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Low-speed drag coefficient increment at zero lift due to full-span split flaps

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THE PREPARATION OF THIS DATA ITEM

The work on this particular Data Item which supersedes Item Nos Aero F.02.01.01-05 was monitored and guided by the Aerodynamics Committee. This Committee first met in 1942 and now has the following membership:

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Mr J.W.H. Thomas	— Hawker Siddeley Aviation Ltd, Hatfield
Mr J. Weir	— University of Salford

The member 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 was

Mr P.D. Chappell	— Group Head.
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LOW-SPEED DRAG COEFFICIENT INCREMENT AT ZERO LIFT DUE TO
FULL-SPAN SPLIT FLAPS

CONTENTS

	Page
1. NOTATION AND UNITS	1
2. INTRODUCTION	1
3. UNSWEPT WINGS	3
4. SWEPT WINGS	3
5. DERIVATION	4
6. EXAMPLE	5

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LOW-SPEED DRAG COEFFICIENT INCREMENT AT ZERO LIFT DUE TO FULL-SPAN SPLIT FLAPS

1. NOTATION AND UNITS

All sectional geometry specified in this Item relates to a plane parallel to the aircraft's plane of symmetry.

		<i>SI</i>	<i>British</i>
A	aspect ratio		
C_D	total drag coefficient of wing		
C_L	total lift coefficient of wing		
c	wing chord	m	ft
c_f	flap chord	m	ft
t	maximum thickness of wing section	m	ft
ΔC_{D0}	increment in drag coefficient at zero lift* due to full-span split flaps on a swept wing		
ΔC_{D0u}	increment in drag coefficient at zero lift due to full-span split flaps on an unswept wing		
δ	flap deflection angle	degree	degree
$\Lambda_{1/4}$	sweepback of wing $1/4$ -chord line	degree	degree

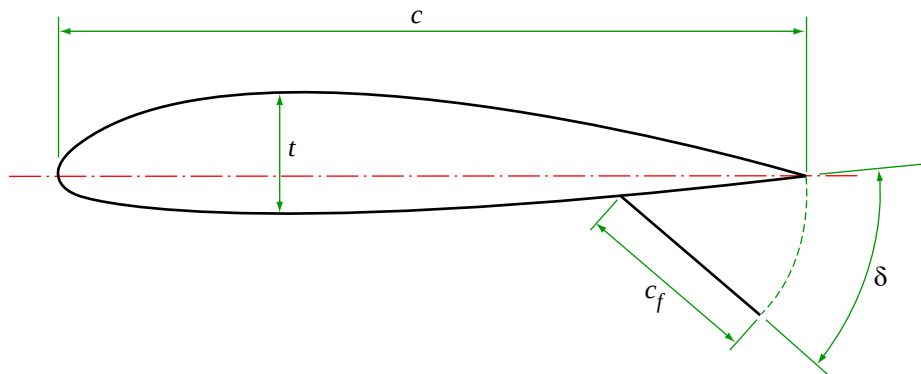
* (i) Frequently referred to as "the profile drag coefficient increment" in some of the older Items, but due to variations in the boundary layer with incidence there is also a lift-dependent component of profile drag (see Item No. 66031) albeit neglected in this Item.

(ii) Sketch 2.1 shows how ΔC_{D0} is derived.

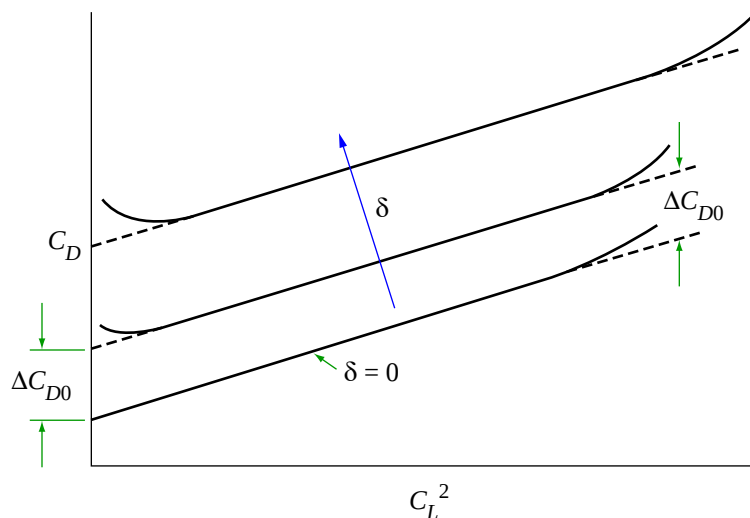
2. INTRODUCTION

The total drag coefficient of a wing with flap deflection can often be represented as a linear variation of C_D with C_L^2 over the range of C_L of interest. The value of C_D at $C_L = 0$ given by this simplified representation minus the clean wing drag coefficient at zero lift is often referred to as the increment in drag coefficient at zero lift arising from flap deflection, ΔC_{D0} .

Over the linear part of the $C_D \sim C_L^2$ curve, the total drag coefficient of a wing with flaps deflected can be represented by the sum of the drag components at zero lift and the lift-dependent drag components. For the case of full-span flaps (see Sketch 2.1) the lift-dependent drag can usually be based on that component arising from trailing vortices only*, calculated via the total lift with a vortex drag factor appropriate to the wing planform (see Item No. 74035). The lift increment due to full-span split flaps can be obtained from Item No. 74009.



(a) Flap geometry in plane parallel to aircraft plane of symmetry



(b) Typical drag characteristics for wing with full-span flaps

Sketch 2.1

The present Item is concerned with the estimation of ΔC_{D0} , the increment in the drag coefficient at zero lift arising from the deflection of full-span split flaps, derived from the experimental data as shown in Sketch 2.1. At low speeds the linear parts of the $C_D \sim C_L^2$ curves for a wing obtained at a series of flap deflections are essentially parallel, so that ΔC_{D0} applies anywhere in the linear range (see Section 3). In addition ΔC_{D0} can be considered to be substantially independent of the wing aspect ratio, section shape (for a given t/c) and Reynolds number (see Section 3).

* The neglect of the lift-dependent drag due to the boundary layer on a wing with flaps deflected is usually found to be reasonable, at other than small flap deflections, when comparisons with experimental data are made.