Dual-bridge strain gauge load cells have a major impact on the structural and fatigue test practices carried out on aircraft.

FULL-SCALE AIRFRAME

Most structural and fatigue testing of aircraft occurs on a full-scale airframe, where the structure is cycled through taxi, pressurization, take-off, climb out, flight maneuvering, descent, on ground, taxi, pressurization, take-off, climb out, flight maneuvering, descent, final approach, landing and take-off. This test method requires the use of dual-bridge strain gauge load cells mounted to hydraulic actuators.

Historically, multibridge load cells were used in the aerospace industry to provide a redundant output signal to combat reliability issues. The load cells are used for active force feedback to hydraulic servo controllers that drive the aircraft structure during tests in a ‘closed loop’. The difference between the two bridge outputs can be monitored, and, if they exceed pre-set load limits, the test is shut down to a neutral position in a controlled manner. The load cells are also used for measuring and recording the force level in a data-acquisition system.

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of a signal conditioner, which is used in conjunction with a strain-gauge based transducer, without exposing the transducer to known, traceable, physical input values. If required, adjustments can then be made to the signal conditioner to ensure accurate measurement results.

Recognizing that a majority of load cell damage occurs at the electrical connection, protecting the electrical connector on the side of the load cell from damage during installation is essential. Connector protectors are simple and effective devices that can save the load cell from the most common damage source – a wrench that slips during installation on the hydraulic actuator. The connector protection (see figure top right) installs using the same electrical connector hardware and extends out past the connector.

The final thing to consider is mounting the load cell to the hydraulic actuator. As the load cells will be cyclic in compression and tension during the entire airframe or component test, pre-tensioning studs should be used to eliminate the backlash associated with loose joints. The studs typically thread into the load cell and lock the threads in position when connected to the end of the hydraulic actuator. Installation of the load cell starts with tension preloading the load cell to 120-150% of full-scale capacity and lightly tightening a jam nut to lock in the preload on both the load cell and base tension rods. Once the preload tension is released, the threads will be securely engaged. Failure to preload the attachment rods/fixtures can result in damage to the threads on the load cell and base during cyclic load tests.

Fatigue-rated load cells are specifically designed for component durability and fatigue test machines where highly cyclical loading is present. These rugged load cells are extremely resistant to extraneous bending and side-loading forces. They are used for material testing, component lifetime testing and structural testing.

All fatigue-rated load cells are guaranteed against fatigue failure for 100 million fully reversed cycles. Load cells with dual outputs can be used for closed-loop control of airframes and fatigue testing of subassemblies and components. Things to consider when installing such load cells are pre-tension studs for proper load cell performance, connector protection to avoid costly downtime, and shunt calibration resistors for periodic online calibration checks. Remembering these items is essential for minimizing errors and lost test time.

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