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Title:
"Hot-fire Test Results of Liquid Oxygen/RP-2 Multi-Element Oxidizer-Rich Preburners"

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Abstract:

As part of the Combustion Stability Tool Development project funded by the Air Force Space and Missile Systems Center, the NASA Marshall Space Flight Center was contracted to assemble and hot-fire test a multi-element integrated test article demonstrating combustion characteristics of an oxygen/hydrocarbon propellant oxidizer-rich staged-combustion engine thrust chamber. Such a test article simulates flow through the main injectors of oxygen/kerosene oxidizer-rich staged combustion engines such as the Russian RD-180 or NK-33 engines, or future U.S.-built engine systems such as the Aerojet-Rocketdyne AR-1 engine or the Hydrocarbon Boost program demonstration engine. To supply the oxidizer-rich combustion products to the main injector of the integrated test article, existing subscale preburner injectors from a previous NASA-funded oxidizer-rich staged combustion engine development program were utilized. For the integrated test article, existing and newly designed and fabricated inter-connecting hot gas duct hardware were used to supply the oxidizer-rich combustion products to the oxidizer circuit of the main injector of the thrust chamber. However, before one of the preburners was used in the integrated test article, it was first hot-fire tested at length to prove it could provide the hot exhaust gas mean temperature, thermal uniformity and combustion stability necessary to perform in the integrated test article experiment. This paper presents results from hot-fire testing of several preburner injectors in a representative combustion chamber with a sonic throat. Hydraulic, combustion performance, exhaust gas thermal uniformity, and combustion stability data are presented. Results from combustion stability modeling of these test results are described in a companion paper at this JANNAF conference, while hot-fire test results of the preburner injector in the integrated test article are described in another companion paper.