A2A SIMULATIONS

BONANZA

ACCU-SIM V35B BONANZA

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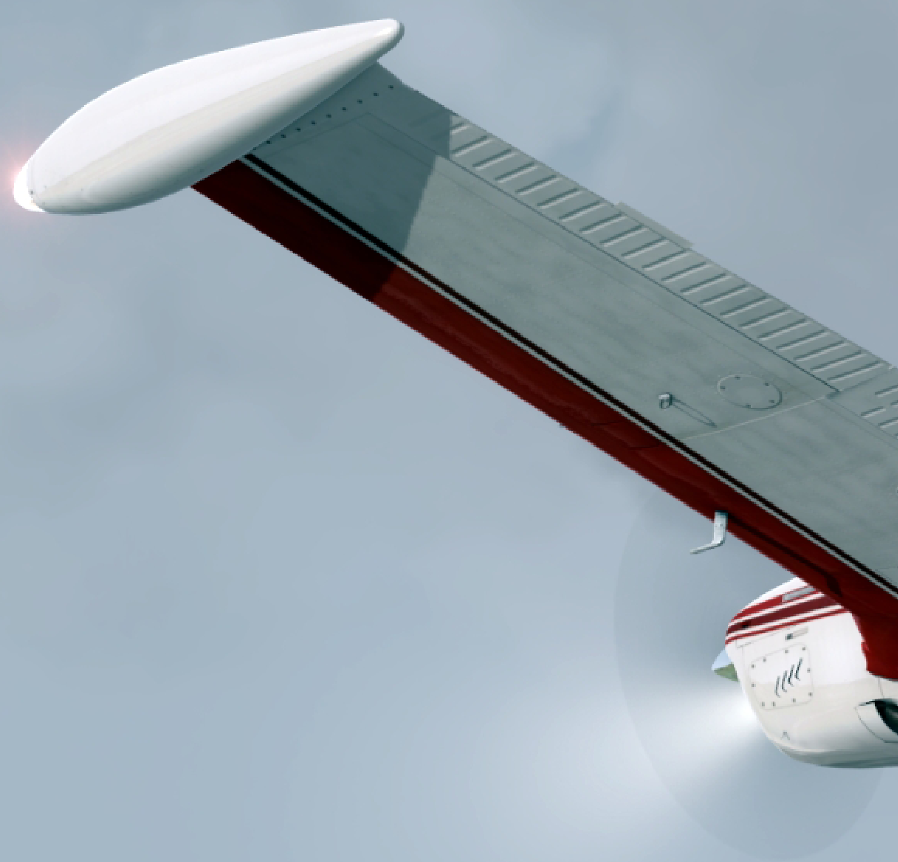
CONTENTS

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BEECHCRAFT BONANZA
Flying Into The Future

by Mitchell Glicksman © 2018

Virtually everyone who gazes upon the fair proportions of a "V"-tail Beechcraft Bonanza has come to feel deeply about its striking appearance. All who have had the privilege to fly a Bonanza have come to appreciate its excellent and unique handing and performance. From its 30º (later 33º) "V"-tail to its tight and trim cowling Bonanza stands out from the rest.

Bonanza is unlike any other General Aviation (GA) aeroplane. In the pilot's seat Bonanza feels different than other similar aeroplanes, more solid, sturdy and substantial. All who may be so fortunate as to fly in a Bonanza immediately perceive the extraordinarily high quality of everything therein, from the seats, windows and curtains, to the fittings, switches, knobs and levers. Flying a "V"-tail Bonanza is a unique and satisfying experience. From engine start to shut-down and throughout the flight "V"-tail Bonanza handles surely, lightly and quickly, more like a fine-tuned piston-engine fighter than any other GA aeroplane of its kind. Whilst Bonanza's handling characteristics are likely to get low-time pilots into trouble in a hurry, experienced and knowledgeable pilots have universally found Bonanza to be a joy to fly. However, none of this came about accidentally but was a direct result of Beech's deliberate concept and design.

Upon its introduction to the public in March 1947 it was clear to all that this aeroplane was miles and years ahead of any other light civilian aeroplane, past or present. All Bonanzas feature a flush-riveted NACA 23000 airfoil wing which Beech had also used on its Model 18 "Twin Beech," a circular, flush riveted stressed aluminium fuselage, fully enclosed electrically retractable undercarriage, a retractable boarding step, gap-sealed recessed flap tracks, cockpit-adjustable cowl flaps, internally hinged control surfaces and, at first, an electrically pitch-adjustable 2-blade wooden propeller which soon afterwards was replaced by a metal constant-speed prop. Most of these features were commonplace for fighter aircraft of the 1940s but had rarely ever before appeared on a light civilian aeroplane.

When it was introduced Bonanza did not merely look supremely clean and fast, its overall drag coefficient (Cd) was, in fact, the lowest of any light aeroplane in the civilian market.

Beech publicity has often attributed much of Bonanza's excellent performance to its unusual "V"-tail. However, as we shall see, it played virtually no part in contributing to such and actually had more than a small negative impact on the aeroplane's reputation.

SETTING THE SCENE

In January 1945, company officers and engineers at Beech Aircraft Company, Inc. began to have serious discussions about what kind of aeroplane they were going to produce when World War II was over and crucial materials such as aluminium, steel, rubber and such once again became available for civilian use.

By this time most of the world had been engaged in the most savage and deadly war in all of human history in excess of six years, four months since the Nazi invasion of Poland, 1 September 1939. Since 7 December 1941 The United States had been engaged in all theatres of this worldwide conflict for more than three years and would ultimately suffer 1,076,245 casualties, the great majority of which had already been inflicted by January 1945.

However, by January 1945, seven months after the Allied invasion of France at Normandy on 6 June 1944, the hoped-for light of peace in Europe, which for six years had but dimly twinkled down at the distant end of the war's terribly long, dismal tunnel, now burned ever more clearly and brightly as a bold torch of triumph. The rolling collapse of Nazi military forces put them finally and irrevocably in full retreat after the failure of one last, desperate Wehrmacht offensive (The Battle of the Bulge - 16 December 1944 - 25 January 1945). By the middle of January 1945 Soviet armed forces, having essentially ground the Nazis' eastern armies and amour to dust, casting their survivors into a frozen, deadly retreat, were in Poland and were pushing rapidly, inexorably and mercilessly towards the very heart of Germany. Daily and nightly thousands of Allied bombers were pounding Germany's factories and cities into rubble, bringing the American public's appreciation and awareness of aviation to its zenith.

By January 1945 in the Pacific Theatre the largest part of Imperial Japan's army, naval and air forces, save for a few isolated battalions which were left alone, bereft of support to haplessly and hopelessly defend the innermost Japanese islands, had been utterly destroyed, essentially neutralizing Japanese aggression. During January 1945 U. S. and Allied forces, suffering great casualties, landed at Luzon, Philippines and liberated Manila.

AT HOME

Even in the years before the war began for the United States a sober look at that which was occurring in Europe engendered a ramping up of industry throughout the country which facilitated the end of the Great Depression. Once at war, virtually all industries, workplaces and factories in the United States were intensely focused upon producing whatever was required to assure the ultimate victory. This was no less true in the aircraft industry. By January 1945 the Allies' spectacular military advances on all fronts were a clear indication to even the most hardened cynic that victory was forthcoming. Whilst horrific combat would still continue for a time in Europe and even longer in the Pacific, by January 1945 the general feeling was that an end to this monstrous blood bath was indeed nigh.

Meanwhile, as 1,000 plane bomber raids were regularly reported in newspapers and shown in newsreels between features in cinemas, the public in the U.S. became more and more air-minded. Accordingly, articles speculating on the future of civilian aviation were published in many magazines and Sunday supplements particularly regarding what was called, among other things, the "Everyman Airplane." In the late 1940s and early 1950s this often took the shape of a new and then highly misunderstood type of aircraft, the helicopter.

In the February 1951 issue of Popular Mechanics an illustration of a two-seat, jet-powered helicopter was shown being pushed back into its garage by a suburban man in his hat and overcoat having ostensibly just flown it back from work. An identical red helicopter is seen above his neighbour's house. The article "reported" that anyone could learn to fly one of these machines in only two hours.

Along with this kind of nonsense, fanciful drawings of boat-aeroplanes and automobile- aeroplanes abounded. One of these, designed to be a true-functioning automobile as well as a true-functioning aeroplane, "Aerocar" towed its folded wings and tail section behind whilst on the road which, when flight was desired, were assembled and flown away. Sounds crazy, does it not? The thing is, it actually worked. Taylor "Aerocar," the exception to the wildly improbable contraptions that had been permeating the press, was both successfully driven and flown in 1949. Along with so many less practical conceptions, "Aerocar" was also intended to be the "Everyman Airplane", however, only six were built and sold. All six still exist, four of them are reportedly in flyable condition and one, N102D, is still flown.

It was in this chimerical aeronautical atmosphere that aircraft manufacturers planned to sell (real) aeroplanes to the public in huge quantities as soon as the war ended.

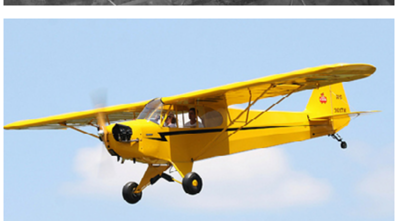
N192D, the only still-flying "Aerocar".

A beautifully restored Belgian-registered Beech Model 17S "Staggerwing." This unique and striking design is a massive and complicated fabric-covered wood and steel structure powered by a 450 hp Pratt & Whitney R-985-AN-1 "Wasp Junior" radial engine. With a top airspeed of 212 mph (184 knots, 341 km/h,) it was a fast biplane in the 1930s, but became less and less competitive as an executive transport with the emergence of the new and more efficient all-metal aviation technology of the 1940s.

Beech Model 18, here as Royal Canadian Air Force (RCAF) transport. This aeroplane's resemblance to the larger Lockheed "Electra" is likely not entirely a coincidence.

Beech AT-11 "Kansan" bomber trainer over Texas in 1943. One of 49 military variants of Model 18, AT-11 was the U. S. Army Air Force's (USAAF) primary bombing trainer during the war in which more than 40,000 bombardiers were trained. Modifications included a transparent bomber's nose, an internal bomb bay and bomb racks and a dorsal gun turret for gunnery training. Photo from "Western Trips"

The second and last prototype Beechcraft XA-38 "Grizzly" shown here was produced with an operational 75 mm cannon. It beggars one's imagination to think that the same company which was still producing the fabric-covered "Staggerwing" biplane also designed and built this formidable-looking and performing modern warplane. Photo from "Old Machine Press"



1947 Piper J-3 "Cub." The great progenitor of all general aviation light aircraft, what Piper offered in 1947 was indistinguishable from the pre-war "Cub."

A TWINKLE IN WALTER BEECH'S EYE

By 1945, along with virtually every U. S. manufacturer Beech Aircraft Company which was founded in Wichita, Kansas in 1932 by Walter Beech, his wife Olive Ann Beech and a few others began to plan for the coming post-war era. However, by the late 1930s Beech had designed and produced only two aeroplane types in any quantity, the 1933 Model 17 "Staggerwing" and the 1937 Model 18, commonly called "Twin Beech."

The 1933 Model 17 is called "Staggerwing" because the upper wing is placed rearward of the lower wing. Model 17's airframe is fabric-covered wood and steel, typical of aircraft of the early-to-mid 1930s, It initially had a fixed and later a retractable undercarriage.

Along with most of the aircraft manufacturers in the United States in the early 1930s a number of circumstances, particularly the deadly crash of TWA Flight 599 in which the beloved Notre Dame University football coach Knute Rockne was killed,[1] informed Beech that all-metal aircraft were the wave of the future. Not content to merely build a simple all-metal single-engine light aeroplane Beech jumped into these new waters with both feet by producing Model 18, a far heavier and more complex aeroplane than it had ever built.

Beech's second aeroplane, Model 18, is an all-metal twin-engine light transport which, since its introduction in January 1937 has been a popular and highly successful civilian and military aeroplane. The first Model 18s were powered by two 330-hp (250-kW) Jacobs L-6 or by two 350-hp (260-kW) Wright R-760E radial engines turning cockpit-adjustable-pitch Hamilton Standard propellers. Model 18's engines were soon upped to 450-hp (336-kW) Pratt & Whitney R-985 radial engines turning the new Hamilton Standard three-blade constant-speed propellers. However, the construction and manufacturing methods required for building Model 18 were entirely new to Beech. In fact, Beech Model 18 was a quantum leap from Model 17 in every way.

Model 17 seats a pilot and three passengers, is a single-engine, fabric-covered biplane with a wingspan of thirty-two feet weighing 4,250 lbs. fully loaded. By comparison, a typical late 1930s Model 18 seats two pilots and up to eight passengers, is a twin-engine, all-metal, cantilever (no external struts) monoplane with a wingspan of forty-seven feet, eight inches weighing 7,500 lbs, fully loaded.

After selling only thirty-eight Beech 18s before the United States' entry into W.W. II including one to Sweden as an air ambulance and six to the Nationalist Chinese Government as M18R Light Bombers, once the war began the various U. S. armed forces, the Royal Canadian Air Force (RCAF) and the Royal Air Force (RAF) purchased more than 4,000 Beech 18s.

Beech built two other aeroplanes during the war. One of these was the twin-engine Beech Model 26 AT-10/11 "Wichita"/"Kansan," a militarized derivative of Model 18. This aeroplane was built in response to the U. S. Army Air Corps' (USAAC) requirement for a twin-engine, retractable undercarriage, multi-engine trainer similar to Cessna's AT-8.

The second military aeroplane that Beech designed and built during the war was the remarkable 1944 Beech XA-38 "Grizzly", an experimental twin-engine ground attack fighter of which only two prototypes were constructed. "Grizzly" was a completely original design created in response to the USAAF's requirement for a replacement for the Douglas A-20 "Havoc" which by 1944 was long past showing its age "Grizzly" was powered by two 2,300 hp Wright R-3350-43 air-cooled radial engines. Unfortunately these engines were already in use by Boeing B-29 Superfortress which had the highest priority for them.

In early 1944 an invasion of Japan was deemed to be likely and the USAAF wanted a fast, powerful and lethal ground attack aeroplane which could be employed to neutralize Japanese fortified ground installations and artillery. For this purpose Beech designed XA-38 around the most powerful engines available (or unavailable as it turned out) installing a 75 mm cannon in its nose as the aeroplane's primary weapon in the same fashion as North American B-25G/H "Mitchell." "Grizzly" also had two remotely operated machine gun turrets similar to those in B-17, P-61, B-29, Me-210 and He-177A. With a total 4,600 hp, it had a blistering top speed of 370 mph at sea level, faster than most of the Japanese fighters that it was likely to encounter. Although the war ended before XA-38 "Grizzly" could go into production and prove its worth in combat, it was, in its day, an extraordinary and unmatched achievement in design and sophisticated construction technique for what had previously been a light aeroplane company. Beech's production of both Model 18 and "Grizzly" set the stage for another aeronautical achievement still to come.

The extraordinarily prolific Beech Model 18 "Twin Beech" was produced in 25 USAAF variants, 14 U. S. Navy (USN)/U. S. Marine Corps (USMC) variants and 9 RAF and RCAF variants as well as being in operation in 43 foreign air forces. But for this versatile and excellently performing modern aircraft Beech might have continued to produce only its

1946 Taylorcraft BC-12D. C. G. Taylor's clean design made BC-12DA a slight refinement of his 1938 Model "BC," which was itself a refinement of the 1938 Piper J-3 "Cub." BC-12 has dual control wheels instead of control columns and a door on each side of the cabin for easy entrance and exit. Whilst Taylorcraft's side-by-side seating is better for instruction as well as for pilot-passenger communication in general, these aeroplanes are not very wide and their snug interiors are insufficient for two "full-sized" adults.

1947 Stinson 108-2 "Station Wagon." A roomy four-seater, interior wood panels and a reinforced floor permit 600 lb (272 kg) of baggage to be carried in the passenger compartment. Its 165 hp Franklin 6A4-165-B3 engine can use automotive fuel with the installation of a converter kit. The Stinson's wings' fixed leading-edge slats make the 108 series excellent and reliable slow fliers, enabling them to easily get into and out of small tree-lined fields.

1947 Aeronca "Champ." Another refinement of the J-3 "Cub" design with similar tandem seating and similar performance. Solo from the front seat is a definite improvement over "Cub's" rear seat solo station and "Champ's" large windows make visibility in all directions much better. Having had a number of hours in a "Champ," this writer has found this responsive and sprightly aeroplane to be the best of the lot of this type.

1947 Luscombe 8A "Silvaire" on floats. Rather fast for its 65 hp engine with a top airspeed of 85 mph or so, the aeroplane in the photo is identical to the "Silvaire" in which this writer first received instruction and learned to fly the age of 12. Luscombe "Silvaire" has dual control sticks rather than control wheels making it a very fun and responsive aeroplane.

Ryan (originally North American L-145) Navion B Super 260 C-FCTI. It is not merely a coincidence that airframe of this excellent four-seat aeroplane is reminiscent of P-51 “Mustang” upon which its design was based. Introduced in 1948, the retractable tricycle undercarriage Navion is powerful and fast. 260 hp Navion variants have a useful load of 920 lbs, a top airspeed of 175 mph, can carry four passengers in comfort over a range of 595 miles, take-off in 400 feet and land in 466 feet. Navion was Bonanza’s closest rival in the late 1940’s and during the 1950s, outperforming Bonanza in many ways. Celebrities Veronica Lake, Arthur Godfrey, Mickey Rooney and Bill Cullen were among those who owned and flew Navions. Many are still flying and whilst offering something of an awkward climb to enter they are considered to be a great bargain on the used aeroplane market. Photo by Barry Griffiths.

Piper Pa-22 “Tri-Pacer.” Introduced in February 1951, this comfortable four-seat aeroplane is essentially a Piper PA-20 “Pacer” with a nose wheel. Although rather a throwback with its fabric-covered aluminium frame and stodgy appearance (derisively nicknamed “Flying Milk Stool,”) 160 hp versions of this fine aeroplane give it useful load of 890 lbs, a top airspeed of 141 mph, an 800 fpm climb rate and a range of 650 miles, all with four 170 lb passengers on board. This writer has enjoyed many pleasant hours flying Tri-Pacers as well as its two-seat version, PA- 22-108 “Colt.” Tri-Pacer was introduced six years ahead of its chief tricycle-undercarriage rival, the all-metal Cessna 172. As good as Tri-Pacer was and is, it has never been serious competition for Bonanza. A John Marco photograph

fabric-covered “Staggerwing” bi-plane as it had before the war. As it was, Beech produced 16 variants of Model 17 “Staggerwing” for the USAAF, the USN/USMC and for fifteen foreign air forces. However, it was Beech’s mass production of the sophisticated Model 18 “Twin Beech” which considerably informed the company regarding modern metal construction methods and gave it otherwise unobtainable and invaluable experience regarding the construction and production of complex all-metal aircraft. This precious experience gave Beech a great advantage over virtually all of the other U. S. light aircraft manufacturers when it conceived and designed Model 35 “Bonanza” in 1944.

Whilst Model 18 was a great success, the production of which continued until 1970 with more than 9,000 ultimately produced, Walter Beech and his staff had been optimistically looking toward the post-war civilian aviation world to come. The plan they developed was to produce a high-performance, luxury, all-metal, four seat, single-engine light executive aeroplane that would be relatively simple and efficient to operate.

Except for Cessna’s AT-8/AT-17/UC-78/JRC “Bobcat”/ “Crane” primarily wooden “Bamboo Bomber” bomber trainers during the war, the other light aeroplane manufacturers primarily produced only slightly modified military versions of what they had been producing before, i.e., light, low-powered, two-seat, “low and slow” fabric-covered aeroplanes.

Piper produced O-59/L-4, the military version of its “Cub” and few glider trainers. Stinson produced a military version of its 105 “Voyager’ designated L-5 “Sentinel,” a military version of its pre-war SR- 10 “Reliant,” designated UC-81, as well as Model 74/L-1 “Vigilant,” a larger, more powerful light observation aeroplane. Aeronca produced a military version of its tandem-seat trainer, “Champ.” designated O-58/L-3 “Defender” and like Piper, a number of glider trainers. Taylorcraft produce a military version of its Model D, designated O-57/L-2.

After the war these manufacturers made few if any modifications to their aeroplanes and those which simply were essentially their early 1940s designs were put back onto the market. Photographs on Page 9 show some of Beech’s “competition” were offering in the post-war, late 1940s:

Of course, more powerful and sophisticated aeroplanes such as Cessna 190/195 (see further discussion of this aeroplane below,) Ryan Navion, Piper Tri-Pacer, Cessna 172 and Bellanca 14-19 would soon be produced; however, until Piper’s 1958 PA-24 “Comanche 250,” nothing came close to ousting Bonanza from its position at the top of the heap.

“I SEE A NEW SUN UP IN A NEW SKY”[2]

It is an oft-told tale that by the end of W.W. II, U. S. light aeroplane manufacturers, all of whom had been forced to curtail their usual retail businesses during the war to supply aircraft for the armed services, looked forward with anxious hearts and open coffers to the soon-to-come peace during which they hoped and believed that the tens of thousands of returning military pilots, having experienced the “joy”[3] of flight, would wish to continue the same and would gladly purchase low-priced, simple aeroplanes by the bushel-full.

The Serviceman’s Readjustment Act of 1944, popularly known as the "G. I. Bill," designed and largely drafted by the American Legion and the Veterans of Foreign Wars, was a Federal entitlement program which provided a range of financial benefits, including free flight instruction all the way to an Airline Transport Rating, for returning WWII veterans. Aircraft manufacturers were all quite aware of this and they saw it as a boost to what they believed would be a glorious new, commercially lucrative general aviation boom.

