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## DYNAMIC PROCESSES IN SOLID ROCKET MOTORS AND THEIR INTERACTION WITH ROCKET STRUCTURE VIBRATIONS: THE STATE OF THE ART AND CURRENT PROBLEMS

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The most critical operating conditions of solid rocket motors (SRMs) are often due to the development of dynamic processes characterized by excess values of operating parameters. Pressure surges and a sharp increase in the combustion product temperature may impair the strength of the combustion chamber structure, cause its failure, and lead to critical conditions of the motor operation, up to extinguishing the propellant combustion in the motor.

It is shown that both in steady and in unsteady operating conditions of an SRM, dynamic processes in its combustion chamber feature a complex interrelation of a large number of processes in the gas-dynamic space of the combustion chamber: physical, chemical, and thermodynamic (heat and mass exchange) processes. It is found that current studies of SRM operation instability are aimed at identifying mechanisms of combustion chamber pressure oscillations, which are usually due to combustion product vortex formation in the chamber space and acoustic feedback resulting from collisions of vortices with the SRM's combustion chamber components or nozzle. Other lines of investigation are the analysis of SRM resonant damping and the establishment of a relationship between aluminum droplet combustion and SRM internal instability. It is noted that accelerations and vibrations of mixed-propellant combustion surfaces may greatly affect the combustion rate and the agglomeration, on-surface confinement, and burn-up of metal additives, which, in its turn, governs the combustion chamber acoustics.

It is pointed out that the interaction of SRM combustion chamber pressure oscillations and the response of the SRM structure observed in flight tests of some rockets should be taken into account in predicting the stability of SRM dynamic processes. This interaction may call into question the sufficiency of SRM static tests and subsequent conclusions on the magnitude of its dynamic effect on the rocket structure.

**Keywords:** *solid rocket motor, operating process stability, combustion product vortex formation, combustion chamber acoustics, agglomeration and burn-up of metal propellant additives.*

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