

**International Congress  
Motor Vehicles & Motors 2012**

**SUSTAINABLE DEVELOPMENT  
OF AUTOMOTIVE INDUSTRY**

**Proceedings of Papers**



October 3<sup>rd</sup> - 5<sup>th</sup>, 2012  
Kragujevac, Serbia

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*Publisher:* Faculty of Engineering, University of Kragujevac  
Serbia, 34000 Kragujevac, Sestre Janjić 6

*For Publisher:* Prof. Dr Miroslav Babić - Dean

*Editors:* Prof. Dr Radivoje Pešić  
Prof. Dr Jovanka Lukić

*Technical preparation:* M.Sc. Dragan Taranović

*Picture on the cover:* Nemanja Lazarević

*Print CD:* Faculty of Engineering, University of Kragujevac  
ISBN 978-86-86663-91-7

*Year of publication:* 2012

*Number of copies printed:* 200

CIP - Каталогизација у публикацији  
Народна библиотека Србије, Београд

629.3(082)(0.034.2)  
621.43(082)(0.034.2)

INTERNATIONAL Congress Motor Vehicles & Motors (2012 ;  
Kragujevac)

Sustainable Development of Automotive Industry [Elektronski izvor] :  
proceedings of papers / International Congress Motor Vehicles & Motors  
2012, October 3rd-5th, 2012., Kragujevac, Serbia ; [congress  
organizers Faculty of Engineering ... [et al.] ; editors Radivoje Pešić,  
Jovanka Lukić]. - Kragujevac : Faculty of Engineering, 2012  
(Kragujevac : Faculty of Engineering). - 1 elektronski optički disk  
(DVD) ; 12 cm

Sistemske zahteve: Nisu navedeni. - Nasl. sa naslovnog ekrana. –  
Tiraž 200. - Bibliografija uz svaki rad

ISBN 978-86-86663-91-7

1. Faculty of Engineering (Kragujevac)

а) Моторна возила - Зборници б) Моторни са  
унутрашњим сагоревањем - Зборници  
COBISS.SR-ID 193560076

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*Publishing of this book is supported by:*

Ministry of Education, Science and Technological Development of the Republic of Serbia

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**MVM2012-061**

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## **AERODYNAMIC RESISTANCE IMPACT ON MOTOR VEHICLE FUEL ECONOMY**

**ABSTRACT:** If we analyze vehicle dynamics, most influential factors can be categorized as road load. One of them general has a lot of influence on modern engineering approach and trucks aerodynamics. Aerodynamic forces that interact with the vehicle caused by air resistance, increase dynamic response of soil, lateral forces, moments galloping, meandering and rolling as well as noise. As a result of good control and optimization of these elements, there is savings in fuel consumption and better car handling. This paper presents the basics of quality aerodynamic vehicle design and what this approach has on the total potential savings in fuel consumption.

**KEYWORDS:** Car aerodynamics, drag coefficient, fuel consumption

### **INTRODUCTION**

The first country who introduced legal norms for fuel consumption of motor vehicles was the United States. These regulations provided that each manufacturer or importer had additional costs per vehicle if its power was higher than allowed one. As Japan has similar legal norms, a growing number of countries are making similar way. The present legal documents in Europe such as R-84 and R-101 define only the method for determining average consumption for its labeling and comparison with other vehicles. Air resistance is most important component of aerodynamic force and is specifically expressed in normal and high-speed car.

### **AERODYNAMIC AIR FORCE RESISTANCE**

Aerodynamic drag force is determined by the formula [1]:

$$F_{aero} = 0.5 \cdot \rho \cdot C_D \cdot A_f \cdot (V_x + V_{wind})^2 \quad (1)$$

where:  $\rho$  – mass density of air,  $C_d$  – aerodynamic drag coefficient,  $A_f$  – vehicle frontal area (projection area in the direction of movement),  $V_x = \dot{x}$  – longitudinal speed of the vehicle, and  $V_{wind}$  – wind velocity (positive when the wind flows from the opposite direction of the vehicle and vice versa).

The size of frontal area is 79-84% of total area (width and height obtained by a passenger car) (Wang 2001). According to Wang the relationship between mass and frontal area (for vehicles with mass in the range of 800-2000 [kg]) is given by equation [1]:

$$A_f = 1.6 + 0.00056 \cdot (m - 765) \quad (2)$$

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