The aeroplanes that they had been producing before being interrupted by the war - Piper J-3 "Cubs", Taylorcrafts. Stinsons and the like would be just perfect, or so they thought. What was not spoken of if it was thought of at all was that immediately after the end of the war a tremendous glut of surplus "grasshoppers" (all of those high-wing, low powered, mostly two-seat aircraft) would be offered as surplus to the public at very low prices. For instance, in 1945 the Office of Price Administration (OPA) made surplus two-seat Aeronca L-3B "Champs" in virtually unused condition available for $1,788.00 ($19,963.94 in 2018 at a cumulative rate of inflation of 1,016.6%) and four-seat Stinson UC-81/AT-19 "Reliants" available for $6,736.00 ($75,210.91 in 2018 at the same rate of inflation.)

However, Walter Beech and his staff had a completely different view of what Beech's role would ideally be in the post-war future. Their experience with light aircraft had solely been with Model 17 "Staggerwing", a fairly large and expensive executive aeroplane. Beech's plan was that its new post-war aeroplane would well-fit this role.

In 1945 and for a decade and a half thereafter, the now-familiar culture of the casual weekend pilot who usually flies locally in good weather with friends and family to sightsee and perchance to purchase a few of those $100 dollar hamburgers at a far-off little airport's snack bar, the vast majority of whom have little flight time and are not instrument (IFR) rated, did not yet exist. Accordingly, once plans for what became Bonanza began to develop, an important aspect of this aeroplane's design was that it did not include compromises which would make it especially forgiving or gentle-flying, particularly not at the expense of performance. Thus, Bonanza was not intended to cater to the aforementioned not-yet- existent culture of casual pilots. Rather, it was designed to be a business tool, an executive transport aeroplane which would be owned by successful businesses and flown by professional pilots who would transport those executives who required quick, private and convenient transportation to places that were too distant or inconvenient for efficient ground travel. Oh yes, and lest we forget, Bonanza was also intended to be an exclusive, conspicuous totem of financial accomplishment.

Since its introduction in 1936, and into the early 1940s, Walter Beech and Co. had been well and painfully aware of their greatest competitor in the corporate aviation genre: Spartan Aircraft Company's 7W "Executive." This highly advanced aeroplane is a sleek and muscular-looking, all-metal, retractable undercarriage, low-wing monoplane which exhibited spectacular performance for its time, with a top airspeed of 257 mph (223 knots, 414 km/h) whilst

1949 Bellanca 14-19 "Cruisemaster." An upgrade of the pre-war Bellanca 14-7 and the post-war Bellanca 14-13, 14-19 has a large, comfortable cabin for four and is powered by a Franklin 6A4-335-B3 190 hp engine. "Cruisemaster's" triple tail and its wooden wing garnered it the nickname "Cardboard Constellation" after Lockheed's "Constellation." However, like Lockheed's triple-tail marvel, "Cruisemaster's" performance was in many ways better than its similar contemporaries, including Bonanza, with a useful load of 1,025 lbs, a top airspeed of 174 mph, a rate of climb of 1,250 fpm and a fully-loaded range of 435 miles. A tailwheel aeroplane with retractable main undercarriage in the new tricycle undercarriage world, its retro wood and fabric construction and undeniably quirky appearance did not aid its overall public acceptance. Whilst in 1959 14-19 would be converted to a retractable tricycle undercarriage by "Downer Aircraft" (Bellanca's new name,) only around 600 of the original 14-19 "Cruisemasters" were produced. Whilst in many ways "Cruisemaster" is a better-performing aeroplane, Bonanza remained unchallenged.

Cessna 172. Introduced in 1956, it was the direct competitor of Piper Tri-Pacer. All metal and looking far more modern than Tri-Pacer, C-172 is a Cessna 170 with a nose wheel. Despite its sleek appearance, C-172 does not perform as well as Tri-Pacer in many areas. 160 hp versions of C-172 give it a useful load of only 758 lbs, a top airspeed of 140 mph, a rate of climb of 721 fpm and a possible range of 696 miles, but with only two rather slim passengers on board. Cessna 172 might have well-competed with Tri-Pacer but it, too, was no competition for Bonanza.

Spartan 7W "Executive." The name says it all. Sleek, modern, powerful and sensual, this was top shelf, first-class personal transportation for the super-rich corporate executive in the mid 1930s and early 1940s. Photo from Flickr.

Restored Spartan 7W "Executive" previously owned by Texaco, Inc. in the late 1930s.

comfortably carrying up to four with a range of 1,000 miles. Spartan "Executive" boasted such notable owners as industrialist and film mogul Howard Hughes, oil magnate, financial wizard and overall S. O. B., J. Paul Getty, and no less than His Royal Highness, King Ghazi of Iraq. To Beech's chagrin, from its first appearance Spartan "Executive" was universally considered to be the "Rolls-Royce" of pre-war executive aeroplanes which even Walter Beech would have had to reluctantly admit, deservedly so.

Compared to the potent and swift-looking Spartan 7W "Executive," Beech's contemporary Model 17's top speed is 45 mph slower and its range of 670 miles is 330 miles less. Walter Beech had to admit, at least inwardly, that his Model 17, while an excellent aeroplane in its own right, was clearly and eminently inferior to Spartan 7W. To make matters even worse for Beech, both Model 17 and Spartan 7W were powered by the same Pratt & Whitney R-985-AN-1 "Wasp Junior" radial engine producing 450 hp (340 kW) at 2,300 rpm.

Whilst Model 17 was attractive to the military in small batches during the war and each of fourteen foreign nations operated a scant few of them, Model 17 never arose to the level of a truly mass-produced aeroplane with a total of only 785 examples having been produced from 1933 to 1949. Spartan 7W was in production for only five years (1936 to 1940) and only 34 examples were produced; however, 7W's spectacular, striking appearance and blazing performance epitomised the value of the practical application of advanced aerodynamics, modern construction methods and materials and the latest concepts in aeronautical structural engineering in the arena of executive aircraft. While no-doubt painful, this lesson was not lost on Walter Beech, who would soon put it to good use.

To be fair, Model 17 "Staggerwing" is a unique and extraordinary design particularly for a biplane, and it is certainly impressive to the eye (many consider "Staggerwing" to be the most beautiful biplane ever built.) Despite its inherent disabilities, the extra wing along with the struts and wires required to keep it in place, "Staggerwing" performed very well indeed. However, aside from its inferior overall performance compared to Spartan 7W whilst powered by the same engine, "Staggerwing" was also very costly to build and delicate to maintain. Its old-school wood and steel-tube construction with thousands of intricate structural parts and connectors covered by stitched and doped fabric, the entirety of which must be meticulously assembled by many skilled hands, was highly labour-intensive (i.e., expensive) to construct. Additionally, "Staggerwing" and all fabric-covered aeroplanes' owners always have a terrible "Sword of Damocles" hanging over them in the form of an inevitable and expensive re-covering and paint job awaiting them in the future. Altogether, it is no wonder that by mid-war Beech was beginning to have serious thoughts about a more modern, more efficient and less complicated replacement for Model 17.

Walter Beech, a man of a considerably forceful personality was, to his credit, not at all hidebound to the past or by traditional methods of building aeroplanes. Additionally, he was determined that his "star" aeroplane would never again be so outperformed as had been Model 17. In January 1945, with the war still raging all around the world but with imminent peace and a bright, shimmering future clearly in sight, Beech, unlike virtually every other light general aviation aeroplane manufacturer, began to draw plans for something entirely new that would be an icon for and of that bright future.

Rolled out of the factory on 9 September 1940, this was the last Spartan 7W, later called "Mrs. Mennen." It was originally purchased by Texaco, Inc. (now a subsidiary of Chevron Corporation) for corporate use in the New York State/New England area. This magnificent aeroplane cost $26,200.40 in 1940 ($467,029.62 in 2018 at a cumulative rate of inflation of 1,682.5%) and was one of five Spartan 7Ws owned by Texaco, who based this aircraft at Roosevelt Field located in Mineola (now Garden City), New York.

This aeroplane was purchased by George Mennen of the Mennen Company, Morristown, New Jersey in the spring of 1969. It was then painted "Mennen Green" and named "Mrs. Mennen." "Mrs. Mennen" was sold, traded and bought by many different owners over the years until it was purchased in October 2004 by Will Mennen, George Mennen's grandson.

"A BUILT-IN TAILWIND"

Walter Beech wanted his new aeroplane to set the standard for quality and performance. It was to be something not yet seen, something that one might to fly into the future.

He told his design staff to come up with something not merely of 1945, but of 1955 and 1965 - and beyond. It had to be a sleek, clean design, all-metal, simple (inexpensive) to build, look sexy, go fast, carry four in comfort and have a range of around 700 miles. These factors were imperative if Beech was going to lead the post-war pack and attract wealthy corporate customers.

It is well to recall that in 1945, as Walter Beech and his team's ideas for a new light aeroplane were accumulating, the current stars of aviation were all-metal, single-engine, retractable undercarriage piston-engine fighters – Mustangs, Corsairs, Spitfires, etc. These powerful, sleek aeroplanes appeared fast even when sitting still and they made the blood rush and the imagination soar just to look upon them. Beech was determined that his new aeroplane would be just like that. He wanted to build a high-performance, light executive transport aeroplane with, as he put it, "a built-in tailwind."

At Walter Beech's behest, Ted Wells, Beech's Vice-President of Engineering who had been instrumental in the design of both the Model 17 "Staggerwing" and Model 18 "Twin Beech," together with project engineer Ralph Harman, set about the task of putting together a team of creative aircraft designers. Their mission was to design an entirely new single-engine aeroplane not only for the post-war era, but for decades to come. Such an aeroplane had also been Harman's dream and he was highly delighted to have the opportunity to be able to make it a reality.

It is reported that Beech's employees and company officers were extremely optimistic about Beech's future given its wartime experiences building powerful and sophisticated all-metal aeroplanes. They rightly felt that they had a significant "leg-up" on their competition and they were anxious and ready to prove what they could do.

The design of what was to become "Bonanza" was very much a team effort. Ralph Harmon was the overall Project Engineer, also taking on responsibility for the design of the interior and undercarriage. Jerry Gordon, Beech's Chief of Aerodynamics, created the shape of the wing and tail surfaces. Wilson Erhart designed the interior structure of the wings. Alex Oderseff designed the fuselage. Noel Naidenoff designed the fuel system and engine compartment. It is a great compliment to the skills of these engineers that Bonanza ultimately appeared to be the conception of a single brilliant individual rather than the product of a committee that it was.

No doubt greatly influenced by Beech's past success with Model 17 as well as the success of rival Spartan Corporation, Walter Beech decided from the outset not to include a trainer or low-cost cruiser in Beech's post-war menu.[4] That field, it was thought, would soon be overfilled with "Cubs", "Champs" and the like. No, Beech's new aeroplane was to be aimed solely at the highest end of the light general aviation aeroplane market. It was to be more than a means of transportation; it was to be an *objet de prestige* like a Rolex or a Rolls-Royce, something literally exclusive which only the wealthiest could afford to obtain, the possession of which would openly attest to the owner's prosperity, sophistication and good taste.

As mentioned, Walter Beech was known to be a very forward character in both his conceptions and his mode of expression. Who else but such a very confident "Type A" individual would plan for his company to enter a new and unknown aviation market with the most advanced and expensive aeroplane of the lot? Whilst Beechcraft would eventually see the efficacy of producing less sophisticated and less expensive aircraft (see endnote 4,) this first post-war Beech was intended to come out of the box firmly sitting atop of the aviation mountain, confidently and resolutely daring all comers to topple it. As history has shown, despite a most valiant but ultimately failed effort by Piper to do just that with its superb PA-24 “Comanche,” no aeroplane, so far, has quite been able to do so.

WHY “BONANZA”?[5]

In Walter Beech’s own words in 1946, “Airplanes have been named after stars, galaxies, constellations, animals, fish, birds, and natural phenomena such as hurricanes, lightning and thunderbolts. For our new Model 35, Beech Aircraft has sought to find a name that would be descriptive of the extra value offered in the way of economy, performance, and pleasure to the owner. We examined the word ‘Bonanza’, which in English has a common meaning of a rich source of profit or gain or an unusual value.”

Whilst there is no evidence to the contrary that Mr. Beech sincerely intended that owners of his new aeroplane would feel that they had indeed purchased a “bonanza”, I think that we may be forgiven if we strongly suspect that he sincerely intended that his new aeroplane would be a “bonanza” for Beech Aircraft as well – and so it has been on both counts.

Additionally, Mr. Beech said, “We found that it (‘bonanza’) … also has an additional meaning of ‘fair weather’ in certain foreign languages.”

In Spanish and Portuguese, “bonanza” means prosperity, success and fair weather;

In French, “bonance” means calm, tranquil and smooth seas.

In Italian, “bonaccia” means prosperity, calmness and tranquillity.

THE “V”

During WWII, as aeronautical engineers in Great Britain and the United States began to think about how the airspeed of currently operational aircraft might be increased, the idea of using a “V”-tail as a replacement for a conventional tail arrangement was raised. “V’- tail was not, however, a new concept at that time.

The first “V” or “Butterfly” tail surface arrangement (an aircraft tail-surface configuration combining rudders and elevators into two, single control surfaces called “ruddervators” was invented and patented in 1930 (*Patent Polksi* # 115938) by Polish pilot and aeronautical/aerospace engineer Jerzy Rudlicki (14 March 1893 – 18 August 1977.)

(For the purpose of this discussion, the term “ruddervator” will refer to each separate “V” surface as well as to the hinged, movable control surfaces at their trailing edges)

A conventional-tailed aeroplane has one or more vertical fins with a hinged, movable rudder(s) at its (their) trailing edge and a horizontal stabilizer with a hinged movable elevator at its trailing edge, often split into left and right horizontal stabilizer/elevator units acting in unison, one on each side of the rearmost end of the fuselage. Accordingly, the position of the rudder affects the yaw axis and is controlled by the pilot by pushing the left (left yaw) or right (right yaw) rudder pedals in the cockpit. The position of the elevator affects the pitch axis and is controlled by the pilot by either pushing (nose down) or pulling (nose up) a control stick or a yoke. Conventional rudder and elevator control surfaces are completely independent of each other.

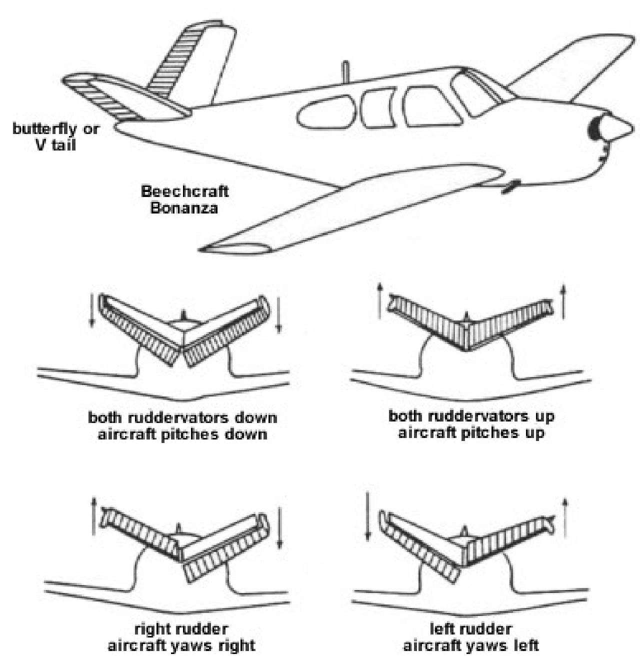
On a “V”-tailed aeroplane, however, the rudder and elevator are not separate and independent control surfaces. Instead, the moveable control surfaces at the trailing edge of the two tail surfaces, the ruddevators, act just as the name indicates, each one controlling both the yaw and pitch axes simultaneously. A fairly complex system of rigging the ruddervators permits a pilot to fly a “V”-tailed aeroplane exactly as he or she flies a conventional-tailed aeroplane using normal rudder pedals and control stick/yoke inputs.

Note: What follows is a description of the operation of an aeroplane’s movable control surfaces where these surfaces are located at the rear of the aeroplane and does not apply to aircraft with elevators ahead of the wing (canard) or aircraft equipped with elevons or ailevators (elevator and aileron operating in a single control surface as found on many “Delta” winged aircraft).

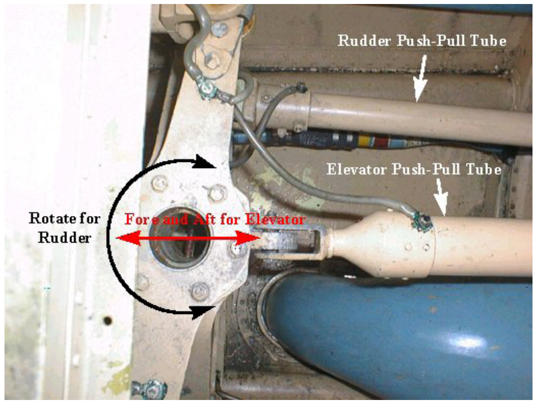
ELEVATOR/PITCH CONTROL

The following drawings show the control surface movements and tail forces for “V”-tailed aircraft when the stick/yoke and rudder pedals are operated as viewed from the rear.

As shown, because the control surfaces are offset from horizontal and vertical, the forces created when the ruddervators are displaced are similarly offset.



1. When the yoke is pushed forward to lower the nose, the ruddervators move downward as does a conventional elevator control surface. However, they also necessarily create additional forces which push and pull to each side (yaw axis) as well. Each ruddervator offsets the other's yaw force, but because of the dual direction of forces created by ruddevators, they are functionally less aerodynamically efficient than a similarly sized and displaced horizontal control surface. Accordingly, rudddervators must be larger and/or be displaced farther than a conventional horizontal elevator surface to create an equal force in the pitch axis.



"V"-tail mixing linkage: The blue section shown is the fuselage's rearmost end looking up from underneath. There are two rods extending off to the left of this photograph that connect to the actual ruddervators. Rightward motion of the top rod (due to either rightward motion of the entire mixer assembly due to a pitch command, or clockwise rotation of the assembly due to a yaw command) will deflect the ruddervator one direction; leftward motion will deflect it the other direction. This is the same for the other ruddervator similarly connected past the bottom of the photograph. Simple, eh?

2. When the yoke is pulled rearward to raise the nose, the ruddervators move upward as does a conventional elevator control surface. However, they also create additional forces which push and pull to each side as well, as described above. The inefficiency caused by the offset forces is similar to when the ruddervators are pushed downward.

3. When the right rudder pedal is pushed to yaw the nose to the right the ruddevators both move to the right. In order for the left ruddervator to move to the right it must also move upward creating an additional nose up force, and when the right ruddervator moves to the right it must also move downward creating an additional downward pitch force. The ruddervators' up and down pitch forces cancel each other out so that only a right yawing force is created. The canceled-out upward and downward forces create inefficiency as stated above.

4. When the left rudder pedal is pushed to yaw the nose to the left, the ruddevators both move to the left. In order for the left ruddervator to move to the left it must also move downward creating an additional nose down force, and when the right ruddervator moves to the left it must also move upward creating an additional nose up force. Each of the ruddervators' up and downward pitch forces cancel each other out so that only a left yawing force is created. The canceled-out upward and downward forces create inefficiency as stated above.

5. When both the yoke and either rudder pedal are moved a combination of the above control surface movements is created so that the nose may be raised or lowered while simultaneously yawing the nose to the left or right as desired.

As you may imagine, the linkages required to move the ruddervators to comply with the exact forces which a pilot may require are quite complicated.

On a "V"-tail Bonanza, with full up elevator and with no rudder input, the left ruddervator is displaced 22½° upward. With full right rudder and with the elevator neutral, the left ruddervator is displaced 23° upward, and with full up elevator and with right rudder simultaneously, the left ruddervator is displaced 44° upward. By contrast, the elevator of the conventional tail of an A36 Bonanza is limited to 23° upward and 20° downward displacement, while the rudder is limited to 25° left or right displacement.

"V"-TAIL DISADVANTAGES:

Weight

While Bonanza's "V"-tail is legendary, the myriad aeronautical claims that Beech has perennially made for it do not entirely or even partially live up to that legend. Bonanza's "V"-tail is not lighter than a conventional tail arrangement as the two ruddervators must each be larger than any of the three conventional tail surfaces. Because the control force of the two ruddervators must equal the control force of the conventional three-surface design, the two ruddervators, in sum, must have approximately equal or greater area because of "V"-tail's aerodynamic inefficiencies when compared to a conventional tail. Additionally, the complex control linkage of the "V"-tail arrangement is heavier than the far simpler conventional-tail linkage and is located at the most rearward position. For example, a 1968 E33A Debonair, which is virtually identical to a similarly equipped 1968 V35A "V"-tail Bonanza except for the tail surfaces, is 45 lbs lighter than V35A. However, this is not the total story of the disadvantages of the "V."

Greater interference drag

NACA wind-tunnel studies of the generic "V"-tail design have found that a small amount of interference drag is reduced by the reduction of one intersection of tail surfaces (two instead of three.) However, what small advantage may be gained thereby is virtually eliminated by the increase of interference drag created at the proximate inside surfaces of the "V" surfaces where they are attached to the aft fuselage. Interference drag caused by the proximity of the inside base of each "V" surface occurs in this manner: Air molecules moving past the lower inside surfaces of the ruddervators become commingled and disorganized creating a disturbed airflow which creates interference drag.

Greater induced drag

In order to ensure pitch stability, the aft pitch controlling surfaces of any aeroplane must be set at such a positive (nose up) incidence when the elevator is neutral that sufficient "decalage" (also known as "horizontal dihedral") is created relative to the wing's angle of incidence. The non-horizontal ruddervators, when at neutral, are less efficient in creating sufficient decalage than a conventional horizontal stabilizer/elevator and therefore must be set at a greater positive incidence. Being at greater incidence puts each of the ruddervators under a greater positive aerodynamic load at all times and thereby creates greater induced drag (drag which occurs whenever an aeroplane's wing and/or tail surfaces positively redirect the oncoming airflow) than are created by conventional horizontal surfaces.

