HPIS

Standard Test Method for Humid Gas Stress Corrosion Cracking of Aluminium Alloys for Compressed Hydrogen Containers

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High Pressure Institute of Japan

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Introduction

This standard is established at the request of automotive industry in order to evaluate the humid gas stress corrosion cracking (HG-SCC) susceptibility of aluminium alloys used in compressed hydrogen containers.

1 Scope

This standard specifies the test method for humid gas stress corrosion cracking (HG-SCC) and the qualification criteria of aluminium alloys for compressed hydrogen containers for automotive use.

2 Normative references

The following referenced documents are indispensable for the application of this document. For dated document, only the edition cited applies. For undated references, the latest edition of the referenced document (including any amendments) applies.

ISO 6892-1, Metallic materials – Tensile testing – Part1: Method of test at room temperature

ISO 7539-6:2011, Corrosion of metals and alloys – Part 6: Preparation and use of precracked specimens for tests under constant load or constant displacement

ISO 7866:2012, Gas cylinders – Refillable seamless aluminium alloy gas cylinders – Design, construction and testing

ASTM E399-12^{e2}, Standard Test Method for Linear-Elastic Plane-Strain Fracture Toughness K_{Ic} of Metallic Materials

3 Terms and definitions

For the purpose of this document, the terms and definitions given in **ISO 7539-6**:2011 and the following apply.

3.1

HG-SCC (Humid Gas Stress Corrosion Cracking)

stress corrosion cracking in a humid gas environment

3.2

***K*$_{I}$**

stress intensity factor of a crack subjected to opening mode displacements (mode I)

3.3

***K*IAPP**

stress intensity factor of a crack when a load was applied to the specimen at the beginning of the HG-SCC test

3.4

$\sigma_{0.2}$

average of the 0.2% proof stress of two specimens measured at room temperature in accordance with the procedures given in **ISO 6892-1**

3.5

small scale yielding condition

condition in which the plastic zone at the crack tip is so small in comparison to the dimensions of the specimen that the plastic zone does not significantly affect the stress distribution in the surrounding elastic zone, thus enabling the description of the field of stress at the crack tip in terms of stress intensity factor *K*

3.6

plane strain condition

condition in which the dimensions of the plastic zone at the crack tip are so small in comparison to the length of the crack and to the thickness of the specimen that plastic deformation along the thickness direction inside the plastic zone is restricted by elastic deformation in the surrounding elastic zone (due to difference in the Poisson's ratios), thus generating a tensile stress in the thickness direction and attaining a tri-axial tensile stress state

4 Principle

A fatigue pre-cracked specimen is loaded by a constant-load or constant-displacement method to a K_{IAPP} equal to a defined value. Then, the specimen is maintained in the loaded state at prescribed environment for a prescribed duration. After the test duration, the specimen is examined as to whether or not the cracking has extended from the initial fatigue pre-crack. If the crack extension length does not exceed a prescribed value, the material of the specimen is considered suitable for compressed hydrogen containers as far as the required resistance to crack extension under loading is concerned.

5 Specimens

5.1 Specimen geometries

The geometries of the HG-SCC specimen shall be as follows.