

Component Testing of the J-2X Augmented Spark Igniter (ASI)

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In support of the development of the J-2X engine, 201 low pressure, liquid oxygen / liquid hydrogen (LOX/LH₂) J-2X Augmented Spark Igniter (ASI) subsystem ignition tests were conducted at Marshall Space Flight Center (MSFC). The main objective of these tests was to start the ASI within the anticipated J-2X engine start box, as well as outside of it, to check for ignition margin. The setup for the J-2X ASI component testing simulated, as much as possible, the tank-head start-up configuration of the ASI within the J-2X Engine. The ignition tests were divided into 124 vacuum start tests to simulate altitude start on a flight engine, and 77 sea-level start tests to simulate the first set of ground tests for the J-2X Engine at Stennis Space Center (SSC). Other ignition parameters that were varied included propellant tank pressures, oxidizer temperature entering the ASI oxidizer feedline, oxidizer valve timing, spark igniter condition (new versus damaged), and oxidizer and fuel feedline orifice sizes.

Propellant blowdowns using venturis sized to simulate the ASI resistance allowed calculation of transient propellant mass flow rates as well as global mixture ratio for all ignition tests. Global mixture ratio within the ASI at the time of ignition varied from 0.2 to 1.2. Detailed electronics data obtained from an instrumented ignition lead allowed characterization of the breakdown voltage, sustaining voltage and energy contained in each spark as the ASI propellants ignited. Results indicated that ignition always occurred within the first five sparks when both propellants were present in the ASI chamber.