

# Appendix A

## Clearance Shorthand

The following shorthand system is recommended by the Federal Aviation Administration (FAA). Applicants for the instrument rating may use any shorthand system, in any language, which ensures accurate compliance with air traffic control (ATC) instructions. No shorthand system is required by regulation and no knowledge of shorthand is required for the FAA Knowledge Test; however, because of the vital need for reliable communication between the pilot and controller, clearance information should be unmistakably clear.

The following symbols and contractions represent words and phrases frequently used in clearances. Most are used regularly by ATC personnel. By practicing this shorthand, omitting the parenthetical words, you will be able to copy long clearances as fast as they are read.

Example: CAF ~~M~~→ RH RV V18 ↑40 SQ 0700 DPC 120.4  
 Cleared as filed, maintain runway heading for radar vector to Victor 18, climb to 4,000, squawk 0700, departure control frequency is 120.4.

<b>Words and Phrases</b>	<b>Shorthand</b>
Above.....	ABV
Above (Altitude, Hundreds of Feet) .....	70
Adjust speed to 250 knots.....	250 K
Advise .....	ADZ
After (Passing) .....	<
Airway (Designation).....	V26
Airport.....	A
Alternate Instructions.....	( )
Altitude 6,000–17,000 .....	60-170
And.....	&
Approach.....	AP
Approach Control.....	APC
Area Navigation .....	RNAV
Arriving.....	↓
At.....	@
At or Above.....	↑
At or Below.....	↓
(ATC) Advises .....	CA
(ATC) Clears or Cleared.....	C
(ATC) Requests .....	CR

Back Course.....	BC
Bearing.....	BR
Before (Reaching, Passing).....	>
Below .....	BLO
Below (Altitude, Hundreds of Feet).....	70
Center .....	CTR
Clearance Void if Not Off By (Time).....	v<
Cleared as Filed.....	CAF
Cleared to Airport .....	A
Cleared to Climb/Descend at Pilot's Discretion .....	PD
Cleared to Cross .....	X
Cleared to Depart From the Fix .....	D
Cleared to the Fix.....	F
Cleared to Hold and Instructions Issued .....	H
Cleared to Land.....	L
Cleared to the Outer Marker .....	O
Climb to (Altitude, Hundreds of Feet).....	↑70
Contact Approach .....	CT
Contact (Denver) Approach Control.....	(den
Contact (Denver) Center .....	(DEN
Course .....	CRS
Cross .....	X
Cruise .....	→
Delay Indefinite.....	DLI
Depart (Direction, if Specified).....	T→( )
Departure Control .....	DPC
Descend To (Altitude, Hundreds of Feet).....	↓70
Direct.....	DR
Direction (Bound)	
Eastbound .....	EB
Westbound.....	WB
Northbound.....	NB
Southbound.....	SB
Inbound.....	IB
Outbound .....	OB
DME Fix (Mile) .....	21
Each.....	EA
Enter Control Area.....	△
Estimated Time of Arrival .....	ETA
Expect .....	EX
Expect-Further-Clearance .....	EFC

Fan Marker.....	FM	Reduce Speed 20 Knots .....	-20 K
Final .....	F	Remain This Frequency .....	RTF
Final Approach.....	FA	Remain Well to Left Side .....	LS
Flight Level.....	FL	Remain Well to Right Side .....	RS
Flight Planned Route.....	FPR	Report Crossing .....	RX
For Further Clearance .....	FFC	Report Departing.....	RD
For Further Headings .....	FFH	Report Leaving.....	RL
From.....	FM	Report on Course .....	R-CRS
Ground .....	GND	Report Over.....	RO
GPS Approach .....	GPS	Report Passing .....	RP
Heading .....	HDG	Report Reaching.....	RR
Hold (Direction).....	H-W	Report Starting Procedure Turn .....	RSPT
Holding Pattern .....		Reverse Course .....	RC
ILS Approach.....	ILS	Right Turn After Takeoff.....	
Increase Speed 30 Knots.....	+30 K	Runway Heading.....	RH
Initial Approach .....	I	Runway (Number) .....	RY18
Instrument Departure Procedure .....	DP	Squawk.....	SQ
Intersection.....	XN	Standby .....	STBY
Join or Intercept Airway/Jet Route/Track or Course.....		Straight-in Approach.....	SI
Left Turn After Takeoff .....		Surveillance Radar Approach .....	ASR
Locator Outer Marker .....	LOM	Takeoff (Direction) .....	T→N
Magnetic .....	M	Tower .....	Z
Maintain .....		Turn Left.....	TL
Maintain VFR Conditions On Top .....	<u>VFR</u>	Turn Right.....	TR
Middle Compass Locator .....	ML	Until .....	/
Middle Marker .....	MM	Until Advised (By).....	UA
Missed Approach .....	MA	Until Further Advised .....	UFA
Nondirectional Beacon Approach.....	NDB	VFR Conditions On Top.....	OTP
Out of (Leave) Control Area.....		Via.....	VIA
Outer Marker.....	OM	Victor (Airway Number).....	V14
Over (Station).....	<u>OKC</u>	Visual Approach .....	VA
On Course .....	OC	VOR .....	
Precision Approach Radar .....	PAR	VOR Approach .....	VR
Procedure Turn.....	PT	VORTAC .....	
Radar Vector .....	RV	While in Control Area.....	
Radial (080° Radial) .....	080R		

# Appendix B

## Instrument Training Lesson Guide

### Introduction

Flight instructors may use this guide in the development of lesson plans. The lessons are arranged in a logical learning sequence and use the building-block technique. Each lesson includes ground training appropriate to the flight portion of the lesson. It is vitally important that the flight instructor brief the student on the objective of the lesson and how it will be accomplished. Debriefing the student's performance is also necessary to motivate further progress. To ensure steady progress, student pilots should master the objective of each lesson before advancing to the next lesson. Lessons should be arranged to take advantage of each student's knowledge and skills.

Flight instructors must monitor progress closely during training to guide student pilots in how to properly divide their attention. The importance of this division of attention or "cross-check" cannot be overemphasized. Cross-check and proper instrument interpretation are essential components of "attitude instrument flying" that enables student pilots to accurately visualize the aircraft's attitude at all times.

When possible, each lesson should incorporate radio communications, basic navigation, and emergency procedures so the student pilot is exposed to the entire IFR experience with each flight. Cross-reference the Instrument Training Lesson Guide with this handbook and the Instrument Practical Test Standards for a comprehensive instrument rating training program.

### Lesson 1—Ground and flight evaluation of student's knowledge and performance

- Aircraft systems
- Aircraft performance
- Preflight planning
- Use of checklists
- Basic flight maneuvers
- Radio communications procedures
- Navigation systems

### Lesson 2—Preflight preparation and flight by reference to instruments

#### Ground Training

- Instrument system preflight procedures
- Attitude instrument flying
- Fundamental instrument skills
- Instrument cross-check techniques

#### Flight Training

- Aircraft and instrument preflight inspection
- Use of checklists
- Fundamental instrument skills
- Basic flight maneuvers
- Instrument approach (demonstrated)
- Postflight procedures

### Lesson 3—Flight instruments and human factors

#### Ground Training

- Human factors
- Flight instruments and systems
- Aircraft systems
- Navigation instruments and systems

#### Flight Training

- Aircraft and instrument preflight inspection
- Radio communications
- Checklist procedures
- Attitude instrument flying
- Fundamental instrument skills
- Basic flight maneuvers
- Spatial disorientation demonstration
- Navigation systems
- Postflight procedures

### Lesson 4—Attitude instrument flying

#### Ground Training

- Human factors
- Flight instruments and systems

Aircraft systems  
Navigation instruments and systems  
Attitude instrument flying  
Fundamental instrument skills  
Basic flight maneuvers

### **Flight Training**

Aircraft and instrument preflight inspection  
Checklist procedures  
Radio communications  
Attitude instrument flying  
Fundamental instrument skills  
Basic flight maneuvers  
Spatial disorientation  
Navigation  
Postflight procedures

## **Lesson 5—Aerodynamic factors and basic flight maneuvers**

### **Ground Training**

Basic aerodynamic factors  
Basic instrument flight patterns  
Emergency procedures

### **Flight Training**

Aircraft and instrument preflight inspection  
Checklist procedures  
Radio communications  
Basic instrument flight patterns  
Emergency procedures  
Navigation  
Postflight procedures

## **Lesson 6—Partial panel operations**

### **Ground Training**

ATC system  
Flight instruments  
Partial panel operations

### **Flight Training**

Aircraft and instrument preflight inspection  
Checklist procedures  
Radio communications  
Basic instrument flight patterns  
Emergency procedures  
Partial panel practice  
Navigation  
Postflight procedures

## **Lesson 7—Recovery from unusual attitudes**

### **Ground Training**

Attitude instrument flying  
ATC system  
NAS overview

### **Flight Training**

Preflight  
Aircraft and instrument preflight inspection  
Checklist procedures  
Radio communications  
Instrument takeoff  
Navigation  
Partial panel practice  
Recovery from unusual attitudes  
Postflight procedures

## **Lesson 8—Navigation systems**

### **Ground Training**

ATC clearances  
Departure procedures  
IFR en route charts

### **Flight Training**

Aircraft and instrument preflight inspection  
Checklist procedures  
Radio communications  
Intercepting and tracking  
Holding  
Postflight procedures

## **Lesson 9—Review and practice**

### **Ground Training**

Aerodynamic factors  
Flight instruments and systems  
Attitude instrument flying  
Navigation systems  
NAS  
ATC  
Emergency procedures

