TRANS ASIA
Industrial Laboratories

MATERIAL ANALYSIS

THINK

TRANS ASIA
Industrial Laboratories

WHEN FAILURE CASES ARISE!

Trasn Aisa is a leading provider of Testing, Inspection, and NDT services on a wide range of products, materials, processes and services and products for a diverse set of end markets, where failure in service is simply not an option.

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AT TRANS ASIA

VAULUES

1.

PRECISION

Excellence lies in the details. Precision guides all we do. With care and accuracy, we meet high standards, building confidence and delivering quality for customers and each other.

2.

Quality

Quality is at the heart of who we are and what we deliver. We take pride in setting high standards and meeting them every time. Our work reflects our commitment to excellence — reliable, consistent, and built to stand the test of time. We pay attention to detail, learn continuously, and never stop improving. Quality isn't just about outcomes; it's about the integrity of our process and the pride we take in doing things right. Through this dedication, we earn trust, create lasting value, and make a meaningful impact for our customers and one another.

3.

RELIABILITY

Reliability is the foundation of trust. Being consistent, dependable, and accountable, we build confidence, strengthen relationships, and maintain a strong, lasting reputation for excellence and integrity.

ABOUT US
WE ARE TRANS ASIA

Trans Asia Industrial Laboratories (TIL), part of the Trans Asia Group, is a multidisciplinary testing and inspection facility delivering reliable, high-quality services aligned with international standards. Fully equipped with advanced technology, TIL offers Physical, Mechanical, Corrosion, Metallography, Chemical, Microbiological, Environmental, and Non-Destructive Testing (NDT) services. Our certified and accredited systems (ISO 9001:2015, ISO 14001:2015, ISO 45001:2018, ISO/IEC 17025:2017, ISO/IEC 17020:2012) ensure precision and consistency.

At Trans Asia Industrial Laboratories (TIL), we envision being a benchmark of innovation and excellence, delivering dependable, precise, and value-driven integrated solutions that meet and exceed global standards.

Committed to being the preferred partner in Laboratory and NDT testing services, TIL upholds unmatched technical expertise, superior quality, and a culture of continuous innovation. The organization embraces technological advancement and scientific progress, providing efficient and cost-effective solutions that enhance industry performance, drive sustainable growth, and foster lasting partnerships built on trust and excellence.

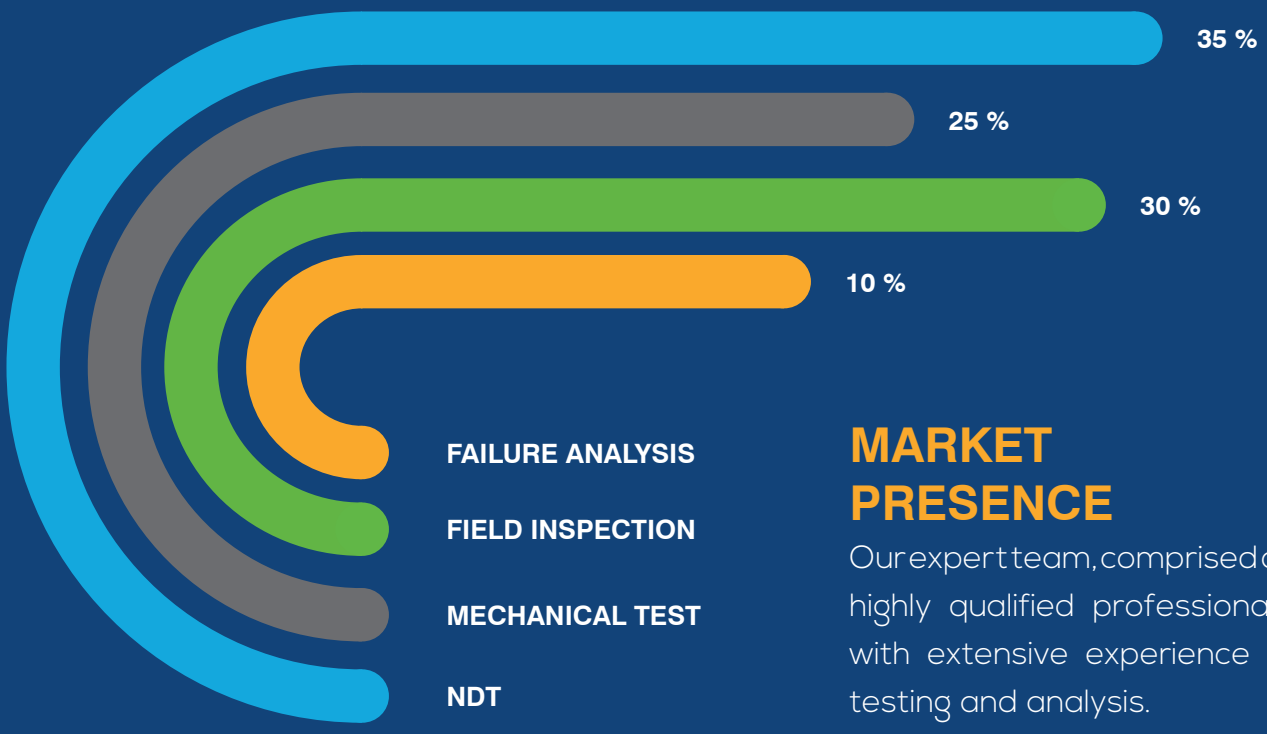
We provide reliable inspection and integrity solutions across a diverse range of industries. Our expertise ensures safety, compliance, and performance for clients operating in some of the world's most demanding environments, the clients include: Aerospace / Aviation, Automotive, Chemical, Construction, Consumer Products, Energy, Government, Industrial, Manufacturing, Military, Nuclear, Oil & Gas, Pharmaceuticals, Power Generation.

