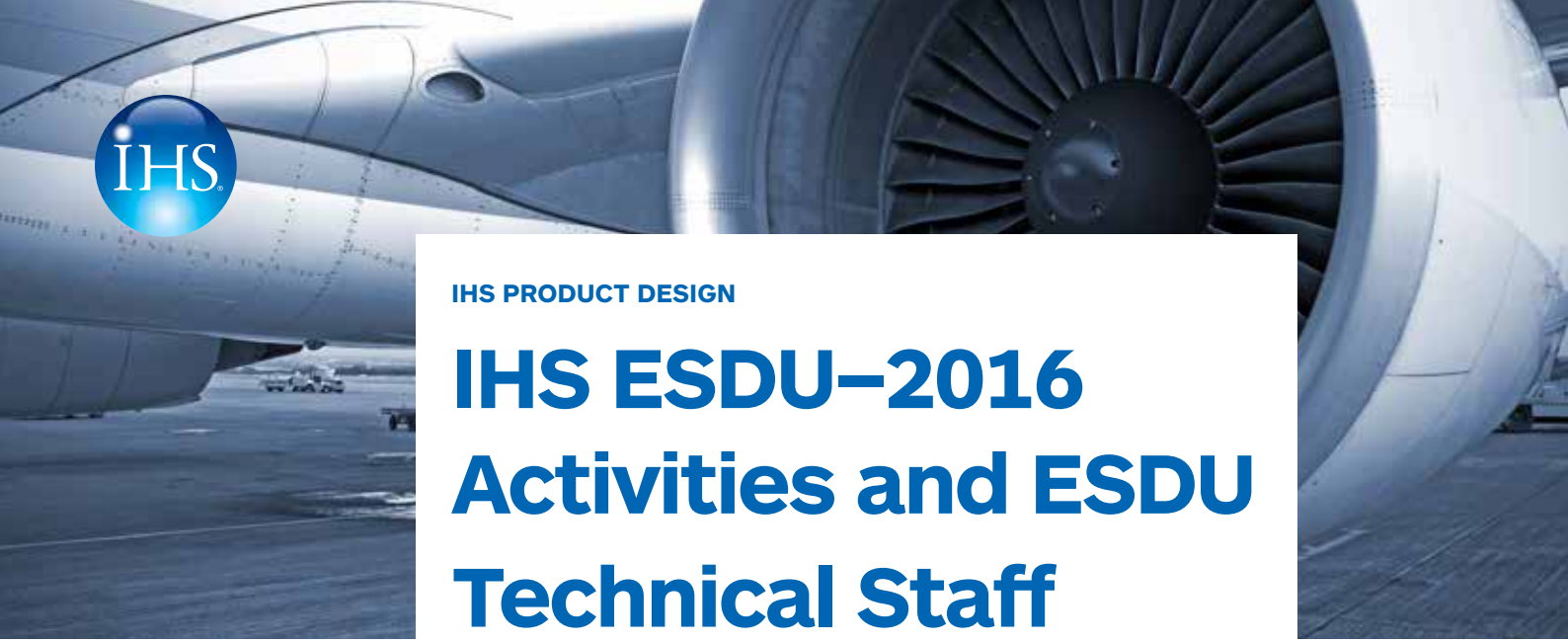

IHS PRODUCT DESIGN

IHS ESDU–2016 Activities and ESDU Technical Staff

This document provides an overview of work being carried out in 2016 across the ESDU Series. This work, which is performed by the ESDU Engineers, and led, monitored, and guided by the ESDU Technical Committee leads, provides validated engineering design data, methods, and software that form an important part of the design operation of companies large and small throughout the world. Endorsed by key professional institutions, the ESDU tools are developed by engineers for engineers.

