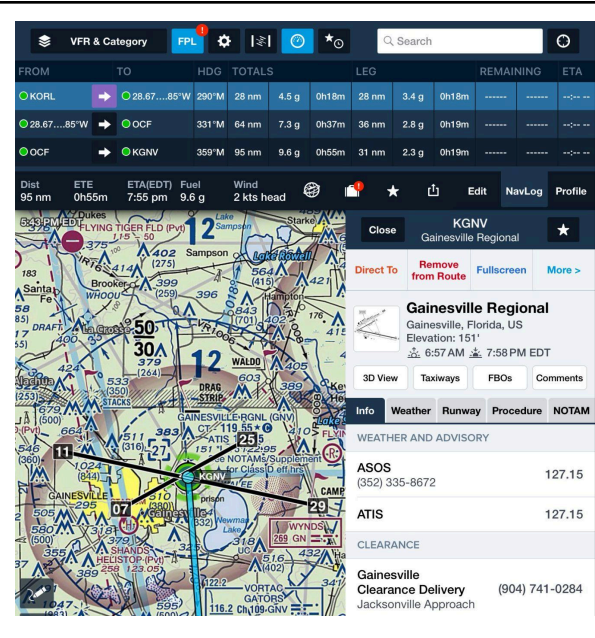


Navigation and Flight Planning

<p>Objective</p>	
<p>To ensure the applicant learns the elements of navigation and flight planning and can plan a VFR cross country properly.</p>	
<p>Purpose</p>	
<p>The entire point of learning to fly is going somewhere! Airplanes are great ways to go to far away places quickly. However, unlike driving a car, navigating in an airplane is considerably more complex. This lesson introduces pilots to the terms and concepts used in air navigation, as well as the basics of planning VFR cross countries, using pilotage, dead reckoning, radio navigation, and more.</p>	
<p>Schedule</p>	<p>Equipment</p>
<ul style="list-style-type: none"> • Ground Lesson: 60 minutes • Student Q&A: 20 minutes 	<ul style="list-style-type: none"> • Airplane POH • VFR Sectional Charts / Plotter / E6B • Electronic Flight Bag (EFB) Software • Nav Log / Scratch Paper • Whiteboard / Markers (optional)
<p>Student Actions</p>	<p>Instructor Actions</p>
<ul style="list-style-type: none"> • Ask any questions, receive study material for the next lesson. • Watch linked video. • Review listed references. 	<ul style="list-style-type: none"> • Deliver the ground lesson (below). • Answer student questions.
<p>Completion Standards</p>	
<ul style="list-style-type: none"> • Student can explain the following concepts: <ul style="list-style-type: none"> • Heading, Course, Track, True vs. Magnetic Headings • Magnetic Variation, Compass Deviation, Wind Correction Angle • How to use an EFB to Plan a VFR XC Course -or- How to use a Plotter and E6B • How to select suitable VFR Navigation Checkpoints, VFR Cruising Altitudes, and Fuel Stops • Pilotage, Dead Reckoning, and Navigation Logs • How to compute fuel, performance, and endurance figures • How to quickly compute diversions using “rule of thumb” calculations, and lost procedures • How to obtain a weather briefing, how to file and use a VFR flight plan, and make a go/no-go decision 	

References

- FLY8MA.com Flight Training - "Ep. 114: X/C Navigation Log | VFR Cross Country Nav Log Calculations"
 - YouTube - <https://www.youtube.com/watch?v=94vSzPU7TDw>
- FAA-H-8083-25C (Pilot's Handbook of Aeronautical Knowledge) - Chapter 16, Page 2-8 [Aeronautical Charts/Latitude Longitude], Chapter 16, Page 8-10 [Effect of Wind], Chapter 16, Page 11-12 [Basic Calculations], Chapter 16, Page 12-17 [Pilotage/Dead Reckoning], Chapter 16, Page 17-22 [Flight Planning/Charting the Course/VFR Flight Plans], Chapter 16, Page 34-35 [Lost Procedures/Flight Diversion]
- FAA-S-ACS-6C (Private Pilot ACS) - Area VI Task A, Area VI Task C, Area VI Task D
- FAA-S-ACS-7B (Commercial Pilot ACS) - Area VI Task A, Area VI Task C, Area VI Task D
- FAA-S-ACS-25 (CFI ACS) - Area II Task I

