Aerodynamics Of Road Vehicles

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Road Vehicle Aerodynamics Veloce Publishing
This book provides an introduction to ground vehicle aerodynamics and methodically guides the reader through the various aspects of the subject. Those needing specific information or a refresher can easily jump to the material of interest. There is a particular emphasis on various vehicle types (passenger cars, trucks, trains, motorcycles, race cars, etc.). However, the book is focused on cars and trucks, which are the most common vehicles in the speed range in which the study of ground vehicle aerodynamics is beneficial. Readers will gain a fundamental understanding of the topic, which will help them design vehicles that have improved aerodynamics; this will lead to better fuel efficiency, improved performance, and increased passenger comfort. The author’s basic approach to the presentation of the material is complemented with review questions, application questions, exercises, and suggested projects at the end of most of the chapters, which helps the reader apply the information presented, either in the classroom or for self-study. Aside from offering a solid understanding of ground vehicle aerodynamics, the book also offers more thorough study of several key topics. One such topic is car-truck interaction, when one vehicle (usually the smaller one) is overtaking the other. There is a direct and instant benefit in terms of safety on the highway from understanding the forces at play when one vehicle passes the other in the same direction and sense. Chapters examine: • Drag • Noise and vehicle soiling • Wind tunnels and road/track testing • Numerical methods • Vehicle stability and control • Vehicle sectional design • Large vehicles: trucks, trailers, buses, trains • Severe service and off-road vehicles • Race cars and convertibles • Motorcycles • Concept vehicles
Race Car Aerodynamics Veloce Publishing Ltd
The scope of this SAE Information Report is confined to wind-tunnel testing, although it is recognized that many aspects of the aerodynamic characteristics of road vehicles can be investigated in other test facilities (such as water-tanks) or, especially, on the road. For example, coastdown testing is often used to determine aerodynamic drag (either in isolation or as part of the total resistance), and artificial gust generators are used to investigate

the sensitivity of vehicles to cross-wind gusts.Also excluded from the present Report are climatic wind-tunnel tests of road vehicles, which are defined in more detail in Section 3.The Report covers the aerodynamic requirements of a wind-tunnel for automotive testing, together with the facility equipment needed and the requirements affecting the test vehicle or model. The test methods and procedures described here include those for six-component force measurements and measurements of pressures and velocities both on the vehicle/model surface and in the surrounding flow-field.Flow visualization techniques are outlined, with reference to the detailed coverage in a related SAE Information Report (2). In addition, the reduction, analysis, and presentation of wind-tunnel data are considered, with further references to associated SAE Information Reports (3,4) on corrections to be applied for wind-tunnel blockage effects. Finally, methods are discussed for the validation of the wind-tunnel data, e.g., by tunnel-to-road correlation studies.As already indicated, this document has been prepared in conjunction with a number of other SAE Information Reports and Recommended Practices (1-5), each of which provides greater detail than is given here on its particular aspect of automotive aerodynamic testing. Much of the information presented in this document is mature and unlikely to change in the foreseeable future. The remainder - relating particularly to moving ground simulation and blockage correction techniques - is nevertheless judged by the Road Vehicle Aerodynamics Committee to be of historical significance. To supplement it contents, users are encouraged to consult more recent revisions of J1252, J1594, and J2881, as well as relevant SAE conference papers published since the 1993 issue of this document.

Aerodynamics of Road Vehicles, Fifth Edition Woodhead Publishing

These Proceedings contain the papers and oral discussions presented at the Symposium on AERODYNAMIC DRAG MECHANISMS of Bluff Bodies and Road Vehides held at the General Motors Research Laboratories in Warren, Michigan, on September 27 and 28, 1976. This international, invitational Symposium was the twentieth in an annual series, each one having been in a different technical discipline. The Symposia provide a forum for areas of science and technology that are of timely interest to the Research Laboratories as well as the technical community at large, and in which personnel of the Laboratories are actively involved. The Symposia furnish an opportunity for the exchange of ideas and current knowledge between participating research specialists from educational, industrial arid governmental institutions and serve to stimulate future research activity. The present world-wide energy situation makes it highly desirable to reduce the force required to move road vehicles through the atmosphere. A significant amount of the total energy consumed for transportation is expended in overcoming the aerodynamic resistance to motion of these vehicles. Reductions in this aerodynamic drag can therefore have a large impact on ground transportation energy requirements. Although aerodynamic development work on road vehides has been performed for many years, it has not been widely reported or accompanied by much basic research.

