Test Devices Inc.

Crack Detection Services

Test Devices' patented Crack Detection System is a Real Time Rotor Health Monitoring System for Low Cycle Fatigue (LCF) testing. By monitoring the behavior of rotating test components while cycling between high and low speeds, Test Devices can detect subtle changes in dynamic stability, which can indicate a crack or other assembly problems, before they cause catastrophic failures.

We have provided crack detection as part of our testing services for over 15 years. Our process has proven highly effective for detecting cracks and other anomalies in a variety of parts.

Figure 1 – Cracks detected using Test Devices' Crack Detection system

This unique capability, combined with the experience and expertise of Test Devices personnel, has allowed customers in many industries to reduce or eliminate costly test interruptions for inspection. More importantly, it enables us to halt a test before catastrophic failure, thus preserving fracture surfaces and discovery of crack initiation site(s).

Technical Depth

Test Devices' crack detection module uses a non-contact probe to constantly monitor and measure the status of a rotating component. Test Devices analyzes this information to evaluate the distinct amplitude and phase changes of the resulting unbalance vector, and to compare it to a previously established baseline. Any small change in the mass distribution, or any relative movement of the components of the assembly, will cause a very small but detectable change in the vector. Other known crack detection systems for spin testing lack the sensitivity required to detect these minute but critical changes.

Testing Features

Continuous health monitoring
- Automated (24/7) operation (unattended testing)
- Integrated with control system to call operator or shut down in unattended mode
- Available for all LCF tests performed at Test Devices

Adjustable
- Adjustable sensitivity
- Can vary sensitivity as testing proceeds

Expertise
- Evaluation/interpretation of equipment indications
- Real time adjustments as test proceeds and/or hardware adapts
- Crack propagation studies

Flexible
- Appropriate and effective for all geometries (bladed and unbladed rotors vs. tip timing)
- Can be used without modification for high temperature or partial atmosphere testing

Equipment Features

Modular packaging
- Easily moved/used on multiple spin test machines

PC Based
- Familiar user interface
- Intuitive & easy to use

Upgradeable
- Higher sampling rates
- Additional features

Low Cycle Fatigue (LCF) Testing

Establishing the fatigue durability of a rotating component is critical to determining the safe working life criteria.

LCF failures typically result from flaws in the material (impurities or voids), poor or inconsistent manufacturing processes, complex geometries (bolt holes, scallops, blade slots, etc.) that create high-stress regions (hot spots) in the component, and/or wear between components. However, even "perfect" components have a finite life and after a certain number of cycles they fail. Although high-speed equipment manufacturers design components to have sufficient fatigue life during field operation, they cannot be certain of the durability until the predicted behavior is validated by testing under realistic conditions.

Our sophisticated spin test facilities subject components to operating loads under realistic conditions including high temperature and temperature gradients (radial/axial).

Compared to engine tests, component tests enable our customers the opportunity to economically push their critical parts up to the limit of failure. This aggressive testing provides the ability to reach the fatigue limit of critical rotating components, well before even "lead the fleet" engines. This early exposure to potential failures gives our customers time to resolve problems before they are experienced in the field.

LCF Features

- Lifing for new platforms or life extension
- 24-hour unattended operation
- Component testing & material evaluation (mini-disk)
- Heated capability (isothermal & gradient)
- Monitoring with patented "crack detection" to prevent rotor failure

Test Devices Rigs

We utilize state-of-the-art equipment to detect cracks during testing, measure elastic/plastic growth while running (at speed) and measure strain at designated points on the component, or over a region of interest.

5 Spin Test Machines

- 54" (1372 mm) diameter x 48" (1219 mm) axial depth
- 42" (1067 mm) diameter x 36" (914 mm) axial depth
- 36" (914 mm) diameter x 36" (914 mm) axial depth
- 24" (610 mm) diameter x 24" (610 mm) axial depth
- 20" (508 mm) diameter x 20" (508 mm) axial depth

Drive Options

Test Devices offers LCF spin testing using high-performance (fast cycle/low cost) drive systems.

- Air turbine & electric motor(s)
- Speed accuracy:
  +/- .01% maximum speed for overspeed testing
  +/- 1 rpm for dynamic spin testing (HCF)

Low Cycle Fatigue Testing

High-speed rotating components typically operate at both a low (idle) speed where there is low centrifugal stress and at a high (operational) speed where high centrifugal stress exists. Repeated cycling (the completion of one repetition from low speed to high speed to low speed) stresses the rotor material much like a paper clip is fatigued when it is bent back and forth in your hand (see Figure 2). This Low Cycle Fatigue (LCF) affect results in the initiation of cracks in the higher stress regions of the component, typically near bolt holes, blade slots, or other complex geometric features, which eventually lead to failure.

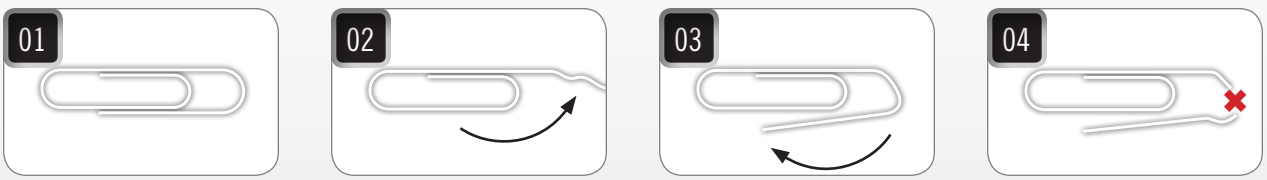

Figure 2 – Low Cycle Fatigue (LCF)

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