### **Flight Training**

Aircraft and instrument preflight inspection  
Checklist procedures  
Radio communications  
Review and practice as determined by the flight instructor

Instrument takeoff  
Radio communications  
Navigation systems  
Emergency procedures  
Postflight procedures

## Lessons 10 through 19—Orientation, intercepting, tracking, and holding using each navigation system installed in the aircraft

### Ground Training

Preflight planning  
Navigation systems  
NAS  
ATC  
Emergencies

### Flight Training

Aircraft and instrument preflight inspection  
Checklist procedures  
Radio communications  
Departure procedures  
En route navigation  
Terminal operations  
Partial panel operation  
Instrument approach  
Missed approach  
Approach to a landing  
Postflight procedures

## Lessons 20 and 21—Cross-country flights

### Ground Training

Preflight planning  
Aircraft performance  
Navigation systems  
NAS  
ATC  
Emergencies

### Flight Training

Emergency procedures  
Partial panel operation  
Aircraft and instrument preflight inspection  
Checklist procedures  
Radio communications  
Departure procedures  
En route navigation  
Terminal operations

Instrument approach  
Missed approach  
Approach to a landing  
Postflight procedures

## Lessons 22 and 23—Review and practice

### Ground Training

Human factors  
Aerodynamic factors  
Flight instruments and systems  
Attitude instrument flying  
Basic flight maneuvers  
Navigation systems  
NAS  
ATC  
Emergency operations

### Flight Training

Aircraft and instrument preflight inspection  
Checklist procedures  
Radio communications  
Review and practice as determined by the flight instructor  
Instrument takeoff  
Partial panel operations  
Unusual attitude recoveries  
Radio communications  
Navigation systems  
Emergency procedures  
Postflight procedures

## Lessons 24 and subsequent—Practical test preparation

### Ground Training

Title 14 of the Code of Federal Regulations (14 CFR) parts 61, 71, 91, 95, and 97  
*Instrument Flying Handbook*  
Practical test standards  
Administrative requirements  
Equipment requirements  
Applicant's requirements

### Flight Training

Review and practice until the student can consistently perform all required tasks in accordance with the appropriate practical test standards.

**NOTE:** It is the recommending instructor's responsibility to ensure that the applicant meets 14 CFR part 61 requirements and is prepared for the practical test, including: training, knowledge, experience, and the appropriate instructor endorsements.



# Glossary

**Absolute accuracy.** The ability to determine present position in space independently, and is most often used by pilots.

**Absolute altitude.** The actual distance between an aircraft and the terrain over which it is flying.

**Absolute pressure.** Pressure measured from the reference of zero pressure, or a vacuum.

**A.C.** Alternating current.

**Acceleration error.** A magnetic compass error apparent when the aircraft accelerates while flying on an easterly or westerly heading, causing the compass card to rotate toward North.

**Accelerometer.** A part of an inertial navigation system (INS) that accurately measures the force of acceleration in one direction.

**ADF.** See automatic direction finder.

**ADI.** See attitude director indicator.

**ADM.** See aeronautical decision-making.

**ADS-B.** See automatic dependent surveillance-broadcast.

**Adverse yaw.** A flight condition at the beginning of a turn in which the nose of the aircraft starts to move in the direction opposite the direction the turn is being made, caused by the induced drag produced by the downward-deflected aileron holding back the wing as it begins to rise.

**Aeronautical decision-making (ADM).** A systematic approach to the mental process used by pilots to consistently determine the best course of action in response to a given set of circumstances.

**A/FD.** See Airport/Facility Directory.

**Agonic line.** An irregular imaginary line across the surface of the Earth along which the magnetic and geographic poles are in alignment, and along which there is no magnetic variation.

**Aircraft approach category.** A performance grouping of aircraft based on a speed of 1.3 times the stall speed in the landing configuration at maximum gross landing weight.

**Air data computer (ADC).** An aircraft computer that receives and processes pitot pressure, static pressure, and temperature to calculate very precise altitude, indicated airspeed, true airspeed, and air temperature.

**AIRMET.** Inflight weather advisory issued as an amendment to the area forecast, concerning weather phenomena of operational interest to all aircraft and that is potentially hazardous to aircraft with limited capability due to lack of equipment, instrumentation, or pilot qualifications.

**Airport diagram.** The section of an instrument approach procedure chart that shows a detailed diagram of the airport. This diagram includes surface features and airport configuration information.

**Airport/Facility Directory (A/FD).** An FAA publication containing information on all airports, communications, and NAVAIDs.

**Airport surface detection equipment (ASDE).** Radar equipment specifically designed to detect all principal features and traffic on the surface of an airport, presenting the entire image on the control tower console; used to augment visual observation by tower personnel of aircraft and/or vehicular movements on runways and taxiways.

**Airport surveillance radar (ASR).** Approach control radar used to detect and display an aircraft's position in the terminal area.

**Airport surveillance radar approach.** An instrument approach in which ATC issues instructions for pilot compliance based on aircraft position in relation to the final approach course and the distance from the end of the runway as displayed on the controller's radar scope.

**Air route surveillance radar (ARSR).** Air route traffic control center (ARTCC) radar used primarily to detect and display an aircraft's position while en route between terminal areas.

**Air route traffic control center (ARTCC).** Provides ATC service to aircraft operating on IFR flight plans within controlled airspace and principally during the en route phase of flight.

**Airspeed indicator.** A differential pressure gauge that measures the dynamic pressure of the air through which the aircraft is flying. Displays the craft's airspeed, typically in knots, to the pilot.

**Air traffic control radar beacon system (ATCRBS).** Sometimes called secondary surveillance radar (SSR), which utilizes a transponder in the aircraft. The ground equipment is an interrogating unit, in which the beacon antenna is mounted so it rotates with the surveillance antenna. The interrogating unit transmits a coded pulse sequence that actuates the aircraft transponder. The transponder answers the coded sequence by transmitting a preselected coded sequence back to the ground equipment, providing a strong return signal and positive aircraft identification, as well as other special data.

**Airway.** An airway is based on a centerline that extends from one navigation aid or intersection to another navigation aid (or through several navigation aids or intersections); used to establish a known route for en route procedures between terminal areas.

**Alert area.** An area in which there is a high volume of pilot training or an unusual type of aeronautical activity.

**Almanac data.** Information the global positioning system (GPS) receiver can obtain from one satellite which describes the approximate orbital positioning of all satellites in the constellation. This information is necessary for the GPS receiver to know what satellites to look for in the sky at a given time.

**ALS.** See approach lighting system.

**Alternate airport.** An airport designated in an IFR flight plan, providing a suitable destination if a landing at the intended airport becomes inadvisable.

**Alternate static source valve.** A valve in the instrument static air system that supplies reference air pressure to the altimeter, airspeed indicator, and vertical speed indicator if the normal static pickup should become clogged or iced over.

**Altimeter setting.** Station pressure (the barometric pressure at the location the reading is taken) which has been corrected for the height of the station above sea level.

**AME.** See aviation medical examiner.

**Amendment status.** The circulation date and revision number of an instrument approach procedure, printed above the procedure identification.

**Ammeter.** An instrument installed in series with an electrical load used to measure the amount of current flowing through the load.

**Aneroid.** The sensitive component in an altimeter or barometer that measures the absolute pressure of the air. It is a sealed, flat capsule made of thin disks of corrugated metal soldered together and evacuated by pumping all of the air out of it.

**Aneroid barometer.** An instrument that measures the absolute pressure of the atmosphere by balancing the weight of the air above it against the spring action of the aneroid.

**Angle of attack.** The acute angle formed between the chord line of an airfoil and the direction of the air striking the airfoil.

**Anti-ice.** Preventing the accumulation of ice on an aircraft structure via a system designed for that purpose.

**Approach lighting system (ALS).** Provides lights that will penetrate the atmosphere far enough from touchdown to give directional, distance, and glide path information for safe transition from instrument to visual flight.

**Area chart.** Part of the low-altitude en route chart series, this chart furnishes terminal data at a larger scale for congested areas.

**Area navigation (RNAV).** Allows a pilot to fly a selected course to a predetermined point without the need to overfly ground-based navigation facilities, by using waypoints.

**ARSR.** See air route surveillance radar.

**ARTCC.** See air route traffic control center.

**ASDE.** See airport surface detection equipment.

**ASOS.** See automated surface observing station.

**ASR.** See airport surveillance radar.

**ATC.** Air Traffic Control.

**ATCRBS.** See air traffic control radar beacon system.

**ATIS.** See automatic terminal information service.

**Atmospheric propagation delay.** A bending of the electromagnetic (EM) wave from the satellite that creates an error in the GPS system.

**Attitude and heading reference systems (AHRS).** System composed of three-axis sensors that provide heading, attitude, and yaw information for aircraft. AHRS are designed to replace traditional mechanical gyroscopic flight instruments and provide superior reliability and accuracy.

**Attitude director indicator (ADI).** An aircraft attitude indicator that incorporates flight command bars to provide pitch and roll commands.

**Attitude indicator.** The foundation for all instrument flight, this instrument reflects the airplane's attitude in relation to the horizon.

**Attitude instrument flying.** Controlling the aircraft by reference to the instruments rather than by outside visual cues.

**Autokinesis.** Nighttime visual illusion that a stationary light is moving, which becomes apparent after several seconds of staring at the light.

