

AVIATION & SPACE DICTIONARY

Chief Editor
ERNEST J. GENTLE

President and Editor-in-Chief of Aero Publishers, Inc.; Director of Aero Technical Institute; and Member of Advisory Board for the California Aviation Education Association. Formerly: Senior Design Engineer and Senior Research Engineer for Lockheed Aircraft Corporation. Member of Tau Beta Pi, National Engineering Honorary, and Sigma Xi, National Science Honorary. Received Master of Science in Aeronautics from California Institute of Technology.

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FOURTH EDITION

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FOREWORD

Aviation and space scientists have created a brand new world and a brand new language to describe it.

For the engineers and scientists who labor in the creation of this world, language is an instrument that must be just as precise as the mathematical formulas with which they work and just as modern as the new concepts on which the aerospace sciences depend.

And for the non-specialist—the man-in-the-street who must live in this new world—an acquaintance with this new language is almost equally important. How else are we to understand the age we live in if we do not know the words that define and explain it?

This edition of the **Aviation & Space Dictionary** contains those words. It is an authoritative and up-to-date compilation, assembled by experts and based on the work of specialists in the many and varied fields that constitute the aerospace sciences.

It will without question find a valued place in the specialist's bookshelves. I believe it will also be an important addition to the library of the intelligent non-specialist who is eager to know what is happening in the exciting world in which we live today.

ROBERT E. GROSS
Board Chairman and
Chief Executive Officer
Lockheed Aircraft Corporation

PREFACE TO FOURTH EDITION

During the past twenty-two years, this standard authority on aviation terms has been titled "Aviation Dictionary & Reference Guide". Now, with the expansion of the aerospace industry and its allied fields, it has been deemed advisable to expand the coverage and to change the title of this fourth edition to **Aviation & Space Dictionary**.

Thus, in addition to having a complete coverage of the aviation industry itself, this new volume now includes terms on astronomy, atomic energy, electronics, guided missiles, helicopters, jet aircraft, meteorology, ordnance, radar, rockets, television and other subjects related to the aerospace industry.

Because of the number of splendid reference volumes that have been made available to the industry during the last few years—such as ALCOA's handbook on aluminum alloys, and the Government's handbook on standards (MIL-HDBK-5)—it was considered advisable to delete the "Reference Guide" section that was included in previous editions. Included now is a photo coverage of many of the major developments in the industry.

The editors and their associates wish to express their appreciation to the hundreds of individuals, companies and organizations, including the National Aeronautics and Space Administration and to the Military Establishments, that have cooperated so generously with Aero Publishers during the preparation of this and previous editions. Complete photo credit is detailed on pages 445 and 446.

ERNEST J. GENTLE
CHARLES EDWARD CHAPEL

Los Angeles, California
September 15, 1961

A

ABANDON: 1. To bail out of an aircraft and let it crash. Used in command, as in 'abandon ship' or 'abandon airplane'. 2. To walk away from and leave an aircraft no longer to be claimed.

"A"-BATTERY: A battery used for heating filaments of vacuum tubes.

ABBOTT SYNCHRONIZER: The Abbott synchronizer is a timing device principally used for the timing of the magnetos.

ABBREVIATIONS: The use of abbreviations is not encouraged in the aircraft industry except where it is necessary to save space, as on name plates, etc., which must occupy a small area on some aircraft part, sub-assembly, etc. The period (.) is used after an abbreviation only when the abbreviation spells an English word. Examples: "ADD." for additional; "AIL." for aileron, etc. Aircraft companies attempt to standardize abbreviations in wartime or when meeting armed forces specifications, but there are many cases where abbreviations vary from one company to another, such as "AL." or "ALUM" for aluminum.

ABBREVIATIONS, valve position: The abbreviations generally used in describing valve positions in valve and ignition timing are:

After bottom center	ABC
After top center	ATC
Before bottom center	BBC
Bottom center	BC
Bottom dead center	BDC
Before top center	BTC
Exhaust closes	EC
Exhaust opens	EO
Intake closes	IC
Intake opens	IO
Top center	TC
Top dead center	TDC

ABERRATION: A defect in an optical picture caused by an imperfection in the lens or mirror and the failure to bring all of the rays of light to the same focus.

ABLATING MATERIALS: Special materials on the surface of a spacecraft that can be sacrificed (carried away, vaporized) during re-entry into the Earth's atmosphere. Kinetic energy is dissipated and excessive heating of the main structure of the spacecraft is prevented.

ABLATION: Melting of nose cone materials during re-entry of spacecraft or other vehicles into the Earth's atmosphere at hypersonic speeds.

ABNORMAL SPIN: A spin which must be developed by abnormal or severe use of the controls, or one in which the airplane

will not recover to normal flight within a maximum of two additional turns after neutralizing the controls. In recovery from an "abnormal spin" it is often necessary to use **opposite controls**. Sometimes severe manipulations of the controls are required in order to overcome the spin.

