The Element laboratory in Warwick, UK, has to be able to conduct many types of tests while staying in front of technology and standards.
The bulk of the work done by the Element Warwick Laboratory is environmental testing for the aerospace sector.
The main laboratory floor at Element’s Warwick facility is a long rectangular strip of environmental chambers, test cells and machines. There are a lot of machines: for heating things up, cooling things down, shaking things, driving sand at things and dropping things. There are instruments for measuring and recording, data acquisition systems and computers for analyzing data. Interspersed are the things being tested, sometimes sitting atop complex metal fixtures. Employees are busy, consulting test plans, making adjustments to tests or looking at graphs on screens.

The Warwick laboratory covers 42,000ft² and is the largest independent UKAS (United Kingdom Accreditation Service) accredited environmental test facility in the UK. It employs 45 full-time engineers and technicians. Around 75% of the testing performed at the laboratory is for the aerospace sector, for clients ranging from large OEMs such as Airbus, Rolls-Royce and UTC Aerospace, to Tier 3 component suppliers in the commercial and defense sectors.

The products being tested vary from large structural elements of aircraft down to small electronic components such as microchips and circuit boards. “It’s mainly products for future deployment. Customers come to us before manufacturing for development and qualification testing,” says Stuart Brown, general manager of the laboratory.

However, Element Warwick isn’t just about physical testing. On the floor above the laboratory is a team of engineers designing in CAD and running FEA simulations. This Early Stage Qualification (ESQ) team helps clients with test procedures and designs the fixtures that hold objects under test while being subjected to shock and vibration. This is key, because a poorly designed fixture could adversely affect test results or cause damage. “We run the simulations to ensure we’re not creating unwanted resonances,” says Brown.

**TESTING HOT AND COLD**

At first the laboratory floor, with its bustle and various activities, seems chaotic – but slowly the organization reveals itself. Dominating the center are eight vibration test cells that house the largest and most valued pieces of test equipment.

Closest to the office area and ESQ team is a section for bespoke testing, where hydraulic, pneumatic and fatigue testing is conducted. A common sight here are items such as fuel pumps, which are fatigue tested using cyclical and differential pressure testing.

Next to the bespoke testing area on one side of the laboratory are 20 environmental chambers of various sizes and types. These can recreate temperatures as low as -73°C (-99°F) and as high as +500°C (932°F) and various humidity levels at altitudes of up to 90,000ft (27,000m). There is a corrosion testing chamber, where entire products can be tested for up to and beyond 10 weeks and a driving sand and dust chamber. Products are placed inside this chamber on a stand and blasted with dust and sand particles of a standardized size to check they do not cause clogging and to measure levels of abrasion.
When moving mission-critical assets from one location to another, bad things can happen. You need to know not only if something bad happens, but when and where. Lansmont’s award-winning SAVER™ environmental shock and vibration data recorders provide high-fidelity asset transport intelligence.

Email sales@lansmont.com to learn more about SAVER field data recorders or visit lansmont.com.
"Clients choose us because we can do all their testing in one place – temperature, humidity, dust, salt, fog, altitude, acceleration, shock, highly accelerated lifecycle tests [HALT], high cycle fatigue [HCF], bounce and vibration," says Brown.

"In-depth analysis of the fixture is required when testing at higher frequencies"

Away from the vibration test cells is a fabrication and storage area for the fixtures. A new fixture is made here every day in the workshop, which employs four technicians. On the opposite side of the laboratory to the test chambers are a number of smaller, self-contained test cells, where most HALT and HCF tests are conducted on many components and products, ranging from turbine blades from Rolls-Royce engines to cell phones. The equipment used in these test cells is smaller – air jets to create vibration and non-contact measurement tools such as laser vibrometers.

"Engine manufacturers want to test at these levels – engines are running hotter and at higher pressures, which transfers to higher frequencies and greater g-levels."

"Vibration is the most complex testing we do. The bigger the product the more complicated it becomes. Testing at higher frequencies is also harder. You have to do in-depth analyses of the fixture you are connecting the product to."

Mark Heaven, director of global aerospace product qualification
NOVEMBER 13-14, 2019 COLOGNE, GERMANY

THE CONFERENCE DEDICATED TO

HYBRIDIZATION.
MORE-ELECTRIC AIRCRAFT.
CLEANER PROPULSION TECHNOLOGIES

WOULD YOU LIKE TO PRESENT A PAPER?
SEE WEBSITE FOR DETAILS

www.electricandhybridaerospacetechnology.com

From the publisher of Aerospace Testing International magazine
Materials Testing

testing, says, "It’s not just about vibration. It’s about being able to control the product during the vibration cycle so that you drive the energy into the right parts. Otherwise you can waste a lot of time and money by not testing properly and damaging the test equipment."

Another complex area the laboratory handles tests for is parts for helicopters and turboprop aircraft. The vibrations in lower frequency areas give lower blade passing frequencies, so ‘sine on random’, or ‘random on random’ with swept tone testing is necessary.

"Those tests can be really complicated to program and to control, but we have the experience and expertise to do it," says Brown.

Electric Partnerships

Heaven anticipates that the emergence of electric and hybrid aircraft is another trend that will cause a change in environmental testing. Electric generators on new aircraft are becoming more common and the first smaller, all-electric aircraft will start to operate in the early 2020s. "An electric propulsion system is different from what we deal with now, so different stresses and issues will have to be dealt with," says Heaven. "But it’s still similar. We will deploy a testing service that meets customer need. Standards tend to lag behind technology, so we have to keep ahead of technology."

The best testing programs therefore usually start with a discussion with clients and continue with consultation throughout. Heaven says, "We are a facility that can be used when needed in a comfortable, connected way. It’s no longer a gated process for testing to standards. Our level of involvement with clients is much higher."

Brown agrees that this close partnership approach is the best way to run tests. "We can do something very prescribed or we can invent something highly bespoke. It depends where the problem is."

"It’s difficult for aircraft manufacturers and suppliers. The specification will be for things that haven’t been made yet and will be in service for 25 to 30 years."