NACE International
Standard
Test Method

Evaluation of Pipeline and Pressure Vessel Steels for Resistance to Hydrogen-Induced Cracking

Contents

Section 1: General

1.1 This standard establishes a test method for evaluating the resistance of pipeline and pressure vessel plate steels to HIC caused by hydrogen absorption from aqueous sulfide corrosion.

1.1.1 Special procedures or requirements for testing small-diameter (nominal pipe size [NPS] 2 through 6), thin-wall (up to 6-mm wall thickness), electric-resistance welded (ERW) and seamless line pipe are included. These small-diameter, thin-wall materials shall be tested in the same manner as other line pipe except as otherwise stated in this standard.

1.2 The test method consists of exposing unstressed test specimens to one of the two standard test solutions—either Solution A, a sodium chloride, acetic acid (NaCl, CH_3COOH) solution saturated with H_2S at ambient temperature and pressure, or Solution B, a synthetic seawater solution saturated with H_2S at ambient temperature and pressure. After a specified time the test specimens shall be removed and evaluated.

1.3 The test method is not intended to duplicate service conditions. It is intended to provide reproducible test environments capable of distinguishing the susceptibility of different steel samples to HIC in a relatively short time. NOTE: The length of the test may not be sufficient to develop maximum cracking in any given steel but has been found to be adequate for the purpose of this test.

1.4 This standard does not include acceptance or rejection criteria. The methods used for determining acceptance and rejection, for comparing different steels, for screening of steels, or for other purposes are beyond the scope of this standard.

Section 2: Reagents

2.1 The reagents for Solution A shall be nitrogen gas for purging, H_2S gas, NaCl, CH_3COOH, and distilled or deionized water. The reagents for Solution B shall be nitrogen gas for purging, H_2S gas, and synthetic seawater. NOTE: H_2S IS HIGHLY TOXIC AND MUST BE HANDLED WITH CAUTION (see Appendix A).

2.2 The NaCl and CH_3COOH shall be reagent grade chemicals.

2.3 The gases shall be reagent grade or chemically pure gases and the water shall be distilled or deionized (see Appendix B).

2.4 The synthetic seawater shall be prepared in accordance with ASTM[(1)] Standard D 1141,[5] Stock Solutions No. 1 and No. 2 (without heavy metal ions).

Section 3: Testing Apparatus

3.1 The test may be performed in any convenient airtight vessel large enough to contain the test specimens with provisions for purging and introduction of H_2S. None of the materials involved in the test set-up shall contaminate or react with the test environment. Figure 1 is a schematic diagram of a typical test assembly.

Section 4: Test Specimens—Pipeline Steels

4.1 Size

4.1.1 Each test specimen shall be 100 ±1 mm long by 20 ±1 mm wide.

4.1.2 The test specimen thickness shall be the full wall thickness of the pipe up to a maximum of 30 mm. For wall thickness greater than 30 mm, the test specimen thickness shall be either the full wall thickness of the pipe or limited to a maximum thickness of 30 mm as described in Section 5. A maximum of 1 mm may be removed from each of the surfaces (i.e., internal and external). Test specimen blanks shall not be flattened.

4.1.3 For small-diameter, thin-wall ERW and seamless line pipe, the test specimen thickness must be at least 80% of the full wall thickness of the pipe. In such cases, curved test specimens cut from the line pipe

(1) ASTM International (ASTM), 100 Barr Harbor Dr., West Conshohocken, PA 19428-2959.