Glossary

Section I
ACRONYMS AND ABBREVIATIONS

AAF Army airfield

AG Adjutant General

AISI automated integrated survey instruments

ALP airpoint location point

ALS approach light system

AMTP Army Mission Training Plan

APO Air Post Office

APPS Analytical Photogrametric Position System

APRT Army physical readiness test

AR Army regulation

ARNG Army National Guard

ARP airpoint reference point

ARSR air route surveillance radar

ARTCC air route traffic control center

ARTEP Army Training and Evaluation Program

ASR airport surveillance radar

ATC air traffic control

AUTOVON automatic voice network

az azimuth

BAQ basic allowance for quarters

BC back course

BCM back course marker

BEQ bachelor enlisted quarters

bkwd backward

bldg building

BLM Bureau of Land Management

BM bench mark

bn battalion

BS backsight

cal calibration

carto cartography, cartographic

cdr commander

CEOI communications-electronics operation instructions

CESI communications-electronics standing instruction

chron chronometer

C/L centerline

co company

COB close of business

CONRAIL Continental Railroad

corr correction

CTI common task test

DD (form), Department of Defense

DE difference in elevation

deg degree

DEH Directorate of Engineering and Housing

DF direction finder

diff difference

DIO Director of Industrial Operations

dir/ang direction/angle

DMA Defense Mapping Agency

DME distance measuring equipment

DPT Director of Plans and Training

dsplcd displaced

D/R direct/reverse

D displaced threshold

EC eccentric correction

EDME electronic distance measuring equipment

elev elevation

encl enclosure

engr engineer

EOR end of runway

exp explement

FAA Federal Aviation Administration

FAO finance and accounting office

FAR Federal Aviation Regulation

FED Facilities Engineering Division

FM field manual

FM frequency modulated

FORSCOM United States Army Forces Command

FOUO For Official Use Only

FRAGO fragmentary order

FTS Federal Telecommunications System

fwd forward

G3 Assistant Chief of Staff, G3 (Operations and Plans)

GCA ground-controlled approach

GPS global positioning system

GSI glide slope indicator

HC horizon closure

H Dist horizontal distance

Hg The symbol for the element mercury

HHC headquarters and headquarters company

HI height of instrument

HQDA Headquarters, Department of the Army

H Scale horizontal scale

HT height of target

IAW in accordance with

IFR instrument flight rules

ILS instrument landing system

IM inner marker

incl inclination

INS inertial navigational system

instr instrument

ISVT initial site visitation trip

kHz kilohertz

km kilometer

lb pound(s)

LDA localizer-type directional aid

L/MF low or medium frequency

LOC Iocalizer

LORAN long range navigation

MACOM major Army command

mag magnetic

MFR memorandum for record

MHz megahertz

micro micrometer

MLS microwave landing system

MM middle marker

mm millimeter

mo month

MOA Memorandum of Agreement

MOS military occupational specialty

MSAW minimum safe altitude warning

MSL mean sea level

NA not applicable

NAD North American Datum

NAVAID navigational aid

NAVD North American Vertical Datum

NCAD New Cumberland Army Depot

NCO noncommissioned officer

NCOIC noncommissioned officer in charge

NDB nondirectional radio beacon

NFDC National Flight Data Center

NFDD National Flight Data Digest

NGS National Geodetic Survey

NGVD National Geodetic Vertical Datum

NLT not later than

no number

NOAA National Oceanic and Atmospheric Administration

OC obstruction chart

ODALS Omnidirectional Approach Light System

OM outer marker

opns operations

OPORD operation order

OVM organization vehicle maintenance

PAC Personnel and Administration Center

PADS position and azimuth determination system

PAPI precision approach path indicator

PAR precision approach radar

PBM permanent bench mark

pgs pages

PLASI pulsating visual approach slope indicator

PMCS preventive maintenance checks and services

POC point of contact

POL petroleum, oils, and lubricants

Pos. Rep. position repetition

POV privately owned vehicle

PX Post exchange

R1 reject value, use first mean value

R2 reject value, use second mean value

RADAR radio detection and ranging

RC rod center

recon reconnaissance

REIL runway end identifier lights

RFI radio frequency interference

RM reference mark

$\mathbf{R_0}$ rejected by observation

RT relocated threshold

RTO radiotelephone operator

RVR runway visual range

RW runway visibility value

rwy runway

S1 Adjutant (US Army)

S3 Operations and Training Officer (US Army)

S4 Supply Officer (US Army)

SATO Scheduled Airline Ticket Office

SCP survey control point

SDF simplified directional facility

SDNCO staff duty noncommissioned officer

SIC survey information center

SIF Stadia Interval Factor

SOI signal operation instructions

SOP standing operating procedure

SP Special publication

SQT skill qualification test

SSGCN Standards and Specifications for Geodetic Control Networks

SSI standing signal instructions

sta station

STP Soldier Training Publication

TACAN tactical air navigation

TBM temporary bench mark

TCMD transportation control management document

TDA tables of distribution and allowances

TDY temporary duty

TDZE touchdown zone elevation

TECHOPORD technical operation order

temp temperature

TERPS terminal instrument procedures

TM technical manual

TMP transportation motor pool

TOE table(s) of organization and equipment

topo topographic

TRADOC United States Army Training and Doctrine Command

trig trigonometric

UHF ultra high frequency

US United States

USAADCENFB United States Army Air Defense Center and Fort Bliss

USAASD-E United States Army Aeronautical Services Detachment, Europe

USAASO United States Army Aeronautical Services Office

USAES United States Army Engineer School

USAR United States Army Reserve

USC&GS US Coast and Geodetic Survey

UTM universal transverse mercator (grid)

VASI visual approach slope indicator

vern vernal

VFR visual flight rules

VOR very high frequency omnidirectional range

VORTAC very high frequency omnidirectional range/tactical air navigation

V scale vertical scale

WDI wind direction instrument

WGS World Geodetic System

WWV transmitting station

yr year

zen dist zenith distance

Section II
SURVEY TERMS

Aberration of light-(astronomic) – The apparent displacement in position of a stellar body due to the velocity of light combined with the motion of the earth itself.