ABORT: Failure of an aerospace vehicle to accomplish its purposes for any reason other than enemy action. An abort may occur at any point from start to count-down or takeoff to the destination. An abort can be caused by human, technical or meteorological errors, miscalculations or malfunction.

ABRASIVE: Natural or artificial materials used for grinding and polishing. Natural abrasives include the diamond, emery, corundum, sand, crushed garnet and quartz, tripoli and pumice. Artificial abrasives are made from natural materials and, in general, are either silicon carbide, or aluminum oxide.

ABRUPT DECELERATION VEHICLE: A high-speed vehicle, usually a rocket-propelled sled, that can be rapidly decelerated at a preselected rate and brought to a stop by water brakes, friction brakes, and other devices.

ABSCISSA; engr: The horizontal reference line of a curve or graph. Horizontal distances measured along this line from the ordinate line to points on a curve are called the abscissa values, e.g., when plotting an airfoil section, horizontal distances along the chord are plotted as abscissa.

ABSOLUTE ALTIMETER: An altimeter that indicates the **absolute altitude** by visual continuous readings, the exact distance between an airplane in flight and the terrain beneath it. An instrument of this type developed by Bell Telephone Laboratories and manufactured by Western Electric utilizes a transmitter to send out radio waves which are reflected back from the earth. The elapsed time for the radio wave to travel to the earth and back is converted into feet and indicated on a dial. This altimeter is not affected by temperature, humidity or atmospheric pressure.

ABSOLUTE ALTITUDE: The height of the airplane above the ground directly beneath it.

ABSOLUTE ANGLE OF ATTACK: The angle of attack of an airfoil, measured from the angle of zero lift.

ABSOLUTE CEILING: The maximum height above sea level at which a given airplane would be able to maintain horizontal flight under **standard air conditions**.

ABSOLUTE HUMIDITY: See HUMIDITY.

ABSOLUTE INCLINOMETER: An instrument which indicates the attitude of an aircraft with reference to the horizontal. The indications of instruments of this type usually depend on gyroscopic action. Also see INCLINOMETER.

ABSOLUTE PRESSURE: The sum of the gage pressure plus the atmospheric pressure. The pressure used to determine the action of gases according to the gas laws.

$$\frac{P V}{T} = \frac{P_1 V_1}{T}$$

ABSOLUTE SYSTEM OF COEFFICIENTS: See ABSOLUTE SYSTEM OF UNITS.

ABSOLUTE SYSTEM OF UNITS: A system of units for expressing lift and drag coefficients of an airplane wing, or any other component part. The lift and drag forces are expressed by the symbols C_L and C_D respectively, and are the standards adopted by the N.A.C.A. The absolute system is different from the engineering system of coefficients in that the mass density (ρ) of the air, or the impact pressure, has been introduced into the formulas of the absolute system and the units are dimensionally correct and consistently expressed, i.e., Lift (in pounds) = $C_L \rho/2 SV^2$ (where S is area in sq. ft. and V is in. ft. per sec.). Drag (in pounds) = $C_D \rho/2 SV^2$. To convert absolute units into the corresponding units in the engineering system multiply by .00256 and vice-versa divide engineering units by .00256 to obtain absolute units.

ABSOLUTE TEMPERATURE: The temperature in centigrade degrees or Fahrenheit degrees measured from absolute zero. The temperature used in the gas laws

$$\frac{P V}{T} = \frac{P_1 V_1}{T} \text{ See Absolute pressure.}$$

ABSOLUTE ZERO: That temperature at which all heat action ceases to exist; 273.1° below zero on the centigrade scale and 459.6° below zero on the Fahrenheit scale.

ABSORPTION, of radiated light and heat: The ability of matter to absorb radiant energy. Of the sun's radiant energy which reaches the top of the atmosphere about 60 per cent reaches the earth's surface, and most of the other 40 per cent is reflected away into space. In coming through the atmosphere from the sun very little is absorbed. Of the 60 per cent which reaches the earth some is reflected away and a good deal is absorbed but the amount depends upon the character of the surface. That which is absorbed is re-radiated in longer wave-lengths, and these are more easily absorbed by the constituents of the atmosphere than the original radiation as it came from the sun. Water vapor is the best absorber.

ABSORPTION PROCESS, for producing gasoline: Extracting a gasoline (of comparatively high volatility and known as casing head or natural gasoline) from certain

compounds present in natural gas. The absorption process is accomplished by forcing natural gas through a heavy lubricating oil which absorbs the liquid content of the natural gas. The oil is then distilled to obtain the light fraction which is gasoline. When properly blended with straight run gasoline it is quite satisfactory as an engine fuel.

A. C.: Abbreviation for altering current.

ACCELERATING PUMP: A pump on the carburetor which enriches the mixture momentarily while the engine is accelerating. It may be actuated by a plunger attached to the throttle, or may be automatically operated by the variation in the suction of the engine induction system.

