Basic Trainer

A look back at the BT-13 Vultee Vibrator

BY BRUCE MOORE

During Complex Times

To the cadets graduating from primary school, the Vultee Valiant was a quantum step up. For the first time, they had an enclosed canopy, adjustable propeller, radios and interphone, and a full set of blind-flying instruments. No longer was a student restricted to local flying. Now he was expected to learn how to navigate to any location—day, night, or in weather.

In basic training, students would also learn radio communication, formation flying, precision landings, and more aerobatics—all in just 10 weeks. Back then there was a greater sense of military purpose to basic training. The basic flight schools and airports were run by the Army Air Force with Air Force instructors, and there was more focus on military maneuvers.

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Cockpit details: note large fluorescent lamp on flexible arm for panel illumination at night.

The airplane of choice for this type of training was the BT-13. It was a step up in all areas. No longer tube-and-fabric or wood, the BT-13 was all metal, except for the control surfaces. It was also bigger (42-foot wingspan), more powerful (450 hp), and more complex (flaps, two-position propeller, electrical system, and avionics). With a gross weight of 4,496 pounds and a Pratt & Whitney R-985 Wasp Jr. on the nose, the aircraft had better power-to-weight than the previous primary trainers (1-to-10 for the BT-13 Valiant compared to 1-to-12 for the PT-17 Stearman). Yet for a cadet with 70 hours in primary trainers, the BT-13 was really an easy plane to fly.

Now let's take a familiarization flight the Army way. You board the ship by climbing up the wing-walk strip on the left wing. The front canopy slides open and you climb into the bucket seat, formed to fit your S-2 parachute. Unlike the open-cockpit trainers, where the pilot sat in the rear seat, you sit in the front seat for all visual flight rules flying. The spacious cockpit provides a better view. The canopy sides are very low, letting you see to the side and lean out to look around the nose better for taxiing.

From the report case on the left side of the cockpit, check the Form 1A for discrepancies and fill out Form 1. Release the control lock yoke in front of the stick and secure it in the spring clips. Fasten your shoulder and safety belts, and adjust the seat height and rudder pedals. Check that carburetor heat is "cold," oil cooler shutter is "open," and mixture is "rich."

On the left side of the cockpit, between the trim wheels, is the big red wobble pump handle. Pump it to get fuel up to the big primer located high-right on the instrument panel. About seven strokes is good for a cold engine; add a few more shots with colder outside temperatures.

Now crack the throttle, check prop clear, and turn the ignition switch to "Bat" position. Early airplanes had the starter controls on a foot pedal in front of the control stick; later planes have a toggle switch on the electrical control panel on the bottom of the instrument panel. Move the starter switch to "energize."

As the starter spools up, turn the ignition switch to "Both" and flip the starter switch to "engage." You should be rewarded with the uneven grumbling of the R-985 coming to life. If necessary, work the wobble pump to keep up fuel pressure to the engine until the fuel pressure warning light stops flickering. As the engine smoothes out adjust your idle to 800-1000 rpm and check oil pressure. Then move the prop control forward to bring the blades into fine pitch.

While you wait for the oil temperature to climb into the operating range you can turn on your radio and tune it to the tower. Most basic trainers were equipped with the SCR command set having a manually tuned receiver and transmitter unit and incorporating an interphone system.

When the engine is sufficiently warmed up it is time to taxi. The view to

the side is good, and you want to leave the canopy open so you can lean out to see around the cowling in your S-turns. The BT is easy to taxi; it has a good turn radius with tail wheel steering throughout the full 35-degree arc of the rudder, and tight turns can be done by holding a brake and letting the tail wheel break free.

Takeoff final checks include selecting the fullest fuel tank, rolling the trim wheels to neutral, and making sure the two-position prop is forward in the high rpm position. Crank the flap handle 10 revolutions to set 20 degrees. Grab the big carbon microphone hanging from its hook on the right side of the cockpit, and call the tower for takeoff. Taxi into position and slowly advance the tall throttle all the way.

The airplane accelerates faster than your previous primary trainer, with a satisfying "blat" as the big 9-foot Hamilton-Standard propeller beats the air at 2300 rpm. The long control stick is topped with a Bakelite pistol grip and feels good in your hand.