PRECISION AND EXCELLENCE

At TIL, every activity is planned to deliver high standards in commercial, technical, quality, and safety aspects—ensuring our clients receive reliable, compliant, and fit-for-purpose solutions.

WE HAVE PRESENCE IN THE MARKET

Trans Asia began in 2000 with the establishment of Trans-Asia Pipeline Services in the UAE, initially focusing on pre-commissioning services for new pipelines, such as cleaning, hydrotesting, dewatering, and drying. In 2006, the company opened a 15,000-square-meter corporate head office and operational hub in the Hamriya Free Zone, Sharjah, UAE, which included workshops, a fabrication shop, and a training center. In 2020, Trans Asia Industrial Laboratories (TIL) was founded under the Trans Asia Group to meet the growing demand for high-quality industrial testing and inspection services. In 2025, TIL expanded its capabilities with the acquisition of Al Arabiah Pipeline Testing Services in Abu Dhabi, enhancing its NDT offerings.



MARKET PRESENCE

Our expert team, comprised of highly qualified professionals with extensive experience in testing and analysis.

THINK TRANS ASIA
WHEN FAILURE CASES ARISE

Our teams of expert metallurgists, chemists, and materials scientists are internationally recognized as some of the most experienced in their field. They have decades of hands-on experience in performing root cause analysis for failures across many sectors, including Aerospace, Oil & Gas, Transportation, provide recommendations and work closely with the customer to find solutions to problems for a diverse range of products and materials.

It is the combination of our materials expertise together with our knowledge on what impact the service environment can have on a material or product, that enables us to rapidly deliver comprehensive recommendations to identify avoid resolutions and future in service failures.

THREE REASONS TO PERFORM FAILURE ANALYSIS

1

Determine the root cause of failure.

2

Prevent similar material failures.

3

Improve process, designandmaterial.

THINK TRANS ASIA WHEN FAILURE CASES ARISE

Failure analysis is a multi-faceted, holistic approach to determining how and why a material or product failed. Failure analysis is a critical aspect of product development and system improvement which not only helps us learn from the past, but helps prevent future failures.
While the root cause analysis and associated responsibility of any failure are the primary goals, the added value is provided in preventing future

Based on findings from the failure analysis process, TIL experts provide recommendations and work closely with the customer to find solutions to problems for a diverse range of products and materials. We have the combination of our materials expertise and knowledge of what impact the service environment can have on a material or a product. This enables rapid delivery of comprehensive results to identify resolutions and avoid future in-service failures.

Our multi-discipline experts are recognized as some of the most trusted in their field by providing reliable failure analysis for a variety of clients, including manufacturers, commercial intermediaries, consumers, lawyers, and insurance companies. They have decades of hands-on experience in performing failure analysis across many sectors, including aerospace, energy, transportation, construction, industrial, energy, and consumer products.

