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Subsonic base and boat-tail pressure drag of cylindrical bodies with circular-arc boat-tails and a central propulsive jet

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THE PREPARATION OF THIS DATA ITEM

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The technical work involved in the assessment of the available information and the development and subsequent construction of the Data Item method was carried out under contract to ESDU by Mr A.J. Clarke.

The person with overall responsibility for the work in this subject area is Mr R.W. Gilbey, Head of Aircraft Aerodynamics Group.

SUBSONIC BASE AND BOAT-TAIL PRESSURE DRAG OF CYLINDRICAL BODIES
WITH CIRCULAR-ARC BOAT-TAILS AND A CENTRAL PROPULSIVE JET

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SUBSONIC BASE AND BOAT-TAIL PRESSURE DRAG OF CYLINDRICAL BODIES WITH CIRCULAR-ARC BOAT-TAILS AND A CENTRAL PROPULSIVE JET

1. NOTATION AND UNITS

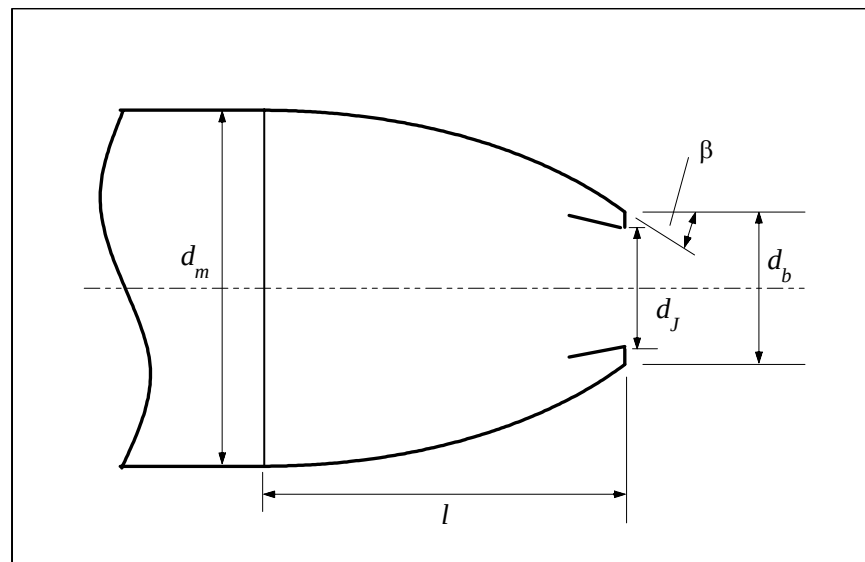
		SI	British
A_m	maximum cross-sectional area of body	m ²	ft ²
C_{DA}	total afterbody pressure drag coefficient, $C_{Db} + C_{D\beta}$, based on A_m		
C_{DAZ}	total afterbody pressure drag coefficient, $C_{DbZ} + C_{D\beta Z}$, based on A_m , with zero jet flow		
C_{Db}	base drag coefficient, $-C_{pb}([d_b/d_m]^2 - [d_J/d_m]^2)$, based on A_m		
C_{DbZ}	base drag coefficient, based on A_m , with zero jet flow		
$C_{D\beta}$	boat-tail pressure drag coefficient, based on A_m		
$C_{D\beta Z}$	boat-tail pressure drag coefficient, based on A_m , with zero jet flow		
C_{pb}	base pressure coefficient		
C_{pbZ}	base pressure coefficient with zero jet flow		
ΔC_{pb}	increment in C_{pb} due to jet efflux, $C_{pb} - C_{pbZ}$		
$(\Delta C_{pb})_I$	intercept of ΔC_{pb} versus g curve on axis $g = 0$		
$(\Delta C_{pb})_{I,cold}$	intercept of ΔC_{pb} versus g curve on axis $g = 0$ for cold jet ($T_{TJ} = 300$ K)		
d_b	base diameter, see Sketch 1.1	m	ft
d_J	jet exit diameter, see Sketch 1.1	m	ft
d_m	maximum body diameter, see Sketch 1.1	m	ft
g	geometry parameter, $[d_J/d_b]^2 d_J/d_m$		
l	boat-tail length, see Sketch 1.1	m	ft
M_∞	freestream Mach number		

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p_{∞}	freestream static pressure	N/m ²	lbf/ft ²
p_{TJ}	jet total pressure	N/m ²	lbf/ft ²
T_{TJ}	jet total temperature	K	K
β	boat-tail angle, $2 \tan^{-1}([d_m - d_b]/2l)$, see Sketch 1.1	deg	deg

Subscripts

$()_{\text{expt}}$	denotes experimental value
$()_{\text{pred}}$	denotes predicted value



Sketch 1.1 Afterbody geometry

2. INTRODUCTION

This Item presents an empirical method of estimating the subsonic pressure drag coefficient of an afterbody with a central propulsive jet. The method is based on that presented in Derivation 3 and is applicable to axisymmetric bodies with circular-arc or similar boat-tails fitted with a convergent or parallel nozzle.

The estimation method is only applicable to afterbody designs that include a significant rear-facing annular base area (see Section 4). A means of pressure drag prediction for afterbodies with negligible annular base area may be found in Item No. 01012 (Reference 6). This method requires estimates for the base pressure and boat-tail pressure drag coefficients without jet flow, which may be obtained from test data or Item No. 96012 (Derivation 5).

The method itself is described in Section 3 and notes on the accuracy and applicability are given in Section 4. A fully worked example is presented in Section 6.