Ground Lesson Outline

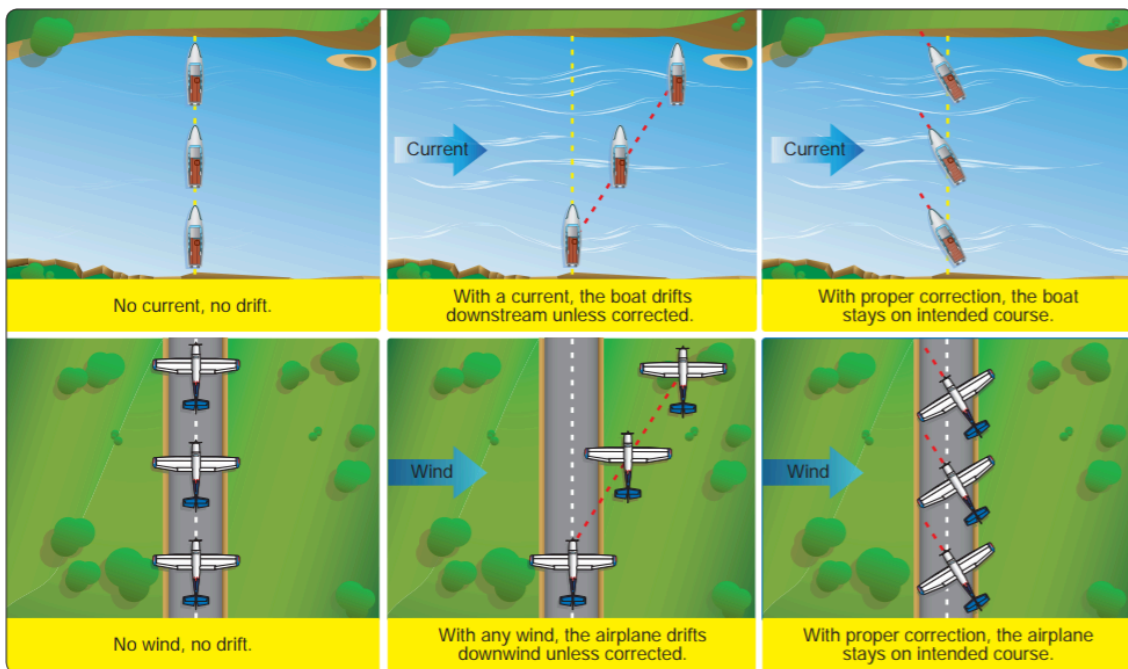
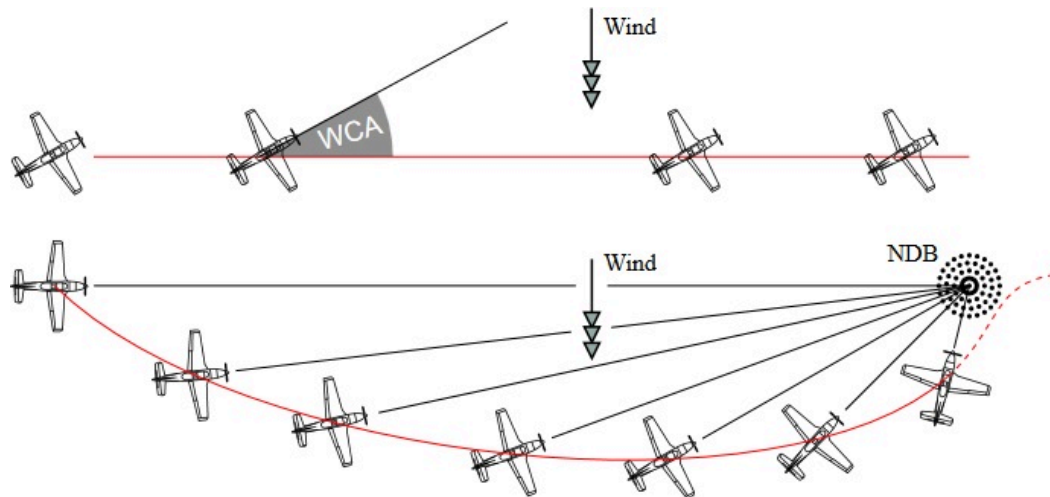
- Navigation Terms
 - Heading, Course, Ground Track, True Airspeed, Ground Speed, etc.
 - Magnetic Variation, Compass Deviation, Wind Correction Angles
- Aeronautical Charts
 - Latitude/Longitude Lines, Isogonic Lines, Scale
 - Spot Elevations, Contour Lines, Maximum Elevation Figures, Obstructions
 - Airports, Depictions of Landmarks/Ground Features, Depictions of Airspace
 - Importance of using the proper and current aeronautical charts
- Plotting a Course (Pen and Paper)
 - Using a Plotter and E6B, Winds Aloft / Weather Data
 - True Course +/- WCA -> True Heading +/- Variation -> Magnetic Heading +/- Deviation -> Compass
 - Performance Charts - Endurance, Performance, Fuel Consumption Calculations and Fuel Stops
 - Selecting an Altitude, VFR Cruising Altitudes - § 91.159
 - Power vs Fuel Consumption, VFR Fuel Requirements - § 91.151
 - Selecting Landmarks and Alternates, Planning for Emergencies
- Planning an XC Using an Electronic Flight Bag (ForeFlight)
- Fundamentals of Pilotage and Dead Reckoning
 - Landmarks - Lakes, Airports, Distinctive Roads, etc.
 - Checkpoints and Nav Logs - Importance of a Nav Log
 - Estimation of Time (behind schedule or ahead of schedule)
- Fundamentals of Radio Navigation
 - VORs, DME, and GPS
- Diversion to an Alternate
 - "Rule of Thumb" / Rough Calculations -> Time, Distance, Fuel
- Lost Procedures - VOR Triangulation, Use of GPS, Climb, Confess, etc.
- Inflight Interception Procedures - *See Supplement*
- Go/No-Go Decisions
 - Weather Briefing, ADM (PAVE/Good Judgement)
 - NOTAMs - Call a weather briefer!
- VFR Flight Plans
 - Purpose, How to File

Common Errors

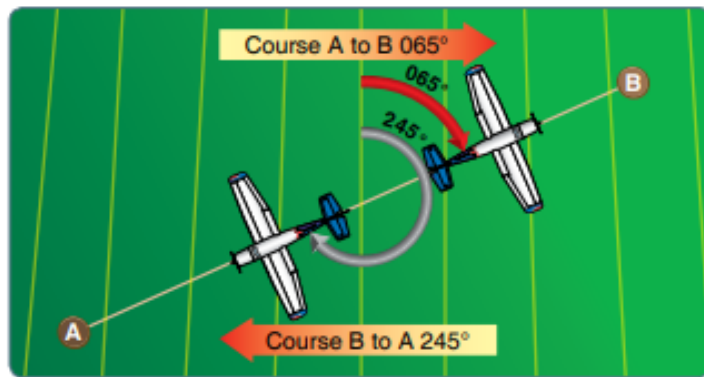
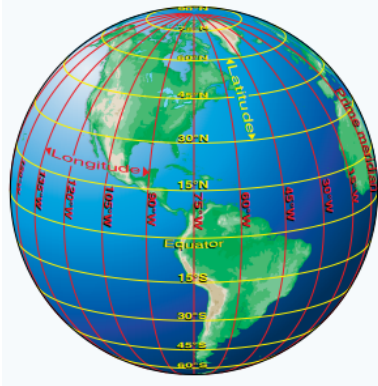
- Misunderstanding the relationship between True and Magnetic Course and Heading
- Inability to use a plotter or E6B to create a VFR Nav Log -or- Inability to use an EFB to effectively plan an XC
- Selection of inappropriate or inadequate visual checkpoints
- Failure to identify location using pilotage

