

Wind and Weather

John Mahany
ATP/CE-500, LR-JET, NB-25, DC-3
MCFI
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Nice weather



And not so nice weather



What causes weather?



Weather is caused by...

- 💧 Solar radiation and the uneven heating of the earth's surface (landmass vs. water), combined with the earth's rotation

What causes wind?

Answer...

- A **difference in air pressure** is what causes the wind to blow.
- Wind is simply **air moving from** a place of **high air pressure to** a place of **low air pressure**.
- The greater the difference in air pressure, the stronger the winds.

Weather is...wind



Wind

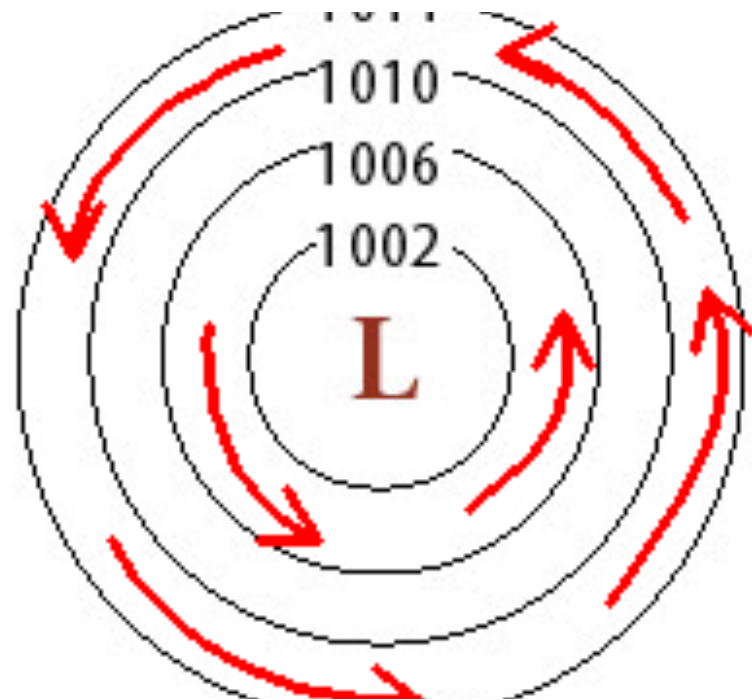
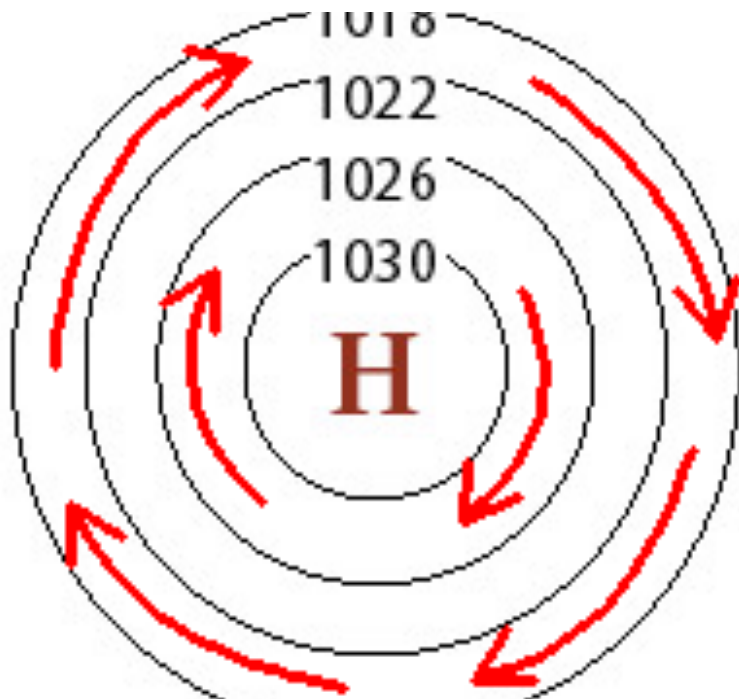


