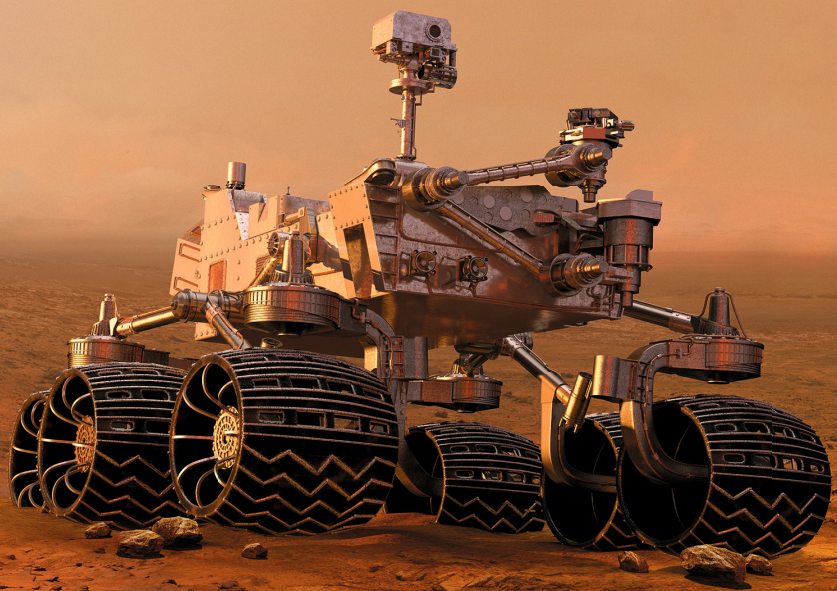
Inklusive Basiswortschatz · basic vocabulary inside · DE EN

John Nixon
Joseph Michaels

MODERN ENGLISH

for Aeronautics and Space Technology

2., vollständig überarbeitete Auflage



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Modern English for Aeronautics and Space Technology

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2nd edition

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Distributed by:
Carl Hanser Verlag
Postfach 86 04 20, 81631 Munich, Germany
Fax: +49 (89) 98 48 09
www.hanserpublications.com
www.hanser-fachbuch.de

Editor: Dipl.-Ing. Volker Herzberg
Production Management: Cornelia Speckmaier
Coverconcept: Marc Müller-Bremer, *www.rebranding.de*, Munich
Titelmotiv: © stock.adobe.com/Corona Borealis
Coverdesign: Max Kostopoulos
Typesetting: Eberl & Kœsel Studio GmbH, Altusried-Krugzell, Germany
Printed and bound by CPI books GmbH, Leck
Printed in Germany

ISBN: 978-3-446-46863-4
E-Book ISBN: 978-3-446-47011-8

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Preface

This book started as a collection of exercises and texts that were developed for English for Specific Purposes (ESP) courses in the English Department at the University of Stuttgart's Language Center – English for Aeronautics and English for Space Engineering. The texts that formed the foundation of the readers had been drawn from various sources, such as scientific magazines, academic journals, textbooks and the Internet, and served as authentic material through which the students could hone their English language skills. These materials were the genesis of the first edition of this textbook, which was published in 2011. For the second edition, John Nixon has been joined by his colleague Joseph Michaels to update the information and reflect current trends in aerospace engineering, which can be found in the second half of the book.

This book is intended as a textbook to accompany ESP courses at post-secondary institutions across the German-speaking world, but, if one disregards the translation exercises involving German, it could easily be used for English for aerospace classes anywhere. Additionally, this textbook can be used by engineers already working in the field of aerospace engineering as part of a structured course or a self-study module.

While there is no pre-requisite per se for the course in which this book is meant to be used, students are generally required to have a firm grasp of the English language. The level that has been aimed for is C1 (Common European Framework of Reference for Languages) or UNIcert Level III.

As the material has been taken from a number of sources in its original context, the variety of English might vary from text to text. Consequently, the British English "centre", for example, might figure next to its American equivalent "center". The differences between these types of English are covered in chapter 12.

This book is a combination of reader and workbook. Space has generally been provided for students to enter their answers into the book as they work through the exercises under the guidance of an instructor or on their own as part of a self-study module.

Although there is a large focus on reading comprehension, the expansion of specialized and academic vocabulary as well writing skills, there are exercises throughout the textbook that provide practice in listening comprehension and speaking. A few task-oriented exercises have also been provided to allow the students to employ all of their English-language resources in authentic, real-life situations.

We cannot vouch for the accuracy of the information provided in the material that we have gathered, but we have endeavoured to ensure that the material has been drawn from reputable sources.