Accidental error – Any small error accidentally incurred in a measurement. Unlike systematic errors, accidental errors are not governed by fixed laws. The theory of probability is based on the occurrence of these errors, which could be positive or negative.

Accuracy – The degree of conformity with a standard, or the degree of perfection attained in a measurement. Accuracy relates to the quality of a result, and is distinguished from precision which relates to the quality of the operation by which the result is obtained.

Actual error- The difference between the accepted value and the measured value of a physical quantity.

Adjusted position – An adjusted value for the horizontal or vertical position of a survey station, in which discrepancies due to errors in the observed data are removed. This adjustment forms a coordinated and correlated system of stations.

Aeronautical beacon – A visual navigational aid displaying flashes of white and/or colored light to indicate the location of an airport, a heliport, a landmark, a certain point of a federal airway in mountainous terrain, or an obstruction. (See Airport Rotating Beacon under Airport Lighting.)

Air navigation facility – Any facility used in, available for use in, or designed for use in aid of air navigation, including landing areas, lights, any apparatus or equipment for disseminating weather information, for signaling, for radio-directional finding, or for radio or other electrical communication, and any other structure or mechanism having a similar purpose of guiding or controlling flight in the air or the landing and takeoff of aircraft, (See Navigational Aid.)

Airport – An area on land or water that is used or intended to be used for the landing and takeoff of aircraft and includes its buildings and facilities, if any.

Airport elevation – The highest point of an airport's usable runways measured in feet from mean sea level (technically, *NGVD 1929* or other vertical datum).

Airport lighting – Various lighting aids that maybe installed on an airport. Types of airport lighting include –

- *Airport rotating beacon.* A visual navigational aid operated at many airports. At civil airports, alternate white and green flashes indicate the location of the airport. At military airports, the beacon flashes alternately white and green, but is differentiated from civil beacons by dualpeak (two quick) white flashes between the green flashes.
- *Approach light system (ALS). An* airport lighting facility which provides visual guidance to landing aircraft by radiating light beams in a directional pattern by which the pilot aligns the aircraft with the extended centerline of the runway on his final approach for landing. A number of ALS configurations exist, both with and without sequenced flashing lights. One system is the Omnidirectional Approach Light System (ODALS), which consists of seven omnidirectional flashing lights located in the approach area of a nonprecision approach. Five lights are located on the runway centerline extended and the other two are located one on each side of the runway threshold.
- *Runway end identifier lights (REIL).* Two synchronized flashing lights, one on each side of the runway threshold, which provide rapid and positive identification of the approach end of a particular runway.
- *Visual approach slope indicator (VASI). An* airport lighting facility providing vertical visual approach slope guidance to aircraft during approach to landing by radiating a directional pattern of high-intensity red and white focused light beams which indicate to the pilot if he is above, below, or on the glide path. (The term "visual approach slope indicator" also has a generic connotation, as used below.)
- *Tri-color approach slope indicator.* A visual approach slope indicator consisting of a single light unit projecting a three-color visual approach path into the final approach area of the runway served by the system.
- *Pulsating visual approach slope indicator (PLASI).* A visual approach slope indicator normally consist-

ing of a single light unit projecting a pulsating two-color visual approach path into the final approach area of the runway served by the system.

- *Precision approach path indicator (PAPI).* A visual approach slope indicator consisting of a single row of two or four light units, similar to the VASI, usually installed on the left side of the runway served by the system.

Airport location point (ALP) - The permanent position, usually expressed in latitude and longitude, of an airport for identification and reference purposes. The ALP coincides with the original Airport Reference Point, (See Airport Reference Point.)

Airport reference point (ARP) – The position of the approximate center of mass of all usable runways. This point is not strictly the center of mass of runways, since runway width, thickness, or material is not considered in the computation. The ARP is not monumented, therefore not recoverable on the ground.

Airport surveillance radar (ASR) – Approach control radar used to detect and display an aircraft's position in the terminal area. The ASR provides range and azimuth information but does not provide elevation data. Coverage of the ASR can extend up to 60 nautical miles.

Air route surveillance radar (ARSR) – Air route traffic control center (ARTCC) radar used primarily to detect and display an aircraft's position while enroute between terminal areas. Coverage of the ARSR can extend up to 200 nautical miles.

Altimeter– An aneroid barometer used for the measurement of approximate elevations or approximate differences of elevation.

Altitude – The vertical angle measured between the plane of the observer's true horizon and a line to the object.

Angle of depression – A negative altitude.

Angle of elevation – A positive altitude.

Apron/ramp –A defined area on an airport or heliport intended to accommodate aircraft for purposes of loading and unloading passengers or cargo, refueling, parking, or maintenance. With regard to seaplanes, a ramp is used for access to the apron from the water.

Arithmetical mean – The value obtained by dividing the sum of a series of values by the number of values in the series.

Astronomical latitude – The angle between the plumb line and the plane of celestial equator, Also defined as the angle between the plane of the horizon and the axis of rotation of the earth. Astronomical latitude applies only to positions on the earth and is reckoned from the astronomic equator (0°), north and south through 90°. Astronomical latitude is the latitude which results directly from observations of celestial bodies, uncorrected for deflection of the vertical.

