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NASA TECH BRIEF

Starter Propellants and Auxiliary Generators for Gas Turbines

Concepts and designs of gas generators were studied in an effort to delineate a better starter system for gas turbines that require a source of clean moderate-temperature hot gas and progressively greater power. The most severe constraint was that the propellants be operable at temperatures between $-250°$ and $+200°$F.

None of the solid propellants were satisfactory. They were all limited by the fact that their burning-rate temperature sensitivities (π_K) at constant K_n were considerably higher than the maximum allowable. No liquid bipropellant or monopropellant was sufficiently liquid at $-250°$F while retaining a reasonable vapor pressure at 200°F. Hybrids proved to be unsuitable, and a gaseous oxygen-hydrogen system met the temperature requirements but failed in other aspects.

It is unlikely that a solid propellant with a π_K low enough to meet the temperature requirements could be developed. A solid propellant with a grain-temperature-compensating device was determined to be the best solution, and various techniques for producing such devices were studied. Preliminary designs of two devices—a thermal coil and a bimetallic strip—were made.

A parametric study relates the geometry (length, and initial and final diameters) of an internally burning, single, solid-propellant grain to the propellant characteristics (burn rate, burn-rate exponent, and grain density), the engine requirements (equilibrium mass flow rate at the beginning of the burn, and ratio between equilibrium mass flow rates at the start and finish of the burn), and the selected starting pressure. The curves derived from the study analysis can be used for selecting propellants to meet specific engine requirements, or for tailoring engine requirements to propellant limitations.

Note:

Requests for further information may be directed to:
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No patent action is contemplated by NASA.

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