

SPACE PROPULSION SYMPOSIUM (C4)  
Propulsion System (1) (1)

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MULTIDISCIPLINE APPROACH TO THE DESIGN AND MODERNIZATION OF HIGH POWER  
LIQUID PROPELLANT ENGINES FOR THEIR REUSE**Abstract**

The well-known way of increasing economic efficiency and competitiveness of the Space Rocket Launcher (SRL) is the reuse of their first stage Liquid Propellant Engines (LPE) as the most valuable and science concise elements, which also defines main SRL's characteristics and dependability. For this goal, and for the providing necessary safe factors and durability of the LPE main elements, multidiscipline approach is used, which included mathematical simulations of the processes, CFD, stress-strain states and experimental analysis of their dynamic characteristics.

Owing to the mixing these two approaches, mathematical models of the main elements were validated and corrected, variation of their dynamic characteristics during the flight were estimated. Due to this, dynamic active power levels, margins and durability limitations were determined.

In order to provide the efficiency of a recovery system it was offered to place the first stage LPE into the individual, non-hermetic rescue capsule, which will protect engine from the damage and pollution, - factors, which come after rescue capsule separation, followed descending and landing on the Earth surface (Patent PCT/RU 2013/001071).

Implementation of the propositioned recovery system was applied to the LPE with thrust levels from 200tf to 800tf (RD191, RD180 and RD171M), - the engines which does not require deep and expensive modifications for reuse since their main components, like: main chamber, preburner, main turbine unit, heat exchanger and others, has more than 10 margin of life time.

Via empirical and theoretical evaluations it was shown what the additional mass of suggested recovery system decreases the payload mass less than in 5%, owing to simplicity and employment only ready for use solutions, which does not need expensive and long-continued developments.