**Automated Weather Observing System (AWOS).** Automated weather reporting system consisting of various sensors, a processor, a computer-generated voice subsystem, and a transmitter to broadcast weather data.

**Automated Surface Observing Station (ASOS).** Weather reporting system which provides surface observations every minute via digitized voice broadcasts and printed reports.

**Automatic dependent surveillance–broadcast (ADS-B).** A device used in aircraft that repeatedly broadcasts a message that includes position (such as latitude, longitude, and altitude), velocity, and possibly other information.

**Automatic direction finder (ADF).** Electronic navigation equipment that operates in the low- and medium-frequency bands. Used in conjunction with the ground-based nondirectional beacon (NDB), the instrument displays the number of degrees clockwise from the nose of the aircraft to the station being received.

**Automatic terminal information service (ATIS).** The continuous broadcast of recorded non-control information in selected terminal areas. Its purpose is to improve controller effectiveness and relieve frequency congestion by automating repetitive transmission of essential but routine information.

**Aviation medical examiner (AME).** A physician with training in aviation medicine designated by the Civil Aerospace Medical Institute (CAMI).

**AWOS.** See automated weather observing system.

**Azimuth card.** A card that may be set, gyroscopically controlled, or driven by a remote compass.

**Back course (BC).** The reciprocal of the localizer course for an ILS. When flying a back-course approach, an aircraft approaches the instrument runway from the end at which the localizer antennas are installed.

**Baro-aiding.** A method of augmenting the GPS integrity solution by using a non-satellite input source. To ensure that baro-aiding is available, the current altimeter setting must be entered as described in the operating manual.

**Barometric scale.** A scale on the dial of an altimeter to which the pilot sets the barometric pressure level from which the altitude shown by the pointers is measured.

**BC.** See back course.

**Block altitude.** A block of altitudes assigned by ATC to allow altitude deviations; for example, "Maintain block altitude 9 to 11 thousand."

**Cage.** The black markings on the ball instrument indicating its neutral position.

**Calibrated.** The instrument indication compared with a standard value to determine the accuracy of the instrument.

**Calibrated orifice.** A hole of specific diameter used to delay the pressure change in the case of a vertical speed indicator.

**Calibrated airspeed.** The speed at which the aircraft is moving through the air, found by correcting IAS for instrument and position errors.

**CAS.** Calibrated airspeed.

**CDI.** Course deviation indicator.

**Changeover point (COP).** A point along the route or airway segment between two adjacent navigation facilities or waypoints where changeover in navigation guidance should occur.

**Circling approach.** A maneuver initiated by the pilot to align the aircraft with a runway for landing when a straight-in landing from an instrument approach is not possible or is not desirable.

**Class A airspace.** Airspace from 18,000 feet MSL up to and including FL 600, including the airspace overlying the waters within 12 NM of the coast of the 48 contiguous states and Alaska; and designated international airspace beyond 12 NM of the coast of the 48 contiguous states and Alaska within areas of domestic radio navigational signal or ATC radar coverage, and within which domestic procedures are applied.

**Class B airspace.** Airspace from the surface to 10,000 feet MSL surrounding the nation's busiest airports in terms of IFR operations or passenger numbers. The configuration of each Class B airspace is individually tailored and consists of a surface area and two or more layers, and is designed to contain all published instrument procedures once an aircraft enters the airspace. For all aircraft, an ATC clearance is required to operate in the area, and aircraft so cleared receive separation services within the airspace.

**Class C airspace.** Airspace from the surface to 4,000 feet above the airport elevation (charted in MSL) surrounding those airports having an operational control tower, serviced by radar approach control, and having a certain number of IFR operations or passenger numbers. Although the configuration of each Class C airspace area is individually tailored, the airspace usually consists of a 5 NM radius core surface area that extends from the surface up to 4,000 feet above the airport elevation, and a 10 NM radius shelf area that extends from 1,200 feet to 4,000 feet above the airport elevation.

**Class D airspace.** Airspace from the surface to 2,500 feet above the airport elevation (charted in MSL) surrounding those airports that have an operational control tower. The configuration of each Class D airspace area is individually tailored, and when instrument procedures are published, the airspace is normally designed to contain the procedures.

**Class E airspace.** Airspace that is not Class A, Class B, Class C, or Class D, and is controlled airspace.

**Class G airspace.** Airspace that is uncontrolled, except when associated with a temporary control tower, and has not been designated as Class A, Class B, Class C, Class D, or Class E airspace.

**Clean configuration.** A configuration in which all flight control surfaces have been placed to create minimum drag. In most aircraft this means flaps and gear retracted.

**Clearance.** ATC permission for an aircraft to proceed under specified traffic conditions within controlled airspace, for the purpose of providing separation between known aircraft.

**Clearance delivery.** Control tower position responsible for transmitting departure clearances to IFR flights.

**Clearance limit.** The fix, point, or location to which an aircraft is cleared when issued an air traffic clearance.

**Clearance on request.** An IFR clearance not yet received after filing a flight plan.

**Clearance void time.** Used by ATC, the time at which the departure clearance is automatically canceled if takeoff has not been made. The pilot must obtain a new clearance or cancel the IFR flight plan if not off by the specified time.

**Clear ice.** Glossy, clear, or translucent ice formed by the relatively slow freezing of large, supercooled water droplets.

**Compass course.** A true course corrected for variation and deviation errors.

**Compass locator.** A low-power, low- or medium-frequency (L/MF) radio beacon installed at the site of the outer or middle marker of an ILS.

**Compass rose.** A small circle graduated in 360° increments, printed on navigational charts to show the amount of compass variation at different locations, or on instruments to indicate direction.

**Computer navigation fix.** A point used to define a navigation track for an airborne computer system such as GPS or FMS.

**Concentric rings.** Dashed-line circles depicted in the plan view of IAP charts, outside of the reference circle, that show en route and feeder facilities.

**Cone of confusion.** A cone-shaped volume of airspace directly above a VOR station where no signal is received, causing the CDI to fluctuate.

**Control and performance.** A method of attitude instrument flying in which one instrument is used for making attitude changes, and the other instruments are used to monitor the progress of the change.

**Control display unit.** A display interfaced with the master computer, providing the pilot with a single control point for all navigations systems, thereby reducing the number of required flight deck panels.

**Controlled airspace.** An airspace of defined dimensions within which ATC service is provided to IFR and VFR flights in accordance with the airspace classification. It includes Class A, Class B, Class C, Class D, and Class E airspace.

**Control pressures.** The amount of physical exertion on the control column necessary to achieve the desired attitude.

**Convective weather.** Unstable, rising air found in cumiliform clouds.

**Convective SIGMET.** Weather advisory concerning convective weather significant to the safety of all aircraft, including thunderstorms, hail, and tornadoes.

**Coordinated flight.** Flight with a minimum disturbance of the forces maintaining equilibrium, established via effective control use.

**COP.** See changeover point.

**Coriolis illusion.** The illusion of rotation or movement in an entirely different axis, caused by an abrupt head movement, while in a prolonged constant rate turn that has ceased stimulating the brain's motion sensing system.

**Crew resource management (CRM).** The effective use of all available resources—human, hardware, and information.

**Critical areas.** Areas where disturbances to the ILS localizer and glide slope courses may occur when surface vehicles or aircraft operate near the localizer or glide slope antennas.

**CRM.** See crew resource management.

**Cross-check.** The first fundamental skill of instrument flight, also known as “scan,” the continuous and logical observation of instruments for attitude and performance information.

**Cruise clearance.** An ATC clearance issued to allow a pilot to conduct flight at any altitude from the minimum IFR altitude up to and including the altitude specified in the clearance. Also authorizes a pilot to proceed to and make an approach at the destination airport.

**Current induction.** An electrical current being induced into, or generated in, any conductor that is crossed by lines of flux from any magnet.

**DA.** See decision altitude.

**D.C.** Direct current.

**Dark adaptation.** Physical and chemical adjustments of the eye that make vision possible in relative darkness.

**Deceleration error.** A magnetic compass error that occurs when the aircraft decelerates while flying on an easterly or westerly heading, causing the compass card to rotate toward South.

**Decision altitude (DA).** A specified altitude in the precision approach, charted in feet MSL, at which a missed approach must be initiated if the required visual reference to continue the approach has not been established.

**Decision height (DH).** A specified altitude in the precision approach, charted in height above threshold elevation, at which a decision must be made either to continue the approach or to execute a missed approach.

**Deice.** The act of removing ice accumulation from an aircraft structure.

**Density altitude.** Pressure altitude corrected for nonstandard temperature. Density altitude is used in computing the performance of an aircraft and its engines.

**Departure procedure (DP).** Preplanned IFR ATC departure, published for pilot use, in textual and graphic format.

**Deviation.** A magnetic compass error caused by local magnetic fields within the aircraft. Deviation error is different on each heading.

**DGPS.** Differential global positioning system.

**DH.** See decision height.

**Differential Global Positioning System (DGPS).** A system that improves the accuracy of Global Navigation Satellite Systems (GNSS) by measuring changes in variables to provide satellite positioning corrections.

**Direct indication.** The true and instantaneous reflection of aircraft pitch-and-bank attitude by the miniature aircraft, relative to the horizon bar of the attitude indicator.

**Direct User Access Terminal System (DUATS).** A system that provides current FAA weather and flight plan filing services to certified civil pilots, via personal computer, modem, or telephone access to the system. Pilots can request specific types of weather briefings and other pertinent data for planned flights.