Astronomical longitude – The angle between the plane of the celestial meridian and the plane of an initial meridian, arbitrarily chosen. Astronomical longitude is the longitude which results directly from observations on celestial bodies, uncorrected for deflection of the vertical.

Astronomical triangle – The triangle on the celestial sphere formed by arcs of great circles connecting the celestial pole, the zenith, and a celestial body. The angles of the astronomical triangles are: at the pole, the hour angle; at the celestial body, the parallactic angle; at the zenith, the azimuth angle. The sides are: pole to zenith, the co-latitude; zenith to celestial body, the zenith distance; and celestial body to pole, the polar distance.

Azimuth-(surveying) – The horizontal direction of a line measured clockwise from a reference plane, usually the meridan. Often called *forward azimuth* to differentiate from *back azimuth,*

Azimuth angle-(astronomy) – The angle less than 180° between the plane of the celestial meridian and the vertical plane containing the observed object, reckoned from the direction of the elevated pole. In astronomic work, the azimuth angle is the spherical angle at the zenith in the astronomical triangle which is composed of the pole, the zenith, and the star. In geodetic work, it is the horizontal angle between the celestial pole and the observed terrestrial object.

Azimuth mark – A marked point or adjacent station visible from an occupied station, the azimuth to which is determined for use in dependent surveys.

Backsight–

(1) In *traversing* a backsight (BS) is a sight on a pre-

viously established traverse or triangulation station, which is not the closing sight on the traverse.
(2) In *leveling,* a backsight is a reading on a rod held on a point whose elevation has been previously determined and which is not the closing sight of a level line.

Baseline – A surveyed line established with more than usual care, to which surveys are referred for coordination and correlation.

Base net – A small net of geometric figures used to expand from a baseline to a line of the main scheme of a triangulation net.

Basic control – Horizontal and vertical control of third- or higher-order accuracy, determined in the field and permanently marked or monumented, that is required to control further surveys.

Bearing – The direction of a line within a quadrant, with respect to the meridian. Bearings are measured clockwise or counterclockwise from north or south, depending on the quadrant.

Bench mark– A relatively permanent object, natural or artificial, bearing a marked point whose elevation above or below an adopted datum is known. Usually designated as a BM, such a mark is sometimes further qualified as a PBM (permanent bench mark), or as a TBM (temporary bench mark).

Blast pad – A specially prepared surface placed adjacent to the ends of runways to eliminate the erosive effect of the high wind forces produced by airplanes at the beginning of their takeoff rolls.

Cadastral survey– A survey relating to land boundaries and subdivisions, made to create units suitable for transfer or to define the limitations of title. The term cadastral survey is now used to designate the surveys of the public lands of the United States, including retracement surveys for the identification and resurveys for the restoration of property lines; the term can also be applied properly to corresponding surveys outside the public lands, although such surveys are usually termed land surveys through preference.

Celestial equator- A great circle on the celestial sphere on which any point is equidistant from the celestial poles, The plane of the earth's equator, if extended, would coincide with that of the celestial equator.

Celestial meridian – A vertical circle, passing through both celestial poles, the plane of which is perpendicular to the celestial equator.

Celestial pole – A reference point located at the point of intersection of an indefinite extension of the earth's axis of rotation and the apparent celestial sphere.

Celestial sphere – An imaginary sphere of infinite radius with the earth as a center. It rotates from east to west on a prolongation of the earth's axis.

Central meridian – The line of longitude at the center of a projection. Generally the basis for constructing the projection.
State plane-coordinate system. The meridian used as the axis of Y for computing projection tables for a state coordinate system. The central meridian of the system usually passes close to the center of figure of the area or zone for which the tables are computed.

Chronometer – A portable timekeeper with compensated balance, capable of showing time with extreme precision and accuracy.

Circle position – A prescribed setting (reading) of the horizontal circle of a direction theodolite, to be used for the observation on the initial station of a series of stations that are to be observed.

Circuit closure – In leveling, the amount by which the algebraic sum of the measured differences of elevation around a circuit fails to equal zero.

Circumpolar star– A star in any given latitude which never goes below the horizon; hence, its polar distance must be less than the given latitude. In astronomy only those stars with a polar distance of less than 10° are considered in practical problems.

Clearway – An area beyond the takeoff runway under the control of airport authorities within which terrain or fixed obstacles may not extend above specified limits. These areas may be required for turbine-powered operations, and the size and upward slope of the clearway will differ depending on when the aircraft was certified.

Closed traverse – A traverse that starts and ends at the same point or at stations whose positions have been determined by other surveys. See *loop traverse.*

Collimation – The line of sight or aiming line of the instrument when coincident with the physical alignment of the instrument; thus, collimation error is the angle between the line of collimation (line of sight) of a telescope and the collimation axis of the instrument.

Compass locator– A low-power, low-or medium-frequency (L/MF) nondirectional beacon installed at the site of the outer or middle marker of an instrument landing system. It can be used for navigation at distances of approximately 15 miles or as authorized in the approach procedure.

Control –
(1) The coordinated and correlated dimensional data used in geodesy and cartography to determine the positions and elevations of points on the earth's surface or on a cartographic representation of that surface.
(2) A collective term for a system of marks or objects on the earth or on a map or a photograph whose positions or elevation, or both, have been or will be determined.

Control survey – A survey which provides positions (horizontal or vertical) of points to which supplementary surveys are adjusted.

Coordinates – Linear or angular quantities, or both, which designate the position of a point in relation to a given reference frame. There are two general divisions of coordinates used in surveying: *polar coordinates and rectangular coordinates.* These may be subdivided into three classes: *plane coordinates, spherical coordinates, and space coordinates.*

Culmination, transit – The instant when any point on the celestial sphere is on the meridian of an observer. When it is on that half of the meridian containing the zenith, it is called the upper transit; when it is on the other half, it is called the lower transit.

