



Designation: E2714 – 13 (Reapproved 2020)

Standard Test Method for Creep-Fatigue Testing¹

This standard is issued under the fixed designation E2714; the number immediately following the designation indicates the year of original adoption or, in the case of revision, the year of last revision. A number in parentheses indicates the year of last approval. A superscript epsilon (ϵ) indicates an editorial change since the last revision or approval.

1. Scope

1.1 This test method covers the determination of mechanical properties pertaining to creep-fatigue deformation or crack formation in nominally homogeneous materials, or both by the use of test specimens subjected to uniaxial forces under isothermal conditions. It concerns fatigue testing at strain rates or with cycles involving sufficiently long hold times to be responsible for the cyclic deformation response and cycles to crack formation to be affected by creep (and oxidation). It is intended as a test method for fatigue testing performed in support of such activities as materials research and development, mechanical design, process and quality control, product performance, and failure analysis. The cyclic conditions responsible for creep-fatigue deformation and cracking vary with material and with temperature for a given material.

1.2 The use of this test method is limited to specimens and does not cover testing of full-scale components, structures, or consumer products.

1.3 This test method is primarily aimed at providing the material properties required for assessment of defect-free engineering structures containing features that are subject to cyclic loading at temperatures that are sufficiently high to cause creep deformation.

1.4 This test method is applicable to the determination of deformation and crack formation or nucleation properties as a consequence of either constant-amplitude strain-controlled tests or constant-amplitude force-controlled tests. It is primarily concerned with the testing of round bar test specimens subjected to uniaxial loading in either force or strain control. The focus of the procedure is on tests in which creep and fatigue deformation and damage is generated simultaneously within a given cycle. It does not cover block cycle testing in which creep and fatigue damage is generated sequentially. Data that may be determined from creep-fatigue tests performed under conditions in which creep-fatigue deformation and damage is generated simultaneously include: (a) cyclic stress-

strain deformation response (b) cyclic creep (or relaxation) deformation response (c) cyclic hardening, cyclic softening response (d) cycles to formation of a single crack or multiple cracks in test specimens.

Note 1—A crack is believed to have formed when it has nucleated and propagated in a specimen that was initially uncracked to a specific size that is detectable by a stated technique. For the purpose of this standard, the formation of a crack is evidenced by a measurable increase in compliance of the specimen or by a size detectable by potential drop technique. Specific details of how to measure cycles to crack formation are described in **9.5.1**.

1.5 This test method is applicable to temperatures and strain rates for which the magnitudes of time-dependent inelastic strains (creep) are on the same order or larger than time-independent inelastic strain.

Note 2—The term *inelastic* is used herein to refer to all nonelastic strains. The term *plastic* is used herein to refer only to time independent (that is, non-creep) component of inelastic strain. A useful engineering estimate of time-independent strain can be obtained when the strain rate exceeds some value. For example, a strain rate of 5×10^{-3} sec⁻¹ is often used for this purpose. This value should increase with increasing test temperature.

1.6 The values stated in SI units are to be regarded as standard. No other units of measurement are included in this standard.

1.7 This standard does not purport to address all of the safety concerns, if any, associated with its use. It is the responsibility of the user of this standard to establish appropriate safety, health, and environmental practices and determine the applicability of regulatory limitations prior to use.

1.8 This international standard was developed in accordance with internationally recognized principles on standardization established in the Decision on Principles for the Development of International Standards, Guides and Recommendations Issued by the World Trade Organization Technical Barriers to Trade (TBT) Committee.

2. Referenced Documents

2.1 ASTM Standards:²

E4 Practices for Force Verification of Testing Machines

¹ This test method is under the jurisdiction of ASTM Committee E08 on Fatigue and Fracture and is the direct responsibility of Subcommittee E08.05 on Cyclic Deformation and Fatigue Crack Formation.

Current edition approved May 1, 2020. Published May 2020. Originally approved in 2009. Last previous edition approved in 2013 as E2714-13. DOI: 10.1520/E2714-13R20.

