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Issue Article

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REFERENCE DATA OF PRESSURE DISTRIBUTION ON THE SURFACES OF AIRFOILS HAVING THE NAMES BEGINNING WITH THE LETTER J

Abstract*: The results of the computer calculation of air flow around the airfoils having the names beginning with the letter J are presented in the article. The contours of pressure distribution on the surfaces of the airfoils at the angles of attack of 0, 15 and -15 degrees in conditions of the subsonic airplane flight speed were obtained.*

Key words*: the airfoil, the angle of attack, pressure, the surface.*
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Introduction

Creating reference materials that determine the most accurate pressure distribution on the airfoils surfaces is an actual task of the airplane aerodynamics.

Materials and methods

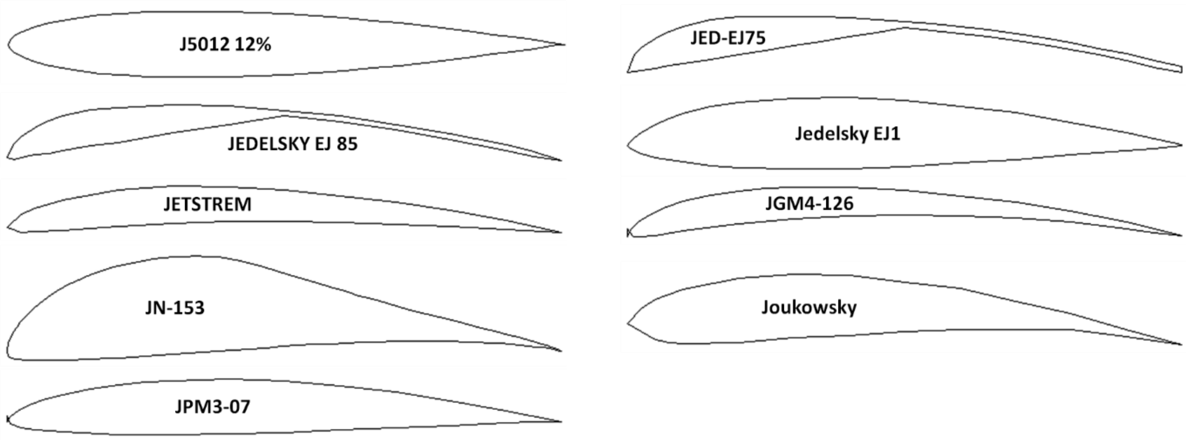
The study of air flow around the airfoils was carried out in a two-dimensional formulation by means of the computer calculation in the *Comsol Multiphysics* program. The airfoils in the cross section were taken as objects of research [1-24]. In this work, the airfoils having the names beginning with the letter *J* were adopted. Air flow around the airfoils was carried out at the angles of attack (α) of 0, 15 and -15 degrees. Flight speed of the airplane in each case was subsonic. The airplane flight in the atmosphere was carried out under normal weather conditions. The geometric characteristics of the studied airfoils are presented in the Table 1. The geometric shapes of the airfoils in the cross section are presented in the Table 2.

Table 1. The geometric characteristics of the airfoils.

Airfoil name	Max. thickness	Max. camber	Leading edge radius	Trailing edge thickness
J5012 12%	12.0% at 34.5% of the chord	0.0% at 83.5% of the chord	1.1982%	0.0%
JED-EJ75	7.03% at 15.0% of the chord	8.6% at 50.0% of the chord	1.59%	1.0%
JEDELSKY EJ 85	6.5% at 15.0% of the chord	8.5% at 50.0% of the chord	1.0103%	0.0%
Jedelsky EJ1	12.9% at 40.0% of the chord	2.21% at 40.0% of the chord	0.3876%	0.165%
JETSTREM	6.7% at 30.0% of the chord	5.05% at 40.0% of the chord	1.3601%	0.0%
JGM4-126	6.32% at 21.1% of the chord	6.68% at 42.1% of the chord	0.761%	2.5%
JN-153	17.57% at 29.9% of the chord	8.35% at 38.0% of the chord	3.3605%	0.0%
Joukowsky	11.53% at 20.0% of the chord	7.05% at 40.0% of the chord	1.5472%	0.0%
JPM3-07	10.66% at 42.1% of the chord	2.83% at 42.1% of the chord	0.4162%	2.0%

Note:
JEDELSKY EJ 85 (d'apres Modele Mag n°379 de 1983);
Joukowsky (I. Joukowsky (Germany)).