Thanks goes to a number of individuals who provided help and advice along the way. In particular, we would like to thank Paula Cilinghir, who was of enormous assistance with the layout and graphics. We are also indebted to our aerospace students, without whose enthusiasm for English and for their field of study this book would never have come about.

Lastly, we would like to thank the Carl Hanser Verlag for their continued support with this manuscript as well as for their ideas regarding formatting, graphics and illustrations.

Stuttgart, May 2021

John D. Nixon

Joseph Michaels

1 Aerodynamic Forces

1.1 Introductory Discussion

There are numerous forces acting on objects in everyday life.

For example, which forces are at play on a boat floating on water?

What about a rock on an incline that doesn't roll down the slope?

Which of these forces operate on an aircraft in flight? Are there any others?

Discuss the preceding introductory questions and then fill in the table below.

Object	Forces Acting on it
Boat	
Rock	
Airplane	

1.2 Exercises

1.2.1 Exercise A

Read the following text and fill in the blanks with the words presented here.

denotes	resists	magnitude	adjust
opposing	overcome (x2)	payload	generate
consumes	varied		

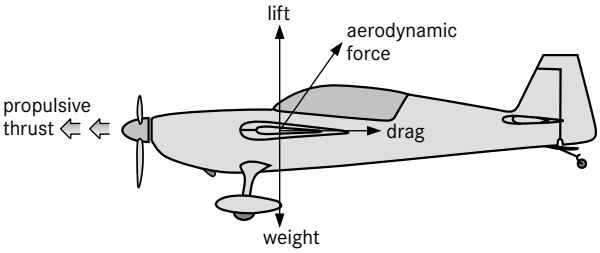

Figure 1.1 Overview of the four aerodynamic forces acting on an airplane

Weight

Weight is a force that is always directed toward the center of the earth. The magnitude of the weight depends on the mass of all the airplane parts, plus the amount of fuel, plus any _____ (1) on board (people, baggage, freight, etc.). The weight is distributed throughout the airplane. But we can often think of it as collected and acting through a single point called the center of gravity. In flight, the airplane rotates about the center of gravity.

Flying encompasses two major problems: overcoming the weight of an object by some opposing force, and controlling the object in flight. Both of these problems are related to the object's weight and the location of the center of gravity. During a flight, an airplanes' weight constantly changes as the aircraft _____ (2) fuel. The distribution of the weight and the center of gravity also changes. So, the pilot must constantly _____ (3) the controls to keep the airplane balanced or trimmed.

Lift

To _____ (4) the weight force, airplanes generate an _____ (5) force called lift. Lift is generated by the motion of the airplane through the air and is an aerodynamic force. "Aero" stands for air and "dynamic" _____ (6) motion. Lift is directed perpendicular to the flight direction. The magnitude of the lift depends on several factors including the shape, size and velocity of the aircraft. As with weight, each part of the aircraft contributes to the aircraft lift force. Most of the lift is generated by the wings. Aircraft lift acts through a single point called the center of pressure. The center of pressure is defined just like the center of gravity, but using the pressure distribution around the body instead of the weight distribution.

Drag

As an airplane moves through the air, there is another aerodynamic force present. The air _____ (7) the motion of the aircraft and the resistance force is called drag. Drag is directed along and opposed to the direction of flight. Like lift, there are many factors that affect the _____ (8) of the drag force including the shape of the aircraft, the "stickiness" of the air, and the velocity of the aircraft. Like lift, we collect all of the individual components' drags and combine them into a single aircraft drag magnitude. And like lift, drag acts through the aircraft center of pressure.

Thrust

To _____ (9) drag, airplanes use a propulsion system to _____ (10) a force called thrust. The direction of the thrust force depends on how the engines are attached to the aircraft. On many planes, two turbine engines are located under the wings and parallel to the body, with thrust acting along the body centreline. On some aircraft, such as the Harrier, the thrust direction can be _____ (11) to help the airplane take off over a very short distance. The magnitude of the thrust depends on many factors associated with the propulsion system including the type of engine, the number of engines and the throttle setting.

(adapted from NASA Glenn Research Center, Aerodynamics Index)

1.2.2 Exercise B: Vocabulary

Look at the previous text extracts and try to answer the questions below with a partner.

1. What is the difference between weight and mass?

2. What is the difference between speed and velocity?

3. What is meant by perpendicular? (see text on **Lift** above)

1.2.3 Exercise C: Translation

Translate the following text into English.

