Corrosion Testing

TCR Engineering Services
A Material Testing Laboratory in India

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Table of Contents

Corrosion Testing in India

TCR Engineering Services (TCR), a NABL and ISO 17025 accredited independent material testing laboratory in Mumbai, India undertakes a wide range of corrosion and stress corrosion test per ASTM, NACE or as per an individual client's requirements.

Senior staff members with specific industry expertise cover a variety of corrosion problems that are encountered in industries such as oil and gas production, oil and gas transmission, energy conversion systems, and nuclear power systems. A wide variety of corrosion related tests can be undertaken at TCR Engineering Services in India to determine weight loss corrosion, intergranular attack, pitting corrosion, corrosion fatigue, stress corrosion cracking, sulfide stress cracking, and hydrogen-induced cracking.

TCR offers comprehensive material testing of corrosion problems, including:

- Pitting Corrosion test as per ASTM G48 Specification
- Salt Spray Test
- Corrosion test as per ASTM G35 specification
- Inter granular Corrosion Test (IGC) per ASTM A-262 Practice A B C D E & F
- Hydrogen-Induced Cracking Test (HIC) as per NACE TM 0284
- Sulfide Stress Corrosion Cracking Test (SSCC) as per NACE TM 0177
- Chloride Stress Corrosion Test as per ASTM G36 Specification
- Ammonia Vapor Test
- Corrosion test as per ASTM A761 Specification

Pitting Corrosion test as per ASTM G48 Method B Specification

This Procedure is used to assist in the selection of test methods that can be used in the identification and examination of pits and in the evaluation of pitting corrosion to determine the extent of its effect. ASTM G48 Method B, Ferric Chloride Test involves exposing a specimen to a highly oxidizing acid chloride environment. The importance of this evaluation is to be able to determine the extent of pitting, either in a service application where it is necessary to predict the remaining life in a metal structure, or in laboratory test programs that are used to select the most pitting-resistant materials for service.

Salt Spray (Neutral / Fog), ASTM B117

This is the most commonly used salt spray for testing of inorganic and organic coatings, especially where such tests are used for material or product specifications. Salt Spray testing is a tool for evaluation the uniformity of thickness and degree of porosity of metallic and nonmetallic protective coatings. A number of samples can be tested at once depending upon their size.

Corrosion test as per ASTM G 35 specification

The polythionic acid (sulfurous acid and hydrogen sulfide) environment provides a way of evaluating the resistance of stainless steels and related alloys to inter granular stress corrosion cracking. This practice can be applied to wrought products, castings, weld metal of stainless steels or other materials to be used in environments containing sulfur or sulfides.

Inter Granular Corrosion Test (IGC) per ASTM A-262

At TCR Engineering Services, several methods exist for the testing of intergranular corrosion. To conduct these tests, we carefully choose a method which is suitable for the steel grade and grain boundary composition to be tested.

The following tests are carried out by TCR Engineering Services in India as per the ASTM A262 specification.

Oxalic Acid Test, ASTM A262, Practice A (Oxalic Acid Etch)

The oxalic acid etch test is a rapid method of screening those specimens of certain stainless steel grades which are essentially free of susceptibility to inter granular attack associated with chromium carbide participates. The test is used for acceptance but not rejection of material.

Ferric Sulfate - Sulfuric Acid, ASTM A262 - Practice B (Streicher Test)

This test is based on weight loss determinations and provides a quantitative measure of the relative performance of the material evaluated. The procedure includes subjecting a specimen to a 24 to 120 hour boil in ferric sulfate - 50% sulfuric acid. This procedure measures the susceptibility of stainless steels and nickel alloys to inter granular attack associated with the precipitation of chromium carbides at grain boundaries.

Nitric Acid, ASTM A262, Practice C, (Huey Test)

The specimens are boiled for five periods, each of 48 hours, in a 65 per cent solution of nitric acid. The corrosion rate during each boiling period is calculated from the decrease in the weight of the specimens. Properly interpreted, the results can reveal whether or not the steel has been heat-treated in the correct manner. The customer must specify the maximum permissible corrosion rate and, in applicable cases, data on sensibilizing heat treatment.

