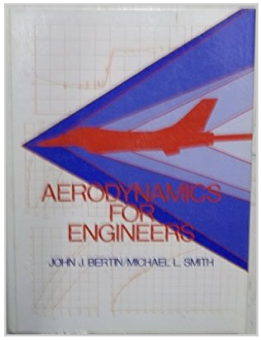

Aerodynamics for Engineers

By John J. Bertin, Michael L. Smith

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The first edition (1979) is cited in BCL3. A textbook for a course in aerodynamics for advanced undergraduates or grad students. Presumes basic physics, thermodynamics, and math. Annotation copyright Book News, Inc. Portland, Or.

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Aerodynamics for Engineers By John J. Bertin, Michael L. Smith Bibliography

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Editorial Review

From the Publisher
This comprehensive guide to aerodynamics focuses on practical problems and discusses the fundamental principles and techniques used to solve these problems.

From the Back Cover

The fourth edition of ***Aerodynamics for Engineers*** has been written to reflect the rapid advances in software and in hardware that have resulted in the ever increasing use of Computational Fluid Dynamics (CFD) in the design of aerospace vehicles. The increased reliance on computational methods has led to two changes unique to the fourth edition.

1. Some very sophisticated numerical solutions for high-alpha flow fields (Chapter 7), transonic flows around an NACA airfoil (Chapter 9), and flow over the SR-71 at three high-speed Mach numbers (Chapter 11) appear for the first time in ***Aerodynamics for Engineers.*** Although these results have appeared in the open literature, the high-quality figures were provided by Cobalt Solutions, LLC, using the post-processing packages Fieldview and EnSight.
2. Chapter 14 has been completely rewritten to provide a discussion of the complementary use of experiment and of computation as tools for defining the aerodynamic environment. This was the greatest single change to the text. Chapter 14 was a major effort, intended to put in perspective the strengths and limitations of the various tools that were discussed individually throughout the text.

This text is designed for use by undergraduate students in intermediate and advanced classes in aerodynamics and by graduate students in mechanical engineering and aerospace engineering. Basic fluid mechanic principles are presented in the first four chapters. Fluid properties and a model for the standard atmosphere are discussed in Chapter 1, "Fluid Properties." The equations governing fluid motion are presented in Chapter 2, "Fundamentals of Fluid Mechanics." Differential and integral forms of the continuity equation (based on the conservation of mass), the linear momentum equation (based on Newton's law of motion), and the energy equation (based on the first law of thermodynamics) are presented. Modeling inviscid, incompressible flows is the subject of Chapter 3, "Dynamics of an Incompressible, Inviscid Flow Field." Modeling viscous boundary layers, with emphasis on incompressible flows, is the subject of Chapter 4, "Viscous Boundary Layers." Thus, Chapters 1 through 4 present material that covers the principles upon which the aerodynamic applications are based. For the reader who already has had a course (or courses) in fluid mechanics, these four chapters provide a comprehensive review of fluid mechanics and an introduction to the nomenclature and style of the present text.

At this point, the reader is ready to begin material focused on aerodynamic applications. Parameters that characterize the geometry of aerodynamic configurations and parameters that characterize aerodynamic performance are presented in Chapter 5, "Characteristic Parameters for Airfoil and Wing Aerodynamics." Techniques for modeling the aerodynamic performance of two-dimensional airfoils and, of finite-span wings at low speeds (where variations in density are negligible) are presented in Chapters 6 and 7, respectively. Chapter 6 is titled "Incompressible Flows around Wings of Infinite Span," and Chapter 7 is titled "Incompressible Flow about Wings of Finite Span."

The next five chapters deal with compressible flow fields. To provide the reader with the necessary background for high-speed aerodynamics, the basic fluid mechanic principles for compressible flows are discussed in Chapter 8, "Dynamics of a Compressible Flow Field." Thus, from a pedagogical point of view, the material presented in Chapter 8 complements the material presented in Chapters 1 through 4. Techniques for modeling high-speed flows (where density variations cannot be neglected) are presented in Chapters 9 through 12. Aerodynamic performance for compressible, subsonic flows through transonic speeds is the subject of Chapter 9, "Compressible Subsonic Flows and Transonic Flows." Supersonic aerodynamics for two-dimensional airfoils is the subject of Chapter 10, "Two-Dimensional Supersonic Flows about Thin Airfoils" and for finite-span wings in Chapter 11, "Supersonic Flows over Wings and Airplane Configurations." Hypersonic flows are the subject of Chapter 12.

At this point, chapters have been dedicated to the development of basic models for calculating the aerodynamic performance parameters for each of the possible speed ranges. The assumptions and, therefore, the restrictions incorporated into the development of the theory are carefully noted. The applications of the theory are illustrated by working one or more problems. Solutions are obtained using numerical techniques in order to apply the theory for those flows where closed-form solutions are impractical or impossible. In each of the chapters, the computed aerodynamic parameters are compared with experimental data from the open literature to illustrate both the validity of the theoretical analysis and its limitations (or, equivalently, the range of conditions for which the theory is applicable). One objective is to use the experimental data to determine the limits of applicability for the proposed models.