Ground Lesson Supplement

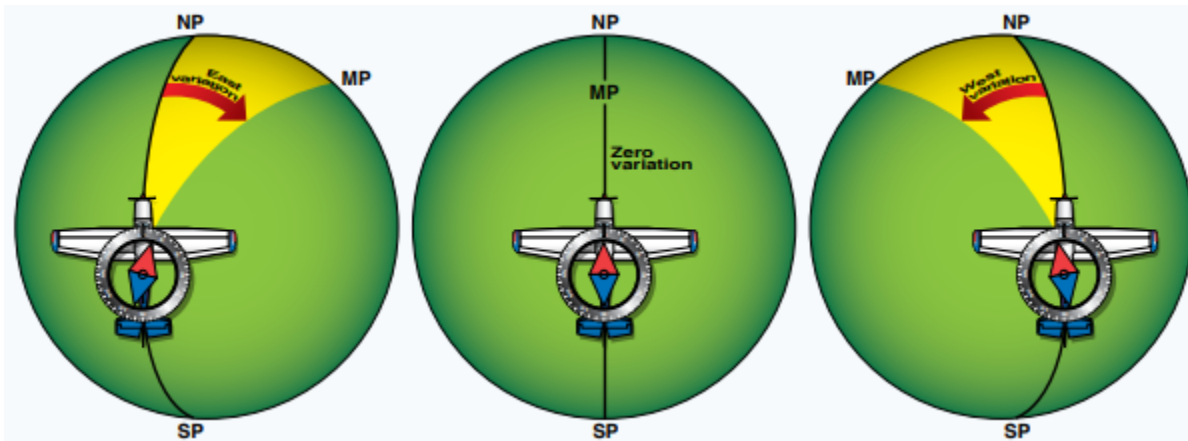
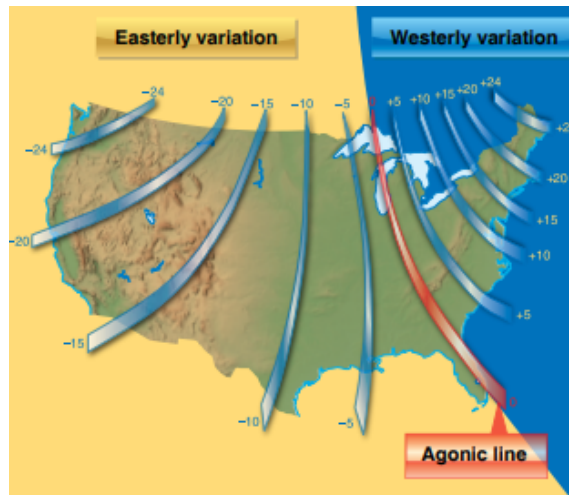
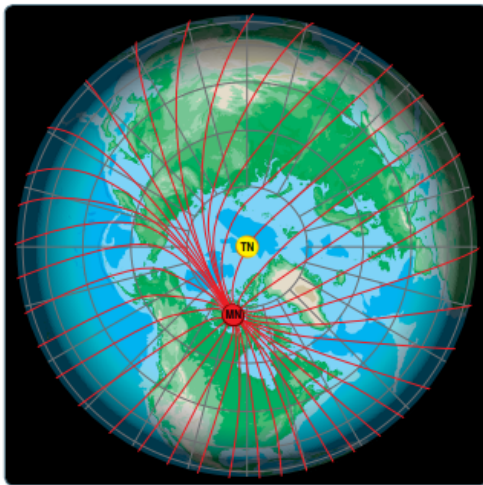
- Heading vs Track** - Airplanes fly within the air, which is nearly always moving. Simply pointing at a ground landmark and flying 'towards' it will result in the airplane flying a longer, curved path. As an airplane flies through the air, in order to track a straight line, called a *course* line, they must fly at an angle relative to the line which counteracts the effects of the wind. This is called a **wind correction angle**, or WCA.



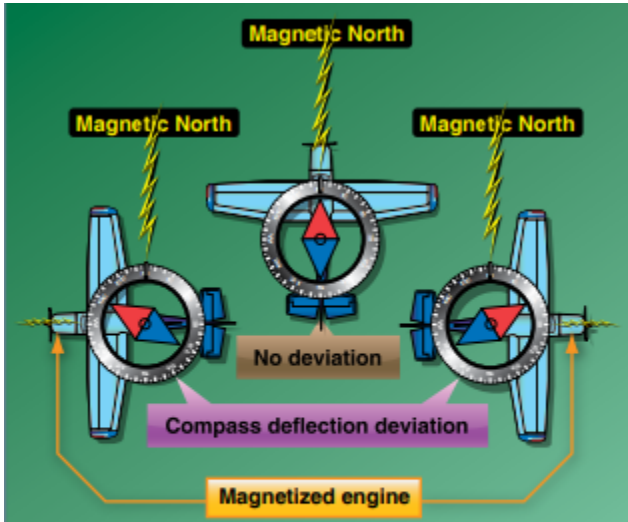
- **Latitude and Longitude** - Course lines are measured relative to lines of longitude.



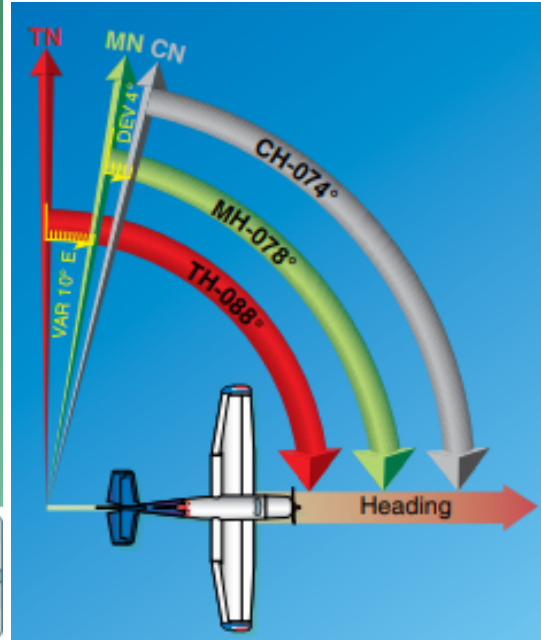
- **Magnetic Variation** - Magnetic North is not coincident with True North, creating *magnetic variation*. *Isogonic lines* are lines of equal magnetic variation.