Datum – Any numerical or geometrical quantity or set of such quantities which may serve as a reference or base for other quantities.
(1) *Geodetic.* A reference surface consisting of five quantities: the latitude and longitude of an initial point, the azimuth of a line from this point, and the parameters of the reference ellipsoid. It forms the basis for the computation of horizontal-control surveys in which the curvature of the earth is considered.
(2) *Leveling.* A level surface to which elevations are referred; usually, but not always, mean sea level.

Declination –
(1) In a system of polar or spherical coordinates, the angle at the origin between a line to a point and the equatorial plane, measured in a plane perpendicular to the equatorial plane.
(2) The arc between the equator and the point measured on a great circle perpendicular to the equator.
(3) Declination, as it relates to astronomy, is the angular distance to a body on the celestial sphere measured north or south through 90° from the celestial equator along the hour circle of the body. Comparable to latitude on the terrestrial sphere.
(4) Often used as a shortened term for magnetic declination although this use is not preferred.

Deflection of the vertical – The angular difference, at any place, between the upward direction of a plumb line (the vertical) and the perpendicular (the normal) to the reference spheroid. This difference seldom exceeds 30 seconds. Often expressed in two components, *meridian and prime vertical.*

Departure – In a plane survey, the difference between the castings of the two ends of the line, which may be either plus or minus. This value is symbolized by a ΔE.

Direction finder (DF) – A radio receiver equipped with a directional sensing antenna used to take bearings on a radio transmitter

Direct leveling– The determination of differences of elevation by means of a continuous series of short horizontal lines. Vertical distances from these lines to adjacent ground marks are determined by direct observations on graduated rods with a leveling instrument equipped with a spirit level.

Direct reading – The reading of the horizontal or vertical circle of a theodolite or engineer transit with the telescope direct. In field notes, a direct reading is indicated by the letter D preceding the observed value.

Direction instrument theodolite – A theodolite in which the graduated horizontal circle remains freed during a series of observations, the telescope being

pointed on a number of signals or objects in succession, and the direction of each read on the circle, usually by means of micrometer microscopes. Direction instrument theodolites are used almost exclusively in first- and second-order triangulation.

Distance angle – An angle in a triangle opposite a side used as a base in the solution of the triangle, or a side whose length is to be computed.

Distance measuring equipment (DME) – Equipment (airborne and ground) used to measure, in nautical miles, the slant range distance of an aircraft from the DME navigational aid.

Ecliptic – The great circle on the celestial sphere which the sun appears to describe in its annual motion among the stars. It is inclined to the celestial equator at an angle of about 23°27'.

Elevation – Vertical distance from a datum, usually mean sea level, to a point or object on the earth's surface. Not to be confused with altitude, which refers to points or objects above the earth's surface.

Elongation – That point in the apparent movement of a circumpolar star when it has reached the extreme position east or west of the meridian.

Emulsion – A suspension of either light-sensitive silver salts, Diazos, or photopolymers, in a colloidal medium which is used for coating films, plates, and papers.

Ephemeris time – The uniform measure of time defined by the laws of dynamics and determined in principle from the orbital motions of the planets, specifically in the orbital motion of the earth.

Equation of time – The algebraic difference in hour angle between apparent solar time and mean solar time, usually labeled plus or minus, as it is to be applied to mean solar time to obtain apparent solar time.

Equinox – One of the two points of intersection of the ecliptic and the celestial equator, occupied by the sun when its declination is 0^{o}.

Error –

(1) The difference between an observed or true value of that quantity.

(2) A class of small inaccuracies due to imperfections in equipment or techniques, surrounding conditions, or human limitations; not to be confused with blunders or mistakes.

Error of closure – The amount by which a quantity obtained by a series of related measurements differs from the true or fixed value of the same quantity.

(1) *Angles.* The amount by which the actual sum of a series of angles fails to equal the theoretically exact value of that sum.

(2) *Azimuth.* The amount by which two values of the azimuth of a line, derived by different surveys or along different routes, fail to be exactly equal to each other.

(3) *Leveling.* The amount by which two values of the elevation of the same bench mark, derived by different surveys or through different survey routes or by independent observations, fail to be exactly equal to each other.

(4) *Loop.* The error in the closure of a survey on itself.

(5) *Horizon.* The amount by which the sum of a series of adjacent measured horizontal angles around a point fails to equal exactly 360°. Measurement of the last angle of the series is called closing the horizon; sometimes called closure of horizon.

(6) *Triangle.* The amount by which the sum of the three observed angles of a triangle fails to equal exactly 180° plus the spherical excess of the triangle.

(7) *Traverse.* The amount by which a value of the position of a traverse station, as obtained by computation through a traverse, fails to agree with another value of the same station as determined by a different set of observations or routes of survey.

Final approach course – A straight line extension of a localizer, a final approach radial/bearing, or a runway centerline, all without regard to distance.

Fixed elevation – An elevation which has been adopted, either as a result of tide observations or previous adjustment of spirit leveling, and which is held at its accepted value in any subsequent adjustment.

Flight path – A line, course, or track along which an aircraft is flying or intended to be flown.

Foresight – An observation of the distance and direction to the next instrument station.

(1) *Transit traverse.* A point set ahead to be used for reference when resetting the transit or line or when verifying the alinement.

(2) *Leveling.* The reading on a rod that is held at a point whose elevation is to be determined.

Frequency- The number of complete cycles per second existing in any form of wave motion.

