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N79-31175

FUSELAGE VENTILATION UNDER WIND CONDITIONS

FIRE MODELING AND SCALING METHODS
510-56-05

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OBJECTIVES

- DETERMINE REALISTIC FUSELAGE VENTILATION RATES FOR POST-CRASH FIRES AND FULL-SCALE FIRE TESTS

- FIND EFFECTS ON WIND-ABOUT-FUSELAGE VENTILATION RATE OF VARIOUS PARAMETERS

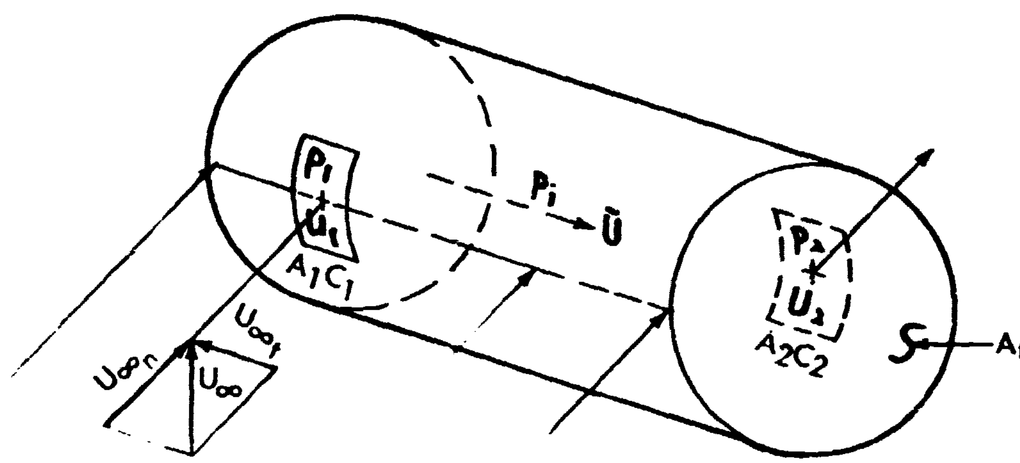
    FUSELAGE SIZE & SHAPE

    FUSELAGE ORIENTATION & PROXIMITY TO GROUND

    FUSELAGE-OPENINGS SIZE & LOCATION

    WIND SPEED & DIRECTION

FLUID MECHANICS OF FUSELAGE VENTILATION



FROM MASS CONTINUITY AND ASSUMING $d\rho = 0$

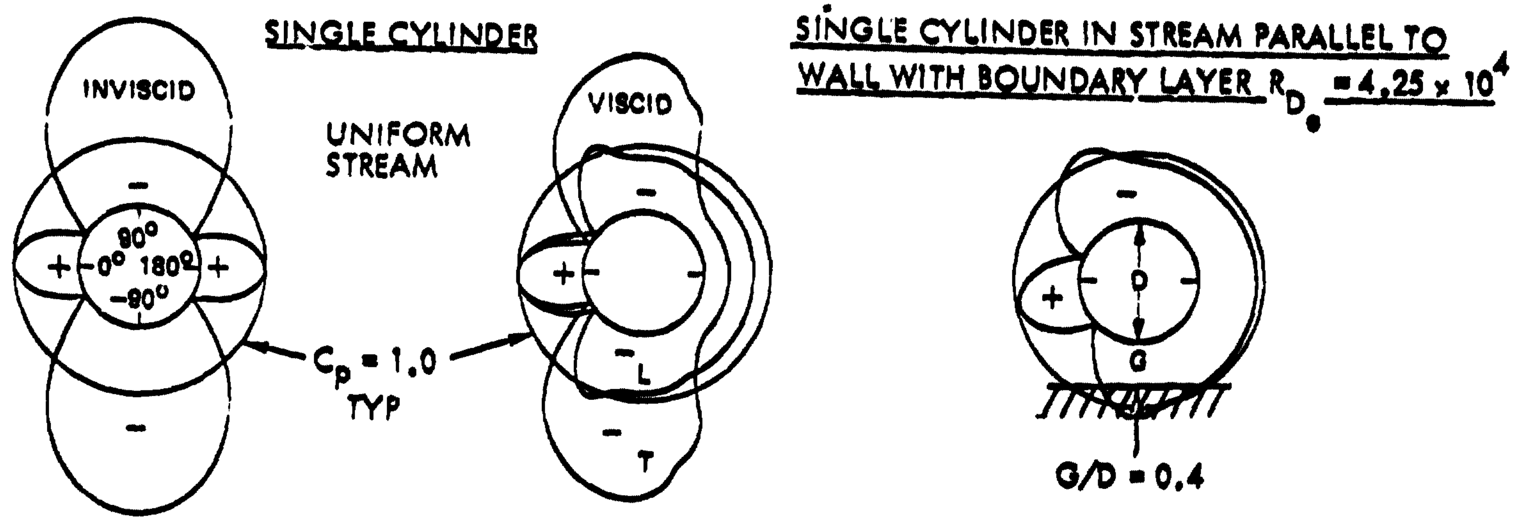
SOLVE $U_1A_1 = U_2A_2$ OR $A_1C_1\sqrt{2(p_1 - p_i)/\rho} = A_2C_2\sqrt{2(p_i - p_2)/\rho}$

