

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

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REGULATION SYSTEMS OF THE CYCLONE-4 LV UPPER STAGE MAIN LIQUID ROCKET  
ENGINE

**Abstract**

In the framework of the Ukrainian-Brazilian project the Yuzhnoye SDO is developing RD861K liquid propellant engine for the Cyclone-4 LV upper stage. It is an up-graded version of RD861 engine created in 1967 and used until now in the Cyclone-3 LV upper stage. The engine of gas-generator-cycle produces thrust of 8000 kgf at Isp of 330 sec with propellants NTO+UDMH. For meeting the external requirements and provision of the engine reliability the following regulation systems are upgraded or used. 1. System of thrust stabilization. The sensitive element is a pressure indicator at the oxidizer (Ox) pump outlet, the executive one – hydraulic throttle with electro-mechanical actuator in the GG fuel (Fu) line. The accuracy of stabilization is 4%. Pressure stabilizer of direct action with a membrane sensitive element and executive throttle of “nozzle-flapper” type. Being installed in the GG Ox line it provides MR stabilization for GG within 2%. The engine MR stabilizer (MRS) consisting of pressure stabilizer of indirect action and two flowmeter units with jet amplifiers. The inaccuracy of MR maintenance does not exceed 14%. Pneumo-piloted helium pressure regulator in the line of the turbine spinning up. During startup the turbine inlet pressure is maintained within 20.4 MPa at helium flowrate of 0.4 kg/s. 5. Helium pressure regulator in the pneumatic unit controlling the start-cutoff valves. The regulator is provided with relief valve. Helium pressure is maintained at a level of 60.4 MPa. The report presents design specificities of all the said control units. By September 2009 all the systems have passed successfully the development phase, 9 engines have been subjected to fire tests. The critical issues of the fire tests were development of the nozzle extension, removal of increased vibrations in the tur-bopump, provision of serviceability and confirmation of the MRS accuracy. The tasks have been solved on steady operation of pressure stabilizer in GG line and helium pressure regulator at the turbine inlet. Development of the engine is being continued.