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A SUB-SCALE SIMULATED ALTITUDE TEST SYSTEM FOR THE LARGE THRUST UPPER-STAGE LO2/LH2 ENGINE OF HEAVY LAUNCH ROCKET

Abstract

Heavy launch rockets are currently playing a very important role in Chinese Lunar Exploration Program. To study the risks in the altitude performance tests of the upper-stage LO2/LH2 engine for heavy launch rocket, a simulated altitude test platform with test samples in 1/20 scale is established, including the sub-scale automated test system, the simulated enginethe diffuser, the afterburner, the cooler, the noise reduction system, and etc. The primary purpose of this platform is to address the critical technology challenges in the testing, which will also provide abundant references for reducing the cost and potential risks in full-scale tests. Additionally, it will also offer insights into further development, such as shortening the test cycle and enhancing the test efficiency. Several keys are performed. (1) Automated remote control is employed for the propellant and air supply system, including test air supplying, pressurization, and pressure regulating. In the meanwhile, the intelligent fault diagnosis system is established to distinguish and locate the system failure modes, and provide feasible solutions. These technical designs are able to minimize the risk of security vulnerabilities and thus improve the test efficiency. (2) The L-shape diffuser is used in the platform, which successfully cut down the height of the platform by shortening the length of its vertical portion. Tests and experiments of the diffuser under thermal loads and impact pressure are performed, especially for the L shape extension portion, which suggests that the distribution of impact pressure and thermal loads will minimize the risk and lay a solid foundation in designing the full-scale diffuser experiment platform. (3) To prevent any possible deflagration, the platform is designed to burn down the remnant hydrogen in the exhausted fuel gas with the processes of cooling, afterburning, and then cooling. The remaining gases, which discharge into the noise reduction system, are vapor and a very few oxygen. The processes of the system start-up and shut-down are also studied. All the data and approaches will be used in designing the full scale test stand.