



Standard Practice for Assessing the Tendency of Industrial Boiler Waters to Cause Embrittlement (USBM¹ Embrittlement Detector Method)²

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1. Scope

1.1 This practice,³ known as the embrittlement-detector method, covers the apparatus and procedure for determining the embrittling or nonembrittling characteristics of the water in an operating boiler. The interpretation of the results shall be restricted to the limits set forth in 8.6.

NOTE 1—The embrittlement detector was designed to reproduce closely the conditions existing in an actual boiler seam. It is considered probable that the individual conditions of leakage, concentration, and stress in the boiler seam can equal those in the detector. The essential difference between the detector and the boiler is that the former is so constructed and operated that these three major factors act simultaneously, continuously, and under the most favorable circumstances to produce cracking; whereas, in the boiler the three factors are brought together only under unique circumstances. Furthermore, in the detector any cracking is produced in a small test surface that can be inspected thoroughly, while the susceptible areas in a boiler are large and can be inspected only with difficulty. In these respects the embrittlement detector provides an accelerated test of the fourth condition necessary for embrittlement, the embrittling nature of the boiler water.

NOTE 2—Cracks in a specimen after being subjected to this test indicate that the boiler water can cause embrittlement cracking, but not that the boiler in question necessarily has cracked or will crack.

1.2 The effectiveness of treatment to prevent cracking, as well as an indication of whether an unsafe condition exists, are shown by this practice. Such treatments are evaluated in terms of method specimen resistance to failure.

1.3 The practice may be applied to embrittlement resistance testing of steels other than boiler plate, provided that a

duplicate, unexposed specimen does not crack when bent 90° on a 2-in. (51-mm) radius.

1.4 The values stated in inch-pound units are to be regarded as standard. The values given in parentheses are mathematical conversions to SI units that are provided for information only and are not considered standard.

1.5 *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:⁵

A108 Specification for Steel Bar, Carbon and Alloy, Cold-Finished

A515/A515M Specification for Pressure Vessel Plates, Carbon Steel, for Intermediate- and Higher-Temperature Service

D1129 Terminology Relating to Water

D1193 Specification for Reagent Water

E3 Guide for Preparation of Metallographic Specimens

E883 Guide for Reflected-Light Photomicrography

E1351 Practice for Production and Evaluation of Field Metallographic Replicas

3. Terminology

3.1 *Definitions*—For definitions of other terms used in this practice, refer to Terminology D1129.

3.2 Definitions of Terms Specific to This Standard:

3.2.1 *embrittlement cracking, n*—a form of metal failure that occurs in steam boilers at riveted joints and at tube ends, the cracking being predominantly intercrystalline.

3.2.1.1 *Discussion*—This form of cracking, which has been known as “caustic embrittlement,” is believed to result from the action of certain constituents of concentrated boiler water

¹ United States Bureau of Mines.

² This test method is under the jurisdiction of ASTM Committee D19 on Water and is the direct responsibility of Subcommittee D19.03 on Sampling Water and Water-Formed Deposits, Analysis of Water for Power Generation and Process Use, On-Line Water Analysis, and Surveillance of Water.

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³ This test method was developed during an investigation conducted under a cooperative agreement between the Joint Research Committee on Boiler Feedwater Studies and the United States Bureau of Mines. For information on the development of this test method reference may be made to the following: Schroeder and Berk, 1941 (1);⁴ Schroeder, Berk, and Stoddard, 1941 (2); *Transactions of the American Society of Mechanical Engineers*, 1942 (3); Whirl and Purcell, 1942 (4); and Berk and Schroeder, 1943 (5).

⁵ 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.