## Pearls of Wisdom – VFR



**1. Quick Clock Face Method of Determining Cross Wind Component**

30º Crosswind: Use 50% (30 Minutes is 50% of an Hour)

45º Crosswind: Use 75% (45 Minutes is 75% of an Hour)

60º Crosswind: Use 100% (60 Minutes is 100% of an Hour)

**Scenario: Wind is 30**º **off runway heading @ 30 kts = 15 knot crosswind component (50% of 30)**

 **Wind is 45**º **off runway heading @ 30 kts = 22 knot crosswind component (75% of 30)**

 **Wind is 60**º **off runway heading @ 30 kts = 30 knot crosswind component (100% of 30)**

**Headwind or tailwind component can be calculated by subtracting the crosswind component above from 90**. **E.g. Crosswind component is 30**º **so headwind or tailwind component is 70º**

**2. Takeoff Abort Rule of Thumb**

Abort the takeoff if you haven’t reached 70% of rotation speed when reaching half the runway distance

# 3. Landing Distance With A Tailwind

Increase the normal landing distance by 5% for each knot of tailwind.

e.g. Normal landing distance from performance charts = 700 ft.

 Tailwind = 10 kts

 Increase by 5% x 10 = 50%

 New Landing Distance = 150% of 700 ft = 1,050 ft.

**4. Takeoff Distance Considering Grade and Wind**

1. **First Calculate Grade:** **(10:1 rule)**

For every 1% of uphill grade add 10% to the ground roll distance calculation.

For every 1% of downhill subtract 10% from the ground roll distance calculation.

2**. Next Calculate Wind Factor:**

**Headwind:** For each 1 knot of headwind subtract 1% from the ground roll distance calculation.

**Tailwind:** For each 1 knot of tailwind add 5% to the ground roll distance calculation.

**Example: Taking off from a 2,000 foot runway with a 2% grade, a wind of 10 kts. Should you takeoff upwind uphill or downwind downhill? First calculate from the POH the no wind, no grade takeoff distance for the current weight and temperature. Let’s say our charts say it is 800 feet. Then:**

**Headwind/Uphill Calculation:**

First Uphill Grade: 2% grade x 10% = 20% added to ground roll which is 160 feet = 960 feet

Next Headwind:10 kts results in a 10% reduction in ground roll which is 960x10% = 96 feet

So, the uphill/headwind scenario results in an effective ground roll of **960-96=864 feet**

**Downwind/Downhill Calculation:**

First Downhill Grade: 2% grade x 10% = 20% reduction in ground roll which is 160 feet = 640 feet

Next Tailwind: 10 kts results in a 50% increase in ground roll which is 640x50%=320 feet

So the downhill/downwind scenario results in an effective ground roll of 640+320= **960 feet**.

Conclusion: Wind is much more influential than grade when calculating effective takeoff distance.

Caveat: Calculations assume either a direct headwind or tailwind scenario. This is seldom the case so the headwind or tailwind component of the wind must be calculated first before applying the above formula. Use the clock face method of determining headwind or tailwind component above as a rule of thumb.

# 5. Approach Speed In Windy Conditions

Add half the gust factor to your approach speed when landing in gusty conditions.

e.g. Approach Speed (1.3 Vso) = 65 kts

 Winds are 10 knots gusting to 20 knots (gust factor of 10 knots)

 New approach speed 65 kts + 5 = 70 kts

# 6. Distance To Begin Descent

Determine altitude to lose (in thousands of feet) and then multiply by either 3, 4, 5, or 6 (depending on groundspeed) to get distance from destination to begin descent at. This assumes you are descending with a 500 fpm VSI indication.

090 kts=3

120 kts=4

150 kts=5

180 kts=6

e.g. Altitude to lose = 4,000 ft (we use 4 because we drop the zeros)

 Descent rate = 120 kts (we use the number 4 from the above figures)

 4 x 4 = 16

 Begin descent at 500 fpm at 16 NM

### 7. Emergency Turn Back To The Runway

To complete a 180º turn in most light singles takes at least 700 feet at a 45º angle of bank. Therefore calculate minimum turn back altitude before takeoff by adding 700 feet to local field elevation. This is your minimum altitude below which you should not attempt a turn back to the field and instead elect to land straight ahead. At airports where there are intersecting runways this rule of thumb may not apply.

