Gleim Instrument Pilot Flight Maneuvers

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NOTE: Sections with changes are indicated by a vertical bar in the left margin. Text that should be deleted is displayed with a line through it. New text is shown with blue underlined font.

If you are tested on any content not represented in our materials or this update, please share this information with Gleim so we can continue to provide the most complete test preparation experience possible. You can submit feedback at www.GleimAviation.com/questions. Thank you in advance for your help!

The changes described and reproduced in this update reflect the FAA's revised Instrument Rating Airman Certification Standards (FAA-S-ACS-8B, Change 1), effective June 2019.

To view the current ACS, go to
www.faa.gov/training_testing/testing/acs/media/instrument_rating_acs_change_1.pdf

The Task reproductions at the beginning of each Part II study unit as well as each Task element within each subunit have been updated to match the FAA ACS document above.

Study Unit 2 – Optimizing Your Flight and Ground Training

Page 9, Subunit 2.1, New item 3.a.:

3. Part 142 explains the certification and operation of aviation training centers, which can provide an alternative means to accomplish the training required by Part 61.

   a. If provided by an authorized instructor in a full flight simulator or flight training device,

      1) A maximum of 30 hr. may be performed in those devices if the instrument time was completed in accordance with Part 142.
      2) A maximum of 20 hr. may be performed in those devices if the instrument time was not completed in accordance with Part 142.

Study Unit 3 – Your FAA Practical (Flight) Test

Page 16, Subunit 3.1, Item 2.:

2. The ACS consists of **Areas of Operation** arranged in a logical sequence, beginning with Preflight Preparation and ending with Postflight Procedures. Each Area of Operation includes tasks appropriate to that Area of Operation. Each task begins with an **Objective** stating what the applicant should know, consider, and/or do. The ACS then lists the aeronautical knowledge, risk management, and skill elements relevant to the specific task, along with the conditions and standards for acceptable performance. Below is an example of the task structure.

   IR.I.C.K4:

   IR = Applicable ACS (Instrument Rating – Airplane)
   I = Area of Operation (Preflight Preparation)
   C = Task (Cross-Country Flight Planning)
   K4 = Task Element Knowledge 4 (Elements of an IFR flight plan)

Study Unit 5 – Weather Information

Page 46, Subunit 5.1, New item 1.c. and item 2.a.2)b)i):

c. Flight Service Stations (FSSs) are FAA facilities that provide a variety of services to pilots, including pilot weather briefings.

1) An FSS provides preflight and in-flight briefings, transcribed weather briefings, and scheduled and unscheduled weather broadcasts, and it furnishes weather support to flights in its area.

a) Flight Service specialists are certificated pilot weather briefers and are not authorized to make original forecasts.

b) They are trained to translate and interpret available forecasts and reports directly into terms of the weather conditions you may expect along your route of flight and at your destination.

2) To contact an FSS by telephone, dial 800-WX-BRIEF (800-992-7433).

a) You will talk to a specialist to obtain the latest information.

3) To receive a weather briefing from Flight Service online, visit www.1800wxbrief.com.

[. . .]

b) Abbreviated briefing

i) Request an abbreviated briefing when you need information to supplement mass disseminated data ~~(e.g., TIBS)~~ or to update a previous briefing, or when you need only one or two specific items.

Page 55, Subunit 5.1, Item 2.a.23)a):

23) If you are already in flight and you need weather information and assistance, the following services are provided by flight service stations (FSSs). They can be accessed over the proper radio frequencies listed on aeronautical charts and the Chart Supplement.

~~a) **Hazardous Inflight Weather Advisory Service (HIWAS)** is a continuous broadcast service over selected VORs of in-flight aviation weather advisories, i.e., AIRMETs, SIGMETs, convective SIGMETs, severe weather forecast alerts (AWW), center weather advisories (CWA), and urgent pilot reports (PIREPs).~~

a) **Flight Information Services-Broadcast (FIS-B).** The implementation of ADS-B has provided pilots the ability to obtain real-time weather advisory information in flight via data-link service. This system supplements preflight briefings, enhancing safety of flight by enabling pilots to receive weather products in the air.

FIS-B Over UAT Product Update and Transmission Intervals

Product	FIS-B Over UAT Service Update Interval[1]	FIS-B Service Transmission Interval[2]
AIRMET	As available	5 minutes
Convective SIGMET	As available	5 minutes
METARs/SPECIs	1 minute/as available	5 minutes
NEXRAD Composite Reflectivity (CONUS)	15 minutes	15 minutes
NEXRAD Composite Reflectivity (Regional)	5 minutes	2.5 minutes
NOTAMs-D/FDC/TFR	As available	10 minutes
PIREP	As available	10 minutes
SIGMET	As available	5 minutes
Special Use Airspace Status	As available	10 minutes
TAF/AMEND	6 hours/as available	10 minutes
Temperature Aloft	12 hours	10 minutes
Winds Aloft	12 hours	10 minutes
Lightning Strikes	5 minutes	5 minutes
Turbulence	15 minutes	15 minutes
Icing Forecasts	15 minutes	15 minutes
Cloud Tops	15 minutes	15 minutes
Graphical AIRMETs	00Z, 03Z, 06Z, 09Z/12 hr. forecasts	3 hours
Center Weather Advisories	As available	As available

1 The Update Interval is the rate at which the product data is available from the source.

2 The Transmission Interval is the amount of time within which a new or updated product transmission must be completed and the rate or repetition interval at which the product is rebroadcast.

3 Notice to Airmen-Distant (NOTAM-D) and Notice to Airmen-Flight Data Center (NOTAM-FDC) products broadcast via FIS-B are limited to those issued or effective within the past 30 days.

Page 66, Subunit 5.1, Item 3.i.2)a)iii)-iv) and New items 3.i.2)a)vii)-x):

iii) ~~The~~Three primary types of structural icing ~~are~~ can accumulate during flight: clear (or glaze) ice, rime ice, and ~~a mixture~~mixed ice, which is the simultaneous appearance of ~~the two~~or combination of glaze and rime icing. Other in-flight icing types may accrete as a result of anti- and deicing procedures during continued flight during known icing conditions.

