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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 I

***Abstract**: The results of the computer calculation of air flow around the airfoils having the names beginning with the letter I 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.*
***Language**: English*
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ISRA (India) = **6.317**	**SIS** (USA) = **0.912**	**ICV** (Poland) = **6.630**
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GIF (Australia) = **0.564**	**ESJI** (KZ) = **8.771**	**IBI** (India) = **4.260**
JIF = **1.500**	**SJIF** (Morocco) = **7.184**	**OAJI** (USA) = **0.350**

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

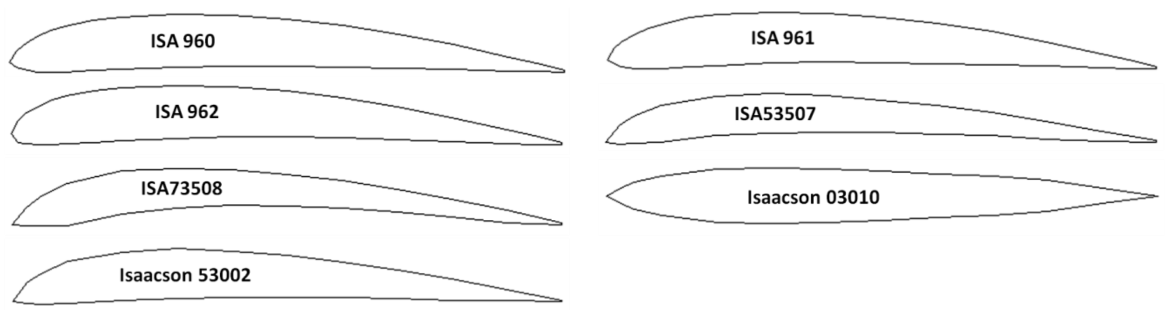
The study of air flow around the airfoils was carried out in a two-dimensional formulation by means of the computer calculation in the *Comsol Multiphysics* program. The airfoils in the cross section were taken as objects of research [1-24]. In this work, the airfoils having the names beginning with the letter *I* 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
ISA 960	9.46% at 30.0% of the chord	5.71% at 40.0% of the chord	0.9136%	0.42%
ISA 961	9.27% at 20.0% of the chord	5.68% at 30.0% of the chord	0.8935%	0.37%
ISA 962	9.58% at 20.0% of the chord	5.93% at 40.0% of the chord	1.5408%	0.42%
ISA53507	7.1% at 20.0% of the chord	5.15% at 30.0% of the chord	1.4377%	0.3%
ISA73508	8.0% at 10.0% of the chord	6.75% at 40.0% of the chord	1.4514%	0.4%
Isaacson 03010	10.0% at 30.0% of the chord	0.0% at 0.0% of the chord	1.677%	0.0%
Isaacson 53002	9.0% at 30.0% of the chord	5.1% at 30.0% of the chord	1.5801%	0.2%

Note:
ISA 960, ISA 961, ISA 962 (ISA (Italy));
Isaacson 03010, Isaacson 53002 (S. Isaacson (Sweden)).

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. 1-7. 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.

7 airfoils of the ISA and Isaacson series were studied in this work. All airfoils are asymmetrical except Isaacson 03010.

The Isaacson 03010 airfoil has the different values of negative pressure on the edges and the surfaces at the angles of attack of 15 and -15 degrees. This pressure difference, under the conditions of the airplane maneuvers, occurs at the maximum thickness of the airfoil with the pointed leading edge.

During horizontal flight of the airplane, the drag arises on the leading edge of the airfoils, which practically does not change in the value. This is true for the airfoils with both rounded and pointed leading edges.

Maneuvering the airplane leads to an increase in the drag by several times, compared with horizontal flight. For example, during the descent of the airplane with the Isaacson 03010 wing profile, maximum pressure of -94.7 kPa occurs near the leading edge. When the airplane climb, maximum pressure of -76.6 kPa near the leading edge is observed for the ISA73508 airfoil. For this airfoil, the minimum drag was also calculated at the angle of attack of -15 degrees. Thus, the climb of the airplane leads to the occurrence of the large drag on the airfoils.