ACTIVITIES AT A GLANCE:

Current work at ESDU includes the following:

- **Aerodynamics**
  Stealth airframe and UAV store deployment; wing pressures and non-linear aerodynamics
- **Aircraft Noise**
  Coaxial jet noise; installing a jet engine under a wing; MATLAB versions of existing programs
- **Performance**
  Tire forces in unfavorable runway conditions; aquaplaning; flight test data
- **Stress & Strength**
  Fatigue crack propagation rates; threshold stress intensity factors; low-cycle fatigue phenomena; stresses in bolted joints, various updates and more
- **Aerospace Structures**
  Shear cleat attachments; flange efficiency factors; FSM Data Item and program consolidation; flat circular isotropic plates under uniform pressure
- **Transonic Aerodynamics**
  High-speed flows and flow separations on wings; critical wing-fuselage junctions
- **Fatigue Vibration & Acoustic**
  Cracks in the engine nacelle; structure endurance in presence of noise; possible damage to satellites, due to the intense rocket noise at take-off; coupling loss factors; acoustics of reverberation chambers

Aerodynamics Committee Activities

The Aerodynamics Committee is continuing its review of cavity aerodynamics and aero-acoustics. This initiative was a response to the requirements of stealth airframe and UAV manufacturers for the internal carriage of stores and munitions, although it has other applications. Methods previously issued addressed the Aerospace aerodynamics in terms of drag, time-averaged, and unsteady flows. Current work considers the alleviation of adverse effects, using both active and passive devices, and the effects on store deployment. A bibliography is being prepared that will contain over 1000 references considered during the review.

In order to consider the application of current and future methods at high angle of attack, an investigation is also under way on the prediction of wing leading–edge pressures and non-linear aerodynamics. This work is likely to impact many methods dealing with stability, and could potentially extend their ranges of applicability. A steering group has been formed to guide this activity.

Aerodynamics Series:

Andy Clarke – Group Head
Chris Batt – Senior Engineer
Steve Wood – Principal Engineer

Aircraft Noise Committee Activities

In the Aircraft Noise Series, ESDU has recently released a Data Item on predicting the effects of flight on coaxial jet noise. The innovative Data Item has been in development for some time, but the Committee is now satisfied that it can predict static-to-flight effects in the third-octave SPLs within a standard deviation of 0.4dB and in the OASPLs within a standard deviation of 0.3dB.

Work is in progress currently on a method for predicting the effects of installing a jet engine under a wing. The analytical model will take into account the curvature of the wing under-surface, wing dihedral and sweep.

Work is also in progress to provide MATLAB versions of existing programs. These will allow users to input data more easily through a Graphical User Interface as well as providing graphical output in addition to standard text output.

Aircraft Noise Series:
Cyrus Chinoy – Group Head

Performance Committee Activities

The Performance Committee is continuing to focus on the development and refinement of methods for the prediction of the take-off and landing performance of aircraft when operating from runways that are contaminated with water, slush, ice, or snow. A major part of this work will be the improvement of the methods for the estimation of tire forces during braking/deceleration and for the determination of the conditions under which aquaplaning may occur. In recent years, there have been a number of accidents and incidents where flight crews were unable to bring aircraft to a stop within the runway distance available. Regulatory authorities are reviewing the causal factors with the intention of implementing measures to reduce the frequency of these events.
The ESDU methods are intended to provide aircraft design organizations with the most accurate means to predict aircraft stopping distances – and all other aspects of aircraft performance.

Work is also in progress to develop further the methods for the derivation of aircraft thrust and drag forces from flight test data.

The ESDU Performance Series contains well over 100 Data Items that provide subscribers with methods data and associated worked examples for the estimation and measurement of aircraft performance. The Performance Series also features the powerful and versatile Aircraft Performance Program, a software suite for the analysis of aircraft performance.

Performance Aircraft Series:

Cliff Whittaker – Group Head
Richard Sayers – Senior Engineer

Stress and Strength Committee Activities

The Stress and Strength of Components (SASC) Committee is used across industry by mechanical engineers, fatigue analysis engineers, and stress engineers. In 2016, the committee is discussing an update to an existing Data Item on fatigue crack propagation rates and threshold stress intensity factors in high strength low-alloy steel plates, bars and forgings. As well as including new stress intensity test data for high strength low-alloy steels, a more comprehensive introduction and discussion of stress intensity factors has been added to assist the reader's understanding and interpretation of the data. There are already several other Items in the SASC Series that compliment this work, including reports on fatigue crack propagation rates and stress intensity factors in high alloy and corrosion resistant steel, in aluminium sheet, plate, bars and forgings, and a Data Item that analyses the effect of stresses at corner cracks in loaded holes in lugs and wide plate, to name but a few.