Sea Level Pressure Chart

ISA 1013.2 mbar



What causes wind? High and Low Pressure Gradients



Santa Ana Conditions



Santa Ana Conditions



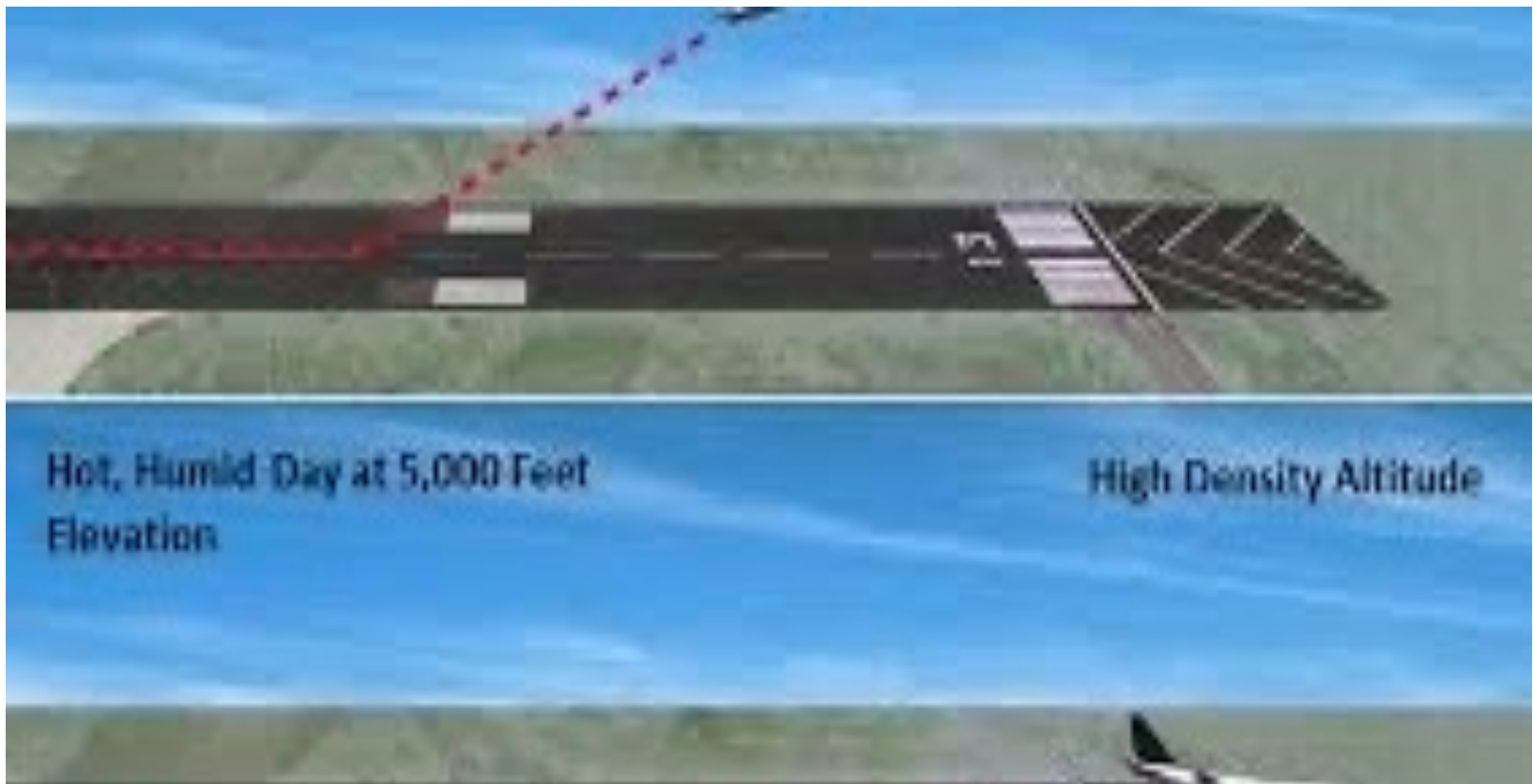
Santa Ana Conditions



Weather is Summer Heat



Density Altitude



Aircraft POH Performance Chart

Full Throttle Prior to Brake Release
Paved, level, dry runway

Lift Off: 48 KIAS
Speed at 50 Ft: 54 KIAS

Press Alt In Feet	0°C		10°C		20°C		30°C		40°C	
	Grnd Roll Ft	Total Ft To Clear 50 Ft Obst	Grnd Roll Ft	Total Ft To Clear 50 Ft Obst	Grnd Roll Ft	Total Ft To Clear 50 Ft Obst	Grnd Roll Ft	Total Ft To Clear 50 Ft Obst	Grnd Roll Ft	Total Ft To Clear 50 Ft Obst
S. L.	745	1275	800	1370	860	1470	925	1570	995	1665
1000	810	1390	875	1495	940	1605	1010	1720	1085	1845
2000	885	1520	955	1635	1030	1760	1110	1860	1190	2000
3000	970	1665	1050	1795	1130	1930	1215	2060	1305	2230
4000	1065	1830	1150	1975	1240	2130	1335	2295	1430	2455

Winter Cold & Snow



Study of Weather Related Accidents

- Fatal weather-related general aviation accidents in the US
- By Andrew J. Fultz & Walker S. Ashley

Weather Related GA Accidents

- 💧 Accidents studied from 1982 – 2013
- 💧 Weather was a cause or contributing factor in 35% of fatal accidents; 60% occurred in IMC.
- 💧 Fatal weather-related GA accidents occurred more often between April & October, weekend mornings and evenings,
- 💧 West Coast, Mountains, and Northeast

Pilots understanding of weather

- 💧 The report notes that “...pilots should have at least *some understanding* of weather processes, the possible hazards associated with weather, and how to recognize those hazards while en route.”
- 💧 How many pilots have at least *some understanding of weather processes*? **Not nearly enough!**

Most common causes of weather-related accidents...

- 💧 Wind
- 💧 Low Visibility
- 💧 Low Ceilings
- 💧 High Density Altitude...every summer this is repeated.