**Distance circle.** See reference circle.

**Distance measuring equipment (DME).** A pulse-type electronic navigation system that shows the pilot, by an instrument-panel indication, the number of nautical miles between the aircraft and a ground station or waypoint.

**DME.** See distance measuring equipment.

**DME arc.** A flight track that is a constant distance from the station or waypoint.

**DOD.** Department of Defense.

**Doghouse.** A turn-and-slip indicator dial mark in the shape of a doghouse.

**Domestic Reduced Vertical Separation Minimum (DRVSM).** Additional flight levels between FL 290 and FL 410 to provide operational, traffic, and airspace efficiency.

**Double gimbal.** A type of mount used for the gyro in an attitude instrument. The axes of the two gimbals are at right angles to the spin axis of the gyro, allowing free motion in two planes around the gyro.

**DP.** See departure procedure.

**Drag.** The net aerodynamic force parallel to the relative wind, usually the sum of two components: induced drag and parasite drag.

**Drag curve.** The curve created when plotting induced drag and parasite drag.

**DUATS.** See direct user access terminal system.

**Duplex.** Transmitting on one frequency and receiving on a separate frequency.

**Eddy currents.** Current induced in a metal cup or disc when it is crossed by lines of flux from a moving magnet.

**EFAS.** See En Route Flight Advisory Service.

**EFC.** See expect-further-clearance.

**Electronic flight display (EFD).** For the purpose of standardization, any flight instrument display that uses LCD or other image-producing system (Cathode Ray Tube [CRT], etc.)

**Elevator illusion.** The sensation of being in a climb or descent, caused by the kind of abrupt vertical accelerations that result from up- or downdrafts.

**Emergency.** A distress or urgent condition.

**Emphasis error.** The result of giving too much attention to a particular instrument during the cross-check, instead of relying on a combination of instruments necessary for attitude and performance information.

**EM wave.** Electromagnetic wave.

**Encoding altimeter.** A special type of pressure altimeter used to send a signal to the air traffic controller on the ground, showing the pressure altitude the aircraft is flying.

**En route facilities ring.** Depicted in the plan view of IAP charts, a circle which designates NAVAIDs, fixes, and intersections that are part of the en route low altitude airway structure.

**En Route Flight Advisory Service (EFAS).** An en route weather-only AFSS service.

**En route high-altitude charts.** Aeronautical charts for en route instrument navigation at or above 18,000 feet MSL.

**En route low-altitude charts.** Aeronautical charts for en route IFR navigation below 18,000 feet MSL.

**Equivalent airspeed.** Airspeed equivalent to CAS in standard atmosphere at sea level. As the airspeed and pressure altitude increase, the CAS becomes higher than it should be, and a correction for compression must be subtracted from the CAS.

**Expect-further-clearance (EFC).** The time a pilot can expect to receive clearance beyond a clearance limit.

**FAA.** Federal Aviation Administration.

**FAF.** See final approach fix.

**False horizon.** Inaccurate visual information for aligning the aircraft, caused by various natural and geometric formations that disorient the pilot from the actual horizon.

**Federal airways.** Class E airspace areas that extend upward from 1,200 feet to, but not including, 18,000 feet MSL, unless otherwise specified.

**Feeder facilities.** Used by ATC to direct aircraft to intervening fixes between the en route structure and the initial approach fix.

**Final approach.** Part of an instrument approach procedure in which alignment and descent for landing are accomplished.

**Final approach fix (FAF).** The fix from which the IFR final approach to an airport is executed, and which identifies the beginning of the final approach segment. An FAF is designated on government charts by a Maltese cross symbol for nonprecision approaches, and a lightning bolt symbol for precision approaches.

**Fixating.** Staring at a single instrument, thereby interrupting the cross-check process.

**FL.** See flight level.

**Flight configurations.** Adjusting the aircraft control surfaces (including flaps and landing gear) in a manner that will achieve a specified attitude.

**Flight director indicator (FDI).** One of the major components of a flight director system, it provides steering commands that the pilot (or the autopilot, if coupled) follows.

**Flight level (FL).** A measure of altitude (in hundreds of feet) used by aircraft flying above 18,000 feet with the altimeter set at 29.92" Hg.

**Flight management system (FMS).** Provides pilot and crew with highly accurate and automatic long-range navigation capability, blending available inputs from long- and short-range sensors.

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

**Flight patterns.** Basic maneuvers, flown by reference to the instruments rather than outside visual cues, for the purpose of practicing basic attitude flying. The patterns simulate maneuvers encountered on instrument flights such as holding patterns, procedure turns, and approaches.

**Flight strips.** Paper strips containing instrument flight information, used by ATC when processing flight plans.

**FMS.** See flight management system.

**Form drag.** The drag created because of the shape of a component or the aircraft.

**Fundamental skills.** Pilot skills of instrument cross-check, instrument interpretation, and aircraft control.

**Glide slope (GS).** Part of the ILS that projects a radio beam upward at an angle of approximately 3° from the approach end of an instrument runway. The glide slope provides vertical guidance to aircraft on the final approach course for the aircraft to follow when making an ILS approach along the localizer path.

**Glide slope intercept altitude.** The minimum altitude of an intermediate approach segment prescribed for a precision approach that ensures obstacle clearance.

**Global landing system (GLS).** An instrument approach with lateral and vertical guidance with integrity limits (similar to barometric vertical navigation (BRO VNAV)).

**Global navigation satellite systems (GNSS).** Satellite navigation systems that provide autonomous geo-spatial positioning with global coverage. It allows small electronic receivers to determine their location (longitude, latitude, and altitude) to within a few meters using time signals transmitted along a line of sight by radio from satellites.

**GNSS.** See global navigation satellite systems.

**Global positioning system (GPS).** Navigation system that uses satellite rather than ground-based transmitters for location information.

**Goniometer.** As used in radio frequency (RF) antenna systems, a direction-sensing device consisting of two fixed loops of wire oriented 90° from each other, which separately sense received signal strength and send those signals to two rotors (also oriented 90°) in the sealed direction-indicating instrument. The rotors are attached to the direction-indicating needle of the instrument and rotated by a small motor until minimum magnetic field is sensed near the rotors.

**GPS.** See global positioning system.

**GPS Approach Overlay Program.** An authorization for pilots to use GPS avionics under IFR for flying designated existing nonprecision instrument approach procedures, with the exception of LOC, LDA, and SDF procedures.

**Graveyard spiral.** The illusion of the cessation of a turn while still in a prolonged, coordinated, constant rate turn, which can lead a disoriented pilot to a loss of control of the aircraft.

**Great circle route.** The shortest distance across the surface of a sphere (the Earth) between two points on the surface.

**Ground proximity warning system (GPWS).** A system designed to determine an aircraft's clearance above the Earth and provides limited predictability about aircraft position relative to rising terrain.

**Groundspeed.** Speed over the ground, either closing speed to the station or waypoint, or speed over the ground in whatever direction the aircraft is going at the moment, depending upon the navigation system used.

**GS.** See glide slope.

**GWPS.** See ground proximity warning system.

**HAA.** See height above airport.

**HAL.** See height above landing.

**HAT.** See height above touchdown elevation.

**Hazardous attitudes.** Five aeronautical decision-making attitudes that may contribute to poor pilot judgment: antiauthority, impulsivity, invulnerability, machismo, and resignation.

**Hazardous Inflight Weather Advisory Service (HIWAS).** Service providing recorded weather forecasts broadcast to airborne pilots over selected VORs.

**Head-up display (HUD).** A special type of flight viewing screen that allows the pilot to watch the flight instruments and other data while looking through the windshield of the aircraft for other traffic, the approach lights, or the runway.

**Height above airport (HAA).** The height of the MDA above the published airport elevation.

**Height above landing (HAL).** The height above a designated helicopter landing area used for helicopter instrument approach procedures.

**Height above touchdown elevation (HAT).** The DA/DH or MDA above the highest runway elevation in the touchdown zone (first 3,000 feet of the runway).

**HF.** High frequency.

**Hg.** Abbreviation for mercury, from the Latin hydrargyrum.

**HIWAS.** See Hazardous Inflight Weather Advisory Service.

**Holding.** A predetermined maneuver that keeps aircraft within a specified airspace while awaiting further clearance from ATC.

**Holding pattern.** A racetrack pattern, involving two turns and two legs, used to keep an aircraft within a prescribed airspace with respect to a geographic fix. A standard pattern uses right turns; nonstandard patterns use left turns.

**Homing.** Flying the aircraft on any heading required to keep the needle pointing to the 0° relative bearing position.

**Horizontal situation indicator (HSI).** A flight navigation instrument that combines the heading indicator with a CDI, in order to provide the pilot with better situational awareness of location with respect to the courseline.

**HSI.** See horizontal situation indicator.

**HUD.** See head-up display.

**Human factors.** A multidisciplinary field encompassing the behavioral and social sciences, engineering, and physiology, to consider the variables that influence individual and crew performance for the purpose of optimizing human performance and reducing errors.

**Hypoxia.** A state of oxygen deficiency in the body sufficient to impair functions of the brain and other organs.

**IAF.** See initial approach fix.

**IAP.** See instrument approach procedures.

**IAS.** See indicated airspeed.

**ICAO.** See International Civil Aviation Organization.

**Ident.** Air Traffic Control request for a pilot to push the button on the transponder to identify return on the controller's scope.

**IFR.** See instrument flight rules.

**ILS.** See instrument landing system.

**ILS categories.** Categories of instrument approach procedures allowed at airports equipped with the following types of instrument landing systems:

**ILS Category I:** Provides for approach to a height above touchdown of not less than 200 feet, and with runway visual range of not less than 1,800 feet.