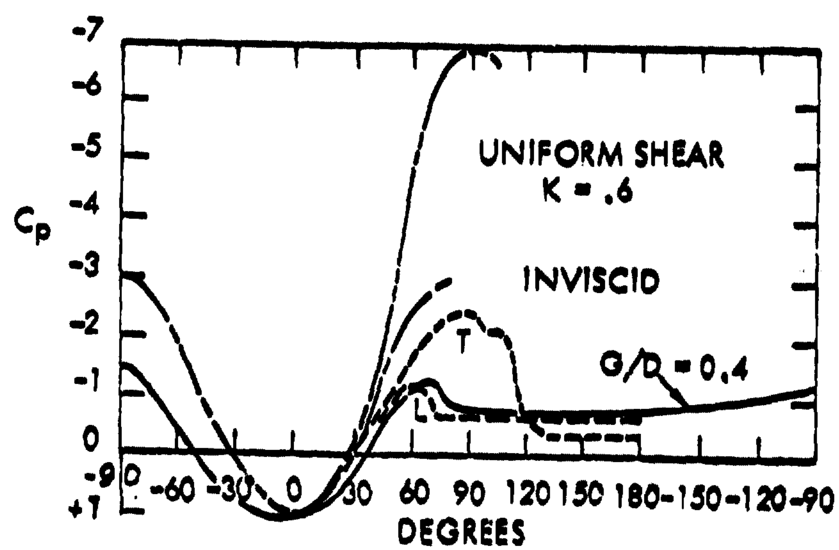
LETTING $C_p = p/q, \quad q = \frac{\rho}{2}\, U_{\infty_n}^2$

<u>VOLUMETRIC RATE</u> $Q = C_1A_1U_{\infty_n}\sqrt{C_{p_1} - \left[C_{p_1} + C_{p_2}\left(\frac{A_2C_2}{A_1C_1}\right)^2\right] \Big/ \left[\left(\frac{A_2C_2}{A_1C_1}\right)^2 + 1\right]}$

<u>INTERIOR VENTILATION SPEED</u> $\bar{U} = Q/A_f$

PRESSURE DISTRIBUTIONS FOR FLOWS AROUND INFINITE CIRCULAR CYLINDERS





REFERENCES FOR PRESSURE DISTRIBUTIONS AROUND CIRCULAR CYLINDERS

1. Forrest E. Gowen and Edward W. Perkins, "Drag of Circular Cylinders for a Wide Range of Reynolds Numbers and Mach Numbers", NACA TN-2960, June 1953

