



Add value.  
Inspire trust.

## Failure analysis

Single-source solutions for investigating the root cause of failure

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### Your challenges

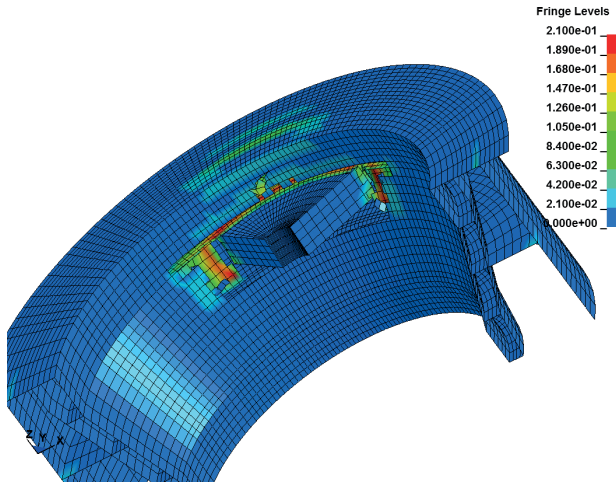
When vital components and structures fail, determining the root cause can be a challenge for manufacturers and operators. Product failure occurs due to any number of reasons including design flaws, manufacturing or material defects, and wear and tear. Misuse or abuse during transportation, on-site storage and chemical cleaning before commissioning and operation may also lead to product failure.

Correctly detecting the root cause of failure requires an experienced failure analyst who can identify the evidence, analyse the observations and use logic inference to come to the right conclusions. Manufacturers and operators may lack the expertise and capabilities to correctly assess the root cause, making it difficult to prevent similar product failures in the future. Failure analysis is also necessary for manufacturers

and operators to learn about the flaws in their design process, manufacturing processes, material properties, installation/assembly processes or actual service conditions. Ineffective or non-existent failure analysis will impede them from making improvements and developing new products.

### What is failure analysis?

Failure analysis is a comprehensive investigation to determine failure mechanisms and root causes. It shows the differences between a component's actual and requested profile. Through this methodology, conclusions are derived regarding the component's behaviour in operation as well as remedial measures. The root cause analysis procedure involves collecting and analysing the data, developing appropriate corrective and/or preventive action, presenting the data clearly and generating a practical recommendation.



### Why is this service important for your business?

Failure analysis detects the root cause of the failure mechanism and recommends preventive measures to avoid repeat occurrences. Regardless of whether you are a manufacturer or an operator, failures that contribute to downtime can affect your business operations and profitability. In worst-case scenarios, failures may even pose a risk to employees, the public and the environment, possibly resulting in reputational damage and lawsuits.

### How can you prepare for failure analysis?

In the event of a failed component or structure, contact TÜV SÜD as soon as possible. It is important to keep the site of the failure in its original condition and prevent any mechanical, thermal or chemical disturbance. You will also have to prepare accurate background information on the failure including service history, working conditions, operation/maintenance records, material specification, relevant drawings and a brief write-up of the event. After consulting with our experts, it may be necessary to provide relevant information such as drawings in overview and detail, process charts, operation conditions, operating data, specifications of the materials involved, as well as the history of the failure and the component's lifetime.

### How can we help you?

As an experienced provider of failure analysis services, TÜV SÜD combines many related fields under one roof. Our expertise includes materials science and engineering, mechanical calculation, construction, process and system engineering, metallographic and chemical investigations, and electronics/biochemical/

electrical/acoustic/surface analyses. We offer statements on the root cause of failure for rehabilitation, repair, prevention of future failure and solutions to interdisciplinary problems. Our services also serve to prevent similar failures, provide early warning of catastrophic incidents and reduce costs associated with unexpected shutdowns. By avoiding hazardous accidents and improving quality and safety, TÜV SÜD helps to protect your company's reputation.

### Our services

#### ■ Failure analysis

In addition to determining the mechanism(s) and root cause(s) of the failure, we also recommend preventive measures to prevent recurrence of the failure and provide technical support in dispute cases, including expert testimony in court.

