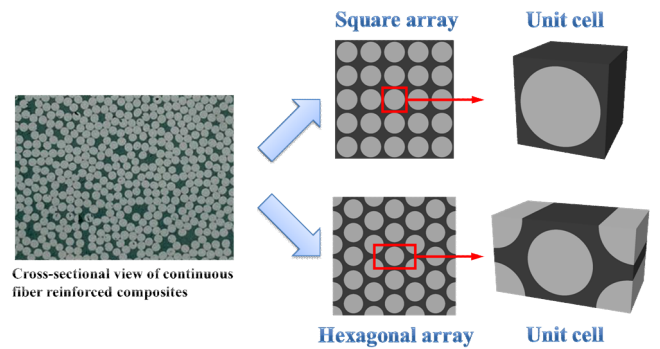


Property according to direction(XYZ)

No.	Symbol	Properties	Unit	Value	Notes
1	ρ	Density	g/mm ³	2.044E-09	-
2	E_1	Young's Modulus X	MPa	130715.2	Longitudinal modulus
3	E_2	Young's Modulus Y	MPa	13616.4	Transverse Modulus
4	E_3	Young's Modulus Z	MPa	9349.928	-
5	ν_{12}	Poisson's ratio XY	MPa	0.5857935	-
6	ν_{13}	Poisson's ratio YZ	MPa	0.5150265	-
7	ν_{23}	Poisson's ratio XZ	MPa	0.2805576	-
8	G_{12}	Shear Modulus XY	MPa	4333.007	In-plane shear modulus
9	G_{13}	Shear Modulus YZ	MPa	3518.532	Out-of-plane shear modulus
10	G_{23}	Shear Modulus XZ	MPa	5451.696	Out-of-plane shear modulus
11	S_{11T}	Longitudinal Tensile strength	MPa	3641.352	Strain: 0.03%
12	S_{11C}	Longitudinal Compressive strength	MPa	-3571.326	Strain: 0.03%
13	S_{22T}	Transverse Tensile strength	MPa	2777.766	Strain: 0.03%
14	S_{22C}	Transverse compressive strength	MPa	-351.3057	Strain: 0.03%
15	S_{33T}	Tensile strength	MPa	389.4319	Strain: 0.03%
16	S_{33C}	Compressive strength	MPa	-343.1358	Strain: 0.03%
17	S_{12S}	Out-of-plane shear strength	MPa	156.7404	-
18	S_{23S}	Shear strength	MPa	126.0738	-
19	k	Thermal conductivity	W/m-K	472.1135	
20	C_p	Specific heat	kJ/kg-K	454.89	

Theory

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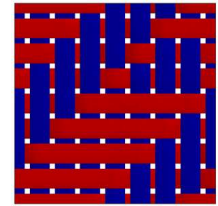
Material properties

□ Weave

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

□ Material properties

Property	Unit	Value
E-Modulus	GPa	100
Poisson's ratio	-	0.3
Density	g/mm ³	1.68



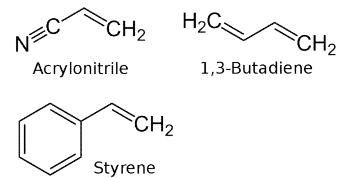
□ Resin

Type	ABS
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□ Material properties

Property	Unit	Value
E-Modulus	MPa	507
Poisson's ratio	-	0.3
Density	g/mm ³	1.57

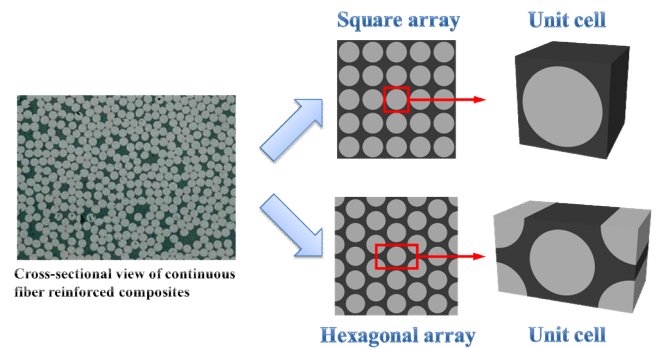


Property according to direction(XYZ)

