COMPREHENSIVE PROGRAM FOR EXPERIMENTAL DEVELOPMENT OF LIQUID ROCKET PROPULSION SYSTEMS

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Experimental development presents an essential milestone in the constr novel launch vehicles. Generally, by the time of experimental develo mathematical models have been worked out, a conceptual design has be and basic features of a candidate launcher have been defined. A conce raises a number of issues that should be experimentally verified and e Depending on knowledge of a process to be studied, hardware of vario used.

Model tests on small-size models are primarily used to investigate regularities of a process and obtain experimental coefficients required for v mathematical models. Medium-scale propulsion systems approach in dimens hardware and are dedicated to verify coefficients, to study interaction processes, to obtain data that cannot be obtained with small-size m full-scale hardware is used in simulated flight conditions. Based on results o operations a recommendation is issued for conducting flight tests.

The paper presents different aspects of development of liquid rocket systems. They include: propellant filling system (including liquid oxygen s high-pressure gas loading of bottles; rocket pre-launch operations includin of non-insulated cryogenic tanks at the launch facility, propellant feed to pre-start and in-flight pressurization of rocket tanks; damping of pressure os in engine propellant manifolds; fire prevention systems in the rocket afterbody. General requirements to experimental propulsion systems of

different size are presented. A typical sequence of autonomous, integrated, cold-flow and firings tests as well as objectives of each test are considered in the paper. Using Zenith-launcher as an example, a comprehensive program of experimental development has been shown. The paper gives analysis of model, full-scale and actual hardware used in creating the rocket. Special attention was given to cleanness of internal volume of propellant tanks. It has been shown that different tasks may be accomplished even with a single hardware if adequate instrumentation is provided. This approach will help to reduce costs of the development. At the same time the comprehensive plan should not be considered as a dogma, but as a flexible document that can be revised and modified depending on results of each development stage.