

SPACE TRANSPORTATION SOLUTIONS AND INNOVATIONS SYMPOSIUM (D2)
Technologies for Future Space Transportation Systems (5)

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A HYDRAULIC BLOWDOWN SERVO SYSTEM FOR LAUNCH VEHICLE

Abstract

This paper introduced a hydraulic blowdown servo system developed for a solid launch vehicle of the family of Chinese Long March Vehicles. It's the thrust vector control (TVC) system for the first stage. This system is a cold gas blowdown hydraulic servo system and consist of gas vessel, hydraulic reservoir, servo actuator, digital control unit (DCU), electroexplosive valve, and pressure regulator etc. A brief description of the main assemblies and characteristics follows. a) Gas vessel is a resin/carbon fiber composite overwrapped pressure vessel with a titanium liner, The volume of the vessel is about 30 liters. b) Hydraulic reservoir is a titanium alloy piston type reservoir with a magnetostrictive sensor as the fluid level indicator. The volume of the reservoir is about 30 liters. c) Servo actuator is a equal area linear piston actuator with a 2-stage low null leakage servo valve and a linear variable differential transducer (LVDT) feedback the piston's position, Its stall force is about 120kN. d) Digital control unit (DCU) is a compact digital controller based on digital signal processor (DSP), and deployed dual redundant 1553B digital busses to communicate with the onboard computer. e) Electroexplosion valve is a normally closed valve to confine the high pressure helium gas. f) Pressure regulator is a spring-loaded poppet pressure valve, and regulates the gas pressure from about 60MPa to about 21MPa. g) The whole system is mounted in the aft skirt of the vehicle. h) This system delivers approximately 40kW hydraulic power, by contrast, the total mass is less than 190kg. the power mass ratio is about 0.21. Have finished the development and the system test. Bench and motor static firing tests verified that all of the performances have met the design requirements. This servo system is complaint to use for the solid launch vehicle.