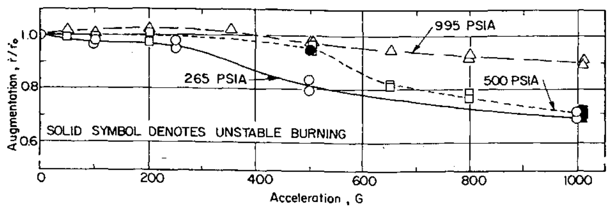

Fig. 1 Effect of acceleration on augmentation of propellant DBNA.

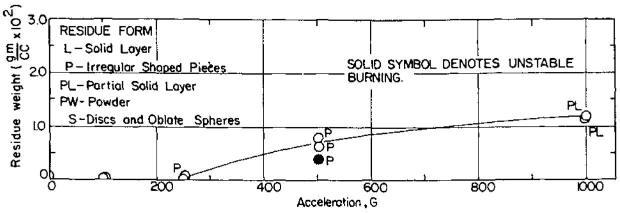

Fig. 2 Effect of acceleration on postfire residue of propellant DBNA at 265 psia.

Fig. 2. The lead has a low melting point and at high accelerations probably forms a partial "flood layer" of molten metal on the surface of the burning propellant—thereby decreasing the burning rate.[1,3] Several 500 psia tests and one 265 psia test exhibited unstable burning at high accelerations as indicated in Fig. 1. The bomb pressure would oscillate in a low-frequency sinusoidal motion. The instability could be the result of periodic flooding and unflooding of the propellant surface.

The data obtained for the aluminized double-base propellant DBA are presented in Figs. 3 and 4. The burning rate augmentation increased with pressure at high accelerations. At 503 psia, augmentation increased slightly with acceleration and then decreased to less than one at 1000g. One test at 503 psia and 1000g exhibited unstable burning. At 1000 psia the augmentation remained practically constant at all accelerations.

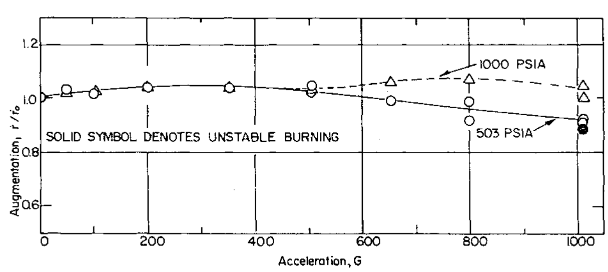

Fig. 3 Effect of acceleration on augmentation of propellant DBA.

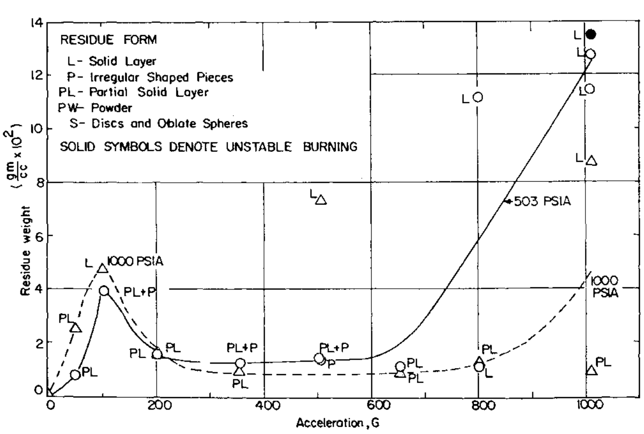

Fig. 4 Effect of acceleration on postfire residue of propellant DBA.

The postfire residue form and weight are practically the same to 600g for both pressures. Above 600g the residue weight varied considerably from run to run at fixed acceleration, and pressure. A general trend was observable. At high accelerations, increasing pressure decreased residue weight and increased augmentation. The postfire residue consisted of aluminum and/or aluminum oxide in addition to lead and/or copper. Comparison of Figs. 1 and 3 indicates that the presence of aluminum enhanced the augmentation at high accelerations.

It appears that lead (and possibly copper) additives tend to flood the propellant surface and decrease augmentation at high accelerations and may cause unstable burning. Addition of aluminum increases the augmentation[1,3] but the lead and/or copper additives prevent significant acceleration induced burning rate augmentation.

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Prevention of Flare-Induced Separation by Boundary-Layer Bleed

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THE theoretical and experimental investigation of hypersonic flow over blunt-nosed bodies with a flare are of interest in aeronautics and astronautics.[1] Calculated inviscid flows on a flare hemisphere cylinder could not be com-

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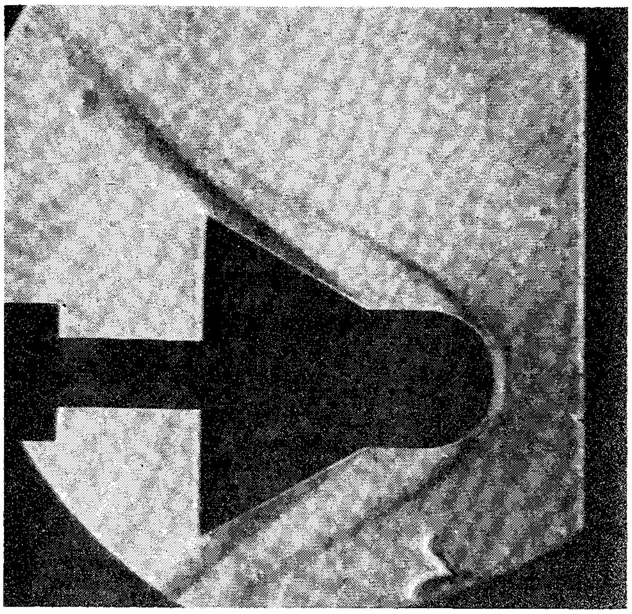

Fig. 1a Flanged hemisphere-cylinder flow, Schlieren photograph.