~~. Each type has its own identifying features.~~

iv) Clear ice, often called glaze ice, forms when, after initial impact, the remaining liquid portion of the drop flows out over the aircraft surface, gradually freezing as a smooth sheet of solid ice.

[. . .]

vii) Residual ice is the ice remaining on the protected surface immediately after actuation of a deicing system.

viii) The ice that accumulates on a protected surface between the actuation cycles of a deicing system is intercycle ice.

ix) After the application of thermal deicing systems, the resulting water that leaves the protected surface can refreeze as it runs back along the unprotected surface, resulting in runback ice.

x) Known or observed or detected ice accretion is actual ice detected by on-board sensors or visually observed by the flight crew.

Page 69, Subunit 5.1, Item 3.j. and New item 3.i.7):

j. **Fog/Mist**

[. . .]

7) Mist is a visible aggregate of minute water droplets or ice crystals suspended in the atmosphere that reduces visibility to less than 7 SM but greater than or equal to 5/8 SM.

a. Mist forms a thin, grayish veil that covers the landscape.

b. Mist is similar to fog but has lower relative humidity (95%-99%) and does not obstruct visibility to the same extent.

Page 70, Subunit 5.1, New item 3.l.:

l. **Obstructions to Visibility (e.g., Smoke, Haze, Volcanic Ash, etc.)**

1) Smoke

a) Smoke is a suspension in the air of small particles produced by combustion due to fires, industrial burning, or other sources.

i) It may transition to haze when the particles travel 25-100 mi. or more, the larger particles have settled, and others become widely scattered through the atmosphere.

b) Not only can smoke reduce visibility to zero, but many of its compounds are highly toxic and/or irritating.

i) The most dangerous is carbon monoxide, which can lead to carbon monoxide poisoning.

c) When skies are clear above a surface-based layer of haze or smoke, visibility generally improves during the day.

i) Heating during the day may cause convective mixing, spreading the smoke or haze to a higher altitude and decreasing the concentration near the surface.

ii) However, the improvement is slower than the clearing of fog. Fog evaporates, but haze and smoke must be dispersed by the movement of air.

iii) A thick layer of clouds above haze or smoke may block sunlight, preventing dissipation. Visibility will improve little, if any, during the day.

2) Haze
   a) Haze is a suspension in the air of extremely small particles invisible to the naked eye and sufficiently numerous to reduce visibility by scattering light.
   b) Haze produces a bluish color when viewed against a dark background and a yellowish veil when viewed against a light background.
      i) This effect may be used to distinguish haze from mist, which yields only a gray obscuration.
   c) Certain haze particles increase in size with increasing relative humidity, drastically decreasing visibility.
   d) While visibility is a measure of how far one can see, including the ability to see the textures and colors therein, haze is the inability to view a similar scene with equal clarity.
   e) Haze occurs in stable air and is usually only a few thousand feet thick, but it may extend upward to 15,000 ft.
   f) A haze layer has a definite ceiling, above which in-flight visibility is unrestricted.
      i) At or below this level, the slant range visibility is poor.
      ii) Visibility in haze varies greatly, depending on whether the pilot is facing into or away from the sun.

3) Volcanic Ash
   a) Volcanic ash is made up of fine particles of rock powder that originate from a volcano and that may remain suspended in the atmosphere for long periods.
      i) Severe volcanic eruptions that send ash into the upper atmosphere occur somewhere around the world several times per year.
      ii) The ash plume may not be visible, especially at night or in instrument meteorological conditions (IMC).
      iii) Even if visible, it is difficult to distinguish visually between an ash cloud and an ordinary cloud.
      iv) Ash cannot be detected by air traffic control (ATC) radar. However, it may be detected by weather radar, particularly during the early stages of a volcanic eruption when the ash is more concentrated.
   b) Flying into a volcanic ash cloud can be exceedingly dangerous.
      i) Volcanic ash is composed of silica (glass).
      ii) When ash is ingested into a jet engine, it melts to produce a soft sticky molten product that adheres to the compressor turbine blades and fuel injectors/igniters.
      iii) With no air going into the engine, the fuel cannot ignite, the engine comes to a slow spinning stop by spooling down, and a flameout occurs.
      iv) As the aircraft exits the ash cloud into colder temperatures, the cooled, hardened silica on the turbine blades becomes dislodged, allowing the fan blades to start rotating, and allows for an engine relight as the air starts moving through the engine again.
      v) Piston-powered aircraft are less likely to lose power, but severe damage is almost certain to ensue after an encounter with a volcanic ash cloud that is only a few hours old.
   c) Volcanic ash also causes abrasive damage to aircraft flying through it at hundreds of miles per hour.
      i) Particles impacting the windshield can sandblast the surface into a frosted finish that obscures the pilot's view.

ii) The sandblasting can also remove paint and pit metal on the nose and leading edges of wings and navigation equipment.

iii) Ash contaminates aircraft ventilation, hydraulic, instrument, electronic, and air data systems.

iv) Ash on a runway can cover the runway markings and cause aircraft to lose traction during takeoffs and landings.