Table 2. The geometric shapes of the airfoils in the cross section.



Results and discussion

The calculated pressure contours on the surfaces of the airfoils at the different angles of attack are presented in the Figs. 1-9. The calculated values on the scale can be represented as the basic values when comparing the pressure drop under conditions of changing the angle of attack of the airfoils.

9 airfoils of different series were studied in this work. All airfoils are asymmetrical except J5012 12%.

The drag coefficient of the airfoils of the airplane wings depends mainly on the value of the radius of the leading edge. The drag coefficient is calculated from the positive pressure values near the leading edge of the airfoil during horizontal flight of the airplane. With an increase in the contact surface of the leading edge with air, the drag also increases. However, with an increase in the radius of the leading edge by 8 times, the drag coefficient increases by 1.017 times. Negative pressure occurs on the upper and lower surfaces of the airfoils. An increase in the negative pressure value is observed for the airfoils with the camber in the cross section.

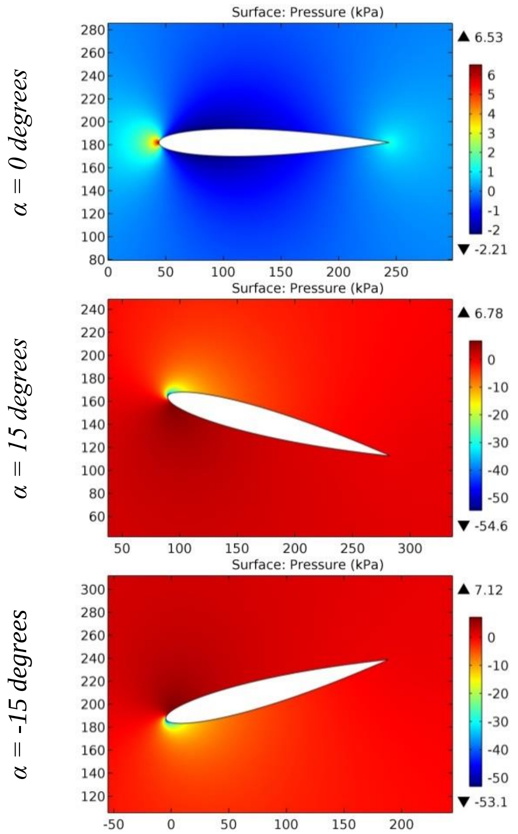


Figure 1. The pressure contours on the surfaces of the J5012 12% airfoil.

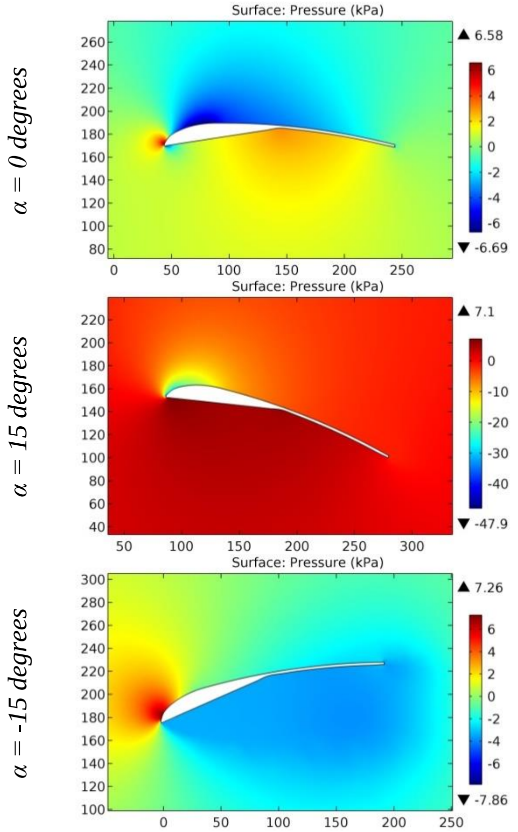


Figure 2. The pressure contours on the surfaces of the JED-EJ75 airfoil.