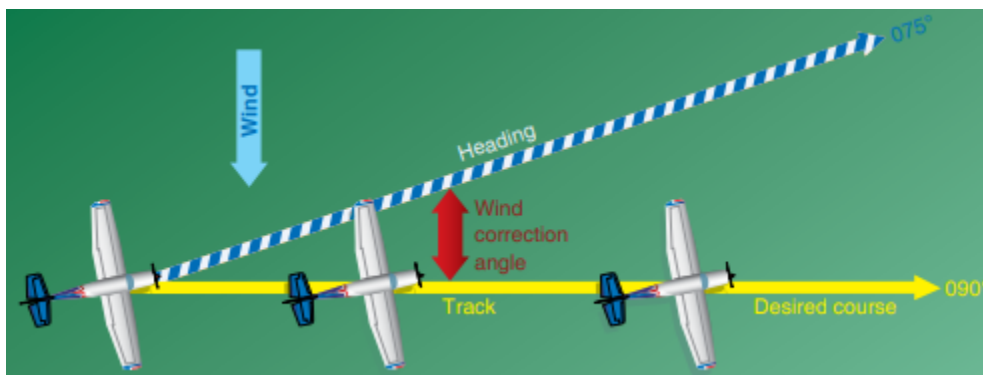
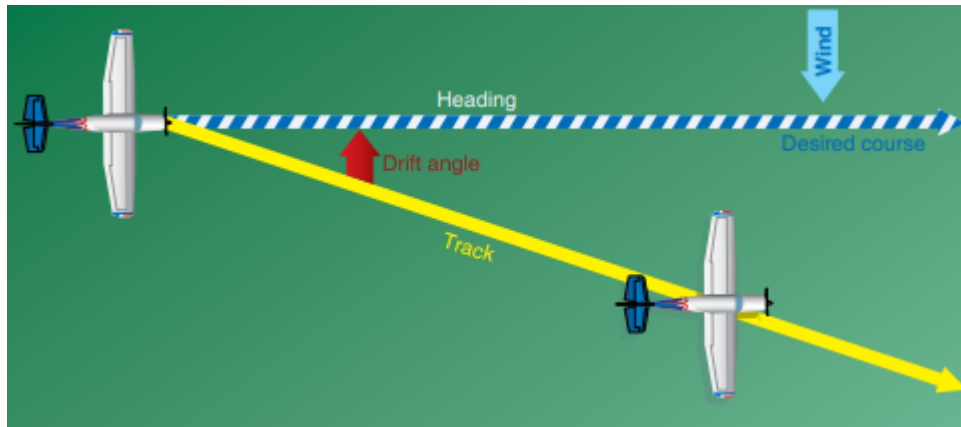
- **Compass Deviation** - Caused by large magnetic disturbances present in the airplane cockpit, depend on the heading. Corrected by using a *compass deviation card* (affixed to the compass)



For (Magnetic)	N	30	60	E	120	150
Steer (Compass)	0	28	57	86	117	148
For (Magnetic)	S	210	240	W	300	330
Steer (Compass)	180	212	243	274	303	332



- **Wind Correction Angle** - Corrects for wind drift.

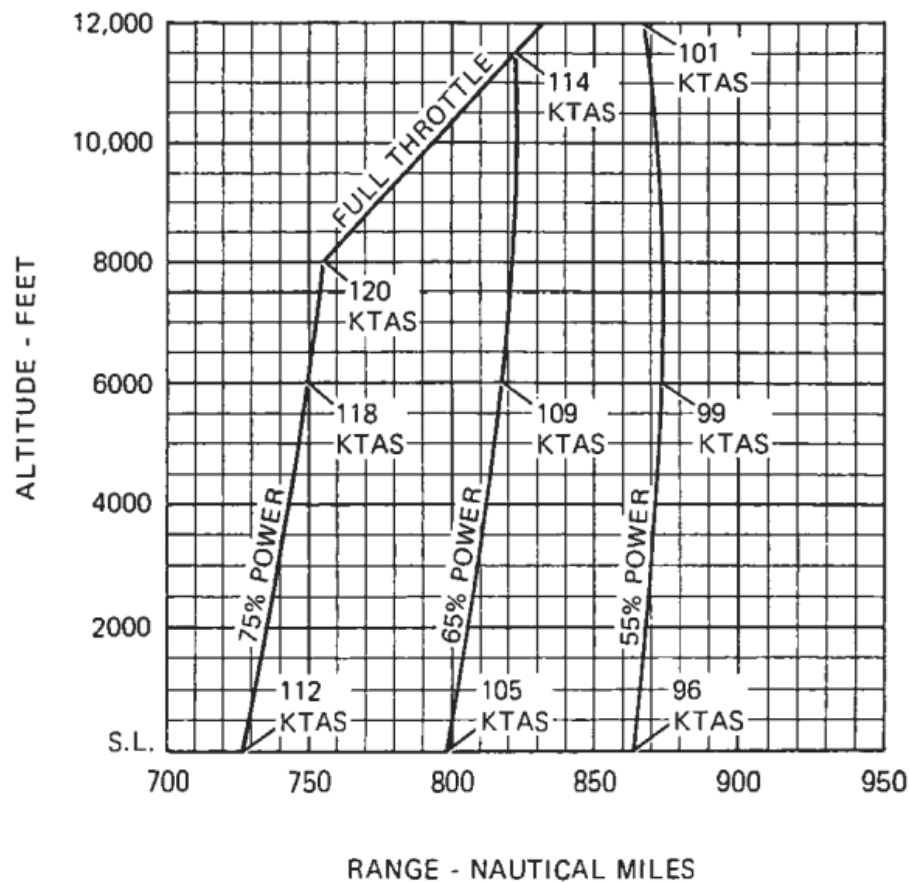


• Cruise Performance

CRUISE PERFORMANCE

CONDITIONS:
 2400 Pounds
 Recommended Lean Mixture (See Section 4, Cruise)

