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Standard Practice for Investigation and Analysis of Physical Component Failures[1]

This standard is issued under the fixed designation E 2332; 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.

1. Scope

1.1 This standard practice for the scientific-engineering, or technical investigation and analysis of component failures covers the collection and analysis of all information and physical evidence pertaining to the failure or perceived failure of a specific component. The data and physical evidence includes but are not limited to background information regarding the design (if available), fabrication and expected service conditions of the component, evidence pertaining to the actual service history of the component, and physical evidence relating to the component failure. The nature of the use of the particular component is immaterial with respect to this standard. This standard does not apply to software.

1.2 For the purpose of collecting and generating data, all values will be used with SI (English) units.

1.3 *This standard may involve hazardous substances and objects, operations, and equipment. 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:* [2]

E 620 Practice for Reporting Opinions of Technical Experts
E 678 Practice for Evaluation of Technical Data
E 860 Practice for Examining and Testing Items that Are or May Become Involved in Litigation
E 1020 Practice for Reporting Incidents
E 1188 Practice for Collection and Preservation of Information and Physical Items by a Technical Investigator
E 1492 Practice for Documenting, Storing, and Retrieving Evidence in a Forensic Science Laboratory

3. Summary of Practice

3.1 Component failure can occur in virtually every imaginable setting. Failures are not limited to industry, the end user or others. As such, the practice of investigating and analyzing component failures can be highly interdisciplinary. Component failures can, themselves, be nested with a larger investigation such as that of a vehicle, machinery, or industrial plant mishap. This practice outlines the typical steps of a metallurgical/materials or mechanical component failure investigation.

4. Significance and Use

4.1 This practice establishes procedures for the investigation and evaluation of a physical component failure. The framework and methodology outlined is not exhaustive, as evaluation of complex component failures often requires unique and/or highly specialized analytical and investigative techniques. Each of the outlined elements of the practice may not be required or possible for each component.

5. Procedure

5.1 *Collection of Evidence and Background Data*—Identify and preserve evidence in accordance with Practices E 1188 and E 1492. Collect available and applicable background information and data in accordance with Practice E 1188. With specific application to component failures, the following information may be applicable:

5.1.1 General nature of failure (that is, corrosion, catastrophic fracture or explosion, wear, etc.),
5.1.2 Component manufacturing/processing history,
5.1.3 Component performance specifications,
5.1.4 Design anticipated service environment,
5.1.5 Design anticipated loading conditions,
5.1.6 Component materials specifications,
5.1.7 Witness accounts regarding failure event,
5.1.8 Witness accounts regarding operation and maintenance of component, and
5.1.9 Actual service condition data.

5.2 *Testing and Analysis of Failed Components*:

5.2.1 All testing and analysis of failed components shall be conducted in accordance with Practice E 860.

[1] This practice is under the jurisdiction of ASTM Committee E30 on Forensic Sciences and is the direct responsibility of Subcommittee E30.05 on Engineering.
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[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* volume information, refer to the standard's Document Summary page on the ASTM website.

5.2.2 Photo-document physical evidence in such a manner as to convey the condition of the component(s) upon receipt. Photodocument any alterations made to the component(s).

5.2.3 The following are recommended for evaluation of a component failure. All items may not be necessary for a complete analysis, nor may they be possible for a given component failure. The benefit of information gained by a specific evaluation must be weighed against the time, resources, and possible alteration of the evidence. Some procedures may be considered destructive.

5.2.3.1 Visual or macroscopic examination,

5.2.3.2 Dimensional evaluation,

5.2.3.3 Microscopic evaluation,

5.2.3.4 Mechanical testing,

5.2.3.5 Other physical property testing,

5.2.3.6 Electrical analysis,

5.2.3.7 Chemical analysis,

5.2.3.8 Performance simulation (bench tests), and

5.2.3.9 Computer modeling and component failure reconstruction.

5.3 *Analysis of Test Data*:

5.3.1 Evaluate technical data in accordance with Practice E 678. Use this evaluation of technical data to facilitate the following:

5.3.1.1 Identification/determination of component failure mechanism,

5.3.1.2 Construction/determination of component failure timeline, and

5.3.1.3 Identification/determination of component failure primary cause(s) and significant contributing factors.

6. Report

6.1 Prepare the report, if required in accordance with either Practice E 620 or Practice E 820.

6.2 Specific elements of the report that may be included are:

6.2.1 Description of relevant background data,

6.2.2 Testing and analytical procedures utilized along with relevant standards for use,

6.2.3 Results of analysis and testing,

6.2.4 Specific findings and conclusions as outlined in 5.3.1, and

6.2.5 Method/timeline for storage, disposal and custody transfer of components and test specimens.

6.3 When design dimension and material property data are available, report measurements in the same units.

7. Keywords

7.1 component; failure analysis; failure mechanism; forensic