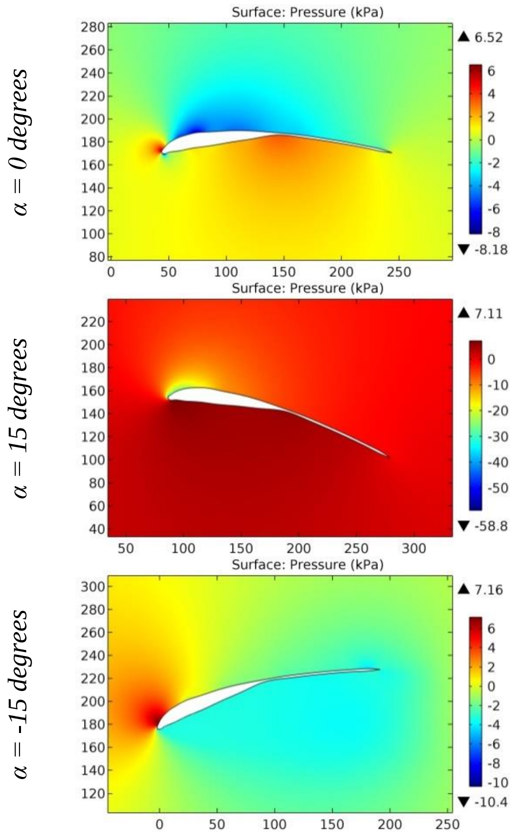


Figure 3. The pressure contours on the surfaces of the JEDELSKY EJ 85 airfoil.

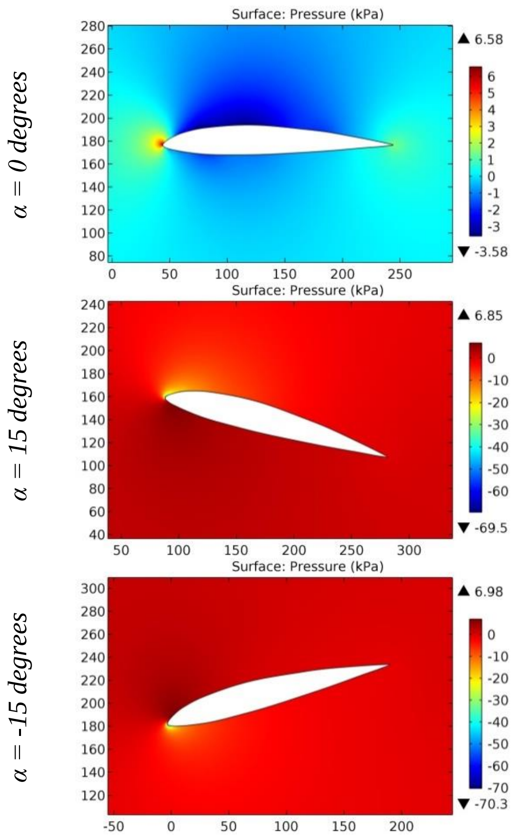


Figure 4. The pressure contours on the surfaces of the Jedelsky EJ1 airfoil.