Aerodynamics of Road Vehicles John Wiley & Sons

The detailed presentation of fundamental aerodynamics principles that influence and improve vehicle design have made Aerodynamics of Road Vehicles the engineer’s “source” for information. This fifth edition features updated and expanded information beyond that which was presented in previous releases. Completely new content covers lateral stability, safety and comfort, wind noise, high performance vehicles, helmets, engine cooling, and computational fluid dynamics. A proven, successful engineering design approach is presented that includes: • Fundamentals of fluid mechanics related to vehicle aerodynamics • Essential experimental results that are the ground rules of fluid mechanics • Design strategies for individual experimental results • General design solutions from combined experimental results The aerodynamics of passenger cars, commercial vehicles, motorcycles, sports cars, and race cars is dealt with in detail, inclusive of systems, testing techniques, measuring and numerical aerodynamics methods and simulations that significantly contribute to vehicle development. Aerodynamics of Road Vehicles is an excellent reference tool and an indispensable source for the industry’s vehicle engineers, designers, and researchers, as well as for enthusiasts, students, and those working in academia or government regulatory agencies.

Advances in Road Vehicle Aerodynamics Createspace Independent Publishing Platform

The detailed presentation of fundamental aerodynamics principles that influence and improve vehicle design have made Aerodynamics of Road Vehicles the engineer's "source" for information. This fifth edition features updated and expanded information beyond that which was presented in previous releases. Completely new content covers lateral stability, safety and comfort, wind noise, high performance vehicles, helmets, engine cooling, and computational fluid dynamics.

The aerodynamics of road vehicles - road measurement of drag and comarison owith wind tunnel measurements SAE International

This volume contains papers presented at the International conference “The Aerodynamics of Heavy Vehicles III: Trucks, Buses and Trains” held in Potsdam, Germany, September 12-17, 2010 by Engineering Conferences International (ECI). Leading scientists and engineers from industry, universities and research laboratories, including truck and high-speed train manufacturers and operators were brought together to discuss computer simulation and experimental techniques to be applied for the design of more efficient trucks, buses and high-speed trains in the future. This conference was the third in the series after Monterey-Pacific Groove in 2002 and Lake Tahoe in 2007.The presentations address different aspects of train aerodynamics (cross wind effects, underbody flow, tunnel aerodynamics and aeroacoustics, experimental techniques), truck aerodynamics (drag reduction, flow control, experimental and computational techniques) as well as computational fluid dynamics and bluff body, wake and jet flows.

The Aerodynamics of Road Vehicles - a Survey of Published Literature Springer Science & Business Media

This text provides a comprehensive introduction to road vehicle aerodynamic design for students, engineers and designers working in the automotive field.

The International Vehicle Aerodynamics Conference Longman Publishing Group

The first book to summarize the secrets of the rapidly developing field of high-speed vehicle design. From F1 to Indy Car, Drag and Sedan racing, this book provides clear explanations for engineers who want to improve their design skills and enthusiasts who simply want to understand how their favorite race cars go fast. Explains how aerodynamics win races, why downforce is more important than streamlining and drag reduction, designing wings and venturis, plus wind tunnel designs and more.

Modifying the Aerodynamics of Your Road Car Robert Bentley, Incorporated

From historical background to state of the art techniques, and with chapters covering airdams, splitters, spoilers, wings, underbodies and myriad miscellaneous devices, Competition Car

Aerodynamics 3rd Edition also features in-depth case studies from across the motorsport spectrum to help develop a comprehensive understanding of the subject.

Aerodynamics of Road Vehicles Linköping University Electronic Press

This book includes the carefully edited contributions to the United Engineering Foundation Conference: The Aerodynamics of Heavy Vehicles: Trucks, Buses and Trains held in Monterey, California from December 2-6, 2002. This conference brought together 90 leading engineering researchers discussing the aerodynamic drag of heavy vehicles. The book topics include a comparison of computational fluid dynamics calculations using both steady and unsteady Reynolds-averaged Navier-Stokes, large-eddy simulation, and hybrid turbulence models and experimental data obtained from wind tunnel experiments. Advanced experimental techniques including three-dimensional particle image velocimetry are presented as well, along with their use in evaluating drag reduction devices.