4) Other Obstructions to Visibility

a) Precipitation is any of the forms of water particles, whether liquid or solid, that fall from the atmosphere and reach the ground, including snow, rain, and drizzle.

i) Heavy snow may reduce visibility to zero.

ii) Rain seldom reduces surface visibility below 1 mi. except in brief, heavy showers.

b) Blowing snow is snow lifted from the surface of the Earth by the wind to a height of 6 ft. or more above the ground and blown about in such quantities that the reported horizontal visibility is reduced to less than 7 SM.

i) Light, dry powder snow is most prone to being blown by the wind.

ii) Strong winds keep the snow suspended up to 50 ft. or so, obscuring the sky and reducing surface visibility to near zero (called a whiteout).

iii) Visibility improves rapidly when the wind subsides.

c) A dust storm is a severe weather condition characterized by strong winds and dust-filled air over an extensive area.

i) A dust storm originates over a region when fine-grained soils, rich in clay and silt, are exposed to strong winds and lofted airborne.

ii) Fine-grained soils are commonly found in dry lake beds, river flood plains, ocean sediments, and glacial deposits.

iii) Surface winds need to be 15 kt. or greater to mobilize dust.

iv) The average height of a dust storm is 3,000-6,000 ft. However, dust storms frequently extend up to 15,000 ft.

d) A sandstorm occurs when particles of sand are carried aloft by a strong wind.

i) The sand particles are mostly confined to the lowest 10 ft. and rarely rise more than 50 ft. above the ground.

ii) Sandstorms are similar to dust storms but occur on a localized scale. This is because sand particles are larger and heavier than dust particles.

iii) Sandstorms are best developed in desert regions where there is loose sand, often in dunes, without much admixture of dust.

Page 79, Subunit 5.2, Item 2.c.8)b):

b) ~~In addition, you can further investigate advisories received from HIWAS and other radio broadcasts.~~ Another practical use of advanced flight deck weather systems is to check the METAR for a destination airport before flying in range of the airport's ATIS broadcast.

Page 81, Subunit 5.3, Item 3.o.:

o. ~~HIWAS~~Urgent PIREPs, SIGMETs, and Center Weather Advisories (CWAs) combined with automated flight deck weather can help you make in-flight diversion decisions.

Study Unit 6 – Cross-Country Flight Planning

Pages 90-93, Subunit 6.1, Item 4.:

4. **The applicant demonstrates understanding of the elements of an IFR flight plan.**

   NOTE: ~~Currently, pilots file flight plans in~~On August 27, 2019, the ~~U.S. under either a~~ FAA transitioned from the domestic ~~or ICAO format. The FAA is proposing to implement~~ flight plan ~~filing~~form to mandatory use of the international (ICAO) flight plan format for ~~civil aircraft exclusively under the format used by the International Civil Aviation Organization (ICAO). This section includes information for both~~all IFR and VFR domestic and ~~ICAO formats~~international civil flights.

   a. Flight plans can be filed in the air by radio, but it is best to file a flight plan either ~~in person at the flight service station (FSS),~~ by phone~~,~~ or online prior to departing.

      1) After takeoff, contact the FSS by radio on the appropriate frequency and report your takeoff time so your flight plan can be activated or opened.
      2) When filing a flight plan by phone or radio, give the information in the order of the numbered spaces.

   b. When a flight plan is filed, it will be held by the FSS until 1 hr. after the proposed departure time and then canceled unless

      1) The actual departure time is received.
      2) A revised proposed departure time is received.
      3) At the time of filing, the FSS is informed that the proposed departure time will be met, but the actual time cannot be given because of inadequate communication. a)This procedure must be initiated by the pilot.

   ~~c. The domestic flight plan form below may be photocopied for your own use, or you may obtain these forms at FSSs and other FAA offices or download these forms online.~~

      ~~1) When filing a flight plan by phone or radio, give the information in the order of the numbered spaces.~~

Form Approved: OMB No. 2120-0034

U.S. DEPARTMENT OF TRANSPORTATION FEDERAL AVIATION ADMINISTRATION **FLIGHT PLAN**	(FAA USE ONLY) ☐ PILOT BRIEFING ☐ VNR ☐ STOPOVER	TIME STARTED	SPECIALIST INITIALS

1. TYPE	2. AIRCRAFT IDENTIFICATION	3. AIRCRAFT TYPE/ SPECIAL EQUIPMENT	4. TRUE AIRSPEED	5. DEPARTURE POINT	6. DEPARTURE TIME		7. CRUISING ALTITUDE
					PROPOSED (Z)	ACTUAL (Z)	
☐ VFR			KTS				
☐ IFR							
☐ DVFR							

8. ROUTE OF FLIGHT

9. DESTINATION (Name of airport and city)	10. EST. TIME ENROUTE		11. REMARKS
	HOURS	MINUTES	

12. FUEL ON BOARD		13. ALTERNATE AIRPORT(S)	14. PILOT'S NAME, ADDRESS & TELEPHONE NUMBER & AIRCRAFT HOME BASE	15. NUMBER ABOARD
HOURS	MINUTES			
			17. DESTINATION CONTACT/TELEPHONE (OPTIONAL)	

16. COLOR OF AIRCRAFT	CIVIL AIRCRAFT PILOTS. FAR Part 91 requires you file an IFR flight plan to operate under instrument flight rules in controlled airspace. Failure to file could result in a civil penalty not to exceed $1,000 for each violation (Section 901 of the Federal Aviation Act of 1958, as amended). Filing of a VFR flight plan is recommended as a good operating practice. See also Part 99 for requirements concerning DVFR flight plans.

FAA Form 7233-1 (8-82) CLOSE VFR FLIGHT PLAN WITH _____ FSS ON ARRIVAL

d. As illustrated on the previous page, a domestic flight plan requires the following information:

1) Type -- VFR, IFR, DVFR

a) DVFR refers to defense VFR flights. They are VFR flights into air defense identification zones that require a VFR flight plan to be filed.

2) Airplane identification

3) Airplane type/special equipment

a) The following table contains the special equipment suffixes and their meanings:

/X --	No transponder
/T --	Transponder with no altitude-encoding capability
/U --	Transponder with altitude-encoding capability
/D --	DME, but no transponder
/B --	DME and transponder, but no altitude-encoding capability
/A --	DME and transponder with altitude-encoding capability
/I --	RNAV and transponder with altitude-encoding capability
/C --	RNAV and transponder, but no altitude-encoding capability
/W --	RNAV, but no transponder
/G --	GPS equipped with oceanic, en route, terminal, and GPS approach capability

4) True airspeed (kt.)

