

CONTENTS

1	Design Considerations	1
1.1	Introduction	1
1.2	Layout of the book	3
1.3	Choice of Data	4
1.4	Composites behaviour	5
1.5	Conclusion	13
1.6	Reference information	13
2	Material selection and data assessment	14
	Summary	14
2.1	Introduction	14
2.2	Material constituents	14
2.3	Material selection	16
2.4	Data assessment	30
2.5	Test methods and standards	31
2.6	Data reduction and presentation	31
2.7	Use of data in design	32
2.8	Reference information	32
3	Properties	35
	Summary	35
3.1	Introduction	35
3.2	The role of fibre and matrix	36
3.3	Fibre properties	38
3.4	Physical from of the reinforcement	46
3.5	Matrix properties	48
3.6	Composite properties	50
3.7	Design and manufacture	53
3.8	Health and safety	54
3.9	Reference information	54
4	Mechanical properties of random and fabric-reinforced resins	55
	Summary	55
4.1	Introduction	55
4.2	Polyester resins	57
4.3	Vinyl ester resins	71
4.4	Phenolic resins	75
4.5	Epoxy resins	84

4.6	Other resins	92
4.7	Design Strategy	94
4.8	Reference information	95
5	Mechanical properties of aligned composites	96
	Summary	96
5.1	General information	96
5.2	Glass fibres	97
5.3	Aramid fibres	106
5.4	Carbon fibres	115
5.5	Material selection and design strategy	132
5.6	Reference information	132
6	Impact and fracture	133
	Summary	133
6.1	Introduction	133
6.2	Impact	138
6.3	Fracture	148
6.4	Design Strategy	152
6.5	Reference information	152
7	Thermal and electrical properties	153
	Summary	153
7.1	Thermal properties	153
7.2	Electrical properties	163
7.3	Design strategy	169
7.4	Reference information	169
8	fire performance	170
	Summary	170
8.1	Introduction	171
8.2	Non-combustibility	172
8.3	Ignitability	173
8.4	Flame spread	174
8.5	Rate of heat release	181
8.6	Smoke and toxic gas emissions	182
8.7	Flash-over	189
8.8	Design strategy	191
8.9	Reference information	192

9	Environmental effects	195
	Summary	195
	9.1 Introduction	195
	9.2 Effect of moisture	197
	9.3 Corrosion resistance	209
	9.4 hardness, abrasion and weathering	217
	9.5 Design strategy	225
	9.6 Reference information	225
10	Creep and fatigue	226
	Summary	226
	10.1 Introduction	226
	10.2 Creep	229
	10.3 Time – temperature superposition	236
	10.4 Fatigue	238
	10.5 Design strategy	266
	10.6 Reference information	268
11	Influence of processing on properties	269
	Summary	269
	11.1 Introduction	269
	11.2 Contact moulding	271
	11.3 Resin transfer moulding	275
	11.4 Press moulding	278
	11.5 Prepreg moulding	284
	11.6 Pultrusion	286
	11.7 Filament winding	290
	11.8 Recycling	293
	11.9 Design strategy	294
	11.10Reference information	294
12	Quality assurance	296
	Summary	296
	12.1 Introduction	296
	12.2 Incoming materials	297
	12.3 Processing	300
	12.4 Non-destructive evaluation	304
	12.5 Destructive testing	308
	12.6 Strategy for quality control	313
	12.7 Reference information	313
	Index	313