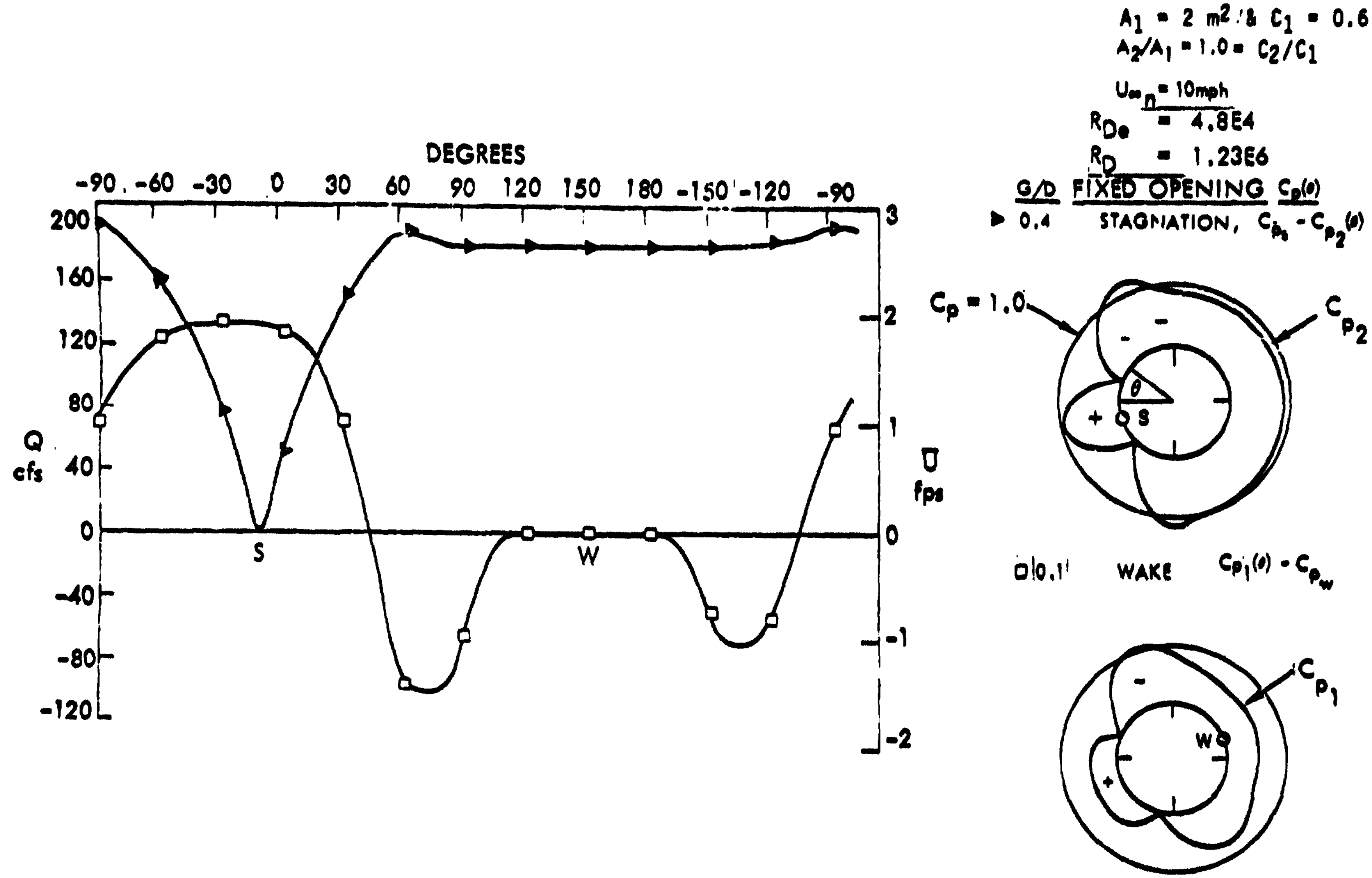
2. Melvin H. Snyder Jr., "Testing of Cylinders in Sheared Flow", J. Aircraft, Vol. 8, August 1971

3. P. W. Bearman and A. J. Wadcock, "Ther Interaction Between a Pair of Circular Cylinders Normal to a Stream", J. Fluid Mech. (1973), Vol. 61, Part 3, pp. 499-511