² For referenced ASTM standards, visit the ASTM website, www.astm.org, or contact ASTM Customer Service at service@astm.org. For Annual Book of ASTM Standards technical information, refer to the standard's Document Summary page on the ASTM website.

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Aerospace Materials and Material Technologies N. Eswara Prasad, R.J.H. Wanhill, 2016-11-07 This book serves as a comprehensive resource on various traditional advanced and futuristic material technologies for aerospace applications encompassing nearly 20 major areas Each of the chapters addresses scientific principles behind processing and production production details equipment and facilities for industrial production and finally aerospace application areas of these material technologies The chapters are authored by pioneers of industrial aerospace material technologies This book has a well planned layout in 4 parts The first part deals with primary metal and material processing including nano manufacturing The second part deals with materials characterization and testing methodologies and technologies The third part addresses structural design Finally several advanced material technologies are covered in the fourth part Some key advanced topics such as Structural Design by ASIP Damage Mechanics Based Life Prediction and Extension and Principles of Structural Health Monitoring are dealt with at equal length as the traditional aerospace materials technology topics This book will be useful to students researchers and professionals working in the domain of aerospace materials *Challenges in Mechanics of Time Dependent Materials, Fracture, Fatigue, Failure and Damage Evolution, Volume 2* Meredith Silberstein, Alireza Amirkhizi, Xia Shuman, Allison Beese, Ryan B. Berke, Garrett Pataky, 2019-12-05 Challenges in Mechanics of Time Dependent Materials Volume 2 of the Proceedings of the 2019 SEM Annual Conference Exposition on Experimental and Applied Mechanics the second volume of six from the Conference brings together contributions to this important area of research and engineering The collection presents early findings and case studies on fundamental and applied aspects of Experimental Mechanics including papers in the following general technical research areas Characterization Across Length Scales Extreme Conditions Environmental Effects Soft Materials and Biomaterials Damage Fatigue and Fracture Structure Function and Performance Rate Effects in Elastomers Viscoelasticity Viscoplasticity Research in Progress In situ Techniques and Microscale Effects on Mechanical Behavior Fracture and Fatigue in Brittle Materials Novel Experimental Methods Fatigue and Fracture in Extreme Environments Integration of Models and Experiments Failure in Elastomers and Gels Rate Effects in Elastomers Microscale and Microstructural Effects on Mechanical Behavior Mechanics of Energy Materials Additive Manufacturing Fatigue and Fracture Mechanics of Composite Materials Interfacial and Mixed Mode Fracture Vibration Effects and High Cycle Fatigue **Precision Metal Additive Manufacturing** Richard Leach, Simone Carmignato, 2020-09-21 Additive manufacturing AM is a fast growing sector with the ability to evoke a revolution in manufacturing due to its almost unlimited design freedom and its capability to produce personalised parts locally and with efficient material use AM companies however still face technological challenges such as limited precision due to shrinkage built in stresses and limited process stability and robustness Moreover often post processing is needed due to high roughness and remaining porosity Qualified trained personnel are also in short supply In recent years there have been dramatic

improvements in AM design methods process control post processing material properties and material range However if AM is going to gain a significant market share it must be developed into a true precision manufacturing method The production of precision parts relies on three principles Production is robust i e all sensitive parameters can be controlled Production is predictable for example the shrinkage that occurs is acceptable because it can be predicted and compensated in the design Parts are measurable as without metrology accuracy repeatability and quality assurance cannot be known AM of metals is inherently a high energy process with many sensitive and inter related process parameters making it susceptible to thermal distortions defects and process drift The complete modelling of these processes is beyond current computational power and novel methods are needed to practicably predict performance and inform design In addition metal AM produces highly textured surfaces and complex surface features that stretch the limits of contemporary metrology With so many factors to consider there is a significant shortage of background material on how to inject precision into AM processes Shortage in such material is an important barrier for a wider uptake of advanced manufacturing technologies and a comprehensive book is thus needed This book aims to inform the reader how to improve the precision of metal AM processes by tackling the three principles of robustness predictability and metrology and by developing computer aided engineering methods that empower rather than limit AM design Richard Leach is a professor in metrology at the University of Nottingham and heads up the Manufacturing Metrology Team Prior to this position he was at the National Physical Laboratory from 1990 to 2014 His primary love is instrument building from concept to final installation and his current interests are the dimensional measurement of precision and additive manufactured structures His research themes include the measurement of surface topography the development of methods for measuring 3D structures the development of methods for controlling large surfaces to high resolution in industrial applications and the traceability of X ray computed tomography He is a leader of several professional societies and a visiting professor at Loughborough University and the Harbin Institute of Technology Simone Carmignato is a professor in manufacturing engineering at the University of Padua His main research activities are in the areas of precision manufacturing dimensional metrology and industrial computed tomography He is the author of books and hundreds of scientific papers and he is an active member of leading technical and scientific societies He has been chairman organiser and keynote speaker for several international conferences and received national and international awards including the Taylor Medal from CIRP the International Academy for Production Engineering