No.	Symbol	Properties	Unit	Value	Notes
1	ρ	Density	g/mm ³	1.973E-09	-
2	E_1	Young's Modulus X	MPa	124879.7	Longitudinal modulus
3	E_2	Young's Modulus Y	MPa	13162.52	Transverse Modulus
4	E_3	Young's Modulus Z	MPa	12617.864	-
5	ν_{12}	Poisson's ratio XY	MPa	0.581862	-
6	ν_{13}	Poisson's ratio YZ	MPa	0.495369	-
7	ν_{23}	Poisson's ratio XZ	MPa	0.36279	-
8	G_{12}	Shear Modulus XY	MPa	3746.585	In-plane shear modulus
9	G_{13}	Shear Modulus YZ	MPa	4104.954	Out-of-plane shear modulus
10	G_{23}	Shear Modulus XZ	MPa	3899.477	Out-of-plane shear modulus
11	S_{11T}	Longitudinal Tensile strength	MPa	5006.859	Strain: 0.03%
12	S_{11C}	Longitudinal Compressive strength	MPa	-4341.612	Strain: 0.03%
13	S_{22T}	Transverse Tensile strength	MPa	3295.193	Strain: 0.03%
14	S_{22C}	Transverse compressive strength	MPa	-315.9028	Strain: 0.03%
15	S_{33T}	Tensile strength	MPa	294.1164	Strain: 0.03%
16	S_{33C}	Compressive strength	MPa	-275.0533	Strain: 0.03%
17	S_{12S}	Out-of-plane shear strength	MPa	160.1478	-
18	S_{23S}	Shear strength	MPa	135.1602	-
19	k	Thermal conductivity	W/m-K	448.338	
20	C_p	Specific heat	kJ/kg-K	400.92	

Theory

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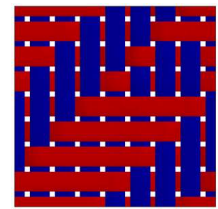
Material properties

□ Weave

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

□ Material properties

Property	Unit	Value
E-Modulus	GPa	127
Poisson's ratio	-	0.3
Density	g/mm ³	1.72



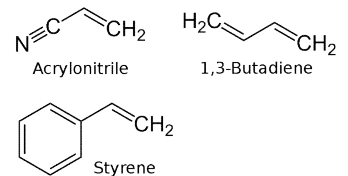
□ Resin

Type	ABS
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□ Material properties

Property	Unit	Value
E-Modulus	MPa	331
Poisson's ratio	-	0.29
Density	g/mm ³	1.68

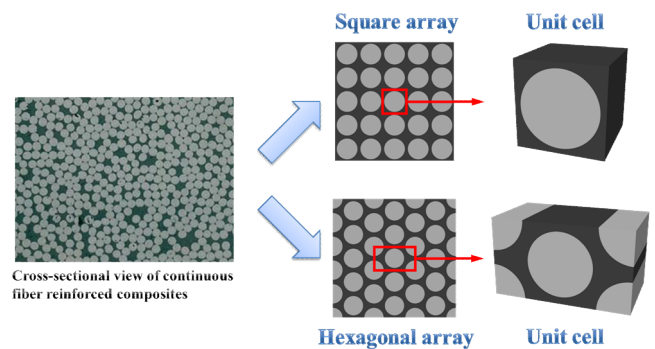


Property according to direction(XYZ)

No.	Symbol	Properties	Unit	Value	Notes
1	ρ	Density	g/mm ³	2.044E-09	-
2	E_1	Young's Modulus X	MPa	163394	Longitudinal modulus
3	E_2	Young's Modulus Y	MPa	9713.032	Transverse Modulus
4	E_3	Young's Modulus Z	MPa	11891.656	-
5	ν_{12}	Poisson's ratio XY	MPa	0.5700675	-
6	ν_{13}	Poisson's ratio YZ	MPa	0.416739	-
7	ν_{23}	Poisson's ratio XZ	MPa	0.3192552	-
8	G_{12}	Shear Modulus XY	MPa	4333.007	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	5338.119	Out-of-plane shear modulus
11	S_{11T}	Longitudinal Tensile strength	MPa	4411.638	Strain: 0.03%
12	S_{11C}	Longitudinal Compressive strength	MPa	-3816.417	Strain: 0.03%
13	S_{22T}	Transverse Tensile strength	MPa	4057.717	Strain: 0.03%
14	S_{22C}	Transverse compressive strength	MPa	-334.9659	Strain: 0.03%
15	S_{33T}	Tensile strength	MPa	370.3688	Strain: 0.03%
16	S_{33C}	Compressive strength	MPa	-302.2863	Strain: 0.03%
17	S_{12S}	Out-of-plane shear strength	MPa	136.296	-
18	S_{23S}	Shear strength	MPa	130.617	-
19	k	Thermal conductivity	W/m-K	509.475	
20	C_p	Specific heat	kJ/kg-K	443.325	

