



**RUBIG**  
DRIVING SUCCESS

## Competence Center

Failure Analysis, Materials Examination,  
Research & Development, Seminars & Training Courses

[www.rubig.com](http://www.rubig.com)

Practical experience shows that any error that can theoretically happen will eventually occur and will repeat itself, unless something is done to address the causes of the error. Therefore, it makes sense to systematically identify the causes of errors and to consistently eliminate them. Damage is undoubtedly an annoying event. Therefore, any damage that has already occurred should be taken as an opportunity for meaningful and targeted improvement, accompanied by a systematic failure analysis. Expensive emergency solutions, as well as impractical or excessive measures can be avoided with the help of professional failure analysis.

# FAILURE ANALYSIS

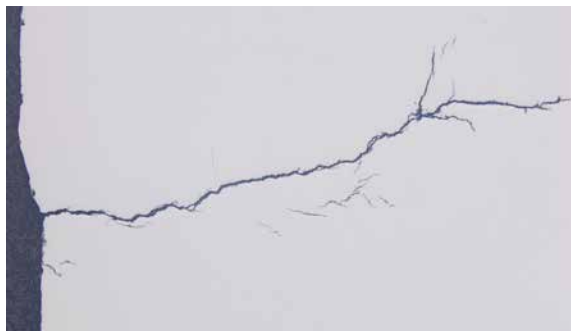
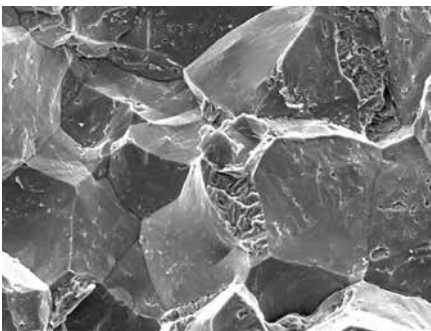
RUBIG identifies failure mechanisms, determines the causes of damage and deduces necessary and practicable measures to prevent damage.

## FAILURE ANALYSIS AT RUBIG:

- ▲ Characterising material, process or application-related failure on metallic components and tools
- ▲ Identifying the causes and deducing suitable, appropriate and practicable prevention measures
- ▲ Assessing and containing potential weak points in component development, after component tests, or as a preliminary test for estimating risks

## YOU BENEFIT FROM:

- ▲ Professional, unbureaucratic and rapid assistance in case of damage
- ▲ Failure analysis reports are understandable, clear, comprehensible, precise and both solution-oriented and practice-based
- ▲ Proposals for targeted, integrated and practicable remedial measures
- ▲ Mutual definition of optimal production processes
- ▲ Competent support in case of claims and complaints
- ▲ A basis for improvement measures and further development



RUBIG offers its expertise and wealth of experience in the field of material and component characterisation as a service. Material tests and examinations are carried out according to the applicable standards and the highest international norms in addition to special tests. RUBIG's regular customers appreciate our in-depth, meticulous – but still rapid, unbureaucratic and practical handling.

# MATERIALS EXAMINATIONS

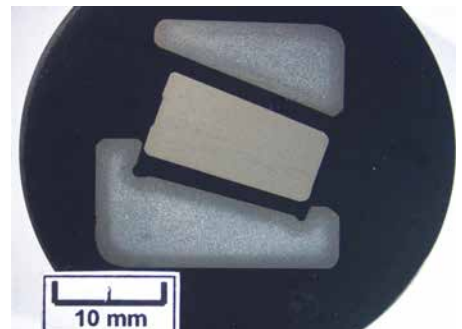
RUBIG tests and characterises the material and heat treatment condition of your components for the required quality certificates, or as competent support in the planning and development phase of new components.

## MATERIAL TESTING AND TESTS AT RUBIG:

- ▲ Conformance verifications and series-related laboratory assessments of components with known specifications
- ▲ Determining and assessing the as-found condition of material, manufacturing process and heat treatment performed on components without knowledge of their specifications
- ▲ Testing methods (overview only):
  - ▲ Mechanical-technological tests (hardness testing, tensile testing, etc.)
  - ▲ Chemical analyses (opt. emission spectroscopy, EDX microanalyses)
  - ▲ Microstructure characterisation
  - ▲ Metallurgical examinations of welds (hardness, microstructure, etc.)
  - ▲ Corrosion tests (atmospheric tests, electrochem. corrosion tests)
  - ▲ X-Ray measurements (residual stress, retained austenite)
  - ▲ Wear tests, tribological tests (scratch tests, tribometer tests)

