ESDU 78019
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March 2017
Supersedes ESDU
Aero B.02.04.01 to 03

Profile drag of axisymmetric bodies at zero incidence for subcritical Mach numbers

Associated software: ESDUpac A7819

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THE PREPARATION OF THIS DATA ITEM

The work on this particular Data Item which supersedes ESDU Aero B.02.04.01 to 03, was monitored and guided by the Aerodynamics Committee. This Committee first met in 1942 and now has the following membership:

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The members of staff who undertook the technical work involved in the initial assessment of the available information and the construction and subsequent development of the Item were

Mr P.D. Chappell — Group Head
Mr S.F. Wood — Principal Engineer.

Subsequent to the issue of ESDU 78019, Addendum A was prepared by Mr P.D. Chappell.

The person with the overall responsibility for the work in this subject area is Mr A.J. Clarke, Head of Aerodynamics Group.

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PROFILE DRAG OF AXISYMMETRIC BODIES AT ZERO INCIDENCE FOR SUBCRITICAL MACH NUMBERS

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PROFILE DRAG OF AXISYMMETRIC BODIES AT ZERO INCIDENCE FOR SUBCRITICAL MACH NUMBERS

1. NOTATION AND UNITS (see Sketch 1.1)

		SI	*British*
A	afterbody parameter, $(l_a/D)\tan\tau$		
B	index in expression for flat plate mean skin friction coefficient with fully-turbulent boundary layer, see Equation (4.3)		
C_D	body profile drag coefficient based on surface area, $D_P/(q_\infty \times \pi DLC_S)$		
C_F	flat plate mean skin friction coefficient (based on skin friction and area of one side of plate)		
C_{F0}	flat plate mean skin friction coefficient (fully-turbulent boundary layer, $x_{tr}/L = 0$), see Equation (4.2)		
C_S	area coefficient, ratio of body surface area to surface area of enclosing cylinder, $S/(\pi DL)$		
C_V	volume (or prismatic) coefficient of body, ratio of body volume to volume of enclosing cylinder, $4V/(\pi D^2 L)$		
C_{Va}	volume coefficient of afterbody, $4V_a/(\pi D^2 l_a)$		
C_{Vf}	volume coefficient of forebody, $4V_f/(\pi D^2 l_f)$		
D	maximum diameter of body	m	ft
D_P	profile drag of body	N	lbf
F_f	correction to correlating parameter C_S/C_V^n to allow for forebody shape and length, see Section 4.2		
F_{M1}, F_{M2}	functions of Mach number, see Equations (4.4) and (4.5)		
K_M	correction factor for M, see Equation (4.1)		
K_{tr}	correction factor for x_{tr}/L, see Equation (4.1)		
k_1	family parameter for Body 7 in ESDU 77028		
L	body length	m	ft
l_a	afterbody length	m	ft

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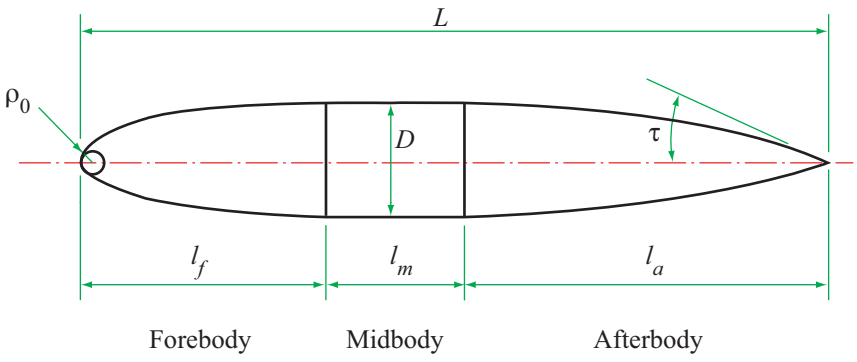
l_f	forebody length	m	ft
l_m	midbody length	m	ft
M	free-stream Mach number		
n	function of C_V and D/L, see Section 4.2		
p, q	functions of $l_f(l - C_{Vf})/L$, see Section 4.3		
q_∞	free-stream kinetic pressure	N/m^2	lbf/ft^2
R_L	Reynolds number based on body length		
S	body surface area	m^2	ft^2
V	body volume	m^3	ft^3
V_a	afterbody volume	m^3	ft^3
V_f	forebody volume	m^3	ft^3
x_{tr}	axial distance of boundary-layer transition from nose	m	ft
λ	normalised drag parameter, C_D/C_F		
λ_G	value of λ relating to required body at datum boundary-layer and flow conditions, see Section 4.2		
ρ_0	nose radius of curvature	m	ft
$\bar{\rho}_0$	non-dimensional nose radius, $\rho_0 l_f/D^2$		
τ	tail half-angle	degree	degree



Sketch 1.1 Body geometry

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