Geodesic line – A line of shortest distance between any two points on any mathematically defined surface. A geodesic line is a line of double curvature, and usually lies between the two normal section lines which the two points determine. If the two terminal points are in nearly the same latitude, the geodesic line may cross one of the normal section lines. It should be noted that, except along the equator and along the meridians, the geodesic line is not a plane curve and cannot be sighted over directly. However, for conventional triangulation the lengths and directions of geodesic lines differ inappreciably from corresponding pairs of normal section lines.

Geodesy – The science which treats of the determination of the size and figure of the earth (geoid) by such direct measurements as triangulation, leveling, and gravimetric observations; which determines the external gravitational field of the earth; and, to a limited degree, the internal structure.

Geodetic control – A system of horizontal and/or vertical control stations that have been established and adjusted by geodetic methods and in which the shape and size of the earth (geoid) have been considered in position computations.

Geodetic latitude – The angle which the normal at a point on the reference spheroid makes with the plane of the geodetic equator. Geodetic latitudes are reckoned from the equator, but in the horizontal-control survey of the United States they are computed from the latitude of station Meades Ranch as prescribed in the *North American Datum of 1927.*

Geodetic leveling – Spirit leveling of a high order of accuracy, usually extended over large areas, to furnish accurate vertical control as a basis for the control in the vertical dimension for all surveying and mapping operations. Spirit leveling follows the geoid and its associated level surfaces which are irregular, rather than any mathematically determined spheroid or ellipsoid and associated regular level surfaces.

Geodetic longitude – The angle between the plane of the geodetic meridian and the plane of an initial meridian, arbitrarily chosen. A geodetic longitude can be measured by the angle at the pole of rotation of the reference spheroid between the local and initial meridians or by the arc of the geodetic equator intercepted by those meridians. In the United States, geodetic longitudes are numbered from the Meridian of Greenwich, but are computed from the meridian of station Meades Ranch as prescribed in the *North American Datum of 1927.* A geodetic longitude differs from the corresponding astronomical longitude by the amount of the prime vertical component of the local deflection of the vertical divided by the cosine of the latitude.

Geographic coordinates – An inclusive term generally used to designate both geodetic coordinates and astronomical coordinates.

Geoid – The figure of the earth considered as a sea-level surface extended continuously through the continents. The actual geoid is an equipotential surface coincident with mean sea level to which, at every point, the plumb line (direction in which gravity acts) is perpendicular. It is the geoid which is obtained from observed deflections of the vertical and is the surface of reference for astronomical observations and for geodetic leveling.

Gravimeter – A weighing device or instrument of sufficient sensitivity to register variations in the weight of a constant mass when the mass is moved from place to place on the earth and thereby is subjected to the influence of gravity at those places.

Gravitation –The acceleration produced by the mutual attraction of two masses, directed along the line joining their centers of masses, and of magnitude inversely proportional to the square of the distance between the two centers of mass.

Gravity – Viewed from a frame of reference freed in the earth, acceleration imparted by the earth to a mass which is rotating the earth. Since the earth is rotating, the acceleration observed as gravity is the resultant of the acceleration of gravitation and the centrifugal acceleration arising from this rotation and the use of an earthbound rotating frame of reference. It is directed normal to sea level and to its geopotential surfaces.

Ground-controlled approach (GCA) – A radar approach system operated from the ground by air traffic control personnel transmitting instructions to

the pilot by radio. The approach maybe conducted with airport surveillance radar (ASR) only or with both surveillance and precision approach radar (PAR).

Hachures – A method of portraying relief by short, wedge-shaped marks radiating from high elevations and following the direction of slope to the lowland.

Height of instrument –

(1) *Spirit leveling.* The height of the line of sight of a leveling instrument above the adopted datum.

(2) *Stadia surveying.* The height of the center of the telescope (horizontal axis) of transit or telescopic alidade above the ground or station mark.

(3) *Trigonometrical leveling.* The height of the center of the theodolite (horizontal axis) above the ground or station mark.

Heliotrope – An instrument composed of one or more plane mirrors so mounted at the station being sighted upon that the sun's rays can be reflected to any one observing station.

Horizontal control - Control which determines horizontal positions only, with respect to parallels and meridians or to other lines of reference.

Horizontal refraction – A natural error in surveying which is the result of the horizontal bending of light rays between a target and an observing instrument. Usually caused by the differences in density of the air along the path of the light rays, resulting from temperature variations.

Hour angle – Angular distance west of a celestial meridian or hour circle; the arc of the celestial equator, or the angle at the celestial pole, between the upper branch of a celestial meridian or hour circle and the hour circle of a celestial body or the vernal eqinox measured westward through 360°.

Hour circle – Any great circle on the celestial sphere whose plane is perpendicular to the plane of the celestial equator.

Imaginary surface – Any surface defined in FAR-77, Subpart C.

. *Specified surface.* An imaginary surface, other than a supplemental surface, designated by appropriate FAA authorities for the purpose of defining obstructions. This surface may or may not be the surface specified in *FAR-77* for existing approach minimums.

• *Supplemental surface.* An imaginary surface designated by appropriate FAA authorities as a "supplemental surface." A supplemental surface will normally lie below a specified surface and is intended to provide additional obstruction information. An object that penetrates a supplemental surface only is a supplemental obstruction.

Instrument landing system (ILS) – A precision instrument approach system which normally consists of the following electronic components and visual aids:

- Localizer
- Glide Slope
- Outer Marker
- Middle Marker
- Approach Lights

Instrument runway – A runway equipped with electronic and visual navigational aids for which a precision or nonprecision approach procedure having straight-in landing minimums has been approved.