## YOU BENEFIT FROM:

- ▲ In-depth support and recommendations on the most technically and economically suitable types of testing and inspection for your task
- ▲ Conformance verifications of material condition and heat treatment quality, e.g. to ensure the required acceptance and release of your components
- ▲ Statements on the as-found condition of material, heat treatment and production for components for which no specifications are available, as well as information regarding processing or usage properties



Close cooperation with material manufacturers, research institutions, technical colleges and universities enables us to incorporate the latest knowledge about materials and their processing possibilities into our daily activities. The resulting theoretical knowledge and practical experience make RUBIG a centre of excellence when it comes to components and tools made of metallic materials.

# RESEARCH & DEVELOPMENT

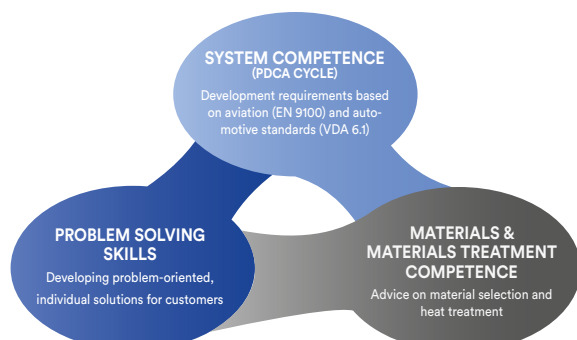
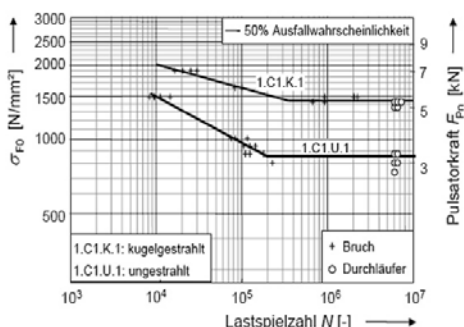
RUBIG draws on its many years of expertise to optimise your components and find the perfect combination of material, production and heat treatment for your component.

## RESEARCH & DEVELOPMENT AT RUBIG:

- ▲ Developments according to automotive and aviation requirements
- ▲ Many years of expertise in the development and optimisation of heat treatment processes in different sectors
- ▲ Development of heat treatment processes for new parts or for technical and economic optimisation of existing components
- ▲ Competent advice, support and coordination of large-scale projects – from planning to sampling and serial implementation of heat treatment on a production scale
- ▲ Close cooperation with steel manufacturers and research institutions

## YOU BENEFIT FROM:

- ▲ Extensive know-how regarding the heat treatment of different steel grades
- ▲ Advice and support regarding the design of components with regard to
  - ▲ Drawing specifications, target values
  - ▲ Design
  - ▲ Material selection
  - ▲ Manufacturing
  - ▲ Heat treatment
  - ▲ Testing
- ▲ Process developments in production facilities ensure a rapid transfer of the development results to series treatment



# SERVICES AT A GLANCE



## FAILURE ANALYSIS

- ▲ Cracks and fractures (fractography)
- ▲ Corrosion and wear
- ▲ Combinations: hydrogen embrittlement, stress corrosion cracking, surface fatigue due to fretting corrosion, bearing damage, etc.

## LIGHT MICROSCOPY

- ▲ General microstructure, heat treat microstructure, material defects
- ▲ Specific metallography, e.g.:
  - ▲ Layer thickness measurements (e.g. ISO 18203, DIN 30902)
  - ▲ Determining degree of cleanliness (DIN 50602)
  - ▲ Determining grain size (ISO 643, ASTM E112)
  - ▲ Characterisation of banding orientation (e.g. for forged parts)

## SCANNING ELECTRON MICROSCOPY (SEM)

- ▲ Characterisation of surfaces, fracture surfaces, corrosion and wear damage
- ▲ EDX microanalysis of selected microscopic areas

## HARDNESS TESTING

- ▲ Hardness testing according to
  - ▲ Vickers (EN ISO 6507, ASTM E92/E384)
  - ▲ Brinell (EN ISO 6506, ASTM E10)
  - ▲ Rockwell (EN ISO 6508, ASTM E18)
  - ▲ Portable hardness tests (DIN 50157, DIN 50159)
- ▲ Instrumented indentation testing / nanoindenter (EN ISO 14577), e.g. for hard coatings
- ▲ Vickers hardness profiles
  - ▲ to determine hardness depth (ISO 18203): CHD, NHD, SHD
  - ▲ to determine the hardness distribution across welding joints