**ILS Category II:** Provides for approach to a height above touchdown of not less than 100 feet and with runway visual range of not less than 1,200 feet.

**ILS Category IIIA:** Provides for approach without a decision height minimum and with runway visual range of not less than 700 feet.

**ILS Category IIIB:** Provides for approach without a decision height minimum and with runway visual range of not less than 150 feet.

**ILS Category IIIC:** Provides for approach without a decision height minimum and without runway visual range minimum.

**IMC.** See instrument meteorological conditions.

**Indicated airspeed (IAS).** Shown on the dial of the instrument airspeed indicator on an aircraft. Directly related to calibrated airspeed (CAS), IAS includes instrument errors and position error.

**Indirect indication.** A reflection of aircraft pitch-and-bank attitude by the instruments other than the attitude indicator.

**Induced drag.** Drag caused by the same factors that produce lift; its amount varies inversely with airspeed. As airspeed decreases, the angle of attack must increase, in turn increasing induced drag.

**Induction icing.** A type of ice in the induction system that reduces the amount of air available for combustion. The most commonly found induction icing is carburetor icing.

**Inertial navigation system (INS).** A computer-based navigation system that tracks the movement of an aircraft via signals produced by onboard accelerometers. The initial location of the aircraft is entered into the computer, and all subsequent movement of the aircraft is sensed and used to keep the position updated. An INS does not require any inputs from outside signals.

**Initial approach fix (IAF).** The fix depicted on IAP charts where the instrument approach procedure (IAP) begins unless otherwise authorized by ATC.

**Inoperative components.** Higher minimums are prescribed when the specified visual aids are not functioning; this information is listed in the Inoperative Components Table found in the United States Terminal Procedures Publications.

**INS.** See inertial navigation system.

**Instantaneous vertical speed indicator (IVSI).** Assists in interpretation by instantaneously indicating the rate of climb or descent at a given moment with little or no lag as displayed in a vertical speed indicator (VSI).

**Instrument approach procedures (IAP).** A series of predetermined maneuvers for the orderly transfer of an aircraft under IFR from the beginning of the initial approach to a landing or to a point from which a landing may be made visually.

**Instrument flight rules (IFR).** Rules and regulations established by the Federal Aviation Administration to govern flight under conditions in which flight by outside visual reference is not safe. IFR flight depends upon flying by reference to instruments in the flight deck, and navigation is accomplished by reference to electronic signals.

**Instrument landing system (ILS).** An electronic system that provides both horizontal and vertical guidance to a specific runway, used to execute a precision instrument approach procedure.

**Instrument meteorological conditions (IMC).** Meteorological conditions expressed in terms of visibility, distance from clouds, and ceiling less than the minimums specified for visual meteorological conditions, requiring operations to be conducted under IFR.

**Instrument takeoff.** Using the instruments rather than outside visual cues to maintain runway heading and execute a safe takeoff.

**Interference drag.** Drag generated by the collision of airstreams creating eddy currents, turbulence, or restrictions to smooth flow.

**International Civil Aviation Organization (ICAO).** The United Nations agency for developing the principles and techniques of international air navigation, and fostering planning and development of international civil air transport.

**International standard atmosphere (IAS).** A model of standard variation of pressure and temperature.

**Inversion illusion.** The feeling that the aircraft is tumbling backwards, caused by an abrupt change from climb to straight-and-level flight while in situations lacking visual reference.

**Inverter.** A solid-state electronic device that converts D.C. into A.C. current of the proper voltage and frequency to operate A.C. gyro instruments.

**Isogonic lines.** Lines drawn across aeronautical charts to connect points having the same magnetic variation.

**IVSI.** See instantaneous vertical speed indicator.

**Jet route.** A route designated to serve flight operations from 18,000 feet MSL up to and including FL 450.

**Jet stream.** A high-velocity narrow stream of winds, usually found near the upper limit of the troposphere, which flows generally from west to east.

**KIAS.** Knots indicated airspeed.

**Kollsman window.** A barometric scale window of a sensitive altimeter used to adjust the altitude for the altimeter setting.

**LAAS.** See local area augmentation system.

**Lag.** The delay that occurs before an instrument needle attains a stable indication.

**Land as soon as possible.** ATC instruction to pilot. Land without delay at the nearest suitable area, such as an open field, at which a safe approach and landing is assured.

**Land as soon as practical.** ATC instruction to pilot. The landing site and duration of flight are at the discretion of the pilot. Extended flight beyond the nearest approved landing area is not recommended.

**Land immediately.** ATC instruction to pilot. The urgency of the landing is paramount. The primary consideration is to ensure the survival of the occupants. Landing in trees, water, or other unsafe areas should be considered only as a last resort.

**LDA.** See localizer-type directional aid.

**Lead radial.** The radial at which the turn from the DME arc to the inbound course is started.

**Leans, the.** A physical sensation caused by an abrupt correction of a banked attitude entered too slowly to stimulate the motion sensing system in the inner ear. The abrupt correction can create the illusion of banking in the opposite direction.

**Lift.** A component of the total aerodynamic force on an airfoil and acts perpendicular to the relative wind.

**Lines of flux.** Invisible lines of magnetic force passing between the poles of a magnet.

**L/MF.** See low or medium frequency.

**LMM.** See locator middle marker.

**Load factor.** The ratio of a specified load to the total weight of the aircraft. The specified load is expressed in terms of any of the following: aerodynamic forces, inertial forces, or ground or water reactions.

**Loadmeter.** A type of ammeter installed between the generator output and the main bus in an aircraft electrical system.

**LOC.** See localizer.

**Local area augmentation system (LAAS).** A differential global positioning system (DGPS) that improves the accuracy of the system by determining position error from the GPS satellites, then transmitting the error, or corrective factors, to the airborne GPS receiver.

**Localizer (LOC).** The portion of an ILS that gives left/right guidance information down the centerline of the instrument runway for final approach.

**Localizer-type directional aid (LDA).** A NAVAID used for nonprecision instrument approaches with utility and accuracy comparable to a localizer but which is not a part of a complete ILS and is not aligned with the runway. Some LDAs are equipped with a glide slope.

**Locator middle marker (LMM).** Nondirectional radio beacon (NDB) compass locator, collocated with a middle marker (MM).

**Locator outer marker (LOM).** NDB compass locator, collocated with an outer marker (OM).

**LOM.** See locator outer marker.

**Long range navigation (LORAN).** An electronic navigational 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. LORAN A operates in the 1750 to 1950 kHz frequency band. LORAN C and D operate in the 100 to 110 kHz frequency band.

**LORAN.** See long range navigation.

**Low or medium frequency.** A frequency range between 190–535 kHz with the medium frequency above 300 kHz. Generally associated with nondirectional beacons transmitting a continuous carrier with either a 400 or 1,020 Hz modulation.

**Lubber line.** The reference line used in a magnetic compass or heading indicator.

**MAA.** See maximum authorized altitude.

**Mach number.** The ratio of the true airspeed of the aircraft to the speed of sound in the same atmospheric conditions, named in honor of Ernst Mach, late 19th century physicist.

**Mach meter.** The instrument that displays the ratio of the speed of sound to the true airspeed an aircraft is flying.

**Magnetic bearing (MB).** The direction to or from a radio transmitting station measured relative to magnetic north.

**Magnetic heading (MH).** The direction an aircraft is pointed with respect to magnetic north.

**Mandatory altitude.** An altitude depicted on an instrument approach chart with the altitude value both underscored and overscored. Aircraft are required to maintain altitude at the depicted value.

**Mandatory block altitude.** An altitude depicted on an instrument approach chart with two underscored and overscored altitude values between which aircraft are required to maintain altitude.

**MAP.** See missed approach point.

**Margin identification.** The top and bottom areas on an instrument approach chart that depict information about the procedure, including airport location and procedure identification.

**Marker beacon.** A low-powered transmitter that directs its signal upward in a small, fan-shaped pattern. Used along the flight path when approaching an airport for landing, marker beacons indicate both aurally and visually when the aircraft is directly over the facility.

**Maximum altitude.** An altitude depicted on an instrument approach chart with overscored altitude value at which or below aircraft are required to maintain altitude.

**Maximum authorized altitude (MAA).** A published altitude representing the maximum usable altitude or flight level for an airspace structure or route segment.

**MB.** See magnetic bearing.

**MCA.** See minimum crossing altitude.

**MDA.** See minimum descent altitude.

**MEA.** See minimum en route altitude.

**Mean sea level.** The average height of the surface of the sea at a particular location for all stages of the tide over a 19-year period.

**MFD.** See multi-function display.

**MH.** See magnetic heading.

**MHz.** Megahertz.

**Microwave landing system (MLS).** A precision instrument approach system operating in the microwave spectrum which normally consists of an azimuth station, elevation station, and precision distance measuring equipment.

**Mileage breakdown.** A fix indicating a course change that appears on the chart as an “x” at a break between two segments of a federal airway.

**Military operations area (MOA).** Airspace established for the purpose of separating certain military training activities from IFR traffic.

**Military training route (MTR).** Airspace of defined vertical and lateral dimensions established for the conduct of military training at airspeeds in excess of 250 knots indicated airspeed (KIAS).

**Minimum altitude.** An altitude depicted on an instrument approach chart with the altitude value underscored. Aircraft are required to maintain altitude at or above the depicted value.

