

SPACE PROPULSION SYMPOSIUM (C4)
Propulsion Systems I (1)

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RESEARCH ON THE START SYSTEM OF LIQUID ROCKET ENGINE

Abstract

The capability of the start system is important for liquid rocket engine. Aimed at the turbopump-fed open cycle liquid rocket engine, which is started by Solid Start Cartridge (SSC), performance of the start system is studied in this paper. The simulated model of the SSC in the start system is established adopting the method of zero-dimensional interior ballistics used in the solid rocket engine numeration. The performance parameter of the SSC under varied conditions is indicated, such as different powder different solid frame and different SSC structure. The numerical model of the powder gas pipeline is established to analyze the effect of that the powder gas total pressure at the pipeline's inlet, the diameters of the pipeline's two throats and the diameter of the pipeline's outlet on the pipeline's flow field characteristic. The character of the shock wave in the pipeline flow field bears much reference to those factors, and so do flow rate, total pressure, Mach number and static temperature at the pipeline flow field's outlet. It's indicated that it's necessary to limit those factors in certain confine for the pipeline outlet's power gas satisfying the requirement of the engine's starting. The start system's model is connected with the model of the liquid rocket engine to analyze the influence of the start system on the engine's starting. The diameter and length of the powder column in the SSC and the diameter of the first throat in the powder gas pipeline are the most effective factors to the engine's start characteristic. The diameter of the powder gas pipeline's second throat and the diameter of the powder gas pipeline's outlet are the least ones in the case of that the powder gas pipeline's flow field keeps rated condition. The simulated result of the start system is proven out by engine test. The numerical models and the research method would offer a certain advice for the engine design.

Key Words: Liquid Rocket Engine; Start-up System; Solid Start Cartridge; Powder Gas Pipeline; Simulation.