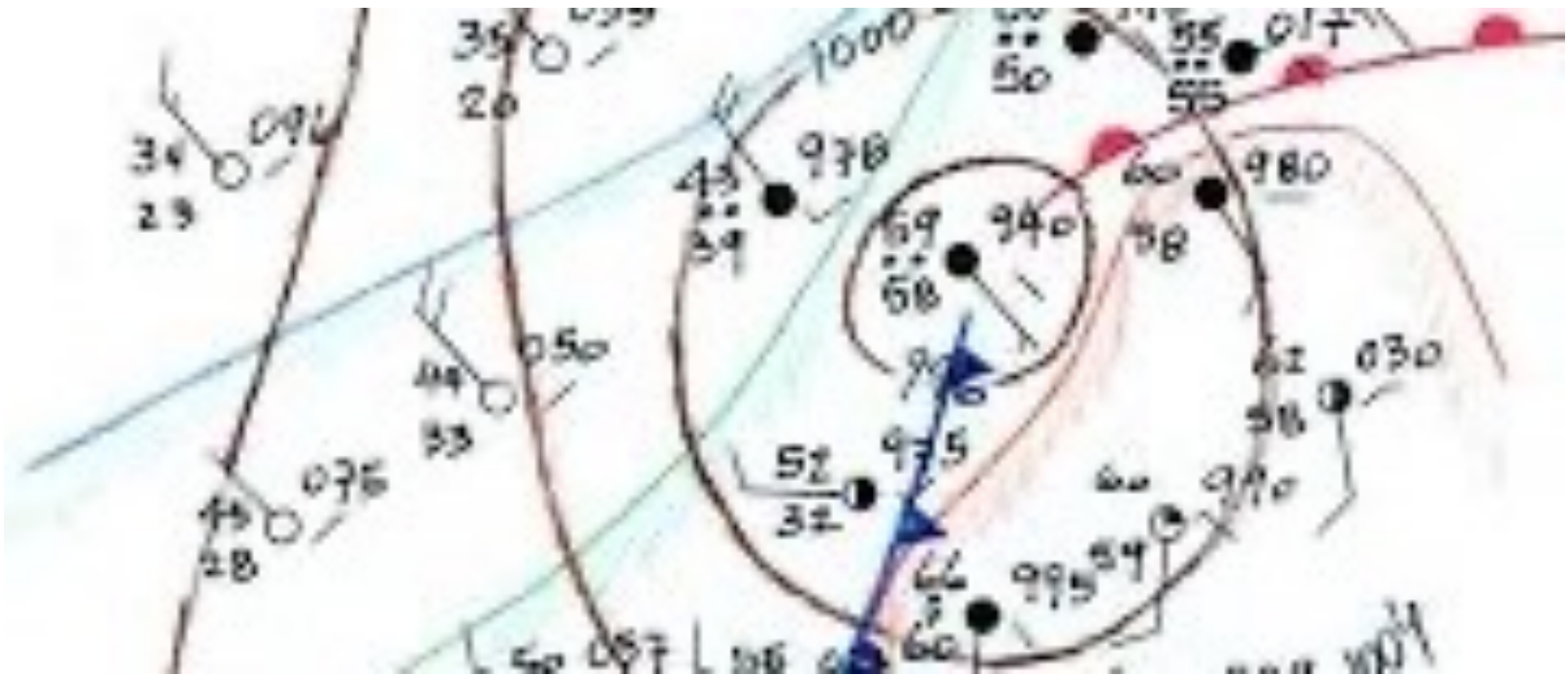
Wind...

- 💧 Headwinds, Tailwinds, Crosswinds, Windshear
- 💧 What's the limit for the airplane you fly?

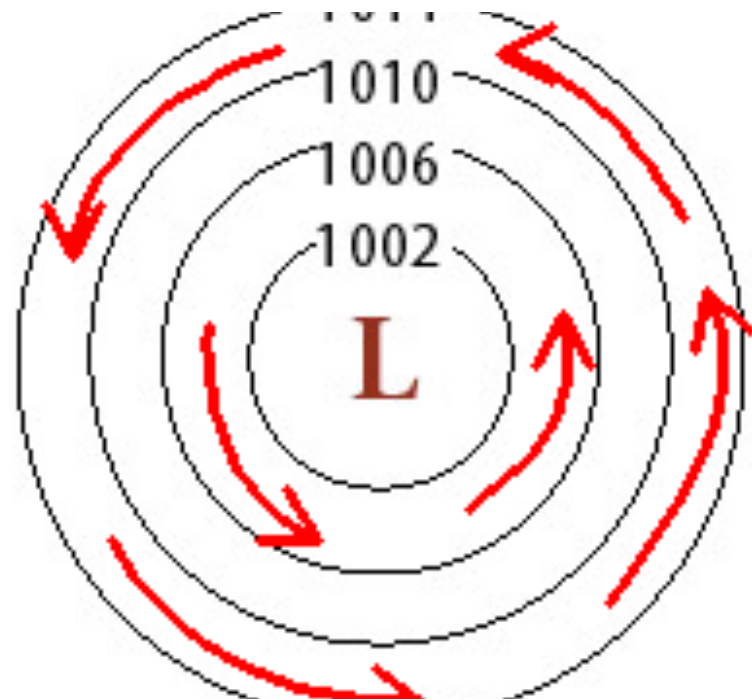
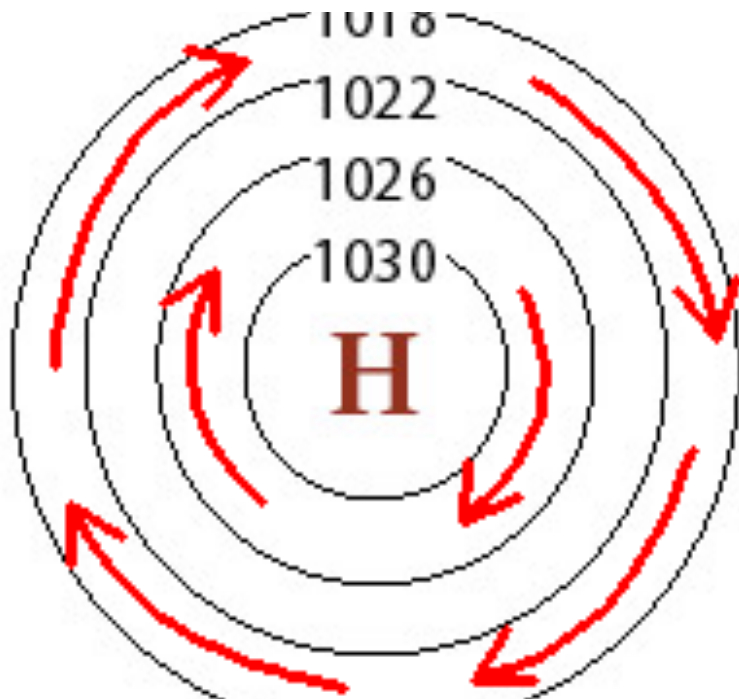
Wind

- 💧 Wind was the most commonly cited weather hazard
- 💧 8,809 weather related accidents from 1982 – 2013
- 💧 Wind was linked to 50% of the weather-related accidents
- 💧 Including gusts, crosswinds and tailwinds
- 💧 Crosswinds were a factor in 40% of non-fatal wind related accidents, but only 13% of fatal wind-related accidents