ACCELERATING SYSTEM may be either an accelerating pump or an accelerating well in a carburetor. The function of an accelerating system is to discharge an additional quantity of fuel into the carburetor air stream when the throttle is opened suddenly, thus causing temporary enrichment of the fuel-air mixture and producing smooth and positive engine acceleration.

ACCELERATING WELL: In a modern carburetor the accelerating well is a space around the discharge nozzle, connected by holes to the fuel-air mixture passage.

ACCELERATION: The rate of change of velocity and expressed in feet per second per second or miles per hour per second, or any other unit of speed divided by any unit of time. Acceleration has direction as well as magnitude, and is forward when the velocity is increased or backward (deceleration) when the velocity is decreased.

ACCELERATION, axial: Acceleration in the direction of the longitudinal axis of the aircraft.

ACCELERATION, lateral: Acceleration perpendicular to the longitudinal axis of the aircraft.

ACCELERATION DUE TO GRAVITY: Any acceleration due entirely to gravity, e.g., in a vacuum a freely falling body falls toward the earth's center at a velocity of 32.2 feet the first second, and an increased velocity of 32.2 feet per second the second second (velocity at the end of the second second is 64.4 feet per second, etc.). In air the rate of acceleration is modified by the force due to air resistance. A freely falling body will finally reach a speed at which the force of gravity and air resistance are equal and no greater speed is gained.

ACCELERATION DUE TO GUSTS: The effective acceleration of an airplane which when flying at high speed (low angle of attack) encounters a current of air, which is flowing vertically (upward). In many cases, reactions measured during flight indicate that vertical air currents will cause a more severe loading condition than by quickly moving the pilot's controls. Vertical gusts cause an increase in

the angle of attack and if the gust is sharp-edged, the change will be very sudden. For purposes of design, allowance must be made for a 30-foot per second sharp-edged gust.

ACCELERATION FACTOR "n"; Engr: See LOAD FACTOR.

ACCELEROMETER (ak-sel'er-om'eter): An instrument which measures and indicates the magnitude of accelerations (g) of an aircraft in flight and is a direct indication of the forces applied to an airplane and its passengers. Maximum safety and comfort can be maintained in rough, bumpy air by reducing speed when the vertical accelerations are too severe. Some accelerometers instantaneously and permanently indicate the loads to which an airplane is subjected.

ACCEPTANCE TEST: A specified series of firing tests under a variety of service-simulated conditions prescribed by the military customer.

ACCESSORIES; eng: Includes units such as fuel pumps, hydraulic pumps, vacuum pumps, generators, starters, etc., mounted on the engine and are operated by the engine accessory drive.

ACCESSORY DRIVE: The accessory drive of an engine is comprised of a drive shaft and the necessary gears to actuate the various accessories mounted on the engine. The drive shaft and gears are generally located on the rear of the engine.

ACCESSORY GEAR TRAINS: A group or series of gears which drive the stub shafts to which are connected the drive shafts of such accessories as tachometer, generator, supercharger, etc.

ACCIDENT; aircraft: An accident involving aircraft is an occurrence which takes place while an aircraft is being operated as such and which results in personal injury or death, or marked or appreciable damage to the aircraft. Also see C.A.R.

ACCIDENTAL JAMMING: Jamming due to transmission by friendly equipment.

ACCUMULATIVE DIMENSION, also known as continuous or consecutive dimension is a type of location dimension which may be used for small parts. An example is dimensioning for the center lines of a series of holes. If a plus error of 1/16-inch is made in laying out the first hole, there may be a total error of 6/16-inch for a series of six holes because each dimension is dependent upon the preceding one in a continuous, consecutive, or accumulative line.

ACCUMULATOR, bladder-type: A storage unit in an aircraft hydraulic system which consists of a spherical steel container with two diametrically opposed ports. A synthetic rubber bladder is installed through the lower port and sealed to the port by means of a cap. The top port is connected to the pressure system. When the accumulator contains no fluid and the air charge is released, the bladder is approximately the same

size as the accumulation shell; hence the bladder is not stretched by air pressure. A metal disc, located in the center of the bladder, prevents the bladder from extruding through the upper port when the fluid is drained from the system.

ACCUMULATOR, diaphragm - type: The diaphragm-type accumulator consists of two hollow, hemispherical steel parts that may be either screwed or bolted together, depending upon the design. The top half has a fitting for connecting the units to the hydraulic system. Fluid is pumped through this connection, thus forcing the diaphragm down and compressing the air in the lower half. A screen, which is installed across the inside of the port, prevents the diaphragm from rupturing when the accumulator is preloaded with air and when the fluid is drained from the system. The lower half is equipped with an air valve for charging the unit with compressed air at a predetermined pressure. During the air-charging operation, the diaphragm unfolds and contacts the inner surface of the upper half of the accumulator. A synthetic rubber diaphragm is mounted between the two halves. It divides the tank into two chambers, one for air and one for fluid. Normally, the accumulator is mounted with the air valve down, thus placing the air chamber in the lower and the fluid chamber in the upper position.