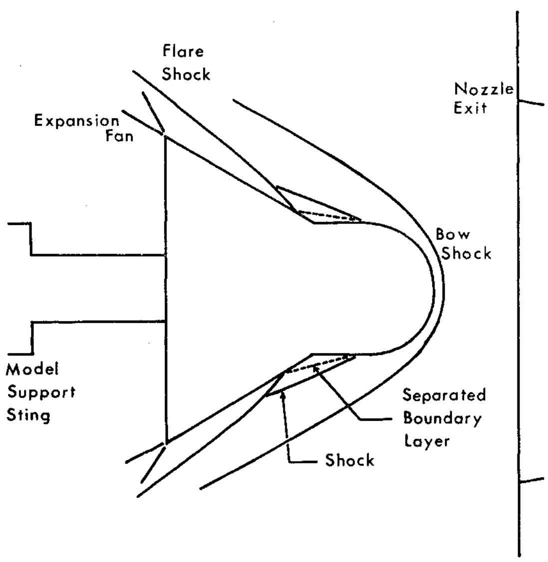

Fig. 1b Flanged hemisphere-cylinder flow, interpretation.

pared with experimental results as boundary-layer separation was induced by the pressure rise across the flare shock. A Schlieren photograph and an interpretive diagram of such a flow are given in Fig. 1.

To eliminate the separation, a bleed was introduced, venting the boundary layer to the wake. A drawing of the model is given in Fig. 2. With a $\frac{1}{64}$-in. gap between the lip of the flare and the cylinder, it was found that the separation was completely removed.

The Australian National University free piston shock tunnel T.2 was used for these experiments.[2] For an initial shock-tube pressure of 6.00-in. Hg (2.03×10^5 dyne/cm^2) of air, the primary shock speed was 0.497×10^6 cm/sec. Resulting nozzle stagnation conditions were calculated by assuming thermodynamic equilibrium behind the primary and reflected shock waves and in an isentropic expansion to the measured stagnation pressure of 3500 psi (2.41×10^8 dyne/cm^2). The resulting stagnation enthalpy was 2.31×10^{11} erg/g.

The freestream conditions were calculated at the exit of the conical nozzle ($\frac{1}{8}$-in. throat diameter, 7.5° cone half-

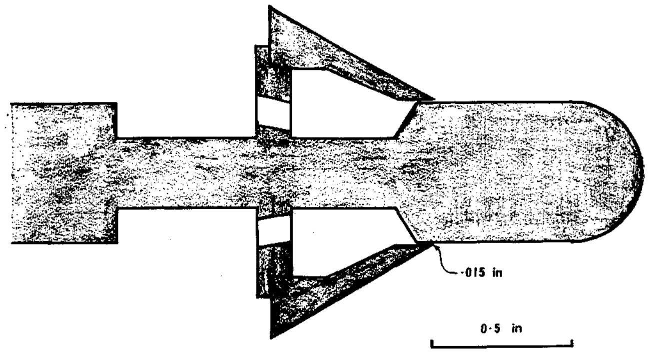

Fig. 2 Model with boundary-layer bleed.

angle, 13.8-cm length) by using a Cornell Aeronautical Laboratory computer program for nonequilibrium gas expansions.[3] The results at the position of the model nose were: temperature, 2140°K; velocity, 5.73×10^5 cm/sec; pressure, 6.89×10^4 dyne/cm^2; Mach number, 5.67; and density, 9.21×10^{-6} g/cm^3.

The Schlieren photographs were taken 100 μsec after shock reflection by using a Hadland HP-101 microflash source with a conventional single-pass system. The knife edges were aligned at a few degrees to vertical. A Wratten type-35 filter and a masking slit were used to reduce the effects of the gas luminosity.

The air-flow over the hemisphere-cylinder-flare was then calculated by using computer programs from the NASA Ames Laboratories[1] with the assumption of a perfect gas satisfying the above freestream conditions. A Schlieren photograph with the calculated points superimposed is given in Fig. 3.

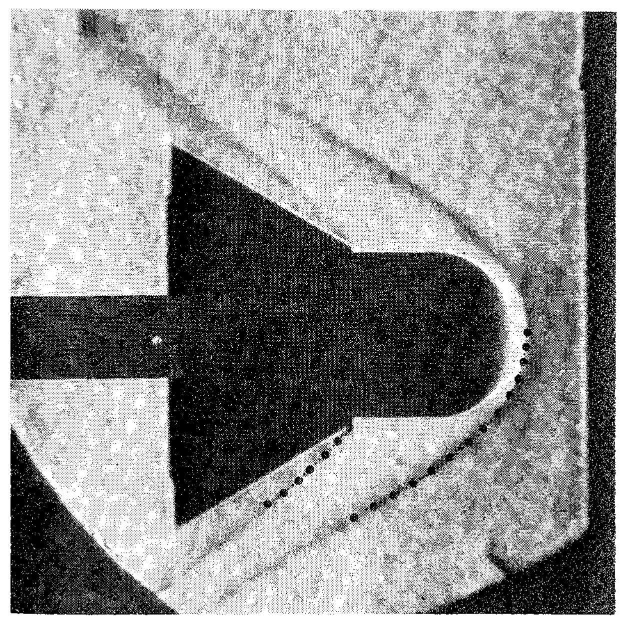

Fig. 3 Calculated and experimental flow.

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