ABS Performance Worksheet: Baron/Travel Air Pilots

This worksheet is suggested "homework" designed to help the pilot develop a deep understanding of his/her Beechcraft, how and where to find performance information in the Pilot's Operating Handbook, and to reinforce the BPPP BEST programs on Performance, Weight and Balance, and Aerodynamics

Completing this worksheet is a great way to reinforce the proper speeds for operating your Baron or Travel Air under different operating conditions, and to understand the changes that occur at varying airplane weights. Please complete this worksheet before your scheduled training flight. Bring it to your training session to discuss with your 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 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 flight 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 (Nose)				
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 BEST program. 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:

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 1980 E55 Baron has a maximum gross weight of 5300 pounds. If that is your airplane, the general weight conditions you should use would be:

Maximum weight:	5300 pounds
Mid-weight:	5000 pounds
Light weight:	4700 pounds

Baron/Travel Air Airspeed Worksheet

Pilot _____ Registration _____

Aircraft type _____ Serial number _____

Field Elevation _____

See explanations for speed adjustments beginning on the next page.

Indicated Airspeeds kts or mph (circle one)	Aircraft Weights			POH or Supplement page reference
	Max	Mid	Light	
Stall and Climb				
1. V_S - Stall, gear and flaps UP				
2. V_{SO} - Stall, gear and flaps DOWN				
3. V_{XME} - Best angle of climb, gear/flaps UP				
4. V_{YME} - Best rate of climb, gear/flaps UP				
Normal Takeoff				
5. Liftoff speed				
6. Speed at 50 ft AGL				
Short Field Takeoff				
7. Liftoff speed				
8. Speed at 50 ft AGL				
Cruise				
9. V_A - Maneuver/turbulent air speed				
10. Speed for maximum range				
11. V_{NO} - Normal operating (all weights)				
12. V_{NE} - 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. V_{FE} - Flaps full down (all weights)				
17. V_{LE}/V_{LO} - Gear in transit/down (all weights)				
Emergencies				
18. V_{MCA} ("Red radial" speed)				
19. V_{YSE} ("Blue line" speed)				
20. Best glide speed (propellers feathered)				
21. Emergency descent				
22. Emergency landing approach				

Explanations for Airspeed Worksheet

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

1. **V_S – Stall, gear and flaps UP**

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

2. **V_{SO} – Stall, gear and flaps DOWN**

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

3. **V_{XME} – Best angle of climb (two engines), 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, with both engines operating.

   NOTE: Both V_{XME} and V_{YME} will be *lower* that POH values when the gear and/or flaps are extended.

   RULE OF THUMB: The published speed should be *reduced* 2% (roughly 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. **V_{YSE} – Best rate of climb (two engines), gear/flaps UP**

   This speed is found in the same place as V_{XME} in your POH.

   RULE OF THUMB: *Reduce* V_{YME} by 2% (roughly one mph or one knot) for every 100 pounds below maximum gross weight, and *reduce* V_{YME} by 1% for every 1000 feet of altitude MSL.

   EXAMPLE: For a B55 the published value for V_{YME} is 107 KIAS. If the airplane is 400 pounds below its maximum gross weight and at 5000 feet MSL, compute V_Y as follows:

   > **V_Y = 107 kts** (POH) **-4 kts** (reduction for weight) **-5 kts** (reduction for altitude; 5% of 90 is 5.4). Under these conditions the adjusted V_{YME} speed is **98 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 except for those airplanes for which the chart specifies "rotation" speed. In that case, establish the pitch attitude at the rotation 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 V_{XME} speed—the 50-foot climb speed is V_{XME} adjusted for airplane weight (some POHs list a single speed for all weights). The V_{XME} 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 V_{YME} 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 V_{YME} 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 V_{YME} and climb out of ground effect.

7. Short field takeoff

Short-field takeoff speeds and techniques are the same as Normal procedures, with the exception of holding the brakes until after attaining full power and beginning the takeoff roll.

8. Short field speed at 50 ft AGL

Short-field takeoff speeds and techniques are the same as Normal procedures, with the exception of holding the brakes until after attaining full power and beginning the takeoff roll.

CAUTION: Some Travel Air Owner's Manuals suggest using partial flaps for a short field takeoff. This will indeed shorten takeoff distance somewhat, but it also tends to get the airplane aloft below V_{MCA}. ABS recommends against using flaps for takeoff in Barons and Travel Airs for this reason.

9. V_A – Maneuvering speed

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

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

EXAMPLE: A B55 has a published V_A of 157 KIAS (181) mph at 5100 pounds maximum gross weight. At 4600 pounds, its corrected V_A is:

181 x square root (4600/5100) = 172 mph = 149 KIAS

RULE OF THUMB: Approximate the weight-adjusted V_A by reducing the published value by 2% (roughly 3 knots or 4 mph) for every 100 pounds below the maximum gross weight.

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 20, 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. V_{NO} – Normal operating

V_{NO} 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 V_{NO} for turbocharged airplanes above 20,000 feet that is also listed in the POH Limitations.

12. V_{NE} – Never exceed

V_{NE} is the never exceed speed, the red line at the top of the yellow arc. V_{NE} does not vary with weight and is found in the Limitations section of the POH. In turbocharged airplanes reduce V_{NE} 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 (V_{SO}) 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. Some Baron and Travel Air manuals list a single speed regardless of airplane weight.