The Huey test environment is strongly oxidizing, and, is only used as a check on whether the material has been correctly heat treated. This test is suitable for the detection of chromium depleted regions as well as intermetallic precipitations, like sigma phase, in the material. The Huey test is also used for materials that come into contact with strongly oxidising agents, e.g. nitric acid. This procedure may also be used to check the effectiveness of stabilizing elements and of reductions in carbon content in reducing susceptibility to inter granular attack in chromium-nickel stainless steels.

Copper - Copper Sulfate - 16% sulfuric acid, ASTM A262 - Practice E (Strauss Test)

This procedure is conducted to determine the susceptibility of austenitic stainless steel to inter granular attack associated with the precipitation of chromium-rich carbides. Once the specimen has been subjected to the solution boil, it is bent through 180° and over a diameter equal to the thickness of the specimen being bent. This test is based on a visual examination of the bent specimen.

Copper - Copper Sulfate - 50% sulfuric acid, ASTM A262 - Practice F

This test is based on weight loss determination which provides a quantitative measure of the relative performance of the material evaluated. It measures the susceptibility of "as received" stainless steels to inter granular attack.

G31-72(2004) Standard Practice for Laboratory Immersion Corrosion Testing of Metals

This practice describes accepted procedures for and factors that influence laboratory immersion corrosion tests, particularly mass loss tests.

G66-99(2005)e1 Standard Test Method for Visual Assessment of Exfoliation Corrosion Susceptibility of 5XXX Series Aluminium Alloys (ASSET Test)

This test method covers a procedure for continuous immersion exfoliation corrosion testing of 5XXX series aluminium-magnesium alloys containing 2.0 % or more magnesium.

This test method provides a reliable prediction of the exfoliation corrosion behaviour of Al-Mg alloys in marine environments. The test is useful for alloy development studies and quality control of mill products such as sheet and plate.

G67-04 Standard Test Method for Determining the Susceptibility to Intergranular Corrosion of 5XXX Series Aluminium Alloys by Mass Loss after Exposure to Nitric Acid (NAMLT Test)

This test method describes a procedure for constant immersion intergranular corrosion testing of 5XXX series aluminium alloys. This test method provides a quantitative measure of the susceptibility to intergranular corrosion of Al-Mg and Al-Mg-Mn alloys. The nitric acid dissolves a second phase, an aluminium-magnesium intermetallic compound (bAl-Mg), in preference to the solid solution of magnesium in the aluminium matrix.

When this compound is precipitated in a relatively continuous network along grain boundaries, the effect of the preferential attack is to corrode around the grains, causing them to fall away from the specimens. Such dropping out of the grains causes relatively large mass losses.

Hydrogen-Induced Cracking (HIC) Test, NACE TM0284

TCR Engineering Services, corrosion testing laboratory in Mumbai (India) performs HIC test to evaluate the resistance of pipeline and pressure vessel plate steels to Hydrogen Inducted Cracking caused by hydrogen absorption from aqueous sulfide corrosion. An unstressed test specimen is exposed to a solution at ambient temperature and pressure and after a specified time, the test specimen is removed and evaluated.

Specimen Size

To conduct the HIC test, TCR Engineering Services requires a set of three test bars taken from specified locations around the circumference of a pipe ring, or at one end and mid-width of the plate, with the longitudinal axis of each bar parallel to the principal rolling direction of the plate. The bars should be 100 mm long x 20 mm wide, with the full wall thickness of the sample up to a maximum of 30 mm. For wall thickness greater than 30 mm, three or more overlapping bars are taken in order to provide full coverage of the thickness.

- For 6-5/8" OD tubulars and larger, a 6" long ring is requested. For smaller diameters, a 15" long sample is requested.

- For plate samples, a 6" x 8" piece is requested with the longer dimension representing the principal rolling direction of the material.

TCR Engineering Services can perform sample machining upon request.

NACE TM0284 Test Solution

NACE TM0284 specifies either Solution A or Solution B. Solution A is acidified brine. Solution B is simulated seawater prepared in accordance with ASTM D1141.52. In either case, H2S is bubbled through the solution constantly throughout the test period. NACE TM0284 specifies test duration of 96 hours.

Detailed Report

TCR Engineering issues a detailed written report upon completion of each test. Each report includes a description of the test sample that was received, the test procedure that was used, and the pH values of the test solution before exposure and after the exposure. The test bars are cut into sections and examined under a microscope for hydrogen-induced cracks. The dimensions of any such cracks are recorded and used to compute the values in percentage for Crack Length Ratio (CLR), Crack Thickness Ratio (CTR) and Crack Sensitivity Ratio (CSR).

