Instrument Study Sheet

Requirements

- ✓ 3rd Class Medical or Above
- ✓ 50 Hours PIC Cross Country
- ✓ 40 Hours Simulated or Actual Instrument Time
- ✓ 15 Hours of Instrument Training with a CFII
- ✓ 3 Hours of Instrument Training within 2 Calendar Months of the Checkride
- ✓ One Instrument Cross Country Training Flight of at Least 250nm with an Approach at Each Airport and Three Different Kinds of Approaches

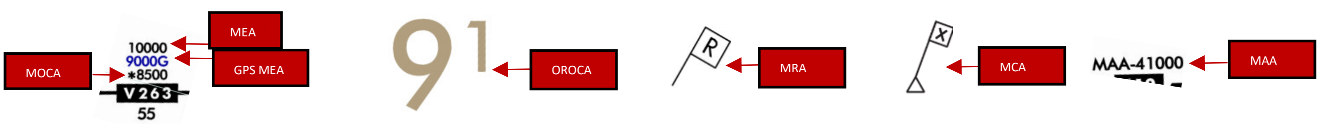
Logging

- Up to 20 hours can be logged in an Advanced Aviation Training Device (AATD). Can be used for currency
- A person can log instrument time when operating solely by reference to instrument in simulated or actual conditions
- Safety pilots can log total time when the PIC is flying under instrument, but they cannot log cross country time

Acronyms

Required Equipment	Instrument Currency	Route Clearance	Illusions in Flight	Lost Comm Procedures
FAR §91.205	FAR §61.57			<u>Route</u>
G: Generator/Alternator	**6:** Instrument Approaches	**C:** Clearance Limit	**I:** Inversion	**A:** Assigned
R: Radios	**6:** Calendar Months	**R:** Routing	**C:** Coriolis	**V:** Vectored
A: Altimeter (Sensitive)	**H:** Holding	**A:** Altitude	**E:** Elevator	**E:** Expected
B: Ball (Slip/Skid Indicator)	**I:** Intercepting	**F:** Frequency (Departure)	**F:** False Horizon	**F:** Filed
C: Clock (Hours & Mins.)	**T:** Tracking	**T:** Transponder Code	**L:** Leans	<u>Altitude (highest of)</u>
A: Attitude Indicator			**A:** Autokinesis	**M:** Minimum IFR Altitude
R: Rate of Turn Indicator			**G:** Graveyard Spin/Spiral	**E:** Expected Altitude
D: Direction Gyro/Heading			**S:** Somatogravic	**A:** Assigned Altitude

IFR **Enroute** Chart Symbols



MEA: Minimum Enroute Altitude: Ensures navigation signal strong enough for reception and guarentees <u>obstacle clearance of at least 1,000 feet and 2,000 feet in designated mountainous areas</u>. Communication is not necessarily guarenteed.
MEA GAP: If navigation signal cannot be assured on the MEA, and MEA gap will be charted
MOCA: Minimum Obstacle Clearance Altitude: Provides same obstacle clearance as MEA, navigation signal only guarenteed within 22nm of cloesest route-defining NAVAID. Has * next to altitude on chart. *See above*
MRA: Minimum Reception Altitude: Lowest altitude where an intersection can be identified by an off course NAVAID
MCA: Minimum Crososing Altitude: Charted when a higher MEA route segment is approached. Pilot must climb to reach MCA by the time of crossing the intersection
MAA: Maximum Authorized Altitude: Highest altitude that an airway can be flown and adequate reception is assured. Has MAA-Altitude on chart
MVA: Minimum Vectoring Altitude: Lowest altitude a controller can approve within a sector. Not information publsihed to pilots.
OROCA: Off-Route Obstruction Clearance Altitude: Provides obstacle clearance of 1,000 feet and 2,000 feet in designated mountainous areas. Similar to VFR Maximum Elevation Figures

IFR Alternate Rules

Do you need to file an alternate?	Alternate Minimums: airport must have weather at least:	Nonstandard Alternate
Not if the weather at the destination is and is forecasted to be at least: **3:** 3sm visibility or greater **2:** 2,000 ft ceiling or great **1:** 1 hour before and 1 hour after ETA	**Precision Approach:** 600ft ceiling, 2sm visibility **Non-Precision Approach:** 800ft ceiling, 2sm visibility	A Nonstandard Alternate Minimums that do not follow 800-2 or 600-2. Check TPP for info A NA Airport cannot be used as alternate

IFR Minimum Fuel Requirements

You must have enough fuel to:

Fly from departure to destination → Fly from destination to alternate → Fly 45 Extra Minutes at Cruise Speed