**Minimum crossing altitude (MCA).** The lowest allowed altitude at certain fixes an aircraft must cross when proceeding in the direction of a higher minimum en route altitude (MEA).

**Minimum descent altitude (MDA).** The lowest altitude (in feet MSL) to which descent is authorized on final approach, or during circle-to-land maneuvering in execution of a nonprecision approach.

**Minimum en route altitude (MEA).** The lowest published altitude between radio fixes that ensures acceptable navigational signal coverage and meets obstacle clearance requirements between those fixes.

**Minimum obstruction clearance altitude (MOCA).** The lowest published altitude in effect between radio fixes on VOR airways, off-airway routes, or route segments, which meets obstacle clearance requirements for the entire route segment and which ensures acceptable navigational signal coverage only within 25 statute (22 nautical) miles of a VOR.

**Minimum reception altitude (MRA).** The lowest altitude at which an airway intersection can be determined.

**Minimum safe altitude (MSA).** The minimum altitude depicted on approach charts which provides at least 1,000 feet of obstacle clearance for emergency use within a specified distance from the listed navigation facility.

**Minimum vectoring altitude (MVA).** An IFR altitude lower than the minimum en route altitude (MEA) that provides terrain and obstacle clearance.

**Minimums section.** The area on an IAP chart that displays the lowest altitude and visibility requirements for the approach.

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

**Missed approach point (MAP).** A point prescribed in each instrument approach at which a missed approach procedure shall be executed if the required visual reference has not been established.

**Mixed ice.** A mixture of clear ice and rime ice.

**MLS.** See microwave landing system.

**MM.** Middle marker.

**MOA.** See military operations area.

**MOCA.** See minimum obstruction clearance altitude.

**Mode C.** Altitude reporting transponder mode.

**MRA.** See minimum reception altitude.

**MSA.** See minimum safe altitude.

**MSL.** See mean sea level.

**MTR.** See military training route.

**Multi-function display (MFD).** Small screen (CRT or LCD) in an aircraft that can be used to display information to the pilot in numerous configurable ways. Often an MFD will be used in concert with a Primary Flight Display.

**MVA.** See minimum vectoring altitude.

**NACG.** See National Aeronautical Charting Group.

**NAS.** See National Airspace System.

**National Airspace System (NAS).** The common network of United States airspace—air navigation facilities, equipment and services, airports or landing areas; aeronautical charts, information and services; rules, regulations and procedures, technical information; and manpower and material.

**National Aeronautical Charting Group (NACG).** A Federal agency operating under the FAA, responsible for publishing charts such as the terminal procedures and en route charts.

**National Route Program (NRP).** A set of rules and procedures designed to increase the flexibility of user flight planning within published guidelines.

**National Security Area (NSA).** Areas consisting of airspace of defined vertical and lateral dimensions established at locations where there is a requirement for increased security and safety of ground facilities. Pilots are requested to voluntarily avoid flying through the depicted NSA. When it is necessary to provide a greater level of security and safety, flight in NSAs may be temporarily prohibited. Regulatory prohibitions are disseminated via NOTAMs.

**National Transportation Safety Board (NTSB).** A United States Government independent organization responsible for investigations of accidents involving aviation, highways, waterways, pipelines, and railroads in the United States. NTSB is charged by congress to investigate every civil aviation accident in the United States.

**NAVAID.** Navigational aid.

**NAV/COM.** Navigation and communication radio.

**NDB.** See nondirectional radio beacon.

**NM.** Nautical mile.

**NOAA.** National Oceanic and Atmospheric Administration.

**No-gyro approach.** A radar approach that may be used in case of a malfunctioning gyro-compass or directional gyro. Instead of providing the pilot with headings to be flown, the controller observes the radar track and issues control instructions “turn right/left” or “stop turn,” as appropriate.

**Nondirectional radio beacon (NDB).** A ground-based radio transmitter that transmits radio energy in all directions.

**Nonprecision approach.** A standard instrument approach procedure in which only horizontal guidance is provided.

**No procedure turn (NoPT).** Term used with the appropriate course and altitude to denote that the procedure turn is not required.

**NoPT.** See no procedure turn.

**Notice to Airmen (NOTAM).** A notice filed with an aviation authority to alert aircraft pilots of any hazards en route or at a specific location. The authority in turn provides means of disseminating relevant NOTAMs to pilots.

**NRP.** See National Route Program.

**NSA.** See National Security Area.

**NTSB.** See National Transportation Safety Board.

**NWS.** National Weather Service.

**Obstacle departure procedures (ODP).** Obstacle clearance protection provided to aircraft in instrument meteorological conditions (IMC).

**ODP.** See obstacle departure procedures.

**OM.** Outer marker.

**Omission error.** The failure to anticipate significant instrument indications following attitude changes; for example, concentrating on pitch control while forgetting about heading or roll information, resulting in erratic control of heading and bank.

**Optical illusion.** A misleading visual image. For the purpose of this handbook, the term refers to the brain’s misinterpretation of features on the ground associated with landing, which causes a pilot to misread the spatial relationships between the aircraft and the runway.

**Orientation.** Awareness of the position of the aircraft and of oneself in relation to a specific reference point.

**Otolith organ.** An inner ear organ that detects linear acceleration and gravity orientation.

**Outer marker.** A marker beacon at or near the glide slope intercept altitude of an ILS approach. It is normally located four to seven miles from the runway threshold on the extended centerline of the runway.

**Overcontrolling.** Using more movement in the control column than is necessary to achieve the desired pitch-and-bank condition.

**Overpower.** To use more power than required for the purpose of achieving a faster rate of airspeed change.

**P-static.** See precipitation static.

**PAPI.** See precision approach path indicator.

**PAR.** See precision approach radar.

**Parasite drag.** Drag caused by the friction of air moving over the aircraft structure; its amount varies directly with the airspeed.

**PFD.** See primary flight display.

**PIC.** See pilot-in-command.

**Pilot-in-command (PIC).** The pilot responsible for the operation and safety of an aircraft.

**Pilot report (PIREP).** Report of meteorological phenomena encountered by aircraft.

**Pilot's Operating Handbook/Airplane Flight Manual (POH/AFM).** FAA-approved documents published by the airframe manufacturer that list the operating conditions for a particular model of aircraft.

**PIREP.** See pilot report.

**Pitot pressure.** Ram air pressure used to measure airspeed.

**Pitot-static head.** A combination pickup used to sample pitot pressure and static air pressure.

**Plan view.** The overhead view of an approach procedure on an instrument approach chart. The plan view depicts the routes that guide the pilot from the en route segments to the IAF.

**POH/AFM.** See Pilot's Operating Handbook/Airplane Flight Manual.

**Point-in-space approach.** A type of helicopter instrument approach procedure to a missed approach point more than 2,600 feet from an associated helicopter landing area.

**Position error.** Error in the indication of the altimeter, ASI, and VSI caused by the air at the static system entrance not being absolutely still.

**Position report.** A report over a known location as transmitted by an aircraft to ATC.

**Precession.** The characteristic of a gyroscope that causes an applied force to be felt, not at the point of application, but 90° from that point in the direction of rotation.

**Precipitation static (P-static).** A form of radio interference caused by rain, snow, or dust particles hitting the antenna and inducing a small radio-frequency voltage into it.

**Precision approach.** A standard instrument approach procedure in which both vertical and horizontal guidance is provided.

**Precision approach path indicator (PAPI).** A system of lights similar to the VASI, but consisting of one row of lights in two- or four-light systems. A pilot on the correct glide slope will see two white lights and two red lights. See VASI.

**Precision approach radar (PAR).** A type of radar used at an airport to guide an aircraft through the final stages of landing, providing horizontal and vertical guidance. The radar operator directs the pilot to change heading or adjust the descent rate to keep the aircraft on a path that allows it to touch down at the correct spot on the runway.

**Precision runway monitor (PRM).** System allows simultaneous, independent Instrument Flight Rules (IFR) approaches at airports with closely spaced parallel runways.

**Preferred IFR routes.** Routes established in the major terminal and en route environments to increase system efficiency and capacity. IFR clearances are issued based on these routes, listed in the A/FD except when severe weather avoidance procedures or other factors dictate otherwise.

**Pressure altitude.** Altitude above the standard 29.92" Hg plane.

**Prevailing visibility.** The greatest horizontal visibility equaled or exceeded throughout at least half the horizon circle (which is not necessarily continuous).

**Primary and supporting.** A method of attitude instrument flying using the instrument that provides the most direct indication of attitude and performance.

**Primary flight display (PFD).** A display that provides increased situational awareness to the pilot by replacing the traditional six instruments used for instrument flight with an easy-to-scan display that provides the horizon, airspeed, altitude, vertical speed, trend, trim, rate of turn among other key relevant indications.

**PRM.** See precision runway monitor.

**Procedure turn.** A maneuver prescribed when it is necessary to reverse direction to establish an aircraft on the intermediate approach segment or final approach course.

**Profile view.** Side view of an IAP chart illustrating the vertical approach path altitudes, headings, distances, and fixes.

**Prohibited area.** Designated airspace within which flight of aircraft is prohibited.

**Propeller/rotor modulation error.** Certain propeller RPM settings or helicopter rotor speeds can cause the VOR course deviation indicator (CDI) to fluctuate as much as  $\pm 6^\circ$ . Slight changes to the RPM setting will normally smooth out this roughness.