Aerodynamics of Road Vehicles SAE International

At last - a book for those who like to modify the aerodynamics of their road cars!In this book author Julian Edgar explores a host of practical and low-cost techniques that you can do yourself without spending a lot of money or needing special facilities. Section 1 introduces aerodynamic drag and lift. The language is simple and straightforward - but still includes concepts such as drag co-efficients, lift co-efficients and the different types of drag that affect road cars. Section 2 is devoted to aerodynamic testing - directly measuring aerodynamic pressures, and seeing airflow patterns by the use of on-road wool-tuft testing. Section 3, the largest part in the book, covers aerodynamic modification. Fitting vortex generators, testing different undertrays, reducing drag, using turning vanes in intercooler ducting - all are covered in detail. In addition, techniques are described for reducing wind noise, building an effective engine intake that breathes high-pressure cold air, siting bonnet vents in the correct location, and testing airflow through intercoolers. With nearly 300 full-colour photos and diagrams, this book is practical and down to earth - and uses techniques able to be carried out on the road.

Theory and Applications of Aerodynamics for Ground Vehicles SAE International

This terminology is intended to provide a common nomenclature for use in publishing road vehicle aerodynamics data and reports. This document has been revised to correct numerous errors and omissions in the previous (1994) revision. That revision, whose sole purpose was to place it into the new SAE Technical Standards Board format, was the only revision to the original (1987) issue. The current (2010) revision has also been used as an opportunity to update applicable references, delete those that are no longer readily available, improve the organization of the document, and modify the directional sense of the axes system as indicated below.The following is the rationale for selection of specific terminologies, conventions, and definitions. Axes System The SAE Road Vehicle Aerodynamics Committee agreed to modify the axes system in the original SAE J1594 issued in 1987, to have x positive rearward and z positive upward, to correspond with the positive directions of drag and lift, respectively. This change does not affect the positive sense of the aerodynamic forces and moments as defined in the previous version of SAE J1594, only their directional sense (specifically for drag, lift, yawing moment, and rolling moment) relative to the signs of the x and z axes in the new axes system. Resolving Center Center of gravity (c.g.) and body geometry-defined resolving centers used in vehicle dynamics (Reference 2.1.1.1) and aeronautics, respectively, are not satisfactory for road vehicle aerodynamics applications. A large portion of automotive aerodynamics development testing is performed before the vehicle c.g. is known. The c.g. location can also vary significantly with vehicle option content and loading. Relating the axis center to the body geometry is also problematic when major body geometry changes are explored during wind tunnel tests. These situations are avoided by placing the resolving center at ground level, positioned at mid-wheelbase and mid-track. An added advantage of this location is the direct translation of aerodynamic loading to tire contact patch ground reactions. Forces and Moments The primary terminology for aerodynamic force and moment components (drag, lift, side force, pitching moment, yawing moment, and rolling moment) were adopted from aeronautical usage. The symbols for drag and lift (D & L) were also taken from aeronautics. To maintain consistency with the symbols for drag and lift, and to provide a mnemonic aid, the other component symbols (S,PM,YM and RM) were based on terminology. Attitude Angles Vehicle attitude angle definitions and symbols also correspond to existing aerodynamics terminology as used for aircraft development. Force and Moment Coefficients Aerodynamic coefficient definitions were chosen consistent with aeronautical terminology, with one exception. Unlike typical aerodynamics convention, the wheelbase is used to compute moment coefficients. Although it makes more aerodynamic sense to use a body length dimension, this is more likely to change during wind tunnel development than wheelbase. Using wheelbase (WB) provides an additional advantage with the chosen axes system in simplifying the computation of axle loadings. For example, the lift coefficient for the front axle is then equal to CLF = CL/2 + CPM. However, if CPM were based on an overall length (OAL), a ratio of WB and OAL would have to be included in the computation. Vehicle Parameters The wheelbase designator (L) used in vehicle dynamics (Reference 2.1.1.1) was not adopted, since it is used for the aerodynamic lift force. Frontal area and scale factor symbols are consistent with aerodynamic usage. Flow Parameters Symbols and definitions for air flow parameters were chosen consistent with aerodynamics terminology. The definition of equivalent full scale velocity (VEQ) is included to provide a simple means of relating reduced scale model flow conditions to full scale. Standard day conditions were chosen to correspond to those defined at sea level conditions for the U.S. Standard Atmosphere adopted by NASA, NOAA and USAF in 1976 (Reference 2.1.3.1). For high-speed (motorsports) and high-humidity (thermal) applications, references are cited to account for the effects of compressibility on dynamic pressure and relative humidity on air density, if deemed necessary. Yaw-Weighted Drag Coefficient Ambient wind magnitude, heading angle and vehicle path directions have an effect on the overall average aerodynamic drag of a vehicle during a particular duty cycle. The yaw-weighted drag coefficient is defined as the average drag coefficient during a particular driving schedule and ambient wind input. The wind and driving schedule factors affecting the wind-averaged drag coefficient have not been standardized. Some examples of yaw-weighted drag coefficient computations are given in References 2.1.1.2 - 2.1.1.4.