Theory

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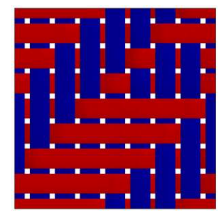
Material properties

□ Weave

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

□ Material properties

Property	Unit	Value
E-Modulus	GPa	102
Poisson's ratio	-	0.27
Density	g/mm ³	1.73



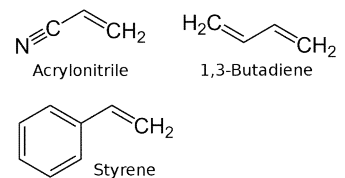
□ Resin

Type	ABS
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□ Material properties

Property	Unit	Value
E-Modulus	MPa	444
Poisson's ratio	-	0.28
Density	g/mm ³	1.6

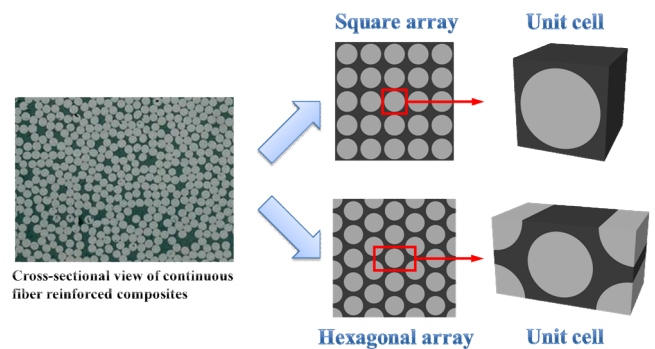


Property according to direction(XYZ)

No.	Symbol	Properties	Unit	Value	Notes
1	ρ	Density	g/mm ³	2.073E-09	-
2	E_1	Young's Modulus X	MPa	141219.1	Longitudinal modulus
3	E_2	Young's Modulus Y	MPa	10711.568	Transverse Modulus
4	E_3	Young's Modulus Z	MPa	10076.136	-
5	ν_{12}	Poisson's ratio XY	MPa	0.4835745	-
6	ν_{13}	Poisson's ratio YZ	MPa	0.424602	-
7	ν_{23}	Poisson's ratio XZ	MPa	0.3216738	-
8	G_{12}	Shear Modulus XY	MPa	3551.111	In-plane shear modulus
9	G_{13}	Shear Modulus YZ	MPa	3681.427	Out-of-plane shear modulus
10	G_{23}	Shear Modulus XZ	MPa	4845.952	Out-of-plane shear modulus
11	S_{11T}	Longitudinal Tensile strength	MPa	3501.3	Strain: 0.03%
12	S_{11C}	Longitudinal Compressive strength	MPa	-5076.885	Strain: 0.03%
13	S_{22T}	Transverse Tensile strength	MPa	3921.552	Strain: 0.03%
14	S_{22C}	Transverse compressive strength	MPa	-299.563	Strain: 0.03%
15	S_{33T}	Tensile strength	MPa	378.5387	Strain: 0.03%
16	S_{33C}	Compressive strength	MPa	-403.0484	Strain: 0.03%
17	S_{12S}	Out-of-plane shear strength	MPa	131.7528	-
18	S_{23S}	Shear strength	MPa	165.8268	-
19	k	Thermal conductivity	W/m-K	485.6995	
20	C_p	Specific heat	kJ/kg-K	497.295	

