ENGINEERING ENCYCLOPEDIA

A Condensed Encyclopedia and Mechanical Dictionary for Engineers, Mechanics, Technical Schools, Industrial Plants, and Public Libraries, Giving the Most Essential Facts about 4500 Important Engineering Subjects

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Abrasive. An abrasive, such as is used in making grinding wheels or abrasive cloth and paper, may either be natural or artificial. The natural abrasives, such as emery and corundum, have been replaced largely by artificial abrasives, of which there are two general classes. One class is known as silicon carbide abrasives and the other as aluminous abrasives. The raw materials used in making the silicon carbide abrasives are pure glass or silica sand and carbon supplied by coke of various grades. The aluminous abrasives are made from bauxite, which is mined in the southern part of the United States and in various other parts of the world. The two general classes of abrasives mentioned are sold under various trade names. For information about the applications of the silicon carbide and aluminous abrasives see Grinding Wheel Selection. See also Aluminum Oxide and Silicon Carbide.

Abrasive Belt Grinding. This production grinding process is performed on machines making use of belts of strong cloth onto which have been coated abrasives similar to those used in grinding wheels. This coated cloth resembles the familiar "emery cloth."

Machines may be dry-belt, wet-belt, or a combination type. In wet-belt grinding, liquid coolants are applied to the grinding area to dissipate heat and to prevent overloading and clogging of the abrasive belt. This method permits high-speed grinding of ferrous and non-ferrous metals, glass, plastics, and other materials.

On machines, the belts are slipped over two drums (uncoated side in contact with drum surface), one of which is driven at high speed. A heavy plate or platen located between the two drums permits the workpiece to be pushed against the moving belt by providing support. The plate may also be shaped to suit the shape of a particular workpiece. Most machines are vertical, that is, the belt runs up and down, but some models are made with the belt in a horizontal position.

In another design, one of the drums acts as the backing plate and may be made of a flexible material so it will yield when a curved workpiece is pressed against it and permit the belt to follow the contour of the work.

Abrasive-belt machines may be used for light polishing work or for heavy stock removal, and are true grinding machines.

Abrasive Grading. The modern method of grading abrasives is by the use of screens or sieves having openings between wires of certain standard dimensions. These screens conform to a table in which the wire diameters and the tolerances for both wire diameters and openings are given. Formerly, the number of screen meshes per lineal inch was used to indicate the screen size, but it is evident that accurate screening must take into account possible variations in wire sizes.

The screens used in testing commercial abrasives are made according to specifications of the Bureau of Standards. The openings in successive screen sizes vary by the fourth root of 2, so that every screen is 1.189 times the size of the preceding one. The standard screen or sieve number differs slightly in most cases from the actual number of meshes per inch. For example, a No. 10 screen has 9.2 meshes per inch. A No. 100 screen has 101 meshes per inch, there being slight variations throughout the series with a few exceptions.

The standard screen numbers are applied to loose abrasives used in polishing and also to abrasives used in grinding wheel manufacture. The arbitrary numbers or symbols, such as varying numbers of ciphers, for indicating the grading of certain classes of abrasive paper and cloth have been largely superseded by the standard screen numbers. This standard system of grading abrasives has been adopted by the Grinding Wheel Manufacturers' Association of United States and Canada.

Abrasive Grit Number. Standard abrasive grain sizes are designated by numbers. These numbers range from number 8, which is the coarsest, to number 240, which is the finest. The allowable limits for the sizing of aluminum-oxide and silicon-carbide abrasives for grinding-wheel manfacture are given in U. S. Simplified Practice Recommendation 118. These numbers in most cases equal approximately the number of sieve openings per inch in the United States Standard Fine Sieve series. For example, a number 30 sieve has 0.0232-inch openings and a sieve wire diameter of 0.0130 inch, making the pitch equal to 0.0362 inch; hence there are 27.6 meshes per inch. The United States Standard Fine Sieve series ranges from number 3½ to number 400.

Grading Abrasives: In the actual grading of abrasives, several standard sieves are used. To illustrate, take grit No. 10.

All material must pass through the coarsest sieve—in this case the No. 7. Through the next to the coarsest sieve, termed the "control sieve"—in this case the No. 8—all material may pass, but not more than 15 per cent may be retained on it. At least 45 per cent must pass through No. 8, and be retained on No. 10 sieve, but it is permissible to have 100 per cent pass through No. 8, and remain on No. 10 sieve, the requirement being that the grain passing through No. 8, and retained on No. 10 and No. 12 must add to at least 80 per cent; consequently, if 45 per cent passed through No. 8 sieve and was retained on No. 10 sieve, then at least 35 per cent must be retained on the No. 12 sieve. Not more than 3 per cent is permitted to pass through the No. 14 sieve.