Recently new Data Items have been published on subjects such as the low-cycle fatigue phenomenon, stresses in bolted joints, and a series of Items on shafts with interference fit collars. This year, following a suggestion from an interested aerospace company, the Committee is creating a new guide to bonded joints suitable for use by engineers already familiar with this subject or by those wishing to learn more about adhesive bonding. This Item includes an introduction to bonding techniques, a guide to learning how to select suitable adhesives and adherents for parts in service, and an examination of the likelihood of loads and stresses in a bonded joint in service. This work will be suitable for use in various industrial applications such as in aerospace, as well as in electronics, structural and semi structural industries, and automotive engineering projects.

Stress and Strength Series:

Adam Quilter – Group Head
Dorothy Downs – Senior Engineer

Aerospace Structures Committee Activities

The ESDU Aerospace Structures and Composite Series Data Items are mainly used during an aircraft's preliminary and detailed design stages of its structural components, such as aircraft wings, horizontal stabilizers, fins and fuselage sections. The Aerospace Structures Committee is focusing on prediction of loads in aircraft structures shear cleat and clip attachments. The new ESDU Data Item presents graphs to enable the prediction of the critical attachment loads for cleats. The Data Item also discusses the proper function of cleats and aspects of good design practice.

A new data item is also in development on flange efficiency factors for curved beams under bending in the plane of curvature. This provides data for the calculation of elastic stresses in the flanges and the deflections of curved beams on a typical fuselage section subjected to bending in the plane of curvature. The data are provided in the form of flange efficiency factors from which equivalent flanges with cross-sectional areas may be obtained for use with beam theory.

Work also continues on consolidation of new and older ESDU finite strip method (FSM) Data Items and programs, as well as new work on deflections and elastic stresses for flat circular isotropic plates under uniform pressure. This ESDU Data Item includes a computer program that calculates maximum stresses and deflections for initially flat circular isotropic plates of uniform thickness under uniform pressure, with various forms of edge restraint conditions.

Aerospace Structures Series:

Adam Quilter – Group Head
Neil Dev-Anand – Senior Engineer

Transonic Aerodynamics Committee Activities

In 2016, the Transonic Aerodynamics Committee will be continuing its focus on the prediction of high-speed flows and flow separations on wings, using the VFP (Viscous Full Potential) code available to subscribers to the Transonic Aerodynamics Series.

The accurate prediction of initial flow separation on a wing's upper surface is a critical design point in the wing definition process, and the current work on VFP indicates great promise for the delivery of such a rapid and reliable computational tool for this purpose. In addition to the prediction of onset of flow separation, a post processor is also being developed to analyse the output, and then present the forces, moments, and 1g (cruise) wing span-wise loading in a tabular form, which will allow a rapid assessment of the wing's performance and loads.

Other VFP projects include an extension and examination of the previously-issued frozen boundary-layer version, developed initially to enable very quick processing times suitable for use in multiple-run optimization exercises, and to explore its ability as a tool for prediction of flow anomalies and separations at the critical wing-fuselage junction. The initial results appear very encouraging, and the method is now being evaluated and tested against specially selected, high-quality wind-tunnel data known to exhibit such issues.

Transonic Aerodynamics Series:

David Philpott – Group Head
Kevin Hackett – Principal Engineer

Vibration & Acoustic Fatigue Committee Activities

Items in the Vibration & Acoustic Fatigue Series are used by engineers in the aircraft and space industries who are concerned with the effect of intense noise on structures and with the prevention of damage to those structures. In the case of commercial aircraft, the engineer might, for example, be concerned with the prevention of cracks in the engine nacelle. Data on noise levels and materials are provided in the Series Items, so that the stress levels and the life of the structure can be estimated. Numerous other applications include the prediction of possible damage to satellites, due to the intense rocket noise at take-off.

