普通高等院校民航
特色专业统编教材

机务专业高职适用

飞机机电专业英语

Technical English for Aircraft Maintenance Engineering

◎邓君香　孙暄　主编

中国民航出版社

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孙　暄（上海民航职业技术学院）

参编：廖向红（广州飞机维修工程有限公司）

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出版前言

当前，我国民航事业呈现快速发展态势，人才需求巨大，人才缺口矛盾突出。为深入实施“科教兴业”和“人才强业”战略，进一步加快民航专业人才培养，提高人才培养质量，努力为推动民航强国建设提供更加强有力的人才保障，在院校教育方面必须十分注重教学基本建设，编写民航统编教材便是其中的一项重要工作。

民航局高度重视统编教材编写工作，自2012年首次推出“空管专业统编教材”以来，其他特色专业教材也得到了系统开发，此次机务专业统编教材的编写出版就是在民航局高度重视下取得的又一成果。

本套教材在编写过程中紧密结合民航机务专业本科和高职人才培养目标的不同要求，在教材编写上各有侧重：机务专业高职教材在编写原则上贯彻以学生为主体的教学思想，理论知识以“必需”和“够用”为度，重点突出实际操作技能；机务专业本科教材在编写原则上是从培养民航高级机务维修和管理人才的目标出发，注重学生理论素养的提升，尽可能吸收民航发展的最新技术和成果。同时，为保证教材的实用性、先进性，并能反映维修过程中的技术水平，本套教材的开发、编写由来自中国民航大学、中国民航飞行学院、中国民航管理干部学院、广州民航职业技术学院、上海民航职业技术学院的机务专业教师与来自中国国际航空股份有限公司、中国东方航空股份有限公司、中国南方航空股份有限公司等企业的专业人员共同完成，使教材内容更具有针对性，更加贴近社会需要和岗位需求标准。

本套教材秉承民航特色专业统编教材的编撰宗旨，在内容、体例、规范等方面更加严谨、务实，编者多是长期从事机务专业教学和研究工作的资深教师及富有飞机维修经验的一线专业人员，书稿中的重要内容均经过行业专家审核把关。该套丛书体现了权威、创新、普适的特点，丰富、更新并完善了近年来机务专业的教材体系，既适合民航大中专院校、社会上各类机务培训机构用作教材，也可作为民航一线维修人员拓展知识、提高实操能力的培训用书。

此次机务专业统编教材的组织编写专业细分性较强，涉及面广，不足之处在所难免，诚恳地欢迎大家在教材使用过程中提出改进意见，使统编教材日臻完善。

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前言

随着中国民航“强国战略”的提出和《国务院关于促进民航业快速发展的若干意见》的出台，中国民航必将迎来高速发展的黄金期，也将引进大批欧美等国家制造的飞机，这就要求飞机维护人员必须熟练掌握飞机维修专业英语。“飞机机电专业英语”课程是飞机机电设备维修专业的一门专业必修课。为了本课程教材紧跟民航的最新发展，我们组织多年从事飞机机电设备维修专业英语教学的一线教师和飞机维修生产一线的技术人员编写了《飞机机电专业英语》一书。

本书课文大部分选自欧美原版英文教材、波音公司和空客公司的飞机维护手册，以及国际著名公司网站提供的技术资料。本书既包括了飞机和发动机理论等航空基础知识，又紧贴民航维修机电类一线工作任务，涵盖了民航各大中型现役主流机型和最新机型的机电维护内容，包括 B737、B747、B777、B787、A320 和 A380 等机型。本书包括航空维修基础、飞机系统和动力装置三个模块。航空维修基础模块包括气动基础知识、机体结构、飞机地勤基础知识、通用手工工具和飞机维护手册。飞机系统模块包括飞机空调系统、座舱增压系统、通信系统、电源系统、飞行操纵系统、飞机燃油系统、液压系统、起落架、机轮和刹车、气源系统、辅助动力装置和飞机舱门。动力装置模块包括燃气涡轮发动机理论、燃气涡轮发动机类型、发动机结构、发动机燃油和控制系统、点火系统、指示系统、滑油系统、起动系统和发动机维护等内容。

本书共 26 课，每课由精读课文、生词/短语表、长难句分析和翻译、练习和泛读课文构成，其中生词/短语表中列出了大量常用的飞机和发动机部件英文单词、音标、词性、中文注释、词组和缩略语，且所有生词和短语汇总在书中最后的词汇部分，便于查找和记忆。每篇课文都包括飞机和发动机各系统的基础知识和机型知识，图文并茂，难度适中。通过本书的学习，学生可以掌握飞机机电设备维修的海量专业英语词汇和缩略语，有助于很好地理解英文版的专业知识、各种飞机维护手册和工卡等英文资料，为胜任今后的飞机维修工作打下坚实的基础。

本书由邓君香、孙暄主编。其中第 1~4 课由顾铮编写，第 6、7、9、12、15 课由王舰编写，第 10、11、13、14、17 课由龚煜编写，第 18~23 课由邓君香编写，第 5、8、16、24、25、26 课由廖向红编写。词汇附录由王舰整理。邓君香负责统稿。