Abrasive-Wheel Cutting Off Process. See Cutting Off Stock with Abrasive Wheels.

Abscissa. In analytical geometry, points are located by designating their distance from two given intersecting lines or axes. In Fig. 1, *XX* and *YY* are the axes, generally known as *coordinate* axes. These intersect at point *O*, called the *origin*. The distances measured parallel to axis *XX* are known as *abscissas;* those mea-

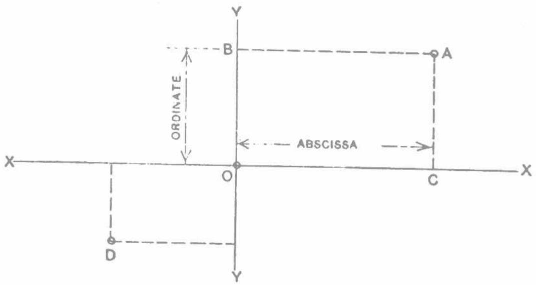


Fig. 1. Rectangular Coordinates

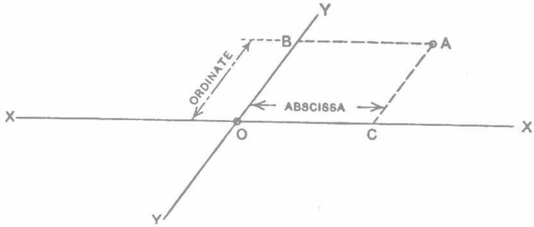


Fig. 2. Measurement of Abscissas and Ordinates

sured parallel to axis *YY*, *ordinates*. In mathematical expressions, the abscissa of a point is generally designated by the letter x and the ordinate by y. The two axes are generally at right angles to each other, in which case they are called *rectangular coordinates*. If the axes are not at right angles to each other, the abscissas and ordinates are measured along lines *parallel* to the axes, and not along lines at right angles to the axes. This is indicated in Fig. 2. The location of the axes is assumed to be known; the location of any point in the same plane, as *A*, can then be given in terms of its distance from the two axes. For example, if *AC* equals 2 inches, and *AB*, 3 inches, the location of point *A* is definitely given with relation to the axes and the origin.

Abscissas measured to the right of axis *YY* are *positive* in value, those measured to the left are *negative*. Ordinates measured above the axis *XX* are positive, those measured below, negative. Hence, both the abscissa and ordinate of point *A*, Fig. 1, are positive, but of point *D*, both are negative.

Absolute and Gage Pressure. The pressure of air, gases, or fluids is generally measured either in absolute pressure or in gage pressure. When measured in absolute pressure, the pressure of the atmosphere is included; the gage pressure is the pressure above that of the atmosphere. The pressure of air at sea level is 14.7 pounds per square inch. Gage pressure may be determined by simply subtracting 14.7 from the absolute pressure.

The steam pressure gage of a boiler measures gage pressure. All pressures used in compressed air computations should be measured from an absolute vacuum, which, for ordinary conditions, is 14.7 pounds per square inch below that of atmospheric or *gage* pressure. In like manner, the *absolute temperature* should be used, which for work of this kind may be assumed as equal to the degrees Fahrenheit plus 460.

Absolute Constant. See Constants in Mathematics.

Absolute Efficiency. See Efficiency of Mechanism.

Absolute System of Measurement. The system of measurement almost universally used in scientific work is based upon the length and weight units of the metric system, with the second as the time unit. The system is known as the C.G.S. (centimeter-gram-second) system or the "absolute system of measurement." As indicated by the letters C.G.S., the centimeter is the unit of length; the gram, the unit of mass (or weight); and the second, the unit of time. From these basic units are derived a number of other units for measuring velocity, force, work, power, etc. These are:

Unit of velocity = 1 centimeter in one second.

Acceleration due to gravity (at Paris) = 981 centimeters in one second.

Unit of force = 1 dyne = 1/981 gram.

Unit of work = 1 erg = 1 dyne-centimeter.

Unit of power = 1 watt = 10,000,000 ergs per second.