Frontal Boundary & Winds



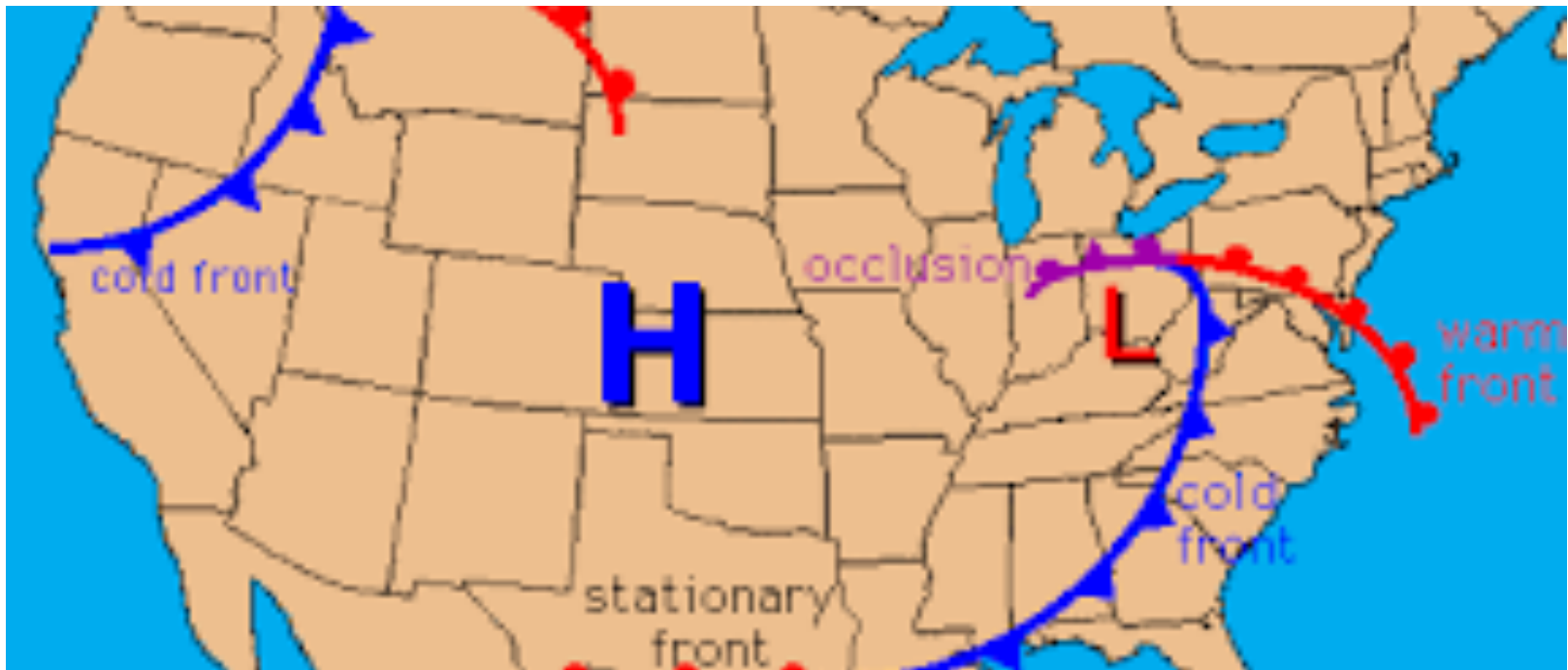
What causes wind? High and Low Pressure Gradients



Frontal Passage marked by

- Wind Shift
- Barometric Pressure Change ~ Altimeter Changes

Frontal Passage



Crosswind Takeoffs



Crosswind Graphic



Crosswind Rule of Thumb

- 💧 5 – 7 – 9 rule (trigonometry applied)
- 💧 IF the wind is 30 degrees to the runway, 50% of the wind speed is the direct crosswind component
- 💧 IF the wind is 45 degrees to the runway, 70% of the wind speed is the direct crosswind component
- 💧 IF the wind is 60 degrees to the runway, 90% of the wind speed is the direct crosswind component