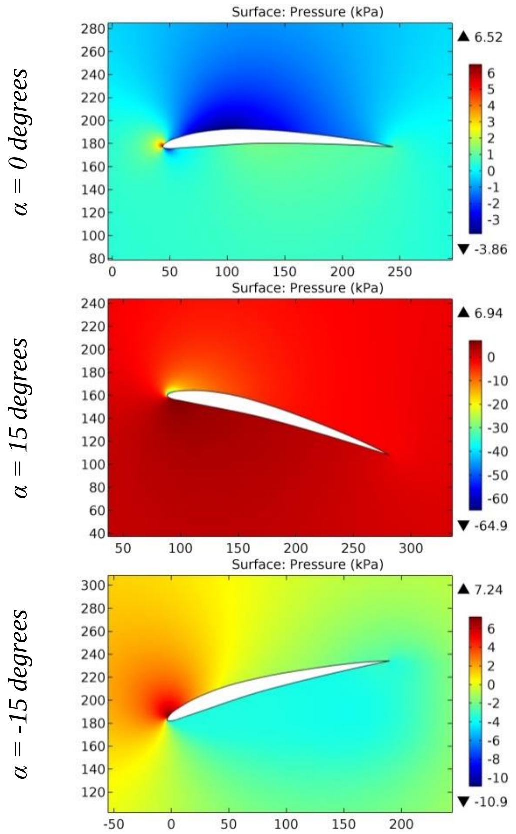


Figure 5. The pressure contours on the surfaces of the JETSTREM airfoil.

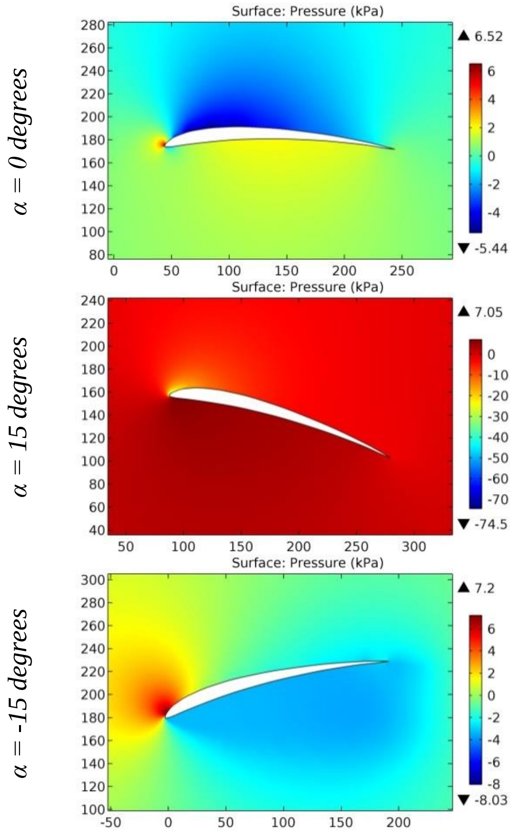


Figure 6. The pressure contours on the surfaces of the JGM4-126 airfoil.

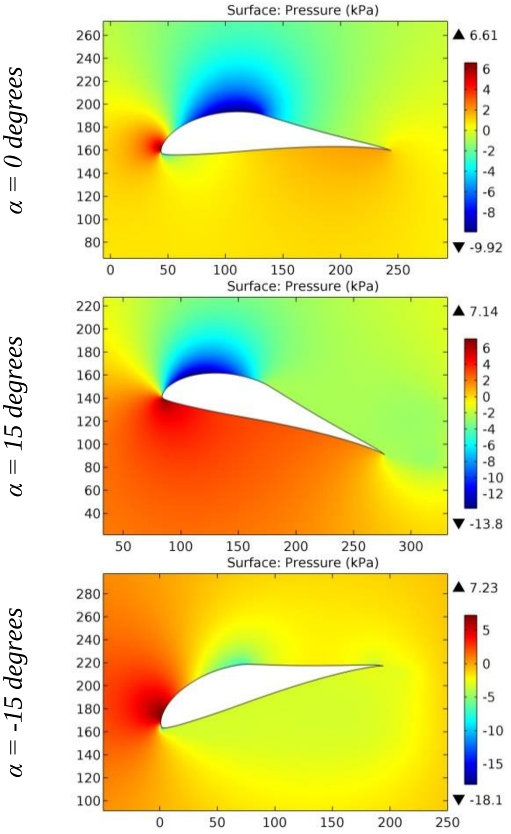


Figure 7. The pressure contours on the surfaces of the JN-153 airfoil.