Charges

The material testing charges at TCR Engineering for Hydrogen Induced Cracking (HIC) Test as per NACE TM 0284 are as follows:

Material less than 80mm Thickness / diameter	US $450.00
Material greater than 80mm Thickness / diameter	US $600.00.

Our corrosion testing laboratory in Mumbai, India requires 2 weeks to complete the HIC test.

Sulfide Stress Corrosion Cracking (SSCC), NACE TM0177

Sulfide stress corrosion cracking (SSCC) is a form of hydrogen embrittlement cracking which occurs when a susceptible material is exposed to a corrosive environment containing water and H2S at a critical level of applied or residual tensile stress. TCR Engineering Services in Mumbai, India conducts the NACE TM0177 tests including Methods A and B for SSCC test, at our corrosion testing laboratory.

NACE TM0177 Test Details

NACE TM0177 tests at TCR includes the following methods:
Method A: Tensile Test (Proof Rings)
Method B: Bent Beam Test (3 or 4 Point Bends)

NACE TM0177 specifies Solution A (acidified), Solution B (acidified and buffered) and Solution C (for martensitic stainless steel). Solution A is used in Methods A unless the properties of Solution B or C are specified. In any case, H2S is bubbled through the solution constantly throughout the test period.

Testing is performed in NACE solutions A and/or B, saturated with H2S at 24º and 90º Celsius. Stressed samples are exposed to sour environment for a pre-determined time, after which they are removed and analyzed for crack detection. NACE TM0177 specifies test duration of 30 days (720 hours) for Method A or B test.

Specimen Size

The SSCC tests at TCR Engineering in India are performed routinely for customers using tensile and bent beam specimens.

A 6-inch length of material is requested for the machining of SSCC specimens. The minimum material thickness for standard Method A specimen is 0.350". Materials with a thickness less than 0.350" can be used in Method B testing. TCR Engineering Services can perform sample machining upon request.

Detailed Report

TCR Engineering issues a written report for each test, or group of tests performed. This report includes a description of the test sample that was received and of the test procedure that was used, the pH values of the test solution before and after the exposure, the results of the hardness test performed on the test specimen and a statement declaring the results of each test.

Charges

The charges at TCR Engineering for Sulfide Stress Corrosion Cracking (SSCC) Test as per NACE TM0177 are as follows:

24º Celsius & ATM Pressure is	US $550.00
90º Celsius & 16 Bar pressure is	US $2800.00

TCR Engineering requires 6 weeks to complete the SSCC test.

About TCR Engineering Services

Founded in 1973, TCR Engineering Services (TCR) is India's most reputed and established, NABL and ISO 17025 accredited independent material testing laboratory. The core services TCR provides include Mechanical Testing, Chemical Analysis, Positive Material identification (PMI), Non Destructive Testing, Metallography, Corrosion Testing, Failure Analysis, Raw Material Inspection, Metallurgical Product evaluation, Engineering Research and Consultancy.

TCR has pioneered in introducing latest analytical facilities and has upgraded the same every decade. TCR has state-of-the art testing facilities for testing of Engineering Goods, Ferrous and Non-Ferrous Metals, Non-Metallic Materials such as Polymers, Ceramics, Glass, etc.

More than 1000 Quality driven clients (in India and a select few globally) in Aerospace, Automotive, Oil Refineries, Petrochemical plants, Chemical Processing, Defense, Nuclear Power and Capital Goods manufacturing trust TCR to handle their Material Testing and Research & Development requirements.

Engineers, Chemists, Metallurgists & Technicians, at TCR, have the qualifications, the education and the experience to meet rigorous standards in the testing field, whether serving the Private and Public Sector, Government or the Military.

Customer Service Representatives, at TCR, provide clients with up-to-the-minute information on the status of your sample through our in-house laboratory automation software. The need for responsiveness is something understood by everyone in the company. We have improved turnaround time without sacrificing quality by operating 12 hours a day in the lab, 16 hours a day in the machine shop.