Takeoff Crosswind Correction

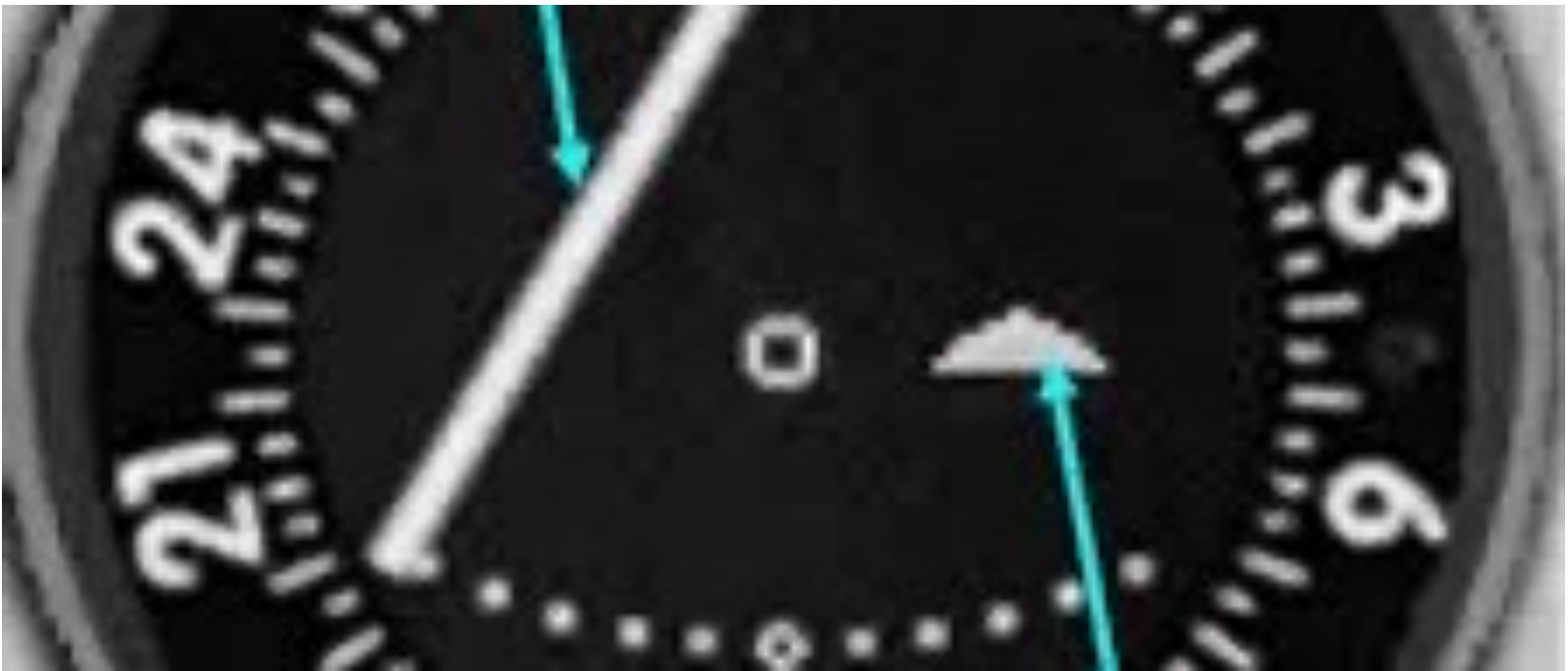
Cross controlled



En Route Frontal Passage Course Correction



Course Correction



Crosswinds

- According to the FAA's publication, the Pilot's Handbook of Aeronautical Knowledge (PHAK), regarding crosswinds, every certified aircraft is tested.
- An aircraft is tested by a pilot with *average piloting skills*, in 90 degree crosswinds with a velocity up to $0.2 V_{so}$ or two-tenths of the aircraft's stalling speed with power off, gear and flaps down.
- So, if the aircraft has a stall speed of 45 knots, it must be capable of landing in a 9 knot 90-degree crosswind. The maximum *demonstrated* crosswind component is published in the AFM/POH.

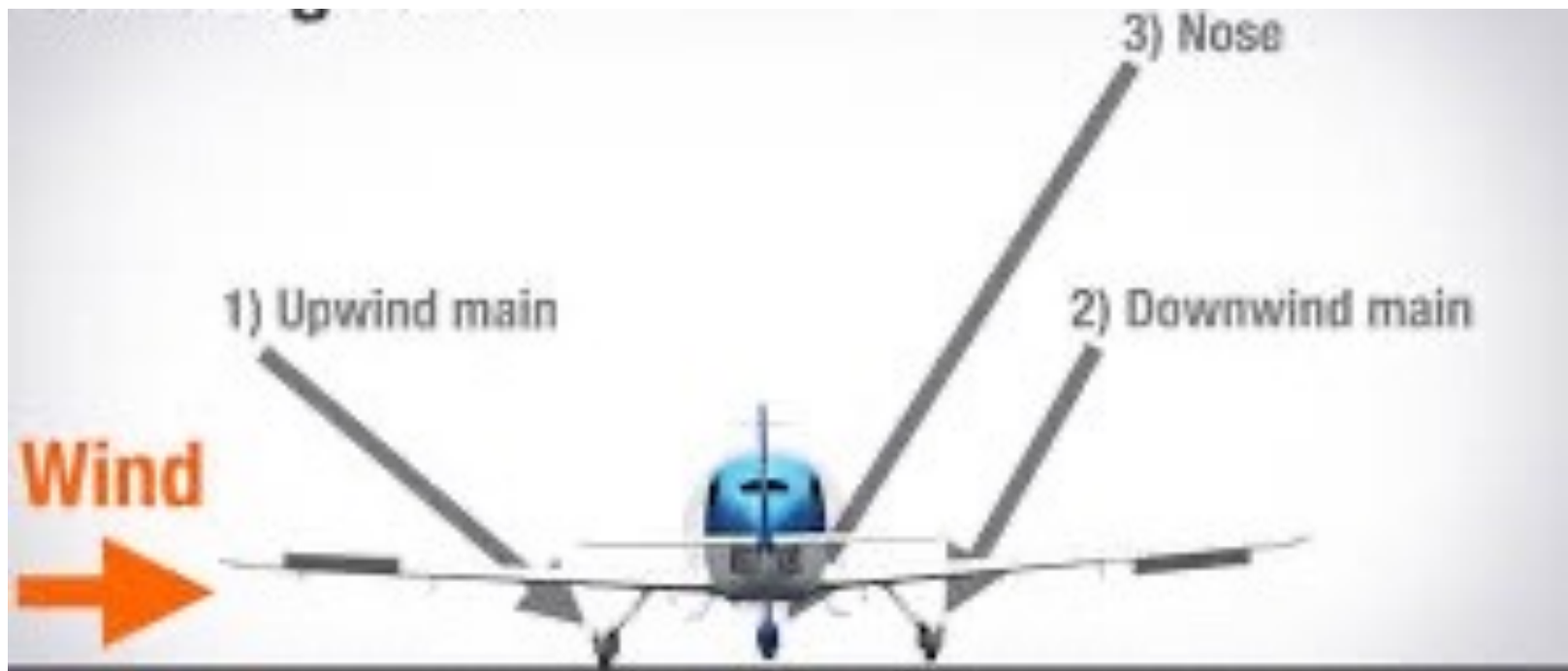
Crosswind Landing



Or this Crosswind Landing



Crosswind Landings...



FAA Airplane Flying Handbook

- Common errors in the performance of crosswind approaches and landings are:
 - Attempting to land in crosswinds that exceed the airplane's maximum demonstrated crosswind component
 - Inadequate compensation for wind drift on the turn from base leg to final approach, resulting in undershooting or overshooting
 - Inadequate compensation for wind drift on final approach
 - Unstable approach

Airplane Flying Handbook

- 💧 Crosswind landings are a little more difficult to perform than crosswind takeoffs, mainly due to different problems involved in maintaining accurate control of the airplane while its speed is decreasing rather than increasing as on takeoff.