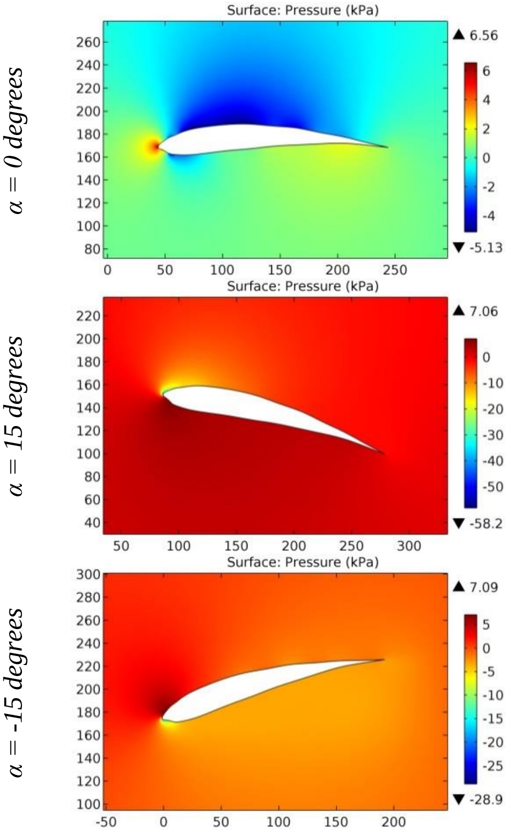


Figure 8. The pressure contours on the surfaces of the Joukowsky airfoil.

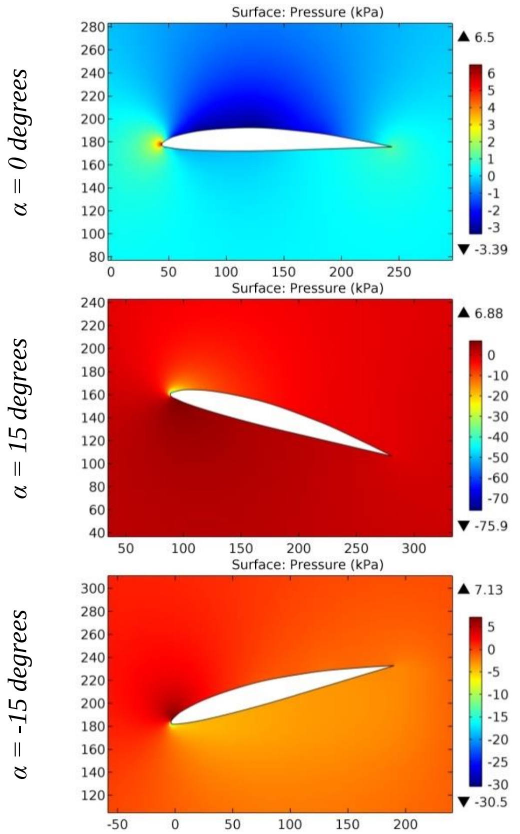


Figure 9. The pressure contours on the surfaces of the JPM3-07 airfoil.

The climb and the descent of the airplane lead to an increase in the negative pressure value on the surfaces and edges of the airfoils. At the same time, the maximum values of negative pressure under the conditions of the airplane maneuvers are determined for the asymmetrical airfoils with the minimal camber, for example, Jedelsky EJ1 and JPM3-07. It is noted that the airfoils with the greatest thickness and camber provide a decrease in the value of negative pressure on the surfaces and edges during the airplane descent. The JED-EJ75 and JN-153 airfoils have such properties.

The JED-EJ75 and JEDELSKY EJ 85 airfoils are almost identical in the cross section. On the JED-EJ75 airfoil, areas of negative pressure of greater intensity, but the less value, are formed than on the JEDELSKY EJ 85 airfoil.

The maximum increase in pressure on the leading edge occurs at the angle of attack of -15 degrees for the Jedelsky EJ1 and JN-153 airfoils. The maximum increase in pressure on the leading edge occurs at the angle of attack of 15 degrees for all other airfoils.

Conclusion

To improve the aerodynamic characteristics, the airfoil must be made with the certain camber, the small radius of the leading edge and the large thickness relative to the chord in the cross section. The more convex upper surface of the JPM3-07 airfoil results in the large drag on the leading edge, which reduces the lift-to-drag ratio of the airplane wing.