Additionally, in Bonanza, the right ruddervator is offset a few degrees more to the right than the left ruddervator to counter P-factor, also called "asymmetric blade effect" and "asymmetric disc effect" (relocation of a spinning propeller's centre of thrust when the propeller disc is at a positive angle of attack [Alpha] which in a right hand-turning propeller exerts a left yawing moment on the aircraft and vice versa). To reiterate, because each ruddervator is offset from vertical, they must be set at a greater degree to the right to counter P-effect than a conventional single fin/rudder surface would need to be to exert the same force.

Form/pressure drag

In order to preserve pitch and yaw stability as well as to grant efficient control displacement forces, the wetted area (the area exposed to the oncoming air) of the ruddervators must be roughly equal to that of conventional tail surfaces. Accordingly, each of the "V" surfaces must be larger both in chord and/or span than that of equally-effective conventional tail surfaces. Accordingly, the ruddervators' wetted area produces form/pressure drag equal to or greater than that produced by conventional tail surfaces.

Yaw/Roll Instability or "Dutch Roll"

Properly applied, a small amount of dihedral creates a stabilising force in a wing or horizontal tail surface so that when it is displaced in the roll axis by turbulence, a gust of wind or after the aircraft is deliberately banked, it will tend to return to level flight. However, when tail surfaces are radically offset upward (as in a "V"-tail,) a very strong dihedral force is created at the rear of the aeroplane.

Some aircraft are designed with some amount of horizontal tail surface dihedral to increase roll-axis stability. Less commonly, some aircraft are designed with some negative (downward) horizontal tail surface dihedral, called "anhedral" or "cathedral," to decrease what is considered to be an excess of roll-axis stability. It is understood that extreme dihedral (or extreme sweepback) tends to instigate a condition called "Dutch Roll," a series of out-of-phase turns in which an aeroplane tends to roll from side to side whilst also yawing in the opposite direction of the roll and not remaining at or returning to level flight without engaging a yaw and/or pitch damper, an auto pilot and/or the pilot's corrective control input.

Accordingly, Bonanza's 30º-33º ruddervators tend to cause Dutch Roll at the rear of the aeroplane, which has been reported to cause both yaw and pitch "wandering" and pitch "seeking" at cruise airspeeds.

ADVANTAGES:

Airspeed?

Beech's claim that a "V"-tail design sufficiently reduces drag so that it increases the aircraft's airspeed as compared to the same aircraft with a conventional tail has been shown not to be so. If any such advantage exists at all, it is *de minimus* at best. Even Beech (which some have claimed has not always been known to have played entirely fairly with regard to its aeroplanes' published airspeed specifications) lists the cruising airspeeds of the last "V"-tail Bonanza, V35B, as being the same (172 knots) as an equally powered F33A (a conventionally-tailed Bonanza.)

Appearance

Many would agree that the undisputed advantage that a "V"-tail has over a conventional tail is its appearance. It is certainly eye-catching and unless the truth of the matter is known to the observer, a "V"-tail appears to be cleaner and more efficient. Beechcraft apparently heavily relied upon this erroneous assumption and affirmatively added to it for decades in order to generate Bonanza sales. As stated before, despite its exotic appearance and appeal, the "V"-tail actually does not improve aircraft performance in any measurable amount as compared to a conventional tail.

A RARELY ADOPTED TAIL DESIGN

There are so many inefficiencies and control rigging complications involved with the "V"-tail design that it is not a surprise that it has been so rarely used.

Whilst at least 15 jet engine-powered military aeroplanes and at least one helicopter incorporating a "V"-tail are known to exist at this time (2018,) the only piston-engine fighter known to have been built with a "V"-tail is the experimental Bell P-63A-8 "Kingcobra". This one-off aeroplane was a test bed to find out if such a tail configuration might increase the top airspeed of the already quite fast P-63D "Kingcobra". Powered by an Allison V-1710-109 engine producing 1,425 hp and with a top airspeed of 437 mph at 30,000 feet (on par with P-51 "Mustang' and P-47 "Thunderbolt"), P-63A-8 was already flying nearly as fast as a propeller-driven fighter could be made to fly. This P-63D was so modified and was designated P-63A-8. It broke up during diving tests before it could be determined whether the substitution of the "V"-tail produced less drag than the conventional tail surface arrangement and accordingly produced any increase of airspeed. It is not reported whether the "V"-tail was the cause of P-63A-8's in-flight breakup but speculation thereof abounds. Experiments with "V"-tails were not made thereafter.

In 1944 Beech built an interesting experimental Model 18 "Twin Beech" designated A-19 on the airframe of a USAAF A-10 "Wichita." A large "V"-tail was substituted for the conventional tail surfaces. Extensive stability and control

1944 Beech built a one-off A-19, which was a USAAF A-10 “Wichita” with an experimental “V”-tail. A-19 was the first and largest Beech aircraft to that date with such. At the time, many might have wondered why Beech was experimenting with a “V”-tail. Time would soon solve that mystery. A-19 would certainly be a challenging subject for a “can you name this aeroplane” contest. USAAF archive photo, circa 1944.

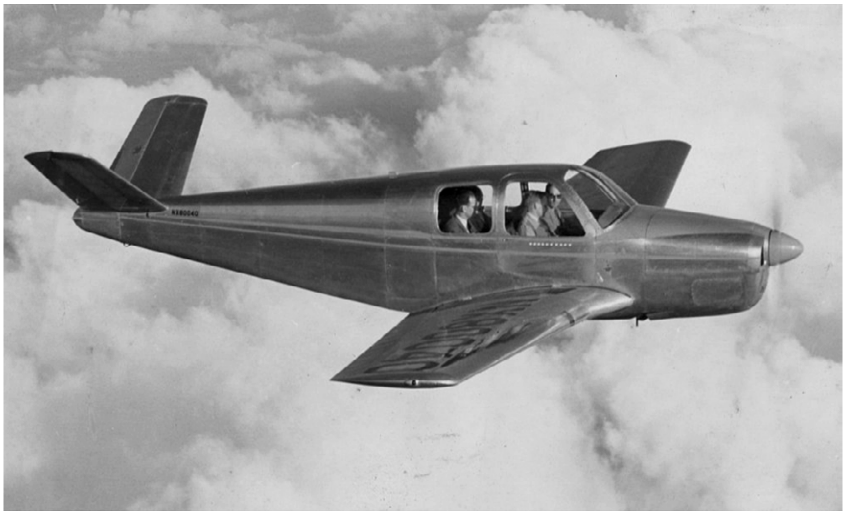
■ 1948 Beech Model 34 “Twin-Quad”

■ Bell P-63A-8 (also designated RP-63G). This one-off experimental aeroplane was based upon the basic airframe and engine of P-63D “Kingcobra” which usually has a bubble canopy in place of P-39 “Airacobra’s” automotive-style doors. However, P-63A-8 retained the old-style doors, possibly to ensure a safer emergency in-flight exit.

■ Eclipse Aviation 400. If you’re going to put a single jet engine on top of the fuselage a “V”-tail seems like your best, if not your only bet.

■ Robin ATL Beyond appearance, there seems to be no real need for a “V”-tail in this design. As can be seen, the ruddervators are so large that they are surely as heavy and produce as much drag as a conventional cruciform tail.

■ H-101 Salto aerobatic sailplane. Here, the “V”- tail makes some sense. Without the need to offset a spinning propeller’s P-Factor, the ruddervators can be smaller (as they clearly are in this design) than on a propeller-driven aircraft, and accordingly may, in fact, be lighter and less drag-producing than a conventional tail would be.



1947 Beech Model 35 Bonanza prototype version 4 of the 5 Bonanza airframes which Beech built and tested. Version 4 was submitted to obtain Model 35's certificate and was extensively flight tested, including a dive test to 286 mph in the manner in which military aircraft of that era were tested. This very aeroplane is pictured in numerous Beech promotional advertisements and, as usual regarding such promotions, Beech populated it with the smallest people it could find in order to make its cabin appear more capacious.

In March 1949, Bonanza prototype version 4, named "Waikiki Beech" and piloted by Captain William Odom, flew from Honolulu, Hawaii to Teterboro, New Jersey, establishing the existing non-stop long-distance record for light general aviation aircraft of 4,957 miles. Between 7 October 1951 and 27 January 1952, Congressman Peter F. Mack, Jr. completed a solo, easterly around the world flight from and back to Springfield, Illinois in this same aeroplane, which he named "Friendship Flame," flying 33,789 miles in 223 hours (113 days) and stopping at 45 cities in 35 countries.

tests were made, the findings of which were that the "V" empennage was altogether satisfactory. These tests continued into 1945 and provided valuable information for the design of the "V"-tail Model 35 "Bonanza."

With its strange appearance and confusing name, Beech produced "Twin-Quad" to meet the newly re-born post-war need for short-haul airline transport aircraft. Quite innovative, its name comes from its four air-cooled, eight cylinder horizontally opposed Lycoming GSO-580 (GSO denoting Geared Supercharged and Opposed engines,) each producing 400 hp at 3,300 rpm. Two engines are mounted inside each wing, each pair of engines driving a single propeller through a gear-box. Model 34's enormous "V"-tail, while visually fascinating, was somewhat off-putting to conservative airline purchasing executives in 1948, many of whom thought that passengers might balk at flying in such a curious-looking contraption.

Whilst timing may not be everything, it is a very important thing. With spacious seating for 20 and/or cargo, excellent performance (top airspeed of 240 mph and a fully-loaded range of 1,456 miles,) Beech 34 fell victim to the post-war era's enormous military surplus of similar aircraft such as the larger and ubiquitous Douglas DC-3/C-47 "Skytrain," Lockheed's rugged and better performing Model 18/C-60 Lodestar, as well as, ironically, Beechcraft's own smaller Model 18. In the face of this formidable array of relatively inexpensive and readily available surplus aircraft, Model 34 was ultimately not a viable alternative.

These aeroplanes aside, a few light aeroplanes have adopted the "V"-tail. Some of these are: Eclipse Aviation 400, a single engine, four-seat light jet; Robin ATL, a single piston-engine, two-seat Avion Très Léger ("Very Light Aircraft,") and H-101 Salto, a single-seat aerobatic pure sailplane (no engine).

TO "V" OR NOT TO "V?"

When designing Bonanza, Beech's engineers considered both a conventional and a "V"-tail until Beech aerodynamicist Jerry Gordon convinced the rest of the team that a "V"-tail, such as had been successfully installed on the experimental A-19 variant of Model 18 (see above,) would save weight and reduce drag by eliminating an entire surface and might possibly be helpful regarding spin prevention and recovery. Unfortunately, none of Mr. Gordon's speculative claims for Bonanza's "V"-tail turned out to have any basis in reality. Whatever Walter Beech may have thought of the "V"-tail's aerodynamic benefits, he was most enthusiastic about it for aesthetic and commercial reasons. He correctly understood that even if the "V"-tail did nothing at all about improving performance, it certainly made Bonanza the most distinctive light general aviation aeroplane in the world. So it was and so it remains.

BONANZA'S GRAND DESIGN

Beech's team set about creating the new aeroplane in the usual way, drawing various configurations and concepts until one emerged which was deemed best. However, one aspect in the creation of Bonanza was unique for its time: Model 35 was the first light general aviation aeroplane to be thoroughly and extensively wind-tunnel tested before its first flight.

Many are not aware that there were actually five pre-production airframe prototypes of what became Model 35, all which were designed, built and tested before Model 35 Bonanza became Beech's general aviation standard bearer. All five of these pre-production airframes were tested in Beech's ten-foot diameter wind tunnel for, amongst other things, structural integrity, flutter and the integrity of the "V"-tail surfaces. Pre-production airframes 1, 2 and 5 were built and so tested but not flown. Airframe version 3 was the first Bonanza to be actually flight tested on 22 December 1945. It was powered by a 4-cylinder Lycoming GO-290 which was an experimental, geared version of the 125 hp, horizontally opposed Lycoming 0-290 CP, which was in this way coaxed and prodded into producing 160 hp. One may justly imagine that this engine was greatly and unhealthily stressed by its gearing in order to produce so much more power than its design rating. Airframe version 3 also had a laminar-flow wing to reduce drag, an airfoil innovation made famous for its use by the USAAF's then first-line fighter, North American P-51 "Mustang."

Pre-production airframe 4, which became the prototype for the production Model 35 Bonanza, was the second of the Model 35 airframe versions to fly; however, its wing has a conventional airfoil.

The first 40 or so production Model 35s were not all-metal as advertised. Their ruddervators, flaps and ailerons were fabric-covered, a common practice for many military aircraft at that time. Fabric instead of metal covering for control surfaces was considered to be a reasonable way to save weight, and it was also believed to help to lighten the ailerons' feel. However, after a time, the control surfaces of high-speed fighter aircraft were metal-covered because, as the British discovered when Spitfire Mk. I flew at airspeeds greater than 260 mph and the fabric covering on its ailerons ballooned away from their underlying frame adding drag and reducing their effectiveness. Whilst Beech Model 35 is not capable of flying at airspeeds where this phenomenon would occur, the ailerons on all Bonanzas after the first 40 were covered with thin magnesium alloy plate and later with aluminium.

Bonanza pre-production airframe 3's original laminar flow wing did not appear on production Model 35s. All Bonanzas, except the experimental one-off laminar-flow wing 1961 O35, have conventional airfoils derived from the popular and often used NACA 23000 series, specifically NACA 23016.5[6] at the wing root and NACA 23012 at the tip. Maximum camber of both of these airfoils is located at 15% of chord aft of the leading edge, which is a bit more forward that the usual 25 % of chord aft of the leading edge common to most similar airfoils. A conventional airfoil's point of maximum camber is far more forward than that of a laminar airfoil in which it is typically near 50% of the chord aft of the leading edge. Maximum thickness of NACA 23016.5 at the wing root is 16.5% of the chord and the maximum thickness of the thinner NACA 23012 at the wing tip is only 12% of the chord.

This airfoil has been used on all Bonanza wings as well as on other Beech aircraft. The NACA 23000 series' rather thick forward section provides a capacious place for the retracted undercarriage and fuel tanks while still showing an excellent lift/drag ratio and close to a neutral pitching moment coefficient, providing a stable and predictable pitch axis throughout its wide Alpha range although, as we shall see, this stability was somewhat undone by the mildly destabilizing characteristics of the "V"-tail.

Early Bonanza's narrow weight and balance envelope makes it all-too-easy to accidentally aft-load them beyond its safe limit (see further discussion below.) Aft-loading beyond an aircraft's envelope creates a destabilized and over sensitive condition in the pitch axis at all airspeeds. At lower airspeeds, as when taking off and landing, over aft-loading greatly exacerbates this condition. Accidental and/or negligent over aft-loading has been a continuing and serious concern for Bonanza owners and operators, particularly with regard to the later, long cabin "V"-tail" models which require particular care and planning when loading the aeroplane.

Bonanza's wing root is set at +4º and the tip of the wing set at +1º to the datum line. This provides the wing with a 3º washout (leading edge lower than the trailing edge at the outer portion of the wing.) Washout is commonly applied in wing designs to reduce the tendency for tip stalling at low airspeeds and in steep turns; i.e., in situations of high Alpha.

Other familiar aircraft of the WWII era known to use the NACA 23016.5 airfoil are: Avro bombers (Lancaster, Manchester, Lincoln, etc.) Curtiss SB2C Helldiver; Douglas DB-7 "Boston;" DC-4 (C-54, R5C); Focke-Wulf Ta-152; Grumman F-4-F "Wildcat," F-6-F "Hellcat," F-7-F "Tigercat," F-8-F "Bearcat" and TBF "Avenger;" Kawasaki Ki-56, 60, 102 and 108; Lavochkin La 5-7; Lockheed "Electra Junior" and P-38 "Lightning;" Martin PBM "Mariner;" Messerschmitt Me-210, 310 and 410; North American B-25/PBJ series; Sikorsky VS-44; Taylorcraft BC-BL-12; Vought VS-326 (a straight wing "Corsair;") and Westland "Whirlwind."

Bonanza's airfoils provide it with a laterally stable, if somewhat abrupt, stall. This kind of stall, whilst unpleasant but acceptable in a fighter/pursuit type, is an undesirable and possibly dangerous characteristic for a general aviation aeroplane. It has been reported that Bonanza's stall has dangerously caught low-time pilots unaware and suddenly finding themselves in a stalled aeroplane at low altitude, always a blueprint for calamity.

The first Model 35 Bonanza, prototype 4 during its final testing stage. This is a rare photograph of this aeroplane at rest. Note the laminated wooden two-blade propeller. It was pilot-variable but not a constant-pitch unit. The pilot had to manually set the desired propeller pitch for any power setting. It curiously seems to be particularly out of place on such an otherwise sleek and modern aeroplane. Beech factory photograph, March 1947

1940 ERCO "Ercoupe", a very cozy side-by-side two-seater. Ercoupe's can still be seen from time-to-time at airports throughout the US.

However, it is well to remember that Beech did not expect their Bonanza to be flown by amateur weekend sports filers. It was expected to be flown by professional, highly experienced ex-military pilots who would not (it was supposed) be at all challenged or put at risk by this or any other of Bonanza's less-than-benign flight characteristics. It is surely an important factor regarding Bonanza's poor initial safety record[7] . Notwithstanding Beech's expectations, from its introduction Bonanza was nevertheless owned and flown by many pilots whose training and experience in such a spirited and demanding thoroughbred was woefully insufficient.

The engine powering prototype #4 and the first production Bonanzas is the now-familiar horizontally opposed, six-cylinder, 165 horsepower, Continental E-165. This engine is reliable, cool running, economical and relatively inexpensive to maintain. It does not require uncommonly available aviation fuel and does not tend to burn oil at a high rate. Only this engine's six cylinders, two more than in a Lycoming of similar power, might be a cause for some objection regarding maintenance and inspection expenses.

However, compared to the contemporary 1947 Cessna 195's seven-cylinder radial 300 hp Jacobs R-755A2, Bonanza's Continental E-165 engine is simplicity and economy itself.

Unusual for a light general aviation aeroplane of this time and a first in its class, Model 35 has an electrically and fully retractable tricycle (nosewheel) undercarriage. Even more unusual for a light aeroplane and another first, the undercarriage when retracted is completely enclosed.

Whilst every USAAF bomber after the 1935 B-17 had tricycle undercarriage, most American WWII era fighter aircraft had a tail-wheel, the few exceptions being Lockheed P-38 "Lightning," Bell P-39 "Airacobra" and P-63 "Kingcobra," and Northrop P-61 "Black Widow" night fighter. However, by 1945, the emerging jet aircraft all utilised a nosewheel. Thus, tricycle undercarriage was clearly the arrangement that virtually all military as well as general aviation aircraft would come to adopt. In this light, it was Walter Beech's most fervent desire that this new aeroplane would be associated with and define the future of general aviation.

It is well to remember that up until 1945, tricycle undercarriage was virtually an unknown feature on general aviation aeroplanes. One of the very few of those with a nosewheel was the brilliant Fred Weick's innovative and prescient ERCO "Ercoupe." First flown in 1937, it remained in production by one manufacturer or another until 1969.

A nosewheel for Model 35 was an innovative feature for an aeroplane of its type. Even rival Spartan 7W had a tailwheel. However, Beech surprisingly held back a bit from complete modernity by designing a freely swiveling nosewheel, requiring differential braking for ground steering. This was done, perhaps, for economy of construction, or possibly because the nose of Model 35 leaves little room for steering linkages. As one might suss, Bonanza's lack of direct nosewheel steering was unpopular in what was loudly purported to be a first-class, top shelf and very expensive machine. Apparently Beech received sufficient complaints to warrant a change and as a result the 1949 Model 35A had a rudder pedal-steerable nosewheel as well as a slightly higher permissible takeoff weight (and concurrently, a slightly lower top airspeed.)

With the exception of "Ercoupe," all other mass produced pre-war light general aviation aircraft had a tailwheel. As mentioned, virtually every US aeroplane manufacturer who had survived the war planned to re-introduce the same or very similar aeroplanes as those they had built and sold before the war, tailwheels, fabric covering, strut-braced high wings and all. Even Cessna's first post-war aeroplane, the 1947 Cessna 190/195, which was introduced almost simultaneously with Bonanza, has a tailwheel. While C-190/195's bow to modernity is its all-metal construction and cantilever (no strut) high wings, its overall design, fixed undercarriage, radial engine(s) and tail wheel are most definitely reminiscent of pre-war aircraft.

Bonanza's nosewheel has always been and remains mounted ahead of the engine, as far forward as possible. It was placed there so that the direct weight of the engine would not be upon it and a larger proportion of the aircraft's

1947 Cessna 195. Produced in 1947, this sleek and truly beautiful aeroplane surely looks classic – that is, a classic from the 1930s. Like Bonanza, C-190/195 was intended to be a high-end business transport. Also like Bonanza, it was sleek, fast and expensive. Unlike Bonanza, however, C-190/195 was never a popular ride and relatively few were sold during its seven year production period. In fact, Beech sold more Bonanzas in 1947, over 1,500, than all of the Cessna 190/195s ever built (approximately 1,180.)

overall weight would sit on the main undercarriage. This arrangement facilitates easier rotation on takeoff, better braking after touchdown, lighter steering on the ground and promotes less wear on the nosewheel system itself.

