



Standard Guide for Preparation of Metallographic Specimens¹

This standard is issued under the fixed designation E 3; 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 reapproval. A superscript epsilon (ϵ) indicates an editorial change since the last revision or reapproval.

This standard has been approved for use by agencies of the Department of Defense.

1. Scope

1.1 The primary objective of metallographic examinations is to reveal the constituents and structure of metals and their alloys by means of a light optical or scanning electron microscope. In special cases, the objective of the examination may require the development of less detail than in other cases but, under nearly all conditions, the proper selection and preparation of the specimen is of major importance. Because of the diversity in available equipment and the wide variety of problems encountered, the following text presents for the guidance of the metallographer only those practices which experience has shown are generally satisfactory; it cannot and does not describe the variations in technique required to solve individual specimen preparation problems.

NOTE 1—For a more extensive description of various metallographic techniques, refer to Samuels, L. E., *Metallographic Polishing by Mechanical Methods*, American Society for Metals (ASM) Metals Park, OH, 3rd Ed., 1982; Peters, G., *Metallographic Etching*, ASM, 1978; and Vanderhoff, G., *Metallography: Principles and Practice*, McGraw-Hill, NY, 2nd Ed., 1969.

1.2 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 and health practices and determine the applicability of regulatory limitations prior to use.

2. Referenced Documents

2.1 ASTM Standards:

- A 90/A 90M Standard Test Method for Weight (Mass) of Coating on Iron and Steel with Zinc or Zinc-Alloy Coatings
- E 7 Terminology Relating to Metallography²
- E 45 Practice for Determining the Inclusion Content of Steel²
- E 340 Test Method for Macroetching Metals and Alloys²
- E 407 Test Methods for Microetching Metals and Alloys²
- E 768 Practice for Preparing and Evaluating Specimens for Automatic Inclusion Assessment of Steel²

- E 1077 Test Method for Estimating the Depth of Decarburization of Steel Specimens²
- E 1122 Practice for Obtaining JK Inclusion Ratings Using Automatic Image Analysis²
- E 1245 Practice for Determining the Inclusion or Second-Phase Constituent Content of Metals by Automatic Image Analysis²
- E 1268 Practice for Assessing the Degree of Banding or Orientation of Microstructures²
- E 1558 Guide to Electrolytic Polishing of Metallographic Specimens²
- E 1920 Guide for Metallographic Preparation of Thermal Sprayed Coatings²

3. Terminology

3.1 Definitions:

3.1.1 For definitions used in this practice, refer to Terminology E 7.

3.2 Definitions of Terms Specific to This Standard:

3.2.1 *castable mount*—a metallographic mount generally made from a two component castable plastic. One component is the resin and the other hardener. Both components can be liquid or one liquid and a powder. Castable mounts generally do not require heat and pressure to cure.

3.2.2 *compression mount*—a metallographic mount made using plastic that requires both heat and pressure for curing.

3.2.3 *planar grinding*—is the first grinding step in a preparation procedure used to bring all specimens into the same plane of polish. It is unique to semi or fully automatic preparation equipment that utilize specimen holders.

3.2.4 *rigid grinding disc*—a non-fabric support surface, such as a composite of metal/ceramic or metal/polymer charged with an abrasive (usually 6 to 15µm diamond particles), and used as the fine grinding operation in a metallographic preparation procedure.

4. Significance and Use

4.1 Microstructures have a strong influence on the properties and successful application of metals and alloys. Determination and control of microstructure requires the use of metallographic examination.

4.2 Many specifications contain a requirement regarding microstructure; hence, a major use for metallographic examination is inspection to ensure that the requirement is met. Other

¹ This guide is under the jurisdiction of ASTM Committee E04 on Metallography and is the direct responsibility of Subcommittee E04.01 on Sampling, Specimen Preparation, and Photography.

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² Annual Book of ASTM Standards, Vol 03.02.