References:

1. Anderson, J. D. (2010). *Fundamentals of Aerodynamics*. McGraw-Hill, Fifth edition.
2. Shevell, R. S. (1989). *Fundamentals of Flight*. Prentice Hall, Second edition.
3. Houghton, E. L., & Carpenter, P. W. (2003). *Aerodynamics for Engineering Students*. Fifth edition, Elsevier.
4. Lan, E. C. T., & Roskam, J. (2003). *Airplane Aerodynamics and Performance.* DAR Corp.

5. Sadraey, M. (2009). *Aircraft Performance Analysis.* VDM Verlag Dr. Müller.
6. Anderson, J. D. (1999). *Aircraft Performance and Design*. McGraw-Hill.
7. Roskam, J. (2007). *Airplane Flight Dynamics and Automatic Flight Control*, Part I. DAR Corp.
8. Etkin, B., & Reid, L. D. (1996). *Dynamics of Flight, Stability and Control.* Third Edition, Wiley.
9. Stevens, B. L., & Lewis, F. L. (2003). *Aircraft Control and Simulation.* Second Edition, Wiley.
10. Chemezov, D., et al. (2021). Pressure distribution on the surfaces of the NACA 0012 airfoil under conditions of changing the angle of attack. *ISJ Theoretical & Applied Science, 09 (101)*, 601-606.
11. Chemezov, D., et al. (2021). Stressed state of surfaces of the NACA 0012 airfoil at high angles of attack. *ISJ Theoretical & Applied Science, 10 (102)*, 601-604.
12. Chemezov, D., et al. (2021). Reference data of pressure distribution on the surfaces of airfoils having the names beginning with the letter A (the first part). *ISJ Theoretical & Applied Science, 10 (102)*, 943-958.
13. Chemezov, D., et al. (2021). Reference data of pressure distribution on the surfaces of airfoils having the names beginning with the letter A (the second part). *ISJ Theoretical & Applied Science, 11 (103)*, 656-675.
14. Chemezov, D., et al. (2021). Reference data of pressure distribution on the surfaces of airfoils having the names beginning with the letter B. *ISJ Theoretical & Applied Science, 11 (103)*, 1001-1076.
15. Chemezov, D., et al. (2021). Reference data of pressure distribution on the surfaces of airfoils having the names beginning with the letter C. *ISJ Theoretical & Applied Science, 12 (104)*, 814-844.
16. Chemezov, D., et al. (2021). Reference data of pressure distribution on the surfaces of airfoils having the names beginning with the letter D. *ISJ Theoretical & Applied Science, 12 (104)*, 1244-1274.
17. Chemezov, D., et al. (2022). Reference data of pressure distribution on the surfaces of airfoils (hydrofoils) having the names beginning with the letter E (the first part). *ISJ Theoretical & Applied Science, 01 (105)*, 501-569.
18. Chemezov, D., et al. (2022). Reference data of pressure distribution on the surfaces of airfoils (hydrofoils) having the names beginning with the letter E (the second part). *ISJ Theoretical & Applied Science, 01 (105)*, 601-671.
19. Chemezov, D., et al. (2022). Reference data of pressure distribution on the surfaces of airfoils having the names beginning with the letter F. *ISJ Theoretical & Applied Science, 02 (106)*, 101-135.
20. Chemezov, D., et al. (2022). Reference data of pressure distribution on the surfaces of airfoils having the names beginning with the letter G (the first part). *ISJ Theoretical & Applied Science, 03 (107)*, 701-784.
21. Chemezov, D., et al. (2022). Reference data of pressure distribution on the surfaces of airfoils having the names beginning with the letter G (the second part). *ISJ Theoretical & Applied Science, 03 (107)*, 901-984.
22. Chemezov, D., et al. (2022). Reference data of pressure distribution on the surfaces of airfoils having the names beginning with the letter G (the third part). *ISJ Theoretical & Applied Science, 04 (108)*, 401-484.
23. Chemezov, D., et al. (2022). Reference data of pressure distribution on the surfaces of airfoils having the names beginning with the letter H (the first part). *ISJ Theoretical & Applied Science, 05 (109)*, 201-258.
24. Chemezov, D., et al. (2022). Reference data of pressure distribution on the surfaces of airfoils having the names beginning with the letter H (the second part). *ISJ Theoretical & Applied Science, 05 (109)*, 529-586.