Aerodynamic Testing of Road Vehicles - Testing Methods and Procedures World Scientific

Aerodynamics has never been more central to the development of cars, commercial vehicles, motorbikes, trains and human powered vehicles, driven by the need for efficiency: reducing carbon dioxide emissions, reducing fuel consumption, increasing range and alleviating problems associated with traffic congestion. Reducing vehicle weight makes it more challenging to ensure that they are stable and handle well over a wide range of environmental conditions. Lighter structures are also more vulnerable to aerodynamically induced vibration. Alongside this,

customers demand an environment that is quiet, comfortable and maintains their vision of the world around them in all weathers. These aims must be met by designing vehicles that engage customers emotionally, promoting the brand values of manufacturers and operators. This can only be done by collaboration between designers and aerodynamicists. Examine the latest developments in vehicle aerodynamic development Explore opportunities to network and share experiences around different areas Focus on future challenges and the engineering knowledge and technology required to resolve them Discuss other areas of development including handling and stability, tyre aerodynamics and modelling, aeroacoustics and fluid structure interaction

Motor Vehicle Dynamics: Modelling And Simulation SAE International

A Choice Oustanding Academic Title The Encyclopedia of Automotive Engineering provides for the first time a large, unified knowledge base laying the foundation for advanced study and in-depth research. Through extensive cross-referencing and search functionality it provides a gateway to detailed but scattered information on best industry practice, engendering a better understanding of interrelated concepts and techniques that cut across specialized areas of engineering. Beyond traditional automotive subjects the Encyclopedia addresses green technologies, the shift from mechanics to electronics, and the means to produce safer, more efficient vehicles within varying economic restraints worldwide. The work comprises nine main parts: (1) Engines: Fundamentals (2) Engines: Design (3) Hybrid and Electric Powertrains (4) Transmission and Driveline (5) Chassis Systems (6) Electrical and Electronic Systems (7) Body Design (8) Materials and Manufacturing (9) Telematics. Offers authoritative coverage of the wide-ranging specialist topics encompassed by automotive engineering An accessible point of reference for entry level engineers and students who require an understanding of the fundamentals of technologies outside of their own expertise or training Provides invaluable guidance to more detailed texts and research findings in the technical literature Developed in conjunction with FISITA, the umbrella organisation for the national automotive societies in 37 countries around the world and representing more than 185,000 automotive engineers 6 Volumes www.automotive-reference.com An essential resource for libraries and information centres in industry, research and training organizations, professional societies, government departments, and all relevant engineering departments in the academic sector.

Theory and Applications of Aerodynamics for Ground Vehicles Springer-Verlag

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Road and Off-Road Vehicle System Dynamics Handbook John Wiley & Sons

This book provides an introduction to ground vehicle aerodynamics and methodically guides the reader through the various aspects of the subject. Those needing specific information or a refresher can easily jump to the material of interest. There is a particular emphasis on various vehicle types (passenger cars, trucks, trains, motorcycles, race cars, etc.). However, the book is focused on cars and trucks, which are the most common vehicles in the speed range in which the study of ground vehicle aerodynamics is beneficial. Readers will gain a fundamental understanding of the topic, which will help them design vehicles that have improved aerodynamics; this will lead to better fuel efficiency, improved performance, and increased passenger comfort. The author’s basic approach to the presentation of the material is complemented with review questions, application questions, exercises, and suggested projects at the end of most of the chapters, which helps the reader apply the information presented, either in the classroom or for self-study. Aside from offering a solid understanding of ground vehicle aerodynamics, the book also offers more thorough study of several key topics. One such topic is car-truck interaction, when one vehicle (usually the smaller one) is overtaking the other. There is a direct and instant benefit in terms of safety on the highway from understanding the forces at play when one vehicle passes the other in the same direction and sense. Chapters examine: • Drag • Noise and vehicle soiling • Wind tunnels and road/track testing • Numerical methods • Vehicle stability and control • Vehicle sectional design • Large vehicles: trucks, trailers, buses, trains • Severe service and off-road vehicles • Race cars and convertibles • Motorcycles • Concept vehicles