UNDERSTANDING FAILURE IN FAILURE ANALYSIS

The term "failure" can be defined as the inability of a part or assembly to perform its intended function. Whereas Failure Analysis is a process that is performed to determine the causes or factors that have led to an undesired loss of functionality. Therefore, Analysing Failures is a critical process in determining the physical root causes of problems. The process is complex, draws upon many different technical disciplines, and uses a variety of observation, inspection, and laboratory techniques.

Define the Issue
Deficiency in terms of the symptoms or indicators.

Propose a Hypothesis
List possible tests to understand nature of failure.

Gather Data
Gather series of events, history, backgroun information.

Test the Hypothesis
Validate hypohesis through tests and analysis test results.

Develop Conclusions
Describe the mechanism of failure corelating the hypothesis.

FAILURE ANALYSIS VS. ROOT CAUSE ANALYSIS

Just as failure analysis is a proven discipline for identifying the physical roots of failures, root-cause analysis (RCA) techniques are effective in exploring some of the other contributors to failures, such as the human and latent root causes.

Properly performed, failure analysis and RCA are critical steps in the overall problem-solving process and are key ingredients for correcting and preventing failures, achieving higher levels of quality and reliability, and ultimately enhancing customer satisfaction.

- DISTORTION
- FRACTURE
- CORROSION
- WEAR

These four represents

PHYSICAL FAILURE

Material failure can be divided into four types: distortion or plastic deformation, fracture, corrosion, and wear. In general, two or more physical failures occur in the same failed part.
These four categories are a convenient way to descriptively categorize and discuss failures, with the ultimate goal of understanding causes and preventing failures.

Categories

of Material Failures

These four categories represent the general forms of failure, and each form of failure may have a variety of different underlying mechanisms.

CATEGORIES OF FAILURE
GENERAL CLASSIFICATION

The physical failure of materials can be placed in one of many categories depending on the classification system.

These four categories represent the general forms of failure, and each form of failure may have a variety of different

underlying mechanisms (e.g., fatigue crack propagation in the case of fracture or galvanic effects in metal corrosion).

In general, two or more physical failures occur in the same failed part.

The root causes of the failure can be divided into three levels; physical roots, human roots, and latent roots. The physical roots can be divided into four categories: design deficiencies, material defects, manufacturing or installation defects, and service life anomalies.

The human roots include inadequate inspection and improper equipment installed. The latent roots are the cultural or organizational rules that lead to the human cause, it is not direct roots.

PRINCIPLE OF FAILURE ANALYSIS

The Principal Task of a failure analyst during a physical cause investigation is to identify the sequence of events involved in the failure. Failure analysis is a process of narrowing down the possible explanations for failure by eliminating those explanations that do not fit the observation.

PERSPECTIVE CONVERGENCE APPROACH

Like the basic process of the scientific method, failure analysis is an iterative process of narrowing down the possible explanations for failure by eliminating those explanations that do not fit the observations. Generally, a failure analyst will start with a broad range of possible explanations but over time will narrow and refine the existing possibilities.

DETERMINATION AND CLASSIFICTION OF DAMAGE

- Collect data
- Identify damage modes present
- Identify possible damage mechanisms
- Test to identify actual mechanisms that occurred
- Identify which mechanism is primary and which is/are secondary
- Identify possible root causes
- Test to determine actual root cause

STAGES AND TECHNIQUES IN FAILURE ANALYSIS

The general procedures, techniques, and precautions employed in the investigation and analysis of metallurgical failures that occur in service are summarized as follows.

The stages in Failure Analysis begin first with the preliminary steps of information gathering such as:

- Collection of background data and selection of samples
- Preliminary examination of the failed part (visual examination and record keeping)
- Non-destructive testing

The tools of failure analysis are not just test machines and analytical instruments. The tools of failure analysis include test machines and analytical instruments and also conceptual tools. Conceptual tools that are essential in determining the cause of any given failure may vary. They include various pattern recognition skills (in the interpretation of macrofractographs, microfractographs, and metallographic images) and engineering and scientific knowledge based on physical metallurgy, polymer physics, solid-state physics, stress analysis, chemistry, and many other fields.

In addition, investigations of a failure employs various tests and techniques. The list below summarizes typical protocol followed during failure investigation.

