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# Corrosion

Testing | Analytics | Research & Development

Mett-Bio offers end-to-end corrosion testing and consulting services, including atmospheric corrosion monitoring, hydrogen embrittlement analysis, and failure diagnostics, aimed at mitigating corrosion risks and reducing long-term maintenance costs. With over a decade of expertise and advanced infrastructure, we deliver accurate insights that help industries prevent material degradation, ensuring durability and operational efficiency. Our tailored corrosion consulting solutions enable clients to enhance performance, extend asset life, and achieve significant cost savings through effective corrosion prevention strategies.

## INTERGRANULAR CORROSION TESTING

“Critical testing guidelines for qualifying stainless-steel products against intergranular corrosion (IGC) to meet industry performance requirements.”

### ASTM A 262 : Applicable for Austenitic stainless steel grades

ASTM A 262 Intergranular corrosion test method is used for rapid screening of batches of Austenitic stainless steel material towards the susceptibility of Intergranular corrosion. This test method contains five unique tests.

This tests refers to deterioration of grain boundaries due to precipitation of carbides at the grain boundaries.

The five intergranular corrosion testing methods within ASTM A262 are

**Method A**  
the Oxalic Acid Test

**Method C**  
the Huey Test

**Method B**  
the Streicher Test

**Method E**  
the Strauss Test

**Method F**  
the Copper Sulphate Test

### ASTM G 28: Applicable for Wrought, Nickel Rich Chromium Bearing Alloys

This test method can be employed to detect the susceptibility to intergranular corrosion that can occur by variation in material processing or composition or both.

**Method A**

**Method B**



## INTERGRANULAR CORROSION TESTING

“Test methods for qualifying ferritic stainless-steel products by detecting susceptibility to intergranular corrosion (IGC).”

### ASTM A 763: Applicable for Ferritic stainless steel grades

This practice includes detecting susceptibility to intergranular attack in ferritic stainless steel. Several methods for preparing test samples are available. Four practices, including practice W, X, Y, and Z, are used to determine susceptibility to intergranular attack in ferritic stainless steel. These practices include the following tests; Oxalic acid etching test, ferritic sulfuric acid test, copper sulphate 50% sulfuric acid test and copper sulfate-16% copper sulfuric acid test. For the ferrite Sulfate-Sulfuric acid test and the copper sulphate-copper sulfate-50% sulfuric acid test, samples should be examined under a binocular microscope at 40x magnification. Bending test evaluations for steel specimens are presented.

**Method W**

**Method X**

**Method Y**

**Method Z**

### ASTM A 923: Applicable for Duplex Austenitic/Ferritic stainless steel grades

This test method is used to detect the presence of intermetallic phases in duplex stainless steels that can affect its corrosion resistance considerably. This test method can be used to detect the effectiveness of the heat treatment.

**Method A**

**Method C**

Pitting and crevice corrosion tests conducted in accordance with ASTM G48 are essential for manufacturing industries as they assess a material's resistance to localized corrosion in aggressive environments.

## Pitting and Crevice Corrosion Testing



Assesses pitting and crevice corrosion by exposing samples to a corrosive environment, often using ferric chloride solutions, to identify the material's susceptibility to these types of attack. Results are often complemented by a standardized method for evaluating the degree of general corrosion and providing detailed guidelines for interpreting the results. Together, these tests enable manufacturers to thoroughly assess material performance in harsh conditions, ensuring that components resist localized degradation effectively.

This test consists of six unique methods, described as :

# MettLab

## A

### **Pitting Corrosion Test**

Determines the resistance to pitting corrosion.

## B

### **Crevice Corrosion Test**

Assesses resistance to crevice corrosion by introducing a crevice to the sample.

## C

### **Critical Pitting Temperature Test**

Determines the critical temperature above which pitting corrosion initiates.

## D

### **Critical Crevice Temperature Test**

Determines the critical temperature for crevice corrosion initiation.

## E

### **Critical Pitting Temperature Test**

Establishes a ranking system for materials based on pitting resistance.