5) Departure point

6) Departure time in Universal Coordinated Time (UTC)

a) You supply the proposed departure time, and the FSS will fill in the actual departure time when you activate the flight plan after takeoff.

7) Cruising altitude

8) Route of flight

9) Destination airport identifier or airport name (name of airport and city if needed for clarity)

10) Estimated time en route (hours and minutes)

11) Remarks

12) Fuel on board (total amount expressed in hours and minutes)

13) Alternate airport(s) (NOTE: This is not required for a VFR flight plan.)

14) Pilot's name, address, and telephone number, and airplane home base

15) Number of people aboard

16) Color of aircraft

17) Destination contact/telephone (NOTE: This is optional, not required.)

~~e.~~c. ICAO Flight Plan

1) Flight plans contain specific information relating to the proposed flight of an aircraft, and controllers use them to provide air traffic services. The use of one format ~~will simplify~~simplifies the process and ~~align~~aligns U.S. flight plans with ICAO standards.

2) Switching from the domestic flight plan format to the ICAO format is relatively simple ~~and aided by the fact that most of the fields in the domestic form are found in the international form~~. ~~3) While some~~Some wording is slightly different, but pilots experienced with filing domestic plans will see close similarities with most of the international fields, allowing them to file ICAO plans with ease. The table below illustrates the similarity between domestic and ICAO fields.

Domestic Fields	**ICAO Field Equivalents**
Aircraft Identification	Aircraft Identification
Type (of Flight)	Flight Rules
Aircraft Type	Type of Aircraft
Special Equipment*	Equipment (COM/NAV)*
Departure Point	Departure Aerodrome**
Departure Time	Time
True Airspeed	Cruising Speed
Cruising Altitude	Level
Route of Flight	Route**
Destination	Destination Aerodrome**
Est Time En route	Total EET
Remarks	Other Information/Remarks
Fuel on Board	Endurance
Number Aboard	Persons on Board
Color of Aircraft	Aircraft Color and Markings
Pilot's Name & Other Information	Pilot in Command

*This field is optional
**ICAO IFR Flight Plans require 4 character location identifiers

3) For additional guidance, refer to the *Aeronautical Information Manual (AIM)* paragraph 5-1-9.

d. Your FSS specialist will be glad to assist you and answer any questions. Keep a copy of the flight plan template in your flight bag and kneeboard. Occasionally, you may have to file a flight plan without an ~~FAA~~ICAO form in front of you. Ask the specialist to prompt you for the required information.

e. For additional guidance, including IFR routing examples, refer to *AIM* paragraph 5-1-8.

f. The ICAO flight plan form below may be copied for your own use, or you may download the form online.

Page 106, Subunit 6.3, Item 5.c.1)a):

a) Even a thin layer of ice at the leading edge of a wing, especially if it is rough, can have a significant effect in increasing stall speed. A layer no thicker than a piece of sandpaper can reduce lift by 30% and increase drag by 40%.

Study Unit 8 – Airplane Flight Instruments and Navigation Equipment

Page 133, Subunit 8.1, New item 1.c.4):

4) **ADS-B**

a) Automatic dependent surveillance-broadcast (ADS-B) forms the foundation for NextGen by moving from ground radar and navigational aids to precise tracking using satellite signals.

b) Pilots will see what controllers see: displays showing other aircraft in the sky. Flight deck displays can also pinpoint hazardous weather and terrain and give pilots important flight information, such as temporary flight restrictions.

c) ADS-B reduces the risk of runway incursions through flight deck and controller displays that show the location of aircraft and equipped ground vehicles on airport surfaces–even at night or during heavy rainfall.

d) Relying on satellites instead of ground navigational aids also means aircraft will be able to fly more directly from Point A to Point B, saving time and money and reducing fuel burn and emissions.

e) With the improved accuracy, integrity, and reliability of satellite signals over radar, controllers eventually will be able to safely reduce the minimum separation distance between aircraft and increase the capacity of the nation's skies.

Page 134, Subunit 8.1, Item 2.a.1)b):

b) NAVAIDs can also transmit voice broadcasts.

~~i) HIWAS broadcast capability is available on select VOR sites.~~

~~ii)~~i) Unless otherwise noted on the chart, all radio navigation aids operate continuously except during shutdowns for maintenance.

ii) During periods of routine or emergency maintenance, coded identification is removed; this removal serves as a warning to pilots that the facility is officially off the air, and may be unreliable even though intermittent or constant signals are received.

Study Unit 10 – Compliance with Air Traffic Control Clearances

Page 174, Subunit 10.1, Item 1.g.1)b):

g. Normally, you will obtain your IFR departure clearance in one of the following ways:

1) At a controlled airport

a) In class B or C airspace, on the clearance delivery frequency.

b) In class D airspace, or in class E ~~or G~~ airspace at an airport with an operating control tower, on the ground control or ~~(frequency use permitting)~~ tower frequency.

Study Unit 13 – Recovery from Unusual Flight Attitudes

Page 266, Subunit 13.2, New item 3.:

3. **The applicant demonstrates the ability to identify, assess, and mitigate risks encompassing exceeding the operating envelop during recovery.**
   a. Recovering from unusual attitudes can involve flight near the edge of an aircraft's operating envelope.
   b. If recovery is not done properly, the pilot may inadvertently exceed the aircraft's load limits and cause structural damage.
      1) General aviation aircraft certified in the normal category can withstand +3.8G and -1.52G.
   c. When recovering from a nose-high unusual attitude, the nose should first be lowered before rolling the wings level in order to prevent excessive negative loading on the wings.
   d. When recovering from a nose-low unusual attitude, the wings should first be rolled level before raising the nose in order to prevent excessively high positive load factors.