With the elevator trim set properly and neutral pressure on the stick, the tail will raise itself when the plane is ready. There is no swerving tendency when the tail comes up; the rudder is effective and runway alignment is easy to maintain. When you feel the airplane getting light on its feet it is close to 70 mph, so apply a little back-pressure, and the ship is up and climbing.

On climb-out pull the throttle back to get 2100 rpm and it settles into cruise climb at 90 mph. Depending on your weight and the outside air temperature, this will give you better than 1,000 fpm. At full takeoff power the engines delivers 450 hp, but you are also burning 49 gph. At cruise-climb with fine pitch and 2100 rpm your power is about 350 hp, and your fuel burn drops to less than 35 gph. As you clear the traffic pattern you can slide the canopy closed. You notice the calmness and quiet as the slipstream wind and engine noise subsides.

To level off, climb past your cruising altitude by about 150 to 200 feet and then pull the prop control back to "Low rpm." Lower the nose and crank the flaps up as you do a shallow dive to your cruise altitude. After the plane stabilizes adjust the throttle for 1900 rpm. With the mixture leaned to best power your fuel consumption is close to 20 gph with a cruise speed of about 135 mph, depending on altitude. Fuel consumption was not a big item before, but now that you will be doing a lot of cross-county flights, proper power management and understanding of your ship's range and endurance are important.

The flight controls are well-

Vultee Valiant Specifications (BT-13)	
Engine:	450-hp Pratt & Whitney R-985-AN-1 Wasp Jr. nine-cylinder radial
Propeller:	Hamilton Standard two-position hydro-controllable (two-blade aluminum)
Empty weight:	3,375 pounds; max takeoff weight: 4,496 pounds
Wingspan:	42 feet
Length:	28 feet 10 inches
Height:	11 feet 6 inches
Fuel capacity:	120 gallons (in two 60-gallon wing tanks)
Fuel grade:	80/87 octane
Oil capacity:	10 gallons
Maximum speed:	180 mph
Ceiling:	21,650 feet
Range:	725 miles
Cruise speed:	130-140 mph

The Valiant was built by Vultee Aircraft Company (later Consolidated-Vultee) from 1939 to 1944. BT-13As had a 12-volt electrical system, and BT-13Bs were 24-volt. Due to a shortage of Pratt & Whitney R-985 engines 1,693 Valiants were built with the Wright R-975 and called the BT-15. The U.S. Navy as the SNV also operated 2,000 Valiants. Total Valiants produced: 11,537.


U.S. ARMY AIR FORCE

BT-13s at Minter Field, California, 1943.

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Author's father, Cadet Willard Moore, at Walnut Ridge, Arkansas, 1943.

harmonized. The ailerons feel especially nice compared to those of your primary trainer; they are lighter and give a higher roll rate. Elevator and rudder trim are located where they fall easily to your left hand. The field of view is excellent. In cruising flight with the nose below the horizon, the low wing and low-cut canopy sides provide outstanding visibility. There are many frame pieces constructing the greenhouse canopy, but with a swiveling neck and binocular vision you hardly notice them after a while.

Switch tanks every 30 minutes to keep the airplane in lateral trim (there is no aileron trim). Fuel is contained in two 60-gallon tanks—the right tank has a standpipe so you can select "R.H. MAIN" on cross-county flights, and when the engine quits you know you have 17 gallons remaining in that tank. Takeoff and landings should be done on the

Special thanks to Brad Neat for displaying his BT-13 for the air-to-air photos.

fullest tank, selecting "L.H. MAIN" or "RES." The fuel selector is on the left side of the front instrument panel, but it's connected to a rod running along the left side of the cockpit so the selector can be switched from the rear cockpit. A wooden grip is located on the rod just behind the trim wheels so you can easily change tanks without loosening your shoulder straps.

Stall clean is 65 mph, and with flaps at 40-60 degrees it is 55 mph. When practicing stalls the airplane gives you plenty of warning, with plenty of elevator buffet and the shaking of the canopy and aft fuselage (which is where the BT-13 received its nickname, the Vultee Vibrator).

On stall break you get moderate nose drop, and it usually rolls off on one wing. As soon as you release backpressure the airplane recovers and can be easily leveled with coordinated aileron and rudder. The tech order cautions against using aileron alone to raise a wing; if this is attempted before the plane is fully recovered from the stall, excessive adverse yaw can induce a spin.