## F

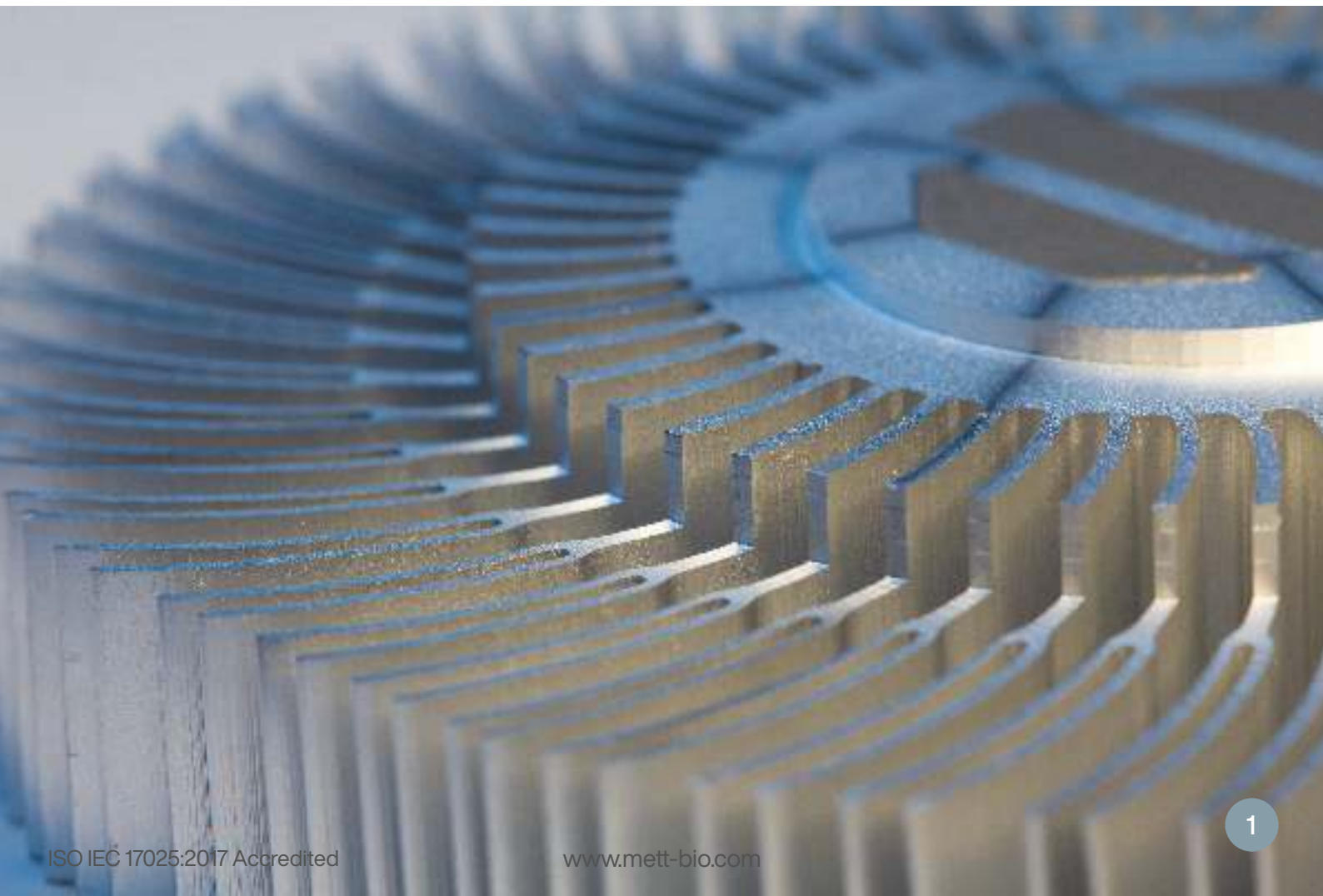
### **Critical Crevice Temperature Test**

Evaluates materials for critical crevice corrosion resistance in one test.

# EXFOLIATION CORROSION

The exfoliation test is crucial for industries, especially those using high-strength aluminium alloys like the 2XXX and 7XXX series, as it assesses susceptibility to exfoliation corrosion. This specialized form of intergranular corrosion occurs when corrosion progresses laterally along planes parallel to the surface, particularly around grain boundaries. The test involves immersing the aluminium alloys in corrosive environments to evaluate how corrosion products lead to the formation of a layered appearance, where the metal is pushed away from the bulk material. By using standard test methods manufacturers can identify and mitigate risks associated with exfoliation corrosion, ensuring the reliability and durability of aluminium components in demanding applications.

Rapid assessment of 2XXX and 7XXX series aluminum alloys' resistance to exfoliation corrosion, ensuring material integrity and longevity in high-performance applications like aerospace and automotive.





## EXFOLIATION CORROSION

# ASSET TEST

We offer precise visual assessment of exfoliation corrosion susceptibility in 5XXX series aluminium alloys, ensuring optimal performance and durability for marine, structural, and industrial applications.