PRESSURE ALTITUDE FT	RPM	20°C BELOW STANDARD TEMP			STANDARD TEMPERATURE			20°C ABOVE STANDARD TEMP		
		% BHP	KTAS	GPH	% BHP	KTAS	GPH	% BHP	KTAS	GPH
2000	2500	---	---	---	76	114	8.5	72	114	8.1
	2400	72	110	8.1	69	109	7.7	65	108	7.3
	2300	65	104	7.3	62	103	6.9	59	102	6.6
	2200	58	99	6.6	55	97	6.3	53	96	6.1
	2100	52	92	6.0	50	91	5.8	48	89	5.7
4000	2550	---	---	---	76	117	8.5	72	116	8.1
	2500	77	115	8.6	73	114	8.1	69	113	7.7
	2400	69	109	7.8	65	108	7.3	62	107	7.0
	2300	62	104	7.0	59	102	6.6	57	101	6.4
	2200	56	98	6.3	54	96	6.1	51	94	5.9
	2100	51	91	5.8	48	89	5.7	47	88	5.5



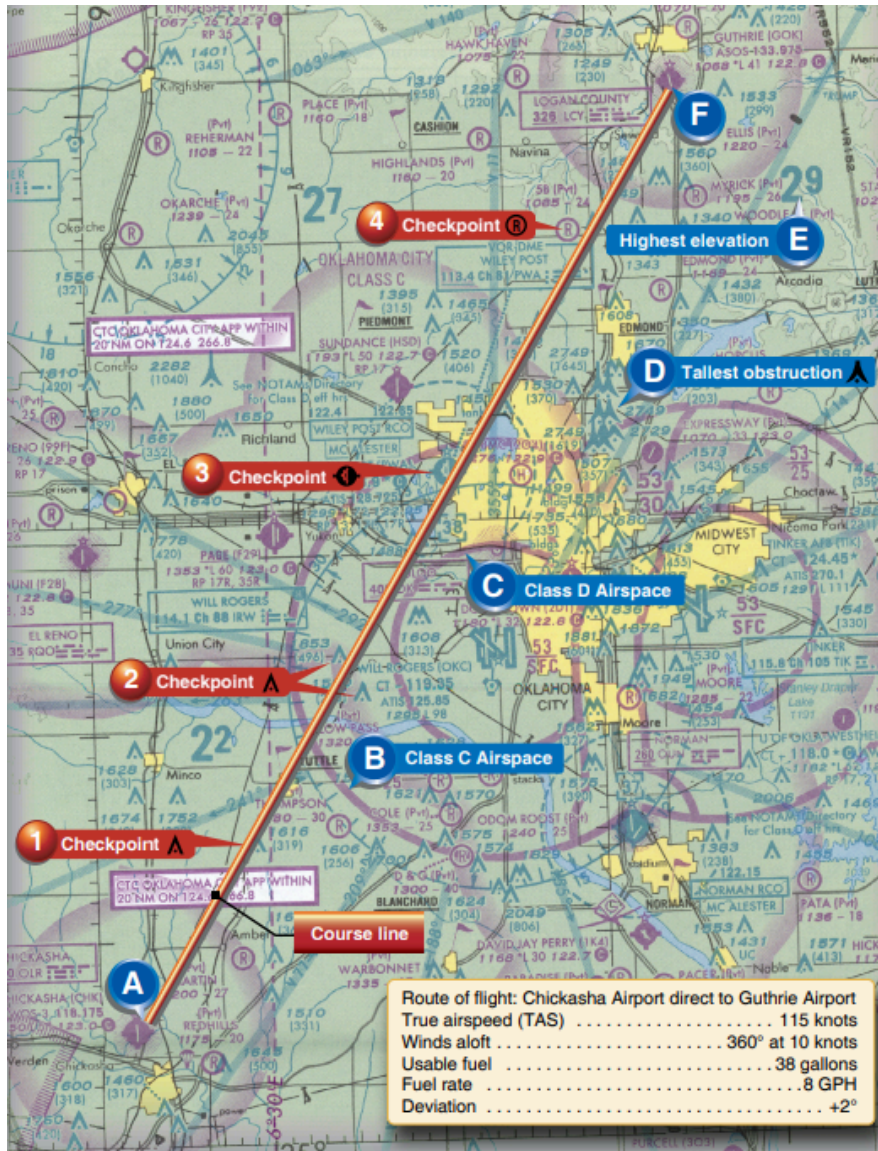
- Charts and Plotting a Course



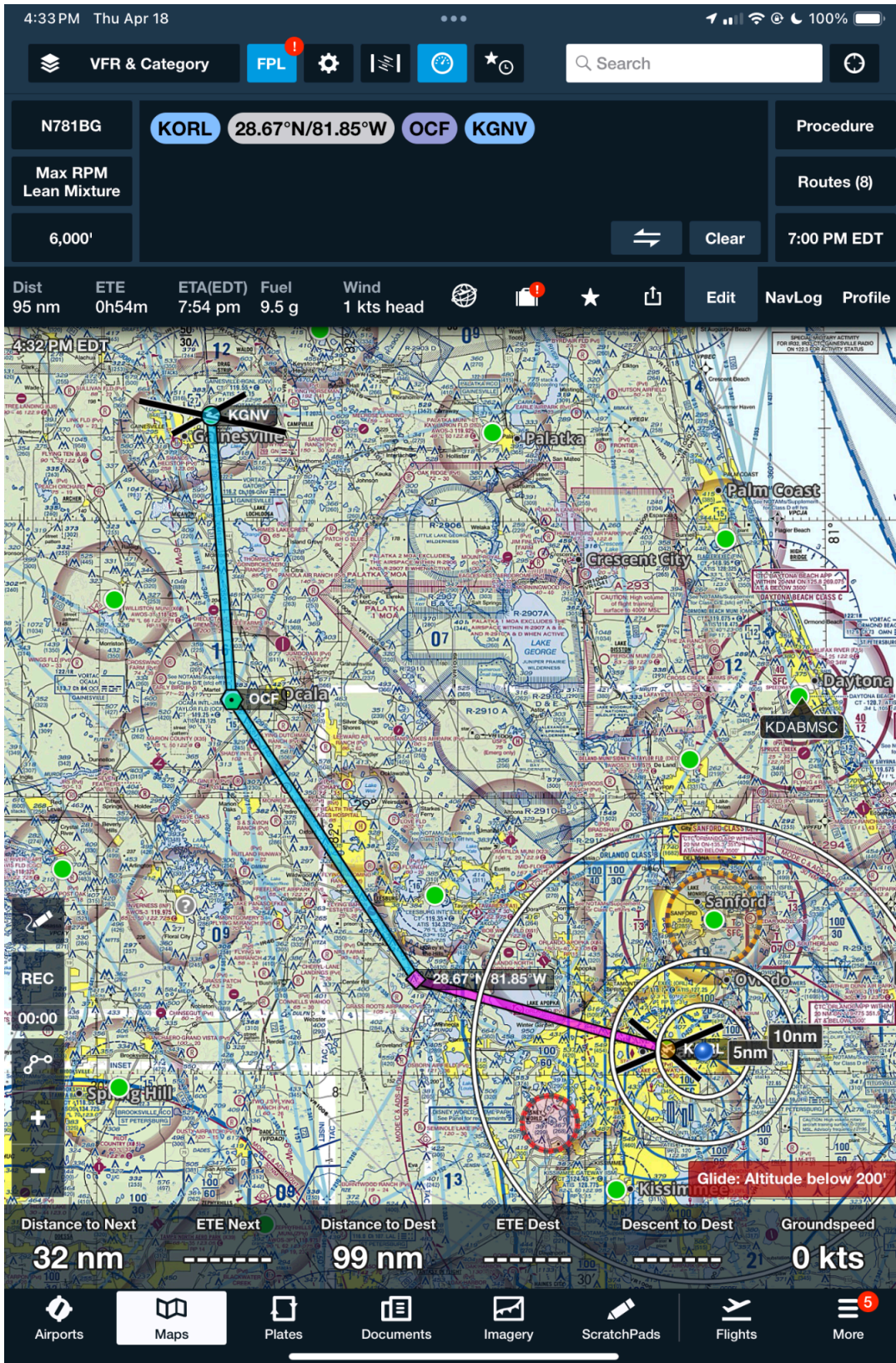
- E6B and Plotter



● VFR Checkpoints



- Flight Planning using an EFB (ForeFlight)
 - Laying out the course and creating waypoints



- **Setup Performance Profile and Select a Cruising Altitude**

- **Performance Profile** - Numbers must be derived from POH. Usually involves converting “Time, Fuel, and Distance to Climb” values to Gallons per Hour units.
- **Cruising Altitude Selection** - ForeFlight will consider winds aloft and aircraft performance to determine the headwind/tailwind, time, and fuel required for each altitude.
 - Make sure you set your Estimated Time of Departure (ETD) accurately!
 - Ensure you consider cloud height forecasts!

Back

GENERAL

Profile Name

CLIMB

Climb TAS (KTS) 74

Climb Fuel Per Hour 14

Climb Rate (FPM) 500

CRUISE

Cruise TAS (KTS) 110

Cruise Fuel Per Hour 9.5

DESCENT

Descent TAS (KTS) 100

Descent Fuel Per Hour 4

Descent Rate (FPM) 500

The fuel numbers above are in GALLONS PER HOUR. You can change this on the Aircraft view, under "Fuel Units."

