Solving Jet Engine Test Problems Using Ruggedized Test Equipment

APPLICATION BRIEF

RELIABLE DATA FIRST TIME EVERY TIME
The Problem

Jet engines are the core of any modern aircraft. Any critical failure risks a serious accident that potentially endangers hundreds of lives. Because a jet engine is the very definition of “mission-critical,” both the law and their own strict quality standards require manufacturers to perform extensive testing on their components, systems, and manufacturing processes. Jet engine tests involve subjecting the unit under test to extreme temperatures, jets of water, simulated hail, severe vibration, and other harsh conditions; sometimes test engineers even slam chicken carcasses against engines to simulate bird strikes. These tests can be exceptionally costly and take years to develop. Engineers must monitor a wide array of factors during these tests, including temperature, flow, pressure, rotation, strain, and vibration.

Selecting the right type of data acquisition hardware and software is a critical step in ensuring accurate data for any test routine, but jet engine testing poses unique requirements that the test engineer must address. Not every data acquisition product can overcome the challenges found in jet engine testing. Some solutions and test methodologies offer better reliability and quality than engineers may realize. This article examines one innovative test approach for jet engine testing that incorporates a ruggedized data acquisition system.

The Traditional Approach

The traditional approach starts with assembling the jet engine outside of the test chamber and then inserting it into the test chamber. Next, the sensors and transducers are mounted, cabled, and configured to the data acquisition instruments. There are often hundreds if not thousands of sensors and transducers, making this an often arduous and time consuming task.

The extreme test conditions mean that the data acquisition instruments themselves cannot function properly if positioned too close to the test cell, so by definition, for any harsh test environment, particularly engine testing, this means longer cable runs. Each of the hundreds or thousands of cables must make its way from the test setup to the instrumentation, with of course the correct labeling. This process is easily prone to human error and takes many hours to complete. The diagram below gives an overview of the traditional approach:
when it comes to excitation voltages. On the one hand, higher voltages mean it is easier to distinguish noise from data, but they also mean more heat produced by instrumentation and shorter equipment life.

On the other hand, lower voltages ensure longer life spans, but it is much harder to tell signals from noise. Longer test cables also mandate higher voltages, putting engineers in an odd spot.

Even more confounding is the fact that those thousands of test cables can come loose or break. That means shutting the whole testing process down, finding and repairing broken wires, perhaps re-routing them carefully away from potential danger zones, and then getting everything back up and running. Periodic maintenance, such as checking that cables are still in working order, cable jackets are intact, connections are tight, and that everything is clean, can take many hours.

A More Innovative Test Approach

Harsh-environment data acquisition equipment can provide significant improvements over laboratory-grade approaches. Using ruggedized data acquisition equipment enables engineer to place components directly in the test chamber, even closer to the jet engine and sometimes on the engine itself. This allows engineers to achieve a test setup seen in this diagram:

Instead of pushing the jet engine under test into the chamber and then configuring sensors inside, engineers can now pre-install all the sensors, transducers, and data acquisition equipment directly on the engine itself before pushing it into the test chamber. Rather than having to set up the engine and separately configure the test equipment, engineers can do both steps at once. Because the instrumentation is located so close to the transducers and sensors, cable lengths are substantially reduced. This reduces not only setup time, cost, and the potential for human error, but it also ensures higher quality signals.

The shorter cable lengths, and the reduced interference and signal loss that comes with that, helps the engineer use lower excitation voltages and therefore extend equipment lifespans. Environmental noise and interference are less of a concern. The data received and used in this innovative testing approach is of a far higher quality and more reliable.

There is no need to manage thousands of long cables and carefully keep track of them; worrying about whether cables are securely connected or seeing if any one of them has broken now means a quick check rather than tracing thousands of long cables.
What makes these setups possible are devices like AMETEK VTI Instruments’ RX0124 24-Channel High-Performance Bridge Measurements device, the RX1032 32-Channel Rugged High Accuracy Thermocouple Brick, and the RX0224 24-Channel High-Performance Charge Vibration Measurements device.

These data acquisition instruments are ruggedized, able to withstand extreme temperatures from -20°C to 60°C, and are designed to withstand high vibration applications. Also, the RX0124 and the RX0224 are IP66 rated, meaning that they totally block dust and powerful water jets, while the RX1032 is IP65 rated, meaning it prevents the ingress of dust and lower pressure water jets.

Making Ruggedized Test Equipment Work for You

Using durable, robust devices, engineers can significantly simplify their testing setups, increase accuracy, reduce downtimes, acquire higher quality signals, use shorter cabling runs, and worry less about interference. Placing them in the test chamber with the jet engine means that the entire test setup is simpler and easier to maintain. Ruggedized test configurations such as those made possible by products like the RX0124, RX0132, and RX0224 save time, money, and frustration.

Even though jet engine testing involves powerful jets of water, extreme temperatures, and thousands of data points, rugged test equipment means that it is far easier and more manageable to carry out tests. If your application is particularly demanding, investing in ruggedized equipment can save you many headaches down the line.

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