

Progress on HG-SCC test method proposal for aluminum alloys

HG-SCC : **H**umid **G**as **S**tress **C**orrosion **C**racking

Transmitted by Japan

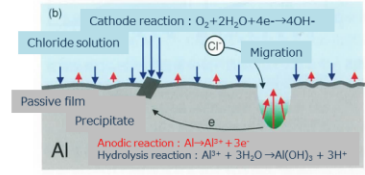
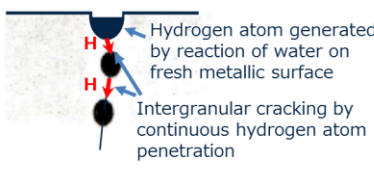

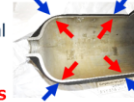
8th Meeting of the informal working group on GTR No.13 (Phase 2)
23-27 October 2020

Current status

- **Japan has been proposing Humid Gas Stress Corrosion Cracking (HG-SCC) test method at the previous GTR No.13 IWG meeting.**
- **This test method is based on "HPIS E 103:2018" which was published as original standard in Japan.**
HPIS : High Pressure Institute of Japan,
authorized by METI as an entity of the Code Committee
- **GTR13 IWG requested Japan the reference verification tests to clarify the certainty of this proposal.**

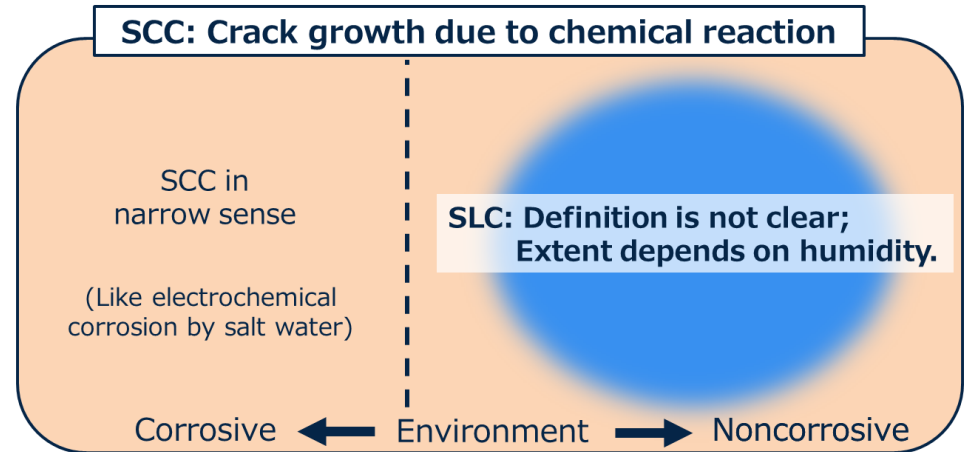
Reminder : Share the necessity of this proposal

2 types of corrosion phenomena in aluminum alloys

Type	Anodic dissolution	SCC in humid gas environment
Principle	Electrochemical corrosion by salt water 	SCC by the reaction of metallic Al and H2O 
Reaction	Anodic reaction : $Al \rightarrow Al^{3+} + 3e^-$ Cathode reaction : $O_2 + 2H_2O + 4e^- \rightarrow 4OH^-$	$2Al + 3H_2O \rightarrow Al_2O_3 + 6H$
Characteristics	<ul style="list-style-type: none"> Need oxygen and solution Need Cl⁻ (break passive film) Not occur in high pressure H₂ (no oxygen and no solution) <p>⇒ Occur only outside of containers</p> 	<ul style="list-style-type: none"> Occur under the presence of H₂O Crack growth by accumulation of hydrogen atoms at the crack tip (on fresh metallic surface), not by dissolution of metal into ion <p>⇒ Occur both outside and inside of containers</p> 
Evaluation	Current test method applied by each car OEM	※ HG-SCC test method (Improved SLC test) proposed by Japan for GTR13

Mechanism explanation on HG-SCC

Evaluation target of HG-SCC test method in comparison with existing test method : ISO 7866 Annex B



← Evaluation by HPIS E 103

← Evaluation by ISO 7866 Annex B

• ISO 7866 Annex B : humidity is not controlled → not enough for SCC evaluation
Result varies with humidity.

• HPIS E 103 : under high-humidity condition → appropriate for SCC evaluation

Reminder : Summary of HG-SCC test method

- The test conditions

- a) Temperature: $25^{\circ}\text{C} \pm 5^{\circ}\text{C}$
- b) Atmosphere and humidity : 85 % or higher in relative humidity in air
- c) Test period: 90 days

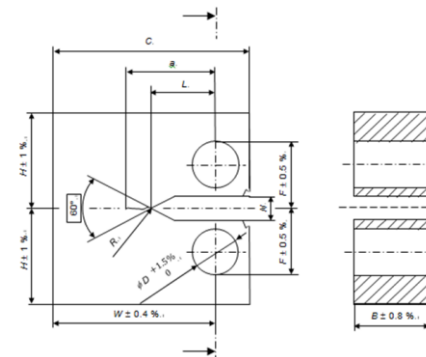
(in accordance with B.6.6 of ISO 7866:2012)

SLC(Sustained Load Cracking) test

- How to judge

The crack extension exceeds 0.16 mm or not under applied stress intensity factor value ($K_{IApp} = 0.056 \sigma_{0.2}$)

ref) K_{IApp} : equivalent to $\sigma_{0.2}$ at the tip of a crack of 1mm length



Example of specimen (CT)

Status of the reference verification test

- **Request from GTR13 IWG :**
 - Need verification tests in humid hydrogen gas environment to compare with the results in humid air.**
- **under evaluating**
- **Test and analysis target : by early 2021**

Summary

- **The effectiveness and necessity of HG-SCC test method are understood at GTR13 IWG meeting.**
- **Japan will complete the reference verification tests by early 2021.**
- **Japan will also prepare the requirements (Part 2) and rationale (Part 1) for the GTR documents.**

**Thank you for
your kind attention**