Extensive discussions of the effects of viscosity, compressibility, shock/boundary-layer interactions, turbulence modeling, and other practical aspects of contemporary aerodynamic design are also presented. Problems at the end of each chapter are designed to complement the material presented within the chapter and to develop the student's understanding of the relative importance of various phenomena. The text emphasizes practical problems and the techniques through which solutions to these problems can be obtained. Because both the International System of Units (Systeme International d'Unites, abbreviated SI) and English units are commonly used in the aerospace industry, both are used in this text. Conversion factors between SI units and English units are presented on the inside covers.

Advanced material relating to design features of aircraft over more than a century and to the tools used to define the aerodynamic parameters are presented in Chapters 13 and 14. Chapter 13 is titled "Aerodynamic Design Considerations," and Chapter 14 is titled "Tools for Defining the Aerodynamic Environment." Chapter 14 presents an explanation of the complementary role of experiment and of computation in defining the aerodynamic environment. Furthermore, the advantages, limitations, and roles of computational techniques of varying degrees of rigor are discussed. The material presented in Chapters 13 and 14 not only should provide interesting reading for the student but, should be useful to professionals long after they have completed their formal academic training.

COMMENTS ON THE FIRST THREE EDITIONS

The author would like to thank Michael L. Smith for his significant contributions to Aerodynamics for Engineers. Michael Smith's contributions helped establish the quality of the text from the outset and the foundation upon which the subsequent editions have been based. For these contributions, he was recognized as coauthor of the first three editions.

The author is indebted to his many friends and colleagues for their help in preparing the first three editions of this text. I thank them for their suggestions, their support, and for copies of photographs, illustrations, and reference documents. The author is indebted to L. C. Squire of Cambridge University; V G. Szebehely of the University of Texas at Austin; R A. Wierum of the Rice University; T. J. Mueller of the University of Notre

Dame; R. G. Bradley and C. Smith of General Dynamics; G. E. Erickson of Northrop; L. E. Ericsson of Lockheed Missiles and Space; L. Lemmerman and A. S. W Thomas of Lockheed Georgia; J. Periaux of Avions Marcel Dassault; H. W Carlson, M. L. Spearman, and P R Coven of the Langley Research Center; D. Kanipe of the Johnson Space Center; R. C. Maydew, S. McAlees, and W. H. Rutledge of the Sandia National Labs; M. J. Nipper of the Lockheed Martin Tactical Aircraft Systems; H. J. Hillaker (formerly) of General Dynamics; R. Chase of the ANSER Corporation; and Lt. Col. S. A. Brandt, Lt. Col. W. B. McClure, and Maj. M. C. Towne of the U.S. Air Force Academy. R R. DeJarnette of North Carolina State University, and J. E Marchman III, of Virginia Polytechnic Institute and State University provided valuable comments as reviewers of the third edition.

Not only has T. C. Valdez served as the graphics artist for the first three editions of this text, but he has regularly located interesting articles on aircraft design that have been incorporated into the various editions.

THE FOUTH EDITION

Rapid advances in software and hardware have resulted in the ever-increasing use of computational fluid dynamics (CFD) in the design of aerospace vehicles. The increased reliance on computational methods has led to three changes unique to the fourth edition.

1. Some very sophisticated numerical solutions for high alpha flow fields (Chapter 7), transonic flows around an NACA airfoil (Chapter 9), and flow over the SR-71 at three high-speed Mach numbers (Chapter 11) appear for the first time in *Aerodynamics for Engineers.* Although these results have appeared in the open literature, the high-quality figures were provided by Cobalt Solutions, LLC, using the postprocessing packages Fieldview and EnSight. Captain J. R. Forsythe was instrumental in obtaining the appropriate graphics.
2. The discussion of the complementary use of experiment and computation as tools for defining the aerodynamic environment was the greatest single change to the text. Chapter 14 was a major effort, intended to put in perspective the strengths and limitations of the various tools that were discussed individually throughout the text.
3. A CD with complementary homework problems and animated graphics is available to adopters. Please contact the author at USAFA.

Major D. C. Blake, Capt. J. R. Forsythe, and M. C. Towne were valuable contributors to the changes that have been made to the fourth edition. They served as sounding boards before the text was written, as editors to the modified text, and as suppliers of graphic art. Since it was the desire of the author to reflect the current role of computations (limitations, strengths, and usage) and to present some challenging applications, the author appreciates the many contributions of Maj. Blake, Capt. Forsythe, and Dr. Towne, who are active experts in the use and in the development of CFD in aerodynamic design.

The author would also like to thank M. Gen. E. R. Bracken for supplying information and photographs regarding the design and operation of military aircraft. G. E. Peters of the Boeing Company and M. C. Towne of Lockheed Martin Aeronautics served as points of contact with their companies in providing material new to the fourth edition.

The author would like to thank John Evans Burkhalter of Auburn University, Richard S. Figliola of Clemson University, Marilyn Smith of the Georgia Institute of Technology, and Leland A. Carlson of Texas A & M University, who, as reviewers of a draft manuscript, provided comments that have been incorporated either into the text or into the corresponding CD.

The author would also like to thank the American Institute of Aeronautics and Astronautics (AIAA), the

Advisory Group f...

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From reader reviews:

Lillie Moreland:

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