The C.G.S. system of power measurements is used exclusively for electrical machines and apparatus on account of the simple relationship which exists between the various units. The unit of work, erg, is so small that in practical work the *joule* is usually employed instead. One joule equals 10,000,000 ergs.

Absolute Temperature and Absolute Zero. A point has been determined on the Fahrenheit and Centigrade thermometer scales, by theoretical considerations, which is called the absolute zero and beyond which a further decrease in temperature is inconceivable. It is the temperature at which a gas would show no pressure if the general law for gases would hold for all temperatures. This point is located at −273.2 degrees Centigrade or −459.7 degrees F. A temperature reckoned from this point, instead of from the zero on the ordinary thermometers, is called absolute temperature. Absolute temperature in degrees C. is known as "degrees Kelvin" or the "Kelvin scale" (K) and absolute temperature in degrees F. is known as "degrees Rankine" or the "Rankine scale" (R).

Degrees Kelvin = degrees C. + 273.2

Degrees Rankine = degrees F. + 459.7

Absolute Velocity. The absolute velocity of a moving body, is its velocity with reference to some object which is considered completely at rest. In practical mechanics, the earth is assumed to be stationary, so that the velocity of any moving body, as for example, a moving train with relation to the rails, would be absolute velocity. The term "absolute velocity" is used to distinguish it from *relative velocity,* which is the rate of motion of a body with relation to another moving body. See also Velocity.

Absorptiometer. The absorptiometer is an instrument invented by Prof. Bunsen, with which it is possible to determine the amount of gas absorbed by a unit volume of a liquid. In its simplest form, this instrument consists of a graduated tube in which a certain quantity of the gas and liquid is agitated over mercury. The amount of gas absorbed by the liquid is measured by the graduations on the scale; the height to which the mercury will rise in pressing up the liquid in the tube, when the gas has been partly absorbed, indicates the degree of absorption.

Absorption Dynamometers. See Dynamometers.

Absorption of Gases. Many liquids have a capacity for taking up or absorbing a certain quantity of gases. The quantity thus absorbed varies with the nature of the liquid and the gas. Many gases, for example, are readily absorbed by water; thus, water will absorb its own volume of carbonic-acid gas, over two times its volume of chlorine, and 430 times its volume of ammonia, but not more than 5 per cent of its volume of oxygen. The weight of gas that a given volume of liquid will absorb is proportionate to the pressure, but as the volume of a given mass of gas is proportionately less as the pressure increases, the volume which a given amount of liquid will absorb at a certain temperature is constant, whatever the pressure. Water, as mentioned, absorbs its own volume of carbonic-acid gas at atmospheric pressure. If the pressure is doubled on both the gas and water, it will still absorb its own volume of the gas under the higher pressure, but, in that case, the density of the gas is doubled and, consequently, double the weight of the gas is dissolved. The quantity of gas absorbed increases as the temperature is lowered. One of the most important instances of the absorption of gases by liquids is met with in the absorption of acetylene by acetone; the latter liquid absorbs, at 60 degrees F. and 180 pounds pressure per square inch, 300 volumes of acetylene gas. This property of acetone makes it possible to safely store and transport acetylene gas in steel cylinders or containers.

Acceleration. The rate of change in the velocity of a moving body is called *acceleration;* hence, the acceleration is the increase in velocity of a body during a very short interval of time, usually one second. When the motion is decreasing instead of increasing, it is called *retarded motion,* and the rate at which the motion is retarded is frequently called the *de-acceleration* or the *deceleration.* The acceleration is said to be uniform if the body gains equal increments of velocity in a given direction in equal successive units of time. A constant force produces a uniform acceleration. Gravity, for example, acting upon a falling body, causes it to fall with a uniformly accelerated motion, providing the effect of the atmospheric resistance is not considered. The acceleration due to gravity varies from 32.09 at the equator to 32.255 at the poles. The value at sea level and for a latitude of about 41 degrees is 32.16, which is the value commonly used.

Accumulator. See Hydraulic Accumulator.

