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AN IMPROVED TEST SYSTEM FOR THERMAL-STRUCTURAL TEST OF THIN SHELL PARTS OF SPACECRAFT.

Abstract

In order to ensure the space vehicles normal operation, the thermal-structural design becomes an important problem of spacecraft design. For the mechanical properties of thin shell parts of spacecraft under the flight condition, 200 degree celsius additional thermal condition was needed in grand static test. Usually, using quartz lamp heater or resistance heating element to realization the thermal environment in open space thermal strength experiment is characterized by complex control, low reliability, high cost, and generation of thermal stress in the mechanical boundary during heating process. Fully considered the temperature uniformity, reliability of mechanical loading, economics of test and boundary thermal stress effect, we describe an improved combined loading test system with thermal loading, mechanical loading, insulation and data acquisition component. The system combined with the mechanical boundary and thermal boundary by using standard resistance heating element and boundary of the same material, with non-constrained during heating process to reduce the thermal stress caused by boundary constrained. Design distributed thermal loading component based on direct-contact heat transfer boundary and non-contact inner heating resistance, and distributed insulation component of multilayer insulating material, reduce non-necessary heat exchange between thin shell parts, boundary, air and strain-displacement test, for the uniform stabilized thermal environment. Experiments on the improved system for thermal-structural test show that temperature stability was 195-200 degree celsius in thin shell parts in open space, no apparent thermal stress caused by boundary constrained, little influence on mechanical loading and data acquisition component, high reliability and easy operation.