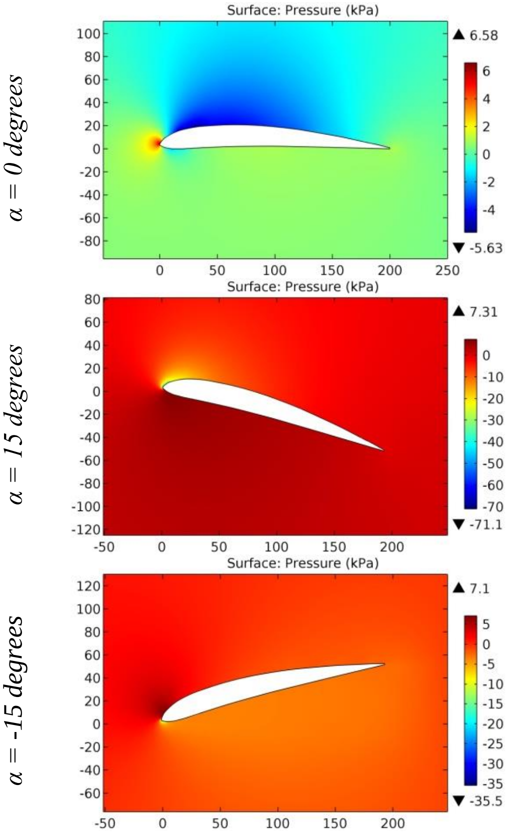


Figure 1. The pressure contours on the surfaces of the ISA 960 airfoil.

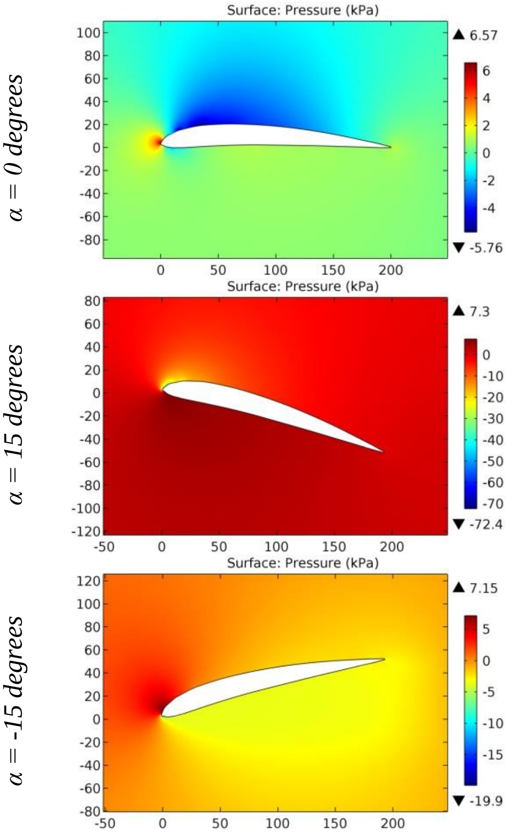


Figure 2. The pressure contours on the surfaces of the ISA 961 airfoil.