VOR Test: Must be Completed Every 30 Days! IFH: 9-16

Location of VOR Test Points are specified in the AFD/Chart Supplement. A VOR check must have a log entry by the pilot that includes:

P: Place of Check
A: Amount of Error
D: Date of Check
S: Signature

Chart Supplement Entry →

MARYLAND
VOR RECEIVER CHECKPOINTS

Facility Name (Arpt Name)	Freq/Ident	Type Check Pt. Gnd. AB/ALT	Azimuth from Fac. Mag	Dist. from Fac. N.M.	Checkpoint Description
Frederick (Frederick Muni)	109.0/FDK	G	035	0.6	On runup pad apch end Rwy 23.
	109.0/FDK	G	359	0.6	Intersection Twy B and Twy C.

Ground Checkpoints	Airborne Checkpoint	VOT
Ground checkpoints are points on an airport with a yellow circle and an arrow. Tune to the VOR and center the needle. The needle should be centered on the radial specified for the checkpoint in the chart supplement.	Visual landmarks will be specified in chart supplement. Tune to VOR and center needle when over visual landmark. The needle should be centered on radial specified for the checkpoint in the chart supplement. You can make your own airborne checkpoint along a victor airway by specifying a visual landmark along the airway and testing the radial of the airway.	VOR Test Facility (VOT) transmits a signal for pilots to perform VOR test on ground. The VOT transmits the 360° radial in all directions. Tune to 108.0 then center the VOR needle. The VOR should read 0° FROM and 180° TO.
Accuracy: +/- 4°	Accuracy: +/- 6°	Accuracy: +/- 4°

Required Inspections for IFR Flight

VOR Receiver Check	Every 30 Days	By Pilot
Annual Inspection	Every 12 Calendar Months	By an A&P Mechanic w/ IA
Transponder Inspection	Every 24 Calendar Months	By an A&P Mechanic
GPS Database	Variable, NAV Data Every 28 Days	Updated by pilot/operator
Pitot-Static Inspection	Every 24 Calendar Months	By an A&P Mechanic
100 Hour (If used for flight training)	Every 100 Hours Tach Time	By an A&P Mechanic

IFR Cruising Altitudes

0-179 Magnetic	Odd thousands
180-359 Magnetic	Even thousands

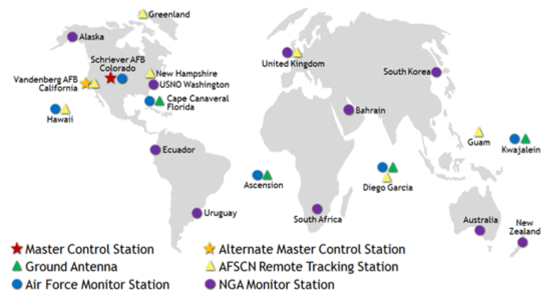
ODD THOUSANDS (EAST)

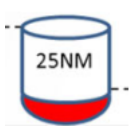
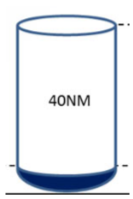
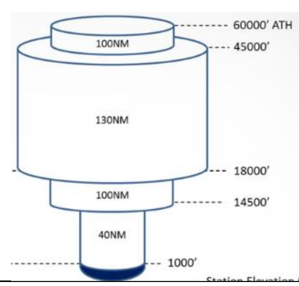
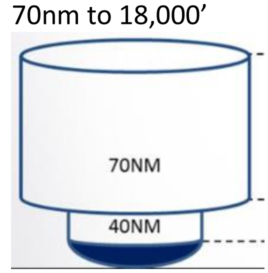
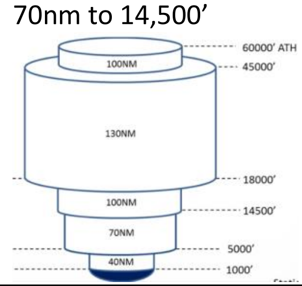
EVEN THOUSANDS (WEST)

Types of Approaches

Non-Precision: MDA – Minimum Descent Altitude		Precision: DA/DH – Decision Altitude/Height	
VOR-Approach	Uses VOR as approach NAVAID	LPV RNAV Approach	WAAS required
Localizer (LOC)	Uses just the horizontal (left/right) component of an ILS	ILS Approach	Glideslope provides both horizontal (left/right) and vertical (up/down) guidance.
LNAV RNAV	Lateral navigation with a GPS only gives horizontal guidance. It is almost like the GPS equivalent of a localizer	Precision Approach Radar	Approach control can vector you down and right/left
Charted Visual Approaches	May be used at towered airports for efficiency. Depicts prominent landmarks to specific runways.	GLS Approach	GBAS Landing System: GBAS: Ground based augmentation system. Augments GPS signals for accuracy