**Rabbit, the.** High-intensity flasher system installed at many large airports. The flashers consist of a series of brilliant blue-white bursts of light flashing in sequence along the approach lights, giving the effect of a ball of light traveling towards the runway.

**Radar.** Radio Detection And Ranging.

**Radar approach.** The controller provides vectors while monitoring the progress of the flight with radar, guiding the pilot through the descent to the airport/heliport or to a specific runway.

**Radials.** The courses oriented from a station.

**Radio or radar altimeter.** An electronic altimeter that determines the height of an aircraft above the terrain by measuring the time needed for a pulse of radio-frequency energy to travel from the aircraft to the ground and return.

**Radio frequency (RF).** A term that refers to alternating current (AC) having characteristics such that, if the current is input to antenna, an electromagnetic (EM) field is generated suitable for wireless broadcasting and/or communications.

**Radio magnetic indicator (RMI).** An electronic navigation instrument that combines a magnetic compass card with two bearing pointers (typically). Generally, one pointer is for the ADF while the other is for an RNAV or VOR navigation system. The pointers are typically different colors and of different widths for ease of identification. Sometimes a function switch is provided to allow the #2 pointer to be slaved to either a VOR or RNAV system. The card of the RMI acts as a gyro-stabilized magnetic compass (usually corrected for north via a flux valve) and shows the magnetic heading the aircraft is flying.

**Radio wave.** An electromagnetic wave (EM wave) with frequency characteristics useful for radio transmission.

**RAIM.** See receiver autonomous integrity monitoring.

**Random RNAV routes.** Direct routes, based on area navigation capability, between waypoints defined in terms of latitude/longitude coordinates, degree-distance fixes, or offsets from established routes/airways at a specified distance and direction.

**Ranging signals.** Transmitted from the GPS satellite, these allow the aircraft's receiver to determine range (distance) from each satellite.

**RB.** See relative bearing.

**RBI.** See relative bearing indicator.

**RCO.** See remote communications outlet.

**Receiver autonomous integrity monitoring (RAIM).** A system used to verify the usability of the received GPS signals and warns the pilot of any malfunction in the navigation system. This system is required for IFR-certified GPS units.

**Recommended altitude.** An altitude depicted on an instrument approach chart with the altitude value neither underscored nor overscored. The depicted value is an advisory value.

**Receiver-transmitter (RT).** A system that permits selection of a unique channel or frequency whereupon a signal (typically communication) can be transmitted and received.

**Reduced vertical separation minimum (RVSM).** Reduces the vertical separation between flight level (FL) 290–410 from 2,000 feet to 1,000 feet and makes six additional FLs available for operation. Also see DRVSM.

**Reference circle (also, distance circle).** The circle depicted in the plan view of an IAP chart that typically has a 10 NM radius, within which chart the elements are drawn to scale.

**Regions of command.** The “regions of normal and reversed command” refers to the relationship between speed and the power required to maintain or change that speed in flight.

**REIL.** See runway end identifier lights.

**Relative bearing (RB).** The angular difference between the aircraft heading and the direction to the station, measured clockwise from the nose of the aircraft.

**Relative bearing indicator (RBI).** Also known as the fixed-card ADF, zero is always indicated at the top of the instrument and the needle indicates the relative bearing to the station.

**Relative wind.** Direction of the airflow produced by an object moving through the air. The relative wind for an airplane in flight flows in a direction parallel with and opposite to the direction of flight; therefore, the actual flight path of the airplane determines the direction of the relative wind.

**Remote communications outlet (RCO).** An unmanned communications facility that is remotely controlled by air traffic personnel.

**Required navigation performance (RNP).** A specified level of accuracy defined by a lateral area of confined airspace in which an RNP-certified aircraft operates.

**Restricted area.** Airspace designated under 14 CFR part 73 within which the flight of aircraft, while not wholly prohibited, is subject to restriction.

**Reverse sensing.** The VOR needle appearing to indicate the reverse of normal operation.

**RF.** Radio frequency.

**Rhodopsin.** The photosensitive pigments that initiate the visual response in the rods of the eye.

**Rigidity.** The characteristic of a gyroscope that prevents its axis of rotation tilting as the Earth rotates.

**Rime ice.** Rough, milky, opaque ice formed by the instantaneous freezing of small supercooled water droplets.

**Risk.** The future impact of a hazard that is not eliminated or controlled.

**RMI.** See radio magnetic indicator.

**RNAV.** See area navigation.

**RNP.** See required navigation performance.

**Runway end identifier lights (REIL).** A pair of synchronized flashing lights, located laterally on each side of the runway threshold, providing rapid and positive identification of the approach end of a runway.

**Runway visibility value (RVV).** The visibility determined for a particular runway by a transmissometer.

**Runway visual range (RVR).** The instrumentally derived horizontal distance a pilot should be able to see down the runway from the approach end, based on either the sighting of high-intensity runway lights, or the visual contrast of other objects.

**RVR.** See runway visual range.

**RVV.** See runway visibility value.

**SA.** See selective availability.

**St. Elmo's Fire.** A corona discharge which lights up the aircraft surface areas where maximum static discharge occurs.

**Satellite ephemeris data.** Data broadcast by the GPS satellite containing very accurate orbital data for that satellite, atmospheric propagation data, and satellite clock error data.

**Scan.** The first fundamental skill of instrument flight, also known as "cross-check;" the continuous and logical observation of instruments for attitude and performance information.

**SDF.** See simplified directional facility.

**Selective availability (SA).** A satellite technology permitting the Department of Defense (DOD) to create, in the interest of national security, a significant clock and ephemeris error in the satellites, resulting in a navigation error.

**Semicircular canal.** An inner ear organ that detects angular acceleration of the body.

**Sensitive altimeter.** A form of multipointer pneumatic altimeter with an adjustable barometric scale that allows the reference pressure to be set to any desired level.

**SIDS.** See standard instrument departure procedures.

**SIGMET.** The acronym for Significant Meteorological information. A weather advisory issued concerning weather significant to the safety of all aircraft.

**Signal-to-noise ratio.** An indication of signal strength received compared to background noise, which is a measure of how adequate the received signal is.

**Simplex.** Transmission and reception on the same frequency.

**Simplified directional facility (SDF).** A NAVAID used for nonprecision instrument approaches. The final approach course is similar to that of an ILS localizer; however, the SDF course may be offset from the runway, generally not more than 3°, and the course may be wider than the localizer, resulting in a lower degree of accuracy.

**Single-pilot resource management (SRM).** The ability for crew or pilot to manage all resources effectively to ensure the outcome of the flight is successful.

**Situational awareness.** Pilot knowledge of where the aircraft is in regard to location, air traffic control, weather, regulations, aircraft status, and other factors that may affect flight.

**Skidding turn.** An uncoordinated turn in which the rate of turn is too great for the angle of bank, pulling the aircraft to the outside of the turn.

**Skin friction drag.** Drag generated between air molecules and the solid surface of the aircraft.

**Slant range.** The horizontal distance from the aircraft antenna to the ground station, due to line-of-sight transmission of the DME signal.

**Slaved compass.** A system whereby the heading gyro is “slaved to,” or continuously corrected to bring its direction readings into agreement with a remotely located magnetic direction sensing device (usually this is a flux valve or flux gate compass).

**Slipping turn.** An uncoordinated turn in which the aircraft is banked too much for the rate of turn, so the horizontal lift component is greater than the centrifugal force, pulling the aircraft toward the inside of the turn.

**Small airplane.** An airplane of 12,500 pounds or less maximum certificated takeoff weight.

**Somatogravic illusion.** The misperception of being in a nose-up or nose-down attitude, caused by a rapid acceleration or deceleration while in flight situations that lack visual reference.

**Spatial disorientation.** The state of confusion due to misleading information being sent to the brain from various sensory organs, resulting in a lack of awareness of the aircraft position in relation to a specific reference point.

**Special use airspace.** Airspace in which flight activities are subject to restrictions that can create limitations on the mixed use of airspace. Consists of prohibited, restricted, warning, military operations, and alert areas.

**SRM.** See single-pilot resource management.

**SSR.** See secondary surveillance radar.

**SSV.** See standard service volume.

**Standard holding pattern.** A holding pattern in which all turns are made to the right.

**Standard instrument departure procedures (SIDS).** Published procedures to expedite clearance delivery and to facilitate transition between takeoff and en route operations.

**Standard rate turn.** A turn in which an aircraft changes its direction at a rate of 3° per second. The turn indicators are typically 2 minute or 4 minute instruments. In a 2 minute instrument, if the needle is one needle width either side of the center alignment mark, the turn is 3° per second and the turn takes 2 minutes to execute a 360° turn. In a 4 minute instrument, the same turn takes two widths deflection of the needle to achieve 3° per second. The 4 minute turn instrument is usually found on high performance aircraft.

**Standard service volume (SSV).** Defines the limits of the volume of airspace which the VOR serves.

**Standard terminal arrival route (STAR).** A preplanned IFR ATC arrival procedure published for pilot use in graphic and/or textual form.

**STAR.** See standard terminal arrival route.

**Static longitudinal stability.** The aerodynamic pitching moments required to return the aircraft to the equilibrium angle of attack.

**Static pressure.** Pressure of air that is still, or not moving, measured perpendicular to the surface of the aircraft.

**Steep turns.** In instrument flight, any turn greater than standard rate; in visual flight, anything greater than a 45° bank.

**Stepdown fix.** The point after which additional descent is permitted within a segment of an IAP.

**Strapdown system.** An INS in which the accelerometers and gyros are permanently “strapped down” or aligned with the three axes of the aircraft.