- Visual inspection and
- Proper protection of component
- NDT Test like RT, UT, MT, PT
- Optical Metallography
- Scanning Electron Microscopy (SEM)
- Energy Dispersive Spectroscopy (EDS)
- X-ray Diffraction (XRD)
- Chemical Composition
- Scale Analysis
- Hardess or Micro Hardness
- Tensile Test
- Charpy Impact Test
- Chemical and Mechanical Test
- Fractography

STAGES AND TECHNIQUES IN FAILURE ANALYSIS

These preliminary steps may then be followed by assessment of the damage and conditions leading to failure.

These stages may differ depending on whether fracture, corrosion, and/or wear conditions are being investigated. In an analysis of a fracture, the following steps are described:

- Selection, identification, preservation, and/or cleaning of critical specimens
- Macroscopic examination and analysis (fracture surfaces, secondary cracks, and other surface phenomena)
- Microscopic examination and analysis of fracture surfaces
- Stress analysis to determine the actual stress state of the failed component
- Fracture mechanics

The investigation can be thought of as a forensic puzzle. The more pieces of the puzzle that are in place, the more conclusive the test results will be. It is often tempting to ask the metallurgist to minimize the amount of testing performed to save time and money. It may also be tempting to withhold background information about the part for fear of biasing the metallurgist's final conclusion. It should be understood, however, that restricting the amount of testing and withholding important information will effectively take away pieces of the puzzle that can prove critical to achieving the correct final conclusion. If the reasons for failure are not properly understood, corrective actions to prevent future failures may be ineffective.

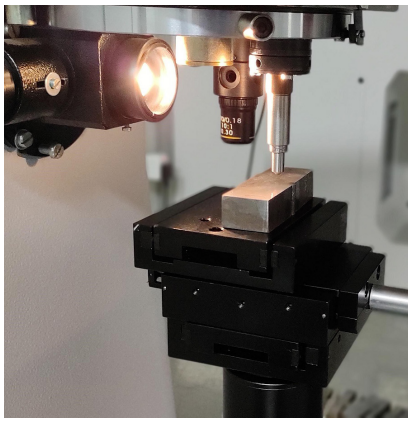
TESTING AND ANALYSIS CAPABILITIES

At Trans Asia

Our comprehensive service portfolio encompasses Laboratory Testing, NDT (Non-Destructive Testing) Solutions, Inspection Services, and PWHT (Post Weld Heat Treatment)—each designed to deliver precision, reliability, and quality assurance across various industries. We proudly serve sectors such as manufacturing, construction, oil and gas, power, automotive, aerospace, and energy.

In our Laboratory Testing division, we offer a wide range of analytical services including mechanical testing, metallurgical examination, chemical analysis, corrosion testing, and failure analysis, ensuring materials meet the highest performance and compliance standards.

TESTING AND ANALYSIS CAPABILITIES



Optical Microscope

Metallographic Analsysis

Metallography is frequently used to determine the material type, grade, or grain size, the inclusion content of a metal, test the corrosion resistance of a coating or material and provide certifications for new material or mixed batches, microstructure analysis, and failure analysis.

SEM and EDS

Material Characteriztion

SEM analysis, provides high-resolution imaging useful for evaluating various materials for surface fractures, flaws, contaminants or corrosion. Through SEM and EDX analysis, our metallurgical experts provide a thorough examination of material properties and give valuable insights of material.

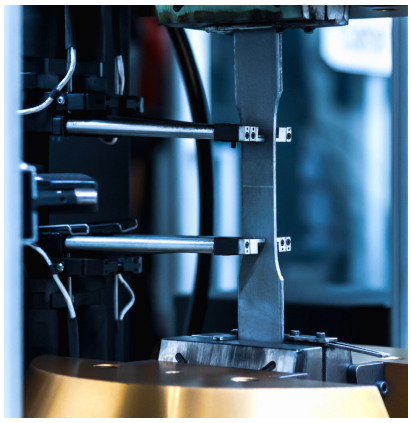
Stereoscope

Macro Topography

Stereo microscopy is used in conjunction with macro photography to closer document a fracture, weld, contamination or other feature of interest.

The stereo microscope is an optical microscope designed for low magnification (up to 80X) observation of a sample.