Additionally, Bonanza sits relatively higher off the ground for its wingspan than other similar tricycle retractable aircraft. Beech engineers wished to design good landing characteristics into Bonanza; a fast aeroplane that was a bear to land would not do, not even amongst the ex-military pilots whom Beech expected would primarily be flying Bonanzas and who, surprisingly, turned out to be largely ex-bomber and transport pilots. Most ex-fighter pilots apparently had enough of the "joy of flying" - see footnote 3. Beech engineers' idea was that a shorter undercarriage would put the wing so low to the ground that it would be deep into ground effect[8] upon landing

When an aeroplane is in ground effect, airspeed tends to decrease more slowly and the aeroplane tends to float just above the runway for a time, complicating the flair and touchdown and making the exact moment of touchdown more difficult to anticipate. Beech's engineers believed that by lengthening Bonanza's undercarriage, the consequences of ground effect would be diminished and landings would therefore be far more predictable. The fact is, however, that a few inches, more or less, makes little difference in this matter. Bonanza floats along in ground effect pretty much the same as other similar low-wing aircraft do, and does so particularly when the approach and landing airspeed is a bit on the higher side (which Bonanza's clean airframe makes all the more likely.)

Personal side note: There was a Cessna 195 on floats (coincidentally in the same colours as the one in the above photo but whose home was certainly not such a bucolic environment, to be sure) based at a seaplane base near my home where I first learned to fly at the age of 12. That C-195 was not used for instruction, of course – that big Jacobs radial cost a bunch to run and maintain. It was used for morning and afternoon commuter flights in and out of New York City. I flew their two Luscombe Silvaire 8A floatplanes (one at a time) that went for $16.00 per hour with an instructor. One day when I was just hanging around the base, there was an empty seat on a scheduled flight. The C-195's most kindly pilot asked me if I would like a ride in the "old girl." My big grin was answer enough. I sat up front with the pilot with three passengers in the wide back seat. If there had been a fourth passenger, he or she would have sat up front where I was. I recall that the dual control wheels were both attached to a single, large "V" yoke. Takeoff was a thrilling, hard push-back into my seat and it was a short, fast ride to the city, all at very low altitude (airspace regulations in the area of then Idlewild, now Kennedy International Airport were not nearly as restrictive as they are today.) We passed (just) over the 59th Street Bridge (now the Ed Koch Queensboro Bridge) and landed in the East River at NY Skyports Seaplane Base (now Midtown Skyport) at the end of East 23rd Street. On the way back, with just the pilot and me on board, I had an opportunity to fly this aeroplane. The pilot told me to just fly straight and level. I remember that the 195 was much easier to keep on an even track than the lighter Luscombe which I was familiar with. When we were near home base, he took back control and climbed to a respectable altitude whereupon he returned control to me and said, "Do what you like, but no aerobatics." For the next 15 minutes or so I steep turned, chandelled, lazy eighted, and generally wrung the 195 out as much as I was then able. All that power and speed and the heft of this aeroplane was a new experience for me. I remember that it was a responsive, satisfying, solid and overall enjoyable aeroplane to fly.

From May 1947 Holiday Magazine. This advert pictures prototype version 4 of the five original Model 35 prototypes.

Another 1947 Beech advert showing how easily Model 35 could beat all that snail-like automobile traffic below. Pictured here again is prototype 4.

The design of Model 35 Bonanza had an unusually long gestation period of almost twelve months between its initial conception in January 1945 and its first flight on December 22, 1945. Beech then announced that Model 35 would not go into full-scale production for a further fifteen months so that Bonanza could be further tested and refined before commencing production. Between the initial announcement of Model 35 by the publication of press releases and advertisements and its first accrual sales day, approximately 1,500 pre-orders had been placed.

What had excited the aviation public so greatly, and particularly those who were in a position to purchase a very expensive aeroplane, were Model 35's unique design features. Nothing like this aeroplane had ever before existed. In 1947, here was an (almost) all-aluminium, monocoque fuselage, low all-metal cantilever wing, electrically retractable fully-enclosed tricycle undercarriage, cabin seating for four, 165 hp Continental six-cylinder engine aeroplane and, oh, that "V"-tail, soon to be referenced by some, more elegantly and aeronautically, as a "Butterfly" tail.

Peculiarly, whilst the 1947 Model 35 was surely chock-full of excellent and innovative light general aviation aeroplane design features, there are other features of Model 35 which, despite its long period of development, may not have been as carefully or as wisely conceived.

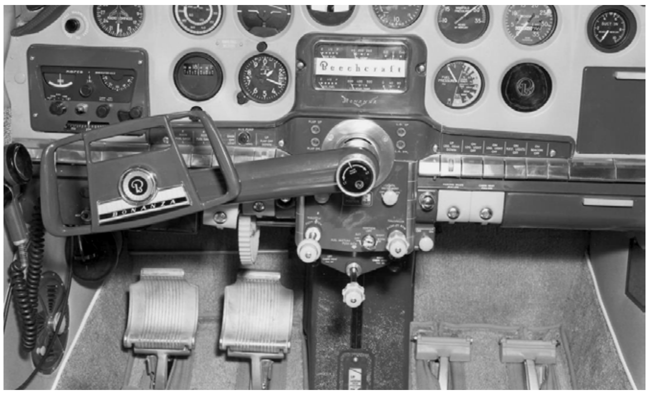
AN EXCELLENT AIRCRAFT, BUT NOT WITHOUT ITS QUIRKS

Bonanza's First Propeller

Rather than install a metal two or three-blade constant-speed propeller which would have greatly enhanced Bonanza's performance, Model 35's original equipment instead included a laminated, wooden, two-blade, electrically manually variable-pitch (not constant-speed) propeller. Constant-speed propellers were nothing new in 1945. Beech itself was quite familiar with them as they were installed on its Model 18s, had been proven reliable and were in general usage on high-performance aircraft since 1935. However, Beech curiously installed this throwback and inefficient propeller system on its new flagship high-performance aeroplane. Acting much like a fixed-pitch propeller, Model 35's wooden propeller requires the pilot to most inconveniently manually re-set the pitch of the propeller upon every power change in order to obtain the desired R.P.M. You may be sure that it was not long after Bonanza's introduction that those original wooden propellers were replaced with more efficient and appropriate metal, two or sometimes three-blade constant-speed types.

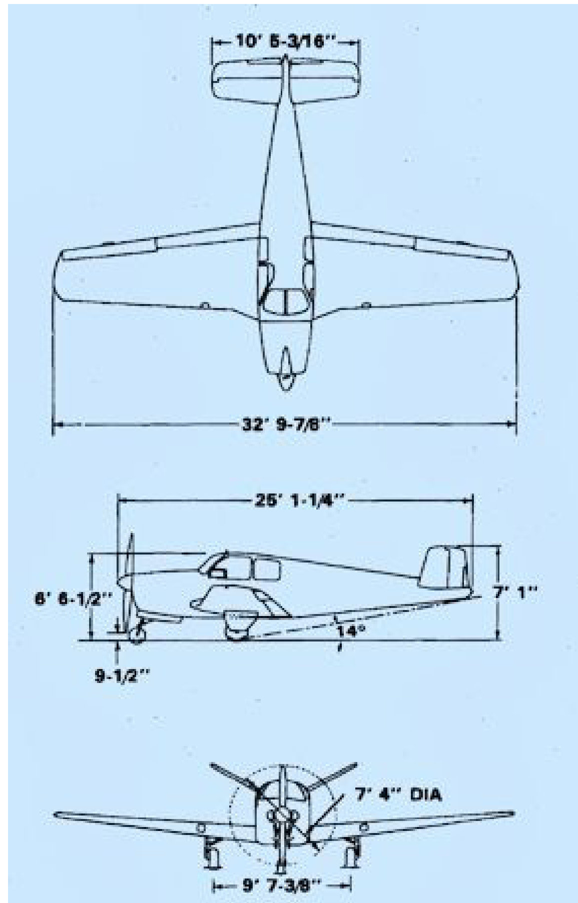
Aileron/Rudder Interconnect

All "V"-tail Bonanzas from the first to the last share an unusual feature: the yoke and rudder pedals are interconnected by a system of bungee cords that assist coordinated turns. The bungee system allows the pilot to make shallow coordinated turns using the yoke alone during cruise flight. This feature also was installed in Piper Tri-Pacer, introduced in 1950. Of course, right-rudder input is still required on takeoff to overcome P-factor and the flexible bungee system allows for this. In the landing phase, the bungee system can easily be manually overridden by the pilot when making crosswind landings, which require cross-control inputs to keep the nose of the airplane aligned with the runway centreline whilst preventing the aeroplane from drifting to the left or right.



D17S “Staggerwing” instrument panel and its throw-over control wheel. Note: No rudder pedals at the right seat.

Late 1950s Bonanza instrument panel with its throw-over control wheel and with no right seat rudder pedals or toe brakes. This aeroplane has non-standard gyro instruments installed and a very old-school “Radio Compass” indicator, but no instrument or receiver for ILS (glide slope) operations and a single primitive, very elementary combination communications and navigation Narco Omnirange radio.



Throw-over Single Control Wheel

Beech’s unique throw-over single control wheel and lack of rudder pedals and toe brakes at the right seat in early Model 35 Bonanza variations were similar to “Staggerwing” and certainly make a bold statement regarding what this aeroplane was intended for. However, the lack of dual control yokes, rudder pedals and toe brakes makes dual instruction and FAA test flights in Bonanzas with a throwover yoke illegal, with exceptions for instrument flight instruction under specific conditions as stated in the footnote below according to The Code of Federal Regulations (CFR)[9] . Adding right-side rudder pedals and toe brakes helped somewhat, but still did not satisfy the appurtenant CFR restrictions.

Even beyond actual dual instruction, this writer can report from personal experience that checking out in a Bonanza with a throw-over control wheel is an awkward and unpleasant experience, especially, I suss, for the check-out pilot.[10]

This “the pilot is solely in command” system has been and remains unpopular with many prospective Bonanza owners, and has precluded such Bonanzas from use as an advanced training aircraft in many flying clubs and schools.

1950 Model B35 Bonanza.

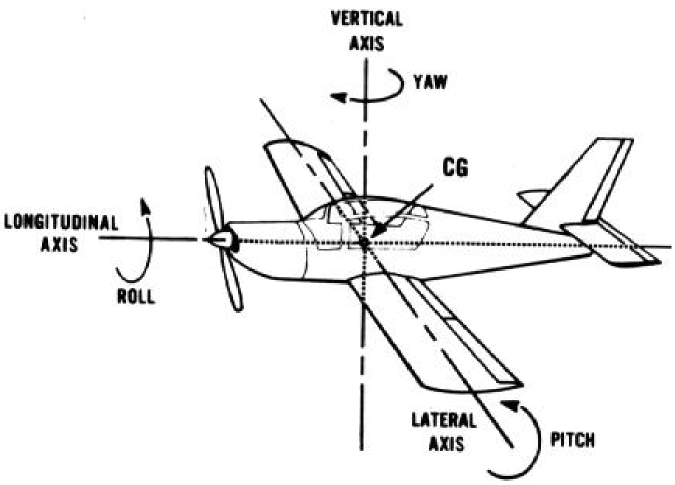
1974 Model A36 Bonanza with its longer fuselage.

A Short Weight and Balance Envelope

All Model 35 Bonanzas until the introduction of the conventional-tail Bonanza Model 36 (really a Debonair) in 1968 had the original design's 25' 1 ¼" short fuselage.

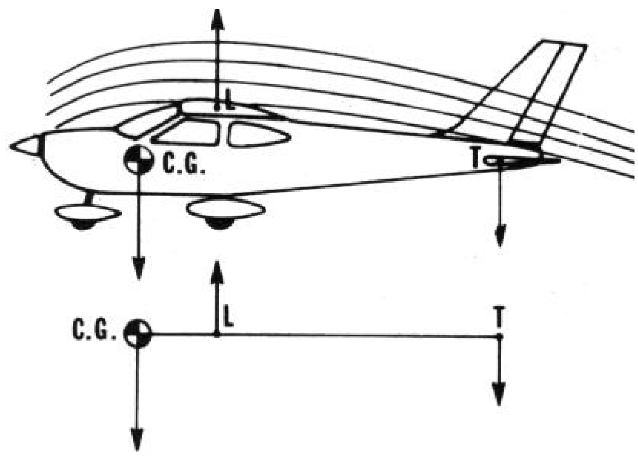
As mentioned, short-fuselage Model 35 Bonanzas suffer from a severe aft limitation in its weight and balance envelope. It is all too easy to load these aeroplanes too far aft without realizing it. The fact is that too often, casual general aviation pilots are not as careful about aft overloading as they ought to be. As mentioned, even under perfect load conditions, Model 35 Bonanza's pitch axis control is already highly sensitive; however, in all aeroplanes as the centre of gravity CG moves aft, pitch sensitivity increases. If an aeroplane is aft overloaded, pitch control becomes more sensitive than it usually is (as mentioned Bonanza's pitch control is quite sensitive under ordinary conditions) and the aeroplane becomes quite unstable in the lateral axis. This combination of control sensitivity and instability greatly increases the chance of over-controlling into a sudden accelerated stall/spin. As mentioned, Bonanza already has a rather abrupt stall. Additionally, as if this isn't bad enough, pitch sensitivity and instability caused by aft overloading becomes greatly exacerbated at lower airspeeds, such as when rotating and climbing out after takeoff and during approach and landing – both being low altitude conditions in which stall/spin recovery is unlikely.

A Brief Primer Regarding Longitudinal Stability



The lateral (pitch) axis of an aeroplane is that axis around which the nose rises and descends. An aeroplane's CG is that point at which aircraft longitudinally balances on the lateral axis. An aeroplane's centre of lift (Cl) is that point at which all of the aeroplane's lifting forces (wing and horizontal stabilizer) are focused. The distance between the locations of the Cl and the CG determines the longitudinal stability of the aeroplane.

When the aeroplane is fully loaded and ready for takeoff, the safe and normal position of the CG is always ahead of the CL. The horizontal stabilizer at the rear of the aeroplane produces sufficient nose up (tail down) force to counter the CG's position forward of the Cl. As weight (fuel, passengers, and baggage) is loaded forward or aft of the unloaded aeroplane's CG, the CG moves forward or aft accordingly. When the aeroplane's CG is within a particular range of positions forward of the Cl, the aeroplane is within its weight and balance envelope (see below) and is longitudinally stable. As the CG moves aft and approaches the CL, the aeroplane's longitudinal stability begins to diminish until at some point the aft load puts the CG so close to the Cl that the aeroplane will be longitudinally unstable in pitch and, accordingly, loaded outside of its weight and balance envelope.

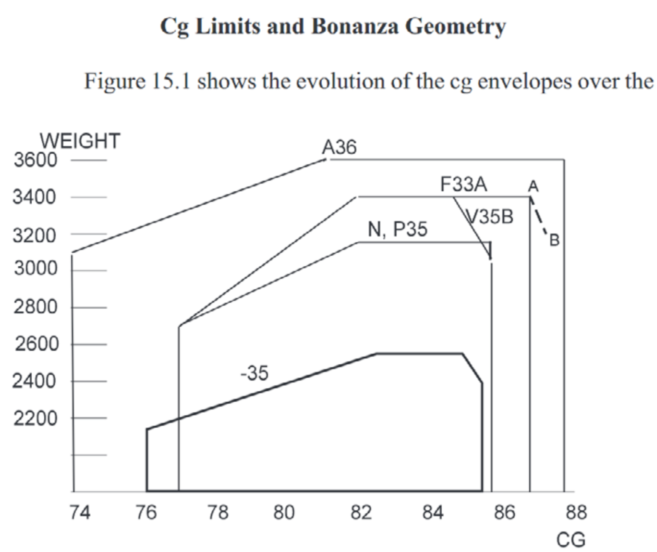


This is a typical (not Bonanza's) loading graph. The pilot determines the weight of each item to be loaded (left side) and notes the moment arm (bottom).

Item	Weight (lb)	Moment (in-lb)
Aircraft Empty Wt.	1,400	53,900
Pilot	180	6,000
Front Passengers	140	4,500
Rear Passengers	210	15,000
Baggage	100	9,200
Fuel	228	10,800
Total	2,258	99,400

This is a typical (not Bonanza's) loading calculator. When the weight and moment arm of all the items to be loaded are added together, the aeroplane must be within its weight and balance envelope (below) or it is unsafe to fly.

Here is an actual diagram of the weight and balance envelopes of all Bonanzas from Model 35 to A36. The numbers running along the left side of the diagram indicate the gross weight of the aeroplane and the numbers running along the bottom of the diagram indicate the moment arm of the aeroplane from forward (left) to aft (right) measured in inches from a specific datum point near the nose and divided by 1,000 inch-pounds. The weight and moment arm must fall within its envelope or the aeroplane is unsafe to fly.



It can be seen that earlier Bonanza models had a very limited fore-aft loading envelope. However, as Bonanza evolved and it carried more useful load, its weight and balance envelope expanded and aerodynamic improvements permitted greater fore and aft loading. However, it is not recommended that any aeroplane be flown very close or exactly at the aft edge of its weight and balance envelope and NEVER flown beyond it, even if by a tiny margin.

All Model 35 Bonanzas carry their fuel in the leading edge of the wing which is forward of the aeroplane's unloaded CG and at the forward end of its weight and balance envelope. This means that as fuel burns off, Bonanza's CG moves aft. Accordingly, a well-fuelled Bonanza may have been loaded within its weight and balance envelope at takeoff, however, whilst in flight and as fuel is consumed, its CG moves aft, possibly to or beyond the edge of its permissible aft weight and balance limit. This Bonanza is now in a longitudinally unstable condition and pitch control and has become highly sensitive, perhaps actually or very nearly uncontrollable (see above discussion). It hardly needs to be stated that a too light and overly sensitive pitch control at landing is a *de facto* unsafe flight condition.

Bonanzas up to S and V models have a rather short passenger cabin with only four seats, two up front and two behind and a small baggage compartment behind the rear seats. Whilst earlier Bonanzas models' weight and balance envelopes are quite narrow, one might expect that their shorter cabins tended to keep aft load conditions within safe CG limits, but apparently this was not the case in too many situations. The last two Model 35 variants, S and V, have optional fifth and sixth passenger seats in the rear which if filled greatly increases the chance of an aft overload condition. Bonanza Models S and V's rearmost safe CG is only slightly farther aft than earlier four seat, short-cabin Bonanza models (see weight and balance envelope diagram above). Recognizing this potential hazard, Beech specifically and firmly forewarned S and V model Bonanza pilots and operators to take extra care not to load the aeroplane beyond its published aft load limits and advised them to consider the two rearmost seats to be child's seats only and not to seat adults so far aft.

A practical solution to Bonanza's limited weight and balance envelope was largely resolved in the next major Bonanza model, Model A36. This aeroplane is a conventional-tail E33 Debonair with a ten-inch fuselage stretch and is powered by a 285 hp Continental IO-520-B engine, with four cabin windows on each side, rear starboard double entry doors and seating for six, including the pilot. Stretching an aeroplane's fuselage has traditionally been a common and effective method to increase its load capacity and flexibility as well as to move the aft edge of its weight and balance envelope further aft. Among other things, a stretched fuselage places the horizontal stabilizer father aft, increasing its moment arm as well as moving the aeroplane's CL farther aft. This widens its weight and balance envelope permitting increased aft loading. Accordingly, stretched Bonanza Model A36's weight and balance envelope is far wider than all earlier Bonanza models (see envelope diagram above).

The Elevator Downspring

From the first Model 35 to the latest Model 36, Bonanza has a downspring incorporated in its elevator control system. The downspring, as its name implies, provides gentle, constant, positive forward pressure on the control wheel. This unusual addition to the control system helps to desensitize Bonanza's very light pitch control and give it more "feel" in all situations..

THE BONANZA BONANZA

The initial price of the Bonanza was $7,345 (the equivalent of $82,010.71 in 2018 with a cumulative inflation rate of 1.016.6%.) A lavishly-equipped 2018 Beechcraft G36 Bonanza was recently placed on sale for $913,105, although earlier and more modestly equipped Bonanzas are regularly purchased for a fraction of that.

In its class and for its time, Bonanza was the epitome of aeronautical design and engineering - fast, sturdy, and looking like nothing which had come before. The particular historical time that Bonanza came into being and went before the American aviation public is a crucial reason for its immediate and enormous commercial success.

One important reason for Bonanza's success when it was introduced is that in the United States, for entirely understandable reasons, in the immediate post-war years there was an innate and urgent desire for freshness and newness as a sign that the coming new, more peaceful world was going to be far better than that in which so recently and so tragically entire nations and populations had been utterly destroyed.

While it took most countries in Europe and Asia many years, and in some cases, decades after the end of the war, to significantly recover and move forward again, the United States, whose cities and civilian population had been spared the cruel ravaging and devastation that had befallen most of the rest of the world during the war, even before the war ended was ready and able, to begin anew.

From the late summer of 1945 and throughout the 1950s people all over the world deeply desired and worked hard to create a new beginning. A new, clean, peaceful and prosperous world had been promised, and now, for some, it was in their grasp. In the United States, everything from buildings to automobiles to kitchen appliances to furniture to the new, retractable ballpoint pens took on a clean, "streamlined" and modern look. The stodgy, old, heavily riveted, ornately carved, massive, dark antique appearance of much of what had defined the pre-war world was now considered more than simply "old-fashioned." In a tacit but very substantial way, the artifacts of the pre-war world and culture were a sore and uncomfortable reminder of how that world and culture had so utterly failed humanity. Many of these things were thrown or given away or were put in the attic or the basement, out of sight. Accordingly, decades passed before "antique" or "used" furniture and objects regained popular appreciation and value. After the war all that was "new" and, most particularly, that which was not at all like what was old, was in high demand.

These are a few magazine advertisements which give a good sense of the flavour of this post-war feeling:

It was into this supercharged, sociologically, historically

No wonder he's smiling.