### 8. Stall Speed At Various Bank Angles

Stall speed increases in proportion to the square root of the load factor. Since load factor increases with bank angle, a relationship can be determined between stall speed and bank angle as follows, using as an example an airplane with a no flaps stall speed (Vs) of 53 knots.

 **Load Factor Sq Root Stall speed**

Level Flight 1 1.00 53 knots (53x1.00)

45º Bank 1.41 1.19 63 knots (53x1.19)

60º Bank 2 1.41 75 knots (53x1.41)

70º Bank 3 1.73 92 knots (53x1.73)

75º Bank 4 2.00 106 knots (53x2.00)

80º Bank 5.76 2.40 127 knots (53x2.40)

### 9. Rolling Out Of A Turn

Begin rolling out of a turn at half the bank angle in degrees prior to reaching your desired heading.

e.g. Bank Angle = 30º

 Desired Heading = 360º

 Lead the roll out by half the bank angle = 15º

 Begin roll out at 345º if in a right turn

 Begin roll out at 015º if in a left turn

**10. Calculating Standard Rate Turn**

Standard rate is10% of the airspeed plus half the result.

e.g. IAS = 100 knots

 100\*10% = 10º + ½ of 10 = 15º

e.g. IAS = 150 knots

 150\*10% = 15º + ½ of 15 = 22º

**11. Calculating how airspeed will change the radius of a turn**

Because of the increased load factor and stall speed increase much beyond a 45° angle of bank, a practical limit of 45° angle of bank should not be exceeded. Since radius of turn at a constant angle of bank is a function of groundspeed, the formula at a 45° bank angle is groundspeed squared divided by 11.3. This becomes important when considering turns in a confined space (like a canyon). Consider two examples at different speeds, same 45° angle of bank.

 Groundspeed 100 knots: 1002 /11.3 = 885 feet

 Groundspeed 150 knots: 1502 /11.3 = 1,991 feet

Therefore an airplane turning at the same angle of bank will take about 1,100 feet more to complete the turn.

**12. Calculating Take Off Distance**

Standard runway light separation is 200 feet, so takeoff distance can be calculated by counting them

**13. TAS Increase With Altitude**

Airspeed increases about 2% per 1,000 feet of altitude.

e.g. TAS is determined to be 120 knots at sea level

At 10,000 feet it will be 20% higher

2% x 10=20%

120+20%=144 knots

**14. Calculating Pressure Altitude**

To calculate pressure altitude, subtract current pressure setting on the altimeter from 29.92. Add 3 decimal places to the result and add that amount to the MSL altitude.

Or if you are in the airplane, just set altimeter to 29.92 and read the pressure altitude off the altimeter.

e.g. Altimeter Pressure 28.68 (AWOS)

 Standard Pressure 29.92

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 Difference 1.24

 Add 3 decimals 1,240

 Therefore pressure altitude is 1,240 feet greater than MSL elevation

**15. Calculating Density Altitude**

**Density altitude in feet = pressure altitude in feet + (120 x (OAT - ISA temperature)**

e.g. Calculate Density Altitude at 1,000 feet pressure altitude when the temperature is 32°C

Since standard temperature is 13°C at 1000 ft, the difference is 19°C more

Therefore 1,000 + (120 x 19) = density altitude of 3,280 ft.

**16. Quick Distance Estimate on a Sectional Chart**

Use two fingers for 10 miles on a sectional chart, four fingers for 20 miles. On a terminal chart use two fingers for 5 miles, four fingers for 10 miles.

**17. Flight Service Frequencies**.

**122.1** FSS receive only, listen through VOR. Call up by name of FSS, location relative to nearest VOR, and frequency you’re using.

Call: Williamsport Radio, Archer 2245W, 10 north of Yardley on 122.1

**122.2** FSS send and receive. Call up by name of FSS, location relative to nearest VOR, and frequency you’re using.

Call: Williamsport Radio, Archer 2245W, 10 north of Yardley on 122.2

**122.6** FSS send and receive, available in some areas only. Call up by name of FSS, location relative to nearest VOR, and frequency you’re using.

Call: Williamsport Radio, Archer 2245W, 10 north of Yardley on 122.6

All FSS stations operate 24/7.