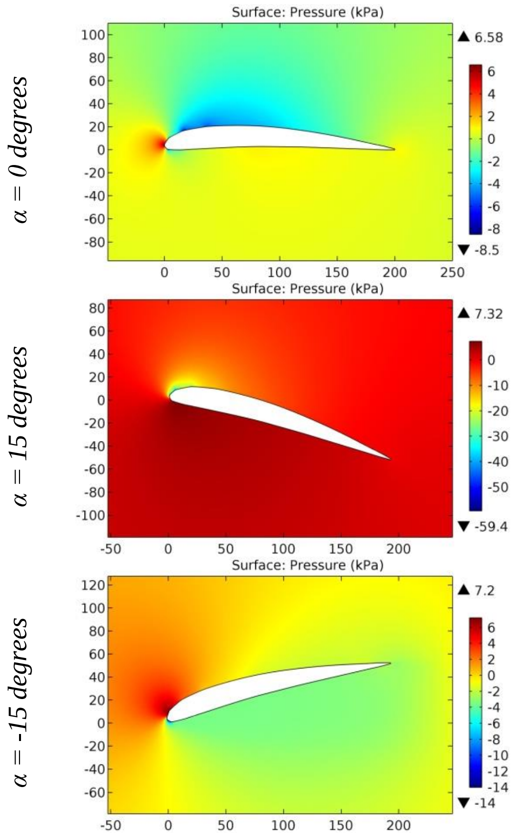


Figure 3. The pressure contours on the surfaces of the ISA 962 airfoil.

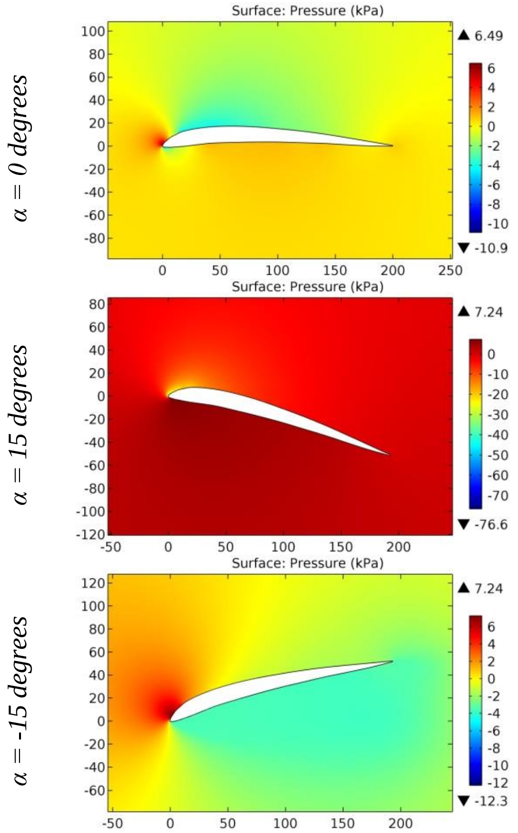


Figure 4. The pressure contours on the surfaces of the ISA53507 airfoil.

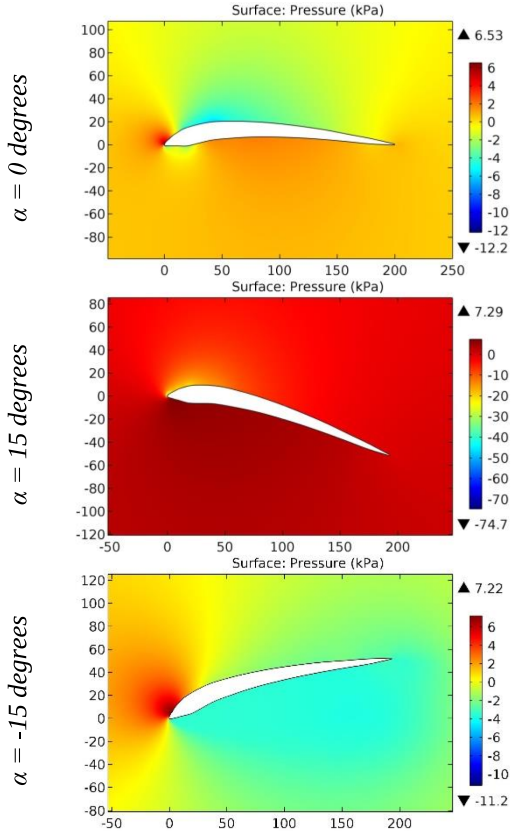


Figure 5. The pressure contours on the surfaces of the ISA73508 airfoil.