Intersection – A method of determining the horizontal position of a point by observations from two or more points of known position, thus measuring directions that intersect at the station being located. A station whose horizontal position is located by intersection is known as an intersection station.

Isogonic chart – A chart of which the chief feature is a system of isogonic lines, each for a different value of the magnetic declination.

Isogonic line– A line drawn on a map or chart joining points of equal magnetic variation.

Landing direction indicator – A device which visually indicates the direction in which landings and takeoffs should be made.

Laplace azimuth – A geodetic azimuth derived from an astronomic azimuth by use of the Laplace equation.

Laplace condition– The Laplace condition, expressed by the Laplace equation, arises from the fact that a deflection of the vertical in the plane of the prime vertical will give a difference between astronomic and geodetic longitude and between astronomic and geodetic azimuth; or, conversely, that the observed differences between astronomic and geodetic values of the longitude and of the

azimuth may both be used to determine the deflection in the plane of the prime vertical.

Laplace equation – The equation which expresses the relationship between astronomic and geodetic azimuths in terms of astronomic and geodetic longitudes and geodetic latitude. Thus, Laplace correction = $(\lambda_A - \lambda_G) \sin \phi_G$.

Laplace station – A triangulation or traverse station at which a Laplace azimuth is determined. At a Laplace station both astronomic longitude and astronomic azimuth are determined.

Level datum – A level surface to which elevations are referred. The generally adopted level datum for leveling in the United States is mean sea level. For local surveys, an arbitrary level datum is often adopted and defined in terms of an assumed elevation for some physical mark (bench mark).

Level net – Lines of spirit leveling connected together to form a system of loops or circuits extending over an area.

Line of sight –

(1) The straight line between two points. This line is in the direction of a great circle, but does not follow the curvature of the earth.

(2) The line extending from an instrument along which distant objects are seen, when viewed with a telescope or other sighting device.

Local hour angle – Angle distance measured on the celestial equator between the celestial meridian and the hour circle that passes through the object. The local hour angle represents physically the amount of rotation of the celestial sphere since the object was last on the observer's celestial meridian, and is always measured westward 0° to 360° from the celestial meridian.

Localizer (LOC) –The component of an ILS which provides course guidance to the runway.

Localizer back course – The course line defined by the Iocalizer signal along the extended centerline of the runway in the opposite direction to the normal localizer approach course (front course).

Localizer-type directional aid (LDA) – A navigational aid used for nonprecision instrument approaches with utility and accuracy comparable to a localizer but which is not part of a complete ILS and is not aligned with the runway.

Long range navigation (LORAN) – An electronic navigation system by which hyperbolic lines of position are determined by measuring the difference in the time of reception of synchronized pulse signals from two fixed transmitters. The LORAN A operates in the 1750-1950 kHz frequency band. The LORAN C and D operate in the 100-110 kHz frequency band.

Loop traverse – A closed traverse that starts and ends at the same station.

Main-scheme station – A station through which the basic survey computations are carried, also called a principal station, The main-scheme stations serve for the continued extension of the survey.

Marker beacon – An electronic navigational aid transmitting a 75 MHz vertical fan or boneshaped radiation pattern. Marker beacons are identified by their modulation frequency and keying code and, when received by compatible airborne equipment, indicate to the pilot, both aurally and visually, that he is passing over the facility.

- *Back course marker (BCM).* When installed, this normally indicates the localizer back course final approach fix where approach descent is commenced.
- *Inner marker (IM)* A marker beacon, used with an ILS category-II precision approach, located between the middle marker and the end of the ILS runway. It also marks progress during an ILS category-III approach. The inner marker is usually located at the point of decision height for ILS category-II approaches.
- *Middle marker (MM).* A marker beacon that defines a point along the glide slope of an ILS usually located at or near the point of decision height for ILS category-I approaches.
- *Outer marker (OM).* A marker beacon at or near the glide slope intercept altitude of an ILS approach. The outer marker is normally located 4 to 7 miles from the runway threshold on the extended centerline of the runway.

Mean sea level (MSL) – The mean surface water level determined by averaging heights at all stages of the tide over a 19-year period. Often used as a reference for general leveling operations.

Meridian angle – Angular distance east or west of the local celestial meridian; the arc of the celestial

equator, or the angle at the celestial pole, between the upper branch of the local celestial meridian and the hour circle of a celestial body, measured eastward or westward from the local celestial meridian through 180°, and labeled E or W to indicate the direction of measurement.

Minimum safe altitude warning (MSAW) – A function of ARTS III computer that aids the controller by alerting him when a tracked Mode C-equipped aircraft is below or is predicted by the computer to go below a predetermined minimum safe altitude.

Minimum – Weather condition requirements established for a particular operation or type of operation; for example, IFR takeoff or landing, alternate airport for IFR flight plans, VFR flight.

Missed approach – A maneuver conducted by a pilot when an instrument approach cannot be completed to landing.

Monument – Any object or collection of objects that indicate the position on the ground of a survey station. In military surveys, the term monument usually refers to a stone or concrete station marker containing a special bronze plate on which the exact station point is marked.

Movement area – The runways, taxiways, and other areas of an airport/heliport which are utilized for taxiing/hover taxiing, air taxiing, takeoff, and landing of aircraft, exclusive of apron areas. At those airports/heliports with a tower, specific approval for entry onto the movement area must be obtained from ATC.

Nadir – The point on the terrestrial sphere directly beneath the observer and directly opposite to the zenith; the lowest point.