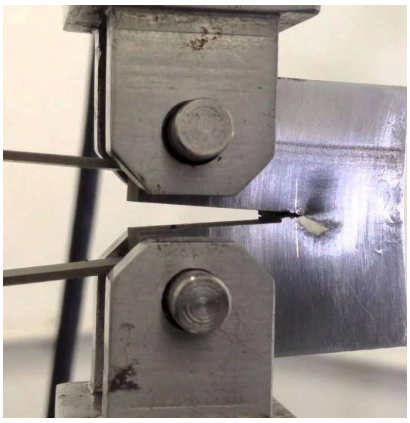
TESTING AND ANALYSIS CAPABILITIES



UTM

Tensile Test

TIL's tensile testing labs provide conditions for exposing materials to a static or slowly applied force, determining their ultimate tensile strength. We perform industry-leading tensile tests for many metallic or non-metallic materials, at applicalbe room temperature or elevated temperature.



Dynamic Testing

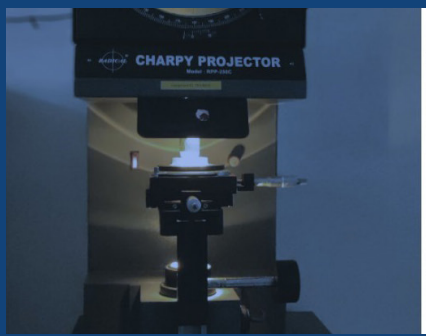
Fatigue Test

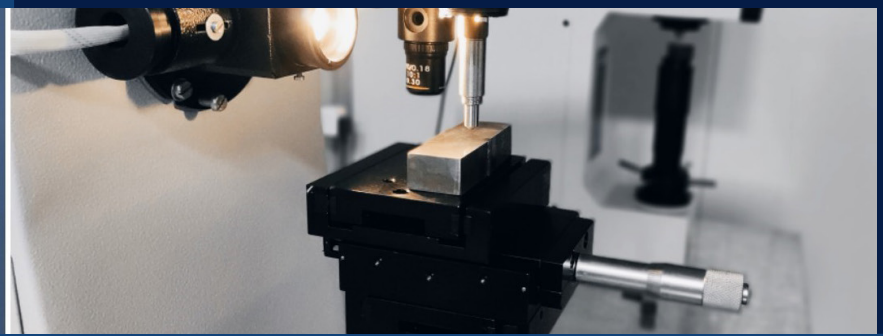
Fatigue testing characterizes material or component behavior during cyclic loading. Our test machines can help test cyclic loads for vital properties, such as fatigue failure, fatigue limit, and fatigue life. Our analytical testing services utilize cyclic loads in test machines to understand fatigue failure.

Creep

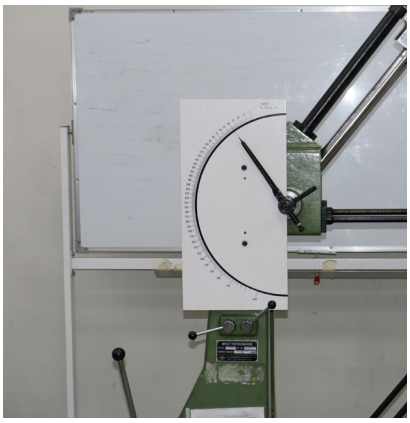
Creep Test

The tests are performed for both stress rupture and creep testing for metals, composites, and plastics to determine the long-term stress on materials. The test is performed in furnaces or environmental chambers and recorded on a graph of strain versus time to show the creep rate.





TESTING AND ANALYSIS CAPABILITIES



HV, HRC, BHN
Hardness Test

Hardness testing applies to a range of materials, both metals, and nonmetals alike, and determines how resistant a material is against deformation, penetration, scratching, or other physical force. Our experts perform hardness testing according to the requirements of the material and its applications.

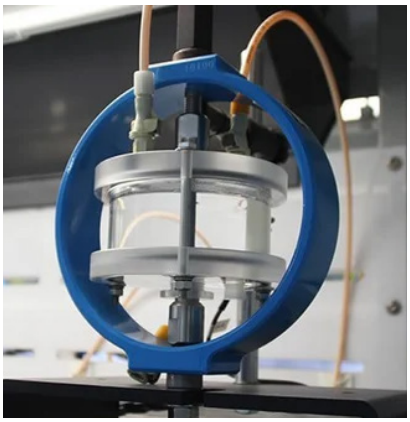
Impact
Impact Test

Impact strength tests are designed to determine the notch toughness of a material by measuring the amount of energy absorbed as it fractures. The Charpy impact test is one of the most popular techniques for determining material notch toughness and helps ensure the safety and integrity of structure.