Acetone. Acetone is a liquid obtained by the destructive distillation of acetates and produced, on a large scale, from the watery liquid obtained in the dry distillation of wood. It has the property of absorbing many times its volume of acetylene gas and is, therefore, used to a great extent in the oxy-acetylene welding and metal-cutting industry. The successful use of acetylene gas depends, to a great degree, upon the fact that it can be absorbed by acetone, and thus used without exposing those in the vicinity of the acetylene container to the dangers of a possible explosion from the gas. The method was invented by French engineers in 1896. One volume of acetone at 60 degrees F., under atmospheric pressure, will absorb 25 volumes of acetylene gas. At a pressure of 180 pounds per square inch, 300 volumes of the gas will be absorbed. Hence, by this method, an enormous quantity of acetylene gas can be stored and transported safely under comparatively low pressure, in cylinders of moderate size. When the pressure is relieved, the acetylene gas escapes gradually. The acetone can be used over and over again for the storage of acetylene gas, the loss in acetone being only about one pound for each 1000 cubic feet of acetylene. The porous substance used in the cylinders is a fine fibre or asbestos bound together with silicate of soda, melted in cakes to fill the interior of the cylinders for which they are intended. The material is porous and admits the acetone into the minute cavities.

Acetylene. Acetylene is a gaseous compound of carbon and hydrogen (chemical formula C_2H_2). It is a colorless gas having a specific gravity of 0.92 (air = 1). It is produced by the action of water upon calcium carbide. Acetylene gas cannot be stored in a compressed state directly in cylinders, because of the danger from explosion, but acetylene is soluble in a number of liquids, and, by dissolving in these liquids, acetylene may be stored with safety. Acetone is the liquid generally used for this purpose. Acetylene gas is of the greatest industrial importance in connection with autogenous welding and cutting of metals, where the great heat of combustion, when using it in conjunction with oxygen, is made use of. The oxygen-acetylene flame is far hotter than the oxy-hydrogen flame, and the fact that it is reducing in character is of great advantage in autogenous welding.

Acetylene was discovered in 1836, but until 1892 its production was merely a laboratory experiment. In that year calcium carbide was accidentally manufactured in an electric furnace at the works of the Willson Aluminum Co., in North Carolina. It was considered of no value and was thrown into the river. It was then accidentally discovered that the gas arising from it when thrown into water, would ignite, and a further investigation proved that this was acetylene. Its commercial exploitation began shortly afterward in its use for isolated lighting plants.

Acheson Process. The method of making silicon carbide—an abrasive used for grinding wheels—by the electric process has, after the inventor, Dr. Acheson, been named the "Acheson process." Silicon-carbide abrasives are produced from quartz and carbon, these substances being heated in an electric resistance furnace. The furnace charge consists of quartz, carbon, sawdust, and sodium chloride. The abrasive is formed at a temperature of 1840 degrees C. (about 3340 degrees F.), and decomposes if it is heated above 2240 degrees C. (about 4060 degrees F.).

Acid. In chemistry, an acid is a compound containing hydrogen in which the hydrogen may be replaced by a metal, or a group of elements equivalent to a metal, to form a salt. An acid is also defined as a compound that will unite with a base to form a salt and water. Most acids are soluble in water, have a sour taste, turn vegetable blue into red, decompose most carbonates displacing the carbonic acid (carbon dioxide) with effervescence; they have also the power of destroying more or less completely the characteristic properties of alkalies. The acids in common use in the industries are hydrochloric, nitric, sulphuric, and hydrofluoric.

Acid Bessemer Process. See Bessemer Process.

Acid Firebrick. A firebrick in which silica predominates and which is generally known as "silica brick."

Acid, Hydrochloric. See Hydrochloric Acid.

Acid, Hydrofluoric. See Hydrofluoric Acid.

Acid Number of Oil. Free fatty acids represent the amount of free organic acid present in the oil, and this should not be confused with mineral acid, as free fatty acids are a normal constituent of the so-called "fixed" or fatty oils. Free fatty acids are determined by titrating in an alcoholic solution with a standard potash solution. The "acid number" is another method of expressing free fatty acids and is the number of milligrams of caustic potash required to neutralize one gram of the fat or oil.

Acid, Picric. See Picric Acid.

Acid-Proof Cement. A cement composed of boiled linseed oil and fireclay resists most acid vapors. A tough and elastic cement is made from 1 part of crude rubber, 4 parts of boiled linseed oil, and 6 parts of fireclay. The rubber is dissolved in carbon disulphide, until a mixture of the consistency of molasses is obtained, and is then mixed with the oil. Asphalt compositions, and compositions of melted sulphur with fillers of stone powder, Portland cement, or sand may also be used as acid-proof cements.

Acid-Proof Tank Lining. A lining for protecting tanks from the corroding effect of acids is made from a mixture consisting of 75 parts (by weight) of pitch; 9 parts of plaster-of-paris; 9 parts of ochre; 15 parts of beeswax; and 3 parts of litharge. The tanks are covered on the inside with a thick coat of this mixture.