Make Default

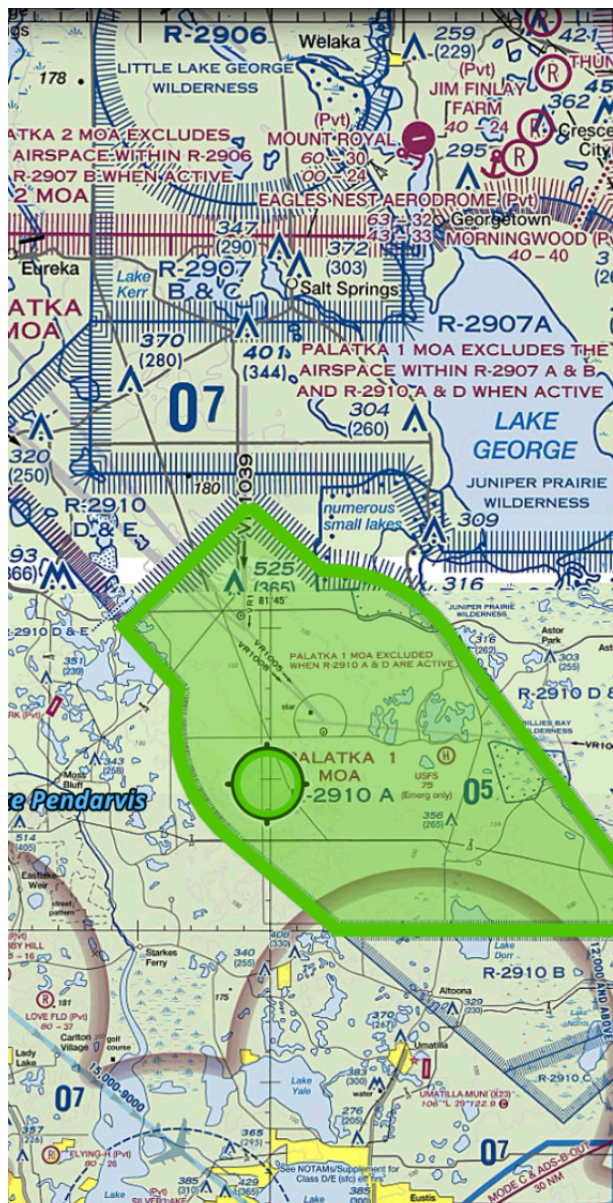
Delete Profile

Close

Altitude			6,500
1,000'	2 kts tailwind	0h50m	8.8g <input type="radio"/>
1,500'	2 kts tailwind	0h51m	8.7g <input type="radio"/>
2,000'	2 kts tailwind	0h51m	8.7g <input type="radio"/>
2,500'	2 kts tailwind	0h51m	8.9g <input type="radio"/>
3,000'	1 kts tailwind	0h52m	9.1g <input type="radio"/>
3,500'	1 kts tailwind	0h52m	9.2g <input type="radio"/>
4,000'	winds calm	0h52m	9.4g <input type="radio"/>
4,500'	winds calm	0h53m	9.4g <input type="radio"/>
6,500'	1 kts headwind	0h55m	9.6g <input checked="" type="radio"/>
8,500'	3 kts headwind	0h58m	9.9g <input type="radio"/>
10,500'	4 kts headwind	1h03m	10.2g <input type="radio"/>

VFR
IFR
Westerly
Easterly
All

- **Investigate Airspace along your route** - Long press on airspace to display important details about the airspace, analogous to looking in the VFR Chart margins or legend.



Back	R-2910A Special Use Airspace
Type	Restricted Area
Designator	2910A
Name	R-2910A
Upper Limit	23,000' MSL
Lower Limit	Surface
COMMUNICATIONS	
Jacksonville ARTCC	134.0
ADDITIONAL INFORMATION	
Activation	Non-continuously
Hours	Intermittent, 0800-2400, daily; other times by NOTAM, 6 hours in advance
OPERATIONAL NOTES	
FAA, Jacksonville ARTCC	

- **Review the Calculated Nav Log in ForeFlight**
 - An *abbreviated* NavLog is available on the main UI
 - **Headings displayed are Magnetic**, and already account for calculated winds aloft!
 - There is also a more detailed traditional Nav Log available in the **Flights** tab.
 - Touch the 'Send To' icon and then select 'Flights'
 - You can also file a VFR Flight Plan using the generated information!
 - **Always Remember, Garbage In = Garbage Out!**
 - You must supply accurate performance data, ETD, etc!
 - **Review the ForeFlight support article -**
<https://support.foreflight.com/hc/en-us/articles/360012904193-What-do-the-items-in-the-Flights-page-NavLog-mean>

The screenshot shows the ForeFlight VFR & Category screen. At the top, there's a navigation bar with 'VFR & Category', 'FPL', and various icons. Below this is a flight plan table with columns: FROM, TO, HDG, TOTALS, LEG, REMAINING, and ETA. The flight plan consists of three legs: KORL to 28.67...85°W, 28.67...85°W to OCF, and OCF to KGNV. Below the table, there are summary statistics: Dist 95 nm, ETE 0h55m, ETA(EDT) 7:55 pm, Fuel 9.6 g, Wind 2 kts head. To the right of the statistics are icons for 'NavLog' and 'Profile'. The main part of the screen is a map showing the flight route around Gainesville, Florida, with KGNV (Gainesville Regional) highlighted. A detailed view of KGNV is shown on the right side of the screen, including options like 'Direct To', 'Remove from Route', 'Fullscreen', and 'More >'. Below this, there's a section for 'Gainesville Regional' with details like 'Gainesville, Florida, US', 'Elevation: 151'', and '6:57 AM 7:58 PM EDT'. At the bottom, there are tabs for 'Info', 'Weather', 'Runway', 'Procedure', and 'NOTAM'. The 'Info' tab is selected, showing 'WEATHER AND ADVISORY' with ASOS (352) 335-8672 at 127.15, ATIS at 127.15, and 'CLEARANCE' for Gainesville Clearance Delivery (904) 741-0284 and Jacksonville Approach.

FROM	TO	HDG	TOTALS	LEG	REMAINING	ETA
KORL	28.67...85°W	290°M	28 nm 4.5 g 0h18m	28 nm 3.4 g 0h18m	-----	---:--
28.67...85°W	OCF	331°M	64 nm 7.3 g 0h37m	36 nm 2.8 g 0h19m	-----	---:--
OCF	KGNV	359°M	95 nm 9.6 g 0h55m	31 nm 2.3 g 0h19m	-----	---:--

Dist 95 nm ETE 0h55m ETA(EDT) 7:55 pm Fuel 9.6 g Wind 2 kts head

KGNV
Gainesville Regional

Direct To Remove from Route Fullscreen More >

Gainesville Regional
Gainesville, Florida, US
Elevation: 151'
6:57 AM 7:58 PM EDT

3D View Taxiways FBOs Comments

Info Weather Runway Procedure NOTAM

WEATHER AND ADVISORY

ASOS (352) 335-8672 127.15

ATIS 127.15

CLEARANCE

Gainesville Clearance Delivery (904) 741-0284
Jacksonville Approach

KORL to KGNV

Navlog
KORL to KGNV



KORL — KGNV (Apr 18, 2024) in N781BG (C172 - 172R Skyhawk) VFR
Full Throttle - Max RPM Lean Mixture @ 6500' - Min RPM 500 fpm

Created Apr 18 2024 2146Z
Winds Apr 18 2024 1200Z

ETE 0h55m	Distance 95NM	Avg Wind 2kt head (293°/003)	ETD 6:00 PM EDT / 2200Z	ETA 6:55 PM EDT / 2255Z	TOW 1925 lbs	ELW 1874 lbs
Block Fuel 15.5 g	Taxi Fuel 1.2 g	Flight Fuel 9.7 g	Reserve Fuel 5.8 g	Alternate Fuel 0.0 g	Extra Fuel 0.0 g	Landing Fuel 5.8 g