**Stress.** The body's response to demands placed upon it.

**Structural icing.** The accumulation of ice on the exterior of the aircraft.

**Suction relief valve.** A relief valve in an instrument vacuum system required to maintain the correct low pressure inside the instrument case for the proper operation of the gyros.

**Synchro.** A device used to transmit indications of angular movement or position from one location to another.

**Synthetic vision.** A realistic display depiction of the aircraft in relation to terrain and flight path.

**TAA.** See terminal arrival area.

**TACAN.** See tactical air navigation.

**Tactical air navigation (TACAN).** An electronic navigation system used by military aircraft, providing both distance and direction information.

**TAWS.** See terrain awareness and warning system.

**TCAS.** See traffic alert collision avoidance system.

**TCH.** See threshold crossing height.

**TDZE.** See touchdown zone elevation.

**TEC.** See Tower En Route Control.

**Technique.** The manner in which procedures are executed.

**Temporary flight restriction (TFR).** Restriction to flight imposed in order to:

1. Protect persons and property in the air or on the surface from an existing or imminent flight associated hazard;
2. Provide a safe environment for the operation of disaster relief aircraft;
3. Prevent an unsafe congestion of sightseeing aircraft above an incident;
4. Protect the President, Vice President, or other public figures; and,
5. Provide a safe environment for space agency operations.

Pilots are expected to check appropriate NOTAMs during flight planning when conducting flight in an area where a temporary flight restriction is in effect.

**Tension.** Maintaining an excessively strong grip on the control column, usually resulting in an overcontrolled situation.

**Terminal Instrument Approach Procedure (TERP).** Prescribes standardized methods for use in designing instrument flight procedures.

**Terminal arrival area (TAA).** A procedure to provide a new transition method for arriving aircraft equipped with FMS and/or GPS navigational equipment. The TAA contains a "T" structure that normally provides a NoPT for aircraft using the approach.

**TERP.** See terminal instrument approach procedure.

**Terrain Awareness and Warning System (TAWS).** A timed-based system that provides information concerning potential hazards with fixed objects by using GPS positioning and a database of terrain and obstructions to provide true predictability of the upcoming terrain and obstacles.

**TFR.** See temporary flight restriction.

**Threshold crossing height (TCH).** The theoretical height above the runway threshold at which the aircraft's glide slope antenna would be if the aircraft maintains the trajectory established by the mean ILS glide slope or MLS glide path.

**Thrust (aerodynamic force).** The forward aerodynamic force produced by a propeller, fan, or turbojet engine as it forces a mass of air to the rear, behind the aircraft.

**Time and speed table.** A table depicted on an instrument approach procedure chart that identifies the distance from the FAF to the MAP, and provides the time required to transit that distance based on various groundspeeds.

**Timed turn.** A turn in which the clock and the turn coordinator are used to change heading a definite number of degrees in a given time.

**TIS.** See traffic information service.

**Title 14 of the Code of Federal Regulations (14 CFR).** The federal aviation regulations governing the operation of aircraft, airways, and airmen.

**Touchdown zone elevation (TDZE).** The highest elevation in the first 3,000 feet of the landing surface, TDZE is indicated on the instrument approach procedure chart when straight-in landing minimums are authorized.

**Tower En Route Control (TEC).** The control of IFR en route traffic within delegated airspace between two or more adjacent approach control facilities, designed to expedite traffic and reduce control and pilot communication requirements.

**TPP.** See United States Terminal Procedures Publication.

**Tracking.** Flying a heading that will maintain the desired track to or from the station regardless of crosswind conditions.

**Traffic Alert Collision Avoidance System (TCAS).** An airborne system developed by the FAA that operates independently from the ground-based Air Traffic Control system. Designed to increase flight deck awareness of proximate aircraft and to serve as a “last line of defense” for the prevention of mid-air collisions.

**Traffic information service (TIS).** A ground-based service providing information to the flight deck via data link using the S-mode transponder and altitude encoder to improve the safety and efficiency of “see and avoid” flight through an automatic display that informs the pilot of nearby traffic.

**Transcribed Weather Broadcast (TWEB).** Meteorological and aeronautical data recorded on tapes and broadcast over selected NAVAIDs. Generally, the broadcast contains route-oriented data with specially prepared NWS forecasts, inflight advisories, and winds aloft. It also includes selected current information such as weather reports (METAR/SPECI), NOTAMS, and special notices.

**Transponder.** The airborne portion of the ATC radar beacon system.

**Transponder code.** One of 4,096 four-digit discrete codes ATC assigns to distinguish between aircraft.

**Trend.** Immediate indication of the direction of aircraft movement, as shown on instruments.

**Trim.** Adjusting the aerodynamic forces on the control surfaces so that the aircraft maintains the set attitude without any control input.

**TWEB.** See Transcribed Weather Broadcast.

**True airspeed.** Actual airspeed, determined by applying a correction for pressure altitude and temperature to the CAS.

**UHF.** See ultra-high frequency.

**Ultra-high frequency (UHF).** The range of electromagnetic frequencies between 962 MHz and 1213 MHz.

**Uncaging.** Unlocking the gimbals of a gyroscopic instrument, making it susceptible to damage by abrupt flight maneuvers or rough handling.

**Underpower.** Using less power than required for the purpose of achieving a faster rate of airspeed change.

**United States Terminal Procedures Publication (TPP).** Booklets published in regional format by the NACO that include DPs, STARs, IAPs, and other information pertinent to IFR flight.

**Unusual attitude.** An unintentional, unanticipated, or extreme aircraft attitude.

**User-defined waypoints.** Waypoint location and other data which may be input by the user, this is the only GPS database information that may be altered (edited) by the user.

**Variation.** Compass error caused by the difference in the physical locations of the magnetic north pole and the geographic north pole.

**VASI.** See visual approach slope indicator.

**VDP.** See visual descent point.

**Vectoring.** Navigational guidance by assigning headings.

**Venturi tube.** A specially shaped tube attached to the outside of an aircraft to produce suction to allow proper operation of gyro instruments.

**Vertical speed indicator (VSI).** A rate-of-pressure change instrument that gives an indication of any deviation from a constant pressure level.

**Very-high frequency (VHF).** A band of radio frequencies falling between 30 and 300 MHz.

**Very-high frequency omnidirectional range (VOR).** Electronic navigation equipment in which the flight deck instrument identifies the radial or line from the VOR station, measured in degrees clockwise from magnetic north, along which the aircraft is located.

**Vestibule.** The central cavity of the bony labyrinth of the ear, or the parts of the membranous labyrinth that it contains.

**VFR.** See visual flight rules.

**VFR-on-top.** ATC authorization for an IFR aircraft to operate in VFR conditions at any appropriate VFR altitude.

**VFR over-the-top.** A VFR operation in which an aircraft operates in VFR conditions on top of an undercast.

**Victor airways.** Airways based on a centerline that extends from one VOR or VORTAC navigation aid or intersection, to another navigation aid (or through several navigation aids or intersections); used to establish a known route for en route procedures between terminal areas.

**Visual approach slope indicator (VASI).** A visual aid of lights arranged to provide descent guidance information during the approach to the runway. A pilot on the correct glide slope will see red lights over white lights.

**Visual descent point (VDP).** A defined point on the final approach course of a nonprecision straight-in approach procedure from which normal descent from the MDA to the runway touchdown point may be commenced, provided the runway environment is clearly visible to the pilot.

**Visual flight rules (VFR).** Flight rules adopted by the FAA governing aircraft flight using visual references. VFR operations specify the amount of ceiling and the visibility the pilot must have in order to operate according to these rules. When the weather conditions are such that the pilot can not operate according to VFR, he or she must use instrument flight rules (IFR).

**Visual meteorological conditions (VMC).** Meteorological conditions expressed in terms of visibility, distance from cloud, and ceiling meeting or exceeding the minimums specified for VFR.

**VMC.** See visual meteorological conditions.

**VOR.** See very-high frequency omnidirectional range.

**VORTAC.** A facility consisting of two components, VOR and TACAN, which provides three individual services: VOR azimuth, TACAN azimuth, and TACAN distance (DME) at one site.

**VOR test facility (VOT).** A ground facility which emits a test signal to check VOR receiver accuracy. Some VOTs are available to the user while airborne, while others are limited to ground use only.

**VOT.** See VOR test facility.

**VSI.** See vertical speed indicator.

**WAAS.** See wide area augmentation system.

**Warning area.** An area containing hazards to any aircraft not participating in the activities being conducted in the area. Warning areas may contain intensive military training, gunnery exercises, or special weapons testing.

**Waypoint.** A designated geographical location used for route definition or progress-reporting purposes and is defined in terms of latitude/longitude coordinates.

**WCA.** See wind correction angle.

**Weather and radar processor (WARP).** A device that provides real-time, accurate, predictive and strategic weather information presented in an integrated manner in the National Airspace System (NAS).

**Weight.** The force exerted by an aircraft from the pull of gravity.

**Wide area augmentation system (WAAS).** A differential global positioning system (DGPS) that improves the accuracy of the system by determining position error from the GPS satellites, then transmitting the error, or corrective factors, to the airborne GPS receiver.

**Wind correction angle (WCA).** The angle between the desired track and the heading of the aircraft necessary to keep the aircraft tracking over the desired track.

**Work.** A measurement of force used to produce movement.

**Zone of confusion.** Volume of space above the station where a lack of adequate navigation signal directly above the VOR station causes the needle to deviate.

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