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PYROSHOCK AND VIBRATION ATTENUATION TESTS USING COMPRESSED MESH WASHER ISOLATORS WITH THE APPLICATION OF PSEUDOELASTIC SMA WIRE

Abstract

During the flight phase of a launch vehicle, pyroshock is generated from the actuation of ordnance devices which are used for several separation events. This pyroshock can cause malfunctions of electric components equipped in launch vehicles or satellites due to its high acceleration peak, short duration, and high frequency characteristics. These malfunctions can result in a catastrophic failure of launch operation. This study introduces a new compressed mesh washer pyroshock isolator using the pseudoelasticity of SMA for the prevention of these electronic malfunctions. The SE508 wire material with its dominant pseudoelastic characteristics were used for the manufacturing of the pseudoelastic SMA washer isolators. For comparison purposes, two other compressed mesh washer isolators were also manufactured using SM495 wire material with its dominant shape memory effect and STS310 metal wire. To confirm the isolation possibility, quasi-static loading tests were performed and test results (load-displacement relationship) showed nonlinear hysteretic curve which assures the dominant absorption capability of the pyroshock energy. From pyroshock isolation tests, it was shown that the SMA washer isolators have the ability of remarkable shock attenuation. Particularly, the SE508 washer isolator showed the best pyroshock isolation performance among the three isolators due to its pseudoelastic characteristics with large hysteresis. The variations in the dynamic characteristic of the compressed mesh washer isolators due to pre-compressive displacements were also studied through the random vibration test. With the increment of the pre-compressive displacement, the stiffness and natural frequency of the washer isolators also increased and the isolation performance of the low-frequency region became worse. However the isolation performance of the high-frequency region showed good results. The results showed that the natural frequency and the isolation capacity can be adjusted by controlling the pre-compressive displacement of the compressed mesh washer isolator. These characteristics can be used for a smart isolation system that utilizes the adjustable dynamic characteristics of the compressed mesh washer isolators.