



EXPERT FAILURE ANALYSIS SERVICES

Working for Power, Petrochemical, Refining and Other Industries

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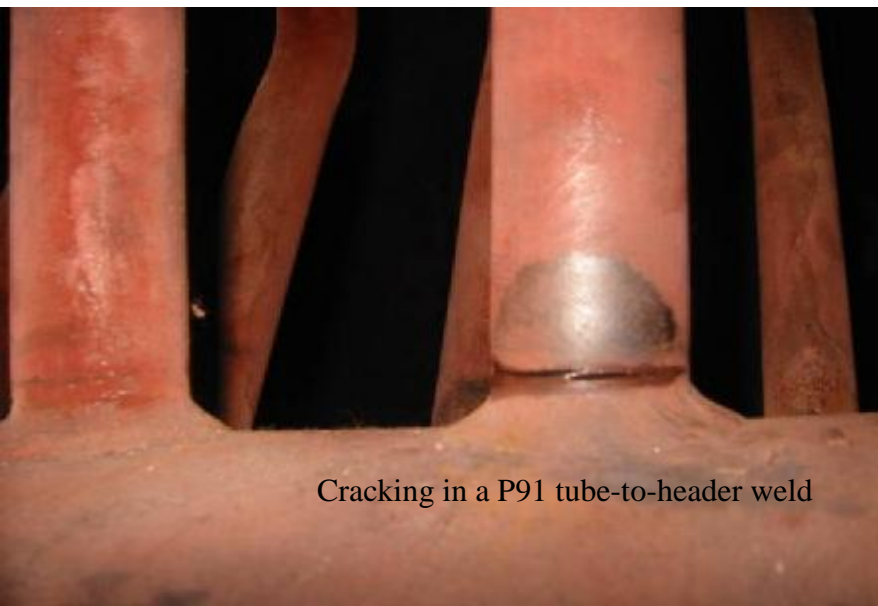
To complement its many services in high temperature plant condition and life assessment technologies, European Technology Development (ETD) also offers a comprehensive failure analysis service aimed at the identification of the damage and failure mechanism (s) (creep, fatigue, corrosion, metal dusting etc.), diagnosis of the *root cause* of failure, and making *recommendations* that will minimize the risk of repeat failures.

ETD has a highly qualified team of metallurgists, mechanical engineers and corrosion specialists with experience in the analysis of component failures in power plant boilers and turbines, oil refineries, petrochemical and process plant, offshore oil & gas, aerospace and other industries, and for a wide range of materials - from plain carbon and low alloy ferritic steels to 9-12%Cr martensitic steels (such as P91), stainless steels, nickel-base alloys and aluminium alloys.



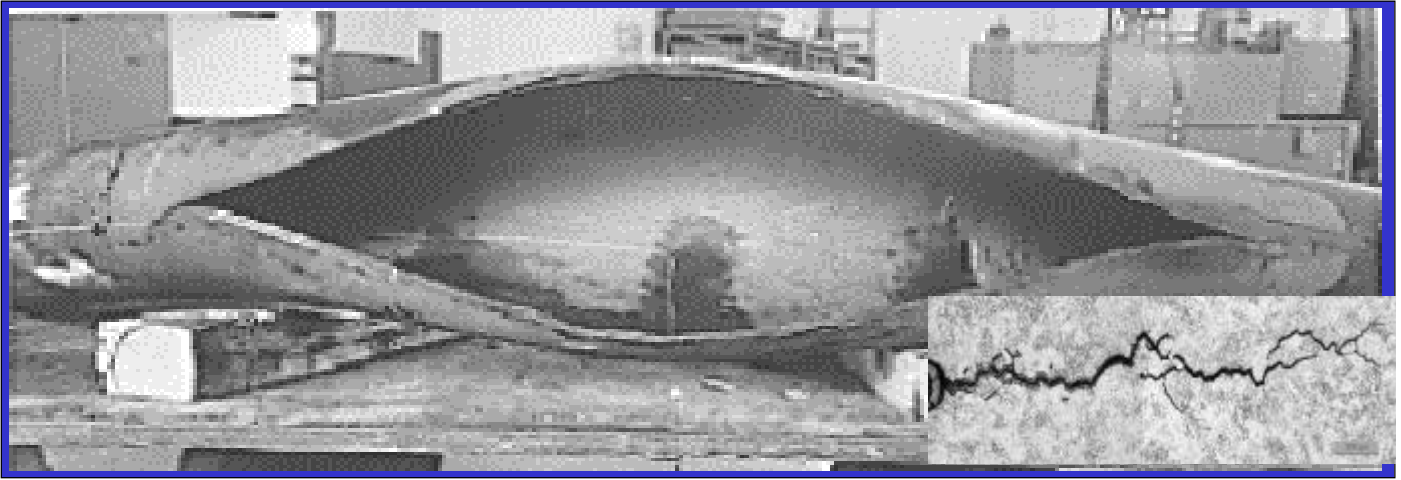
Component failures can be caused by a multitude of factors such as inappropriate material selection, deficiencies in component design, incorrect heat treatment, manufacturing defects, quality assurance problems, welding defects, inappropriate operating parameters, and maintenance and inspection issues.

