ASSEMBLY ACOUSTIC TESTS

Practice:

Subject selected (large surface area, low mass) assemblies, in addition to the full-up flight system, to acoustic noise. It is imperative on missions with fixed launch windows that acoustic problems on assemblies not be deferred to system level tests.

Benefit:

Acoustic noise tests subject potentially susceptible hardware to a significant launch environment, revealing design and workmanship inadequacies which might cause problems in flight.

Programs That Certified Usage:

Mariner Series, Viking, Voyager, Galileo

Center to Contact for Information:

Jet Propulsion Laboratory (JPL)

Implementation Method:

Apply broadband random acoustic noise (~ 25 to 5000 Hz) to the test item in a reverberant chamber. Control the noise level in one-third octave frequency bands with microphones (generally four or more) distributed around the test item at least one foot from test item surfaces.

Technical Rationale:

Random-incidence, broadband, random acoustic noise is employed to simulate the effects of the launch acoustic environment. The noise generated by launch vehicle engine exhaust during liftoff and by boundary layer turbulence during transonic and high dynamic pressure events is indeed broadband and random in nature. The acoustic environment that a payload is exposed to within a launch vehicle shroud does tend to be reverberant (random-incidence) in nature. In fact, the reverberant acoustic noise test is one of the most realistic environmental tests employed for payloads. Acoustic noise external to a launch vehicle is not random-incident; however, the actual acoustic wave angle of incidence distribution is seldom known. In practice, employing a random-incidence acoustic test envelops the effects of the flight environment.

Acoustic noise is usually the most severe dynamic environment for a launch vehicle or payload in the mid to high frequency range (~ 50 to 2000 Hz). The acoustic pressure fluctuations will induce severe vibrations in relatively large lightweight structures, such as solar panels and reflectors, potentially causing failures of the

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structure or attached electrical components. These structures should be acoustically tested at the assembly level to avoid potential cost and schedule impacts of a failure during system level testing. The full up spacecraft acoustic test provides verification of the integrated system for the vibroacoustic environment, including verification of the adequacy of assembly random vibration requirements. The acoustic test also qualifies spacecraft elements, such as blankets, cable harnesses, plumbing lines, and secondary structure not tested at the assembly level.

Impact of Nonpractice:

The probability of failure during systems acoustic testing, or during flight due to the acoustic environment, is increased.