TCR laboratories are located in Lower Parel, Mumbai and Electronic Zone, Navi Mumbai with a sample collection office in the Mumbai Metal market. TCR Advanced Services, a TCR Engineering affiliate company, has its laboratory in Baroda. Engineering professionals travel across India to conduct on-site material testing. International clients are served by a sales office in Washington DC, USA.

ISO 17025 Accredited Laboratory in India

TCR Engineering Services is a Bureau of Indian Standards and NABL accredited laboratory. NABL approval is from Department of Science and Technology, Government of India. NABL provides laboratory accreditation services to laboratories that are performing tests / calibrations in accordance with ISO 17025.

TCR is one of the select few test houses, in India, to be on the approved list of such organization as Bharat Heavy Electrical Ltd., Nuclear Power Corporation of India Ltd. (NPCIL), Larsen & Toubro Ltd. (L&T), Engineers India Ltd. (EIL), Toyo Engineering India Ltd., Oil & Natural Gas Commission (ONGC), Bhabha Atomic Research Centre (BARC), Vikram Sarabhai Space Centre (VSSC), Dept. of Defense, DGS&D, Indian Railways, Mumbai Municipal Corporation, Dept. of Telecommunications, Electronic Corporation of India Ltd and others.

TCR is also approved by international recognition bodies such as American Bureau of Shipping (USA), Bureau Veritas (France), Lloyds Register of Shipping (UK), Det-Norske Veritas (Norway), SGS (India) Ltd. and others.

Material Testing Laboratory Services

TCR Engineering Services' ability to provide value to our metal testing customers is based on organizing our talents into a focused set of technological capabilities. This gives us the unique ability to apply appropriate combinations of capabilities and expertise to provide multi-disciplinary solutions for our clients.

We have several testing services, but, no matter which discipline we use, one thing is certain. When you send a sample to TCR, you can have confidence in the results, because you are working with a company that has a reputation for being meticulous.

The list of services offered by TCR includes:

Mechanical and Physical Testing

Comprehensive range of Mechanical Testing with a dedicated machine shop to assist in sample preparation. Capabilities include: Tensile, Impact, Weldability, Bend, Compression, Flaring/Flattening, Hardness, Dynamic Loading, Drop Weight, Proof Load, Fasteners, Hydraulic/Pneumatic, Component Testing, and more.

Chemical Analysis

State of the art Chemical Analysis laboratory allows our expert chemists to analyze ferrous and non-ferrous metals, ceramics, glass, refractories, mineral and ferro alloys in PPB or PPM level or in percentage. Our capabilities include: Wet Chemistry, Optical Emission Spectroscopy (OES), Inductively Coupled Plasma (ICP) Spectrometer, Automatic Combustion based Carbon and Sulfur determination, Glow Discharge spectrometer for (GDS) chemical depth profiling, and more.

Positive Material Identification (PMI)

TCR Engineering's Positive Material Identification service is fast becoming an integral part of process safety management in the petroleum refining, petrochemical and electric power generation industries in India, Middle-East and Asia-Pacific. Our capabilities include: Portable Optical Emission Spectrometer and a number of Portable X-Ray Florescence (XRF) Spectrometers.

Failure Analysis and Metallography Testing

Our facilities include Optical Microscope with Image Analysis system, Micro Hardness Tester, In-situ Metallography Kits, Stress Analyzer, Dilatometer, and Electronic Polishing and Etching system. TCR can procure on-hire basis, a scanning electron microscope and an elemental analysis by EDAX.

Corrosion Testing

TCR performs a wide range of Corrosion and Stress Corrosion Tests as part of the AST, NACE or client supplied specifications. Senior staff members are available to help and advise on corrosion problems or materials selection in laboratory or on-site inspection. Routine tests undertaken to evaluate the corrosion resistance of materials to environmental corrosion, pitting corrosion, resistance of materials to stress corrosion and inter-granular attack, including HIC, and SSCC tests.

Specialized Non Destructive Testing (NDT) Services

Radiography Testing, Ultrasonic Flaw detection, Magnetic Particle and Liquid Dye Penetrant Testing, Portable Hardness detection, Ultrasonic Thickness Gauging survey and Raw Material Inspection. Residual Life Assessment (RLA) of Boilers and pressure vessels.

Locations

We welcome service and technical inquiry, from simple questions to more involved interpretations of codes and specifications. We are located at:

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Sample collection centers in India:

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