Bonanza/Debonair Pilots

Completing this worksheet is a great way to reinforce the proper speeds for operating your Bonanza or Debonair under varying operating conditions, and to understand the changes that occur at varying airplane weights. Please complete this worksheet before your scheduled BPPP flight. Bring it to your training session to discuss with your BPPP flight instructor before you fly.

Weight and Balance

Use the generic form below, your Pilot's Operating Handbook and your airplane's weight and balance data to compute the Takeoff Condition and likely Landing Condition. You'll need to ask your BPPP instructor for his/her weight to make these calculations. If you prefer, use flight planning or other weight and balance software to make calculations, and be ready to show those results to your BPPP instructor.

Aircraft Weight and Balance
(Generic; use the lines that apply to your Beechcraft)

Item	Weight	Arm	Moment	CG Location
Basic empty condition				
Front seat occupants				
Seats 3 & 4 occupants				
Seats 5 & 6 occupants				
Baggage area 1				
Baggage area 2				
Baggage area 3				
Cargo				
Zero fuel condition				
Fuel				
Ramp condition				
Less fuel for start, taxi, and takeoff				
Takeoff condition				
Less fuel to destination				
Landing condition				

Questions:

1. If your airplane is overweight or out of CG limits, how would you fix the condition?
2. What is your CG position in inches aft of the datum in the Takeoff condition above?
3. As you burn fuel, what will happen to the CG position?

Speed Sheet

This is a do-it-yourself worksheet to add to the knowledge you gained in the BPPP before-flight program (online or classroom). With the help of the accompanying explanations, use your Pilot's Operating Handbook (POH), Aircraft Flight Manual (AFM) or Beechcraft Owner's Manual to find the speeds that apply to the specific airplane you will fly. Most speeds are dependent upon aircraft weight and are affected only slightly by altitude. However, climb speeds and rates are sensitive to changes in density altitude, as are takeoff and landing distances.

NOTE: Indicated airspeed (IAS) is the key performance indicator for most maneuvers. To attain "book," or computed performance, you must accurately fly the "book" airspeed. As pilot you should always know the correct speed for a particular maneuver or phase of flight, and the corresponding Power, Attitude and Configuration (PAC) to attain the correct speed and safely complete the maneuver.

A growing number of Beech airplanes have an Angle of Attack Indicator (AOAI) installed. General aviation AOAIs are useful as a trend warning, but they do not have the accuracy necessary to replace flight by IAS altogether. Manufacturers of AOAIs recommend establishing a target IAS, noting the AOA indication, and then continually crosschecking the two to obtain predictable aircraft performance.

To become more familiar with the impact of changes in airplane weight on the indicated airspeeds for predictable performance, complete the Speed Sheet matrix on the next page. List the correct Indicated Airspeed based on a general weight condition and with adjustments for other factors as described in the *Explanations* section that follows. As you complete the matrix, include the page reference in the POH/AFM/Owner's Manual and/or STC paperwork where you found the information.

For the general weight conditions on the matrix use the following:

STC weight	The maximum weight permitted under a Supplemental Type Certificate that provides a gross weight increase (GWI) over that airplane's original maximum weight.
Maximum weight	The originally approved maximum gross weight for the airplane.
Mid-weight	300 pounds less than the maximum weight of the airplane.
Light weight	600 pounds less than the maximum weight of the airplane.

For example, a 1990 A36 Bonanza might have a GWI STC permitting takeoff at 4000 pounds. If that is your airplane, the general weight conditions you should use would be:

STC weight:	4000 pounds
Maximum weight:	3650 pounds
Mid-weight:	3350 pounds
Light weight:	3050 pounds

Bonanza/Debonair
Airspeed Worksheet

Pilot _____ Registration _____

Aircraft type _____ Serial number _____

Field Elevation _____

Indicated Airspeeds kts or mph (circle one)	Aircraft Weights				POH or Supplement page reference
	STC	Max	Mid	Light	
Stall and Climb					
1. Vs - Stall, gear and flaps UP					
2. Vso - Stall, gear and flaps DOWN					
3. Vx - Best angle of climb, gear/flaps UP					
4. Vy - Best rate of climb, gear/flaps UP					
Normal Takeoff					
5. Liftoff speed					
6. Speed at 50 ft AGL (Vx adjusted for weight)					
Short Field Takeoff					
7. Liftoff (flaps APPROACH or 15-20 degrees)					
8. Speed at 50 ft AGL (Vx with flaps)					
Cruise					
9. Va - Maneuver/turbulent air speed					
10. Speed for maximum range					
11. Vno - Normal operating (all weights)					
12. Vne - Never exceed (all weights)					
Approach and Landing					
13. 50 ft AGL, normal, flaps DOWN					
14. Short field at 50 ft AGL					
15. Balked landing					
16. Vfe - Flaps full down (all weights)					
17. Vle/Vlo - Gear in transit/down (all weights)					
Emergencies					
18. Best glide (max range, power off)					
19. Emergency descent					
20. Emergency landing approach					

Do not include STC speeds if the airplane is not approved for a maximum gross weight increase.