Auf ein Flugzeug, das sich gerade im Flug befindet, wirken immer vier Kräfte ein: der Auftrieb, die Schwerkraft (also das Gewicht des Flugzeugs), der Schub (oder auch Vortrieb genannt) und der Widerstand. Wie man sich vorstellen kann, sind

Auftrieb und Schwerkraft gegeneinander gerichtet, und dasselbe gilt auch für den Vortrieb (Schub) und den Widerstand. Der Auftrieb ist das wesentlichste Element beim Fliegen. Während des Fluges wirken aber noch andere Kräfte auf das System ein und in deren Zusammenspiel ergibt sich das Flugverhalten des Geräts.

(adapted from Drachen- und Gleitschirmclub, *www.dgcb.de*)

1.3 Why an Aircraft Flies

The following text was considered for a long time the traditional explanation, but is now deemed incomplete. While you read this text, try to determine what piece of information has been proven incorrect through wind tunnel tests.

1. As an aircraft is “heavier than air”, it needs an upward force to keep it aloft. This force is provided by the “lift” developed by the supporting surfaces (wings) and is directed at right angles to the direction of movement. In addition, the air offers a certain frictional resistance, called “drag”. By suitable design of the cross-sectional shape of the wing, the drag can be kept small in relation to the lift. A shape of this kind is known as an airfoil section (Figure 1.2).

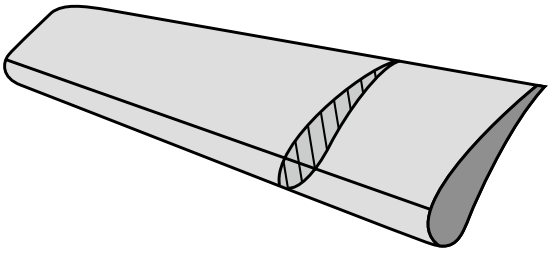

Figure 1.2 Airfoil section

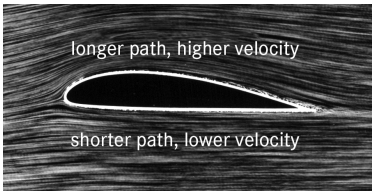

Figure 1.3 Airflow around an airfoil

2. When the wing of an aircraft moves forward through the air, the flow of air along the lower surface arrives at the trailing edge before the flow along the upper surface. The lower surface flow attempts to expand around the trailing edge. As a result of this, a vortex is formed. The rotation of this vortex accelerates the upper surface flow, so that the length of time required for a particle of air to move from the leading edge to the trailing edge becomes the same for the upper and the lower surface flow. The increased velocity of the upper surface flow eliminates the formation of a vortex by the lower surface air at the trailing edge, and it produces a lower pressure at each point on the upper surface than exists at the corresponding points on the lower surface. It is this difference in pressure that produces the lift. The distribution of lift along the cross-section of a wing is illustrated by the pressure-distribution diagram (Figure 1.4). The magnitude of the forces changes with the angle of attack (or angle of incidence), i.e. the angle between the direction of the air flow and the chord line of the wing (Figure 1.5). The resultant aerodynamic force acts at the centre of pressure (Figure 1.4); its position varies with the angle of attack. The stability of an aircraft is significantly determined by the displacement of the centre of pressure. With an increasing angle of attack, this point moves forward. When the angle is increased beyond the value that produces maximum lift, “stall” occurs: this results in loss of flying speed and lift and finally loss of control; the air flow detaches itself from the upper surface (Figure 1.6).

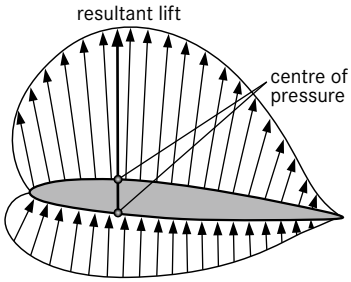

Figure 1.4 Pressure distribution diagram

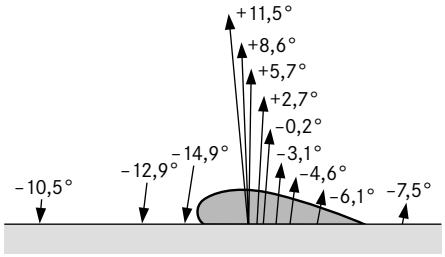

Figure 1.5 Variation of forces and position of centre of pressure with angle of attack

