Stress and strain

DURABILITY

IABG

Durability | Stress and strain.

Vertical dynamic structural test bench: operational strength analyses, noise detection, environmental simulation

Durability

Safety, reliability and economic efficiency are central criteria for the successful development of products and components. As part of this, durability describes their ability to tolerate static and dynamic loads without damage within the designated service life, taking relevant environmental conditions into consideration. The estimation and proof of durability plays a vital role not only in the design of all types of aircrafts and vehicles, but also in mechanical and plant engineering.

Due to the demand for lightweight construction and optimised utilisation of materials, the analytical service life prediction has become more important in recent years. In particular in the case of safety-relevant components, however, an experimental verification of the durability in the completed component is essential. Only in this way the interaction of design, material, production and environmental influences can be safely determined.

For the design and stress analysis of components, knowledge of the operational loads occurring is essential. On the one hand, these must be determined and statistically evaluated with regard to type, size, frequency, sequence and possible interaction with other loads in operation, and on the other hand the resistance of the components to these loads has to be verified.

We support our customers concerning all questions relating to the durability of their products and components. As development partner, we offer experience, gained from a long-term cooperation with different industries, in all stages of development, production and operational process – from determining the load and carrying out tests to damage analysis. With our customised experimental set-ups, we aim, in accordance with clients' requirements, to subject the test object to realistic stress conditions. We conduct and facilitate all experimental testing on our own premises by calculation with MBS, FEM, CFD and others.

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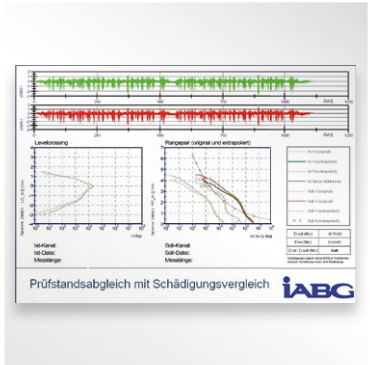
Durability testing of car bodies

Test benches for fatigue testing of bogies

Rotating bending machine

Optimization of damage-equivalent test signals from load measurements



Determining the load

- Application of strain gages, metrological instrumentation of test items
- Performance and analysis of load measurements
- Evaluation in time and frequency range
- Definition of design goals and test loads

Test programme development

- Time and cost efficient testing
- Load analysis for identifying the necessary number of test channels
- Development of test programmes
- Optimisation of test signals

Test implementation

- Design, construction, production and commissioning of test stands
- Test implementation with state-of-the-art superstructures and systems
- Test item inspection with destructive and non-destructive test methods
- Statistical planning and evaluation of test runs

Wide range of test stands

- Tension testing machines for determining static mechanical properties
- Servo-hydraulic test frames for investigation of fatigue behaviour under variable amplitude loading
- Resonance testing machines for investigation of fatigue behaviour under single- or multi step loading up to very high cycle fatigue
- Rotating bending fatigue test machines for investigation of fatigue behaviour up to very high cycle fatigue (rotary bending)
- Resonance testing machines for cyclic testing of coil springs and stabilizer bars with single- or multi step loading
- Shock absorber and air spring test stands for functional/durability testing
- Internal high-pressure test stands for cyclic testing up to 3500 bar
- Variable test setups for single and multi-axle testing of components
- Centrifugal test stand
- Hydraulic multi-axis shaker table (HyMAS) with payload up to 10 t
- Wheel and wheel bearing test stands (high-speed external drum test bench, rotating bending test machine for wheel bearings)
- Cylinder head test stand for testing of thermo-mechanic fatigue behaviour of cobustin chamber roof
- Vertical dynamic structural test bench

Failure analysis and component optimisation

- Macroscopic and microscopic and scanning electron microscopic analysis of fracture surfaces
- Component optimisation with regard to material, design, production and protection against corrosion
- X-ray test center
- Residual stress determination

Method development

- Development and optimisation of experimental and analytical methods including statistical design and evaluation of experiments
- Application-oriented and customized software solutions

Resonance spring test stand with corrosion installation (optional with climatic simulation)

Wheel testing on the highspeed external drum test bench

Functional testing with environmental simulation

Climatic environmental simulation on an aircraft door

Effects of additional influences

Our test results have to reflect reality as far as possible. In addition to the accurate reproduction of mechanical loads in the form of forces, moments or deformations, also other case-specific influences must be taken into account in order to get a safe prediction of durability under real life service conditions

Preconditioning

In order to evaluate the influence of pre-existing defects or permanent modifications caused by environmental influences, a preconditioning of the test item may be necessary.

Typical examples are

- impact treatment with grit ore loose gravel
- impact loads (e.g. impact at curb stone)
- salt fog, salt spray or contamination with other corrosive media
- exposal to increased temperature

Environmental simulation during static and cyclic testing

Environmental influences bring about changes in the static and cyclic behaviour of materials and components. We investigate and evaluate their effect on durability by simulating corresponding environmental conditions during the testing procedure, typically

- temperature
- humidity
- water
- salt mist
- salt spraying

Often a combination of prior conditioning and subsequent environmental simulation is necessary during dynamic testing.

Dynamic influences

Dynamic influences are to be taken into account when testing components such as shock absorbers or vibrating systems such as entire vehicle bodies including chassis, whose loads in operation depend substantially on inertia forces, friction and damping.

Typical tasks here are determining

- identification of natural frequencies and damping values
- functional and fatigue testing with sine, shock and random signals or real time operational loads
- advanced methods for accelerated testing with true to frequency and true to fatigue damage test signals
- advanced methods for definition of test standards for dynamically loaded components and systems (sine, sine sweep, broadband noise)

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