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BERYLLIUM EROSION CORROSION INVESTIGATION FOR SOLID ROCKET NOZZLES

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Abstract: Contract AF04(611)-10753 was conducted over the period June 1965 to March 1967. The program was directed toward understanding erosion-corrosion mechanisms of nozzle heat sink and insulation materials in state-of-the-art beryllium solid propellant exhausts. The major task was the design, fabrication and evaluation of the results of the 29 motor tests. Primary design variables included propellant, grain design, motor configuration, nozzle contour, materials and nozzle scale. Four beryllium propellants were tested in 5 designs (100 and 500 pound grains) in 25 tests. **Aluminum** analogs were used in 4 tests. Submerged, conventional and steep inlet nozzles were designed to exceed 5000 F with pyrolytic graphite, ATJ graphite, dense tungsten, carbon cloth and asbestos phenolic materials. The hardware, wall deposits and exhaust plume particles are described. Measured nozzle temperatures and ballistic performance were used to determine throat temperature, corrosion and **oxide** deposition histories. Design parameter effects on nozzle and ballistic performance and material failure mechanisms are discussed. Supporting chemical reaction, arc plasma, cold flow modeling, data correlation and analytical studies are described. A generalized model for nozzle design and performance evaluation is presented. The model includes improved heat transfer, corrosion and deposition analyses. Standard materials can be used with either beryllium or **aluminum** propellants in properly designed motors. Poor nozzle and ballistic performance relates to incomplete metal combustion and inadequate thermostructural design.

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