Theory

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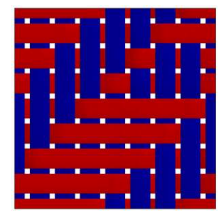
Material properties

□ Weave

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

□ Material properties

Property	Unit	Value
E-Modulus	GPa	113
Poisson's ratio	-	0.26
Density	g/mm ³	1.62



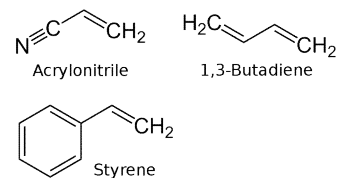
□ Resin

Type	ABS
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□ Material properties

Property	Unit	Value
E-Modulus	MPa	515
Poisson's ratio	-	0.25
Density	g/mm ³	1.71

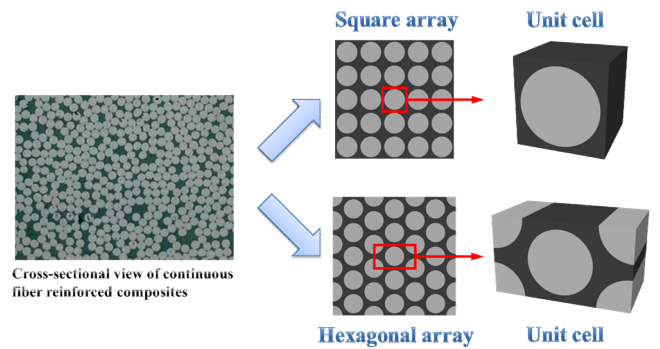


Property according to direction(XYZ)

No.	Symbol	Properties	Unit	Value	Notes
1	ρ	Density	g/mm ³	1.816E-09	-
2	E_1	Young's Modulus X	MPa	137717.8	Longitudinal modulus
3	E_2	Young's Modulus Y	MPa	9349.928	Transverse Modulus
4	E_3	Young's Modulus Z	MPa	12436.312	-
5	ν_{12}	Poisson's ratio XY	MPa	0.511095	-
6	ν_{13}	Poisson's ratio YZ	MPa	0.47178	-
7	ν_{23}	Poisson's ratio XZ	MPa	0.2466972	-
8	G_{12}	Shear Modulus XY	MPa	4463.323	In-plane shear modulus
9	G_{13}	Shear Modulus YZ	MPa	4267.849	Out-of-plane shear modulus
10	G_{23}	Shear Modulus XZ	MPa	4997.388	Out-of-plane shear modulus
11	S_{11T}	Longitudinal Tensile strength	MPa	4656.729	Strain: 0.03%
12	S_{11C}	Longitudinal Compressive strength	MPa	-4201.56	Strain: 0.03%
13	S_{22T}	Transverse Tensile strength	MPa	3758.154	Strain: 0.03%
14	S_{22C}	Transverse compressive strength	MPa	-337.6892	Strain: 0.03%
15	S_{33T}	Tensile strength	MPa	397.6018	Strain: 0.03%
16	S_{33C}	Compressive strength	MPa	-307.7329	Strain: 0.03%
17	S_{12S}	Out-of-plane shear strength	MPa	134.0244	-
18	S_{23S}	Shear strength	MPa	136.296	-
19	k	Thermal conductivity	W/m-K	397.3905	
20	C_p	Specific heat	kJ/kg-K	535.845	

Theory

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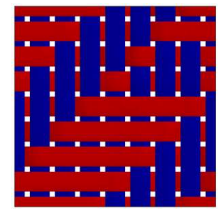
Material properties

□ Weave

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

□ Material properties

Property	Unit	Value
E-Modulus	GPa	130
Poisson's ratio	-	0.3
Density	g/mm ³	1.75



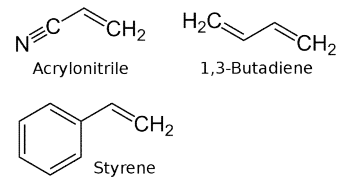
□ Resin

Type	ABS
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□ Material properties