Study Unit 15 – Departure, En Route, and Arrival Operations

Page 310, Subunit 15.3, Item 8.a.1):

1) ~~Hazardous Inflight Weather Advisory Service (HIWAS) is a continuous broadcast service over selected VORs of in-flight aviation weather advisories, i.e.,~~ AIRMETs, SIGMETs, convective SIGMETs, severe weather forecast alerts (AWW), center weather advisories (CWA), and urgent pilot reports (PIREPs)~~.~~ can all be obtained easily with FIS-B.

Study Unit 16 – Nonprecision Approach

Page 340, Subunit 16.1, New items 3.-4.:

3. **The applicant demonstrates understanding of ground-based and satellite-based navigation systems used for a nonprecision approach.**
   a. A nonprecision approach can be designed using a variety of ground-based navigation aids, such as a VOR or localizer, or satellite-based navigation systems, such as GPS.
      1) Study Unit 8, Subunit 1, item 2., has information on ground-based and satellitebased navigation systems used for a nonprecision approach.
4. **The applicant demonstrates understanding of a stabilized approach, including energy management concepts.**
   a. Criteria for Stabilized Approaches Conducted in GA Airplanes
      1) Under most circumstances, the airplane should be stabilized by 1,000 ft. above airport elevation in instrument meteorological conditions (IMC) and by 500 ft. above airport elevation during straight-in approaches in visual meteorological conditions (VMC).
      2) Pilots should monitor at least seven major elements that define a stabilized approach in a GA airplane. The FAA considers an approach to touchdown to be stabilized when the airplane meets all of the following criteria, with only minor deviations:
         a) Glide Path
            i) The airplane is on the correct flight path.
            ii) Typically, the glide path is 3° to the runway touchdown zone (TDZ) (obstructions permitting).

b) Heading

i) The airplane is tracking the extended centerline to the runway with only minor heading/pitch changes necessary to correct for wind or turbulence to maintain alignment.

ii) Bank angle should not exceed 15° on final approach.

c) Airspeed

i) The pilot maintains a constant target airspeed within +10/–5 kt. indicated airspeed (KIAS), which is usually at, but not lower than, one of the following:

- The recommended landing speed specified in the POH/AFM,
- Approved placards/markings, or
- 1.3 times the stall speed or minimum steady flight speed at which the airplane is controllable in the landing configuration (V_{SO}), if another speed is not specified.

ii) Most small airplanes maintain a speed well in excess of 1.3 times V_{SO} on an instrument approach (at the pilot's discretion).

- An airplane with a V_{SO} of 50 kt. has a normal approach speed of 65 kt. However, the same airplane may maintain 90 kt. (1.8 V_{SO}) while on the final segment of an instrument approach.
- Pilots generally select an appropriate approach speed for the prevailing weather, aircraft, traffic, and performance conditions, but not less than 1.3 V_{SO}.
- However, aircraft are usually slowed to a normal landing speed when on the final approach just prior to landing.

d) Configuration

i) The airplane is in the correct landing configuration with flaps as required, landing gear extended, and the airplane in trim.

e) Rate of Descent

i) Descent rate is a constant and generally no greater than 500 feet per minute (fpm).

ii) If a descent greater than 500 fpm is required due to approach considerations, it should be reduced prior to 300 ft. above ground level (AGL) and well before the landing flare and touchdown phase.

f) Power Setting

i) Power setting is appropriate for the airplane configuration and is not below the minimum power for approach as defined by the POH/AFM.

g) Checklists/Briefings

i) All briefings and checklists (except the landing checklist) are completed prior to initiating the approach.

ii) For a typical GA piston airplane in a traffic pattern, if the approach becomes unstabilized below 300 ft. AGL, the pilot should initiate an immediate go-around.

b. Energy Management

1) Energy management refers to managing the energy state of the airplane. The energy state of an airplane is the balance between airspeed, altitude, drag, and thrust, and it represents how efficiently the airfoil is operating.

a) In other words, it is the ability to manage the kinetic and potential energy of the aircraft.

2) The more efficiently the airfoil operates, the larger the stall margin present.

a) Increasing a pilot's situational awareness of the energy condition of the airplane can provide him or her with information that (s)he needs to prevent a loss of control (LOC) scenario resulting from a stall/spin.

b) Additionally, the less energy utilized to maintain flight, the greater the overall efficiency of the airplane, which is typically realized in fuel savings. This equates to a lower operating cost to the pilot.

3) A pilot should be aware of the aircraft's energy condition during all phases of flight (e.g., taxi, takeoff, climb, level off, descent, maneuvers, approach, landing, and parking). A pilot should strive to perfect the art of energy management.

a) There are four basic forces always acting on an airplane: lift, weight, thrust, and drag.

b) Airspeed, along with trending airspeed, power settings, drag, altitude, and environmental conditions all factor into an aircraft's energy.

i) How the pilot controls the variables of aircraft energy is the making of the artistic balance of flight.

ii) A poorly performed action or lack of action can fundamentally "snowball" into another maneuver or phase of flight, causing disastrous effects.

4) To understand energy management, the pilot must understand basic aerodynamics.

a) In steady (or constant) flight, the four basic forces are in equilibrium.

i) When pressure is applied to one or more of the airplane controls, one or more of the basic forces change in magnitude and become greater than the opposing force, causing the airplane to move in the direction of the applied force(s).

- EXAMPLE: If power is applied (increasing thrust) and altitude is maintained, the airplane will accelerate. As speed increases, drag increases until a point is reached at which drag again equals thrust. Then the airplane will continue in steady flight at a higher speed.

ii) The amount of lift that a given wing generates at a given altitude is directly related to its angle of attack and airspeed.

b) The amount of drag present at a given airspeed is equal to the amount of thrust required to maintain level flight at that airspeed and angle of attack.

i) If thrust is increased beyond that required for level flight, the airplane will climb unless it is retrimmed for a lower angle of attack and a higher airspeed.

ii) If thrust is reduced, the airplane will descend.