Airplane Flying Handbook

- There are two usual methods of accomplishing a crosswind approach and landing—the crab method and the wing-low (sideslip) method.
- Although the crab method may be easier for the pilot to maintain during final approach, it requires a high degree of judgment and timing in removing the crab immediately prior to touchdown.
- The wing-low method is recommended in most cases, although a combination of both methods may be used.

Narrow Runways – a challenge



Narrow Runways – and more challenging



Crosswind landing??



Youtube video crosswind landings

Runway Width & Crosswinds



My method for crosswind landings?

- 💧 I typically aim for the upwind 1/3 of the runway.
- 💧 When flaring to land, as speed and control are diminished, the airplane will usually drift onto the runway centerline.
- 💧 It's nice when it works. 😊

Crosswind landing...



CE 172 Crosswind Limit?

- 💧 Per the POH, the maximum *demonstrated* crosswind component is 15 knots, and is NOT a limit. The POH says '(not a limitation)', in section 5, page 13, revision 4.
- 💧 The question is, what is the level of your proficiency?

Coordination Exercise helps with crosswind technique



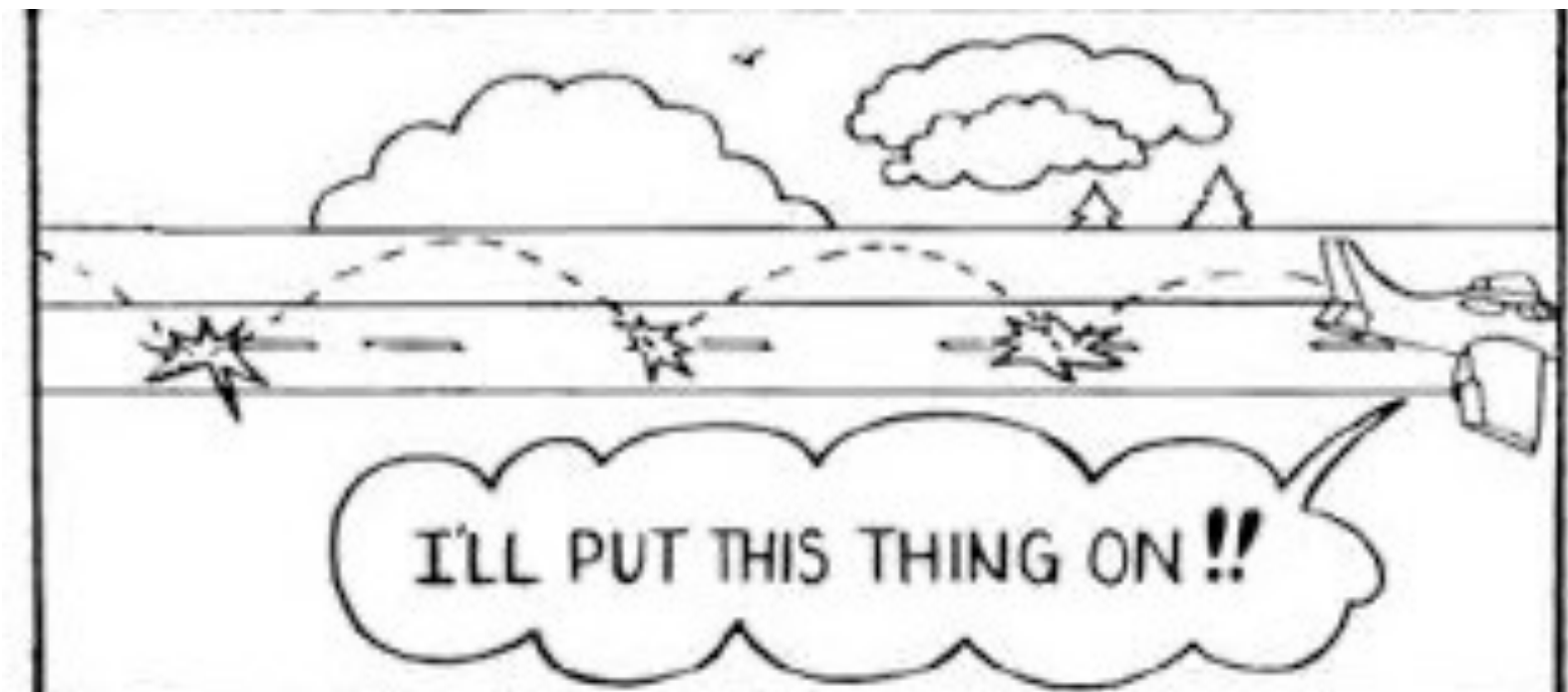
Rule of Thumb for Wind

- 💧 Add $\frac{1}{2}$ the steady wind speed plus all the gust factor to your approach speed, not to exceed 20 knots
- 💧 Ex; Winds 36010G20KT (360 @ 10 kts. gusting 20 kts.) add $\frac{1}{2}$ of 10 (steady) = 5 + 10 (1/2 gust) = 15 knots added to final approach speed. This gives you more control. Also, suggest using less flaps under these conditions. Suggest 20 or 10 degrees for better control. PIC judgment call based on experience.

Speed control on landing

- 💧 As was mentioned in Aviation Safety Magazine –
- 💧 Many pilots correctly add to their approach speed in windy conditions, but then they don't slow down in the flare. ??
- 💧 Then with too much speed they attempt to land, and because they have too much (speed) energy, they bounce instead. This can lead to loss of control (LoC) on landing.
- 💧 Be ready to Go Around!!
- 💧 How is your airspeed control on landing? Especially in a gusty crosswind?

Bounced landing!



