
Contents

Symbols	IX
1 Introduction	1
2 Evolution of Theoretical Concepts of Thermal Stress Resistance	5
3 Design Estimates of Temperature Fields and Strain Condition of Bodies	13
3.1 Plane Problem of Thermal Elasticity for Bodies with a Volumetric Heat Generation	18
3.2 Effect of Temperature Dependence of Physical-Mechanical Properties on Calculation of Thermal-Elastic Stresses	20
3.3 Thermal-Elastic Stresses in a Finite Hollow Cylinder	24
3.4 Temperature Stresses at Inelastic State of a Body	25
3.5 The Thermal-Elastic Stresses at Local Radiation Loading of a Body	30
3.6 Calculation of Thermal Stresses in the Cylindrical Body Cooled on Lateral Surface in Water	36
4 Methods of Testing for Thermal Stress Resistance	39
4.1 Basic Methods of Testing for Thermal Stress Resistance	40
4.2 Methods of Testing for Thermal Stress Resistance Under Cooling Conditions	41
4.3 Heating Methods of Testing for Thermal Stress Resistance	47
5 Mechanism of Crack Propagation in Non-Uniform Fields of Thermal Stresses	67
5.1 Limit Equilibrium of Edge and Central Cracks in the Thermal-Loaded Disk	67

VIII Contents

5.2	Interaction of Growing Cracks and Redistribution of Stresses in the Disk	70
5.3	Energy Fracture Model of Thermal-Heated Bodies	78
6	Influence of Thermal Loading Modes on Fracture	85
6.1	Fracture of Cylindrical Bodies Heated on a Lateral Surface in Liquid Media	85
6.2	Fracture of Cylindrical Body Thermally Loaded on an End Surface	89
6.3	Local Thermal Loading of a Surface Body	90
6.4	Influence of Residual Stresses on Fracture at Thermal Loading	98
6.5	Fracture of Elastic–Brittle Bodies at Combined Thermal and Mechanical Loadings	107
6.6	Influence of Temperature on Thermal Stress Resistance	111
6.7	Fracture of a Body at Cyclic Thermal Loading	115
7	Effect of Structural Parameters on Thermal Stress Resistance	121
7.1	Thermal Stress Resistance of Mono-phase Ceramic Materials ..	121
7.2	Thermal Stress Resistance of Heterogeneous Ceramic Materials	127
7.3	Thermal Stress Resistance of Composites with Fissured Structure	139
7.4	Thermal Stress Resistance of Functionally Graded Materials ..	145
7.5	Thermal Stress Resistance of Anisotropic Bodies	155
8	Elastic–Plastic Deformation Under Local Heating	171
9	Criteria of Thermal Stress Resistance of Materials	179
9.1	Criteria of Comparative Estimation of Thermal Resistibility of Materials	179
9.2	Criterion of an Estimation of Bearing Capacity of Thermally Loaded Body	182
10	Ways of Increasing Thermal Stress Resistance of Ceramic Materials	189
A	The General Data on Properties of Constructional Materials	203
A.1	Structural Condition of Materials	203
A.2	Fracture Toughness	206
A.3	Dependences of Strength Change	210
A.4	Creep and Rupture Life	218
	References	223
	Index	237