For industries dealing with aluminium alloys, particularly those with directional structures like the 5XXX series aluminium-magnesium alloys containing at least 2% magnesium this test effectively predicts susceptibility to exfoliation corrosion, a phenomenon where corrosion causes the material to peel away, potentially compromising the structural integrity by reducing the effective cross-section. Standard Test Method provides reliable insights into how these alloys will perform in marine environments, making it an invaluable tool for alloy development and quality control. It ensures that mill products such as sheets and plates meet necessary standards, thus preventing premature failure and extending the lifespan of critical components.

Code	Classification
<i>N</i>	No appreciable attack
<i>P</i>	Pitting
<i>E</i>	Exfoliation

## ENVIRONMENTALLY ASSISTED CRACKING/ FAILURE

### SUSCEPTIBILITY TO STRESS CORROSION AND HYDROGEN EMBRITTLEMENT TESTS

Protect your steel pipelines and pressure vessels from hydrogen-induced corrosion and cracking with our expert solutions designed to ensure lasting integrity and reliability."



## HIC / SOHIC



## HYDROGEN INDUCED CRACKING

### SOLUTION

**A** a solution of sodium chloride acetic acid (NaCl, CH<sub>3</sub>COOH) saturated with H<sub>2</sub>S at temperature and ambient pressure,

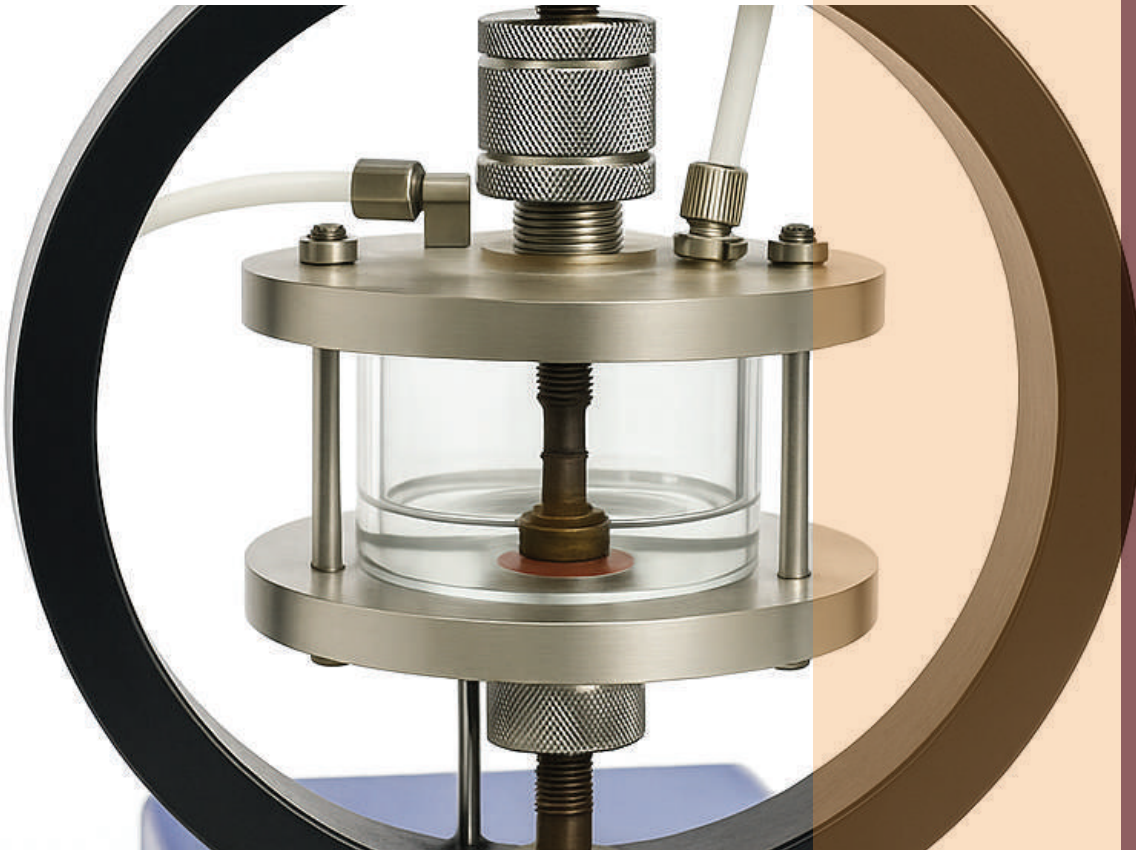
**B** a solution of synthetic seawater saturated with H<sub>2</sub>S at ambient temperature and pressure.

