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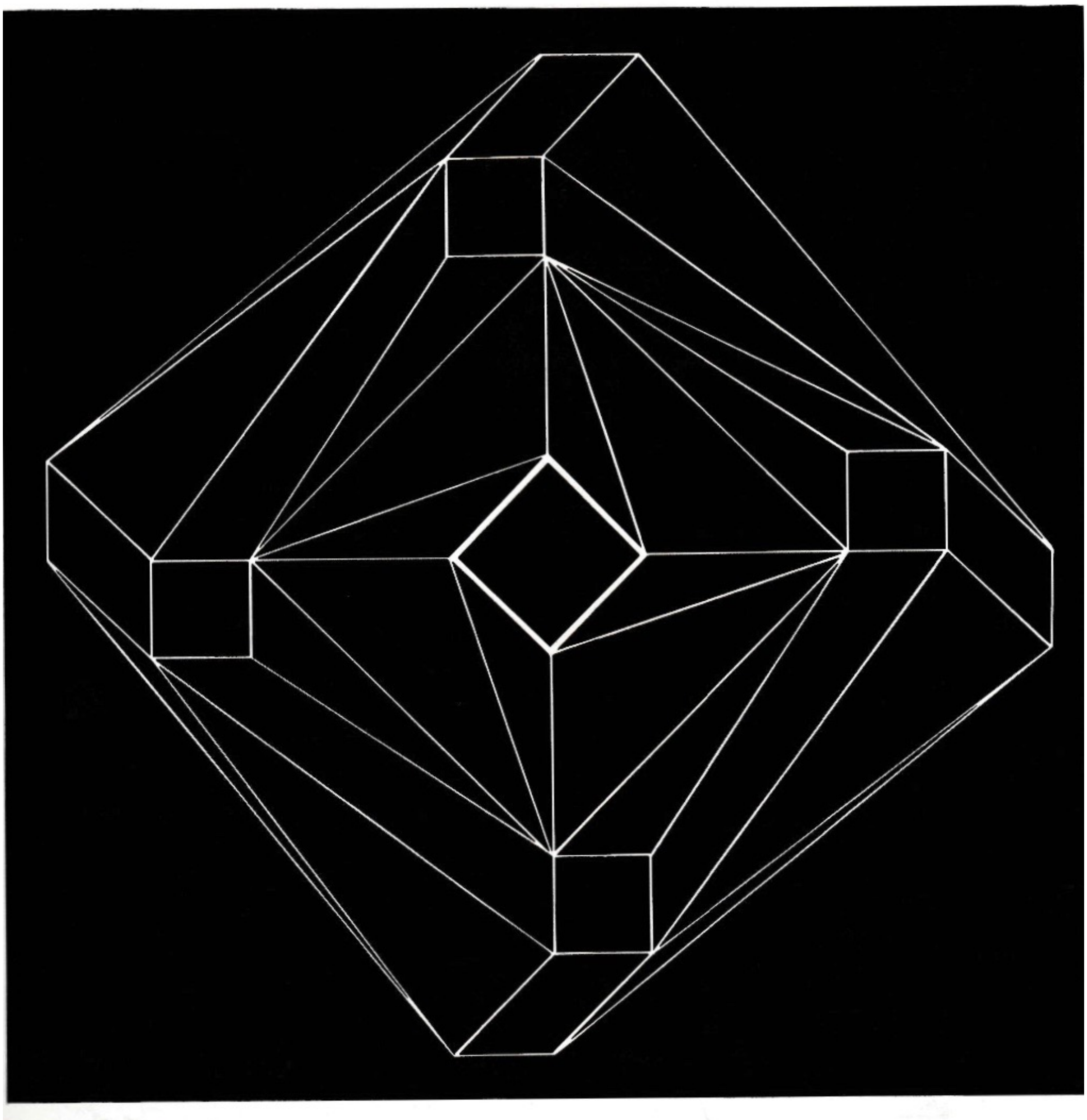

Enhancement of Engine Exhaust Flow Attachment for USB Configurations

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One of the difficulties with USB-STOL aircraft relates to the attachment of the engine exhaust flow to the wing and extended USB flap surfaces during low-speed operations.

We have developed a device, side fences, as one of the solutions for enhancing Coanda flow attachment and bring about efficient powered-lift as applied to the USB-STOL propulsive lift system. In the present paper, we attempt to summarize the the principal aerodynamic characteristics that affect the powered lift augmentation for USB configurations, as ascertained by a wind tunnel experiment together with surveys of the engine exhaust flow field over the wing and USB flap surfaces using the 8%-scale semispan model of NAL Quiet STOL Research Aircraft, with special emphasis on the basic properties of the mechanisms for the enhancement of exhaust flow attachment by side fences. Results were compared with those attained either by using the system without special devices or by using vortex-generating vanes.

Nomenclature

AR_e	: Aspect ratio defined as nozzle area A divided by square of nozzle maximum height D, $= A/D^2$
C_j	: Thrust coefficient defined as engine thrust T divided by qS
C_L	: Lift coefficient defined as lift force divided by freestream dynamic pressure q times wing area S, $=$ Lift$/qS$
C_p	: pressure coefficient defined as ΔP divided by jet mean dynamic pressure at nozzle exit, $= \Delta P/0.5\,\rho U_{jet}^2$
F_A	: Axial force
F_N	: Vertical force
q	: Freestream dynamic pressure, $= 0.5\rho U_\infty^2$
S	: Wing area
T	: Static thrust force based upon engine calibrations with flap removed, $= \sqrt{F_N^2 + F_A^2}$
α	: Angle of attack, deg.
ΔP	: Static pressure difference relative to ambient pressure P_0
WSTA	: Spanwise position on USB flap, wing station
δ_f	: USB flap deflection angle, deg.
δ_j	: Jet turning angle, deg.
η_j	: Jet turning efficiency
γ	: Flight path angle, deg.

I. INTRODUCTION

The National Aerospace Laboratory (NAL) of Japan has since 1977 been conducting