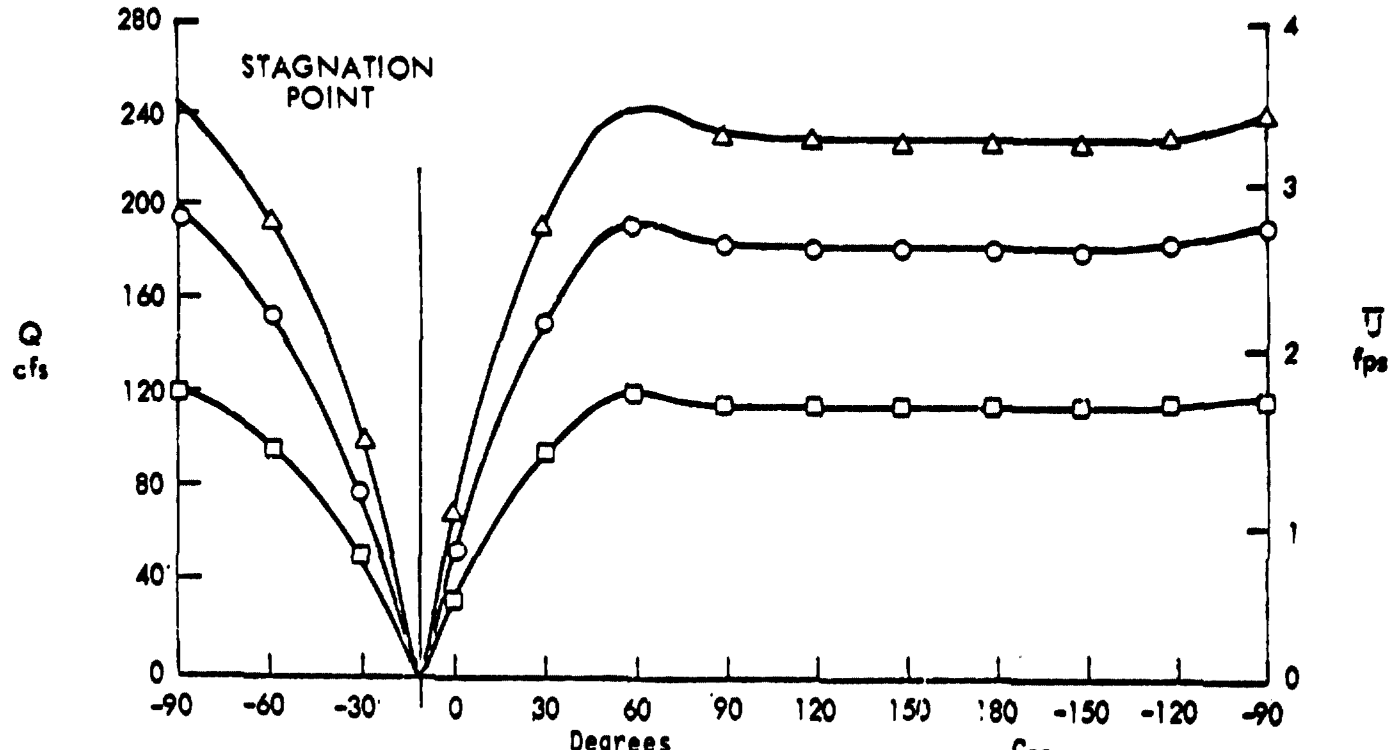
4. P. W. Bearman and M. M. Zdravkovich, "Flow Around a Circular Cylinder Near a Plane Boundary", J. Fluid Mech. (1978), Vol. 89, Part 1, pp. 33-47

VENTILATION PERFORMANCE COMPARISON

FIXED OPENINGS



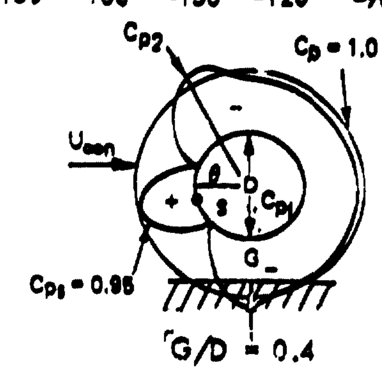
VENTILATION PERFORMANCE
IN 2-DIM. FLOW OVER FUSELAGE



$C_1 = C_2 = 0.6$

U_∞ = 10mph
A_t = $2m^2$
R_{D_e} = 4.8E4
R_D = 1.23E6

A_2/A_1
△ 2.0
○ 1.0
□ 0.5



RECOMMENDATIONS

- CONDUCT JSC FULL-SCALE FIRE TESTS TO VALIDATE THE ESTIMATES OF FUSELAGE VENTILATION OF THIS ANALYSIS

- FOR THE REAL WIND-ABOUT-FUSELAGE CONDITIONS EXPERIMENTALLY DETERMINE VENTILATION RATES APPLICABLE TO POST-CRASH FIRES & FULL-SCALE FIRE TESTS

  WIND SPEED & DIRECTION

  FULL-SCALE REYNOLDS NUMBERS

  FUSELAGE SHAPE

  FUSELAGE ORIENTATION & PROXIMITY TO GROUND

  FUSELAGE-OPENINGS SIZE & LOCATION

  FIRE-CONVECTION INDUCED SPEED OR CIRCULATION