ACCUMULATOR, electric: A storage battery.

ACCUMULATOR functions are: (1) Maintaining pressure in the pressure manifold by storing energy in the form of fluid under pressure, thereby supplementing the power pump when it is under a peak load; (2) Supplying a limited amount of fluid under pressure to actuating units when the power pump fails to operate; (3) Dampening pressure surges which may be caused by pulsating fluid delivery from the power pump; (4) Absorbing fluid shocks, such as those which occur when the pressure regulator seals the pressure manifold and directs the fluid to the reservoir; and (5) Preventing the too-frequent cut-in and cut-out of a pressure regulator, thereby reducing wear on the pump and the pressure regulator.

ACCUMULATOR, hydraulic, early type: An early accumulator consisted of a cylinder divided by a floating piston into two chambers. One end of the cylinder contained air compressed to the desired degree, the air having been obtained from an outside source. The other end of the cylinder contained a fitting that connected it to the pressure manifold. Fluid was forced through the fitting by a pump. Packing seals around the piston wore rapidly, thus permitting air to enter the system and mix with the fluid.

ACCUMULATOR; hydraulic systems: A reservoir used to store up oil, especially hydraulic fluid, under pressure for emergency use and to operate the hydraulic system in the event of failure of the hydraulic pump.

ACCURACY LANDINGS; Power-off accuracy work: A general expression for various maneuvers designed to develop the ability to estimate the distance the airplane will glide to a landing spot. A prime requisite to accurate landings is the ability of a student to maintain a constant gliding angle and the ability to recognize the normal glide of any one airplane and visualize the true flight path. Most accuracy landings are made through a 90° approach to the landing field rather than a long straight glide from considerable altitude which causes a great deal of difficulty in judging the flight path and landing spot.

A. C. - D. C. receiver: A television or radio receiver which will operate from an a. c. or a d. c. power source.

AC FITTINGS, tubes, and other parts are simply aircraft components referred to by an "AC" (Air Corps) serial number.

ACETATE BUTYRATE DOPE: A solution combining the fire-resistant qualities of acetate dope with the toughening properties of nitrate dope. Frequently used for interior cabin head linings and similar applications. Also see AIRCRAFT DOPE.

ACETATE DOPE: Dope manufactured from cellulose and acetic acid. Inflammable but to a much less extent than nitrate dope.

ACETONE: An inflammable liquid prepared by special fermentation of grain, forming butyl alcohol and acetone. A general solvent used as an ingredient for the thinning of dope and lacquer.

ACETYLENE (a-*set'*-y-lene) GAS: A non-toxic, colorless, inflammable gas generated from Calcium Carbide and containing two parts, by weight, of hydrogen (C_2H_2). It is explosive in air between the limits of 2% acetylene by volume with 98% oxygen by volume, or one-half air and one-half acetylene by volume. When mixed with oxygen for welding will give a temperature of 3500°C. Principally used in oxy-acetylene gas welding. Mixtures for welding flame will give a temperature of 3500°C. Prestolite is the trade name of the product obtained by dissolving acetylene in acetone. Also see DISSOLVED ACETYLENE.

ACHROMATIC: Lacking in color, referring to the transmission of light without breaking it up into the colors of the spectrum.

ACHROMATIC LENS: Two lenses, one converging and the other diverging. The dispersion of one lens corrects the other to overcome chromatic dispersion which pertains to the different focus points for different colors.

ACID-COOLED ROCKET ENGINE: Rocket vernacular for a liquid-propellant rocket engine that consumes an acid (as one of the propellants) after utilizing the same acid as the coolant medium for regeneratively cooling the thrust-chamber walls.

ACID EXTRACTION, for refining oil: The chemical treatment of the crude oil lubricating stock with sulphuric acid which reacts chemically with many of the undesirable compounds, thereby removing them from the mixture. The acid concentration and the duration of the treatment are accurately controlled. Insufficient exposure will not remove all of the undesirable compounds and over exposure will destroy a part of the desirable constituents. Crude oil lubricating stock containing a good percentage of paraffine hydrocarbons is essential to producing superior lubricating oil by the acid extraction method.

ACID LEAD: Rocket vernacular for an oxidizer lead. The flow of an acid-type oxidizer into a rocket combustion unit at a slight advance, in time, over the flow of the fuel into the same unit.

ACID-PROOF PAINT: Paint made to resist acid.

ACK-ACK: A term of British origin for referring to an anti-aircraft gun or its fire. In the latter sense it is the same as *flak*.

A. C. MEASURING INSTRUMENTS are electrical devices for measuring alternating current and may be divided into three classes: (1) Indicating instruments from which the value is read directly as a needle moves across the face of a dial; (2) Nonindicating instruments from which a reading is obtained by adjusting dials, switches, etc., and then noting their positions; and (3) Recording instruments which make a continuous record of required values over period of time.