Acid-Resisting Alloys. Some common alloys which are noted for their acid-resisting characteristics are stainless steel, nickel, Monel and Inconel. In general, stainless steels are unaffected by nitric acid, affected somewhat by the sulphur acids, and greatly affected by the halogen acids. Of the nickel alloys, Monel resists sulphuric acid best, nickel resists hydrochloric acid best, while Inconel possesses fair resistance to both of these acids.

Acid-Resisting Iron. See Duriron.

Acid Salt. In chemistry, an acid salt is a salt formed when only part of the hydrogen in the acid is replaced by the base.

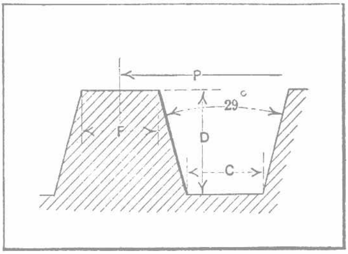
Acids, Etching. See Etching Acids.

Acme Thread. The Acme thread is extensively used in preference to the square thread, especially for lead screws and similar parts. The Acme form is stronger than the square thread, and it may be cut with a die more readily than a square thread. When an Acme thread is engaged by a sectional nut like the half-nut of a lathe, engagement or disengagement is more readily effected than with a square thread; an adjustable split nut may also be used in connection with an Acme screw thread to compensate for wear and to eliminate back-lash or lost motion.

There are two basic types of Acme screw threads: American Standard Acme screw threads and American Standard Stub Acme screw threads. Two forms of American Standard Acme threads exist, each of which is used for a different application. The General Purpose form has clearance on all diameters for free movement, and may be used in assemblies with the internal thread rigidly fixed and lateral movement of the external thread limited by its bearing or bearings. There are three classes of General Purpose threads, 2G, 3G, and 4G; 2G being the preferred choice. Internal and external threads of the same class are usually used together. The other form of American Standard Acme threads, Centralizing Acme threads, comes in five classes: 2C, 3C, 4C, 5C, and 6C; and has limited clearance at the major diameters of the internal and external threads so that a bearing at the major diameters maintains approximate alignment of the thread axis and prevents wedging on the flanks of the thread.

The American Standard Stub Acme threads are used for those unusual applications where, due to mechanical or metallurgical considerations, a coarse-pitch thread of shallow depth is required. The fit of the Stub Acme threads is generally that of the Class 2G American Standard General Purpose Acme threads.

The pitch, P, for all Acme threads is equal to the reciprocal of the number of threads per inch. The accompanying illustration gives the basic form of the Acme thread. For the General Purpose form the following relationships exist: Depth of thread, $D = 0.5\ P$ + ½ allowance on minor diameter (for external thread) or $D =$ $0.5\ P +$ ½ allowance on major diameter (for internal thread); basic flat at crest, $F = 0.3707\ P$ (for external and internal thread); basic flat at root for internal thread, $C = 0.3707\ P$ — $0.259 \times$ (major diameter allowance on internal thread); basic flat at root for external thread, $C = 0.3707\ P - 0.259 \times$ (minor diameter allowance on external thread — pitch diameter allowance on external thread). The Centralizing form is governed by the same relationships as the General Purpose but the outline of the thread form differs in that the external threads have the crest corners chamfered at an angle of 45 degrees with the axis to a minimum depth of $P \div 20$ and a maximum depth of $P \div 15$ and may have root fillets not greater than $0.1\ P$ for Classes 2C, 3C, and 4C and between $0.07\ P$ and $0.1\ P$ for Classes 5C and 6C; and the internal threads have a root fillet of $0.06\ P$, maximum. Stub Acme threads have the following relationships: Depth of thread, $D = 0.3\ P +$ ½ allowance on minor diameter (for external thread) or $D = 0.3\ P +$ ½ allowance on major diameter (for internal thread); basic flat at crest, $F = 0.4224\ P$ (for external and internal thread); basic flat at root for internal thread, $C =$ $0.4224\ P - 0.259 \times$ (major diameter allowance on internal thread); basic flat at root for external thread, $C = 0.4224\ P$ — $0.259 \times$ (minor diameter allowance on external thread — pitch diameter allowance on external thread).



