



Standard Practice for Evaluation of Disbonding of Bimetallic Stainless Alloy/Steel Plate for Use in High-Pressure, High-Temperature Refinery Hydrogen Service¹

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1. Scope

1.1 This practice describes a procedure for the evaluation of disbonding of bimetallic stainless alloy/steel plate for use in refinery high-pressure/high-temperature (HP/HT) gaseous hydrogen service. It includes procedures to (a) produce suitable laboratory test specimens, (b) obtain hydrogen charging conditions in the laboratory that are similar to those found in refinery HP/HT hydrogen gas service for evaluation of bimetallic specimens exposed to these environments, and (c) perform analysis of the test data. The purpose of this practice is to allow for comparison of data among test laboratories on the resistance of bimetallic stainless alloy/steels to hydrogen-induced disbonding (HID).

1.2 This practice applies primarily to bimetallic products fabricated by weld overlay of stainless alloy onto a steel substrate. Most of the information developed using this practice has been obtained for such materials. The procedures described herein, may also be appropriate for evaluation of hot roll bonded, explosive bonded, or other suitable processes for applying stainless alloys on steel substrates. However, due to the broad range of possible materials, test conditions, and variations in test procedures, it is up to the user of this practice to determine the suitability and applicability of these procedures for evaluation of such materials.

1.3 This practice is intended to be applicable for evaluation of materials for service conditions involving severe hydrogen charging which may produce HID as shown in Fig. 1 for stainless steel weld overlay on steel equipment (see Refs 1 and 2 in Appendix X1). However, it should be noted that this practice may not be appropriate for forms of bimetallic construction or service conditions which have not been observed to cause HID in service.

1.4 Additional information regarding the evaluation of bimetallic stainless alloy/steel plate for HID, test methodologies, and the effects of test conditions, materials, and welding variables, and inspection techniques is given in Appendix X1.

1.5 The values stated in SI units are to be regarded as the standard.

1.6 *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.* See Section 6 for additional safety information.

2. Referenced Documents

2.1 ASTM Standards:

G 111 Guide for Corrosion Tests in High-Temperature or High-Pressure Environment, or Both²

E 3 Practice for Preparation of Metallographic Specimens³

2.2 ASME Standard:

Boiler and Pressure Vessel Code Section V, Article 5, Technique Two⁴

3. Terminology

3.1 Definitions:

3.1.1 **HID**—a delamination of a stainless alloy surface layer from its steel substrate produced by exposure of the material to a hydrogen environment.

3.1.2 **Discussion**—This phenomenon can occur in internally stainless alloy lined steel equipment by the accumulation of molecular hydrogen in the region of the metallurgical bond at the interface between the steel and stainless alloy surface layer produced by exposure to service conditions involving HP/HT hydrogen in the refinery hydroprocessing.

4. Summary of Practice

4.1 Stainless alloy/steel specimens are exposed to a gaseous hydrogen containing environment at HP/HT conditions for sufficient time to produce hydrogen charging in the material. Following exposure, the specimens are cooled to ambient temperature at a controlled rate. The specimens are then held at room temperature for a designated period to allow for the development of HID between the stainless alloy surface layer

¹ This practice is under the jurisdiction of ASTM Committee G01 on Corrosion of Metals and is the direct responsibility of Subcommittee G01.05 on Laboratory Corrosion Tests.

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² *Annual Book of ASTM Standards*, Vol 03.02.

³ *Annual Book of ASTM Standards*, Vol 03.01.

⁴ Available from American Society of Mechanical Engineers, 345 E. 47th St., New York, NY 10017.