Bend
Bend Test

These test methods cover bend testing for ductility of materials. Bend tests for ductility provide a simple way to evaluate the quality of materials by their ability to resist cracking or other surface irregularities during one continuous bend. No reversal of the bend force shall be employed during these tests.

TESTING AND ANALYSIS CAPABILITIES



SST
Salt Spray Test

At TIL, our high-capacity salt spray testing labs can test a number of test specimens of many sizes, shapes and dimensions for the Salt Spray Test. We can also accommodate the duration of the exposure for the test according to specific to customers' requirements.

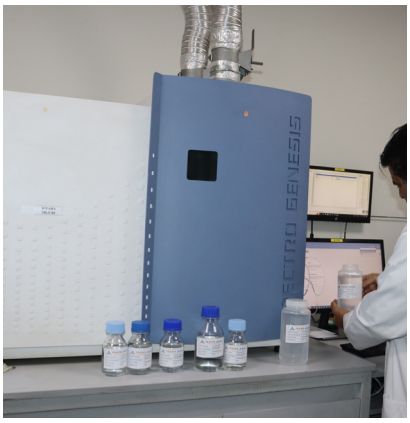
Non-Sour
Corrosion Test

Our corrosion experts follow international testing standards and protocols such as ASTM, NACE, and API. We can assist you with a wide range of corrosion testing services and evaluations, material selection, corrosion assessments, recommending efficiencies, and preventative mitigation measures.

Sour
Corrosion Test

Our sour service labs use hydrogen sulfide and other sour gases to replicate the highly aggressive conditions found in the Oil & Gas industry. TIL's specialized corrosion laboratories meet stringent international standards with a variety of traditional and advanced sour service corrosion testing.

TESTING AND ANALYSIS CAPABILITIES



OES
Chemical Test

TIL has chemical analysis laboratories across the US, Europe, and Asia, allowing you worldwide access to our trusted expertise and unique range of services. From trace metals identification to comprehensive failure analysis programs, our experts provide the certainty your project requires.

ICP-OES
Cheical Analysis

With cutting-edge ICP equipment, TIL's ICP analysis services offer effective and precise quantification and identification of elements in a wide range of materials across diverse industries and serving a variety of applications, with both high and low concentrations down to ppm/ppb levels.

ONH & CS
Analysis

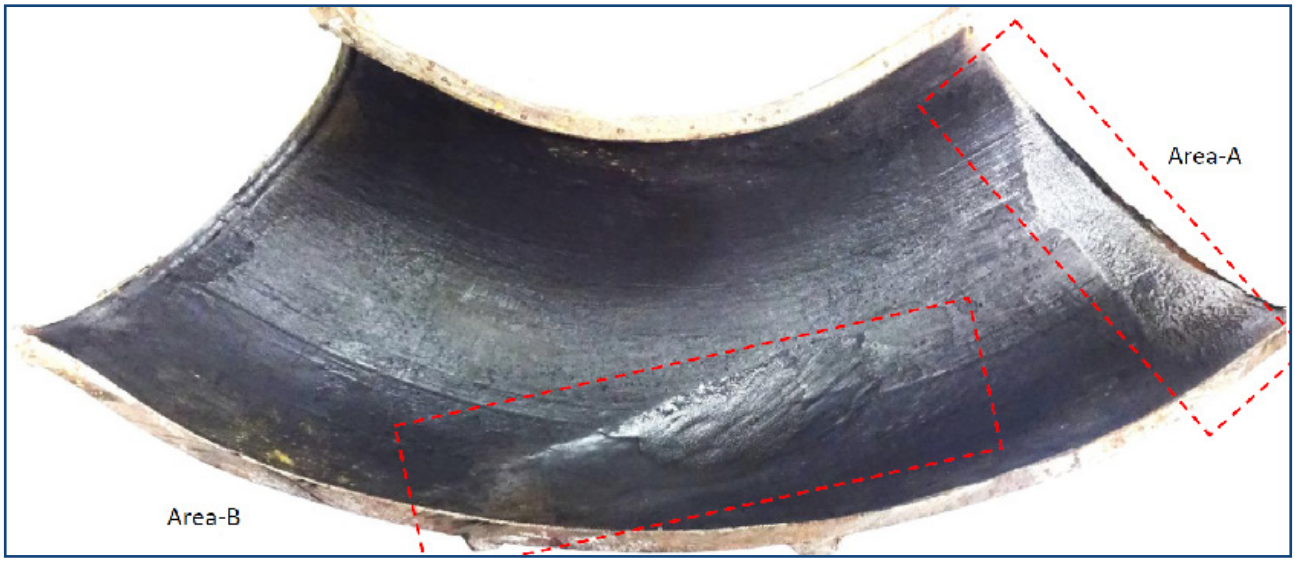
Elemental analysis using LECO and ELTRA are reliable method for determining the concentration of elements within a metallic sample, including Carbon, Hydrogen, Nitrogen, Oxygen and Sulfur. Our experts help industries to quantify these elements in their material.