## TENSILE TESTING

- ▲ on round samples, at room temperature, according to method A or B (EN ISO 6892-1, ASTM E8/E8M)
- ▲ incl. sample preparation
- ▲ tensile tests on components (e.g. screws, bolts): on request
- ▲ compression tests: on request

## X-RAY DIFFRACTOMETER ANALYSIS (XDA)

- ▲ Residual stress measurement [MPa], residual stress profiles (EN 15305)
- ▲ Determination of retained austenite content [%], retained austenite profiles (ASTM E975)

## CHEMICAL ANALYSIS

- ▲ Optical Emission Spectrometry
  - ▲ to determine the type of material (if material is not known)
  - ▲ to ensure material delivery quality
  - ▲ in case of suspected material mix-ups
- ▲ Glow discharge optical emission spectroscopy (GDOES)
  - ▲ depth profile analysis for conductive and non-conductive samples
- ▲ EDX microanalyses e.g. for very small components, chips, for selected, microscopic areas, etc.

## CORROSION TESTS

- ▲ Analysis of corrosion damage
- ▲ Corrosion tests in atmospheric chambers
  - ▲ Salt spray tests (DIN EN ISO 9227-NSS or similar)
  - ▲ Condensation water tests with constant humidity (DIN EN ISO 6270-2 or similar)
  - ▲ Cyclic humidity change tests (e.g. DIN EN ISO 11997-1 cycle B, VDA 621-415 or similar)
- ▲ Electrochemical corrosion tests
  - ▲ Current density potential measurements (DIN 50918, DIN ISO 17475)
  - ▲ Electrochemical impedance spectroscopy (ISO 16773, ISO/TR 16208)

## WEAR TESTS & TRIBOLOGICAL TESTS

- ▲ Wear damage analysis
- ▲ Scratch tests (ASTM C1624)
- ▲ Tribometer test (DIN 50324, ASTM G99)

## HEAT TREATMENT TESTING & DEVELOPMENT FOR COMPONENT OPTIMISATION

- ▲ Atmospheric furnaces, vacuum furnaces, plasma furnaces, coating furnaces, deep-freeze units at laboratory or production scale
- ▲ Classic heat treatments (annealing, hardening, tempering, case-hardening/carbonitriding, nitriding/nitrocarburising)
- ▲ Special heat treatments (low-pressure carburising, hard coatings)

## SEMINARS & TRAINING COURSES

- ▲ Heat treatment of steel, especially for designers, manufacturers, work preparation and quality managers
- ▲ Online or as a classroom seminar (at RUBIG or externally)

The RUBIG Competence Center combines materials science with practical experience in processing and finishing metallic components. This enormous wealth of experience provides a valuable basis for metallurgy, material testing and the general understanding of metallic components and their load capacity — and RUBIG is happy to pass on this knowledge!



# SEMINARS & TRAINING COURSES

RUBIG shares theory and practical experience in the field of heat treatment and the use of materials and gears its seminars to the needs of design engineers, manufacturers, planning engineers and quality managers who wish to acquire such knowledge or deepen their existing knowledge.

## SEMINARS & TRAINING COURSES AT RUBIG:

- ▲ What designers, manufacturers, planning engineers and quality managers should know about steel and heat treatment
- ▲ Which of the different heat treatment processes can be used for which application
- ▲ Which technical principles should be followed
- ▲ Which standards and sources of information are available for this
- ▲ How material and heat treatment specifications should be presented in your drawings
- ▲ The perfect roadmap, from the component requirements through to the right choice of material and heat treatment
- ▲ How to avoid errors at the early stages when planning a component
- ▲ How heat treatment should be commissioned

## THE FOLLOWING KNOWLEDGE IS PROVIDED BY THE SEMINAR:

- ▲ Information on the properties and characteristic values that the individual heat treatment processes can achieve for your components
- ▲ Understanding of the issues that need to be considered when designing and manufacturing your components and when commissioning heat treatment in order to get the full performance potential from your components
- ▲ Knowing the criteria for choosing material and heat treatment of your components and understanding which drawing specifications are necessary and make both technical and economic sense
- ▲ Learn how heat treatment can be used specifically for technical and cost-effective improvements of your components and to solve problems



DIN 1.8550 / 34CrAlNi7-10

gas nitrided  
SH  $\geq$  800 HV  
NHD  $\geq$  0,25 mm

## CONTACT

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