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A NOTCHING METHOD FOR RANDOM VIBRATION ACCELERATION SPECTRA DERIVED FROM THE FORCE LIMITING TECHNIQUE

Abstract

The random vibration test is primarily used to test and to qualify spacecraft assemblies and components. The input acceleration spectra consist of a mix of frequencies between 20 and 2000 Hz. Since the impedance of the shaker must be greater that that of the real spacecraft structure, the shaker system could introduce much more dynamic loads in the equipment than the real supporting vibrating structure. To prevent overloading, the vibration inputs must be decreased during the tests. Usually, the notching of acceleration spectra is dependant on engineering experience or former test data at some measuring points. In this paper, a new notching method for the traditional random vibration acceleration spectra based on the force limiting technique is derived. The notching method is originated from the force limiting concept that the input acceleration spectra would be appropriate without severe overtest if the hard-mounted component interface forces equal to those for the soft-mounted conditions on the real spacecraft structure at the main resonant frequencies. In order to derive accurate equivalent interface forces, the frequency response analysis is performed in stead of random vibration analysis, because the resultant component interface forces cannot be directly obtained by adding up the force spectral density for each mounting points. Besides, the Modal Assurance Criterion (MAC) is used to search the main hard-mounted modes corresponding to the soft-mounted ones. Finally, the notching method is applied to specify the input acceleration spectra of a spacecraft component. The results show that this method is convenient and applicable to determine the acceleration notching level before random vibration acceleration tests, while avoiding the force limiting tests which require special force transducers and related controlling systems.