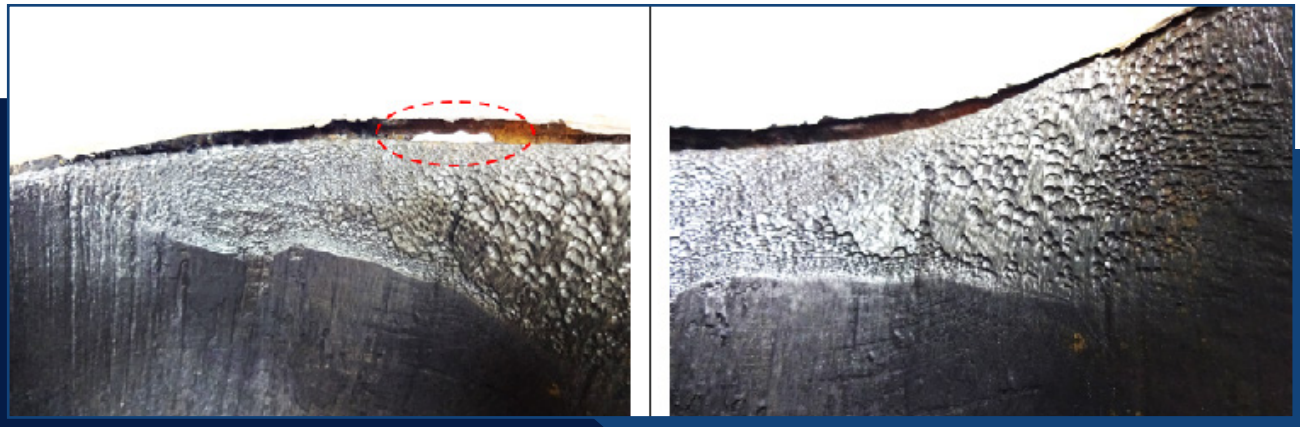
INVESTIGATED
FAILURE CASES

The high number of failure analysis cases undertaken at TIL in recent years provides testimony to technical expertise TIL hold. Various components arrive to carry out failure analysis, and each case is attended with scope of work designed for the case. The adaptive methodology embraced at TIL stretch from carrying out field studies to extensive laboratory tests that has enabled TIL to establish not only in failure root-causes but also mitigation and control solutions. Following failure cases are few examples that were investigated at TIL.