Stalls were taught power off, power on, turning, with excessive top or bottom rudder, and with crossed controls. As a demonstration of what can happen with a larger plane that is intolerant of improper trim settings on go-arounds or takeoffs, the BT-13 can be "trim-tab stalled."

For this demonstration set flaps 20 degrees, trim for the glide, then add takeoff power; if you don't hold the nose down with forward elevator pressure, the plane will pitch up into a stall. The airplane was also good for teaching spins. It had normal spin characteristics and spun rapidly with a steep nose-down attitude, and its powerful rudder and elevators facilitated spin entry and recovery.

Aerobatic maneuvers can be flown more easily in the BT-13 than in the primary trainers, the plane is cleaner and holds its energy well, and the roll rate is much better. Basic training maneuvers consisted of loops, snap rolls, slow rolls, half-roll and reverse, and Immelmann turns.

When flying aerobatics you will notice wrinkles between the rib bays on the top wing skin under the higher positive *g*-loads. The tech order says this is normal and that the bottom wing skin and spars are carrying the entire load when this condition is observed. The plane was known for its flexibility. Students joked that when you snapped it, the tail was a quarter turn behind the rest of the airplane.

Now it's time for some landings. When approaching one of the auxiliary fields stay at least 1,000 feet above the pattern, overhead the field, and check the wind-tee setting and windsock. Look carefully for other BTs in the pattern or on the ground. Move your propeller to "High RPM" and slide open your canopy, entering the pattern below 120 mph and crank down 20 degrees of flaps.

Fly your downwind at 700 feet and 105 to 110 mph, or at 2000 rpm. Set up a crab to compensate for any crosswind drift. Consider the wind and choose your spot to turn base, using a medium banked turn. Shout your final check out loud: "Gas—on fullest tank, mixture—full rich, propeller—high rpm."

At the key position cut your throttle and adjust your glide for 90 mph. Make another medium banked turn to final and crank in another 10 turns to get 40 degrees of flaps and lower your nose to maintain 90. Managing the flaps can be done without looking at the indicator, since every revolution of the flap handle gives you 2 degrees of flaps.

As you approach 40 degrees of flap, the crank force increases and you know you are reaching 40 degrees. At 90 mph elevator trim is close to full back. About 50 to 30 feet above the ground start to break your glide, and gradually transition so that you reach a three-point attitude just as you touch the ground.

There is no tendency to ground loop, and the plane tracks well once the tail is on the ground. With any crosswind the standard wing-down sideslip works well. You have plenty of rudder control at all speeds, and you will find that you run out of crosswind aileron before rudder, so the aileron is the limiting factor.

The BT-13 has effective flaps, and you no longer need to slip to control glide path. For short field landings with 60 degrees of flaps and 75 mph, there is still ample elevator to arrest your descent and control the landing. Small adjustments for the landing flare and crosswinds are easy to make even in gusty conditions.

For wheel landings the trick is to let the plane touch at minimum sink rate before the tail is low enough to touch the ground. Often carrying a little power lets you arrest the descent more easily, but it uses more runway. At touchdown, add forward stick to keep the weight on the mains and keep the tail up as you slow. Wheel landings are a good technique if better forward visibility is required on rollout or if you need to test the surface of your landing field before you commit to stopping.

For the hurdle stage you will be landing from a steep full-flap approach over a flagged rope stretched at a height of 16 feet across the runway. This requires good speed control and timing. With an approach speed of 75 mph and 60 degrees of flaps, the approach path and sink rate are controlled with the throttle.

Just before crossing the obstacle, cut the throttle and arrest the increased sink with back elevator. A perfectly executed hurdle landing will result in the aircraft touching down just as your stick hits the rear stop; the plane will be fully stalled and the ground roll will be minimal. As the cadets are still perfecting this technique, the long stroke oleo struts are often called upon to absorb considerable landing impact, and they do a good job of protecting the airplane and the student's spine.

The Vultee Valiant was a great trainer for teaching military flying the military way. The incremental method of training with more advanced aircraft and more demanding tasks in three phases produced the best pilots of World War II. Sadly at the end of the war the Vultee Vibrator all but vanished. There was a surplus of pilots, and the BT-13 was seen as unnecessary. Many were sold surplus and scrapped for their engines, wheels, and instruments. The survivors are few, but some proudly hold up their noses on the flightline of EAA AirVenture Oshkosh every year . . . the others can only look back at the faded photographs of our fathers.