In the sunrise of post-war
Railroad Transportation
SLEEK luxury trains, gleaming with the beauty of stainless steel, fashioned in designs expressing the civilization of a peacetime world . . . they are coming, over the horizon! Ready for use in their fabrication will be Superior Stainless Strip Steel . . . long coils of permanently bright, solidly enduring, exceedingly strong metal, in any standard analysis and rolled to exact size . . . serving to equal advantage the designers, builders, owners of tomorrow's finer trains.
Superior
STAINLESS
STRIP STEEL
Superior Steel
CORPORATION
CARNEGIE · PENNSYLVANIA


The CLIPPER
FOR THOSE WHO LOVE TO TRAVEL!
Lightweight • High Speed
....LUXURY TRAILERCOACH
• Light weight — Easy to handle — 22' overall
• All aluminum construction with stamped heat treated ribs
• Warner electric brakes
• Completely blanketed with spun glass insulation
• 12 gallon water tank and pump
• Full screen door
• Duo Pane windows on the sides
• DuPont Lucite windows fore and aft
• Interior painted Pearl glow hammer tone
• Venetian blinds and drapes
• Butane or oil heat
• Electric refrigeration — optional
• And many other features
FORMERLY MANUFACTURED BY CURTIS WRIGHT INDUSTRIES
Dealers and customers
ARE WELCOME TO INSPECT OUR NEW FACTORY
SILVER STREAK TRAILER CO.
1166 CHICO AVE. • EL MONTE, CALIF.


Look to OLDS
for all that's NEW!
A NEW AND FINER
HYDRA-MATIC DRIVE
OLDSMOBILE
Product of GENERAL MOTORS


ARRIVING YEARS AHEAD OF TIME!
The makers of America's first Diesel-Electric Locomotive present the first of a complete new line of Super Diesel-Electrics!
American Locomotive


Packard is Back!
WITH AN AMAZING NEW ELECTRIC DRY SHAVER!
4 SMOOTH, ROUND HEADS SHAVE CLOSER, FASTER, EASIER!
PACKARD TWIN DUAL Electric Shaver

Still sleek and modern looking, this is Beech Model 35 version 4. It is currently being displayed in the National Air and Space Museum of the Smithsonian on the National Mall in Washington D. C. as Captain William Odom's "Waikiki Beech." Whilst this is the oldest flyable Beech Model 35, it is not currently flight-worthy. Note the large tip-tanks installed for the record 1949 flight.

and psychologically nova-venerating American culture that Beechcraft introduced its Bonanza in 1947. It was no coincidence that Bonanza was ready-made for those times. It epitomized them. Those who were in the market for the finest and most modern of personal or business aeroplanes and could afford its price lined up to place their orders. In fact, it was this enormously positive response to the Bonanza in 1947 that fueled many GA aircraft manufacturer's starry-eyed optimism and belief in an aviation sales boom that never happened.

Beechcraft's goal and expectations for the Bonanza were clear from the outset – to create the fastest aeroplane for its horsepower that could carry up to four in comfort and which would be purchased primarily by corporations and businesses for use as a luxury executive transport. Visually stunning, made of the same materials and being of the same design philosophy as current front-line fighter aircraft, promising spectacular performance whilst powered by a modestly-sized and economical-to-operate engine and presenting a futuristic "new world" look and attitude, Beech Model 35 Bonanza hit every note and nerve, clicked on every button and twanged every heart string.

Unfortunately for most, although a part of Beech's plan, only those with a great deal of hard cash could buy into the Bonanza club. Of course, financial ability does not necessarily imply aeronautical ability or experience. Far too many private Bonanza owners in those first post-war years were woefully unprepared to fly it safely.

IS THE "V"-TAIL BONANZA SAFE?

Let me say at the outset of this topic discussion that "V"-tail Bonanza, and all properly designed and competently built aeroplanes for that matter, are ultimately only as safe as the competency and diligence of their pilots. Proper maintenance and inspection along with careful and knowledgeable piloting are the requisites for all safe flight.

However, it is not a secret that early "V"-tail Bonanzas have had a poor safety record. Many have blamed the "V"-tail for this, but that is not entirely fair. Other more important factors have been found to have been responsible for this record. It appears that the greatest reason why there were so many early fatal Bonanza accidents is that the aeroplane was simply ahead of its time and more of a handful than most general aviation pilots could then handle. General aviation pilots in the late 1940s and early 1950s were not used to aircraft as clean and demanding as Bonanza, and why should they have been? Nothing like Bonanza had previously been available to them.

Aerodynamically "clean" (low drag) aeroplanes are excellent and efficient cruisers. They get the most out of the power available and they go fast. Unfortunately, that is not the totality of the matter. "Clean" aeroplanes, like Bonanza, also tend to be challenging for those pilots who are unfamiliar with the flight characteristics of such aircraft. The problem is that when a clean aeroplane's nose goes below its normal cruising attitude with power on, the aeroplane accelerates at a very high rate, far faster than anything in which most casual general aviation pilots might have trained or previously flown. As the airspeed indicator rapidly winds past the end of the green arc (VNO – maximum structural cruising speed) into and through the yellow arc (cautionary maneuvering airspeeds) and towards and beyond the red line (VNE – never exceed airspeed,) the situation is often already too late for all but the most careful and knowledgable pilots to correct (and likely too late for even them, as well).

All pilots know that to reduce airspeed, the nose must be raised by pulling back on the control stick/yoke, increasing the aeroplane's Alpha which, in turn, creates a positive g-force (accelerative force applied in addition to the force of gravity) on the aeroplane and those onboard. However, when airspeed is at a critically high level, it is possible, perhaps likely, that even the smallest amount of rearward control stick/yoke pressure will create a powerful positive g-force sufficient to overload the aeroplane's wings and tail structures, causing a catastrophic failure thereof. In extreme circumstances, even the gentlest pull on the controls when the airspeed needle is at, or worse, beyond the red line will instantly cause such dire consequences. Not doing anything is no solution either.

Once the aeroplane is past the redline it is under tremendous structural stress. Every second is crucial and recovery which safely and effectively lowers the airspeed must be done right now! Closing the throttle is, of course, the first thing to do in such a situation, but that might not be sufficient to avoid a tragedy. If you have a speed brake, of course, extend it immediately, but speed brakes are not installed in Bonanzas nor in virtually any other general aviation aircraft. Trying to lower the undercarriage and/or flaps to slow down at such a high airspeed is very risky may not work. Additionally, doing this is likely to cause just the serious structural damage you are trying to avoid. In fact, once you are hurtling past the redline there may be no way to avoid a tragedy.

With this in mind, it is well to be aware that in nearly all fatal Bonanza accidents in which a failure of the aircraft's structure was involved, it was determined that the aeroplane had been flown outside its normal flight envelope (i.e., flying too damn fast). In most instances these accidents were preceded by loss of control due to the pilot's apparent misinterpretation of the aeroplane's situation causing him/her to make incorrect control inputs, exacerbating rather than correcting the problem.

When Bonanza was introduced in 1947, very few pilots were trained or competent to fly in what is called "instrument flight rules" (IFR) conditions, which are essentially those in which the pilot is unable to see the horizon and is unable to accurately and safely fly the aeroplane without reference to instruments. At this time not even many ex-military pilots had much IFR training or experience and the vast majority of civilian pilots had even less. The IFR navigation system, so sophisticated, efficient and ubiquitous in modern times, was in its bare infancy in early 1950s and virtually non-existent in the late 1940s. In that era gyroscopic instruments, common today and which are a crucial aid during IFR flight, were not standard or even available equipment in early Bonanzas and most of the other general aviation aeroplanes.

When the weather obscures or completely hides the horizon, safe flight becomes dependant upon the pilot's ability to fly the aeroplane with sole reference to and reliance upon what instruments may be on the panel. Yes, IFR flying can be done without gyros and learning to do so is a part of IFR training, but doing this effectively requires professional instruction and lots of practice.

Unless an auto-pilot has been engaged, even a well-trimmed aeroplane will not maintain straight and level flight by itself for very long. Even assuming perfectly calm winds (which is rarely the case, particularly at altitude,) the torque of the engine and propeller causes a steady left banking tendency which is likely to go unnoticed unless the pilot has reference to the horizon (real or gyroscopic), the terrain and/or notices that the aircraft's compass heading is slowly changing.

An ordinary magnetic compass (sometimes called a "whisky compass" for its visible yellow/brown-coloured lubricating oil) is notoriously inaccurate and misleading under many flight conditions and is considered to be unreliable as the sole source of heading information during IFR flight. An aeroplane out of true rigging, subtle trim inaccuracies, gusts of wind and/or turbulence may cause pitch and roll changes as well, all of which may also go unnoticed by a pilot not trained to fly in IFR conditions.

As mentioned, pilots have reported that "V"-tail Bonanzas are very light and sensitive in pitch to the extent that flying a "V"-tail Bonanza has been described as being "sportscar-like." Also, "V"-tail Bonanzas are notoriously unsteady in pitch and roll, tending to constantly "seek" pitch position and laterally wander from level flight. Beech designed Bonanza for maximum performance with little to no considerations or compromises for flight by low-time pilots. Whilst Bonanza's "sportscar-like" – perhaps even "warbird-like" – flight characteristics may be quite satisfying to an experienced pilot, when in IFR conditions these characteristics are likely to create an unintended and unnoticed banked, nose down condition. When these are combined what is called a "spiral dive" is likely to occur.

Over many decades of close and diligent study of fatal general aviation aircraft accidents and reports from flight instructors, the loss of a visual horizon has been cited as the most common cause of the spiral dive phenomenon and the fatal accident which soon and inevitably follows. It has been determined by a number of flight instructors that if a pilot without an instrument rating tries to turn around in IFR conditions to fly back to clear weather he /she is likely to mishandle the turn by not applying sufficient back pressure on the yoke/stick, thereby allowing the nose to drop. Add to this banked attitude the aerodynamically clean Bonanza's tendency to quickly accelerate to and beyond its redline (Vne) when the nose drops, and therein exists a formula for catastrophe that is, as is said, "Just waiting to happen."

What happens all-too-often is this: a pilot inadvertently and/or negligently flies into a low -visibility weather condition and soon loses sight of the horizon. If not trained to fly in IFR conditions and relying upon his/her "senses,"[11] he/she "feels" that all is well all whilst the left wing has already slightly dropped and, because the aeroplane is no longer flying level, the nose has also begun to drop. As mentioned, this situation is exacerbated if this pilot attempts a turn in IFR conditions. What this pilot usually then hears is the rising sound of the outside air flow and immediately sees the airspeed indicator needle quickly rising. He/she naturally pulls back on the control wheel to alleviate this but, because the aeroplane's wings are no longer level, up elevator input only steepens the left bank which, accordingly, causes the nose to drop further. Meanwhile, airspeed continues to increase until it is quickly well past the redline as the pilot frantically but vainly pulls back even harder on the control wheel to slow the airplane. This continues for only a short while until either the wings and/or tail structures fail or the aeroplane contacts the ground in a sharp nose-down left bank at a very high speed.

This is, in fact, what apparently happened to John Kennedy, Jr. on July 16, 1999 when his high-performance, high-powered and aerodynamically clean Piper PA32R "Saratoga," which he had recently purchased and in which he had little flight time, crashed into the Atlantic Ocean off the coast of Martha's Vineyard, Massachusetts, killing all three on board (Kennedy, his wife Carolyn and his sister-in-law Lauren Bessette). On that day, Kennedy had been delayed by business and did not takeoff from Essex County Airport, near Fairfield, New Jersey to attend the wedding of his cousin Rory Kennedy at Martha's Vineyard, Massachusetts until almost sunset. He soon found himself flying in the dark of the evening in very hazy, humid low-visibility weather, always a perilous flight condition for VFR flying. At some point he apparently lost clear sight and sense of the horizon and became spatially disoriented (see footnote below.) The installed sophisticated three-axis autopilot was not engaged and he was not instrument rated. Kennedy's "Saratoga" crashed into the ocean at an extremely high speed in a steep left bank and with the nose steeply down.

All of the foregoing is not to say that Model 33 Debonairs and later the Model 36 Bonanzas with conventional tails did not occasionally have fatal accidents, including those involving a pilots' loss of control in IFR weather. The difference was that in these accidents, the tail surfaces were found not to have failed in flight and were not considered to be a significant factor in these accidents. It was determined that the ruddervators of the early "V"-tail Bonanzas tended to fail early in the course of an over-speed situation, whilst conventional-tail Bonanzas and Debonairs were discovered to have granted a bit more time for a pilot to extricate him/herself from the overspeed situation before the tail surfaces departed.

Of course, Beech took this matter extremely seriously and from Bonanza C35 (late 1950 to 1952) onward, the chord (leading to trailing edge) of the ruddervators was increased by seven inches, putting the non-moving stabilizer part of the ruddervator sixteen inches ahead of its main spar. On early Bonanzas up to model C-35 the ruddervators' main spars were their sole attachment points to the fuselage. The problem was that with this increase in area, an even larger part of the ruddervator was now unattached to the fuselage.

This redesign was a logical attempt to create a more stable and less sensitive pitch control by increasing the overall area of the ruddervators. Unfortunately, the ruddervators' internal structure was not similarly enhanced, which some have speculated was because of Beech's apparent reluctance to officially and publicly acknowledge that there was anything fundamentally wrong with the original "V"-tail design to begin with.

In addition to the increase in the ruddervators' area, Bonanza C35 has a more powerful Continental E-185-11 engine, upping the hp from 165 hp to 205 hp for one minute and 185 hp continuous, all of which make it a very desirable and sought-after early Bonanza.

Unfortunately, not anchoring the ruddervators more securely in C35, such as at their leading edges as well as the spar, caused a number of in-air ruddervator failures which, in turn, caused the wings to fail as well. All of these accidents occurred after the aeroplane had been flown at airspeeds beyond the redline (Vne,) as occurs in an uncontrolled spiral dive. Based upon inspection of the wreckage of these crashed aeroplanes, Beech ultimately determined that Bonanza's ruddervators would henceforth be required to be attached to the fuselage at both the spar and leading edge.

This fix was effective and thereafter the number of Bonanzas which crashed due to tail surface collapse or departure decreased. Recovering to level flight from airspeeds higher than the redline no longer tended to cause immediate airframe disintegration and in some instances with careful handling, a pilot could now extricate such a hurtling Bonanza from its dive to level flight without incident.

Piper PA-32R "Saratoga." This advanced and very high-performance aeroplane was initially called "Piper Lance," a retractable undercarriage Piper PA- 32 Cherokee Six. As this aeroplane evolved it became known as Piper "Saratoga." Similar to Lance in most ways, Saratoga has a tapered wing, whilst Lance's wing is Cherokee Six's un-tapered "Hershey Bar" type.

"ALRIGHT, WE GET IT"

Whilst spokespersons for Beech are not known to have actually publicly said this or acknowledged "V" -tail Bonanza's deficiencies, Beech certainly tacitly made such a statement when, in 1959, Model 33 "Debonair", essentially a conventional-tail Bonanza, was introduced. Surely this was a strong response to the burgeoning criticism and the historically poor safety record of "V"-tail Bonanza. At this or any time Beech could have simply changed to a conventional tail arrangement whilst retaining the Bonanza name, as it actually did in 1968 with the introduction of the conventional-tail Model 36 "Bonanza." The introduction of "Debonair," a new non-"V"-tail Beech aeroplane, was Beech's clear invitation to "V"-tail sceptics and critics to purchase a Beech aeroplane that in every substantial way is everything that Bonanza is, but with a reassuring (for some) conventional-tail.

As the years passed fewer and fewer Bonanza fatal accidents were reported and its accident rate became comparable to other similar aircraft. In addition to the mentioned structural improvements in Bonanza perhaps the most important reason for this improvement in safety has nothing to do with Bonanza at all. What happened was that throughout the 1950s and into the 1960s private pilot training greatly improved, and FAA checkout requirements for pilots who flew or sought to fly high-performance aircraft such as Bonanza was made more rigourous. Wealthy "Doctors" and others who purchased or regularly flew Bonanzas were carefully taught how to fly such a high-performance aeroplane. Equally important, as time passed, moiré and more elementary IFR and "extreme attitude recovery" training was added to the private pilot training curriculum (FAR- 14 CFR Part 61 ;). Whilst not in any way comparable to or a replacement for an Instrument Rating, even this rudimentary instrument training on many occasions was a life-saving aid to many pilots who found themselves in low visibility weather. Most flying clubs and aircraft rental businesses wisely require that a pilot must hold a current Instrument Rating in order to fly high-performance aircraft such as Bonanza.

To be fair to Bonanza, all aircraft are and always have been in danger of airframe destruction when flown beyond their flight envelopes, a condition which clean, high-powered aircraft tend to enter with greater ease and frequency than other less slippery and less powerful aircraft, and/or when flown by pilots whose aeronautical experience is not equal to the aeroplane which they are flying.

Bonanza's improved accident rate throughout the 1950s and into the 1960s did not, however, prevent certain factions, who had reasons of their own, to continue to disparage "V"-Tail Bonanzas. Not the least of these was William T. Piper and Co. who in 1956 was developing Piper PA- 24 "Comanche," which Mr. Piper hoped and publicly stated would be "The Bonanza Killer." Whilst Comanche is a superb aeroplane, in every way comparable and in some ways superior to Bonanza, neither it nor any other aeroplane has ever been able to "kill" Bonanza. Since Bonanza's introduction it has been the icon at the top of the hill of general aviation aircraft and is likely to remain so for quite some time.

THE BONANZA LEGACY

Still in production, since 1947 more than 17,000 Beech Bonanzas have been produced. Of these, more than 12,000 Bonanzas of every variation are currently listed in FAA's aircraft registry which well-attests to Beech build quality. In all of its 37 variations (and counting,) Bonanza is the sixth most numerously produced general aviation aeroplane, not far behind the 20,000-plus Piper J-3 "Cubs." To date (2018,) Bonanza is the 15th most numerous aeroplane of any kind.

Many of the earliest Bonanzas have gone the way of normal attrition due to age and wear, but a good number of these have been and are being restored back to flightworthy condition by loving owners and operators. Over the 71 years since Bonanza was first introduced, it has justly earned the respect of the general aviation community as well as the deep affection of its owners and pilots.

Beechcraft Bonanza V35B – a study in grace and power. The last "V"-tail Bonanza, not at all coincidentally designated V35 was introduced in 1966. Minor improvements to it were made in V35A (1968-69) and many more in V35B (1970-82.)

THE END OF AN ERA - BEECHCRAFT MODEL V35B "BONANZA"

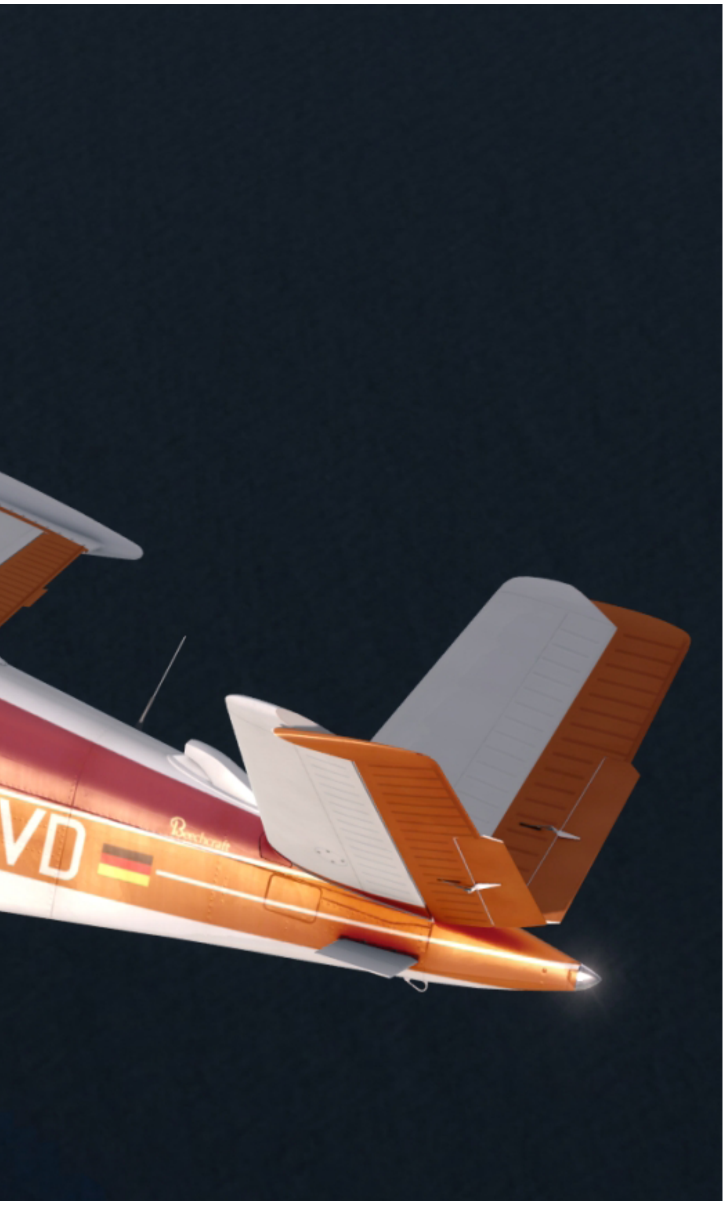
V35B, first produced in 1970, is the specific aircraft that A2A has developed as our latest flight simulation offering. From its first iteration in 1947 as Model 35, Bonanza has constantly been improved and has greatly evolved. Almost every year or so a new letter model Bonanza has been produced, each one an improvement over those which came before. After sixteen "V"-tail model Bonanzas, from the 1947 Model 35 to the 1964-65 S35, every aspect of the aeroplane has been upgraded to maintain Bonanza's reputation as the highest quality and best performing aeroplane in its class.

On 29 November 1950, Olive Ann Beech, a co-founder of Beech Aircraft Company, became its President after her husband and co-founder, Walter Herschel Beech, suffered a

sudden and fatal heart attack. She remained at Beech's helm until it was purchased by Raytheon Company on 8 February 1980. With this sale Beech Aircraft Corporation was, for the first time, no longer headed by a Beech family member. In 1982, Raytheon Company decided to close the era of the "V"-tail Bonanza. Whether this would have occurred if Olive had still been Beech's president is a matter for interesting speculation.