Standard Guide For Preparation Of Metallographic Specimens

**The Minerals, Metals & Materials
Society**



Standard Guide For Preparation Of Metallographic Specimens:

Standard Guide for Preparation of Metallographic Specimens, 2007 **ASTM E3-01**, 2009 **Metallographer's**

Guide B. L. Bramfitt, A. O. Benscoter, 2001-01-01 This book provides a solid overview of the important metallurgical concepts related to the microstructures of irons and steels and it provides detailed guidelines for the proper metallographic techniques used to reveal capture and understand microstructures This book provides clearly written explanations of important concepts and step by step instructions for equipment selection and use microscopy techniques specimen preparation and etching Dozens of concise and helpful metallographic tips are included in the chapters on laboratory practices and specimen preparation The book features over 500 representative microstructures with discussions of how the structures can be altered by heat treatment and other means A handy index to these images is provided so the book can also be used as an atlas of iron and steel microstructures Handbook of Engineering Practice of Materials and Corrosion Jung-Chul (Thomas)

Eun, 2020-09-04 This handbook is an in depth guide to the practical aspects of materials and corrosion engineering in the energy and chemical industries The book covers materials corrosion welding heat treatment coating test and inspection and mechanical design and integrity A central focus is placed on industrial requirements including codes standards regulations and specifications that practicing material and corrosion engineers and technicians face in all roles and in all areas of responsibility The comprehensive resource provides expert guidance on general corrosion mechanisms and recommends materials for the control and prevention of corrosion damage and offers readers industry tested best practices rationales and case studies **Handbook of Measurement in Science and Engineering, Volume 2** Myer Kutz, 2015-12-03 A

multidisciplinary reference of engineering measurement tools techniques and applications Volume 2 When you can measure what you are speaking about and express it in numbers you know something about it but when you cannot measure it when you cannot express it in numbers your knowledge is of a meager and unsatisfactory kind it may be the beginning of knowledge but you have scarcely in your thoughts advanced to the stage of science Lord Kelvin Measurement falls at the heart of any engineering discipline and job function Whether engineers are attempting to state requirements quantitatively and demonstrate compliance to track progress and predict results or to analyze costs and benefits they must use the right tools and techniques to produce meaningful useful data The Handbook of Measurement in Science and Engineering is the most comprehensive up to date reference set on engineering measurements beyond anything on the market today Encyclopedic in scope Volume 2 spans several disciplines Materials Properties and Testing Instrumentation and Measurement Standards and covers Viscosity Measurement Corrosion Monitoring Thermal Conductivity of Engineering Materials Optical Methods for the Measurement of Thermal Conductivity Properties of Metals and Alloys Electrical Properties of Polymers Testing of Metallic Materials Testing and Instrumental Analysis for Plastics Processing Analytical Tools for Estimation of Particulate Composite Material Properties Input and Output Characteristics Measurement Standards

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Guide for Preparation of Metallographic Specimens Malaysia. Jabatan Standard, 2009

Titanium, Niobium, Zirconium, and Tantalum for Medical and Surgical Applications Lyle D. Zardiackas, Matthew J. Kraay, Howard L. Freese, 2006

Metallographic and Materiallographic Specimen Preparation, Light Microscopy, Image Analysis, and Hardness Testing, *Material Forming* Lukasz Madej, Mateusz Sitko, Konrad Perzynski, 2023-04-25 These proceedings present papers on Additive Manufacturing Composites Forming Processes Extrusion and Drawing Forging and Rolling Formability of Metallic Materials Friction and Wear in Metal Forming Incremental and Sheet Metal Forming Innovative Joining by Forming Technologies Lionel Fourment MS on Optimization and Inverse Analysis in Forming Machining and Cutting Material Behavior Modelling New and Advanced Numerical Strategies for Material Forming Non Conventional Processes Polymer Processing and Thermomechanical Properties Sustainability on Material Forming and Property Controlled Forming

TMS 2020 149th Annual Meeting & Exhibition Supplemental Proceedings The Minerals, Metals & Materials Society, 2020-02-13 This collection presents papers from the 149th Annual Meeting Exhibition of The Minerals Metals Materials Society

