



Hydrogen Embrittlement Testing of Ultra High Strength Steels and Stampings by Acid Immersion

1 Introduction

Note: Nothing in this standard supercedes applicable laws and regulations.

Note: In the event of conflict between the English and domestic language, the English language shall take precedence.

1.1 Purpose. This standard describes a test method for evaluating the susceptibility of cold rolled and hot rolled Advanced High Strength Steels (AHSS) and Ultra High Strength Steels (UHSS) to hydrogen embrittlement.

1.2 Applicability. Hydrogen embrittlement can occur in steels with tensile strengths greater than approximately 980 MPa, although some steel microstructures, especially those containing retained austenite, may be susceptible at lower tensile strengths under specific conditions. This standard is intended for testing uncoated steels and is not applicable to zinc coated steels, passivated steels, or steels covered by primers or other organic coatings.

1.3 Remarks. Requirements for this test will be specified in the base metal specification, such as in GMW3399, GMW14400 and GMW17627. The thickness range of materials that can be evaluated is limited by test fixture capability to strain the test materials to the specified stress levels in this test method.

Due to the specific conditions that must be present for hydrogen embrittlement to occur, test sample cracking during this test does not indicate that parts made from test material would crack in an automotive environment. Results of this test, in conjunction with the strain state of the material and the environment exposure of the part, must be considered when selecting any AHSS or UHSS.

2 References

Note: Only the latest approved standards are applicable unless otherwise specified.

2.1 External Standards/Specifications.

ISO 17025 ISO/TS 16949

2.2 GM Standards/Specifications.

GMW3399 GMW14400 GMW17627

2.3 Additional References.

- Test report.

3 Resources

3.1 Facilities. The laboratory must be certified to ISO 17025 or approved to the latest version of ISO/TS 16949.

3.1.1 Calibration. The test facilities and equipment shall be in good working order and shall have a valid calibration label.

3.1.2 Alternatives. Alternative test facilities and equipment may also be used. However, all measuring variables as specified in this standard shall be determined correctly with respect to their physical definition.

3.2 Equipment.

3.2.1 Strain Gauge.

3.2.2 Bend Test Fixture.

3.2.3 Plastic containers with covers.

3.3 Test Vehicle/Test Piece. See 4.1.

3.4 Test Time.

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Calendar time: 5 days

Test hours: 120 h

Coordination hours: 4 h

3.5 Test Required Information. Not applicable.

3.6 Personnel/Skills. Not applicable.

4 Procedure

4.1 Preparation. The test sample configuration is shown in Figure 1. The samples shall be cut from a flat sheet of steel using a water jet cutter, electrical discharge machining (EDM), or computer numerical control (CNC) milling with a minimal amount of edge deformation imparted to the test sample. The surface of each sample shall be cleaned with acetone to remove oils and surface contaminants.

4.1.1 Test Sample Configuration. The test coupon is 180 mm x 30 mm orientated in the longitudinal direction to rolling. Testing may be performed in other directions as specified by the requester. See 4.1.2 for edge condition requirements.

Two slots are cut in the end of each sample. The slots are 15 mm deep and 13.5 mm wide (Figure 1). These notches will be used to bolt the two ends of the test piece together. It has been shown that loading samples in groups of two (2) can be advantageous in maintaining the stress state during the test as shown in Figure 2.

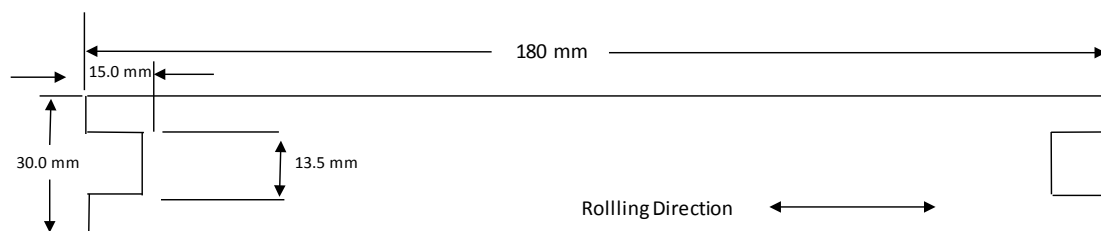


Figure 1: Test Sample Dimensions

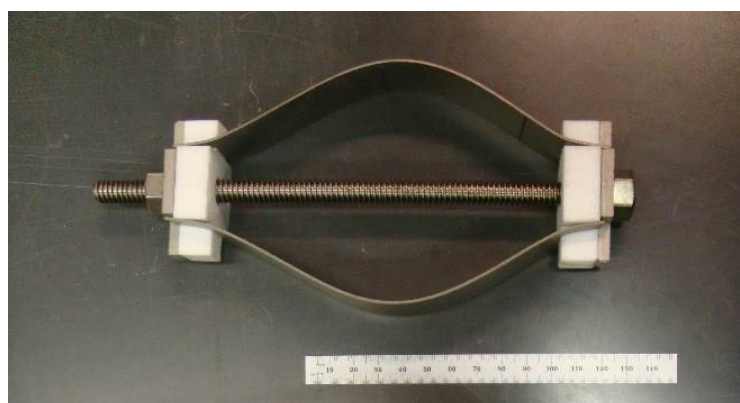


Figure 2: Double Sample in Strained Stress State

4.1.2 Edge Condition. Edge condition may affect test results. If samples are sheared prior to final edge machining, the following tooling standards shall be followed.

- The punch die shall have a 15% die clearance for steels tested to this standard.
- The tolerance on the die clearance is $\pm 1\%$.

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