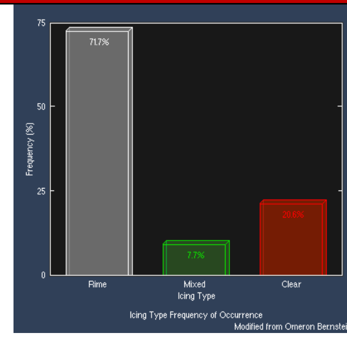
Approach Category	Speed Classification	Circling Radius (miles)	Example Aircraft
Category A	<90 KIAS	1.3	Cessna 172
Category B	91-120 KIAS	1.5	Piper Aztec
Category C	121-140 KIAS	1.7	Airbus a320
Category D	141-165 KIAS	2.3	Boeing 787
Category E	>165 KIAS	4.5	Lockheed C5

Elements of GPS	
Space Element	30 Satellites are all positioned so that 5 satellites are in view at all times
Control Element	Consists of ground-based GPS monitoring and control stations • 5 monitoring stations ○ Hawaii ○ Colorado Springs, CO ○ Cape Canaveral, FL ○ Diego Garcia, Pacific Ocean ○ Kwajalein Island, Pacific Ocean • 3 ground antennas ○ Cape Canaveral, FL ○ Ascension Island, Atlantic Ocean ○ Kwajalein Island, Pacific Ocean • 1 master control station ○ Colorado Springs, CO 
User Element	• Antennas on aircraft • Receiver/processors on aircraft • GPS (TSO C-129 for IFR) 

VOR Standard Service Volume				
Current Volume			Minimum Operational Network Volume	
Terminal	Low	High	Low	High
25nm  Will be removed as part of the MON	40nm  	40nm to 14,500’  	40nm to 5,000’ 70nm to 18,000’  	40nm to 5,000’ 70nm to 14,500’ 

GPS CDI Deflection
When using GPS for navigation, full deflection indicated
Enroute: 2nm from course centerline
Terminal: 1nm from course centerline
Past Final Approach Fix: .3nm from course centerline

Structural Icing (not to be confused with induction or carburetor icing)



Supercooled water: Supercooled water is water suspended in the air that is not frozen but will freeze when it comes in contact with a surface. Strikes the edge of airfoil and freezes immediately

Droplet Sizes:

- Cumulus: Large drops
- Stratus: Small drops
- High Clouds: Ice Crystals

Conditions required for icing, most icing occurs between +2 and -20°C:

1. Visible moisture
2. Temperature of aircraft surface 0° or colder (can be caused by aerodynamic cooling)

Clear Icing	Rime Icing	Mixed Icing (mix of clear and rime)
Clear Smooth Glossy	Rough Coarse	Hard Rough Conglomerate
Warmer temperatures High liquid content Larger droplets Higher aircraft speeds	Colder temperatures Lower liquid content Small droplets Lower aircraft speeds	Variation in temperatures Variation in liquid contents Variation in droplet size

Icing Classification

Intensity	Rate of Accumulation	Airframe Effects
Trace	No significant accumulation	Usually not hazardous even without anti/deice
Light	Significant accumulations for prolonged flight	Occasional use of de/anti ice removes/prevents accumulation
Moderate	Significant accumulation for shorter flight	Even short encounters can be hazardous and use of de/anti ice (possibly diversion) is necessary
Severe	Rapid, dangerous accumulations	De/anti ice equipment fails to remove ice. Diversion is required