Acme Thread

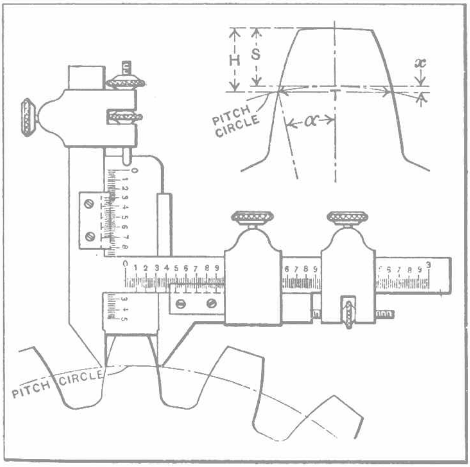
Acute Angle. See Angle.

Acyclic Machines. Acyclic machines, sometimes also called *homo-polar* or, incorrectly, *uni-polar*, are direct-current machines in which the voltage generated in the active conductors maintains the same direction with respect to those conductors.

Adamantine Boron. A crystalline form of the chemical element *boron*. It has a luster and hardness only slightly inferior to that of the diamond.

Adapter. The term "adapter" is commonly applied to any device for holding a milling cutter or arbor, which, without an adapter, would not fit into the spindle hole or onto the spindle "nose," as the case may be. For example, the standard taper for milling machine spindles is 3½ inches per foot, and the largest diameter of a No. 50 taper is 2¾ inches. If the comparatively small shank of an end-mill is to be held in this spindle, an adapter must be used. The outside of this adapter fits into the machine spindle, and a hole in the center has the same taper as the shank of the end mill. This term adapter may also be applied to work-holding or other devices which serve as an intermediate supporting member.

Addendum. The addendum of a gear tooth is the distance (*S* in illustration) from the pitch circle to the top of the tooth. In standard diametral pitch gearing having full-depth teeth, the addendum is equal to 1 divided by the diametral pitch. The addendum of the American Standard stub teeth, equals 0.8 divided by the diametral pitch. The *corrected addendum* is the perpendicular distance measured from the chord across the tooth at the pitch circle to the top of the tooth, as shown at *H* in the illustration. This distance is used when measuring the thickness of gear teeth at the pitch line by gear-tooth calipers, as indicated. When a gear tooth is measured in this way, it is the chordal thickness *T* that is obtained, instead of the thickness along the pitch circle.



Checking Size of Gear Tooth by Measuring Chordal Thickness

If a = one-half of the angle subtended from the center of the gear by one gear tooth (see illustration); $N =$ number of teeth in gear; $T =$ chordal thickness of tooth at pitch line; and $R =$ pitch radius of gear; then:

$$a = 90° \div N; \qquad T = 2R \times \sin a.$$

The height x of the arc equals 1 minus the cosine of angle a, multiplied by the pitch radius of the gear, or, expressed as a formula, $x = R\ (1 - \cos a)$. The vertical scale of the caliper is set to dimension H or $x +$ addendum S.

Adhesion and Friction. Friction should not be confused with "adhesion," which not only resists the motion of one body upon another, but tends to hold the two together so that they cannot be separated. Adhesion is independent of the pressure between the bodies, while friction increases with the pressure Moreover, the smoother the rubbing surfaces the greater is the adhesion but the less is the friction; two perfectly smooth surfaces, if such were possible, would be frictionless, while the adhesion between them would be very great, as in the case of precision gage-blocks. Lubricants increase the adhesion and diminish the friction. When the pressure between two bodies is small, the adhesion forms a considerable part of the resistance, and, as the pressure increases, it becomes proportionately less, since adhesion does not increase with the pressure. At ordinary pressures, the effect of adhesion can generally be neglected, and the whole resistance considered as friction. The coefficient of friction of solid rubber tires on cement and vitrified brick roads is about 0.6, while that of pneumatic tires under similar conditions is 0.5. The coefficient of adhesion is greater than that of friction, and incidentally this partly explains why an automobile stops more rapidly when the wheels are kept moving than when they are locked; hence the increased danger when a car skids if the rear wheels are locked by the brakes.

Adhesion, Gage-Block. See Gage-block Adhesion.