ACORN: A fitting located at intersections of cross bracing (wires, tubes, etc.) for the purpose of preventing chaffing at the intersection and also to streamline the intersection.

ACOUSTICS: The science or study of sounds, and includes the generation, perception, measurement, reproduction, and control of material vibrations.

ACOUSTIC VELOCITY: The speed of sound, or the speed of pressure waves similar to sound waves.

ACOUSTIC WAVE: A sound wave.

ACQUISITION AND TRACKING RADAR: A radar set which searches for, acquires and tracks an object by means of reflected radio frequency energy from the object, or by means of radio frequency signal emitted by the object. Continuous position information on the object is provided after original acquisition of the target.

A. C. receiver: A radio or television receiver which operates from an a. c. power source only.

ACROBATICS: Acrobatics are unnecessary flight evolutions, voluntarily performed with an aircraft, requiring or resulting in an abrupt change in its attitude, an abnormal attitude or operations in excess of the aircraft's design level flight speed (placard value). A normal bank not in excess of 70 degrees will not be considered as an abrupt change in the aircraft's attitude or as an abnormal attitude.

ACRYLIC, or ACRYLATE, RESIN or PLASTIC: A thermoplastic resin resembling glass, made by polymerizing esters of acrylic or methacrylic acid and used in making transparent parts, such as lenses, aircraft windows, etc.

ACTINIC RAYS: Light rays which cause a chemical or electrochemical action.

ACTINOMETER (ak'ti-nom'e-ter): An instrument used in determining the amount of insulation or protection received from the sun (it is a black bulb thermometer placed in a properly constructed vacuum chamber).

ACTION TIME: When representing the firing duration of a solid-propellant rocket-propulsion unit, this term denotes the particular time interval that starts at a point corresponding to 10 per cent of the maximum thrust and ends at a corresponding point where the thrust has decreased to 10 per cent of the same maximum value.

ACTIVATED CHARCOAL: A charcoal made from organic substances in such a manner that all traces of hydrocarbons have been removed from the core of the charcoal. It is used extensively as an absorbent. Commonly used in absorption of solvent vapors and filtration of liquids. It will absorb large quantities of gas.

ACTIVE ELECTRONIC COUNTERMEASURES: Electronic countermeasures involving actions taken which are of such nature that their employment is detectable by the enemy. See COUNTERMEASURES; ECM; ELECTRONIC COUNTERMEASURES; PASSIVE ELECTRONIC COUNTERMEASURES.

ACTIVE HOMING: The homing of a guided missile in which energy waves (as radar) are transmitted from the missile to the target and reflected back to the missile to direct the missile toward the target.

ACTIVE MATERIAL: Fluorescent substances, such as zinc phosphate, zinc silicate, calcium tungstate, etc., which are used to produce cathode-ray tube screens.

ACTIVE MATERIAL: The substance held in the grid (framework) of a storage battery plate is called the active material. It is essentially a lead-compound paste. The paste for the positive plates is usually made of red lead (Pb_3O_4) and a small amount of litharge (PbO). The mixture for negative plates is essentially litharge with a small percent-

age of red lead.

ACTIVE JAMMING: The deliberate radiation or reradiation of electromagnetic energy with the object of impairing the use of a specific band of frequencies.

ACTUATING CYLINDER parts are a cylinder, one or more pistons and piston rods, and seals to prevent the escape of hydraulic fluid.

ACTUATING CYLINDER, double-acting: Fluid under pressure can be applied to either side of the piston of a double-acting actuating cylinder to provide movement in either direction. This device is also known as a two-port actuating cylinder.

ACTUATING CYLINDER, purpose of: The purpose of an actuating cylinder is to transform energy in the form of fluid flow under pressure into mechanical force, or action, to perform some kind of work. Another definition is: A unit which receives fluid from the selector valve and which is connected to some movable part of the airplane in order to produce linear motion.

ACTUATING CYLINDER, single-port: Fluid under pressure enters a port of a single-port actuating cylinder and forces the piston in the other direction, that is, against the opposite end of the cylinder and against the force of a spring. The piston is returned to its original position by the spring after the necessary linear movement has been completed and fluid under pressure is no longer acting against the piston. This type of actuating cylinder is also known as a single-acting device.

ACTUATING CYLINDER spring snubber: Spring snubbers may be installed on the piston rod of an actuating cylinder. When the piston nears the end of the cylinder, the spring is compressed and the rate of piston travel is consequently reduced. This slower rate of speed prevents damage to the unit connected to the piston rod.

ACTUATING CYLINDER, three-port or triple-acting: The three-port or triple-acting actuating cylinder is used when it is necessary to move two mechanisms simultaneously from the same source of pressure. There are three ports and two pistons.