Property	Unit	Value
E-Modulus	GPa	467
Poisson's ratio	-	0.25
Density	g/mm ³	1.52

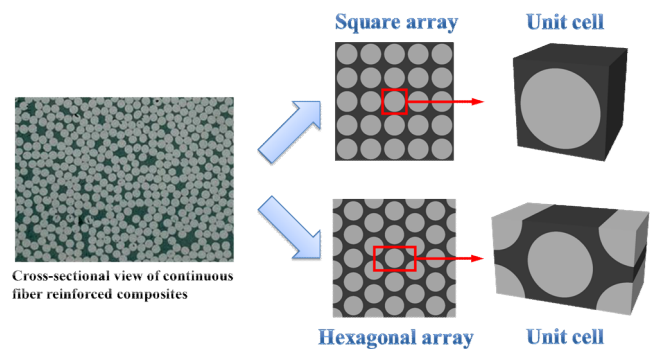


Property according to direction(XYZ)

No.	Symbol	Properties	Unit	Value	Notes
1	ρ	Density	g/mm ³	1.844E-09	-
2	E_1	Young's Modulus X	MPa	171563.7	Longitudinal modulus
3	E_2	Young's Modulus Y	MPa	9803.808	Transverse Modulus
4	E_3	Young's Modulus Z	MPa	10257.688	-
5	ν_{12}	Poisson's ratio XY	MPa	0.589725	-
6	ν_{13}	Poisson's ratio YZ	MPa	0.573999	-
7	ν_{23}	Poisson's ratio XZ	MPa	0.350697	-
8	G_{12}	Shear Modulus XY	MPa	3648.848	In-plane shear modulus
9	G_{13}	Shear Modulus YZ	MPa	3355.637	Out-of-plane shear modulus
10	G_{23}	Shear Modulus XZ	MPa	4921.67	Out-of-plane shear modulus
11	S_{11T}	Longitudinal Tensile strength	MPa	5111.898	Strain: 0.03%
12	S_{11C}	Longitudinal Compressive strength	MPa	-3711.378	Strain: 0.03%
13	S_{22T}	Transverse Tensile strength	MPa	2913.931	Strain: 0.03%
14	S_{22C}	Transverse compressive strength	MPa	-324.0727	Strain: 0.03%
15	S_{33T}	Tensile strength	MPa	334.9659	Strain: 0.03%
16	S_{33C}	Compressive strength	MPa	-343.1358	Strain: 0.03%
17	S_{12S}	Out-of-plane shear strength	MPa	138.5676	-
18	S_{23S}	Shear strength	MPa	126.0738	-
19	k	Thermal conductivity	W/m-K	339.65	
20	C_p	Specific heat	kJ/kg-K	497.295	

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.



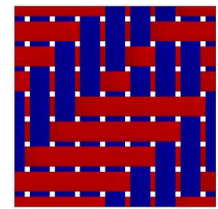
Material properties

☐ Weave

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

☐ Material properties

Property	Unit	Value
E-Modulus	GPa	128
Poisson's ratio	-	0.29
Density	g/mm ³	1.82



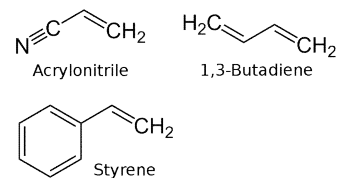
☐ Resin

Type	ABS
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☐ Material properties

Property	Unit	Value
E-Modulus	MPa	445
Poisson's ratio	-	0.3
Density	g/mm ³	1.54

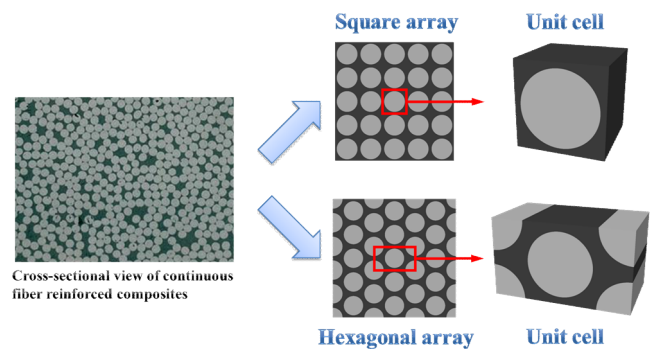


Property according to direction(XYZ)

