

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

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DETERMINATION METHOD OF OPTIMUM MAIN DESIGN PARAMETERS OF LOX-LH2
EXPANDER-CYCLE LRE FOR REUSABLE OTV(ORBITAL TRANSFER VEHICLE)

Abstract

In the article the design procedure of optimum main design parameter determinations of LOx-LH2 expander-cycle liquid rocket engine (LRE) for the reusable orbital transfer vehicle (OTV) and mathematical model based on this procedure are considered. The main design parameters in this research are O/F ratio, combustion chamber pressure, nozzle expansion ratio and propellant massflow rate.

This mathematical model allows determining optimum main design parameters of Lox-LH2 expander-cycle LRE and its engineering appearances concerning the OTV missions. The main criteria of optimization in this mathematical model are the maximization of payload weight and the minimization of specific cost of payload ascent into target orbit.

In order to decide optimum design parameters, following tasks will be solved sequentially;

- estimation of mass characteristics of construction of LRE and all OTV
- estimation of payload weight
- cost estimation of development and product of LRE and all OTV
- definition of optimum main design parameters of liquid rocket propulsion system and design shape

The estimation of calculation accuracy was carried out by comparison with operated LRE and OTV. This model shows good results with higher accuracy.

With this developed model, optimum main design parameters of LRE for single-use OTV for the route of Low Earth orbit (LEO) to Low Lunar orbit (LLO), LEO to geo-transfer orbit (GTO) and LEO to geo-stationary orbit (GSO) have been found and analyzed. Moreover, optimum parameters for LRE for reusable OTV on the route of LEO to GTO and LEO to LLO also have been investigated. The results show that there are significant differences of optimum parameters of LRE propulsion system between single-use and reusable OTV.