Appropriately, Raytheon/Beech skipped Model 35T and 35U designations and went right to Model V35 for the last "V"-tail Bonanza. V35B retains the basic V35 nomenclature; however, the 35B is, in fact, a new model. V35B features a completely new interior with additional headroom including redesigned and improved seats, a new instrument panel and a more efficient ventilation system. The exterior remains essentially the same as V35, however V35B has a new paint scheme. The price of a V35B was $41,600 in 1972 ($248,359.96 in 2018 with an a cumulative inflation of 497%).

Model V35B, along with a turbo-charged variant, V35B-TC, was produced from 1970 -82. It would be the last of the breed. The first conventional-tailed Bonanza (an oxymoron to some) was the 1968-69 Model E33, basically a re-named continuation of the Debonair line. Model 36 Bonanza is an E33A with ten inches added to the fuselage, four cabin windows on each side, right-side double-doors and six seats. From that time to the present there have been no new "V"-tail Bonanzas.



SPECIFICATION

Model	Model V35B	
Engine	1 x Continental IO-520-BB flat-six piston engine, 213kW	
Weights		
Take-off weight	1,542 kg	3,400 lb
Empty weight	955 kg	2,105 lb
DIMENSIONS		
Wingspan	10.21 m	34 ft 6 in
Length	8.05 m	26 ft 5 in
Height	2.31 m	8 ft 7 in
Wing area	16.81 m2	180.94 sq ft
PERFORMANCE		
Max. speed	338 km/h	210 mph
Cruise speed	253 km/h	157 mph
Ceiling	5445 m	17850 ft
Range	1,648 km	1,024 miles

BEECHCRAFT BONANZA V35B

PRODUCTION YEARS: 1970-1982

SERIAL NUMBERS: D-7977 thru D-8598

ENGINE: Continental IO-520B 285 hp

DISTINGUISHING FEATURES

- Trapezoidal long rear windows
- Long-chord stabilators
- Stinger tail cone
- One-piece windshield (no center strip)
- Ventilation inlet scoop between stabilators
- Single, throw-over control yoke
- Vernier (twist operation) engine and mixture controls
- Gear handle on right, flap on left
- Gear-driven alternator
- Extended aft baggage area

COMMON OPTIONS AND MODIFICATIONS

- Long-range fuel (two 40-gallon tanks)
- V35TC - TSIO-520D STC
- Other engine upgrades
- Forward facing "family" 5th and 6th seats in aft baggage area
- Tip tanks
- Large aft baggage door
- Improved cabin ventilation system
- Dual control yoke
- Avionics upgrades

OUR NEW BIRD

We hope that you will find flying A2A's Bonanza V35B to be an enjoyable, authentic and satisfying experience. Many of those on our Beta Development Team, including this writer, have cumulatively had many hundreds of hours flying a number of full-size Bonanza variants, including V35B and some of us have instructed in them. It is universally held amongst us that all Bonanzas are high-quality, beautifully performing aeroplanes which fly with grace and élan. We have put all of our collective experience into assuring that A2A's V35B Bonanza is as accurate and enjoyable a simulation of the full-size aeroplane as possible. We are confident that once you, too, have flown A2A's V35B "Bonanza," you will come to feel this way as well.

ENDNOTES

1 TWA (Transcontinental and Western Airlines) Flight 599 was a flight from Kansas City, Missouri to Los Angeles, California on 31 March 1931. There were a number of stops scheduled along the way. The first stop after taking off from Kansas City was to be Wichita, Kansas. The Fokker F.10 Tri-motor with eight passengers aboard never made it to Wichita. It crashed into a wheat field a few miles southwest of Bazaar, Kansas, a little more than halfway to Wichita, killing all on board, including Knute Rockne. The nation mourned as if a President had died, and President Hoover called Rockne's death "a national loss," such was Rockne's popularity and fame.

Public outcry at Rockne's death in the crash prompted aviation officials and experts to commence what was the first extensive official study of a crashed aircraft's wreckage as well as a detailed scientific analysis of the cause of the crash, setting an intensive aeronautical forensic standard that continues to this day. TWA's first explanation was that the Fokker was brought down by extreme turbulence. The evidence presented for this theory was that the co-pilot had made a radio call to Wichita after an hour into the flight, saying, "The weather here is getting tough. We're going to turn around and go back to Kansas City." Another theory that TWA posited was that the Tri-motor flew into undetectable and unreported clear-air turbulence which overstressed its wing, causing it to fail. At that time clear-air turbulence was not nearly as well understood as it became in later years.

Before long it was clear that the actual and officially recognized cause of the crash of TWA Flight 599 was the break-up and departure of the Fokker's wooden wings. TWA's attempts to blame weather conditions for the crash were quickly shown to be erroneous. Upon close inspection, the cause of the wings' break-up was determined to be the partial interior delaminating of the wings' plywood skin which was bonded to the ribs and spars with water-based aliphatic-resin glue. The aircraft's previous flights in rain and its exposure to rain and moisture on the ground had deteriorated the glue bond inside the wing to the extent that sections of the plywood covering had eventually separated from its under-structure in flight. It was deemed that given the type of glue and the materials used in the construction of the wing that the eventual separation of the wings' plywood skin and the wings' subsequent catastrophic break-up was inevitable. The accident was, of course, a terrible misfortune; however, the tragic loss of such a beloved public figure and the publicity that it created sparked the beginning of a new and more enlightened era in aviation accident forensics and caused the immediate institution of dozens of safety regulations.

One of the positive changes which were made was with regard to more regular and intensive inspection of commercial aircraft. As might be expected, after the Rockne crash and the widely published official report of its cause, wooden-winged aeroplanes went distinctly out of favour. In particular, the wooden-wing Fokker F.10 was no longer trusted by the public, most of who refused to fly in them. TWA, which operated many Fokkers, nearly went out of business. The slower but all-metal Ford Tri-Motor was substituted for Fokkers in many instances, setting the stage for future all-metal airliners such as Boeing 247 and Douglas DC-2/3.

2 Lyric from the song, "New Sun in the Sky" appearing in the 1953 film "The Band Wagon" written by Betty Comden, Adolph Green and Alan Jay Lerner

3 Medal of Honor recipient U. S. Marine Corps Colonel Gregory "Pappy" Boyington may have put it best when he said, "(Combat) flying is hours and hours of boredom sprinkled with a few seconds of sheer terror."

4 It was not until 1963 that Beechcraft produced its first "sport" type aeroplane to compete with Piper's PA-28 "Cherokee" line and Cessna's 172 "Skyhawk." The first of Beech's low-to-middle line aeroplanes was the fixed tricycle-undercarriage entry-level Model 23 "Musketeer," a number of versions of which were produced during the 1960s with increased power and seating intended for the low-to-middle level sport aircraft market.

In 1966 Beech Model 19, "Musketeer Sport," a toned-down, lower-powered, lower-priced version of Model 23 "Musketeer" was produced, intended to be a trainer which would be attractive to flying schools and clubs as competition to the wildly popular Piper Cherokee 140 and Cessna 150. From 1966 to 1979, models A19, B 19 and M19 "Musketeer Sport" versions were built with engine and interior upgrades. Simultaneously with the Model 19 trainer, Beech produced Beechcraft 23-24 Musketeer Super III, an upgraded, more powerful fixed tricycle-undercarriage version of Model 23. The last of the Beech "Musketeer" aircraft was the retractable undercarriage Model 24 "Sierra," developed to be similar to and compete with the popular Piper PA-28R-200 "Arrow" which was essentially a retractable undercarriage Cherokee 180/Archer with a 200 hp fuel injected engine turning a constant-speed propeller.

Whilst Beech Bonanza and Debonair have ruled the high-end, high performance light aeroplane market since their inceptions, none of the excellent "Musketeer/Sierra" series were nearly as popular, commercially successful or as market competitive as their Piper and Cessna counterparts.

5 English usage of "bonanza" dates back to at least 1829, primarily in the United States. Basic definitions include "a thing that produces excellent results" and "a great quantity of something of value." It was also commonly used, particularly in the 19th century American West to describe a

large deposit of rich minerals such as gold or silver. This usage seems likely to be that which generated the name of the popular American television series (1959-73) of that name.

Etymology- The English word "bonanza" is taken from the modern Spanish language. In Spanish, "bonanza" literally means "calm sea," which implies prosperity and also refers to a rich cargo or find. This is derived from the Vulgar Latin [Vulgar Latin or Sermo Vulgaris meaning "common speech" was the non-standard form(s) of Latin (as opposed to the classical] spoken in the Mediterranean region during and after the classical period of the Roman Empire) "bonacia.". "Bonacia" is a combination of the Latin "bonus," which means "good," and "malacia," which means "calm sea." In turn, "malacia" comes from the Greek "malakia," which means "softness."

6 Beech Baron B55 and B58 twins also use this airfoil

7 As has been said of Messerschmitt BF-109, also not considered to be a particularly pilot-friendly aeroplane, "The pilot is not to expect it to perform, it expects the pilot to."

As calculated by both Beech and the CAA, (forerunner of the FAA) Beech Model 35's fatal accident rate was, from 1947 through 1952, a whopping 4.90 per 100,000 flight hours. The following Models A35, B35 and C35 were reported to have a fatal accident rate over the same period of 2.50 per 100,000 flight hours. By comparison, the contemporary Cessna 195's fatal accident rate over the same period was reported to be approximately 2.0 per 100,000 flight hours and Beech 18's fatal accident rate over the same period was reported to be only .80 per 100,000 flight hours. As a comparison to a current high-performance aeroplane, studies show that as of 2018 a modern day Bonanza equivalent, Cirrus SR-20, has averaged a fatal accident rate of 1.63 per 100,000 hours, less than ⅓ the rate of the 1947 Model 35 Bonanza during its first six years.

8 Ground Effect is that condition which begins when an aeroplane is approximately the length of its wingspan above the ground and is maximized when it is at approximately 1/5th of its wingspan above the ground. When in ground effect, the aeroplane glides more efficiently and airspeed decreases more slowly. This may cause touchdown to occur much farther down he runway than the pilot anticipated, sometimes so far that the aeroplane could be in danger of running out of runway. Ground Effect is caused by the disruption of the wingtip vortices and the downwash at the wing's trailing edge (which are always generated by the wing when in flight) by contact with the ground. This disruption limits the size of the vortices and alters the direction of the downwash which becomes more vertical, increasing lift but also reducing drag (opposite and equal reaction). The altered angle of lift reduces Induced Drag which accordingly reduces the rate at which the aeroplane decelerates. It is the combination of additional lift and reduced drag which causes the aeroplane to float above the runway when in Ground Effect.

9 4 CFR 91.109 states: "No person may operate a civil aircraft (except a manned free balloon) that is being used for flight instruction unless that aircraft has fully functioning dual controls. However, instrument flight instruction may be given in a single-engine airplane equipped with a single, functioning throwover control wheel in place of fixed, dual controls of the elevator and ailerons when—

(1) The instructor has determined that the flight can be conducted safely; and

(2) The person manipulating the controls has at least a private pilot certificate with appropriate category and class ratings.

3) Except in the case of lighter-than-air aircraft, that aircraft is equipped with fully functioning dual controls. However, simulated instrument flight may be conducted in a single-engine airplane, equipped with a single, functioning, throwover control wheel, in place of fixed, dual controls of the elevator and ailerons, when—

(i) The safety pilot has determined that the flight can be conducted safely; and

(ii) The person manipulating the controls has at least a private pilot certificate with appropriate category and class ratings.".

10 The Bonanza/Baron/Travel-Air Pilot Proficiency Program, Inc. (BPPP), created and overseen by the American Bonanza Society Air Safety Foundation, holds a CFR exemption allowing the use of single-yoke equipped aircraft (single- and multi-engine) for recurrency training. The exemption is valid only during approved BPPP classes. Like many others, I took my Bonanza check ride before this exemption was instituted.

11 E xtensive studies dating from as early as the 1930s have shown that a pilot in a moving aeroplane without reference to the horizon and/or without a clear view of the outside world will often completely misinterpret the actual attitude of the aeroplane, and how it is actually moving. This phenomena is called "spatial disorientation", i.e., the failure to maintain body orientation and posture in relation to the surrounding environment (physical space) when at rest and especially during motion. This is caused by the incorrect response of the pilot's vestibular (organs of equilibrium located in the inner ear) and proprioceptive (muscle spindles in skeletal striated muscles and tendons) systems as follows: the aeroplane's acceleration and turning as well as centrifugal and inertial forces all act upon the pilot's inner ear which informs the net gravitoinertial force which the pilot perceives. The pilot's Otolith organs, the Utricle and Sacculus become misaligned with gravity which leads to spatial misjudgement and disorientation.

DEVELOPER'S NOTES

Some say the hardest thing for an artist to draw is the human hand, because it is the part of our body that we are all most familiar with. Simulating the Beechcraft Bonanza V-tail is like drawing that human hand. Additionally, there are many Bonanza variants through history with owners that know their airplane in some ways better than they know themselves.

Yet we all interpret life around us differently, including how an airplane feels to each pilot. It is up to us, at A2A, to not just create an airplane that objectively performs in line with the actual airplane, but to capture that human feel and interaction with the real airplane. We have to somehow magically capture that experience that applies to all pilots. And Accu-Sim technology allows us to achieve this better than anything we've used before.

Beyond modeling a specific airplane, the Bonanza history is surrounded with tales and stories developed over many decades, some are true and some not. Probably the most common nick name the Bonanza V-tail is known for is being the "doctor killer." When the Bonanza was first introduced, it was unlike anything anyone has ever seen in the general aviation market. And for the decade following it's release, successful businessmen and professionals were buying the Bonanza in great numbers. Many of these pilots had primary careers that demanded a great deal of their time, not leaving much room for flying. And like many "weekend warriors" today who spend the whole week sitting behind a desk then go out and play a sport on the weekend, injuries erupt. The same holds true for the busy professional working all week who then decides to occasionally fly a high performance airplane like the Beechcraft Bonanza V-tail.

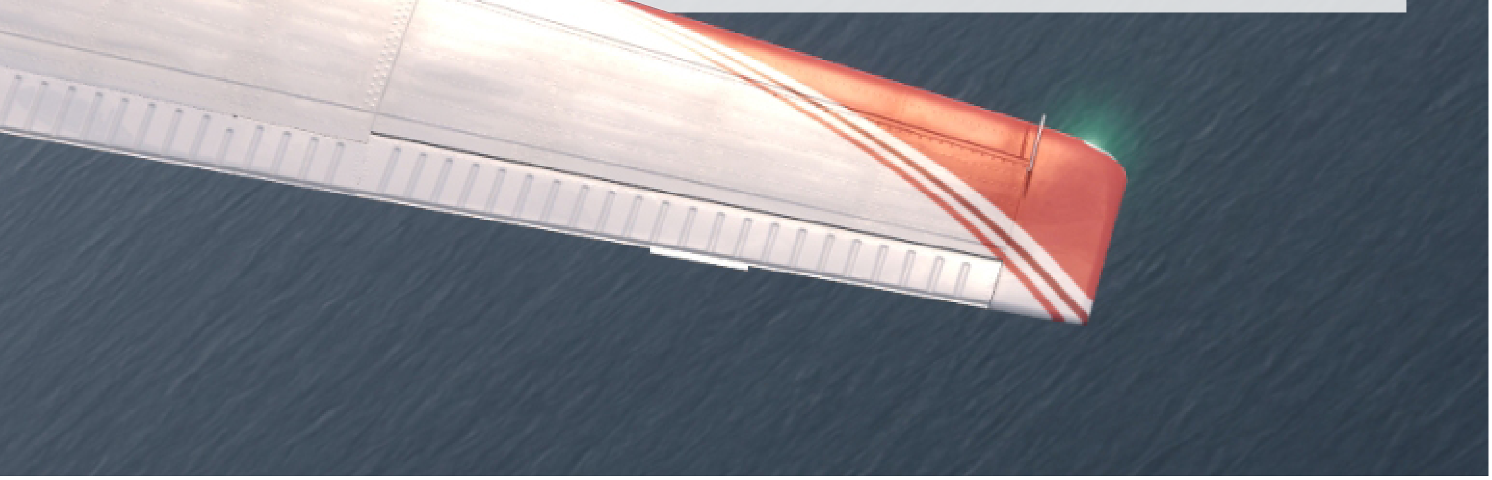
The V-tail Bonanza was built from World War II fighter technology, which was designed for highly trained professional pilots. And like most Warbirds, the Bonanza want so fly fast, all the time. Unlike general aviation aircraft that were developed in later years to have benign flight characteristics, the Bonanza inherently has all of the challenging qualities of the World War II fighter. From my point of view, flying a Bonanza is just like flying a Warbird. It rumbles, shakes, rattles, is heavy and can bite the low time pilot in a heart beat. Therefore it's this writer's opinion that the new pilot should approach flying a V-tail Bonanza exactly the same as approaching an aircraft like a P-51 Mustang. The V-tail Bonanza, like the Warbird, is designed for experienced pilots who take the time to study and fly and operate such an aircraft with organization, patients, and preparedness.

For those pilots who do approach the V-tail Bonanza with the respect it deserves, it will reward the pilot with an experience unlike any other aircraft in the general aviation fleet today. It is for this reason the V-tail Bonanza still stands alone today, as it did on the first day it was introduced to the public.

We hope our work on this aircraft meets and exceeds all of our customers expectations, and also hope this aircraft delivers not weeks or months, but years of excitement, wonder, surprise, and the most complete simulated aviation experience to date.

Thank you to all of our customers for allowing us to pursue our dreams, and hopefully help pass our dreams onto you too.

Scott
Founder
A2A Simulations Inc.



FEATURES

- Aircraft DNA technology re-creates actual engine and airframe vibrations.
- V-tail physical modeling captures the character of this classic aircraft.
- New analog gauge physics delivers a living cockpit unlike ever before.
- Install a 285 Hp or 300 Hp Continental engine in the maintenance hangar.
- Native Accu-Sim rain effects (P3D)
- Directional cockpit and dynamic exterior lighting (P3D)
- A true propeller simulation.
- Experience the world's most recognizable high performance general aviation airplane.
- Hand towing.
- Immersive pre-flight inspection system designed by pilots while operating the actual Bonanza V-35B.
- Electric starter with accurate cranking power.
- Dynamic ground physics including both hard pavement and soft grass modeling.
- Primer-only starts are now possible. Accu-Sim monitors the amount of fuel injected and it’s effectiveness to start and run the engine.
- Persistent airplane where systems, corrosion, and temperatures are simulated even when the computer is off.
- Immersive in-cockpit, physics-driven sound environment from A2A engineered recordings.
- Complete maintenance hangar internal systems and detailed engine tests including compression checks.

- Piston combustion engine modeling. Air comes in, it mixes with fuel and ignites, parts move, heat up, and all work in harmony to produce the wonderful sound of a Continental 520 and 550 cubic inch engine. Now the gauges look beneath the skin of your aircraft and show you what Accu-Sim is all about.
- Actual avionics used in real Bonanza V35B's flying today.
- The TSO'd King KFC 200 Flight Director/ Autopilot with complete 2-axis (pitch and roll with altitude hold) integrated system with professional 3-inch Flight Director displays.
- Three in-sim avionics configurations including no GPS, GPS 295, or the GNS 400. Built-in, automatic support for 3rd party avionics.
- As with every A2A aircraft, it is gorgeously constructed, inside and out, down to the last rivet.
- Designed and built to be flown "By The Book."
- Visual Real-Time Load Manager, with the ability to load fuel, people, and baggage in real-time.
- Four naturally animated passengers that can sit in any seat including the pilot's.
- 3D Lights 'M' (built directly into the model).
- P3D's support of directional lighting allows a more advanced lighting system.
- Pure3D Instrumentation now with natural 3D appearance with exceptional performance.
- A total audible cockpit and sound engineered by A2A sound professionals.
- In cockpit pilot's map for handy in-flight navigation.
- Authentic fuel delivery includes priming and proper mixture behavior. Mixture can be tuned by the book using the EGT, Fuel flow or by ear. It's your choice.
- All models include A2A specialized materials with authentic metals, plastics, and rubber.
- Airflow, density and its temperature not only affect the way your aircraft flies, but how the internal systems operate.
- Real-world conditions affect system conditions, including engine temperatures.
- Spark plugs can clog and eventually foul if the engine is allowed to idle too low for too long. Throttling up an engine with oil-soaked spark plugs can help clear them out.
- Overheating can cause scoring of cylinder head walls which could ultimately lead to failure if warnings are ignored and overly abused
- Engine, airframe, cockpit panel and individual gauges tremble from the combustion engine.
- Authentic drag from the airframe and flaps
- System failures, including flaps that can independently jam or break based on the actual forces put upon them. If you deploy your flaps at too high a speed, you could find yourself in a very dangerous situation.
- Authentic battery. The battery capacity is based on temperature. The major draw comes from engine starting.
- Oil pressure system is affected by oil viscosity (oil thickness). Oil viscosity is affected by oil temperature. Now when you start the engine, you need to be careful to give the engine time to warm
- Eight commercial aviation sponsors have supported the project including Phillips 66 Aviation, Champion Aerospace, and Knots2u speed modifications.

FSX QUICKSTART GUIDE

Chances are, if you are reading this manual, you have properly installed the A2A Accu-sim V35B Bonanza. However, in the interest of customer support, here is a brief description of the setup process, system requirements, and a quick start guide to get you up quickly and efficiently in your new aircraft.

SYSTEM REQUIREMENTS

The A2A Simulations Accu-Sim V35B Bonanza requires the following to run:

- Requires licensed copy of Microsoft Flight Simulator X
- Service Pack 2 (SP2) required

NOTE: While the A2A Accu-Sim V35B Bonanza may work with SP1 or earlier, many of the features may not work correctly, if at all. We cannot attest to the accuracy of the flight model or aircraft systems under such conditions, as it was built using the SP2 SDK. Only Service Pack 2 is required. The Acceleration expansion pack is fully supported but is NOT REQUIRED.