Metallography of Steels: Interpretation of Structure and the Effects of Processing Hubertus Colpaert, 2018-08-01 Updated and translated by Andr Luiz V da Costa e Silva This book is a combination of a metallographic atlas for steels and cast irons and an introductory textbook covering the fundamentals of phase transformations and heat treatment of these materials Every important stage of processing from casting to cold working is clearly discussed and copiously illustrated with metallographs that show the obtained structures both desired and those achieved when deviations occur First published in 1951 by Professor Hubertus Colpaert from the Institute for Technological Research IPT of S o Paulo Brazil this book became one of the most important Brazilian references for professionals interested in the processing treatment and application of steels and cast irons In the Fourth Edition and English translation updated and translated by Professor Andr Luiz V da Costa e Silva the concept of the of the original edition was preserved while the important developments of recent decades both in metallographic characterization and in steel and iron products as well as progress in the understanding of the transformations that made the extraordinary developments of these alloys possible were added Most metallographs are of actual industrial materials and a large number originate from industry leaders or laboratories at the forefront of steel and iron development As steel continues to be the most widely used metallic material in the world Metallography of Steels continues to be an essential reference for students metallographers and engineers interested in understanding processing

properties structure relationships of the material The balance between theoretical and applied information makes this book a valuable companion for even experienced steel practitioners *Proceedings of International Conference on Advances in Tribology and Engineering Systems* Himanshu C. Patel, Gunamani Deheri, Harshvadan S. Patel, Shreya M. Mehta, 2013-10-17 This book contains advanced level research material in the area of lubrication theory and related aspects presented by eminent researchers during the International Conference on Advances in Tribology and Engineering Systems ICATES 2013 held at Gujarat Technological University Ahmedabad India during October 15 17 2013 The material in this book represents the advanced field of tribology and reflects the work of many eminent researchers from both India and abroad The treatment of the presentations is the result of the contributions of several professionals working in the industry and academia This book will be useful for students researchers academicians and professionals working in the area of tribology in general and bearing performance characteristics in particular especially from the point of view of design This book will also appeal to researchers and professionals working in fluid film lubrication and other practical applications of tribology A wide range of topics has been included despite space and time constraints Basic concepts and fundamentals techniques have been emphasized upon while also including highly specialized topics and methods such as nanotribology bio nanotribology Care has been taken to generate interest for a wide range of readers considering the interdisciplinary nature of the subject

Al-Si Alloys Francisco C. Robles Hernandez, Jose Martin Herrera Ramirez, Robert Mackay, 2017-07-02 This book details aluminum alloys with special focus on the aluminum silicon Al Si systems that are the most abundant alloys second only to steel The authors include a description of the manufacturing principles thermodynamics and other main characteristics of Al Si alloys Principles of processing testing and in particular applications in the Automotive Aeronautical and Aerospace fields are addressed *Surface Modification of Metals and Alloys* Oriol Rius-Ayra, Nuria Llorca-Isern, 2021-08-31 Over the past four decades there has been increased attention given to the research of fluid mechanics due to its wide application in industry and phycology Major advances in the modeling of key topics such Newtonian and non Newtonian fluids and thin film flows have been made and finally published in the Special Issue of coatings This is an attempt to edit the Special Issue into a book Although this book is not a formal textbook it will definitely be useful for university teachers research students industrial researchers and in overcoming the difficulties occurring in the said topic while dealing with the nonlinear governing equations For such types of equations it is often more difficult to find an analytical solution or even a numerical one This book has successfully handled this challenging job with the latest techniques In addition the findings of the simulation are logically realistic and meet the standard of sufficient scientific value *Engineering Design Applications VI* Andreas Öchsner, Holm Altenbach, 2024-07-18 This book gives an update on recent developments in the mentioned areas of modern engineering design application Different engineering disciplines such as mechanical materials computer and process engineering provide the foundation for the design and development of improved structures materials and processes The

modern design cycle is characterized by an interaction of different disciplines and a strong shift to computer based approaches where only a few experiments are performed for verification purposes A major driver for this development is the increased demand for cost reduction which is also connected to environmental demands In the transportation industry e g automotive this is connected with the demand for higher fuel efficiency which is related to the operational costs and the lower harm for the environment One way to fulfil such requirements are lighter structures and or improved processes for energy conversion Another emerging area is the interaction of classical engineering with the health medical and environmental sectors