National Flight Data Center (NFDC) – A facility in Washington, DC established by the FAA to operate a central aeronautical information service for the collection, validation, and dissemination of aeronautical data in support of the activities of government, industry, and the aviation community. The information is published in the *National Flight Data Digest.*

National Flight Data Digest (NFDD) – A daily (except weekends and Federal holidays) publication of flight information appropriate to aeronautical charts, aeronautical publications, Notices to Airmen, or other media serving the purpose of providing operational flight data essential to safe and efficient aircraft operations.

NAVAID survey – The process of determining the position and/or elevation of one or more navigational aids and adjunctive points on associated runways or runway centerlines extended. A NAVAID survey that is performed as part of the OC survey is a Combined NAVAID Survey. A NAVAID survey that is not performed as part of a normal OC survey is a Special NAVAID Survey.

Navigable airspace – Airspace at and above the minimum flight altitude prescribed in the FARs, including airspace needed for safe takeoff and landing.

Navigational aid (NAVAID) – Any Visual or electronic device airborne or on the surface which provides point-to-point guidance information or position data to aircraft in flight. (See Air Navigation Facility.)

Nondirectional beacon (NDB) – An L/MF or UHF radio beacon transmitting nondirectional signals whereby the pilot of an aircraft equipped with direction-finding equipment can determine his bearing to or from the station. When the NDB is installed in conjunction with an Instrument Landing System marker, it is normally called a Compass Locator.

Nonprecision approach procedure – A standard instrument approach procedure in which no electronic glide slope is provided; for example, VOR, TACAN, NDB, LOC, ASR, LDS, and SDF approaches.

North American Datum of 1927 – The initial point of this datum is located at Meades Ranch, Kansas. Based on the Clarke spheroid of 1866, the geodetic positions of this system are derived from a readjustment of the triangulation of the entire country, in which Laplace azimuths were introduced.

Observer's meridian – A celestial meridian passing through the zenith at the point of observation and the celestial poles.

Obstruction – Any object that penetrates a specified surface. An object that penetrates a supplemental surface only is a supplemental obstruction. The most obstructing object in a set of objects is the one which penetrates an imaginary surface further than any other object in the set. (See Imaginary Surface.)

Occultation –

(1) *Astronomy.* The disappearance of a celestial body behind another body of larger apparent size. When the moon passes between the observer and a star, the star is said to be occulted.

(2) *Survey.* Name applied to a geodetic survey technique which employs the principle of occultation where repeated observations are made on an unknown position, accurately timed with similar observations at another unknown station, and mathematically reducing this data to determine the exact geodetic position of the unknown stations.

Offset line – A supplementary line close to and roughly parallel with a main line, to which it is referred by measured offsets. Where the line for which data are desired is in such position that it is difficult to measure over it, the required data are obtained by running an offset line in a convenient location and measuring offsets from it to salient points on the other line.

Open traverse – A survey traverse which begins from a station of known or adopted position, but does not end upon such a station.

Order of accuracy – A mathematical ration defining the general accuracy of the measurements made in a survey. The order of accuracy of surveys are divided into four classes labeled first order, second order, third order, and fourth or lower order.

Parallax –

(1) The apparent displacement of the position of a body, with respect to a reference point or system, caused by a shift in the point of observation.

(2) The apparent displacement between objects on the earth's surface due to their difference in elevation.

Permanent bench mark (PBM) – A bench mark of as nearly permanent character as it is practicable to establish. Usually designated simply as a bench mark or BM. A permanent bench mark is intended to maintain its elevation with reference to an adopted datum without change over a long period of time.

Personal equation – The time interval between the sensory perception of a phenomenon and the motor reaction thereto. A personal equation maybe either positive or negative, as an observer may anticipate the occurrence of an event or wait until he actually sees it occur before making a record. This is a systematic error, treated as the constant type.

Personal error– An error caused by an individual's personal habits, his inability to perceive or measure dimensional values exactly, or by his tendency to react mentally and physically in a uniform manner under similar conditions. Contrasted with blunder; mistake.

Picture point – In surveying, a terrain feature that is easily identified on an aerial photograph and whose horizontal or vertical position or both have been determined by survey measurements. Picture points are marked on the aerial photographs by the surveyor and are used by the photomapper.

Plumb line –

(1) The line of force in the geopotential field. The continuous curve to which the direction of gravity is everywhere tangential.

(2) The line indicated by a plumb-bob cord.

Precision approach procedure – A standard instrument approach procedure in which an electronic glide slope is provided; for example, ILS and PAR approaches.

Precision approach radar (PAR) – Radar equipment, usually located at military or joint use airfields, that detects and displays azimuth, elevation, and range of aircraft on the final approach course to a runway. The controller issues guidance instructions to the pilot based on the aircraft's position and elevation relative to the touchdown point on the runway displayed on the radar scope.

Prime meridian – The meridian of longitude 0°, used as the origin for measurement of longitude. The meridian of Greenwich, England, is almost universally used for this purpose.

Prime vertical – The vertical circle through the east and west points of the horizon. It maybe true, magnetic, compass, or grid depending upon which east or west points are involved.

Radar approach – An instrument approach procedure which utilizes Precision Approach Radar (PAR) or Airport Surveillance Radar (ASR).

Radio beacon – See Nondirectional Beacon.

Radio detection and ranging (RADAR) – A device which, by measuring the time interval between transmitted and received radio pulses, provides in-

formation on range, azimuth, and/or elevation of objects in the path of the transmitted pulse.

- *Primary radar.* A radar system which uses reflected radio signals.
- *Secondary radar.* A radar system wherein a radio signal transmitted from a radar station initiates the transmission of a radio signal fron another station.

Ramp – See Apron.

Right ascension – The angular distance measured eastward on the equator from the vernal equinox to the hour circle through the celestial body, from 0 to 24 hours.