本书可作为大、中专院校飞机机电设备维修相关专业的专业英语课程教材，也可

供航空公司、飞机维修公司、飞机部件修理公司和发动机部件修理公司的维修技术人员培训和自学使用。

本书在编写过程中参考了相关原版英文教材、各种飞机和发动机维护手册，以及国际著名制造公司和科技公司网站提供的技术资料，同时得到了广州民航职业技术学院、上海民航职业技术学院各级领导和民航企业的大力支持和帮助，在此一并表示最诚挚的感谢！

由于编者能力和时间有限，书中错漏在所难免，恳请各位专家和读者批评指正。

编　者

2015 年 5 月

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Module 1

Aviation General

Lesson 1

Basic Aerodynamic Knowledge

An aircraft in straight-and-level un-accelerated flight has four forces acting on it (in turning, diving, or climbing flight, additional forces come into play)[1]. These forces are: lift, an upward-acting force; drag, a retarding force of the resistance to lift and to the friction of the aircraft moving through the air; weight, the downward effect that gravity has on the aircraft; and thrust, the forward-acting force provided by the propulsion system (or, in the case of unpowered aircraft, by using gravity to translate altitude into speed). Drag and weight are elements inherent in any object, including an aircraft. Lift and thrust are artificially created to enable an aircraft to fly (Figure 1-1).

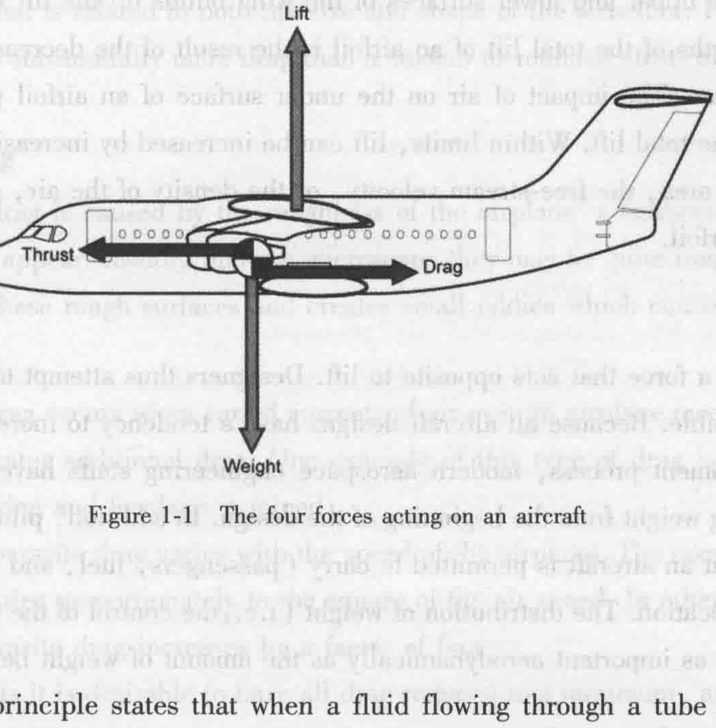

Figure 1-1 The four forces acting on an aircraft

Lift

Bernoulli's principle states that when a fluid flowing through a tube reaches a constriction, or the narrowest part of the tube, the speed of the fluid flowing through that constriction is increased and its pressure decreased. The cambered (curved) surface of an air-

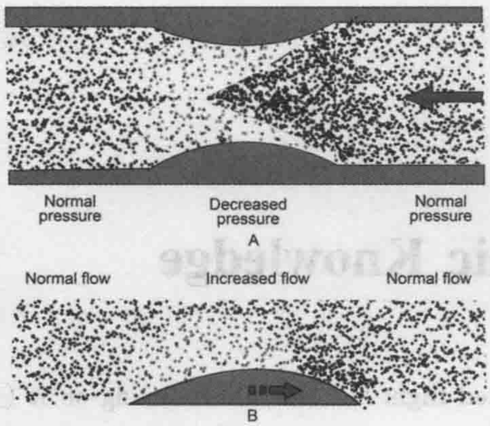

Figure 1-2 Bernoulli's principle

foil (wing) affects the airflow exactly as a constriction in a tube affects airflow[(2)]. This resemblance is illustrated in Figure 1-2. Diagram A of Figure 1-2 illustrates the effect of air passing through a constriction in a tube. In Diagram B, the air is flowing past a cambered surface, such as an airfoil, and the effect is similar to that of air passing through a restriction.

Air flowing over the top surface of the wing must reach the trailing edge of the wing in the same amount of time as the air flowing under the wing. To do this, the air passing over the top surface moves at a greater velocity than the air passing below the wing because of the greater distance it must travel along the top surface. This increased velocity, according to Bernoulli's principle, means a corresponding decrease in pressure on the surface. Thus, a pressure differential is created between the upper and lower surfaces of the wing, forcing the wing upward in the direction of the lower pressure. In the other words, the difference in curvature of the upper and lower surfaces of the wing builds up the lift force.