In addition to Items concerned with the endurance of structures in the presence of noise, there are a number of Items which consider more generally the analysis of vibration. In this context, the committee is working on an Item on coupling loss factors, a concept unique to Statistical Energy Analysis. In Statistical Energy Analysis, the coupling loss factor represents a dimensionless measure of the power loss between two subsystems and is a vital part of the equation for the power transfer between these subsystems.

An Item on the acoustics of reverberation chambers is also being prepared for issue. In reverberation chambers, reflected sound is dominant and very high sound levels can be achieved. This makes them useful for testing the endurance of structures such as satellites in sound fields.

Vibration & Acoustic Fatigue:

Cyrus Chinoy – Group Head
John Anderson – Senior Engineer

Meet the ESDU Engineers

ESDU committees encompass a broad range of independent technical professionals from a wide range of industries that contribute invaluable technical knowledge to our products. ESDU's technical solutions are closely monitored and guided by these independent committees to develop rigorously validated methods, data, and software that are trusted by industry and academia.

As a subscriber of ESDU, users have direct access to ESDU engineering expertise as part of the ESDU subscription service. To have this level of access to such expertise is extremely rare, highly valuable, and helps ensure safety and quality in products around the world.

Listed below are the lead engineers for the various ESDU Series.

Aerodynamics – Andy Clarke – Group Head
Andy.Clarke@ihs.com

Andy has twenty five years experience of developing empirical and semi-empirical methods and design data for the ESDU Aerodynamics Series, originally as a staff Engineer and then as an external consultant. He re-joined the staff of ESDU in 2008 as a Senior Engineer and became Head of the Aerodynamics Group in 2011. Previously, he worked at BAE Systems Hatfield. He holds a BSc in Engineering Science from the University of Exeter.

Aerodynamics – Steve Wood – Principal Engineer
Steve.Wood@ihs.com

Steve is responsible for the creation, updating, and support of the ESDU Aerodynamics Series. Steve has been with IHS since 2011. Previously he was with BAE SYSTEMS for 30 years responsible for aerodynamic design and support to a wide variety of civil and military aircraft. He also served on the ESDU Aerodynamics Committee from 2002 to 2011. Steve has a BSc (Hons) in Aeronautical Engineering from Manchester University.

Aerodynamics – Chris Batt – Senior Engineer
Chris.Batt@ihs.com

Chris has been an aerodynamicist developing prediction methods within the ESDU Aerodynamics Group since 1996. Chris has a BEng degree in Mechanical Engineering from Coventry Polytechnic, an MSc degree in Engineering Design from Loughborough University, and an MSc degree in Aerodynamics from Cranfield University. Chris also holds a Commercial Pilot's License and is a part time Flying Instructor.

Aircraft Noise and Structural Dynamics – Dr. Cyrus Chinoy – Group Head
Cyrus.Chinoy@ihs.com

Dr. Chinoy is responsible for the Aircraft Noise Series and the Vibration & Acoustic Fatigue Series, which are issued by the ESDU Aircraft Noise & Structural Dynamics Group.
Over the past few years, he has been addressing the various noise-generating mechanisms of modern aero-engines and airframes with the aim of predicting emanating sound pressure levels. After graduation from IIT, Bombay he specialized in acoustics with a Master's degree from the University of London, a short spell of research at the University of Cambridge, and then a doctorate while working as a Research Associate at the Welsh School of Architecture, University of Wales. He joined ESDU in 1984.

Fluid Mechanics – Internal Flow – Eva Vitora – Engineer
Eva.Vitora@ihs.com

Eva works on the ESDU Fluid Mechanics, Internal Flow Series. She is developing design guidelines and performing computational fluid dynamics simulations for different flow applications in A&D and Energy. She has been with IHS since January 2012. Previously, Eva was an M&E consultant for LEDA Ltd. Eva has Masters Degree in Engineering from The Technical University in Prague and an MSc in Computational Fluid Dynamics from The University of Leeds.