ACTUATING CYLINDERS: Aircraft brake actuating cylinders are units of the brake assembly which cause the brake shoes to press against the brake drum when pressure is transmitted to them from the master cylinders in one type of hydraulic-brake actuating system.

ACTUATING UNIT: A hydraulic actuating unit transforms liquid pressure into mechanical force to move some mechanism. Actuating cylinders, hydraulic motors and surface-control boosters are examples of actuating units.

- ACTUATION DURATION:** The total time covered or spanned from the "instant" the first operational movement is made with the first switch until the last intended action is completed in the firing of a liquid-propellant rocket engine.
- ACTUATOR DISK:** A concept used in the momentum theory of propellor or rotary-wing action, in which the rotating propeller or rotor is regarded as composed of an infinite number of blades (hence becoming a disk) capable of accelerating the air uniformly through the blades or disk with no air losses at the blade tips, or periphery of the disk.
- ACTUATOR MOTOR** is one which sets some mechanism into operation, throws a switch, or performs some other operation of an intermittent-duty type as distinguished from a motor of the continuous-duty type.
- ADAPTER:** A device for changing terminal connections of a unit, part, or circuit, either permanently or temporarily.
- ADAPTER SKIRT:** A flange or extension of a missile stage or section that provides a ready means of fitting another stage or section to it.
- ADDITION, ALGEBRAIC:** When a minus quantity is added to a plus quantity, the smaller quantity is subtracted from the larger and the answer has the sign of the larger quantity.
- ADDITIVE:** A substance added to a propellant to achieve some purpose such as a more even rate of combustion.
- ADDITIVES** are elements or substances added to the conventionally made calcium or sodium-soap-base greases for lubrication or anti-seize purposes. Examples are graphite, talc, mica, and such metal oxides as zinc oxide and lead oxide.
- ADIABATIC:** The word applied in the science of thermodynamics to a process during which no heat is communicated to or withdrawn from the body or system concerned. Adiabatic changes of temperature in a gas are those that occur only in consequence of compression or expansion accompanying an increase or a decrease of pressure. In the atmosphere such pressure changes take place most readily due to ascent (expansion) of air, which produces cooling (see **ADIABATIC LAPSE RATE**), or descent (compression), which produces heating. Adiabatic heating and cooling are sometimes termed **dynamic heating and cooling**.
- ADIABATIC CHART:** A thermodynamic diagram in which temperature is plotted against pressure (generally on a logarithmic scale or pressure to the 0.288 power) and in which dry **adiabats** are constructed. The chief use of this chart is the evaluation of aerological soundings.
- ADIABATIC LAPSE RATE:** The rate at which ascending air cools, or descending air warms, when no heat is added or taken away. (See **ADIABATIC**.) The adiabatic rate for dry air is 5.4° Fahrenheit, per 1000 feet. However, in the case of ascending saturated air, the condensation of moisture releases **latent heat** of condensation, which lessens the decrease of temperature. The saturated adiabatic rate varies with temperature and pressure, and is smallest for high temperature and low pressure. Following are sample values of the saturated adiabatic lapse rate in degrees per thousand feet:
- | | 70°F | 50°F | 20°F | 0°F |
|----------------|------|------|------|-----|
| 1000 millibars | 2.3 | 2.9 | 3.8 | 4.6 |
| 800 millibars | 2.1 | 2.7 | 3.5 | 4.4 |
- ADIABATIC PROCESS:** A thermodynamic process in which no heat is transferred from the working substance to the exterior or vice versa; a thermally insulated process. Also see **ADIABATIC**.
- ADIACINIC:** That which prevents the passage of actinic rays of light, such as red glass, etc.
- ADJUSTABLE-AREA NOZZLE:** A rocket thrust-chamber nozzle that is provided with an external mechanism or a mechanical assembly of nozzle parts to permit the throat area to be increased or decreased, before a firing, for the purpose of increasing or decreasing the thrust output.
- ADJUSTABLE PITCH PROPELLER:** A propeller which has a means of pitch adjustment on the ground prior to flight but is not adjustable during flight. It can be set for best efficiency at any predetermined air speed, and for maximum efficiency for any specific horsepower output.
- ADJUSTABLE PROPELLER:** Same as **ADJUSTABLE PITCH PROPELLER**.
- ADJUSTABLE ROCKET NOZZLE:** The more common name for this particular rocket thrust-chamber nozzle is adjustable-area nozzle, a term that is in accordance with existing applications of this idea.
- ADJUSTABLE STABILIZER:** A stabilizer through which the **angle of setting** can be varied through a limited range. Some adjustable stabilizers are adjustable from the cockpit while the airplane is in flight, whereas, others are only adjustable while the airplane is on the ground. In many cases in modern design **trimming tabs** are used in lieu of adjustable stabilizers.
- ADMINISTRATION:** See **FEDERAL AVIATION AGENCY**.
- ADMINISTRATOR:** Administrator except as otherwise specifically provided for in the Civil Air Regulations, means the Administrator of Civil Aeronautics, or an officer or employee of the Administrator of Civil Aeronautics designated by him in writing for the purpose specified in such designation.
- ADMIRALTY METAL:** A brass containing approximately 70% copper, 1% tin, and the remainder zinc. See **NAVAL BRASS**.