5) Energy management requires an understanding of the relationship between pitch and power. In many situations, pilots must appropriately manage the energy available to them.
    a) Adjusting the angle of attack varies the amounts of lift and drag produced by the wing.
    b) Adjusting the airplane's power allows the airplane to change airspeed, altitude, or both.
    c) Thus, the pilot can achieve a desired performance from the airplane (in terms of airspeed and altitude) through a variety of pitch and power combinations.
        i) A climb may be initiated by raising the nose to increase the angle of attack, or by increasing power, or by using both.
        ii) A descent may be initiated by lowering the nose to reduce the angle of attack, or by decreasing power, or by using both.
        iii) To increase airspeed in level flight, power must be increased and angle of attack reduced to maintain level flight.
        iv) To decrease airspeed in level flight, power must be reduced and angle of attack increased to maintain level flight.
    d) Depending on the aircraft configuration, a combination of both pitch and power adjustments are necessary to change altitude and airspeed.
6) In critical situations, such as when flying at a high angle of attack (e.g., takeoff and initial climb) or when airplanes are without power (e.g., a power-off approach or engine out situation), energy management is paramount because pilots must rely on inertia instead of thrust to gain airspeed.
    a) Unfortunately, in these scenarios, the only force a pilot can control is pitch because no additional (or any) thrust is available.
    b) To keep from stalling the airplane, a pilot's only choice is to decrease the pitch (i.e., lower the nose of the airplane).
    c) When flying the **backside of the power curve** or **region of reversed command**, you should avoid the natural tendency to pull back on the control yoke in order to climb because increasing the angle of attack will increase drag and may cause the airplane to descend or stall (if the critical angle of attack is exceeded).
    d) In essence, by decreasing the pitch, gravity is providing the energy by turning the airplane's potential energy (i.e., altitude) into kinetic energy. In other words, the airplane will gain airspeed at a cost of altitude.
        i) In power-off or engine out situations, it is imperative for pilots to try to maintain their best glide speed.
        ii) By pitching for the best glide speed, pilots can use the least amount of energy to keep them airborne, so they can glide the farthest, allowing them to make the runway or emergency landing area.
    e) In practice, this is why your instructor, during a stall, tells you to lower the nose to decrease your angle of attack.

7) Energy management is necessary to achieve safe landings.

a) During approach and landing, there may be situations in which a deficit of energy (low/slow) or excess (high/fast) regularly occur. These situations can result in landing short/long, overshooting the runway, a go-around/missed approach, or even a loss of control.

8) Energy management is helpful in other situations.

a) Pilots can continually ensure they manage the energy of their aircraft by keeping the airspeed at or near the maximum endurance speed (V_{ME}).

i) This is the airspeed that requires the least amount of thrust to obtain the highest airspeed. An example can be found in *Pilot Handbook*, Study Unit 1, Subunit 7.

9) Pilots must monitor and adjust the energy of the aircraft in all phases of flight.

a) Pilots accomplish this with the coordination of power, drag, flight path, and altitude by the manipulation of the controls available.

b) The FAA and the General Aviation Joint Steering Committee (GAJSC) promote the use of an angle of attack indicator to show the amount of reserve lift available. This helps prevent LOC accidents.

Page 341, Subunit 16.2, New items 1.-2.: The order of existing items in this subunit were updated to match the ACS.

16.2 RISK MANAGEMENT

1. **The applicant demonstrates the ability to identify, assess, and mitigate risks encompassing failure to follow the correct approach procedure (e.g., descending too early, etc.).**

a. If an approach is flown in IMC, the only way to ensure proper obstacle clearance and traffic separation is to follow the published procedure.

b. It is important for pilots to thoroughly brief the approach to prevent ambiguity about what courses and step-down altitudes are being used.

1) During the briefing, pilots should make special note of any time a heading or altitude change is required.

2) A turn or descent should not be initiated until the airplane has crossed the appropriate fix on the approach procedure.

2. **The applicant demonstrates the ability to identify, assess, and mitigate risks encompassing selecting an incorrect navigation frequency.**

a. When flying an instrument approach, it is imperative that the navigation equipment is correctly set up for the desired approach.

b. The navigation aid frequency must be accurately tuned, or it will not be able to provide any helpful information for the approach.

1) Furthermore, if a pilot believes a navigation aid frequency is properly selected when it is not, the pilot may inadvertently follow the incorrect course guidance and fly the aircraft into a hazardous situation.

Page 347, Subunit 16.3, VOR Approach, New item 7.: The order of existing items in this subunit were updated to match the ACS.

7. **The applicant demonstrates the ability to complete the appropriate checklist.**
    a. During the initial approach segment, you should also complete your before-landing checklist as described in your POH/AFM.
        1) All fuel-related items, such as fuel selectors, fuel pumps, and mixture, should be set for landing.
        2) Most pilots will lower the landing gear (if applicable) at the beginning of the final approach segment (i.e., over the FAF).
        3) At the FAF, you should have completed your before-landing checklist.

Page 348, Subunit 16.3, VOR Approach, Item 10.a.: Prior to the reorder of existing items in this subunit as noted above, this item was 9.a.

a. **Notices to Airmen (NOTAMs)**
    1) Flight Data Center (FDC) NOTAMs are regulatory in nature and inform you of amendments to IAPs or aeronautical charts prior to their normal publication. ~~Temporary flight restrictions (TFRs) are also issued as FDC NOTAMs.~~
        a) FDC NOTAMs are available from FSS and ~~are published in the *Notices to Airmen Publication (NTAP)*~~ can be viewed on the official FAA NOTAM search website at https://notams.aim.faa.gov/notamSearch/nsapp.html#/ offering "Airport, Facility, and Procedural" notices.
    ~~2) The *NTAP* contains all FDC NOTAMs that are currentthe time of publication and those NOTAM (D)s that are expected to remain in effect for 7 days after the issuance of the publication. The *NTAP* is issued every 28 days~~
        b) "General" notices remain as on-request items when obtaining FSS weather briefings.
        ~~a)~~c) During your preflight briefing, you must ask your FSS specialist for any published NOTAMs that are pertinent to your flight.
        ~~b) Alternatively, view the *NTAP* web version at www.faa.gov/air_traffic/publications/notices~~.
    2) You should also gather all preflight IFR route and amendment FDC NOTAM information via the NOTAM search portal.
        a) Domestic and International notices are available digitally at www.faa.gov/air_traffic/publications/notices

Page 356, Subunit 16.3, RNAV (GPS) Approach, New item 7.: The order of existing items in this subunit were updated to match the ACS.