**18. Calculating Hydroplaning Speed**

Hydroplaning can occur with as little as ten thousandths of an inch of water on the runway. Use this formula to determine hydroplaning speed.

Calculate square root of tire pressure. Multiply this number by 9 for take-off hydroplaning speed and 7.7 for landing hydroplaning speed.

 e.g. Tire Pressure 30 PSI

 Square Root of 30 = 5.5

Take Off Hydroplaning Speed 9 \* 5.5 = 50 knots

Landing Hydroplaning Speed 7.7 \* 5.5 = 42 knots

On landing you must slow to at least 42 knots before applying brakes to avoid the potential for hydroplaning.

On take-off you should try to rotate by 50 knots to avoid the potential for hydroplaning.

Note: This rule of thumb will vary depending on the condition of the tire and type/condition of runway.

**19. Calculating Best Glide Speed**

For Single Engine Fixed Prop: Multiply Vs (bottom of green arc) by 1.5. That’s approximate best glide speed at max gross. To get best glide for the weight of the airplane, multiply the max gross number by the percentage of max gross of the airplane. For single engine retractable gear, use 2.0 as the multiplier instead of 1.6 and follow the same procedure.

 e.g. Archer 180

 Vs 52 knots

 Best Glide (Max Gross) 52 \* 1.6 = 83 knots

 Airplane weight is 80% of max gross

 Best glide is 83 \* 80% = 66 knots for that weight

#### Pearls of Wisdom – IFR



**1. Stabilized Decent for a 3° Glide-Slope**

A stabilized decent can be thought of as a 3° glide-slope, similar to most ILS approaches or VASI/PAPI systems. A 3° glide-slope is always equal to a 300 ft/nautical mile decent rate, regardless of speed. If a 300 foot/nm decent is the goal, then knowing your ground speed will allow you to convert into the actual decent rate in feet per minute that you can read on your VSI. Just take half your ground speed and add a zero. For glide-slope of ½° more or less than 3° add or subtract 100 feet per minute. For 1/4° add or subtract 50 feet per minute.

e.g. Groundspeed = 90 knots

 90/2=45(0)

 Decent Rate = 450 ft/minute

**2. 60:1 Rule in Determining Decent Gradient**

Here’s how the so called 60:1 rule verifies the decent rate for various decent gradients – the most common being the 3% gradient used in ILS approaches and VASI/PAPI glide paths. First, take a circle that has a radius of 60 nautical miles and determine the circumference by applying the formula 2 pi r (2\*3.14\*60). This yields 376 nautical miles as the circumference of the circle. Now stand that circle so that it is one long line 376 miles in length. If you now divide 376 by the number of degrees in a circle (360), you get 1.05 miles for each degree. Since 1.05 is close to a mile, we know that 1 mile per degree is close enough.

So if 1**°**is 1 mile in height at a distance of 60 miles, then at 1 mile it would be 6,072 feet divided by 60, which equals 101 feet. Therefore each degree of gradient at 1 mile equals 100 feet. So therefore, a 3**°** glide slope equals a 300 feet per nautical mile.

**3. 60:1 Rule in Determining VOR Distance Off Course**

At 60 miles, each degree of needle deflection equals 1 mile off course. At 30 miles, each degree of needle deflection equals ½ mile off course.

**4. Calculating the Visual Decent Point (VDP)**

The VDP is the point at the MDA beyond which a stabilized decent is not possible. It is therefore helpful to know where the VDP is on any non precision approach. Use this formula: Height Above Threshold (HAT) divided by 300 = VDP.

e.g. HAT = 600 ft AGL

 VDP = 600/300 = 2 miles from runway

**5. Converting Climb Gradient From Feet Per Mile to Feet Per Minute**

Formula is climb rate (feet per nautical mile) times (groundspeed divided by 60)

e.g. Groundspeed = 90

 Climb Gradient = 400 Ft/Mile

 (400) x (90/60)

 400 x 2 = 600 ft/min

 Climb Gradient is 600 Feet Per Minute

Another method is to use the E6B flight computer and put groundspeed over 60 and read fpm over fpm on outer scale