ADMISSION STROKE: The piston of an engine moves downward during the admission or intake stroke as a charge of combustible fuel and air is admitted into the cylinder through the open intake valve.

ADMITTANCE: The opposite of impedance in alternating current circuits.

ADVANCE WIRE: An alloy of nickel and copper used in electric heating devices.

ADVANCED AND ACROBATIC MANEUVERS.

Advanced Maneuvers
 ADVANCED STALL
 CHANDELLE
 LAZY EIGHT
 PRECISION SPIN
 WING-OVER

Acrobatic Maneuvers
 DOUBLE SNAP ROLL
 FALLING LEAF
 HALF ROLL or SPLIT-S
 IMMELMAN TURN
 INVERTED SPIN
 LOOP
 ROLL ON TOP OF A LOOP
 SNAP ROLL
 THE SLOW or AILERON ROLL
 VERTICAL REVERSEMENT or CART-
 WHEEL

ADVANCED PRESSURE GRADIENT: In a fluid flow system or field, a pressure gradient of increasing static pressure in the direction of the flow.

ADVANCED STALL: An advanced flight training maneuver which is a continuation of an elementary or partial stall. The airplane is in a fully stalled attitude with just enough lateral and longitudinal control remaining to **nose down** and regain **flying speed**.

ADVANCING BLADE: On a rotary-wing aircraft in horizontal motion, a rotor blade or wing moving against or into the relative wind. With a rotary-wing aircraft in forward motion, a blade is considered advancing as it moves from its extreme aft position to its extreme forward position.

ADVECTION (ad-vek'-shun): The process of transfer by horizontal motion, particularly applied to the transfer of heat by horizontal motion of the air. The transfer of heat from low to high latitudes is the most obvious example of advection.

ADVECTION FOG: Fog resulting from the transfer of warm, humid air over a cold surface, especially a cold ocean surface, or from the transport of air that is relatively very cold over water surface that is relatively very warm.

ADVECTIONAL CURRENTS: Horizontal air currents.

AEOLIPILE: A device invented about the year 120. B.C., in Alexandria, Egypt, by a man named Hero. Two metal tubes leading from a kettle of boiling water supported a hollow metal ball which rotated about the ends of these tubes. Leading out from the ball were shorter

tubes, bent at right angles and open to the air. Steam came from the kettle into the ball through the supporting tubes and escaped through the short tubes, causing the ball to rotate about its horizontal axis. This is probably the first recorded application of the jet propulsion principle.

AERIAL: Operated or mounted high overhead, such as an **aerial mine**, which is a large bomb dropped from an airplane and delayed in its descent by a parachute. The word **aerial** is also commonly used to mean the same thing as **radio antenna**.

AERIAL; rdo: An antenna.

AERIAL MAPPING CAMERA: Cameras of various types, especially constructed for the making of highly accurate vertical aerial photographs.

AERIAL NURSE CORPS OF AMERICA: (A.N.C.O.A.) A nursing organization formed by Lauretta Schimmoler in 1936 for the purpose of training its members in the science of aviation and allied subjects and are required to be members of their respective State Nurses' Association, trained to be of benefit in any catastrophe or emergency which necessitates air transportation.

AERIAL PHOTOGRAPH: Any photograph made from an aircraft while in flight.

AEROASTHENIA: Flying fatigue. 'Flying fatigue' is the preferred term.

AEROBALLISTIC MISSILE: A wingless vehicle employing the boostglide and continuous roll technique for flight at hypersonic speeds within the Earth's atmosphere. The trajectory is ballistic to apogee, after which the vehicle assumes an angle of attack (10 to 20 degrees) and descends partly ballistically and partly through aerodynamic lift to an altitude of about 60,000 feet, thereafter resuming a ballistic dive to the surface. A slow continuous roll is imparted to the wingless vehicle during the aerodynamic portion of flight to distribute frictional heat evenly over the airframe so as to preserve the structural integrity.

AEROBALLISTICS: A term derived from aerodynamics and ballistics and dealing primarily with the motion of bodies such as guided rockets, whose flight path is determined by applying the principles of both sciences to different portions of the path.

AEROBATICS: British. See ACROBATICS, U.S.

AEROCLUB: A club for flying personnel, esp. one founded to encourage amateur flying activities.

AERODONTIA: A branch of dentistry concerned with the peculiar dental problems of flying personnel.

AERODYNAMIC AXIS OF AN AIRFOIL: An imaginary line along the span of the airfoil, which connects the **aerodynamic centers** of each **element** of the airfoil.