7. **The applicant demonstrates the ability to complete the appropriate checklist.**
    a. During the initial approach segment, you should also complete your before-landing checklist as described in your POH/AFM.
        1) All fuel-related items, such as fuel selectors, fuel pumps, and mixture, should be set for landing.
        2) Most pilots will lower the landing gear (if applicable) at the beginning of the final approach segment (i.e., over the FAF).
        3) At the FAF, you should have completed your before-landing checklist.

Page 358, Subunit 16.3, RNAV (GPS) Approach, Item 10.a.: Prior to the reorder of existing items in this subunit as noted above, this item was 9.a.

a. **Notices to Airmen (NOTAMs)**
    1) Flight Data Center (FDC) NOTAMs are regulatory in nature and inform you of amendments to IAPs or aeronautical charts prior to their normal publication. ~~Temporary flight restrictions (TFRs) are also issued as FDC NOTAMs.~~
        a) FDC NOTAMs are available from FSS and ~~are published in the *Notices to Airmen Publication (NTAP)*~~ can be viewed on the official FAA NOTAM search website at https://notams.aim.faa.gov/notamSearch/nsapp.html#/ offering "Airport, Facility, and Procedural" notices.
    ~~2) The *NTAP* contains all FDC NOTAMs that are currentthe time of publication and those NOTAM (D)s that are expected to remain in effect for 7 days after the issuance of the publication. The *NTAP* is issued every 28 days~~
        b) "General" notices remain as on-request items when obtaining FSS weather briefings.
        ~~a)~~c) During your preflight briefing, you must ask your FSS specialist for any published NOTAMs that are pertinent to your flight.
        ~~b) Alternatively, view the *NTAP* web version at www.faa.gov/air_traffic/publications/notices~~.
    2) You should also gather all preflight IFR route and amendment FDC NOTAM information via the NOTAM search portal.
        a) Domestic and International notices are available digitally at www.faa.gov/air_traffic/publications/notices

Page 365, Subunit 16.3, LOC Approach, New item 7.: The order of existing items in this subunit were updated to match the ACS.

7. **The applicant demonstrates the ability to complete the appropriate checklist.**
    a. During the initial approach segment, you should also complete your before-landing checklist as described in your POH/AFM.
        1) All fuel-related items, such as fuel selectors, fuel pumps, and mixture, should be set for landing.
        2) Most pilots will lower the landing gear (if applicable) at the beginning of the final approach segment (i.e., over the FAF).
        3) At the FAF, you should have completed your before-landing checklist.

Page 367, Subunit 16.3, LOC Approach, Item 10.a.: Prior to the reorder of existing items in this subunit as noted above, this item was 9.a.

a. **Notices to Airmen (NOTAMs)**
    1) Flight Data Center (FDC) NOTAMs are regulatory in nature and inform you of amendments to IAPs or aeronautical charts prior to their normal publication. ~~Temporary flight restrictions (TFRs) are also issued as FDC NOTAMs.~~
        a) FDC NOTAMs are available from FSS and ~~are published in the *Notices to Airmen* Publication *(NTAP)*~~ can be viewed on the official FAA NOTAM search website at https://notams.aim.faa.gov/notamSearch/nsapp.html#/ offering "Airport, Facility, and Procedural" notices.
    ~~2) The *NTAP* contains all FDC NOTAMs that are currentthe time of publication and those NOTAM (D)s that are expected to remain in effect for 7 days after the issuance of the publication. The *NTAP* is issued every 28 days~~
        b) "General" notices remain as on-request items when obtaining FSS weather briefings.
        ~~a)~~c) During your preflight briefing, you must ask your FSS specialist for any published NOTAMs that are pertinent to your flight.
        ~~b) Alternatively, view the *NTAP* web version at www.faa.gov/air_traffic/publications/notices~~.
    2) You should also gather all preflight IFR route and amendment FDC NOTAM information via the NOTAM search portal.
        a) Domestic and International notices are available digitally at www.faa.gov/air_traffic/publications/notices

Study Unit 17 – Precision Approach

Page 378, Subunit 17.1, New items 2.-4.:

2. **The applicant demonstrates understanding of navigation system displays, annunciations, and modes of operation.**
   a. Study Unit 16, Subunit 1, item 2., has information on navigation system displays, annunciations, and modes of operation.
3. **The applicant demonstrates understanding of ground-based and satellite-based navigation (orientation, course determination, equipment, tests and regulations, interference, appropriate use of navigation data, and signal integrity).**
   a. Study Unit 8, Subunit 1, item 2., has information on ground-based and satellite-based navigation systems.
4. **The applicant demonstrates understanding of a stabilized approach, including energy management concepts.**
   a. Study Unit 16, Subunit 1, item 4., has information on a stabilized approach, including energy management concepts.

Page 379, Subunit 17.2, New items 1.-2.: The order of existing items in this subunit were updated to match the ACS.

17.2 RISK MANAGEMENT

1. **The applicant demonstrates the ability to identify, assess, and mitigate risks encompassing failure to follow the correct approach procedure (e.g., descending below the glide slope, etc.).**
   a. If an approach is flown in IMC, the only way to ensure proper obstacle clearance and traffic separation is to follow the published procedure.
   b. It is important for pilots to thoroughly brief the approach to prevent ambiguity about what courses and altitudes are being used.
      1) During the briefing, pilots should make special note of any time a heading or altitude change is required.
      2) A turn or descent should not be initiated until the aircraft has crossed the appropriate fix on the approach procedure.
   c. Once the glide slope is intercepted on a precision approach, the pilot should not allow the aircraft to descend beneath the glide slope to ensure clearance over any obstacles that may exist in the final approach path.
2. **The applicant demonstrates the ability to identify, assess, and mitigate risks encompassing selecting an incorrect navigation frequency.**
   a. Study Unit 16, Subunit 2, item 2., has information on selecting an incorrect navigation frequency.