OPERATING SYSTEM:

- Windows XP SP2
- Windows Vista
- Windows 7
- Windows 8 & 8.1
- Windows 10

PROCESSOR:

2.0 GHz single core processor (3.0GHz and/or multiple core processor or better recommended)

HARD DRIVE:

250MB of hard drive space or better

VIDEO CARD:

DirectX 9 compliant video card with at least 128 MB video ram (512 MB or more recommended)

OTHER:

DirectX 9 hardware compatibility and audio card with speakers and/or headphones

INSTALLATION

Included in your downloaded zipped (.zip) file, which you should have been given a link to download after purchase, is an executable (.exe) file which, when accessed, contains the automatic installer for the software.

To install, double click on the executable and follow the steps provided in the installer software. Once complete, you will be prompted that installation is finished.

Important: If you have Microsoft Security Essentials installed, be sure to make an exception for Microsoft Flight Simulator X as shown on the right.

REALISM SETTINGS

The A2A Simulations Accu-Sim V35B Bonanza was built to a very high degree of realism and accuracy. Because of this, it was developed using the highest realism settings available in Microsoft Flight Simulator X.

The following settings are recommended to provide the most accurate depiction of the flight model. Without these settings, certain features may not work correctly and the flight model will not perform accurately. The figure below depicts the recommended realism settings for the A2A Accu-Sim V35B Bonanza.

FLIGHT MODEL

To achieve the highest degree of realism, move all sliders to the right. The model was developed in this manner, thus we cannot attest to the accuracy of the model if these sliders are not set as shown below.

INSTRUMENTS AND LIGHTS

Enable “Pilot controls aircraft lights” as the name implies for proper control of lighting. Check “Enable gyro drift” to provide realistic inaccuracies which occur in gyro compasses over time.

“Display indicated airspeed” should be checked to provide a more realistic simulation of the airspeed instruments.

ENGINES

Ensure “Enable auto mixture” is NOT checked.

FLIGHT CONTROLS

It is recommended you have “Auto-rudder” turned off if you have a means of controlling the rudder input, either via side swivel/twist on your specific joystick or rudder pedals.

ENGINE STRESS DAMAGES ENGINE

(Acceleration Only). It is recommended you have this UNCHECKED.

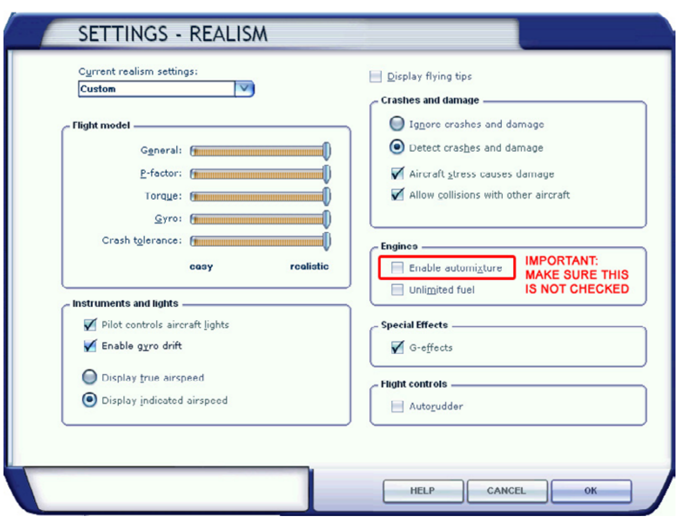
DISPLAY SETTINGS

Under Aircraft, “High Resolution 3-D cockpit” must be checked.

NOTE: It is recommended that the aircraft is NOT set as the default aircraft/flight in FSX.

SUPPORT AND QUESTIONS?

Please visit us and post directly to the A2A support and community forums; https://a2asimulations.com/forum/index.php



QUICK FLYING TIPS

- To Change Views Press A or SHIFT + A.
- Keep the engine at or above 800 RPM. Failure to do so may cause spark plug fouling. If your plugs do foul (the engine will sound rough), try running the engine at a higher RPM. You have a good chance of blowing them clear within a few seconds by doing so. If that doesn’t work, you may have to shut down and visit the maintenance hangar.
- On landing, once the airplane settles slowly pull back on the yoke for additional elevator braking while you use your wheel brakes. Once the airplane has slowed down you can raise your flaps.
- Be careful with high-speed power-on dives (not recommended in this type of aircraft), as you can lose control of your aircraft if you exceed the max allowable speed.
- For landings, take the time to line up and plan your approach. Keep your eye on the speed at all times.
- Using a Simulation Rate higher than 4× may cause odd system behavior.
- A quick way to warm your engine is to re-load your aircraft while running.
- In warm weather, use reduced power and higher speed, shallow climbs to keep engine temperatures low.
- Avoid fast power reductions especially in very cold weather to prevent shock cooling the engine.

P3D QUICKSTART GUIDE

Chances are, if you are reading this manual, you have properly installed the A2A Accu-Sim V35B Bonanza. However, in the interest of customer support, here is a brief description of the setup process, system requirements, and a quick start guide to get you up quickly and efficiently in your new aircraft.

SYSTEM REQUIREMENTS

The A2A Simulations Accu-Sim V35B Bonanza requires the following to run:

- Requires licensed copy of Lockheed Martin Prepar3D

OPERATING SYSTEM:

- Windows 7
- Windows 8 & 8.1
- Windows 10

PROCESSOR:

2.2 GHz single core processor (3.5 GHz and/or multiple core processor or better recommended)

HARD DRIVE:

600MB of hard drive space or better

VIDEO CARD:

DirectX 11 compliant video card with at least 2 GB video ram (8 MB or more recommended)

OTHER:

DirectX 11 hardware compatibility, audio card with speakers and/or headphones and scroll wheel mouse. Joystick strongly recommended

INSTALLATION

Included in your downloaded zipped (.zip) file, which you should have been given a link to download after purchase, is an executable (.exe) file which, when accessed, contains the automatic installer for the software.

To install, double click on the executable and follow the steps provided in the installer software. Once complete, you will be prompted that installation is finished.

Important: If you have Microsoft Security Essentials installed, be sure to make an exception for Lockheed Martin Prepar3D as shown on the right.

REALISM SETTINGS

The A2A Simulations Accu-Sim V35B Bonanza was built to a very high degree of realism and accuracy. Because of this, it was developed using the highest realism settings available in Lockheed Martin Prepar3D.

The following settings are recommended to provide the most accurate depiction of the flight model. Without these settings, certain features may not work correctly and the flight model will not perform accurately. The figure below depicts the recommended realism settings for the A2A Accu-Sim V35B Bonanza.

FLIGHT MODEL

To achieve the highest degree of realism, move all sliders to the right. The model was developed in this manner, thus we cannot attest to the accuracy of the model if these sliders are not set as shown below.

INSTRUMENTS AND LIGHTS

Enable "Pilot controls aircraft lights" as the name implies for proper control of lighting. Check "Enable gyro drift" to provide realistic inaccuracies which occur in gyro compasses over time.

"Display indicated airspeed" should be checked to provide a more realistic simulation of the airspeed instruments.

ENGINES

Ensure "Enable automixture" is NOT checked.

FLIGHT CONTROLS

It is recommended you have "Auto-rudder" turned off if you have a means of controlling the rudder input, either via side swivel/twist on your specific joystick or rudder pedals.

ENGINE STRESS DAMAGES ENGINE

It is recommended you have this UNCHECKED.

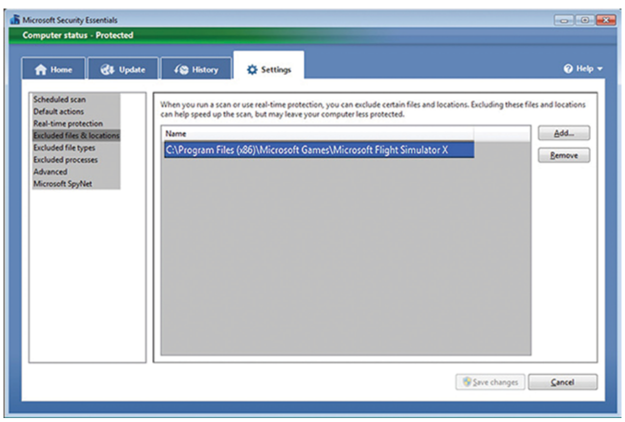
DISPLAY SETTINGS

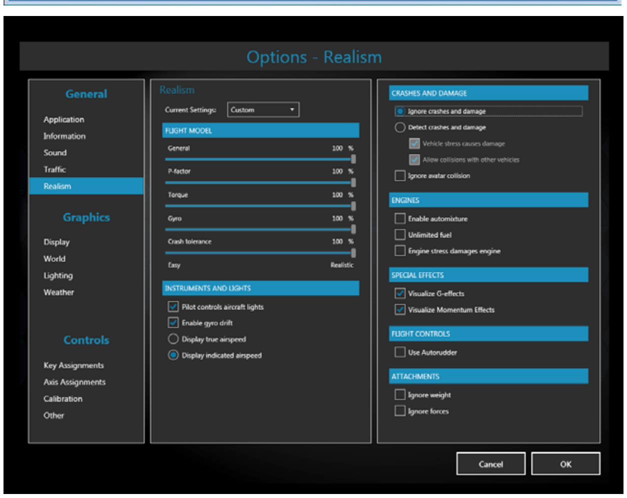
Texture resolution should be set to "Ultra 4096x4096" for best visual quality.

NOTE: It is recommended that the aircraft is NOT set as the default aircraft/flight in P3D.

SUPPORT AND QUESTIONS?

Please visit us and post directly to the A2A support and community forums; https://a2asimulations.com/forum/index.php





QUICK FLYING TIPS

- To Change Views Press A or SHIFT + A.
- Keep the engine at or above 800 RPM. Failure to do so may cause spark plug fouling. If your plugs do foul (the engine will sound rough), try running the engine at a higher RPM. You have a good chance of blowing them clear within a few seconds by doing so. If that doesn't work, you may have to shut down and visit the maintenance hangar.
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- A quick way to warm your engine is to re-load your aircraft while running.
- In warm weather, use reduced power and higher speed, shallow climbs to keep engine temperatures low.
- Avoid fast power reductions especially in very cold weather to prevent shock cooling the engine.

ACCU-SIM

Accu-Sim is A2A Simulations' growing flight simulation engine, which is now connectable to other host simulations. In this case, we have attached our V35B Bonanza to Microsoft Flight Simulator X and Lockheed Martin's Prepar3D to provide the maximum amount of realism and immersion possible.

WHAT IS THE PHILOSOPHY BEHIND ACCU-SIM?

Pilots will tell you that no two aircraft are the same. Even taking the same aircraft up from the same airport to the same location will result in a different experience. For example, you may notice one day your engine is running a bit hotter than usual and you might just open your cowl flaps a bit more and be on your way, or maybe this is a sign of something more serious developing under the hood. Regardless, you expect these things to occur in a simulation just as they do in life. This is Accu-Sim, where no two flights are ever the same.

Realism does not mean having a difficult time with your flying. While Accu-Sim is created by pilots, it is built for everyone. This means everything from having a professional crew there to help you manage the systems, to an intuitive layout, or just the ability to turn the system on or off with a single switch. However, if Accu-Sim is enabled and the needles are in the red, there will be consequences. It is no longer just an aircraft, it's a simulation.

ACTIONS LEAD TO CONSEQUENCES

Your A2A Simulations aircraft is quite complete with full system modeling and flying an aircraft such as this requires constant attention to the systems. The infinite changing conditions around you and your aircraft have impact on these systems. As systems operate both inside and outside their limitations, they behave differently. For example, the temperature of the air that enters your carburetor has a direct impact on the power your engine can produce. Pushing an engine too hard may produce just slight damage that you, as a pilot, may see as it just not running quite as good as it was on a previous flight. You may run an engine so hot, that it catches fire. However, it may not catch fire; it may just quit, or may not run smoothly. This is Accu-Sim – it's both the realism of all of these systems working in harmony, and all the subtle, and sometimes not so subtle, unpredictability of it all. The end result is when flying in an Accu-Sim powered aircraft, it just feels real enough that you can almost smell the avgas.

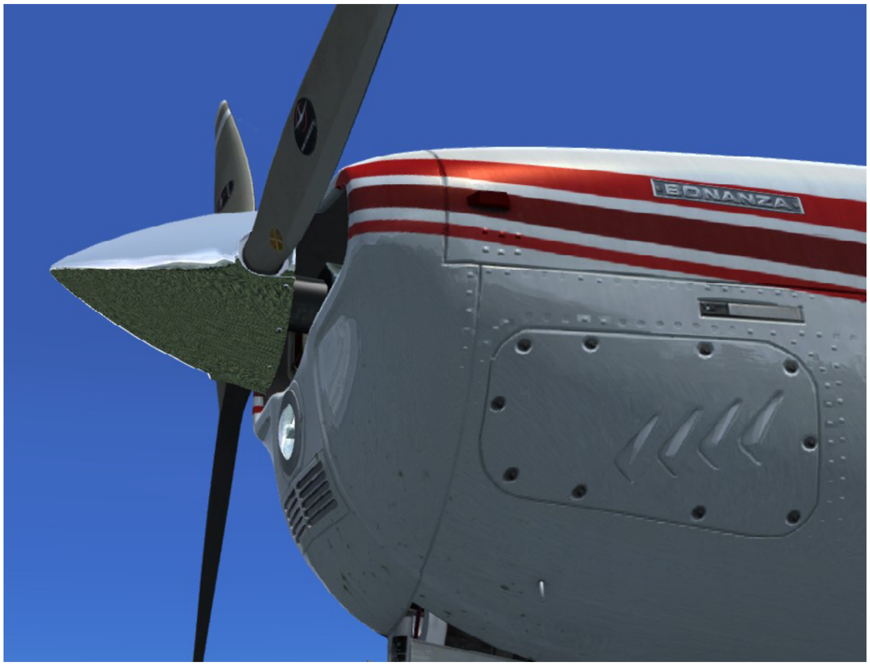
YOUR AIRCRAFT TALKS

We have gone to great lengths to bring the internal physics of the airframe, engine, and systems to life. Now, when the engine coughs, you can hear it and see a puff of smoke. If you push the engine too hard, you can also hear signs that this is happening. Just like an actual pilot, you will get to know the sounds of your aircraft, from the tires scrubbing on landing to the stresses of the airframe to the window that is cracked opened.

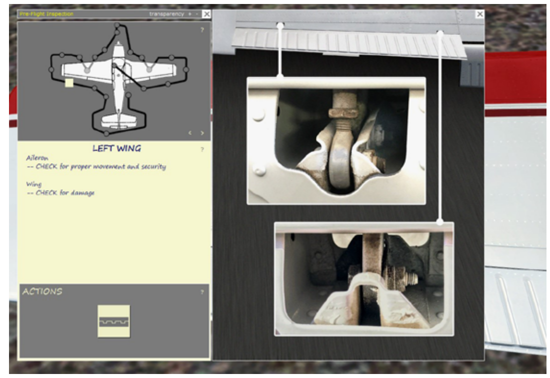
BE PREPARED – STAY OUT OF TROUBLE

The key to successfully operating almost any aircraft is to stay ahead of the curve and on top of things. Aircraft are not like automobiles, in the sense that weight plays a key role in the creation of every component. So, almost every system on your aircraft is created to be just strong enough to give you, the pilot, enough margin of error to operate safely, but these margins are smaller than those you find in an automobile. So, piloting an aircraft requires both precision and respect of the machine you are managing.

It is important that you always keep an eye on your oil pressure and engine temperature gauges. On cold engine starts, the oil is thick and until it reaches a proper operating temperature, this thick oil results in much higher than



normal oil pressure. In extreme cold, once the engine is started, watch that oil pressure gauge and idle the engine as low as possible, keeping the oil pressure under 100psi.



PERSISTENT AIRCRAFT

Every time you load up your Accu-sim V35B Bonanza, you will be flying the continuation of the last aircraft which includes fuel and oil, along with all of your system conditions. So be aware, no longer will your aircraft load with full fuel every time, it will load with the same amount of fuel you left off when you quit your last flight. You will learn the easy or the hard way to make, at the very least, some basic checks on your systems before jumping in and taking off, just like a real aircraft owner.

Additionally, in each flight things will sometimes be different. The gauges and systems will never be exactly the same. There are just too many moving parts, variables, changes, etc., that continuously alter the condition of the airplane, its engine and its systems.

> **NOTE:** Signs of a damaged engine may be lower RPM (due to increased friction), or possibly hotter engine temperatures.

SOUNDS GENERATED BY PHYSICS

Microsoft Flight Simulator X and Lockheed Martin's Prepar3D, like any piece of software, has its limitations. Accu-Sim breaks this open by augmenting the sound

system with our own, adding sounds to provide the most believable and immersive flying experience possible. The sound system is massive in this Accu-sim V35B Bonanza and includes engine sputter / spits, bumps and jolts, body creaks, engine detonation, runway thumps, and flaps, dynamic touchdowns, authentic simulation of air including buffeting, shaking, broken flaps, primer, and almost every single switch or lever in the cockpit is modeled. Most of these sounds were recorded from the actual aircraft and this sound environment just breaks open an entirely new world. However, as you can see, this is not just for entertainment purposes; proper sound is critical to creating an authentic and believable flying experience. Know that when you hear something, it is being driven by actual system physics and not being triggered when a certain condition is met. There is a big difference, and to the simulation pilot, you can just feel it.

GAUGE PHYSICS

Each gauge has mechanics that allow it to work. Some gauges run off of engine suction, gyros, air pressure, or mechanical means. The RPM gauge may wander because of the slack in the mechanics, or the gyro gauge may fluctuate when starting the motor, or the gauge needles may vibrate with the motor or jolt on a hard landing or turbulent buffet.

The gauges are the windows into your aircraft's systems and therefore Accu-Sim requires these to behave authentically.

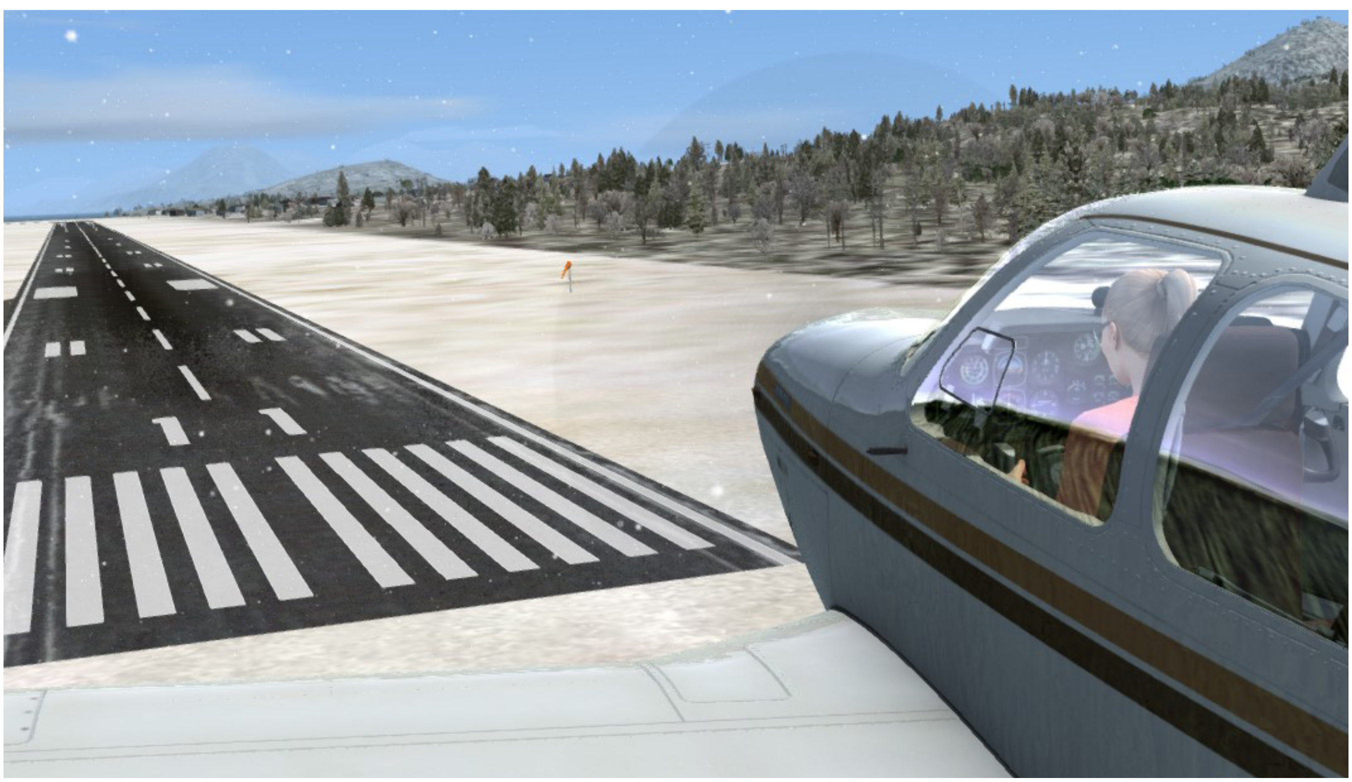
LANDINGS

Bumps, squeaks, rattles, and stress all happens in an aircraft, just when it is taxiing around the ground. Now take that huge piece of lightweight metal and slam it on the pavement. It's a lot to ask of your landing gear. Aircraft engineer's don't design the landing gear any more rugged than they have too. So treat it with kid gloves on your final approach. Kiss the pavement. Anything more is just asking too much from your aircraft.