Tailwind takeoffs & landings

- Headwind will increase the airplane performance by shortening the takeoff distance and increasing the angle of climb.
- However, a tailwind will decrease performance by increasing the takeoff distance and reducing the angle of climb.

CE 172 POH

- 💧 Takeoff Distance; for operations with tail winds, up to 10 knots, increase distances by 10% for each 2 knots.
- 💧 So with a 10 knot tail wind the takeoff distance will increase 50%!?!?
- 💧 Given this, what are the effects of a high density altitude takeoff with a tail wind? At a one way airstrip in the mountains? The odds are against you.
- 💧 Check the POH for the airplane you fly!

CE 172 POH

- 💧 For landing with a tail wind, per the POH, similar to takeoff performance, with tail winds up to 10 knots, increase the distance by 10% for each 2 knots of wind. Again, a 50% increase in the distance.
- 💧 If the tail wind is more than 10 knots, you are on your own, meaning there is no takeoff performance data, and now you are in test pilot territory. Be aware.

Jets & tailwind limits

- 💧 Typically, jets are limited to a 10-knot tailwind, for both takeoff and landing.

Wind Shear anyone?

- 💧 What is wind shear?
- 💧 Audience participation 😊 anyone?

Wind Shear

- A change in the **wind direction** or **speed** within 2000 ft AGL.
- This condition can present danger to aircraft, *especially at landing*, when a sudden shift from



What causes wind shear?

Wind shear can be caused by

- 💧 Unstable atmospheric conditions
- 💧 Squall line or cold frontal passage
- 💧 Thunderstorm/convective activity
- 💧 Inversion layer

Wind Shear Indications

- 💧 Sudden gain or loss of airspeed
- 💧 Sudden gain or loss of altitude
- 💧 Sudden change in heading

Windshear

- 💧 Why the sudden gain or loss of airspeed and altitude?

Wind Shear Recovery Technique

- 💧 Aggressively pitch up! 10 – 15 degrees!
- 💧 Add full power!
- 💧 Do NOT Change Configuration –
- 💧 Leave Flaps and Gear Alone!
- 💧 Pitch for airspeed, don't stall

When is wind shear more dangerous?

- 💧 Takeoff?
- 💧 or
- 💧 Approach and landing?
- 💧 Audience participation 😊

Wind Shear on Takeoff



Wind Shear on Landing



Turbulence

- 💧 What about flying in turbulence?
- 💧 What's the best way to handle flying in turbulence?
- 💧 What the best speed to fly in turbulence, and what configuration to use? Flaps up or down?
- 💧 Why are crosswind limits 'demonstrated' for airplanes?

Load Factor Normal Category

Normal Category

Max takeoff weight of 2550 lbs.

Flaps Up	+3.8g, -1.52g
Flaps Down	+3.0g

The design load factors are 150% of the above, and in all cases the structure meets or exceeds the design loads.

Personal Minimums

- 💧 What are your personal minimums regarding the wind, or, when is it too windy for you?
- 💧 Many pilots are not proficient with crosswinds because they don't get enough practice.
- 💧 Practice, practice, practice! Look for windy conditions, and take a competent instructor with you!

Flying my Cessna 150 to AirVenture!



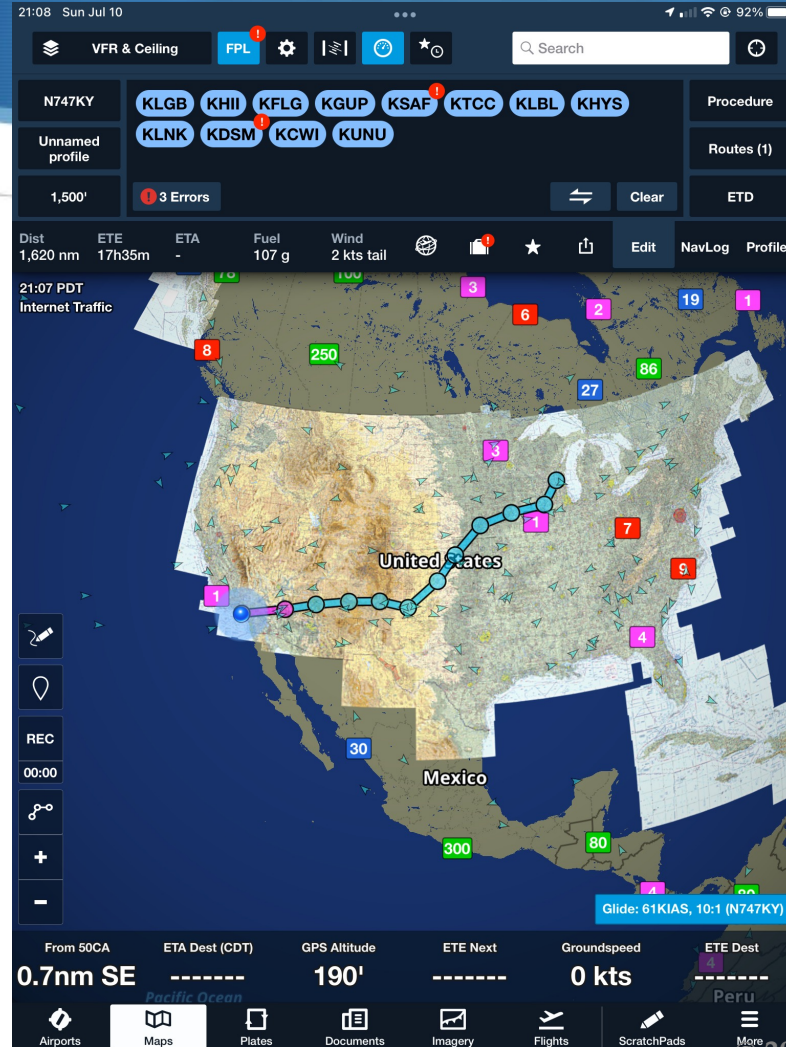
Flying my Cessna 150 to OSH

- ◆ So how did I plan for this? Carefully. IF it could not be done safely due to weather or other problems, then I would not go, or get an airline ticket instead. Last minute if need be. No reason to play 'hero'.
- ◆ I put my 'Cessna 150' hat on. Started planning months in advance. When to schedule the 'annual', etc.
- ◆ Think, limited –
 - ◆ Takeoff & climb performance
 - ◆ Speed
 - ◆ Range, etc.

