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 Propulsion, Engines and Missiles ■  Combustion and Ignition
Investigation of the Effects of Solid Rocket Motor Propellant Composition on Plume SignatureAuthors: [Clay J. Snaza](#); [NAVAL POSTGRADUATE SCHOOL MONTEREY CA](#)

Abstract: Three propellants with **aluminum**/silicon weight percentages of 18/0%, 13.5/4.5%, and 12/6% were fired in a subscale motor to determine if the plume infrared signature could be reduced without a significant loss in specific impulse. Spectral measurements from 2.5 to 5.5 micrometers and thermal measurements from 3.5 to 5.0 micrometers were made. Plume particle size measurements showed that only particles with small diameters (less than 1.93 micrometers) were present with any significant volume. Replacing a portion of the **aluminum** in a highly metallized solid propellant with silicon was found to eliminate the Al₂O₃ in favor of SiO₂ and Al₆SiO₃, without any change in particulate mass concentration or any large change in particle size distribution. These particulates were found to have significantly lower absorptivity than Al₂O₃. An additional investigation was conducted to determine the particle size distribution at the nozzle entrance. Malvern ensemble scattering, phase-Doppler single particle scattering and laser transmittance measurements made through windows in the combustion chamber at the nozzle entrance indicated that large particles were present (to 250 micrometers). However, most of the mass of the particles was contained in particles with diameters smaller than 5 micrometers. Approximate calculations made with the measured data showed that if 100 micrometers particles are present with the smoke (particles with diameters less than 2 micrometers) they could account for only approximately 10% of the article volume. Solid rocket, **Aluminum oxide**, Infrared signature, **Aluminum**/Silicon propellant, Particle size distribution

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