

Contents

Section 1: Introduction	1
Industrial Significance of Fatigue Problems	3
Fracture and Structure.....	5
Fatigue Properties in Engineering	15
Alloy Design for Fatigue and Fracture.....	27
Micromechanisms of Monotonic and Cyclic Crack Growth	42
Section 2: Fatigue Mechanisms, Crack Growth, and Testing	61
Fatigue Failure in Metals	63
Cyclic Stress-Strain Response and Microstructure	73
Fatigue Crack Nucleation and Microstructure	96
Fatigue Crack Growth under Variable-Amplitude Loading.....	110
Fatigue Crack Thresholds	134
Behavior of Small Fatigue Cracks	153
Effect of Crack Shape on Fatigue Crack Growth.....	159
Fatigue Crack Growth Testing	168
Appendix: High-Temperature Fatigue Crack Growth Testing	181
Mechanisms of Corrosion Fatigue	185
Corrosion Fatigue Testing	193
Detection and Monitoring of Fatigue Cracks	210
Section 3: Fatigue Strength Prediction and Analysis	225
Fundamentals of Modern Fatigue Analysis for Design	227
Estimating Fatigue Life	250
Multiaxial Fatigue Strength	263
Factors Influencing Weldment Fatigue.....	274
Fatigue of Mechanically Fastened Joints	287
Statistical Considerations in Fatigue	295
Planning and Evaluation of Fatigue Tests	303
Surface Effects on Fatigue	
Effect of Surface Conditions and Processing on Fatigue Performance.....	314
Fretting Fatigue.....	321
Contact Fatigue	331
Fatigue of Special Forms or Components	
Fatigue and Fracture Control for Powder Metallurgy Components	337
Fatigue and Life Prediction of Gears	345
Fatigue and Life Prediction of Bearings.....	355
Fatigue of Springs	363
Section 4: Fracture Mechanics, Damage Tolerance, and Life Assessment	369
An Introduction to Fracture Mechanics	371
Fracture Resistance of Structural Alloys	381
Fracture Toughness Testing	393
Concepts of Fracture Control and Damage Tolerance	410
The Practice of Damage Tolerance Analysis	420
Residual Strength of Metal Structures	427
Fatigue and Fracture Control of Weldments.....	434
Fracture Mechanics in Failure Analysis	450
Stress Maps for Failure Control	457
Failure Control in Process Operations	468
Environmental Effects	
Stress Corrosion Cracking and Hydrogen Embrittlement	483
Elevated-Temperature Crack Growth.....	507
High-Temperature Life Assessment	520
Thermal and Thermo-Mechanical Fatigue of Structural Alloys ..	527
Damage Tolerance of Aircraft Systems	
Life Extension and Damage Tolerance of Aging Aircraft	557
Damage Tolerance Certification of Commercial Aircraft	566
The Air Force Approach to Aircraft Damage Tolerant Design.....	577
Section 5: Fatigue and Fracture Resistance of Ferrous Alloys	589
Fracture and Fatigue Properties of Structural Steels	591
Fatigue Resistance and Microstructure of Ferrous Alloys	605
Fracture Mechanics Properties of Carbon and Alloy Steels.....	614
Fatigue and Fracture Properties of Cast Steels.....	655
Fatigue and Fracture Properties of Cast Irons	665
Bending Fatigue of Carburized Steels	680
Contact Fatigue of Hardened Steels	691
Fatigue and Fracture Mechanics of Heat-Resistant (Cr-Mo) Ferritic Steels	704
Fatigue and Fracture Properties of Stainless Steels	712
Fracture Toughness of Austenitic Stainless Steels and Their Welds	733
Fatigue and Fracture Properties of Duplex Stainless Steels	757
Section 6: Fatigue and Fracture Resistance of Nonferrous Alloys	769
Selecting Aluminum Alloys to Resist Failure by Fracture Mechanisms	771
Fatigue and Fracture Properties of Cast Aluminum Alloys	813
Fatigue Strength of Aluminum Alloy Welds,	823
Fatigue and Fracture Resistance of Titanium Alloys	829
Fatigue and Fracture Properties of Superalloys	854
Fatigue Properties of Copper Alloys	869
Fatigue and Fracture Resistance of Magnesium Alloys	874
Fatigue of Solders and Electronic Materials	882
Section 7: Fatigue and Fracture of Composites, Ceramics, and Glasses	
Ceramics	893
Fracture and Fatigue of DRA Composites	895
Fatigue of Composite Laminates	905
Residual Strength with Damage in Composite Aircraft Structures	920
Fatigue of Brittle Materials	936
Toughening and Strengthening Models for Nominally Brittle Materials	946
Fatigue and Fracture Behavior of Glasses	955
Appendices	961
Parameters for Estimating Fatigue Life	963
Stress Intensity Factors	980
Metric Conversion Guide	1001
Abbreviations and Symbols	1003
Index	1005