

Root Cause Failure Analysis (RCFA)

WHY SGS?

We are the world's leading Testing, Inspection and Certification company. We are recognized as the global benchmark for quality and integrity. Our 96,000 employees operate a network of 2,700 offices and laboratories, working together to enable a better, safer and more interconnected world.

WHY RCFA FROM SGS?

We have highly experienced staff, specialized laboratories equipped with state-of-the-art analytical equipment, unrivaled resources and proven expertise to help you:

- Perform root cause analysis and define responsibilities.
- Avoid future occurrences of failures and improve performance through failure prevention.
- Gain rapid and accurate results by different methods such as physical and chemical analyses, mechanical testing, metallography and welding tests from our fully equipped testing laboratories.

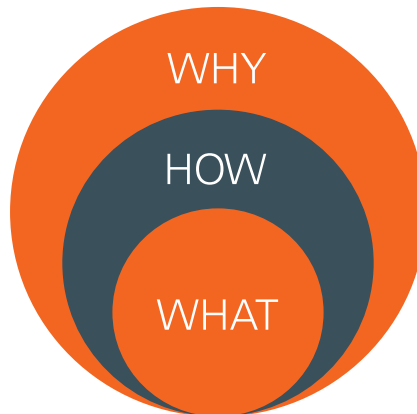
As a world leader in failure analysis and failure prevention, we are the first choice for clients in every industry across the world. Having successfully identified the causes of failure in over 1,000 investigations per year, we offer you unrivaled expertise.

Our technical experts are highly qualified engineers with PhD or Masters Degrees in mechanics, material science (metals and polymers), physics, electronics and chemistry. As a result, they offer you industrial skills, local accreditations and extensive experience in a variety of failure analysis techniques. That is why we act as advisors to the legal and insurance community and provide expert testimony in cases of civil litigation.

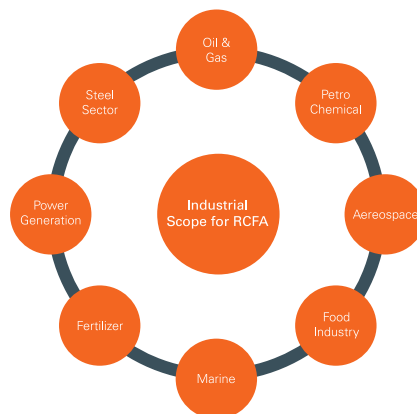
WHAT IS ROOT CAUSE FAILURE ANALYSIS?

Root cause failure analysis is one of the most effective tools for pinpointing and solving failure issues efficiently and accurately. It is a simple and discipline process used to investigate, rectify and eliminate equipment failure. RCFA requires investigators to look beyond the solution to immediate problem and understand the root cause(s). RCFA is mainly connected to four basic questions:

- What is the problem?
- How it happened?
- Why did it happen?
- What will be done to prevent it?



DIVERSIFIED INDUSTRIAL SCOPE OF RCFA



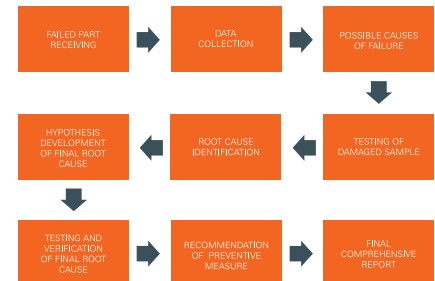
NEED FOR ROOT CAUSE FAILURE ANALYSIS

When an industrial asset failed to perform properly due to occurrence of any damage or failure then we need to know the root cause(s) of failure for which we perform RCFA. This study takes you beyond from just "why it fails" but it also tells you what weakness is in your management system.

SGS is committed to provide our clients with cost-effective, practical and timely solutions that improves the safety and reliability of their assets.



SGS APPROACH TO RCFA METHODOLOGY



SGS INVESTIGATION TOOLS

Mechanical tools/techniques:

The mechanical properties of materials are the best indicators of its past history. Extensive/extended use of an item can drastically alter its mechanical properties, and potentially lead to its failure. SGS provide a complete range of mechanical tool tests that includes:

- Tensile test
- Hardness test
- Impact test
- In-situ hardness test
- Bend test
- Compression test

Metallurgical tools/techniques:

Metallurgy and material's experts combined with a fully equipped metallurgical lab, make our investigations more searching, in-depth and reliable. Our laboratory is equipped with tools to deliver vast scope:

- Scanning electron microscopic analysis
- Fractography examination
- Metallographic analysis
- In-situ metallography analysis
- X-ray diffraction examination
- Grain sizing determination
- Ferrite content determination
- Carburization/decarburization depth analysis
- Micro hardness testing
- Inclusion rating

CHEMICAL TOOLS/TECHNIQUES:

Chemical contents are the major

governing factor in any material's failure. Minor changes in chemical composition can significantly alter the behavior of a material. To determine the chemical content of metals we provide:

- Optical Emission Spectroscopy (OES)
- Positive Material Identification (PMI)
- Wet chemical analysis
- Metal gas analysis

NDT tools/techniques:






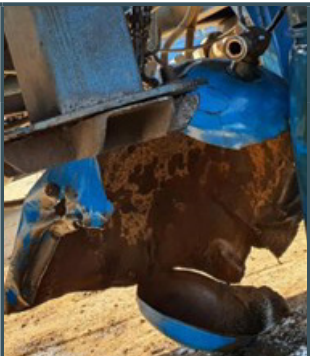
SGS has the knowledge, expertise and experience to perform Conventional and Advanced Non-Destructive Testing (NDT) around the world, it includes:

- Time of Flight Diffraction (TOFD)
- Corroscan
- Positive Material Identification (PMI)
- Alternating Current Fields

Measurement (ACFM)

- Leak Testing
- Thermography
- Electromagnetic Testing (ET)
- Remote Field Eddy Current (RFEC)
- Internal Rotary Inspection System (IRIS) Radiation detection Remote Visual Inspection (RVI)
- Videoscapy Inspections

SGS RCFA Case Studies:

<p>Fracture of raw mill main drive motor shaft</p> <p>Sudden fracture shaft was observed of raw mill main drive motor due to fretting fatigue during operation.</p>		<p>Fracture analysis of ground screw</p> <p>Material of screw was observed as hot dip galvanized, after five years of service severe deterioration/ corrosion failures of ground screw has been observed.</p>	
<p>Fracture of centrifugal pump drive shaft</p> <p>The failure was caused by high cycle low stress fatigue which was initiated at subsurface high stress concentration areas at outer periphery due to misalignment of shaft, resulted in unsymmetrical torsion stresses on shaft.</p>		<p>Failure Analysis of Ruptured Boiler Tube</p> <p>Based on the investigation carried out through chemical, mechanical, metallographic and forensic results, the main reason of this failure was overheating of a pipe in boiler.</p>	
<p>Failure analysis of crankshaft of engine</p> <p>Failure investigated was due to metallurgical defect of material, which could be attributed to inadequate processing of crankshaft.</p>		<p>Failure investigation of air storage tank</p> <p>Based on the investigation carried out the failure of the air tank occurred due to synergic effect of thinning (generalised corrosion), pitting and cavitations (MIC damage) along with improper/ inadequate inspection and testing.</p>	

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