CASE STUDY

Biaxial Fatigue Testing for Truck Wheel Durability

Testing Time Reduced by 50% While Ensuring Accurate Real-World Stress Simulation

Industry

Automotive Component Manufacturing

Client Summary

Our client is a leading manufacturer of high-performance truck wheels, catering to both domestic and international markets. Their plant specializes in producing durable, lightweight steel and aluminum wheels for commercial vehicles, with a strong emphasis on innovation, safety, and sustainability. Utilizing advanced engineering and manufacturing processes, they meet the demanding requirements of the trucking industry, ensuring exceptional product quality and reliability.

Importance of Biaxial Fatigue Testing

- **Realistic Load Simulation:** Biaxial testing provides a more accurate representation of real-world conditions, applying stress in multiple directions simultaneously.
- **Material Insight:** Engineers gain a better understanding of material behavior under complex stress patterns, improving design safety and accuracy.
- **Fatigue Life Prediction:** The test helps predict component fatigue life, reducing the risk of unexpected failures in the field.

Challenges

Complex Stress States:

- **Challenge:** Biaxial testing involves applying loads in two different directions (e.g., tension and torsion or bending), creating a complex stress state within the material. Accurately modeling and predicting material behavior under these conditions is difficult.
- **Impact:** Understanding the interaction between these combined stresses and their effect on fatigue requires advanced analytical methods to correctly interpret the results.

Accurate Load Control and Synchronization

- **Challenge:** Controlling and synchronizing two independent loads (e.g., axial and torsional) simultaneously is critical. Maintaining precise force or strain on both axes is essential for valid test results.
- **Impact:** Any variation in applied loads could result in inaccurate data or premature specimen failure, complicating the ability to draw meaningful conclusions about the material's performance.

Tuning of PID: Critical to maintain the applied load, with setpoints achieved within defined timeframes to ensure proper test simulation.

Euro Cycle Testing: Testing is carried out following the Euro Cycle standards.

Software Used

PLC Programming: Siemens Simatic Manager Step 7

SCADA: WinCC 7.3

Project Requirements

SCADA & PLC Development: Integration of drives, load cells, and linear scales with PLC.

Automated Testing: A 99-step logic is implemented to test automatically, requiring no manual intervention.

These tests follow a sequence of carefully designed steps to mimic actual road conditions. The wheel is tested over the equivalent of 60,000 km, which requires 2-3 days of continuous and rigorous testing. The goal is to ensure the wheel has undergone the proper production process and can withstand real-world stress.

User-Friendly SCADA Screens:

- Display of current test status
- Easy-to-use alarm troubleshooting
- Operator-friendly screens for maintenance mode
- Data logging and report generation features

About Instron Technologies

With operations in Canada and India, Instron Technologies is a leader in Process Skid Plants, Digital Factory Solutions, and Test Bench Systems. Committed to sustainability, our dynamic team develops innovative solutions that not only meet critical customer challenges but also emphasize eco-friendly practices. Serving over 200 clients in more than 10 countries, we demonstrate our dedication to innovation, operational efficiency, and environmental responsibility.

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