Flight Instruments

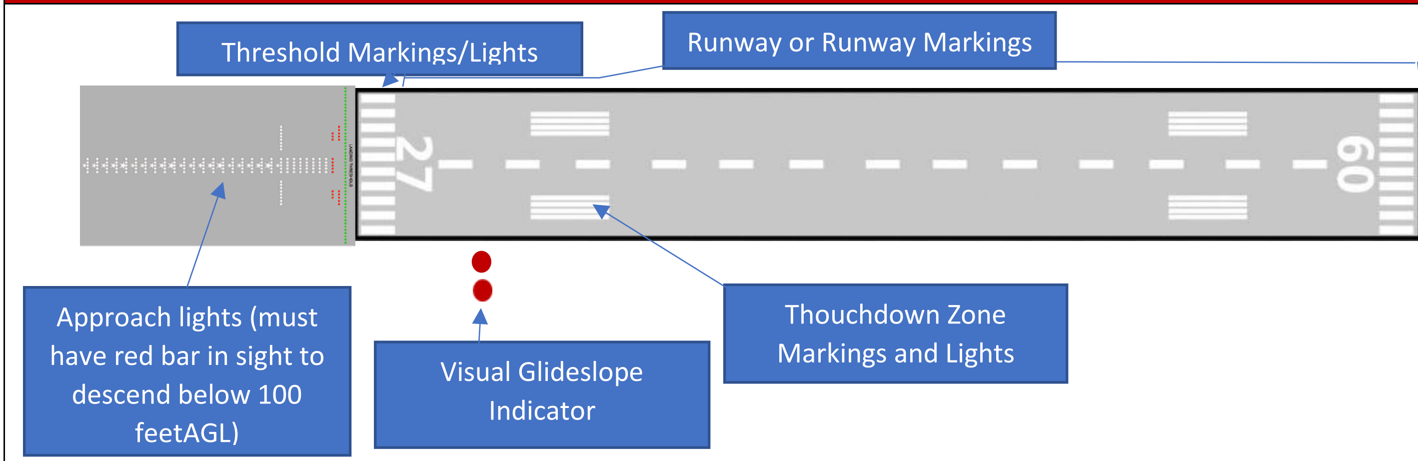
Pitot Static System

Airspeed Indicator	Altimeter	Vertical Speed Indicator
Info from both pitot tube and static port	Info from static port	Info from static port
Measured difference between ram pressure from pitot head and atmospheric pressure from static source.	Aneroid barometer that measures pressure of ambient air and displays it	
	Warmer than standard: True altitude will be higher than indicated Colder than standard: True altitude will be lower than indicated • Correct for error by 4% height increase for every 10C below standard	
	Max allowable error for IFR: 75 feet from field elevation	

Required Reporting Points to ATC Under IFR 91.183

1. Compulsory reporting points ▲
2. Unforcasted weather conditions
3. Information relating to the safety of flight
4. When vacating previously assigned altitude
5. When making a VFR on top altitude change
6. When unable to climb/descend at 500 ft/min
7. Missed approach
8. Change in average TAS when it changes by:
   a. 5%
   b. 10 Knots
9. Time/altitude upon reaching holding fix
10. When in controlled airspace, the loss of
    a. VOR/TACAN
    b. ADF
    c. GPS Abnormalities
    d. ILS Receiver

Visual Cues to Descend from MDA/DA 91.175



IFR Takeoff Minimums 91.175

Part 91	1-2 Engine	>2 Engines
None	1sm visibility	1/2sm visibility

Approach Obstacle Clearance TERPS

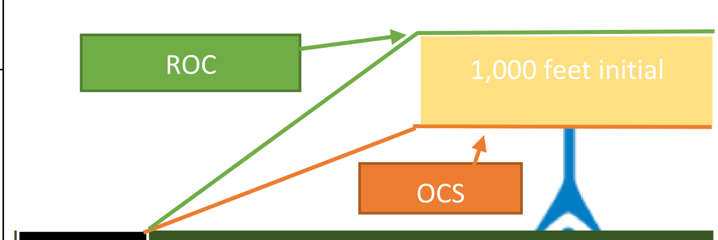
OCS: Obstacle Clearance Surface

Imaginary line drawn from highest obstacle among approach path

ROC: Required Obstacle Clearance

Minimum vertical separation between the aircraft and the OCS (highest obstacle)

