



SOUTHWEST RESEARCH INSTITUTE

## Failure Prevention for Structural Components

Using systematic failure analysis, Southwest Research Institute® (SwRI®) isolates the causes of catastrophic failures of components and makes recommendations to prevent costly recurrences. SwRI has specialized failure analysis expertise in the power generation, aerospace, petrochemical, manufacturing, transportation, and medical industries.

### Failure Prevention

Failure investigations help clients prevent future failures, extend component service life, and establish inspection intervals. SwRI conducts analyses to:

- Determine the causes of failures
- Identify design and operating deficiencies
- Improve reliability and safety
- Lower operating costs
- Provide impartial, unbiased evaluations

### Primary Failure Mechanisms

SwRI engineers have extensive experience in identifying failure mechanisms including:

- High- and low-cycle fatigue
- Stress corrosion cracking
- High-temperature degradation
- Brittle failure mechanisms
- Fretting and wear mechanisms
- Welding defects
- Petrochemical corrosion mechanisms

*Stereomicroscopy reveals features on the fracture surface of a bolt that failed due to hydrogen embrittlement from improper plating procedures.*

*Fracture surface analysis is a critical part of many root-cause failure investigations. During the failure sequence of a wire rope, abrasion damage to the left-most wire strand resulted in the tensile failure (and characteristic cup-and-cone fracture features) of the remaining two strands.*

1 mm

*SEM imaging and X-ray spectroscopy show the distribution of chemical species in a damaged metallic overlay coating on a turbine blade.*

## Facilities and Equipment

SwRI's mechanical and materials engineering laboratories include:

- Two scanning electron microscopes (SEM) for fractographic and metallographic analysis
- Two energy-dispersive X-ray spectrometers (EDS), coupled to each SEM, to identify elemental composition of materials
- Powder X-ray diffractometer for crystallographic analysis of materials and deposits
- Scanning Auger microprobe spectrometer to characterize surface and interface chemistry
- Scanning-tunneling and atomic force microscopes (STM/AFM) for analysis of nanoscale surface topography
- Metallographic imaging equipment for heat treat verification, microstructural examination, and material characterization
- Bulk, micro, and nano hardness testing capability
- Portable microscope, hardness testing unit, and replication kit for field investigations
- Fully equipped mechanical testing laboratory, including 40 closed-loop, servo-hydraulically controlled mechanical test systems
- Two profilometers for surface roughness measurements
- Micro-computed tomography (microCT) system for high-resolution inspection and reconstructive imaging of polymeric, metallic, and ceramic components
- Autoclaves for high-pressure and high-temperature corrosion investigations
- Raman spectroscopic imaging and microanalysis system for spatially mapped compositional analysis of materials
- HEPA filtrated metals lab and hot cells capable of handling multicurie specimens

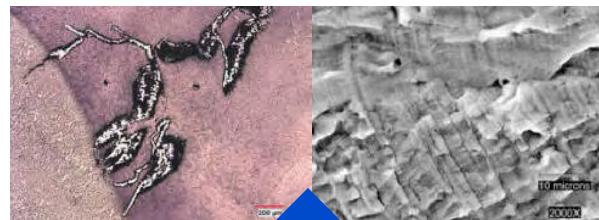
## Additional Services

When investigations require in-depth studies of failure mechanisms, SwRI applies:

- Finite element analysis
- Damage tolerance analysis
- Life extension prediction
- Mechanical testing
- In-service condition assessment
- Nondestructive evaluation
- Maintenance optimization
- Design/redesign



Using a scanning electron microscope coupled with an energy dispersive x-ray spectrometer, SwRI can perform fractographic analyses of materials while evaluating chemical compositions of discrete areas on the sample.



SwRI engineers often identify corrosion mechanisms and fatigue when conducting metallurgical failure analysis. The photomicrograph (left) shows branched intergranular cracking and selective phase attack in a nickel-aluminum-bronze flange fitting from an offshore platform firewater system. The SEM fractograph (right) shows fatigue striations on a 7075 aluminum airframe component.

## We welcome your inquiries.

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## SOUTHWEST RESEARCH INSTITUTE

Southwest Research Institute is a premier independent, nonprofit research and development organization using multidisciplinary services to provide solutions to some of the world's most challenging scientific and engineering problems. Headquartered in San Antonio, Texas, our client-focused, client-funded organization occupies 1,500 acres, providing more than 2.3 million square feet of laboratories, test facilities, workshops, and offices for more than 2,700 employees who perform contract work for government and industry clients.

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