HPIS

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

HPIS E 103:2024

Revised : 2024-6-28

Edited and Issued by 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 documents are referred to in the text in such a way that some or all of their content constitutes requirements of this document. For dated references, 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 7539-6:2018, 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 E399-23, Standard Test Method for Linear-Elastic Plane-Strain Fracture Toughness of Metallic Materials

3 Terms and definitions

For the purpose of this document, the terms and definitions given in **ISO 7539-6**:2018 and the following apply.

HG-SCC (Humid Gas Stress Corrosion Cracking)

stress corrosion cracking in a humid gas environment

K_I

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

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

This explanation relates to the matters specified and/or described in **HPIS E 103** and the relevant matters, but does not constitute part of this standard.

1 Purpose of establishment

ISO 7866:2012 has been established as a standard for compressed hydrogen cylinders using aluminum alloys (see **Clause 2** of **HPIS E 103**), and its **Annex B** specifies "Test method to determine the sustained-load cracking resistance of aluminium alloy gas cylinders". It is known that depending on the type of alloy or temper of aluminum alloys, stress corrosion cracking (SCC) occurs when exposed to a moist environment under loaded force. Since **Annex B** does not specify environmental conditions, it is considered inappropriate to judge the suitability for cylinders based solely on the standard.

Therefore, the High Pressure Institute of Japan established **HPIS E 103**:2018 (first edition), which specifies test methods and judgment conditions in a humid environment, based on **ISO 7866**. This standard is intended to be applied not only to containers, but also to the evaluation of materials before they are processed into containers.

2 Contents of the amendment

HPIS E 103:2024 (second edition) has the following amendments.

a) In "**2 Normative references**", the latest editions of **ISO 7539-6** and **ASTM E399** are cited. It has been confirmed that the provisions cited by **HPIS E 103** from these standards have not changed from the old editions.

b) The provision of **a)7)** of **Clause 6** is revised from recommendation (should) to requirement (shall), because **Clause 6** as a whole is a requirement.

c) In **b)** of **Clause 6**, a (effective crack length) was defined as "distance between fatigue pre-crack tip and load axis in mm" in the first edition, which was intended for compact type specimens. Since this standard applies to specimens of various type [see **a)** of **5.1**], this definition statement has been deleted.

d) Regarding "**—** For constant force condition" in "**7.6.2** Small scale yielding and plane strain conditions", the first edition stated that the test was invalid if the small scale yielding and plane strain conditions were no longer met at the end of the test. In this second edition, the provisions are divided into (1) "In case of $(a_{scc} - a_{pre}) \leq 0.16$ (mm)" and (2) "In case of $(a_{scc} - a_{pre}) > 0.16$ (mm)" (0.16 mm is the value at which HG-SCC extension is judged to pass). This is because the test is judged to be valid if the small scale yielding and plane strain conditions are met at the length of HG-SCC extension in (1) and 0.16 mm of HG-SCC extension in (2).

e) In accordance with **ISO** and **ASTM** standards, a distinction has been made between force and load throughout this standard. Also, the related expressions are revised.