Aerodynamic Drag Mechanisms of Bluff Bodies and Road Vehicles Elsevier

This unique handbook assumes no starting knowledge of vehicle aerodynamics. It begins with simple ideas and finishes with sophisticated and effective aerodynamic modifications that work. Three major chapters cover on-road testing techniques that give you all the information you need to decide what modifications you should make – and, after you’ve made them, how well they work. Low-cost techniques allow you to visualise the patterns of airflow over your car so that you can actually see the problem areas that need improvement. Uniquely, you’re also shown how to measure aerodynamic pressures, so you can determine which body surfaces are creating lift, drag and downforce. Want to work out where a wing should be placed? On-road testing to find that out is covered as well. The book also shows you how to measure downforce to see if that wing is actually working! If you wish to reduce drag, more than ten different areas are covered. Reducing frontal area, lowering cooling system drag, optimising vehicle ride height and rake, reducing the strength of the wake, achieving clean airflow separation and optimising wheel designs – they’re all covered using the latest research findings. And if you’re a performance driver, there’s a major chapter devoted to reducing lift and improving stability. This chapter includes the design and development of undertrays and diffusers, wings and spoilers. The example car developed measurable downforce when fitted with an undertray and rear diffuser, something that transformed its on-road handling. The author has been writing about the aerodynamics of road cars for more than 25 years. He is also an experienced and proficient car modifier who has performed numerous aerodynamic modifications and upgrades to his own cars. The book’s technical consultant, RH Barnard, is an acknowledged world leading automotive aerodynamicist. If you want a practical, hands-on guide that demystifies and explains car aerodynamics, and shows you how to make effective aerodynamic modifications to your car, this book is for you.

Aerodynamics of Road Vehicles CRC Press
The automobile is an icon of modern technology because it includes most aspects of modern engineering, and it offers an exciting approach to engineering education. Of course there are many existing books on introductory fluid/aero dynamics but the majority of these are too long, focussed on aerospace and don’t adequately cover the basics. Therefore, there is room and a need for a concise, introductory textbook in this area. Automotive Aerodynamics fulfils this need and is an introductory textbook intended as a first course in the complex field of aero/fluid mechanics for engineering students. It introduces basic concepts and fluid properties, and covers fluid dynamic equations. Examples of automotive aerodynamics are included and the principles of computational fluid dynamics are introduced. This text also includes topics such as aeroacoustics and heat transfer which are important to engineering students and are closely related to the main topic of aero/fluid mechanics. This textbook contains complex mathematics, which not only serve as the foundation for future studies but also provide a road map for the present text. As the chapters evolve, focus is placed on more applicable examples, which can be solved in class using elementary algebra. The approach taken is designed to make the mathematics more approachable and easier to understand. Key features: Concise textbook which provides an introduction to fluid mechanics and aerodynamics, with automotive applications Written by a leading author in the field who has experience working with motor sports teams in industry Explains basic concepts and equations before progressing to cover more advanced topics Covers internal and external flows for automotive applications Covers emerging areas of aeroacoustics and heat transfer Automotive Aerodynamics is a must-have textbook for undergraduate and graduate students in automotive and mechanical engineering, and is also a concise reference for engineers in industry.
The Aerodynamics of Road Vehicles John Wiley & Sons
A comprehensive introduction for students, practising automotive engineers and designers, and anyone with a general interest in the subject. Intended to be affordable by students. Unnecessary details or highly vehicle-specific information has been omitted, but a comprehensive list of references is given, usually with a summary.
Modifying the Aerodynamics of Your Road Car Springer Science & Business Media
Aerodynamics of Road Vehicles details the aerodynamics of passenger cars, commercial vehicles, sports cars, and race cars; their external flow field; as well as their internal flow field. The book, after giving an introduction to automobile aerodynamics and some fundamentals of fluid mechanics, covers topics such as the performance and aerodynamics of different kinds of vehicles, as well as test techniques for their aerodynamics. The book also covers other concepts related to automobiles such as cooling systems and ventilations for vehicles. The text is recommended for mechanical engineers and phycisists in the automobile industry who would like to understand more about aerodynamics of motor vehicles and its importance on the field of road safety and automobile production.