No.	Symbol	Properties	Unit	Value	Notes
1	ρ	Density	g/mm ³	2.002E-09	-
2	E_1	Young's Modulus X	MPa	140052	Longitudinal modulus
3	E_2	Young's Modulus Y	MPa	11347	Transverse Modulus
4	E_3	Young's Modulus Z	MPa	9168.376	-
5	ν_{12}	Poisson's ratio XY	MPa	0.416739	-
6	ν_{13}	Poisson's ratio YZ	MPa	0.534684	-
7	ν_{23}	Poisson's ratio XZ	MPa	0.2926506	-
8	G_{12}	Shear Modulus XY	MPa	3290.479	In-plane shear modulus
9	G_{13}	Shear Modulus YZ	MPa	3485.953	Out-of-plane shear modulus
10	G_{23}	Shear Modulus XZ	MPa	4618.798	Out-of-plane shear modulus
11	S_{11T}	Longitudinal Tensile strength	MPa	4201.56	Strain: 0.03%
12	S_{11C}	Longitudinal Compressive strength	MPa	-4061.508	Strain: 0.03%
13	S_{22T}	Transverse Tensile strength	MPa	2750.533	Strain: 0.03%
14	S_{22C}	Transverse compressive strength	MPa	-305.0096	Strain: 0.03%
15	S_{33T}	Tensile strength	MPa	334.9659	Strain: 0.03%
16	S_{33C}	Compressive strength	MPa	-305.0096	Strain: 0.03%
17	S_{12S}	Out-of-plane shear strength	MPa	113.58	-
18	S_{23S}	Shear strength	MPa	170.37	-
19	k	Thermal conductivity	W/m-K	489.096	
20	C_p	Specific heat	kJ/kg-K	547.41	

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.



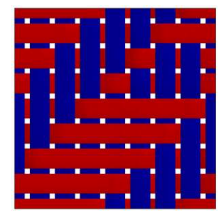
Material properties

□ Weave

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

□ Material properties

Property	Unit	Value
E-Modulus	GPa	104
Poisson's ratio	-	0.3
Density	g/mm ³	1.72



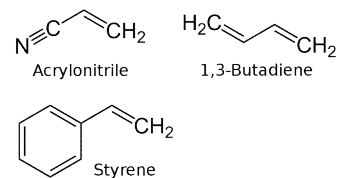
□ Resin

Type	ABS
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□ Material properties

Property	Unit	Value
E-Modulus	GPa	413
Poisson's ratio	-	0.3
Density	g/mm ³	1.57



Property according to direction(XYZ)

No.	Symbol	Properties	Unit	Value	Notes
1	ρ	Density	g/mm ³	2.116E-09	-
2	E_1	Young's Modulus X	MPa	122545.5	Longitudinal modulus
3	E_2	Young's Modulus Y	MPa	12436.312	Transverse Modulus
4	E_3	Young's Modulus Z	MPa	12073.208	-
5	ν_{12}	Poisson's ratio XY	MPa	0.5307525	-
6	ν_{13}	Poisson's ratio YZ	MPa	0.4285335	-
7	ν_{23}	Poisson's ratio XZ	MPa	0.3361854	-
8	G_{12}	Shear Modulus XY	MPa	4202.691	In-plane shear modulus
9	G_{13}	Shear Modulus YZ	MPa	3779.164	Out-of-plane shear modulus
10	G_{23}	Shear Modulus XZ	MPa	4429.503	Out-of-plane shear modulus
11	S_{11T}	Longitudinal Tensile strength	MPa	3641.352	Strain: 0.03%
12	S_{11C}	Longitudinal Compressive strength	MPa	-3676.365	Strain: 0.03%
13	S_{22T}	Transverse Tensile strength	MPa	2913.931	Strain: 0.03%
14	S_{22C}	Transverse compressive strength	MPa	-329.5193	Strain: 0.03%
15	S_{33T}	Tensile strength	MPa	329.5193	Strain: 0.03%
16	S_{33C}	Compressive strength	MPa	-329.5193	Strain: 0.03%
17	S_{12S}	Out-of-plane shear strength	MPa	140.8392	-
18	S_{23S}	Shear strength	MPa	141.975	-
19	k	Thermal conductivity	W/m-K	421.166	
20	C_p	Specific heat	kJ/kg-K	443.325	