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Title

Measurements of aerodynamic loads on afterbody-nozzle configuration of HSTDV-SERN nozzle system

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Abstract

An experimental study has been carried out on a 1:7 scale model of HSTDV afterbody-SERN nozzle configuration, simulating external afterbody contour along with expansion ramp angle (18°) at a freestream Mach number of 3.5 in the 0.5m dia base flow wind tunnel. Jet nozzle Mach number (M_j) of 1.9 was simulated in the presence of nozzle cowl extension of 0.6h and parallel fences geometry. For these studies a new strain gauge balance having load capacities of AF = 20 Kgf, NF=30 Kgf, and PM = 500Kg-Cms has been designed, fabricated and tested. Aerodynamic loads on the afterbody-nozzle system in the presence of jet exhaust were measured based on metric-nonmetric concept. 'Metric' afterbody model consists of contoured afterbody geometry, cowl extension, and parallel fences with jet flow on the expansion ramp. Nozzle along with its duct system was designed as 'non-metric' part of the model.

There is a complex behaviour of supersonic jet-freestream interactions on the afterbody configuration due to the nature of normal forces which acts in the opposite directions on cowl extension and ramp surface and their net effect have to be measured by the strain gauge balance system during wind tunnel experiments.

The test technique used for the measurement of aerodynamic loads on this afterbody-SERN nozzle configuration clearly captured the complex behaviour of jet-freestream interactions causing changes in aerodynamic loads on the HSTDV-SERN nozzle flow system under various operating conditions of the nozzle