AERODYNAMIC BALANCED SURFACE:

See AERODYNAMICALLY BALANCED CONTROL SURFACE.

AERODYNAMIC BRAKING BY REVERSE THRUST

is the use of reversible propellers as landing brakes for large multi-engine land planes and is accomplished by changing the angles of propeller blades in their hub sockets from a positive to a negative angle, resulting in a backward thrust. Reverse thrust adds safety and economy to landing, permits emergency landings in small spaces and on wet or icy runways. It reduces taxiing time after landing, increases maneuverability on the ground and reduces tire wear.

AERODYNAMIC CENTER OR AXIS OF CONSTANT MOMENTS:

See AERODYNAMIC CENTER OF A WING SECTION

AERODYNAMIC CENTER OF A WING SECTION:

A point located on the wing chord approximately one-quarter of the chord length back of the leading edge about which the moment coefficient is practically constant for all angles of attack.

AERODYNAMIC CHORD:

See MEAN AERODYNAMIC CHORD.

AERODYNAMIC HEATING:

The rise in the skin temperature of a missile due to the friction of the air at high speed. A severe problem with the long-range ballistic missile re-entering the atmosphere at a high mach number. Aerodynamic heating reinforced by heat from the missile components can also cause excessive internal temperatures and affect operation of the components. See RE-ENTRY.

AERODYNAMIC MISSILE:

A missile which uses aerodynamic forces to maintain its flight path, generally employing propulsion guidance and a winged configuration.

AERODYNAMIC OVERBALANCE:

A condition existing when aerodynamic forces cause an aircraft or aircraft component to rotate or turn excessively about a point or line; specif., the condition of an aircraft control surface existing when its deflection results in a hinge moment tending to increase the deflection.

AERODYNAMIC TWIST:

See WASHIN and WASHOUT.

AERODYNAMIC VOLUME (OR AIR VOLUME):

The total volume of an aerostat, including its projecting parts.

AERODYNAMIC WEAPON SYSTEM:

A weapon system in which the weapon vehicle flies entirely through the atmosphere, and is subject to aerodynamic guidance and control as it flies toward target. The B-58 or the Snark are examples of an aerodynamic weapon system.

AERODYNAMICALLY BALANCED CONTROL SURFACE:

A control surface is balanced aerodynamically when a portion of the surface is ahead of the hinge-line, or when, as in some cases, a small auxiliary wing is mounted above the

surface in such a manner as to secure aerodynamic balance around the hinge line of the control surface. Control surfaces are balanced aerodynamically to make them more easily manipulated by the pilot, and assist in avoiding flutter conditions. See also TABS and FLETTNER CONTROLS.

AERODYNAMICS (a'-er-o-dy-nam-ics): The branch of dynamics that treats of the motion of air and other gaseous fluids and of the forces acting on solids in motion relative to such fluids.

AERODYNE: Any type of heavier-than-air aircraft, i.e., aircraft whose support in flight is due principally to aerodynamic forces. The term is strictly technical (derivation aerodyne, C.G.S. system) and is general enough to all new types of heavier-than-air aircraft which might be developed in the future.

AEROELASTIC: 1. Of a material or aircraft component: Subject to being stretched or deformed under the stress of aerodynamic forces. 2. Of a stretching or deformity in an airframe or aircraft surface: Brought on during flight by an interaction between aerodynamic forces, elastic materials, and inertia.

AEROEMBOLISM: The effects produced by a rapid decrease of pressure below one atmosphere, such as may occur in aircraft flights to high altitude, and which is marked by the formation of nitrogen bubbles in the body tissues and fluids, i.e., nitrogen expands rapidly at high altitudes and unless appropriate preventive measures are taken, the nitrogen in the body will expand and boil at altitudes reaching into and above the stratosphere (anywhere above approx. 25 to 30 thousand feet). Also see SUPERCHARGING, airmen.

AEROFOIL: Same as AIRFOIL. The term is practically obsolete in the U.S., but still used quite extensively abroad.

AEROGRAPH (a-e-r-o-graf): Same as METEOROGRAPH.

AERO-ISOCINIC: Of an airfoil: That maintains, or tends to maintain, the same angle of attack at all airfoil sections, esp. when flexed or bent.

AEROLOGY (a-er-ol'-o-ji): That part of meteorology that deals with the upper or free air. It is the study of the upper air regions by kites, balloons, or airplanes and by the observation of clouds.

AEROL OLEO-PNEUMATIC SHOCK ABSORBING STRUT: A landing gear shock absorbing strut using a piston and cylinder in conjunction with a combination of air and oil (and suitably located orifices), as the shock absorbing medium. The strut is manufactured by the Cleveland Pneumatic Tool Company. See also BENDIX PNEUDRAULIC.

AEROMETEOGRAPH: A multi-purpose instrument used in recording pressure, temperature, humidity of the air, and sometimes wind velocity.