

Title: Erosion Resistant Rocket Nozzle Graphites

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Erosion and shock resistant conventional graphites of consistent quality are needed for use as nozzle throat materials for solid propellant rocket motors and development by English and French manufacturers has resulted in the production of a number of useful grades.

Their erosion resistance is attributed to careful selection of raw materials and processing on the one hand and to a unique series of gas impregnation, purification, oxidation inhibition and graphitisation treatments on the other. Microstructures has been examied and each material has been assessed by a firing test on a standard rocket motor using cast double base propellant. Erosion rates have been decreased from 3.6×10^3 to 0.6×10^{-3} inches per second.

Motors with small nozzle throat diameters are particularly sensitive to variations in graphite quality affecting erosion resistance. Evidence from firing tests on a variety of graphites shows that bulk density, open porosity and flexural strength all play their part in determining erosion resistance whilst not necessarily being interrelated.

To meet the high degree of reliability required of rocket motors quality control of individual nozzle components is necessary. Non-destructive techniques for the determination of the above properties in finish machined nozzle shapes have been developed, particularly the determination of flexural strength by measuring resonance frequency.