INVESTIGATED FAILURE CASES

CASE 1: FAILURE ANALYSIS ON LEAKED ELBOW FROM CONDENSATE PIPING NETWORK





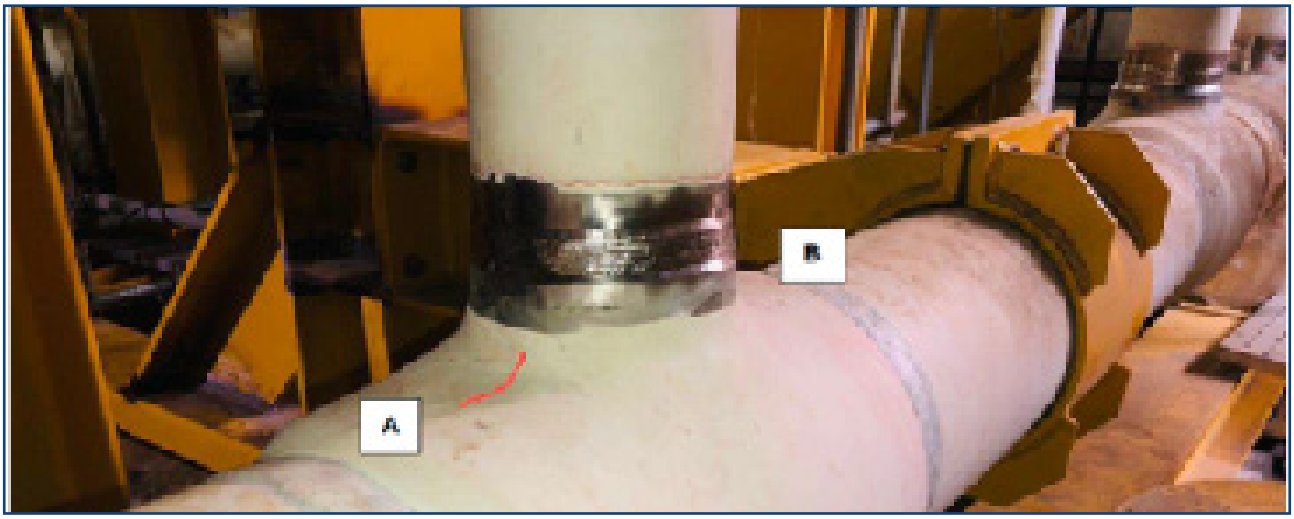
In a condensate piping network, 2 elbow and 1 equal-tee were found leaking. An Elbow – 6" Sch. Std. from the condensate piping network was sent to us for Failure Analysis, where the component had a through thickness hole at weld.

Although, the chemical composition, mechanical properties and microstructures of the elbow were typical of the grade requirement of ASTM A234 Grade WPB. However, the weld chemical composition was not found matching to the grade requirement. The visual examination and stereo-examination evidenced honeycomb-shaped cavities near the leak at damage, and general erosion-corrosion thinning at damage away from leak. The wall thickness loss of approx. 3mm was observed on the damaged area.

Based on detailed failure investigation carried out in the laboratory on the failed portion of the elbow, leakage and thinning happened due to combination of erosion-corrosion and cavitation-erosion. And the contributing factor for erosion-corrosion that led to leakage and thinning were abrasive compounds, inhomogeneity in microstructure near welding, bubble impingement at the transition near weld.

INVESTIGATED FAILURE CASES

CASE 2: LEAKAGE AND CRACKS ON SEAMLESS PIGGABLE BARRED TEE



The leakage along the crotch area of the one of the 10" x 6" barred tees on both sides of the branch during initial pressurization for hydrotest of the manifold was observed. Linear cracks on the shoulder/crotch of the barred tee were discovered on either side.

Two prominent cracks were observed in the shoulder of the barred Tee in longitudinal direction during hydro-test as a part of FAT activities. No other anomalies were observed in pipe to Tee weld joints. These two cracks were observed to be propagating near welded bar section from the inner surface of the tee and traversing to exterior surface.

Although the chemical composition of the material found meeting the grade requirement of 25% Super Duplex Stainless Steel (UNS S32760), non-conformity in mechanical properties like tensile, hardness, impact, inhomogeinity in microstructures and deviation ferrite content were reported after tests.

Based on the detailed investigations & laboratory test results, the cracks in the tee body developed because of inhomogeneity and significant presence of deleterious phases resulting in embrittlement due to improper thermal cycle exposure.

INVESTIGATED FAILURE CASES

CASE 3: FAILURE ANALYSIS ON CRACKED CS FLANGE

After welding of pipe to the flange, a crack was observed while performing inspection on the joint. Two such flanges were under failure investigation.

Although the tensile properties of one flange were found to be complying, the test result for other flange did not meet the requirement of specified grade ASTM A105. While the general core microstructure was found typical of the grade, however long interlinked embeded foreign material was observed in the microstructure at location near the crack.

The defect area was observed and characterised using SEM. And the SEM micrographs showed the disbonding of the metal matrix in the cracked region, which subsequently formed deep recess which were observed in each SEM images.

The EDS analysis confirmed the presence of predominantly O, Fe, Ca, Mn, Si, Al which constitues chemical components as oxides such as CaO, SiO2, Fe2O3, Al2O3, MnO, FeO. There chemical components are prevalent in steel slag.

So the defect was primality foreign material, deemed to be slag, the brittle nature of foreign material, made the flange susceptible to cracking under stress condition.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