See explanations for speed adjustments beginning on the next page.

Explanations for Airspeed Worksheet

The item numbers below correspond to the item numbers on the table on the previous page.

1. **Vs – Stall, gear and flaps UP**

   See the Stall Speed chart in the Performance section of your POH.

2. **Vso – Stall, gear and flaps DOWN**

   See the Stall Speed chart in the Performance section of your POH.

3. **Vx – Best angle of climb, gear/flaps UP**

   See the Normal Procedures section, Speeds for Safe Operation page of your POH. This speed is for sea level at maximum gross weight, gear and flaps UP.

   NOTE: Both Vx and Vy will be *lower* that POH values when the gear and/or flaps are extended.

   RULE OF THUMB: The published speed should be *reduced* one mph or one knot for every 100 pounds below maximum gross weight, and *increased* one-half percent for every 1000 feet of altitude MSL.

4. **Vy – Best rate of climb, gear/flaps UP**

   This speed is found in the same place as Vx in your POH.

   RULE OF THUMB: *Reduce* Vy by one mph or one knot for every 100 pounds below maximum gross weight, and *reduce* Vy by 1% for every 1000 feet of altitude MSL.

   EXAMPLE: For a P35 the published value for Vy is 90 KIAS. If the airplane is 400 pounds below its maximum gross weight and at 5000 feet MSL, compute Vy as follows:

   > **Vy = 90 kts** (POH) **-4 kts** (reduction for weight) **-5 kts** (reduction for altitude; 5% of 90 is 4.5). Under these conditions the adjusted Vy speed is **81 KIAS**.

5. **Liftoff speed**

   Liftoff speed varies with weight. A table of speeds versus airplane weight is at the top of the Takeoff Distance chart in the Performance section of the POH. Begin to pull the nosewheel off the surface ("rotate") approximately five knots/five mph, as applicable, prior to reaching the liftoff speed. The angle of attack will be the same for all weights when the correct indicated airspeed is used.

6. **Climb speed at 50 ft AGL**

   50-foot climb speed also varies with airplane weight. This speed is found alongside the Liftoff speed, in the table at the top of the Takeoff Distance chart. You'll notice that the 50-foot speed at maximum weight is the published Vx speed—the 50-foot climb speed is Vx adjusted for airplane weight. The weight-adjusted Vx speed is the speed Beech considers optimal for takeoff and initial climb performance. This is the technique necessary to obtain POH-computed performance. The angle of attack will be the same for all weights when the correct indicated airspeed is used.

   After liftoff, establishing the correct attitude will allow the airplane to accelerate and attain this speed as it climbs through roughly 50 feet in altitude above the ground. A simple technique is to raise the attitude to approximately +10 (10º UP) at liftoff, and hold it there. Takeoff trim is usually set for Vy

speed, so an additional pull is required to attain this attitude. Once attitude is established, release elevator pressure and allow the airplane to accelerate to Vy after passing 50 ft AGL.

For high density altitude takeoffs (approximately 5000 feet DA and higher), raise the nose to only +7 (7º UP) at rotation and wait for the airplane to fly off. Then hold this attitude and raise the landing gear when you are sure you will not settle back onto the runway. Attain Vy and climb out of ground effect.

7. Short field takeoff

Some versions of the Bonanza/Debonair POHs and Beechcraft Owner's Manuals recommend partial flaps for reducing ground roll distance. NOTE: Use of flaps many not reduce obstacle clearance distance, and at higher weights and/or density altitudes obstacle clearance distance may increase with the use of partial flaps for takeoff.

1984 and later A36s, B36TCs and G36s have two Takeoff Performance charts in the Performance section of the POH—one for Flaps UP, and one for the preselect-switch Flaps APPRAOCH. Use the Liftoff speed from the chart that corresponds to your selected flap setting. Compare the calculated performance from both charts under the same conditions to determine whether to take off with flaps UP or in the APPROACH position for a given departure.