Performance– Cliff Whittaker – Group Head
Cliff.Whittaker@ihs.com

Cliff is responsible for the ESDU Aircraft Performance series. He joined ESDU in March 2015. Following graduation from Queen Mary College, University of London, Cliff worked as an aerodynamicist for British Aerospace at Hatfield for 15 years. During that period he was involved in flutter prediction and testing, stability and control, performance, aerodynamic data for structural loads, wind tunnel testing and flight test analysis – as applied to the BAe 146 series, Airbus A330/340 initial design and the BAe 125 series of aeroplanes. Subsequently, Cliff was employed by the Civil Aviation Authority for 20 years: spending 15 years in the airworthiness discipline (9 of which were as Policy Manager for design airworthiness) and then 5 years as Head of Policy for Flight Crew Licensing.
He achieved Chartered Engineer status in 1995. He has a BSc (Hons) (1st class) in Aeronautical Engineering.

Aircraft Performance – Richard Sayers – Senior Engineer
Richard.Sayers@ihs.com

Richard is currently involved with the study of aircraft performance on contaminated runway surfaces. He joined ESDU in 1999 as an engineer working on the ESDU Stress and Strength Series. Richard has a BEng and MEngSc from the Department of Mechanical Engineering at Monash University, Australia.

Aerospace Stress & Strength Analysis – Adam Quilter – Technical Director & Group Head
Adam.Quilter@ihs.com

Adam joined ESDU in 1995 as an engineer working on the Stress and Strength Series. In 1997, he became head of the ESDU Strength Analysis Group with responsibility for the Aerospace Structures, Composites, Fatigue – Endurance Data, Fatigue – Fracture Mechanics and Stress and Strength Series and for the Metallic Materials Data Handbook (MMDH), although his technical work focused on aircraft structures, with emphasis on instability analysis. In 2008 he became Technical Director of the ESDU Aerospace products. He has BA (Hons) and MA (Hons) degrees from the University of Cambridge.

Stress Analysis and Strength of Components – Dorothy Downs – Engineer
Dorothy.Downs@ihs.com

Dorothy is responsible for maintaining and developing the content of the ESDU Stress and Strength Series. Dorothy joined IHS in 2007. Previously, Dorothy worked at Goshawk Aerospace and TWI (The Welding Institute). Dorothy has a BEng (Hons) in Materials Science and Engineering from the University of Wales, Swansea, an MSc (Eng) in Laser Engineering and Manufacturing from Liverpool University, and a PhD (co-sponsored by TWI) in Metallurgy from the University of Cambridge.

Structures (Aerospace) – Neil Dev-Anand – Senior Engineer
Neil.Dev-Anand@ihs.com

Neil Dev-Anand is a Senior Engineer working on the ESDU Aerospace Structures Series. He has been with IHS since 1998. Before moving to IHS he was an Aerospace Structural Engineer at GKN Westland Aerospace Ltd (UK) and was involved in the stress analysis of the Bombardier Dash 8 400 aircraft nacelle during its final flight test program. Neil has an MSc in Aerospace Vehicle Design from Cranfield University and a BEng (Hons) in Air Transport Engineering (Aeronautical Engineering with Airline Economics) from City University, London.

Transonic Aerodynamics – David Philpott – Group Head
David.Philpott@ihs.com

David has worked on a half-time basis for ESDU since 1993 and is currently responsible for the Transonic Aerodynamics Group. David started his career with the Royal Aircraft establishment, working on the Concorde project, was Assistant Chief Research Engineer at British Aerospace (Airlines Division), Principal Aerodynamics Engineer at Raytheon Corporate Jets and Reader in Aerodynamics at the University of Hertfordshire. He graduated from the University of Bristol and holds BSc, MSc and PhD degrees in Aerospace Engineering.

Transonic Aerodynamics – Kevin Hackett – Senior Engineer
Kevin.Hackett@ihs.com

Kevin is responsible for the maintenance and development of the ESDU Transonic Aerodynamics Series. Having completed a five year apprenticeship with British Aerospace at Hatfield, Kevin spent 14 years in the Aerodynamics department, working on wing designs for several Airbus aircraft, culminating in the A330/A340 aircraft. He then transferred to Corporate Jets which included future project studies and supporting the development of the U125A for the Japanese Air force. He joined QinetiQ (then DERA) in 1995 and spent 13 years working on, and leading, several UK and European research programs covering advanced wing design concepts, wind tunnel testing, and flow control. During this period, he provided the aerodynamic support for the Zephyr HALE program. Kevin left QinetiQ to join ESDU in 2008. He is the co-inventor on a number of patents. He achieved Chartered Engineer status in 1990 and became a Fellow of the RAeS in 2005. He has a BSc (Hons) (1st class) in Aeronautical Engineering.