14. Short field landing speed at 50 feet AGL

Early Beechcraft Owner's Manuals recommended using 1.2 times the V_{SO} 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 V_{SO} 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: A Baron 58 at 4800 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 70 knots.
- 1.2 x 70 knots = 84 knots
- Winds are gusting from 15 to 22 knots. 22 – 15 = 7 knots of gust factor. One-half the gust factor is four knots
- 84 knots + 4 knots = a short field landing speed at 50 feet AGL of 88 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, or a single speed regardless of weight in some Baron manuals. It is very near V_{XME} under those conditions.

16. V_{FE} – Flaps down speed

V_{FE} 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 V_{FE} as applicable to *any* flap extension at all.

Barons with APPROACH flap preselect switches (15° extension) have a higher APPROACH flap extension speed, the same as the gear extension and operating speed (V_{LE}/V_{LO}; see item 17 below). Full flaps are limited to the published V_{FE} speed in these airplanes.

V_{FE} is reduced in turbocharged airplanes above 20,000 feet. This speed is also listed in the Limitations section.

17. V_{LE}/V_{LO} – Landing gear extension/operating speed

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

18. V_{MCA} – Minimum Controllable Speed/Airborne

V_{MCA} is a design certification speed below which directional control cannot be maintained with full-scale rudder and aileron deflection under worst-case conditions: left engine inoperative with its propeller windmilling; maximum power on the right engine; maximum weight with the center of gravity at the rear

limit; flaps and landing gear up; and no more than 5° of bank and/or one ball width of the slip/skid indicator toward the operating engine. The published V_{MCA} is found on the Airspeeds for Safe Operation at the beginning of the Normal Procedures section of the Pilot's Operating handbook and the Travel Air Owner's Manual. In Barons V_{MCA} is marked with a red radial on the airspeed indicator. Travel Airs predate "red radial" marking rules and may not have V_{MCA} marked on the airspeed indicator.

Like most other performance speeds, V_{MCA} is actually a function of angle of attack and, as such, reduced by about 2% (one to two knots/mph) for each 100 pounds below maximum gross weight assuming all other certification factors remain in their worst-case condition.

WARNING: Any changes in the certification variables away from their worst-case conditions reduces V_{MCA}. Because stall speed will not reduce, however (except for as a result of airplane weight), the wing may stall before directional control is lost on one engine. Historically piston twins that stall on one engine quickly enter a "flat" spin that is often unrecoverable. It is vital to maintain a speed at or above the published V_{MCA} in single-engine flight regardless of airplane weight and changes in the other variables, to provide a significant buffer above single-engine stall.

WARNING: Any reduction in power on the operating engine below maximum rated power results in reduced asymmetric thrust and therefore a lower V_{MCA} speed. As density altitude increases, the speed at which directional control cannot me maintained drops as well. Because stall speed will not reduce, however (except for as a result of airplane weight), the wing may stall before directional control is lost on one engine. Historically piston twins that stall on one engine quickly enter a "flat" spin that is often unrecoverable. It is vital to maintain a speed at or above the published V_{MCA} in single-engine flight regardless of airplane weight and changes in the other variables, to provide a significant buffer above single-engine stall.

NOTE: See the ABS Maneuvers Profiles at www.bonanza.org and the ABS Flight Instructor Academy course for techniques for safely presenting the V_{MCA} maneuver required for the multiengine rating and certain pilot certificates.

19. V_{YSE} – Best single-engine performance speed ("Blue line")

This indicated airspeed provides the best available performance at maximum gross weight on one engine in zero-sideslip flight. Depending upon airplane weight, density altitude, available power on the operating engine, and whether the inoperative engine's propeller is feathered, V_{YSE} may result in a climb, level flight at the airplane's absolute single-engine ceiling, or least rate of descent (during "drift down" to the absolute single-engine service ceiling).

Barons (except 56TC/A56TC): V_{YSE} is found in the Emergency Airspeeds in Section III of Baron Pilot's Operating Handbooks. Because the "blue line" marking is required on Baron airspeed indicators, V_{YSE} is also found in the Limitations section on the table of required airspeed indicator markings.

Baron 56TC/A56TC: V_{YSE} is found in Section IV, Emergency Procedures, of the Turbo Baron Owner's Manual, and in Section V, Limitations.

Travel Airs: V_{YSE} is found in Section IV, Emergency Procedures, of the Travel Air Owner's Manual. It is also found in Section III, Performance Specifications and Limitations, for those models of Travel Air that are required to have the "blue line" airspeed indicator marking.

V_{YSE} is determined during aircraft certification at the airplane's maximum gross weight. Although the published speed does not change, the "blue line effect" airspeed decreases at approximately 2% for every 100 pounds below the airplane's maximum gross weight.

20. Best glide speed – maximum range with engines out/propellers feathered

This is the indicated airspeed that permits the greatest distance with both engines inoperative. It assumes both engines have failed and both propellers are feathered. If published in your model of Baron, this speed is listed in the Speeds for Emergency Operation in the Emergency Procedures section of the POH. If it is not published, assume Best Glide speed is about 10 knots faster than "blue line" speed, using those POHs providing this information as a guide.

Similar to V_A, Best Glide speed decreases with a reduction in airplane weight. Approximate Best Glide speed at reduced weights by decreasing the published speed by 2% (1 to 2 mph) for every 100 pounds below the airplane's maximum gross weight.

21. 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.

22. 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 on the next page—you might make a copy of that page, fill in the airspeeds, cut out the reference card and laminate it for use in the cockpit. A quick check before each time you fly will reinforce the numbers that result in maximum, predictable performance in normal, abnormal and emergency situations.

BARON/TRAVEL AIR AIRSPEEDS
KIAS/MPH as applicable to the airplane
(maximum gross weight)

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

* 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.