**C** The reagents for Test Solution shall be an inert gas for purging, a mixture of H<sub>2</sub>S and carbon dioxide (CO<sub>2</sub>), with H<sub>2</sub>S content sufficient to produce the specified H<sub>2</sub>S partial pressure, NaCl, CH<sub>3</sub>COONa, hydrochloric acid (HCl) or sodium hydroxide (NaOH) added to achieve the specified pH and distilled or deionized water.

The **NACE**™ TM0284/ TM 0103 test method is vital to the oil and gas industry as it assesses the resistance of pipelines, pressure vessels, and steel plates to Hydrogen-Induced Cracking (HIC/SOHIC) in environments containing hydrogen sulfide (H<sub>2</sub>S). HIC occurs when atomic hydrogen, absorbed through aqueous sulfide corrosion, diffuses into carbon or low-alloy steels, forming molecular hydrogen that causes internal pressure and initiates cracks. This test method calculates critical ratios crack sensitivity, crack length, and crack thickness using optical microscopes to evaluate failed test pieces. By identifying the material's susceptibility to HIC, the test ensures the durability and safety of components used in H<sub>2</sub>S-rich environments, helping industries prevent catastrophic failures and optimize

# SOUR SERVICE CORROSION TESTING

Build to Withstand – Certify for Safety in Sour Environments



SSC | SCC | CSC

ENSURING THE SAFETY AND RELIABILITY OF OIL AND GAS INFRASTRUCTURE AND EQUIPMENT.

Gas or Mixed Gas available Option :

**CO<sub>2</sub>**  
Carbon dioxide

**H<sub>2</sub>S**  
Hydrogen sulfide

**NO<sub>2</sub>**  
Nitrogen dioxide

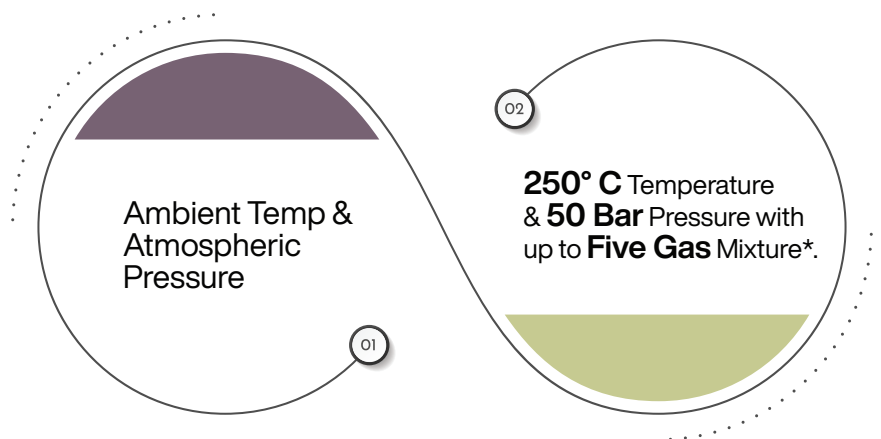
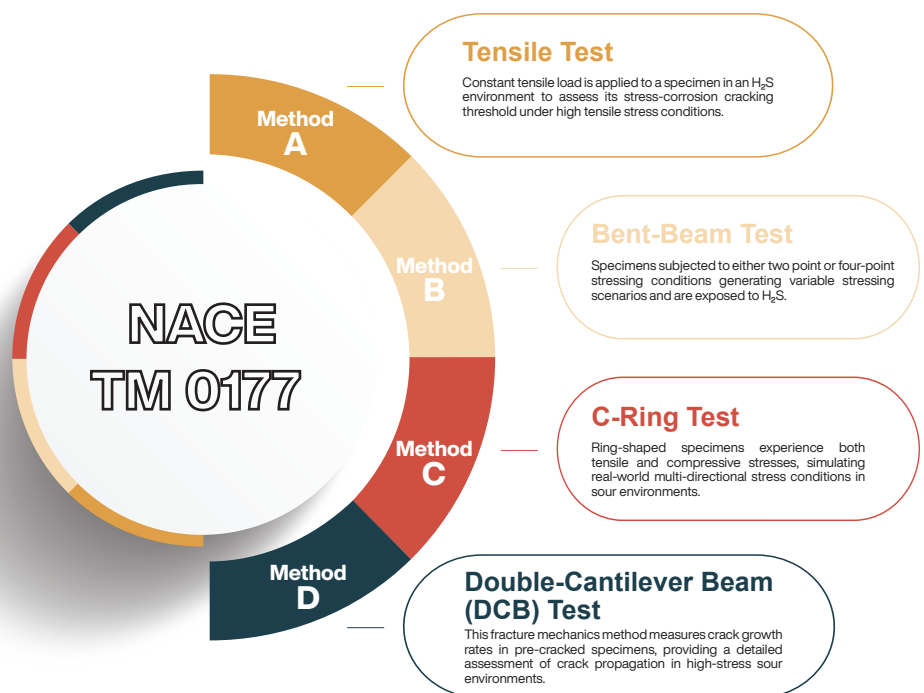
**SO<sub>2</sub>**  
Sulfur dioxide

**Cl**  
Chlorine

**NH<sub>3</sub>**  
Ammonia

Manufacturing industries in oil and gas production must qualify their materials against sour service corrosion tests to ensure reliability in environments containing hydrogen sulfide (H<sub>2</sub>S).