Page 388, Subunit 17.3, New item 7.: The order of existing items in this subunit were updated to match the ACS.

7. **The applicant demonstrates the ability to complete the appropriate checklist.**

   a. During the initial approach segment, you should also complete your before-landing checklist as described in your POH/AFM.

      1) All fuel-related items, such as fuel selectors, fuel pumps, and mixture, should be set for landing.
      2) Most pilots will lower the landing gear (if applicable) at the beginning of the final approach segment (i.e., glide slope intercept).
      3) At the FAF, you should have completed your before-landing checklist.

Page 389, Subunit 17.3, Item 10.a.: Prior to the reorder of existing items in this subunit as noted above, this item was 9.a.

a. **NOTAMs**

   1) Flight Data Center (FDC) NOTAMs are regulatory in nature and inform you of amendments to IAPs or aeronautical charts prior to their normal publication. ~~Temporary flight restrictions (TFRs) are also issued as FDC NOTAMs.~~

      a) FDC NOTAMs are available from FSS and ~~are published in the *Notices to Airmen Publication (NTAP)*~~ can be viewed on the official FAA NOTAM search website at https://notams.aim.faa.gov/notamSearch/nsapp.html#/ offering "Airport, Facility, and Procedural" notices.

   ~~2) The *NTAP* contains all FDC NOTAMs that are currentthe time of publication and those NOTAM (D)s that are expected to remain in effect for 7 days after the issuance of the publication. The *NTAP* is issued every 28 days~~

      b) "General" notices remain as on-request items when obtaining FSS weather briefings.

      ~~a)~~c) During your preflight briefing, you must ask your FSS specialist for any published NOTAMs that are pertinent to your flight.

      ~~b) Alternatively, view the *NTAP* web version at www.faa.gov/air_traffic/publications/notices.~~

   2) You should also gather all preflight IFR route and amendment FDC NOTAM information via the NOTAM search portal.

      a) Domestic and International notices are available digitally at www.faa.gov/air_traffic/publications/notices

Study Unit 18 – Missed Approach

Page 403, Subunit 18.3, New item 3.: The order of existing items in this subunit were updated to match the ACS.

3. **The applicant demonstrates the ability to configure the airplane in accordance with the airplane manufacturer's instructions, establish a positive rate of climb, and accelerate to the appropriate airspeed, ±10 knots.**
   a. Reduce drag by following the procedures described in your POH/AFM.
      1) Once you have established a positive rate of climb by checking the VSI and confirming it with the ALT, retract the landing gear (if retractable~~).~~) and accelerate to and maintain V_Y ±10 kt.

         In your airplane, V_Y is _____.

      2) When reaching a safe altitude (e.g., 500 ft. AGL), retract the flaps.

Page 405, Subunit 18.3, Item 10.b.: Prior to the reorder of existing items in this subunit as noted above, this item was 9.b.

b. Single-pilot resource management (SRM) and crew resource management (CRM) specifically ~~refers~~refer to the management of all resources onboard the aircraft as well as outside resources available to the single pilot or the flight crew.

Study Unit 19 – Circling Approach

Page 411, Subunit 19.2, New item 5.b.:

b. Circling approaches are often done at the circling MDA, which can be a much lower altitude than a standard VFR traffic pattern.
   1) The pilot must take this into consideration and be careful to not begin a descent to land too early, or the approach may be too low.
   2) However, the pilot must also be careful not to gain altitude while circling, or the airplane may re-enter IMC, causing visual contact with the runway to be lost.

Page 415, Subunit 19.3, New items 7.-8.: The order of existing items in this subunit were updated to match the ACS.

7. **The applicant demonstrates the ability to, if a missed approach occurs, turn in the appropriate direction using the correct procedure and appropriately configure the airplane.**
   a. If visual reference is lost while circling-to-land from an instrument approach, the missed approach specified for that particular procedure must be followed unless an alternate missed approach procedure is specified by ATC.
   b. To become established on the prescribed missed approach course, make an initial climbing turn toward the landing runway and continue the turn until established on the missed approach course.
   c. Because the circling maneuver may be accomplished in more than one direction, different patterns may be required for becoming established on the prescribed missed approach course, depending on the aircraft position at the time visual reference is lost.

8. **The applicant demonstrates the ability to, if landing, initiate a stabilized descent and to touch down on the first one-third of the selected runway without excessive maneuvering, without exceeding the normal operating limits of the airplane, and without exceeding 30° of bank.**

    a. Once the runway is in sight during a circling approach, a normal descent to land should be made.

    b. Depending on the approach, you may need to fly portions of downwind, base, and final legs of the traffic pattern.

    c. The circling minimums are often lower than the normal traffic pattern altitude.

        1) If you gain visual contact with the runway at the MDA, be careful not to begin your descent too early since you will already be lower than a normal pattern.

        2) If you gain visual contact with the runway early enough, level off at pattern altitude and fly a normal pattern.

    d. Once established on final approach, the airplane should be stabilized with a constant airspeed and a constant descent rate and aligned with the runway centerline.

Appendix E – Instrument Pilot Related Federal Aviation Regulations

Pages 509-510, New 14 CFR sections 91.176, 91.225, and 91.227:

91.176 Straight-in landing operations below DA/DH or MDA using an enhanced flight vision system (EFVS) under IFR.

[. . .]

91.225 Automatic Dependent Surveillance-Broadcast (ADS-B) Out equipment and use.

91.227 Automatic Dependent Surveillance-Broadcast (ADS-B) Out equipment performance requirements.