

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

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INJECTOR CONCEPTIONS FOR USAGE OF LOX/METHANE PROPELLANT COMPOSITION IN
LIQUID-LIQUID, EXPANDER AND STAGED COMBUSTION CYCLES OF A LIQUID ROCKET
ENGINE**Abstract**

Methane with liquid oxygen are attractive green propellants for usage in Liquid Rocket Engines both in future heavy launchers and also for in-space operations. Numerous studies described advantages of such propellant combination in their maintenance and operational parameters. Yet, experimental investigations showed that usage of these propellants is not so easy and produce significant problems, mainly with the respect of combustion efficiency and stability, defined by combustible mixture preparation in injector assembly. When both liquid propellants are used, elevated vaporability of methane can lead to separation of impinged sprays and so to decrease mixing efficiency. When methane is used as a coolant in expander cycle, kinetic energy of vaporized methane is significantly less than those of hydrogen in the same cycle, which leads to decreased efficiency of LOX atomization by gaseous methane spray. Widely used shear coaxial injector cannot be satisfactory solution there. It is necessary to intensify LOX/methane mixing by means of using another types of injector elements. The presentation includes comparative analysis of most possible injector versions for direct injection of liquid propellants, gas-liquid injectors for LOX and gasified methane, and for staged combustion cycle with oxidizer-rich preburner and both gasified propellants. Results of fire tests in model combustion chamber showed acceptable injector versions.