Three-fourths of the total lift of an airfoil is the result of the decrease in pressure over the upper surface. The impact of air on the under surface of an airfoil produces the other one-fourth of the total lift. Within limits, lift can be increased by increasing the angle of attack, the wing area, the free-stream velocity, or the density of the air, or by changing the shape of the airfoil.

Weight

Weight is a force that acts opposite to lift. Designers thus attempt to make the aircraft as light as possible. Because all aircraft designs have a tendency to increase in weight during the development process, modern aerospace engineering staffs have specialists in the field controlling weight from the beginning of the design. In addition, pilots must control the total weight that an aircraft is permitted to carry (passengers, fuel, and freight) both in amount and in location. The distribution of weight (i.e., the control of the center of gravity of the aircraft) is as important aerodynamically as the amount of weight being carried.

Thrust

Thrust, the forward-acting force, opposed to drag as lift is opposed to weight. Thrust is obtained by accelerating a mass of ambient air to a velocity greater than the speed of the aircraft; the equal and opposite reaction is for the aircraft to move forward. In reciprocating or turboprop-powered aircraft, thrust derives from the propulsive force caused by the rotation of the propeller, with residual thrust provided by the exhaust. In a jet engine, thrust derives from the propulsive force of the rotating blades of a turbine compressing air, which then expanded by the combustion of introduced fuel and exhausted from the engine.

Drag

Acting in continual opposition to thrust is drag, which has two elements: parasitic drag and induced drag.

Parasite Drag

Parasite drag includes all drag created by the airplane, except that drag directly associated with the production of lift. It's created by the disruption of the flow of air around the airplane's surfaces. Parasite drag is normally divided into three types: form drag, skin friction drag, and interference drag.

Form Drag

Form drag is created by any structure which protrudes into the relative wind. The amount of drag created is related to both the size and shape of the structure. For example, a square strut creates substantially more drag than a smooth or rounded strut. Streamlining reduces form drag.

Skin Friction Drag

Skin friction drag is caused by the roughness of the airplane's surfaces. Even though these surfaces may appear smooth, under a microscope they may be quite rough. A thin layer of air clings to these rough surfaces and creates small eddies which contribute to drag.

Interference Drag

Interference drag occurs when varied currents of air over an airplane meet and interact. This interaction creates additional drag. One example of this type of drag is the mixing of the air where the wing and fuselage is joined.

Each type of parasite drag varies with the speed of the airplane. The combined effect of all parasite drag varies proportionately to the square of the air speed. In other words, if airspeed doubled, parasite drag increases by a factor of four.

For most flights it is desirable to have all drag reduced to a minimum, and for this reason considerable attention is given to streamlining the form of the aircraft by eliminating as much drag-inducing structure as possible (e.g., retracting the landing gear, using flush riveting, and painting and polishing surfaces). Some less obvious elements of drag include the relative disposition and area of fuselage, wing, engine, and empennage surfaces; the intersection of wings and tail surfaces.

Induced Drag

Induced drag is the main by-product of the production of lift. It is directly related to the angle of attack of the wing. The greater the angle, the greater the induced drag.

Over the past several years the winglet has been developed and used to reduce induced drag. As discussed earlier in this article, the high pressure air beneath the wing tends to spill over to the low pressure area above the wing, producing a strong secondary flow. If a winglet of the correct orientation and design is fitted to a wing tip, a rise in both total lift and drag is produced. However, with a properly designed winglet, the amount of lift produced is greater than the additional drag, resulting in a net reduction in total drag.

As the angle of attack increases, so does drag; at a critical point, the angle of attack can become so great that the airflow is broken over the upper surface of the wing, and lift is lost while drag increases. This critical condition is termed the stall[3] (Figure 1-3).

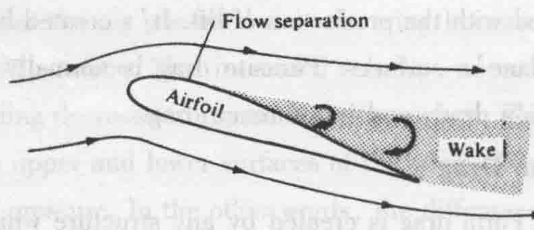

Figure 1-3 Flow around airfoil at high angle of attack

The aerodynamics of supersonic flight is complex. The Mach number (M) refers to the method of measuring airspeed that was developed by the Austrian physicist Ernst Mach. Mach number is the speed of an object moving through air, or any other fluid substance, divided by the speed of sound as it is in that substance for its particular physical conditions, including those of temperature and pressure.

The critical Mach number for an aircraft has been defined as that at which on some point of the aircraft, the airflow has reached the speed of sound.

At Mach numbers in excess of the critical Mach number (that is, speeds at which the airflow exceeds the speed of sound at local points on the airframe), there are significant changes in forces, pressures, and moments acting on the wing and fuselage caused by the formation of shock waves. One of the most important effects is very large increase in drag as well as a reduction in lift.

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