



ESDU 74011

Issued July 1974

With Amendment A

March 1997

Supersedes ESDU Aero C.01.01.06

Rate of change of lift coefficient with control deflection for full-span plain controls

Endorsed by
The Royal Aeronautical Society

 **Documents**
Document Sharing Hub

ESDU DATA ITEMS

Data Items provide validated information in engineering design and analysis for use by, or under the supervision of, professionally qualified engineers. The data are founded on an evaluation of all the relevant information, both published and unpublished, and are invariably supported by original work of ESDU staff engineers or consultants. The whole process is subject to independent review for which crucial support is provided by industrial companies, government research laboratories, universities and others from around the world through the participation of some of their leading experts on ESDU Technical Committees. This process ensures that the results of much valuable work (theoretical, experimental and operational), which may not be widely available or in a readily usable form, can be communicated concisely and accurately to the engineering community.

We are constantly striving to develop new work and review data already issued. Any comments arising out of your use of our data, or any suggestions for new topics or information that might lead to improvements, will help us to provide a better service.

THE PREPARATION OF THIS DATA ITEM

The work on this particular Data Item which supersedes ESDU Aero C.01.01.06, was monitored and guided by the Aerodynamics Committee. This Committee first met in 1942 and now has the following membership:

Chairman	
Mr E.C.Carter	— Aircraft Research Association
Vice-Chairman	
Prof. G.M. Lilley	— Southampton University
Members	
Prof. L.F. Crabtree	— Bristol University
Mr. R.L. Dommett	— Royal Aircraft Establishment
Mr. H.C. Garner	— Royal Aircraft Establishment
Mr. J.R.C. Pedersen	— British Aircraft Corporation Ltd, Stevenage
Mr. J.J. Perrin	— Aérospatiale, Châtillon
Mr. M.R. Pike	— Rolls-Royce (1971) Ltd, Derby
Mr. M.W. Salisbury	— British Aircraft Corporation Ltd
Mr. J.J. Spillman	— Cranfield Institute of Technology
Mr. J. Taylor	— Hawker Siddeley Aviation Ltd, Woodford
Mr J.W.H. Thomas	— Hawker Siddeley Aviation Ltd, Hatfield
Mr. J. Weir	— Salford University.

The work on this Item was carried out in the Aircraft Motion Group of the Engineering Services Data Unit under the supervision of Mr P.D. Chappell, Group Head. 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 J.W. Allan	— Senior Engineer.
---------------	--------------------

RATE OF CHANGE OF LIFT COEFFICIENT WITH CONTROL DEFLECTION FOR FULL-SPAN PLAIN CONTROLS

CONTENTS

	Page
1. NOTATION AND UNITS	1
2. NOTES	2
3. DERIVATION	3
4. EXAMPLE	4
FIGURES 1 to 3	5 to 6

RATE OF CHANGE OF LIFT COEFFICIENT WITH CONTROL DEFLECTION FOR FULL-SPAN PLAIN CONTROLS

This Item deals with plain-trailing-edge flaps when used as controls. For reference to Items that treat plain controls as part of a high-lift system, see the introductory information in Item No. 97002.

1. NOTATION AND UNITS

		SI	British
A	aspect ratio		
C _L	lift coefficient		
c	wing chord	m	ft
c _f	flap chord	m	ft
k ₁	correction factor for wing thickness (see Equation (2.1))		
k ₂	correction factor for Reynolds number (see Equation (2.1))		
M	free-stream Mach number		
R	Reynolds number based on aerodynamic mean chord of wing and free-stream velocity		
t	maximum thickness of wing section	m	ft
α	wing incidence	rad	rad
β	compressibility parameter, (1 – M ²) ^{1/2}		
δ	flap deflection angle in plane parallel to aircraft plane of symmetry*, positive downwards	rad	rad
Λ _{1/2}	sweepback of mid-chord line	degree	degree
Suffix			
T	refers to theoretical value		

* The flap deflection is usually specified in a plane normal to the hinge line. It follows that

$$\delta = \tan^{-1} (\tan \delta_H \cos \Lambda_h),$$

where δ_H is the deflection in the plane normal to the hinge line and Λ_h is the sweepback of the hinge line.