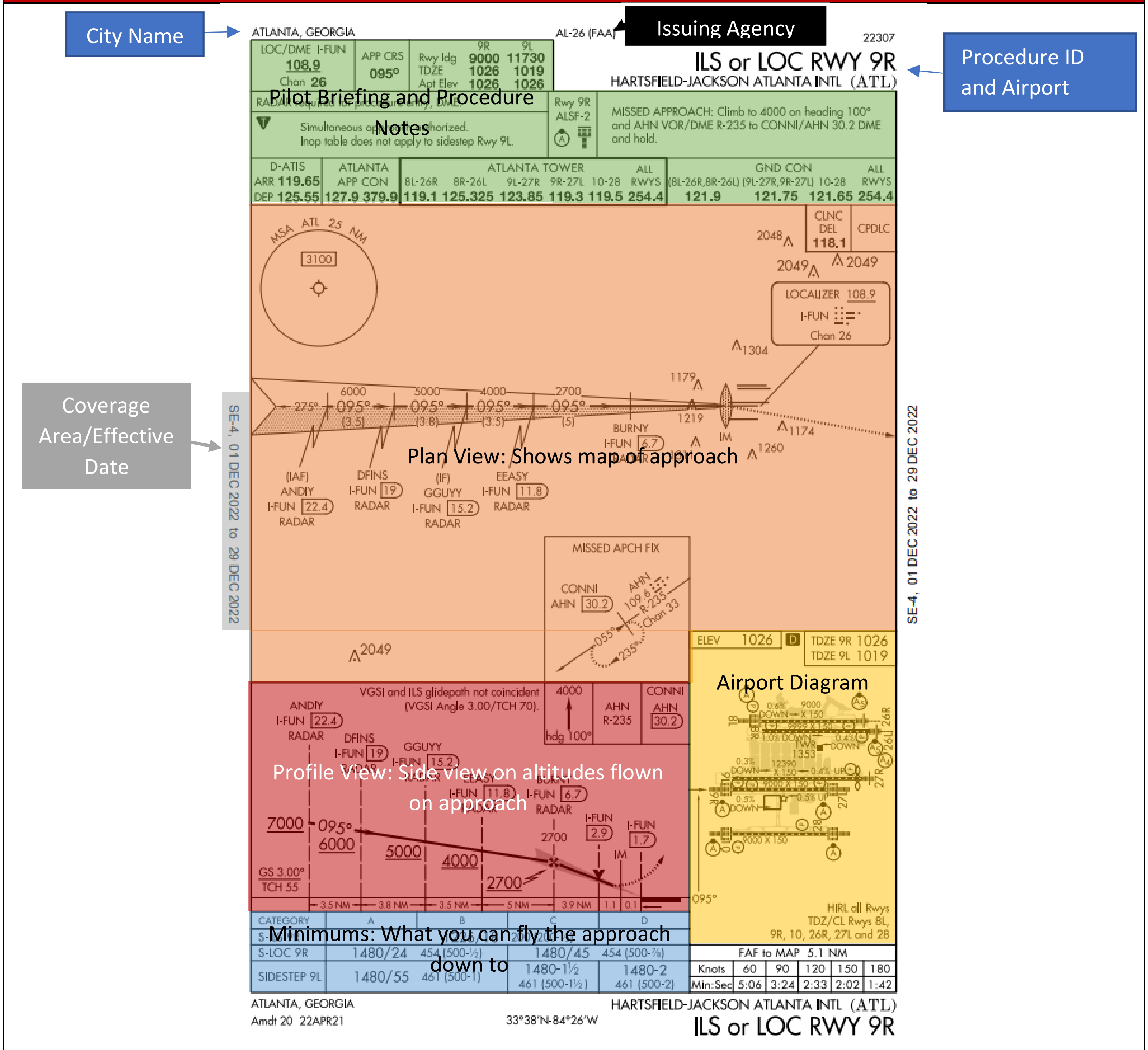
Different separation requirements on different approach segments



Segment	ROC
Initial Segment	1,000’
Intermediate Segment	500’
Final Segment	Non-Precision: 250’
	Precision: 200’

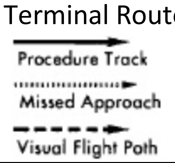
*May be level for non-precision approaches with an MDA or sloping for precision approaches with a glideslope

Reading an Approach Plate

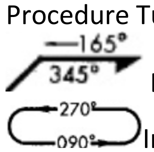


Approach Chart Symbols

Terminal Routes



Procedure Turns



Barbed

In leui of

Navigation Aids/Fixes

Lightining Bolt Symbol

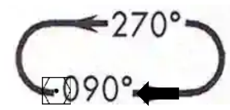
Plan View: NAVAID Intersection

Profile View: Glideslope Intercept

Holds and Hold Entries

What is a Hold?

A hold is a racetrack shape that consists of 2 parallel 1-minute segments and a 1 minute, 180° turn at the end of each segment to make up a racetrack shape. A hold is usually based off a VOR radial with the outbound leg being the radial you are holding on. For example, in the picture to the right, you would be holding on the 270° radial



Shape of a Hold

Determining Hold Entry

Standard Hold Entry Overlay

To determine hold entry, look at your heading indicator and imagine the overlay to the left. Whatever quadrant would take you direct to the radial is the type of entry you would execute. For example, if you were told to hold on the 330° radial standard turns, a teardrop entry would be the proper entry. If you were told to hold on the 210° radial standard turns, you should execute a parallel hold entry. If turns were nonstandard, parallel and teardrop quadrants would be reversed and the overlay would read "TPD"

Direct	Parallel	Teardrop