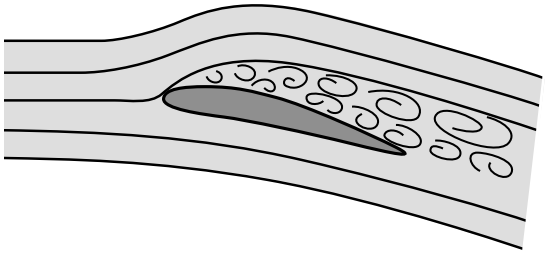

Figure 1.6 Formation of Stall

3. The airfoil section is so shaped as to present minimum air resistance at the design speed of the aircraft and at the same time provide the necessary amount of lift. Figs. 1.7a and 1.7b represent the wing sections of a cargo-carrying aircraft and a faster aircraft respectively. The lift provided by the thick highly curved wing is about half as much again as that of the thinner and flatter wing, but its drag is about twice as high.

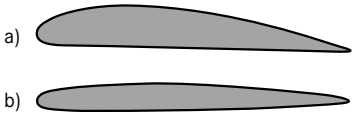

Figure 1.7 Different airfoils

4. The principles of airfoil design are also applicable to propeller blades. The function of the propeller is to convert the torque developed by the engine into a propulsive thrust to drive the aircraft forward. This thrust is produced by acceleration of the air around the propeller. Since the velocity at each blade section is a function of radius, the blades are twisted to maintain a favourable angle of attack all along the blade. The principal forces and velocities associated with the action of the propeller are shown in Figure 1.8. The pitch angle of the propeller blade corresponds to the angle of attack of the wing: it is the angle between the blade chord line and the plane of rotation. A variable-pitch propeller is designed to maintain propeller efficiency as the forward velocity changes. The pitch setting can be changed while the propeller is rotating.

Source: How things work

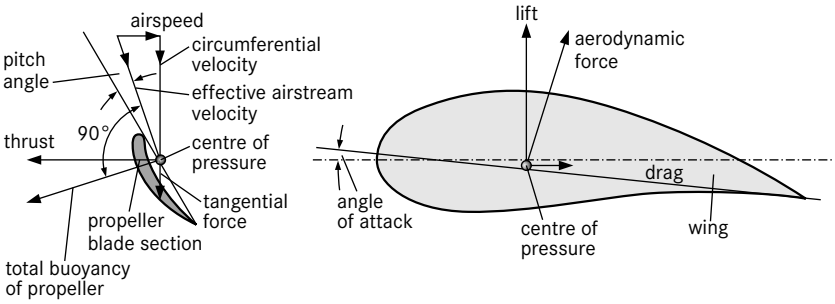

Figure 1.8 Cross-section of an airfoil and the various forces at work

1.3.1 Exercise A: Comprehension

Based on the text above, answer the following questions using full sentences.

1. Define the concepts “lift” and “drag”.

2. How is lift produced?

3. What factor determines the stability of an aircraft?

4. How does the wing shape of a cargo plane differ from that of a faster aircraft?

5. What is the function of a propeller?

6. What is a variable-pitch propeller?

_____

_____

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_____

1.3.2 Exercise B: Vocabulary

Paragraph One

a) What does ‘aloft’ mean?

b) What German word is ‘loft’ related to?

c) Can you think of other words with the same type of structure ‘a’ + ‘noun’/‘adj’ = ‘adj’ or ‘adverb’

Paragraph Two

d) What is the opposite of ‘accelerate’?

e) What is the plural of ‘aircraft’?

Paragraph Three

f) What is the purpose of the word ‘respectively’ in the second sentence?

g) Create a sentence using the structure ‘so + adj. + as to’ found in this paragraph.

Paragraph Four

h) What does the word ‘maintain’ mean in the text here? What is another meaning, which is not found in the text?

i) Define ‘torque’.

j) Word formation: propeller

→_____ (verb)

→_____ (adj.)

1.3.3 Exercise B: Part Two

Read this aerodynamics course description from the University of Michigan. Fill in the missing words with the words below. Note that there are not enough words and that you will have to come up with a few on your own. Refer back to the text you just read to find the answers.

aerodynamics **separation** **calculated** **concepts**

This course deals with the fundamental _____ in aerodynamics. Students learn how _____ produce lift, and how the pressure _____ about an airfoil can be _____. The course also introduces the boundary-layer concept, how boundary _____ lead _____ drag, and what makes them prone to instability or _____. It covers the effects of the wing planform shape on lift and drag and includes an introduction to airfoil design and high-speed _____.

1.3.4 Exercise C: Writing

In your own words and using complete sentences, try to explain the function of wings and engines on an airplane. Focus on the role of these airplane parts as they relate to aerodynamic forces.

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