**6. Partial Panel Compass Turning Error**

Use UNOS – Undershoot North, Overshoot South. When turning to a northerly heading stop short (undershoot) desired heading. When turning to a southerly heading, overshoot (go past) desired heading. Use the latitude as the number of degrees to overshoot or undershoot.

e.g. You are turning right to a heading of 350° and your latitude is 40°. Stop your turn when the compass reads 310°

**7. Important Checklists**

**Approach Checklist**

Do the following checklist at least 10 miles outside the FAF **PSPS HAR**

Primary Com Frequency Set

Secondary Com Frequency Set

Primary Nav Frequency Tune, Set, Identify

Secondary Nav Frequency Tune, Set, Identify

Heading Check (Set DG)

Atis then Altitude

Review Approach Chart

**Landing Checklist**

Do the following at least 5 miles outside the FAF **PFGUMPS**

Power – Reduce to desired setting

Flaps – Employ or not

Gas – On proper tank

Undercarriage – Gear Down if appropriate

Mixture – Rich

Props – High RPM

Switches – Fuel Pump, Landing Light, GPS/VLOC Switch, Marker Switch

**8. Instant Position At A Glance Using VOR**

With a FROM indication, your position is on a radial located in the top quadrant opposite the needle. With a TO indication, your position is on a radial located in the bottom quadrant opposite the needle. For example, assume the OBS is oriented with 360° at the top, the indication is FROM and the needle is left. Therefore your position is on a radial in the right top quadrant opposite the needle (0°-90°). If in the same example everything was the same but the indication was TO, your position would be on a radial in the bottom right quadrant

**9. Have I passed the Radial Yet Using VOR**

#### With a FROM indication, the needle always points to the VOR before you get to the radial dialed in the OBS. This only works if the radial on top of the VOR is on the same side of the VOR as the side you are on. The other method which works regardless of where you are is to look at the 90° intercept and that heading will take you to an intercept of the radial dialed in at the top. If this is not your approximate heading (or almost the opposite) you have passed it.

**10. Time to a VOR**

Without GPS or DME, how do you calculate how long it will take you to get to a VOR. First, center the VOR needle with a TO indication, then twist the OBS 10° to either side. Turn 10° to intercept it and count the seconds until the needle centers. Subtract a zero from the total seconds and that’s how many minutes it will take to get there. Don’t forget to re-center the needle and fly the appropriate course.

e.g. You count 120 seconds until the needle re-centers, drop the zero and find that you will arrive at the VOR in 12 minutes. From this information you can also calculate how far you are away. For most training airplanes, multiply the time by 2 to get 24 miles for this example.

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Pearls of Wisdom – Weather



**1. Thunderstorm Avoidance**

Circumnavigate thunderstorms by at least 20 miles. Hail is most likely to be thrown out on the downwind side. Tornadoes are most likely to be present on the upwind side. These are the reasons for the 20-mile margin of safety.

**2. Convective Weather Likelihood**

Here are three ways you can tell if thunderstorms are likely.

* Dew point of 65°F or more in the morning
* Lifted Index of –3 or greater (more negative) - Composite Moisture Stability Chart
* K Index of +30 or greater (more positive) - Composite Moisture Stability Chart

**3. Cloud Prediction**

Cloud bases can be predicted by taking the ground temperature and dew point spread in °C and dividing by 2.5. The result (adding 3 zeros) is the expected height of the bases. This formula works best in rising air because unsaturated (rising) air, cools at 3°C and the dew point decreases at .5°C per thousand feet. Therefore the temperature and dew point converge at 2.5 °C per thousand feet.

e.g. Temperature = 15°C

 Dew Point = 10°C

 Height of Bases = 5/2.5 or 2(000)

 Therefore cloud bases would be expected at 2,000 feet.

**4.** **Important Moisture Stability Value**

The composite moisture stability chart provides useful information about the likelihood a severity of convective activity. The two most important values are the K Index and Lifted Index. An easy way to remember warning values is 24/7. If the Lifted Index (indication of the stability of the atmosphere) is -7 or more negative or the K Index (indication of the amount of moisture in the air) is +24 or more positive, there is a high probability of significant convective activity.

**5. Wind Direction and Weather**

If the wind is from your left, you’re flying into an area of worsening weather.

**6. Estimating Wind Direction Aloft**

Winds aloft are usually 40° to the right of the surface winds