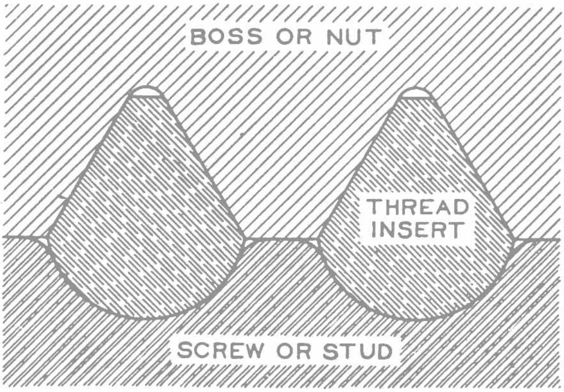
Adiabatic Curve. A curve used in a diagram to show the condition under which a gas, such as air, is compressed or expanded in adiabatic compression.

Adiabatic Expansion and Compression. Adiabatic expansion means that heat is neither added nor taken away during the expansion of air or gases; hence such expansion is accompanied by a reduction in temperature. Inversely adiabatic *compression* is accompanied by a rise in temperature. The pressure during adiabatic expansion falls faster than with isothermal expansion and rises faster for adiabatic compression than for isothermal compression. See also Isothermal Expansion and Compression.

Admiralty Metal. A name used for a number of alloys having the property of resisting the action of sea water, and used for parts of engines and machinery on board ships. One alloy consists of 87 per cent of copper, 5 per cent of zinc, and 8 per cent of tin. Another alloy, used for surface condenser tubes exposed to sea water, is composed of 70 per cent of copper, 29 per cent of zinc, and 1 per cent of tin.

Aerometer. Instruments for weighing air or for ascertaining the density of air, gases, or fluids are generally known as *aerometers*. The barometric aerometer is an instrument which consists of a vertical U-tube with open ends, mounted upon a stand in such a manner that it can be used for measuring the relative specific gravities of liquids. The method in which it is used is as follows: Water is poured into one branch of the tube, and the oil or liquid, the specific gravity of which is to be measured, is poured into the other. The vertical parts of the tube are provided with graduations. If it is found, for example, that 9 inches of water balances 10 inches of oil, then the relative specific gravities are as 10 to 9 or the specific gravity of the oil is 0.9.

Aero-Thread. The name "Aero-thread" has been applied to a patented screw thread system that is especially applicable in cases where the nut or internally threaded part is made from a



The Basic Thread Form Used in the Aero-Thread System

soft material, such as aluminum or magnesium alloy, for the sake of obtaining lightness, as in aircraft construction, and where the screw is made from a high-strength steel to provide strength and good wearing qualities.

The nut or part containing the internal thread has a 60-degree truncated form of thread (See illustration). The screw, or stud, is provided with a semi-circular thread form, as shown. Between the screw and the nut there is an intermediary part known as a thread lining or insert, which is made in the form of a helical spring, so that it can be screwed into the nut. The stud, in turn, is then screwed into the thread formed by the semicircular part of the thread insert.

When the screw is provided with a V-form of thread, like the American Standard, frequent loosening and tightening of the screw would cause rapid wear of the softer metal from which the nut is made; furthermore, all the threads might not have an even bearing on the mating threads. By using a thread insert which is screwed into the nut permanently, and which is made from a reasonably hard material like phosphor bronze, good wearing qualities are obtained. Also, the bearing or load is evenly distributed over all the threads of the nut since the insert, being in the form of a spring, can adjust itself to bear on all of the thread surfaces.

Afterblow. That part of the basic Bessemer process during which the phosphorus is oxidized and removed.

Aging. A heat-treating term which is defined as a change in a metal by which its structure recovers from an unstable condition produced by quenching or by cold working. The change in structure consists in precipitation, of a constituent, often submicroscopic, and is marked by a change in physical properties. Aging which takes place slowly at room temperature may be accelerated by a slight increase in temperature.

It is also a term used to express the increase in hysteresis loss in the core laminations of electrical machines. See Hysteresis.

Aich Metal. Aich metal is an alloy of about 38 per cent zinc, 60 per cent copper, and 2 per cent iron. Sometimes the iron percentage is only 1.5 per cent. It is malleable at a red heat and can be hammered, rolled, or drawn into fine wire. The metal has been used as a material for cannons. The tensile strength is about 50,000 pounds per square inch; the addition of a small percentage of iron increases the strength perceptibly. At temperatures of from 200 to 1000 degrees F., Aich metal is about 50 per cent stronger than brass of about the same composition, but without the iron. The strength of Aich metal at 200 degrees F. is about 45,000 pounds per square inch; at 500 degrees F., 30,000 pounds per square inch; and at 900 degrees F.,