Iaeng Transactions On Engineering Sciences: Special Issue For The International Association Of Engineers Conferences 2016 (Volume Ii) Sio-iong Ao, Len Gelman, Haeng Kon Kim, Mahyar A Amouzegar, 2017-11-17 Two large international conferences on Advances in Engineering Sciences were held in London UK 29 June 1 July 2016 under the World Congress on Engineering WCE 2016 and San Francisco USA 19 21 October 2016 under the World Congress on Engineering and Computer Science WCECS 2016 respectively This volume contains 42 revised and extended research articles written by prominent researchers participating in the conferences Topics covered include electrical engineering manufacturing engineering industrial engineering computer science engineering mathematics and industrial applications The book offers state of the art advances in engineering sciences and also serves as an excellent reference work for researchers and graduate students working with on engineering sciences

Predicting the Future Fernando Sánchez Lasheras, 2020-12-29 Due to the increased capabilities of microprocessors and the advent of graphics processing units GPUs in recent decades the use of machine learning methodologies has become popular in many fields of science and technology This fact together with the availability of large amounts of information has meant that machine learning and Big Data have an important presence in the field of Energy This Special Issue entitled Predicting the Future Big Data and Machine Learning is focused on applications of machine learning methodologies in the field of energy Topics include but are not limited to the following big data architectures of power supply systems energy saving and efficiency models environmental effects of energy consumption prediction of occupational health and safety outcomes in the energy industry price forecast prediction of raw materials and energy management of smart buildings

Advances in Material Sciences and Engineering Mokhtar Awang, Seyed Sattar Emamian, Farazila Yusof, 2019-09-19 This book presents selected papers from the 4th International Conference on Mechanical Manufacturing and Plant Engineering ICMMPE 2018 which was held in Melaka Malaysia from the 14th to the 15th of November 2018 The proceedings discuss genuine problems concerning joining technologies that are at the heart of various manufacturing sectors In addition they present the outcomes of experimental and numerical works addressing current problems in soldering arc welding and solid state joining technologies

Current Trends in Friction Stir Welding (FSW) and Friction Stir Spot Welding (FSSW) Mukuna Patrick Mubiayi, Esther Titilayo Akinlabi, Mamookho Elizabeth Makhatha, 2018-06-14 This book provides an overview of friction stir welding and friction stir spot welding with a

focus on aluminium to aluminium and aluminium to copper It also discusses experimental results for friction stir spot welding between aluminium and copper offering a good foundation for researchers wishing to conduct more investigations on FSSW Al Cu Presenting full methodologies for manufacturing and case studies on FSSW Al Cu which can be duplicated and used for industrial purposes it also provides a starting point for researchers and experts in the field to investigate the FSSW process in detail A variant of the friction stir welding process FSW friction stir spot welding FSSW is a relatively new joining technique and has been used in a variety of sectors such as the automotive and aerospace industries The book describes the microstructural evolution chemical and mechanical properties of FSW and FSSW including a number of case studies

Failure Analysis of Microbiologically Influenced Corrosion Richard B. Eckert,Torben Lund Skovhus,2021-11-07

Failure Analysis of Microbiologically Influenced Corrosion serves as a complete guide to corrosion failure analysis with an emphasis on the diagnosis of microbiologically influenced corrosion MIC By applying the principles of chemistry microbiology and metallurgy readers will be able to reliably determine the mechanistic cause of corrosion damage and failures and select the appropriate methods for mitigating future corrosion incidents FEATURES Provides background information on the forensic process types of data or evidence needed to perform the analysis industrial case studies details on the MIC failure analysis process and protocols for field and lab use Presents up to date advances in molecular technologies and their application to corrosion failure investigations Offers specific guidelines for conducting MIC failure analyses and case studies to illustrate their application Examines state of the art information on MIC analytical tools and methods With authors with expertise in microbiology corrosion materials and failure investigation this book provides tools for engineers scientists and technologists to successfully combat MIC issues

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