Additive Manufacturing Handbook Adedeji B. Badiru, Vhance V. Valencia, David Liu, 2017-05-19 Theoretical and practical interests in additive manufacturing 3D printing are growing rapidly Engineers and engineering companies now use 3D printing to make prototypes of products before going for full production In an educational setting faculty researchers and students leverage 3D printing to enhance project related products Additive Manufacturing Handbook focuses on product design for the defense industry which affects virtually every other industry Thus the handbook provides a wide range of benefits to all segments of

business industry and government Manufacturing has undergone a major advancement and technology shift in recent years

Future Landscape of Structural Materials in India Debashish Bhattacharjee, Shantanu Chakrabarti, 2022-07-30 This book provides a perspective on the research development and manufacturing aspects of structural materials in India The contents highlight materials to strengthen technology advancements in sectors like aerospace defense automotive energy health and ICT With the momentum of the Make in India initiative India has seen an increase in manufacturing of advanced components for these sectors The vast field of materials covers a whole gamut including structural materials such as metals like steel aluminum titanium polymers glass cement and composites functional materials such photovoltaics and smart materials are also discussed This anthology focuses on structural materials and studies in particular the Indian landscape of manufacturing capability R D capability and status of advanced structural materials compared to the rest of the world This study highlights the gaps and suggests necessary actions in the national landscape of structural materials given the pull that will come from the burgeoning advanced components manufacturing over the next 10 15 years The scope of this study is limited to structural materials covering metals and alloys structural polymers cement glass composites and high temperature ceramics The contents of this book will be useful to researchers industry professionals and policy makers alike **Digital**

Manufacturing Chandrakant D. Patel, Chun-Hsien Chen, 2022-07-06 Digital Manufacturing The Industrialization of Art to Part 3D Additive Printing explains everything needed to understand how recent advances in materials science manufacturing engineering and digital design have integrated to create exciting new capabilities Sections discuss relevant fundamentals in mechanical engineering and materials science and complex and practical topics in additive manufacturing such as part manufacturing all in the context of the modern digital design environment Being successful in today s art to part cyber physical manufacturing age requires a strong grounding in science and engineering fundamentals as well as knowledge of the latest techniques all of which readers will find here Every chapter is developed by leading specialists and based on first hand experiences capturing the essential knowledge readers need to solve problems related to digital manufacturing Helps produce the T shaped engineers needed in today s digital manufacturing age by providing carefully selected foundational information from a range of disciplines Covers every step in the additive manufacturing process from product design through inspection Addresses business models and socioeconomic trends related to cyber physical manufacturing along with technical aspects **Building Standards** International Conference of Building Officials, 1985 Woldman's Engineering

Alloys Norman Emme Woldman, 1990 Chiave dell'acciaio C. W. Wegst, 1989 ASTM Standards on Textile Materials American Society for Testing Materials. ASTM Committee D-13 on Textile Materials, 1942 ASTM Standards on Textile Materials ASTM Committee D-13 on Textile Materials, 1954 **ASTM Standards on Textile Materials** American Society for Testing Materials. ASTM Committee D-13 On textile materials, 1940 **ASTM Standards on Textile Materials** American Society for Testing and Materials. ASTM committee D-13 on textile materials, 1963 *ASTM Standards on Textile*

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