In Bonanzas and Debonairs without a Takeoff Performance chart for use of flaps, early Beechcraft Owner's Manuals recommended using 10º-20º of flaps for short field takeoffs. When flaps are used, the liftoff speed should be reduced four to seven knots/mph (as appropriate) below the recommended flaps UP takeoff speed. Subtract five from the flaps UP takeoff speed.

8. Short field speed at 50 ft AGL

1984 and later A36s, B36TCs and G36s have two Takeoff Performance charts in the Performance section of the POH—one for Flaps UP, and one for the preselect-switch Flaps APPRAOCH. Use the 50-foot speed from the chart that corresponds to your selected flap setting. Compare the calculated performance from both charts under the same conditions to determine whether to take off with flaps UP or in the APPROACH position for a given departure.

In airplanes without flap preselect switches, some Beechcraft Owner's Manuals recommend maintaining the liftoff speed during initial climb through 50 feet AGL. Vx with flaps extended is lower than the published Vx, which assumes flaps UP. Liftoff speed with partial flaps approximates Vx speed with 10º-20º of flaps extended.

CAUTION: The technique in the preceding paragraph has the airplane climbing at a speed below the Emergency Landing Approach/Landing Without Power speed of 83 knots/96 mph. Should engine failure occur in climb using this technique, *immediately* lower the nose to slightly below level flight (0º), leave the gear and flaps down, and attain the Emergency Landing Approach/Landing Without Power speed until touchdown. Do *not* attempt to accelerate to Best Glide speed, which would require a very steep nose down attitude and consequently a steep descent path. This would result in a very high sink rate, so high you may not be able to stop the descent to flare before landing.

9. Va – Maneuvering speed

The POH lists this in the Limitations section. The published Va is a not-to-exceed speed determined at the airplane's original maximum gross weight with gear and flaps UP. Va should be reduced at weights lower than the original maximum gross weight. You may compute the corrected value for Va as follows:

Corrected Va = Published Va (in mph) x square root (actual weight/maximum weight)

EXAMPLE: A V35B has a published Va of 154 mph at 3400 pounds maximum gross weight. At 2800 pounds, its corrected Va is:

154 x square root (2800/3400) = 140 mph

RULE OF THUMB: Approximate the weight-adjusted Va by reducing the published value by two knots/two mph for every 100 pounds below the maximum gross weight.

Use the published Va speed at weights above the original maximum gross weight when higher weights are approved by STC.

10. Speed for maximum range

This is the indicated airspeed at which maximum range (in still air) is available for a given fuel quantity and a given aircraft weight. It provides the maximum endurance (time aloft), useful when factoring in winds and ground speed. Sometimes called the Carson's Speed, add 15 to the Best Glide speed for a given weight (as computed in item 18, below). On a long-range flight, the speed for maximum range/endurance decreases as the airplane weight decreases with fuel burn. Therefore, a maximum range/endurance flight requires gradual reduction in power to reduce indicated airspeed as the flight progresses.

11. Vno – Normal operating

Vno is the maximum normal operating speed, the top of the green arc. It does not vary with weight and is found in the Limitations section of the POH. There is a second, significantly lower Vno for turbocharged airplanes above 20,000 feet that is also listed in the POH Limitations.

12. Vne – Never exceed

Vne is the never exceed speed, the red line at the top of the yellow arc. Vne does not vary with weight and is found in the Limitations section of the POH. In turbocharged airplanes reduce Vne by four knots indicated airspeed for each 1000 feet above 16,000 feet, according to a note in the POH Limitations.

13. Speed at 50 feet AGL, normal landing

This is the indicated airspeed to be decelerating through as you pass a point 50 feet above ground level, with full flaps and gear down, during a normal landing. It varies by airplane weight at the time of landing, and is 1.3 times the stalling speed in the landing configuration (Vso) for that weight. There is a table on the Landing Distance chart in the Performance section of the POH that lists the 50-foot speed by airplane weight.

14. Short field landing speed at 50 feet AGL

Early Beechcraft Owner's Manuals recommended using 1.2 times the Vso as adjusted for weight, plus ½ of any gust factor, as the indicated airspeed to be decelerating through as you pass a point 50 feet above ground level, with full flaps and gear down, during a short field landing. This speed is not mentioned in the Pilot's Operating Handbook. To compute it, use the Stall Speeds – Power Idle chart in the POH Performance section to determine wings-level Vso at the landing weight, then multiply that value by 1.2 to derive the short field landing speed at 50 feet AGL. Adjust this result for wind gusts as needed.

EXAMPLE: An S35 at 2800 pounds is landing at an airport with a reported wind of 15 gusting to 22 knots.