These tests, evaluate the resistance of materials to corrosion mechanism due to sulfide stress cracking (SSC). Materials, including pipelines, pressure vessels, and other critical components, must demonstrate their ability to withstand sour environments without suffering from mechanical failure or degradation. By passing these tests, manufacturers ensure that their products meet stringent safety and performance requirements, preventing catastrophic failures and enhancing the lifespan of components used in sour service conditions.

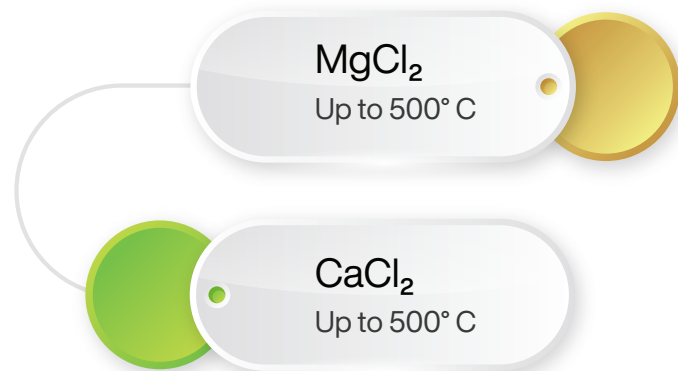


# CHLORIDE STRESS CORROSION TEST



Chloride stress corrosion cracking (CSCC) occurs when materials, particularly stainless steels and other alloys, experience cracking due to the combined effects of tensile stress and exposure to chloride ions. This form of corrosion is especially problematic in environments with high chloride concentrations, such as those found in coastal or industrial settings. The significance of chloride stress corrosion testing in manufacturing lies in its ability to identify materials prone to this type of failure before they are used in critical applications.

U-bend samples tested are crucial for evaluating the susceptibility of materials to stress corrosion cracking (CSCC) in various environments. This test involves bending metal samples into a U-shape and subjecting them to a corrosive environment under tensile stress to simulate service conditions. The use of solutions like Magnesium/calcium chloride creates an aggressive environment that accelerates the onset of stress corrosion cracking. By applying this method, manufacturers can assess how materials perform under real-world stresses and corrosive conditions, ensuring their durability and reliability in applications exposed to chloride environments, such as in chemical processing or marine environments. surface finish, microstructure and stress on the susceptibility of these materials on Chloride stress corrosion cracking



## Possible Outcomes:

- Time to initiate cracks
- The rate of crack growth
- The time to failure

# Copper alloys - Dezincification resistance



Dezincification is a form of corrosion that selectively removes zinc from copper alloys containing zinc, such as brass, leading to a porous, weakened structure that compromises the material's mechanical integrity and performance. The importance of dezincification resistance in copper alloys with zinc lies in ensuring the longevity and reliability of components used in environments where they are exposed to water, acids, or other corrosive substances. For industries like plumbing, marine, and chemical processing, where these alloys are commonly used, materials with high dezincification resistance are essential to prevent premature failure, leaks, and structural damage. Ensuring that copper alloys resist dezincification helps maintain safety, reduces maintenance costs, and extends the service life of critical components.

Facilities and experts at Mett-Bio can provide precise quantitative analysis of degree and depth of dezincification.



## Stress Corrosion Resistance Copper Alloys - Ammonia Environments

- 01 Detect impact of applied or residual stresses Applicable for both assemblies and partial components
- 02 Accelerated stress corrosion test for Cu alloys Detect impact of residual stresses for components

Copper alloys particularly those used in critical applications such as plumbing, heat exchangers, and electrical systems are prone to stress corrosion cracking due to either external stresses or internal residual stresses from manufacturing. The ammonia test for stress corrosion cracking (SCC) is crucial for determining the susceptibility of copper alloys. Ammonia vapor can cause stress corrosion cracking in copper alloys by attacking the material at points of mechanical stress, leading to the formation of cracks that can propagate and cause sudden failure.