Tribology, Mechanisms – Keith Waters – Senior Engineer
Keith.Waters@ihs.com

Keith is currently involved with development of web services for the delivery of engineering data. Keith has been with IHS since its acquisition of ESDU at which time he was responsible for the Tribology Series. Previously he was involved in research at Warren Spring Laboratory and with aero-engine design at Rolls Royce. Keith has a BSc in Aeronautical Engineering from Queen Mary College, London.

Vibration and Acoustic Fatigue – John Anderson – Senior Engineer
John.Anderson@ihs.com

John is responsible for the ESDU Vibration and Acoustic Fatigue Series and has been with ESDU since 2000. John has previously worked at City University, Max Planck Institute for Fluid Flow Research at Göttingen, Rolls-Royce Aero Engines and the Aerodynamics Division at the National Physical Laboratory. He has a PhD from London University and is a Chartered Engineer (Royal Aeronautical Society).

Engineering Software – Dave Gallagher – Senior Software Engineer
Dave.Gallagher@ihs.com

Dave has been responsible for a range of software projects, including the ESDU Interactive Graphs program, development of JAVApacs and other projects geared towards delivery of ESDU software, including ESDU Connect and other areas of development involving .NET technologies and MATLAB. Dave has been with ESDU since May 2000. Prior to that, Dave was in an RA post in the Electrical Engineering Department at UCL. Previously, he was a research scientist in the Physical Electronics Group at Stanford Linear Accelerator Center and also has five years' experience as a science teacher in his local area of Tottenham, North London. Dave holds a BSc in Chemistry, a PhD in Surface Science (both from the University of Wales), a PGCE from the University of London IoE, and an MSc (IT) obtained jointly from the Electrical Engineering and Computer Science Departments at University College, London.

ESDU Products

IHS ESDU offers a unique, comprehensive collection of validated analytical methods, data, and software that are co-developed by aerospace industry expert committees and ESDU engineers. This collaboration allows the aerospace industry worldwide to identify knowledge gaps and share best practices and data to develop consensual solutions that can be applied with absolute confidence. While in the first instance engineers rely on internal design guides that contain valuable, proprietary knowledge and experience, ESDU complements these internal design practices, addresses information gaps, and provides access to best-in-class industry expertise.

ESDU Series

- Aerodynamics
- Aircraft Noise
- Composites
- Dynamics
- Fatigue - Endurance Data
- Fatigue - Fracture Mechanics
- Fluid Mechanics, Internal Flow
- Fluid Mechanics, Internal Flow (Aerospace)
- Heat Transfer
- Mechanisms
- Performance
- Physical Data, Chemical Engineering
- Stress and Strength
- Structures
- Transonic Aerodynamics
- Tribology
- Vibration and Acoustic Fatigue
- Wind Engineering

ESDU Packages

- Aerodynamics Design
- Aerospace
- Aerostructures
- Automotive
- Nuclear Engineering
- Process Engineering
- Technology
- Structures Design

Aerospace Materials Data

- MMDH - Metallic Materials Data Handbook
- MMPDS - Metallic Materials Properties Development and Standardization

Additional Engineering References

- Bruhn: Analysis and Design of Flight Vehicle Structures
- NACA Collection
- NASA Collection
- USAF DATCOM

For more information

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ABOUT IHS

IHS (NYSE: IHS) is the leading source of information, analytics and expertise in critical areas that shape today's business landscape. Businesses and governments in more than 140 countries around the globe rely on the comprehensive content, expert independent analysis and flexible delivery methods of IHS to make high-impact decisions and develop strategies with speed and confidence. IHS has been in business since 1959 and became a publicly traded company on the New York Stock Exchange in 2005. Headquartered in Englewood, Colorado, USA, IHS is committed to sustainable, profitable growth and employs nearly 9,000 people in 33 countries around the world.

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