Runway – A defined rectangular area on a land airport prepared for the landing and takeoff run of aircraft along its length.

Sea Level Datum of 1929 – The current standard datum for geodetic leveling in the United States, based on tidal observations over a number of years at various tide stations along the coasts.

Sexagesimal system – A system of notation by increments of 60; as the division of the circle into 360°, each degree into 60 minutes, and each minute into 60 seconds.

Sidereal day – The interval of time from a transit of the (true) vernal equinox across a given meridian to its next successive transit across the same meridian.

Sidereal time – Time based upon the rotation of the earth relative to the vernal equinox.

Simplified directional facility (SDF) – A navigational aid used for nonprecision instrument approaches. The final approach course is similar to that of an ILS localizer, except that the SDF course may not be aligned with the runway and the course may be wider, resulting in less precision.

Solar day –

(1) The interval of time from the transit of either the sun or the mean sun across a given meridian to the next successive transit of the same body across the same meridian.

(2) The duration of one rotation of the sun.

Solar time -

(1) Time based upon the rotation of the earth relative to the sun.

(2) Time on the sun.

Spheroid – Any figure differing slightly from a sphere. *Geodesy.* A mathematical figure closely approaching the geoid in form and size and used as a surface of reference for geodetic surveys.

Stopway – An area beyond the takeoff runway, no less wide than the runway and centered upon the extended centerline of the runway, able to support the airplane during an aborted takeoff without causing structural damage to the airplane and designated by the airport authorities for use in decelerating the airplane during an aborted takeoff. The location of threshold lights has no bearing on an area being designated a stopway.

Tactical air navigation (TACAN) – An ultra-high frequency electronic rho-theta air navigational aid which provides suitably equipped aircraft a continuous indication of bearing and distance to the TACAN station.

Target –

(1) Any object or point toward which something is directed.

(2) An object which reflects a sufficient amount of a radiated signal to produce an echo signal on detection equipment.

(3) The distinctive marking or instrumentation of a ground point to aid in its identification on a photograph. In photogrammetry, target designates a material marking so arranged and placed on the ground as to form a distinctive pattern over a geodetic or other control-point marker, on a property corner or line, or at the position of an identifying point above an underground facility or feature. A target is also the image pattern on aerial photographs of the actual mark placed on the ground prior to photography.

Tetrahedron – A device normally located on uncontrolled airports and used as a landing direction indicator. The small end of the tetrahedron points into the wind, therefore the direction of landing.

Threshold – The beginning of that portion of the runway usable for landing.

- *Displaced Threshold (DT).* A threshold that is located at a point on the runway other than the designated beginning of the runway. The displaced area is available for takeoff or rollout of aircraft. The dis-

placed threshold paint bar is entirely on the usable landing surface.

• *Relocated Threshold (RT).* A threshold that is located at a point on the runway other than the beginning of the full strength pavement. The area between the former threshold and the relocated threshold is not available for the landing or takeoff of aircraft. The abandoned runway area mayor may not be available for taxiing.

Tidal bench mark – A bench mark set to reference a tide staff at a tidal station and the elevation of which is determined with relation to the local tidal datum.

Tidal datum – Specific tide levels which are used as surfaces of reference for depth measurements in the sea and as a base for the determination of elevation on land. Many different datums have been used, particularly for leveling operations.

Touchdown zone – The first 3,000 feet of the runway beginning at the threshold.

Touchdown zone elevation (TDZE) – The highest elevation in the touchdown zone. The OC program specifications require that the TDZE will be determined only for runways with specially prepared hard surfaces equal to, or greater than, 3,000 feet in length.

Transmissometer – An apparatus used to determine visibility by measuring the transmission of light through the atmosphere. It is the measurement source for determining runway visual range (RVR) and runway visibility value (RVV).

Transit – The apparent passage of a star or other celestial body across a defined line of the celestial sphere, as a meridian, prime vertical, or almucantar. The apparent passage of a star or other celestial body across a line in the recticle of a telescope, or some line of sight. The apparent passage of a smaller celestial body across the disk of a larger celestial body. The transit of a star across the meridian occurs at the moment of its culmination, and the two terms are sometimes used as having identical meanings; such usage is not correct, even where the instrument is in perfect adjustment. At the poles, a star may have no culmination but it will transit the meridians.

Vernal equinox – That point of intersection of the ecliptic and the celestial equator, occupied by the sun as it changes from south to north declination, on or about March 21, Same as first of Aries; first point of Aries; March equinox.

Vertical circle –

(1) A great circle of the celestial sphere, through the zenith and nadir. Vertical circles are perpendicular to the horizon.

(2) A graduated disk mounted on an instrument in such a manner that the plane of its graduated surface can be placed in a vertical plane. It is primarily used for measuring vertical angles in astronomical and geodetic work.

Vertical control – The measurements taken by surveying methods for the determination of elevation only with respect to an imaginary level surface, usually mean sea level.

Vertical-control datum – Any level surface (as, for example, mean sea level) taken as a surface of reference from which to reckon elevations. Although a level surface is not a plane, the vertical-control datum is frequently referred to as the datum plane.

Very high frequency omnidirectional range station (VOR) – A very high frequency navigational aid which provides suitably equipped aircraft a continuous indication of bearing to the VOR station.

Very high frequency omnidirectional range/tactical air navigation (VORTAC) – A navigational facility consisting of two components, VOR and TACAN, which provide three services: VOR azimuth, TACAN azimuth, and TACAN distance.

Zenith – The point where an infinite extension of a plumb (vertical) line, at the observer's position, pierces the celestial sphere above the observer's head.

Zenith distance – The complement of the altitude, the angular distance from the zenith of the celestial body measured along a vertical circle.