#### ■ Materials-related evaluation

TÜV SÜD offers materials expertise covering materials selection, evaluation on conditions of important devices, comparison of different processes, corrosion evaluation and protection, and weld quality evaluation. Our experts also provide risk assessment for special failure mechanisms such as hydrogen embrittlement, stress corrosion cracking, pitting corrosion and degradation of polymeric materials.

#### ■ Troubleshooting

We provide troubleshooting services for industrial processes such as:

- Plating processes
- Heat treatment processes
- Injection moulding processes
- Casting, forging and stamping processes
- Soldering, brazing and welding processes
- Assembling processes
- EDM processes

#### ■ Evaluation (Metallurgical and Mechanical-Technological)

Our evaluation services include metallurgical tests such as PCB cross-sectional examination, SEM/EDX examination on coatings, metallographic examination, particle size distribution testing, X-ray radiography, X-ray CT, airworthiness welding qualification testing (AWQT) and over-temperature testing for aerospace (HPT, HPC blades). We also provide mechanical-technological tests such as tensile tests, bending tests, impact tests and hardness tests.





#### ■ **Training**

TÜV SÜD offers training courses for failure analysis as well as corrosion engineering. Our experts also provide guest lectures on failure analysis at universities.

#### ■ **Investigated components and structures**

- **Power generation and supply:** gas & steam turbine components, boilers, generator rotor shafts, boiler/waste heat boiler components, eco-components, electricity distribution station equipment, transformers, submarine power cables, switch gears, contactors, etc.
- **Renewable energy:** assembly group & components such as solar assembly, wind turbine main bearing & gearbox bearing, etc.
- **Oil & gas:** drilling equipment, offshore rigs, oil tankers, etc.
- **Petrochemical:** high-T & high-P devices, tanks, pipes, heat exchangers, etc.
- **Real estate and infrastructure:** crane booms, lifts, cable car systems, piling machines, tempered glass panels, gas/water pipes, etc.
- **Rail:** rails, conduction rail system, OCS system, power cables, message cables, train structure, etc.
- **Aerospace:** various aircraft engines, landing gear, engine starters, exhaust nozzles, engine mounts, helicopters, etc.
- **Marine:** various submarines/ships, hovercraft engines, propellers, gearboxes, port structures and equipment, ship-lifting systems, offshore structures, etc.
- **Medical:** stainless steel guide wire for heart operation, laryngeal mask, surgical implant, etc.

- **Electronics:** IC chips, MLC, Ta-capacitor, PCBA, wafers, thermal printers, etc.

### Your business benefits

- **Ensure availability and safety** – through qualified inspections using modern inspection technology.
- **Minimise risk** – by identifying quality problems early on to reduce the risk of time-consuming and expensive rework as well as legal liabilities that lead to reputational damage.
- **Benefit from an expert partnership** – providing experience in failure analysis to support your projects.
- **Draw upon global support** – with TÜV SÜD's strong international and regional presence, providing a high level of knowledge in most markets, backed up by local expertise.
- **Protect your reputation** – with technical support in legal disputes (including court cases) and identification of root causes of problems in product quality cases.

### Why choose TÜV SÜD?

TÜV SÜD is renowned internationally as an independent third-party provider of premium solutions. We obtain unfiltered information for clients and offer them reliable and realistic reports as a solid basis for making decisions. Our international experience makes us an ideal partner that is capable of supporting your global operations by delivering premium quality services in local markets throughout the world.



Our multidisciplinary team of failure analysis experts possesses a wealth of experience and capabilities across various industries including aerospace, marine, power generation, oil and gas, petrochemical, electronics, construction and medical health services. We hold an array of national and international approvals and accreditations such as DIN EN ISO/IEC 17025 and DIN EN ISO/IEC 17020, making us one of the world's most highly respected Certification Bodies.

### Add value. Inspire trust.

TÜV SÜD is a trusted partner of choice for safety, security and sustainability solutions. It specialises in testing, certification, auditing and advisory services. Through

more than 25,000 employees across over 1,000 locations, the company adds value to customers and partners by enabling market access and managing risks. By anticipating technological developments and facilitating change, TÜV SÜD inspires trust in a physical and digital world to create a safer and more sustainable future.

### Related services

TÜV SÜD provides the following related services:

- Plant status assessment
- Rehabilitation management
- Non-destructive testing for industrial plants and systems

### Our ASEAN offices

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