Flying my 150 to OSH...

- 💧 I looked at several possible routes and considered terrain. I posted a question about this on a FaceBook Aviators page. Several good suggestions. I opted for the 'southern route'.
- 💧 Having only 22.5 gal. usable fuel, I conservatively planned a fuel stop about every 2 hours, or ~ 200NM. About ½ tanks.
- 💧 Always had reserves!
- 💧 That worked out well 😊

My route...both to and from



Flying my 150 to OSH...

- 💧 I tried to avoid remote unattended airports, to avoid problems...and getting 'stuck' somewhere. I called some airports in advance to check.
- 💧 I planned RON's in larger cities; Santa Fe, NM (KSAF), Lincoln, NE (KLNK), Juneau/Dodge Cty WI, (KUNU) with a hotel. 😊 slept better!
- 💧 I did NOT camp nor sleep on the FBO couch. Nope. Not for me. Maybe for you. No room for a sleeping bag nor camping gear, either.
- 💧 I did NOT fly into the night. I typically stopped by 6pm, to avoid 'flying fatigued'.
- 💧 Fatigue leads to 'pilot error' and mistakes. 😞 I avoided that! 😊

Flying my 150 to OSH

- 💧 Tools I used -
- 💧 Primarily ForeFlight, plus Sectionals, and TAC Charts (as backups, in case)
- 💧 WingX not so much. I prefer FF.
- 💧 www.1800wxbrief.com
- 💧 Sirius XM Weather Receiver
- 💧 www.airnav.com
- 💧 Called Leidos 1-800-992-7433, daily once en route. Standard and 'update' Briefings.
- 💧 Flight following when/where possible.

Flying to OSH

The screenshot displays the 1800wxbrief.com website. The top navigation bar includes links for ACAS, EasyActivate™ EasyClose™, Close Reminders, ATC Notices, SE-SAR, Preflight Summaries, and My Aircraft. The main content area features a 'Flight Plans' section with a 'No current flight plans' message. Below this is a 'Map Snapshot' section with a map of the United States and two smaller maps labeled 'U.S. Weather Depiction' and 'U.S. Surface Analysis'. A 'Quick Search' section allows users to search for METARs, TAFs, or D-NOTAMs. The 'Airport Conditions' section shows a list of airports: LAX, LGB, and SNA, each with a 'Density Altitude' and a 'VFR' status. The LAX entry shows a density altitude of 238 ft and a VFR status of 'VFR'. The LGB entry shows a density altitude of 623 ft and a VFR status of 'VFR'. The SNA entry shows a density altitude of 471 ft and a VFR status of 'VFR'.

1800wxbrief.com

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WED FRI 10:13:10 PM | U:13:10

Flight Service

Optimize your experience
Learn & Register

ACAS

EasyActivate™
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Close Reminders

ATC Notices

SE-SAR

Preflight Summaries

Provide information for improved service
My Aircraft

Flight Plans (Activate, Close, Amend, Cancel, and View Alerts here)
No current flight plans

Map Snapshot (click for Interactive Map)

Weather Charts Edit Charts

U.S. Weather Depiction

U.S. Surface Analysis

Quick Search - METARs, TAFs, D-NOTAMs
Enter ICAO/Domestic Airport IDs, FRDs, or Lat/Longs

Search

METAR TAF D-NOTAM

Airport Conditions Edit Airports

LAX Area Brief LGB Area Brief SNA Area Brief *Aircraft ID: N747KY

METAR TAF D-NOTAM Plain Text

LAX (Density Altitude: 238 ft)
VFR KLAX 082353Z 26010KT 10SM CLR 17/08 A3019 RMK AO2 SLP224 T01720078 10217 20172 56009 \$

LGB (Density Altitude: 623 ft)
VFR KLGB 082353Z 29011KT 10SM CLR 21/07 A3018 RMK AO2 SLP218 T02110067 10233 20178 55011

SNA (Density Altitude: 471 ft)
VFR KSNV 082353Z 26010KT 10SM CLR 17/08 A3019 RMK AO2 SLP224 T01720078 10217 20172 56009 \$

Flying to OSH. My flight planning form...a Word doc.

N747KY KLGB – KOSH Summer 2022 Tentative Flight Planning

From/To	Dist. NM	ETE. Hrs.	Approx. Fuel Burn/Gal. +~1 Gal. Start/Taxi/T/O 100LL Fuel prices Jun. 14
Day 1			
1 KLGB – KBLH Long Beach/ Blythe, CA	172	1.7	13
Fuel Stop			\$8.63
2 KBLH – KFLG Blythe, CA/ Flagstaff, AZ	177	1.9	14
Fuel & Lunch			\$7.94
3 KFLG - KGUP Flagstaff, AZ/ Gallup, NM	143	1.3	10
Fuel			\$7.96
4 KGUP – KSAF Gallup, NM/ Santa Fe, NM	132	1.2	10
Fuel/Dinner/RON			\$7.24
Day 1 totals		6.2 hrs.	47 gal

Flying my 150 to OSH. My Sirius XM Wx Receiver...



Recommended reading.

- 💧 I have been a 'student' of weather for decades. That helps!
- 💧 Also qualified as an aircraft dispatcher.
- 💧 Weather Flying, Bob Buck (4 editions)
- 💧 Severe Weather Flying, Dennis Newton
- 💧 Flying the Weather Map, Richard L. Collins

Thank you

- 💧 For attending
- 💧 johnmahanycfi@gmail.com