- Use the Stall Speeds – Power Idle chart to determine the wings-level Vso at this weight is 47 knots.
- 1.2 x 47 knots = 56 knots
- Winds are gusting from 15 to 22 knots. 22 – 15 = 7 knots of gust factor. One-half the gust factor is four knots
- 56 knots + 4 knots = a short field landing speed at 50 feet AGL of 60 knots.

Adjust power for a shallower or steeper glide path to clear obstacles and touch down at your desired landing spot.

CAUTION: You may need to add a short burst of power in the flare to arrest the sink rate.

15. Balked landing

The initial balked landing (go-around) speed appears on the Speeds for Safe Operation page of the Normal Procedures section you the POH. It is the same as the speed at 50 feet AGL during a normal takeoff (item 6 above) for a given airplane weight and configuration, and is very near Vx under those conditions.

16. Vfe – Flaps down speed

Vfe is found in the Limitations section of the POH. Some POHs and Beech Owner's Manuals state specifically that this is a maximum *full* flap extension speed. There is no guidance on the use of partial flaps in handbooks that make this distinction. Most Beech POHs and Owner's Manuals define Vfe as applicable to *any* flap extension at all.

Bonanzas with APPROACH flap preselect switches (12°-15° extension, depending on model and year) have a higher APPROACH flap extension speed, the same as the gear extension and operating speed (Vle/Vlo; see item 17 below). Full flaps are limited to the published Vfe speed in these airplanes.

Vfe is reduced in turbocharged airplanes above 20,000 feet. This speed is also listed in the Limitations section.

17. Vle/Vlo – Landing gear extension/operating speed

Vle/Vlo, the maximum landing gear extension and operating speed, is found in the Limitations section of the POH. Vle/Vlo is reduced in turbocharged airplanes above 20,000 feet. This speed is also listed in the Limitations section.

18. Best glide speed – maximum range with engine out

This is the indicated airspeed that permits the greatest distance with a failed engine. It assumes that the landing gear and flaps are up, the cowl flaps (if installed) are closed, and the propeller control is in the LOW RPM position. Best Glide speed is listed in the Speeds for Emergency Operation, in the Emergency Procedures section of the POH.

Similar to Va, Best Glide speed decreases with a reduction in airplane weight. Approximate Best Glide speed at reduced weights by decreasing the published speed by two knots/two mph for every 100 pounds below the airplane's maximum gross weight.

19. Emergency descent speed

This is the indicated airspeed for a maximum rate of descent at idle power and, in some models as noted in their POH, partial flaps extended. The emergency descent speed is usually the Vle/Vlo speed. It is found in the Speeds for Emergency Operation, in the Emergency Procedures section of the POH.

20. Emergency landing approach speed

The Emergency Landing Approach speed, called the Landing Without Power speed in some POHs and Beechcraft Owner's Manuals, is the recommended final approach speed when making an emergency landing (on or off airport) with no power, full flaps and gear down. After reaching a runway or other landing zone using the Best Glide speed, transition to Emergency Landing Approach speed on final approach. This reduces impact forces by reducing the airplane's inertia, but it also provides enough air flow over the elevators to permit a flare prior to touchdown. Since there is no propeller blast over the elevators with a failed engine, the Emergency Landing Approach speed is slightly faster than the 50-foot AGL speed for a normal or short field landing. The Emergency Landing Approach or Landing Without Power speed is found in the Speeds for Emergency Operation in the Emergency Procedures section of the POH.

All this good research will quickly fade from your memory without regular review. Enter some of the key numbers into a handy reference like that below—you might make a copy of this page, fill in the airspeeds, cut out the reference card and laminate it. A quick check before each time you fly will reinforce the numbers that result in maximum, predictable performance in normal, abnormal and emergency situations.

BONANZA/DEBONAIR AIRSPEEDS
KIAS/MPH as applicable to the airplane
(maximum gross weight)

PILOT PROFICIENCY PROGRAM

Takeoff/Climb		**Pattern**	
$V_{LIFTOFF}$	_____	Downwind	_____
V_X	_____	Base	_____
V_Y	_____	Final (flaps UP)	_____
V_{CC}	_____	Final (flaps DN)	_____
V_{SI}	_____	**BEST GLIDE**	_____*
V_{SO}	_____	**ROUGH AIR**	_____**

* Reduce 2kts or mph/100 lbs below maximum gross weight.

** MP ~ 17 inches. Maximum speed for moderate or greater turbulence. Reduce 2kts or mph/100 lbs below MGW.