ETD's team of specialists have the expertise to understand the interactions between the failure



Cracking in a P91 tube-to-header weld



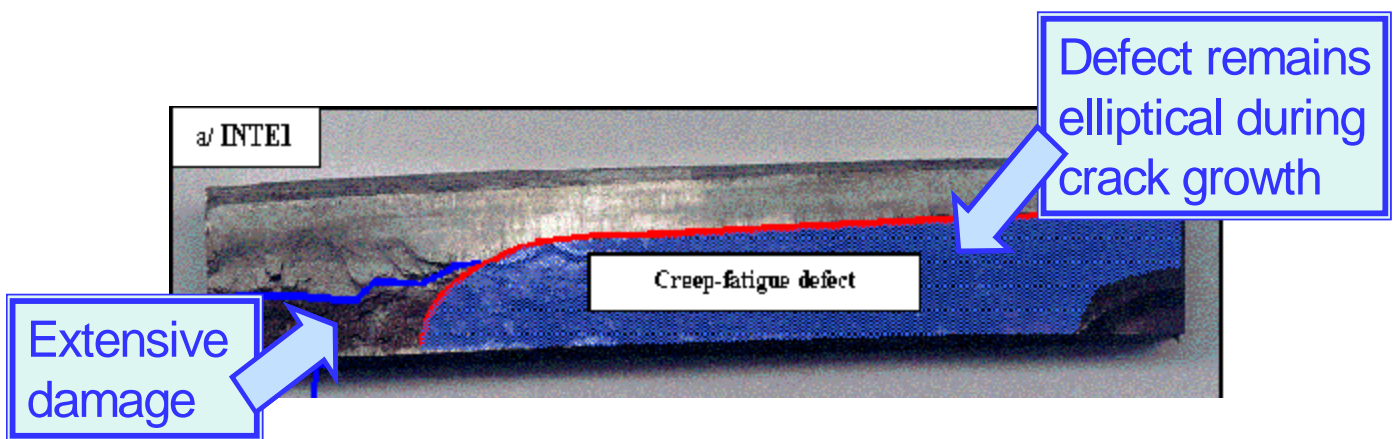


mechanism(s) and the material, design, operation and maintenance issues, to identify the **root cause** of failure and thus to make **recommendations** that will prevent similar damage and repeat failures in the future.

Recommendations may concern material selection and improvements in component design, quality assurance issues in manufacturing and welding, selection of weld consumables and welding process/parameters, and operating & maintenance practices.

condition and conformance to specifications.

To support the findings of the failure investigation, ETD's Structural Integrity team can perform stress analysis, including Finite Element modelling, to establish actual stress levels that may have caused the failure to the complex component geometries and loading situations. Similarly, fracture mechanics methods can be applied retrospectively, using material properties data, to estimate the cracking rate and time to failure for correlation with the actual observations.



As part of an effective failure investigation, ETD staff may analyse the component operating conditions, maintenance and inspection history, as well as providing expert examination of the failed component/ equipment using proven techniques. A combination of visual examination, Optical, Atomic Force and Scanning Electron Microscopy, as required, may be used to determine the damage and failure mechanism(s). Microstructural examination, chemical analysis and mechanical testing, as appropriate, are used to assess the material

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