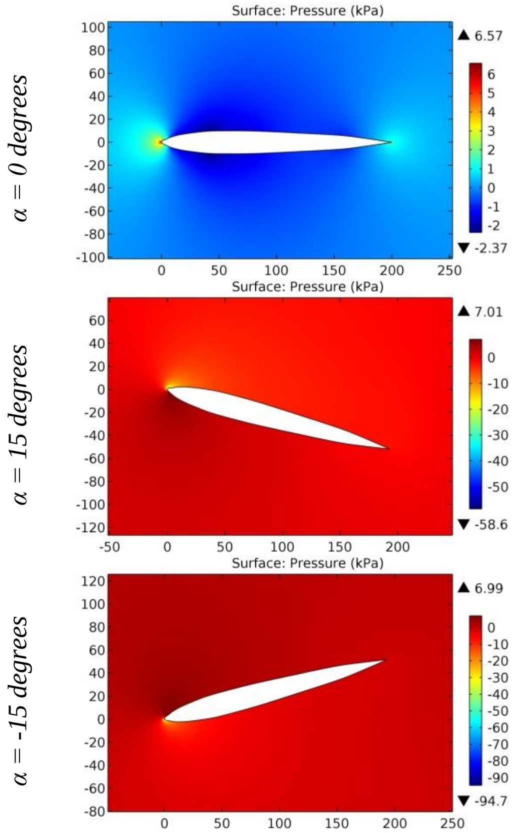


Figure 6. The pressure contours on the surfaces of the Isaacson 03010 airfoil.

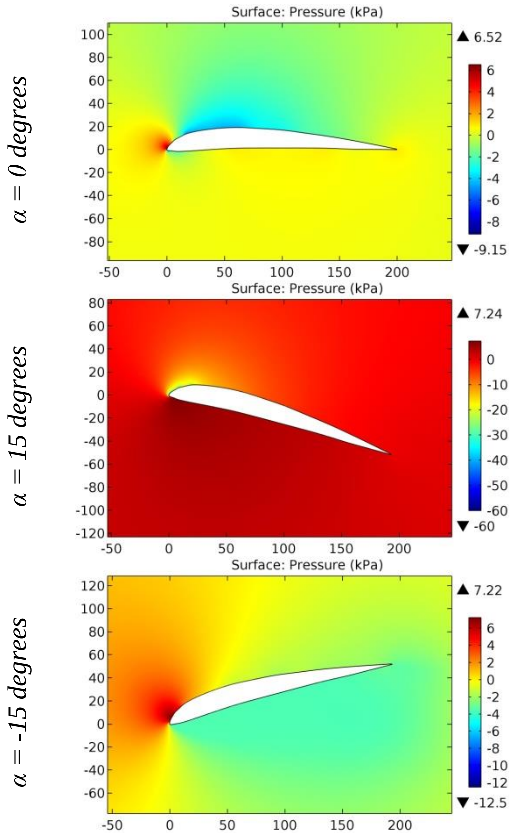


Figure 7. The pressure contours on the surfaces of the Isaacson 53002 airfoil.

The maximum camber of the Isaacson 03010 airfoil in the cross section creates the greatest wing drag during the airplane descent.

The maximum increase in pressure on the leading edge occurs at the angle of attack of 15 degrees for the following airfoils: ISA 960, ISA 961, ISA 962, ISA53507, ISA73508 and Isaacson 53002. The maximum increase in pressure on the leading edge occurs at the angle of attack of -15 degrees for the Isaacson 03010 airfoil only.

Conclusion

The camber of most of the considered airfoils affects the pattern of formation of the pressure intensity value, i.e. during the airplane climb the area of high negative pressure is formed, and negative pressure decreases by 3-5 times during the airplane descent. Positive pressure changes insignificantly with the difference of 1 kPa in all cases. The large drag on the leading edge and the small pressure difference on the upper and lower surfaces of the Isaacson 03010 airfoil reduce the aerodynamic quality of the wing during the airplane descent.

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