Route

2840N08151W OCF

RAIM (5° Mask, With Baro-aid)

✓ RAIM: No outages predicted

WAYPOINT	AIRWAY	MAG			WIND			SPD KT		DIST NM		FUEL G		ACT	TIME			ACT
		HDG	CRS	ALT	CMP	DIR/SPD	ISA	TAS	GS	LEG	REM	USED	REM		LEG	REM	ETE	
KORL		-	-	113	-	-	+11	-	-	-	95	1.2	14.3		-	0:55	-	
-TOC-	DCT	291	292	6500	T1	159/001	+12	84	84	17	78	3.7	11.8		0:13	0:42	0:13	
2840N08151W	DCT	291	291	6500	H3	282/003	+10	120	117	11	67	4.5	11.0		0:05	0:37	0:18	
OCF OCALA 113.7	DCT	333	334	6500	H1	282/002	+10	120	118	36	31	7.3	8.2		0:19	0:18	0:37	
-TOD-	DCT	360	002	6500	H3	307/005	+11	120	117	12	19	8.2	7.3		0:06	0:12	0:43	
KGNV	DCT	360	002	151	H3	267/003	+12	91	88	19	-	9.7	5.8		0:12	-	0:55	

WINDS ALOFT	3000 FT (ISA: 9°C)		5000 FT (ISA: 5°C)		7000 FT (ISA: 1°C)		8000 FT (ISA: -1°C)		10000 FT (ISA: -5°C)	
	(COMP)	WIND ISA	(COMP)	WIND ISA	(COMP)	WIND ISA	(COMP)	WIND ISA	(COMP)	WIND ISA
-TOC-	(H2)	225/003 +12	(H2)	227/003 +12	(H6)	312/007 +11	(H13)	329/017 +12	(H16)	327/020 +12
2840N08151W	(H1)	221/003 +12	(H1)	222/003 +12	(H6)	314/007 +11	(H12)	330/017 +12	(H16)	326/020 +12
OCF	(T1)	209/003 +12	(T1)	201/002 +12	(H6)	324/006 +11	(H17)	334/017 +12	(H21)	324/021 +12
-TOD-	(T2)	205/003 +12	(T2)	192/002 +12	(H6)	327/006 +11	(H17)	336/018 +12	(H18)	323/021 +12
		0h51m (-0:04), 7.7 g Avg wind comp: T2		0h53m (-0:02), 8.2 g Avg wind comp: T1		0h55m (0:00), 8.6 g Avg wind comp: H1		0h59m (+0:04), 9.1 g Avg wind comp: H7		1h06m (+0:11), 9.3 g Avg wind comp: H10

SUMMARY & TIMES

PIC	Ryan C Binns
Souls on board	1
Tail	N781BG (C172)
Profile	Full Throttle - Max RPM Lean Mixture @ 6500' - Min RPM 500 fpm
Fuel Flow	9.2 g/hr
Distance	95NM
ETD	6:00 PM EDT / 2200Z
ETE	0h55m
ETA	6:55 PM EDT / 2255Z
Route	2840N08151W OCF

FUEL & WEIGHTS

Block Fuel	15.5 g
Taxi Fuel	1.2 g
Flight Fuel	9.7 g
Reserve Fuel Min: 5.8 g	5.8 g
Alternate Fuel	0.0 g
Extra Fuel	0.0 g
Additional	0.0 g
Payload	200 lbs
ZFW	1839 lbs
TOW	1925 lbs
ELW	1874 lbs

NOTES

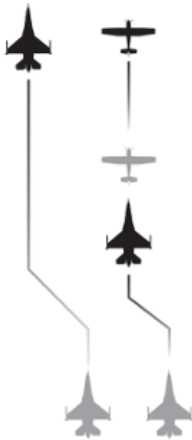
Out:	In:	Block time:
Off:	On:	Flight time:
Start:	Stop:	Hobbs time:
Start:	Rem:	Fuel used:
Signature:		

Visual Intercept Signals

Fighter Aircraft:	Meaning:	Intercepted Aircraft:
Approaches pilot-side of aircraft and matches speed and heading. (Nighttime) Will also flash navigation lights.	You have been intercepted.	(Daytime) Rock wings to acknowledge. (Nighttime) Rock wings and flash navigation lights to acknowledge.
Initiates a slow, level turn.	Follow me. Fly this way.	Match heading and follow. Continue on heading in direction of fighter.
Initiates abrupt turn across nose; may dispense flares.	Warning! Turn now in direction of fighter.	Immediately match heading and follow.
Circles airport, lowers landing gear, and overflies runway in direction of landing. (Nighttime) Will also turn on landing lights.	Land at this airport.	Lower landing gear (if equipped) and land on runway. If airport inadequate, raise landing gear (if equipped) while flying over runway and flash landing lights. Continue to circle airport between 1,000-2,000 feet until fighter signals to follow to alternate airport.
Performs the breakaway maneuver.	Fighter understands intercepted aircraft's intentions.	If cannot comply, switch on and off all available lights at <i>regular</i> intervals. If in distress, switch on and off all available lights at <i>irregular</i> intervals.

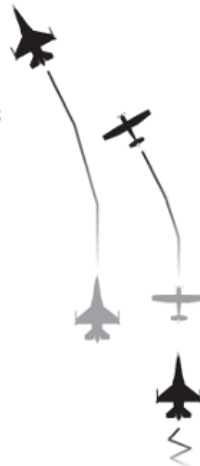
Approach & Identification

Typically two fighter jets approach from the rear. One fighter flies around to make visual contact with the pilot. This may also be conducted with a law enforcement helicopter.



Fly This Way

A slow turn by a fighter jet indicates that you should follow in the same direction. Be cautious of wake turbulence.



Breakaway Maneuver

Fighter jets will abruptly break away from pursuit when they understand your intentions.

