

CONTENTS

	Page
1. Introduction	1
2. Broad structural types and their mechanical behaviour	4
2.1 Relevance of primary chemical structure	4
2.2 Forces between molecules – secondary bonds	10
2.3 Physical effects of temperature	12
2.4 Elastomers	15
2.5 Glass – rubber transition	16
2.6 Significance of time-scale	16
2.7 Mechanical strength	24
2.8 Effects of plasticisers	26
3. Chemical stability	27
3.1 Nature of thermal limitations and methods of estimating allowable operating temperature	27
3.2 Thermal classification system	32
3.3 Effects of solvents	36
3.4 Stability under irradiation	36
4. General features of electrical behaviour	38
4.1 Permittivity and dielectric loss	38
4.2 Transport processes – conduction	50
4.3 Electric breakdown of solids	60
4.4 Electric breakdown of liquids	73
4.5 Tracking and tree-burning	75
5. Moisture in insulation	80
5.1 Effects of moisture	80
5.2 Removal of moisture from high voltage insulation	86
6. Test methods	89
6.1 Mechanical properties	90
6.2 Thermal limitations	94
6.3 Electrical behaviour	100
6.4 Water absorption test	114
7. Traditional fibrous and solid insulants	117
7.1 Cellulose paper, pressboard and vulcanised fibre	117
7.2 Natural fabrics	123
7.3 Derivatives of natural cellulose	124
7.4 Asbestos	125
7.5 Mica	126
7.6 Bitumens, waxes and compounds	132
7.7 Natural drying oils and resins	134
8. Linear synthetic polymers and elastomers	137
8.1 Polyethylene and polypropylene	142
8.2 Polystyrene	151
8.3 Polyparaxylylene	153
8.4 Polytetrafluorethylene	153
8.5 Tetrafluorethylene-hexafluoropropylene copolymer	155

8.6 Poly(vinyl chloride)	156
8.7 Poly(methyl methacrylate)	160
8.8 Poly(ethylene terephthalate)	162
8.9 Polycarbonate	164
8.10 Polyoxymethylene (acetal)	166
8.11 Poly(vinyl formal), poly(vinyl acetal), poly(vinyl butyral)	167
8.12 Polyamides, polyimides and combinations	168
8.13 Polysulphones	172
8.14 Elastomers	172
9. Cross-linked synthetic polymers	180
9.1 Phenolic resins	181
9.2 Urea formaldehyde, melamine formaldehyde and aniline formaldehyde	185
9.3 Alkyd resins	186
9.4 Unsaturated polyesters	189
9.5 Epoxy resins	192
9.6 Diallyl phthalate	198
9.7 Cross-linked silicone (polysiloxane) resins	199
9.8 Polyurethane or isocyanate resins	201
10. Liquid insulants	205
10.1 Mineral oils	206
10.2 Chlorinated aromatic hydrocarbons	221
10.3 Vegetable oils and other esters	226
10.4 Synthetic hydrocarbons	226
10.5 Fluorine liquids	227
10.6 Silicone liquids	227
10.7 Nitrobenzene	228
10.8 Liquefied elemental gases	229
11. Glass and ceramics	232
11.1 Glasses	235
11.2 Ceramics	245
12. Appendix	259
Bibliography and index of authors	261
Index	278