TESTING ACOUSTIC FATIGUE

High-intensity acoustic fatigue testing in Chinese spacecraft ensures the resilience of key components

Spacecraft, including satellites and launch vehicles, experience high levels of mechanical, thermal and acoustic stress, particularly during launch. High sound pressure levels can cause damage to thin metal plates and electronic printed circuit boards within the spacecraft assembly. Rigorous acoustic fatigue testing is an important part of ensuring the resilience of spacecraft and their components.

Founded in 1956, the Beijing Institute of Strength and Environment Engineering (BISEE) is the main research institute and certification testing organization for aerospace structural reliability engineering in China. It has ISO 9000 certification, ISO/IEC17025 national laboratory accreditation and multiple military qualifications. BISEE is part of the China Academy of Launch Vehicle Technology, one of the largest centers for launch vehicle research, design and manufacture in the world. Its most successful product is the Long March vehicle.

BISEE uses an m+p international system with a total of more than 760 channels to perform environmental and reliability testing, including acoustic fatigue and vibration testing on various types of missile, rocket, satellite, ground equipment and instruments.

ACOUSTIC TEST FACILITIES

To achieve the high noise levels required for realistic acoustic fatigue testing (typically 130-170dB), a reverberant acoustic test facility (RATF) or a progressive wave tube (PWT) is normally used. An RATF uses the internal resonances within a chamber to store energy and deliver diffuse high sound power levels to the test object. A PWT is a tube (usually rectangular) in which the sound energy flows in approximately flat waves, with virtually no reflections, either at right angles to the test object or at grazing incidence. RATF facilities are used to test larger assemblies – for example, a satellite – whereas PWTs are used for smaller components, or flat items, which may be incorporated into one wall of the PWT. The high sound levels required for acoustic fatigue testing are potentially dangerous and it is therefore essential that the system controlling the noise generator(s) is responsive and reliable to ensure that sound levels do not exceed specification.

CONTROLLING PWTs

BISEE uses m+p international's VibRunner hardware and VibControl software to provide fully automatic, repeatable closed-loop control to a reference narrowband spectrum for its PWTs. Eight m+p VibRunner modules, each with 16 analog input channels and two analog output channels, are employed to control and measure up to 12 PWTs simultaneously using a single computer. Separate control profiles can be defined for each PWT. A key benefit of the system is that each drive signal can be stored for later use, avoiding the need for an equalization stage and speeding up test time. Additional safety features include automatic microphone drop-out detection and exclusion and extensive octave band and OASPL (overall sound pressure level) alarm and abort checks.

The institute also uses three more m+p international systems for acoustic control and testing in its RATFs. "Over extensive testing, the high performance and reliability of the m+p system was proven, especially in complex and hostile conditions," a BISEE engineer comments. "The scalability and flexibility of the hardware and software system makes it very easy to adapt our systems to meet new requirements." ▮

ABOVE RIGHT: **China's Long March 5 launch vehicle**

RIGHT: **m+p international's system for automatic, closed-loop PWT control**