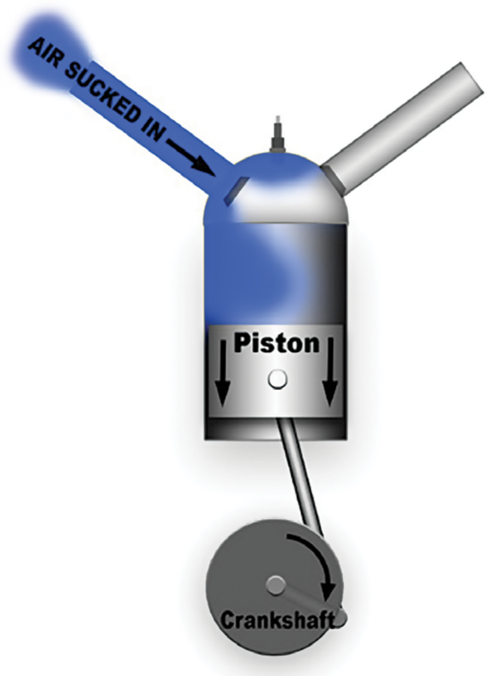
Accu-Sim watches your landings, and the moment your wheels hit the pavement, you will hear the appropriate sounds (thanks to the new sound engine capabilities). Slam it on the ground and you may hear metal crunching, or just kiss the pavement perfectly and hear just a nice chirp or scrub of the wheels. This landing system part of Accu-Sim makes every landing challenging and fun.

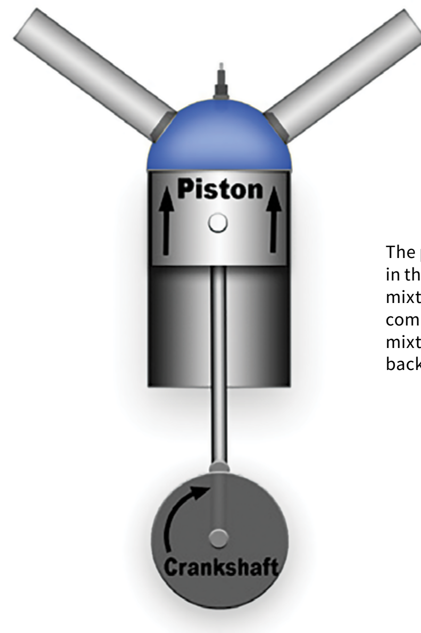
YOUR TURN TO FLY SO ENJOY

Accu-Sim is about maximizing the joy of flight. We at A2A Simulations are passionate about aviation, and are proud to be the makers of the A2A Simulations V35B Bonanza. Please feel free to email us, post on our forums, or let us know what you think. Sharing this passion with you is what makes us happy.

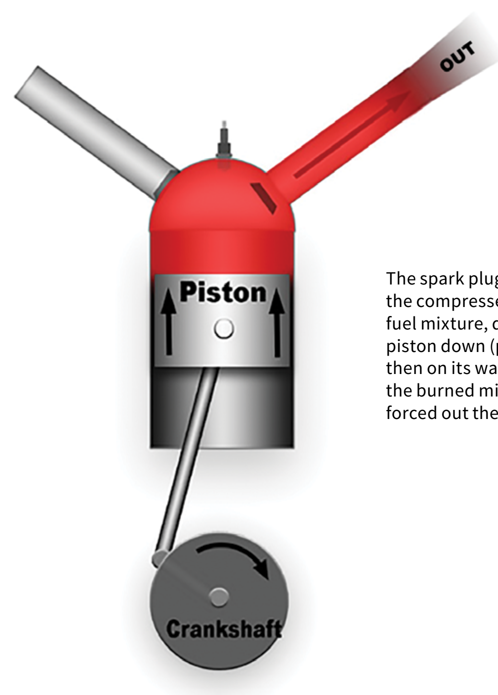


ACCU-SIM AND THE COMBUSTION ENGINE





The piston pulls in the fuel / air mixture, then compresses the mixture on its way back up.



The spark plug ignites the compressed air / fuel mixture, driving the piston down (power), then on its way back up, the burned mixture is forced out the exhaust.

The combustion engine is basically an air pump. It creates power by pulling in an air / fuel mixture, igniting it, and turning the explosion into usable power. The explosion pushes a piston down that turns a crankshaft. As the pistons run up and down with controlled explosions, the crankshaft spins. For an automobile, the spinning crankshaft is connected to a transmission (with gears) that is connected to a driveshaft, which is then connected to the wheels. This is literally "putting power to the pavement." For an aircraft, the crankshaft is connected to a propeller shaft and the power comes when that spinning propeller takes a bite of the air and pulls the aircraft forward.

The main difference between an engine designed for an automobile and one designed for an aircraft is the aircraft engine will have to produce power up high where the air is thin. To function better in that high, thin air, a supercharger can be installed to push more air into the engine.

OVERVIEW OF HOW THE ENGINE WORKS AND CREATES POWER

Fire needs air. We need air. Engines need air. Engines are just like us as – they need oxygen to work. Why? Because fire needs oxygen to burn. If you cover a fire, it goes out because you starved it of oxygen. If you have ever used a wood stove or fireplace, you know when you open the vent to allow more air to come in, the fire will burn more. The same principle applies to an engine. Think of an engine like a fire that will burn as hot and fast as you let it.

Look at these four images on the left and you will understand basically how an engine operates.

The piston pulls in the fuel / air mixture, then compresses the mixture on its way back up.

The spark plug ignites the compressed air / fuel mixture, driving the piston down (power), then on its way back up, the burned mixture is forced out the exhaust.

AIR TEMPERATURE

Have you ever noticed that your car engine runs smoother and stronger in the cold weather? This is because cold air is denser than hot air and has more oxygen. Hotter air means less power.

Cold air is denser and so provides more oxygen to your engine. More oxygen means more power.

MIXTURE

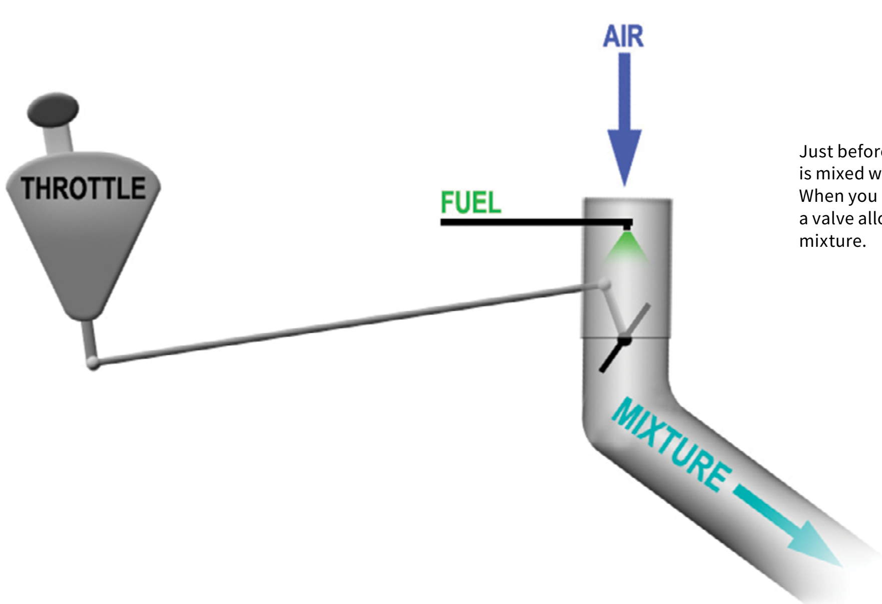
Just before the air enters the combustion chamber it is mixed with fuel. Think of it as an air / fuel mist.

A general rule is a 0.08% fuel to air ratio will produce the most power. 0.08% is less than 1%, meaning for every 100 parts of air, there is just less than 1 part fuel. The best economical mixture is 0.0625%.

Why not just use the most economical mixture all the time?

Because a leaner mixture means a hotter running engine. Fuel actually acts as an engine coolant, so the richer the mixture, the cooler the engine will run.

However, since the engine at high power will be nearing its maximum acceptable temperature, you would use your



Just before the air enters the combustion chamber it is mixed with fuel. Think of it as an air / fuel mist. When you push the throttle forward, you are opening a valve allowing your engine to suck in more fuel / air mixture.

best power mixture (0.08%) when you need power (takeoff, climbing), and your best economy mixture (.0625%) when throttled back in a cruise when engine temperatures are low.

So, think of it this way:

- For HIGH POWER, use a RICHER mixture.
- For LOW POWER, use a LEANER mixture.

THE MIXTURE LEVER

Most piston aircraft have a mixture lever in the cockpit that the pilot can operate. The higher you fly, the thinner the air, and the less fuel you need to achieve the same mixture. So, in general, as you climb you will be gradually pulling that mixture lever backwards, leaning it out as you go to the higher, thinner air.

HOW DO YOU KNOW WHEN YOU HAVE THE RIGHT MIXTURE?

The standard technique to achieve the proper mixture in flight is to lean the mixture until you just notice the engine getting a bit weaker, then richen the mixture until the engine sounds smooth. It is this threshold that you are dialing into your 0.08%, best power mixture. Be aware, if you pull the mixture all the way back to the leanest position, this is mixture cutoff, which will stop the engine.

INDUCTION

As you now know, an engine is an air pump that runs based on timed explosions. Just like a forest fire, it would run out of control unless it is limited. When you push the throttle forward, you are opening a valve allowing your engine to suck in more fuel / air mixture. When at full throttle, your engine is pulling in as much air as your intake system will allow. It is not unlike a watering hose – you crimp the hose and restrict the water. Think of full power as you just opening that water valve and letting the water run free. This is 100% full power.

In general, we don't run an airplane engine at full power for extended periods of time. Full power is only used when it is absolutely necessary, sometimes on takeoff, and otherwise in an emergency situation that requires it. For the most part, you will be 'throttling' your motor, meaning you will be setting the limit.

MANIFOLD PRESSURE = AIR PRESSURE

You have probably watched the weather on television and seen a large letter L showing where big storms are located. L stands for LOW BAROMETRIC PRESSURE (low air pressure). You've seen the H as well, which stands for HIGH BAROMETRIC PRESSURE (high air pressure). While air pressure changes all over the world based on weather conditions, these air pressure changes are minor compared to the difference in air pressure with altitude. The higher the altitude, the much lower the air pressure.

On a standard day (59°F), the air pressure at sea level is 29.92 in. Hg BAROMETRIC PRESSURE. To keep things simple, let's say 30 in. Hg is standard air pressure. You have just taken off and begin to climb. As you reach higher altitudes, you notice your rate of climb slowly getting lower. This is because the higher you fly, the thinner the air is, and the less power your engine can produce. You should also notice your MANIFOLD PRESSURE decreases as you climb as well.

Why does your manifold pressure decrease as you climb?

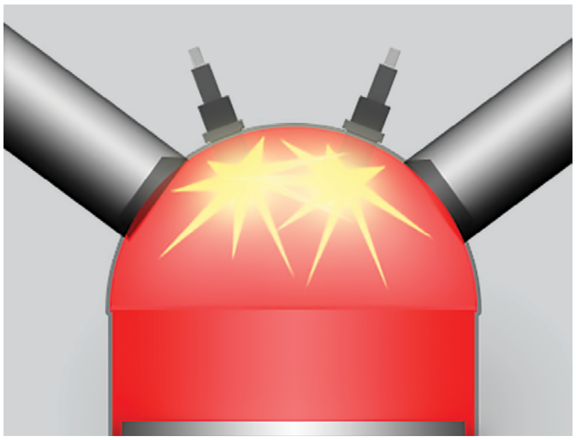
Because manifold pressure is air pressure, only it's measured inside your engine's intake manifold. Since your engine needs air to breath, manifold pressure is a good indicator of how much power your engine can produce.

Now, if you start the engine and idle, why does the manifold pressure go way down?

When your engine idles, it is being choked of air. It is given just enough air to sustain itself without stalling. If you could look down your carburetor throat when an engine is idling, those throttle plates would look like they were closed. However if you looked at it really closely, you would notice a little space on the edge of the throttle valve. Through that little crack, air is streaming in. If you turned your ear toward it, you could probably even hear a loud sucking sound. That is how much that engine is trying to breath. Those throttle valves are located at the base of your carburetor, and your carburetor is bolted on top of your

intake manifold. Just below those throttle valves and inside your intake manifold, the air is in a near vacuum. This is where your manifold pressure gauge's sensor is, and when you are idling, that sensor is reading that very low air pressure in that near vacuum.

As you increase power, you will notice your manifold pressure comes up. This is simply because you have used your throttle to open those throttle plates more, and the engine is able to get the air it wants. If you apply full power on a normal engine, that pressure will ultimately reach about the same pressure as the outside, which really just means the air is now equalized as your engine's intake system is running wide open. So if you turned your engine off, your manifold pressure would rise to the outside pressure. So on a standard day at sea level, your manifold pressure with the engine off will be 30".



The air and fuel are compressed by the piston, then the ignition system adds the spark to create a controlled explosion.

IGNITION

The ignition system provides timed sparks to trigger timed explosions. For safety, aircraft are usually equipped with two completely independent ignition systems. In the event one fails, the other will continue to provide sparks and the engine will continue to run. This means each cylinder will have two spark plugs installed.

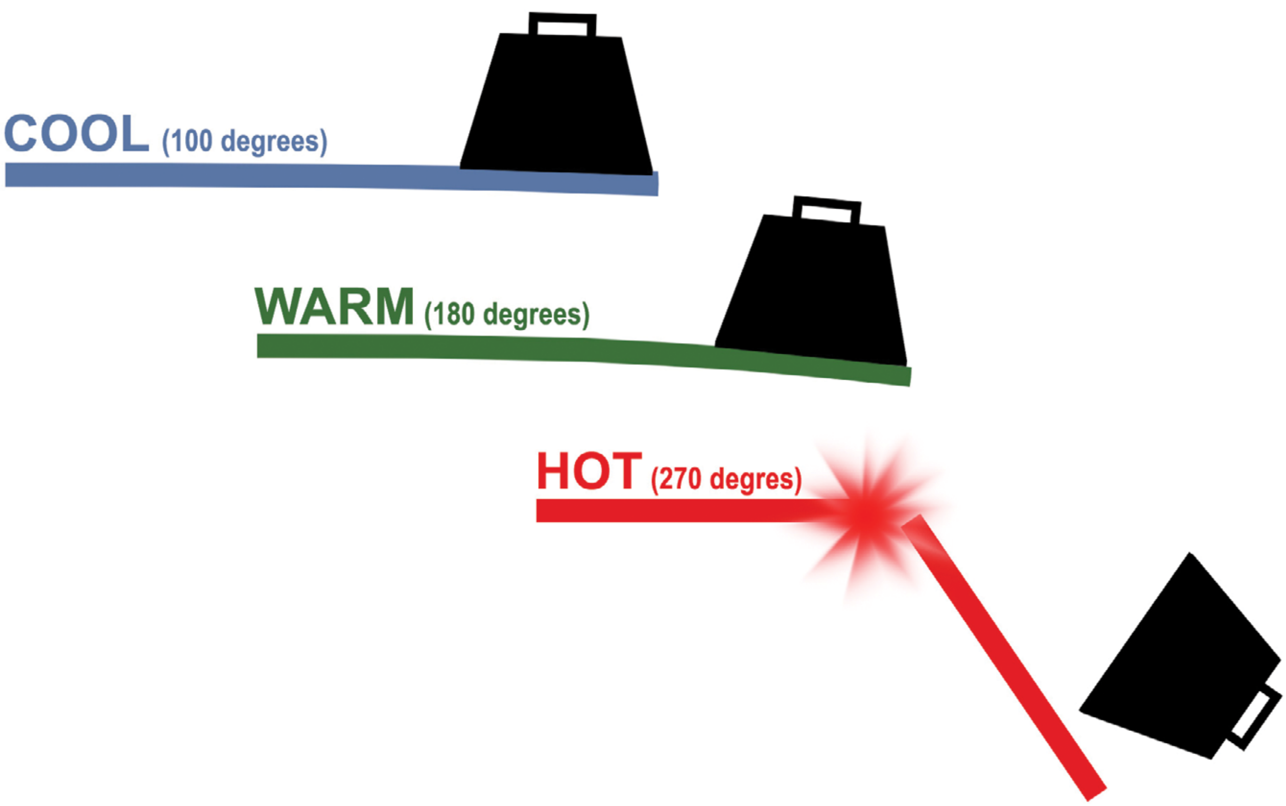
An added advantage to having two sparks instead of one is more sparks means a little more power. The pilot can select Ignition 1, Ignition 2, or BOTH by using the MAG switch. You can test that each ignition is working on the ground by selecting each one and watching your engine RPM. There will be a slight drop when you go from BOTH to just one ignition system. This is normal, provided the drop is within your pilot's manual limitation.

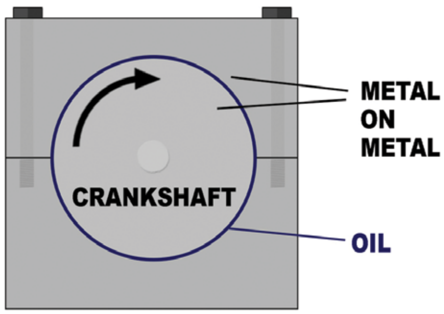
ENGINE TEMPERATURE

All sorts of things create heat in an engine, like friction, air temp, etc., but nothing produces heat like COMBUSTION.

The hotter the metal, the weaker its strength.

Aircraft engines are made of aluminum alloy, due to its strong but lightweight properties. Aluminum maintains most of its strength up to about 150°C. As the temperature





Without the layer of oil between the parts, an engine will quickly overheat and seize.

approaches 200°C, the strength starts to drop. An aluminum rod at 0°C is about 5× stronger than the same rod at 250°C, so an engine is most prone to fail when it is running hot. Keep your engine temperatures down to keep a healthy running engine.

LUBRICATION SYSTEM (OIL)

An internal combustion engine has precision machined metal parts that are designed to run against other metal surfaces. There needs to be a layer of oil between those surfaces at all times. If you were to run an engine and pull the oil plug and let all the oil drain out, after just minutes, the engine would run hot, slow down, and ultimately seize up completely from the metal on metal friction.

There is a minimum amount of oil pressure required for every engine to run safely. If the oil pressure falls below this minimum, then the engine parts are in danger of making contact with each other and incurring damage. A trained pilot quickly learns to look at his oil pressure gauge as soon as the engine starts, because if the oil pressure does not rise within seconds, then the engine must be shut down immediately.

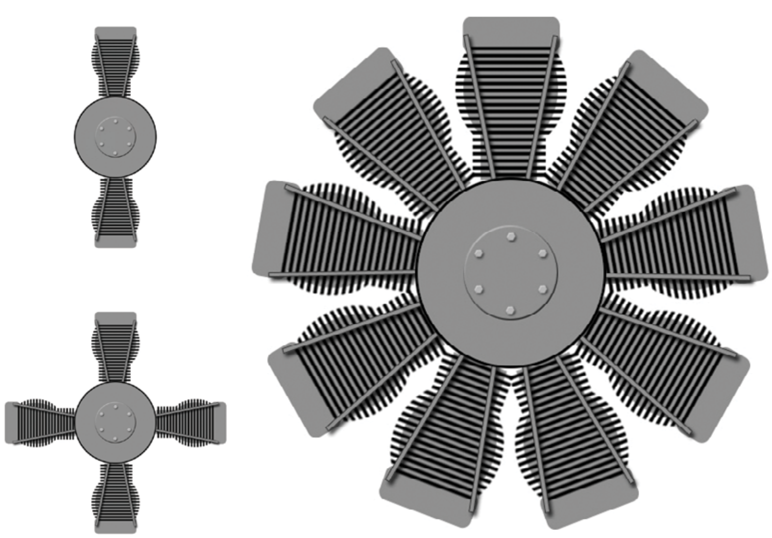
Above is a simple illustration of a crankshaft that is located between two metal caps, bolted together. This is the very crankshaft where all of the engine's power ends up. Vital oil is pressure-injected in between these surfaces when the engine is running. The only time the crankshaft ever physically touches these metal caps is at startup and shutdown. The moment oil pressure drops below its minimum, these surfaces make contact. The crankshaft is where all the power comes from, so if you starve this vital component of oil, the engine can seize. However, this is just one of hundreds of moving parts in an engine that need a constant supply of oil to run properly.

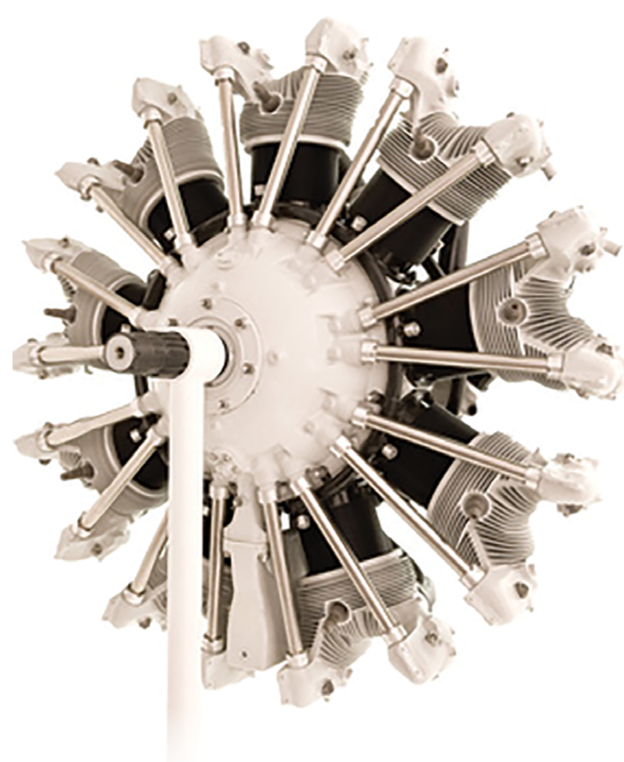
MORE CYLINDERS, MORE POWER

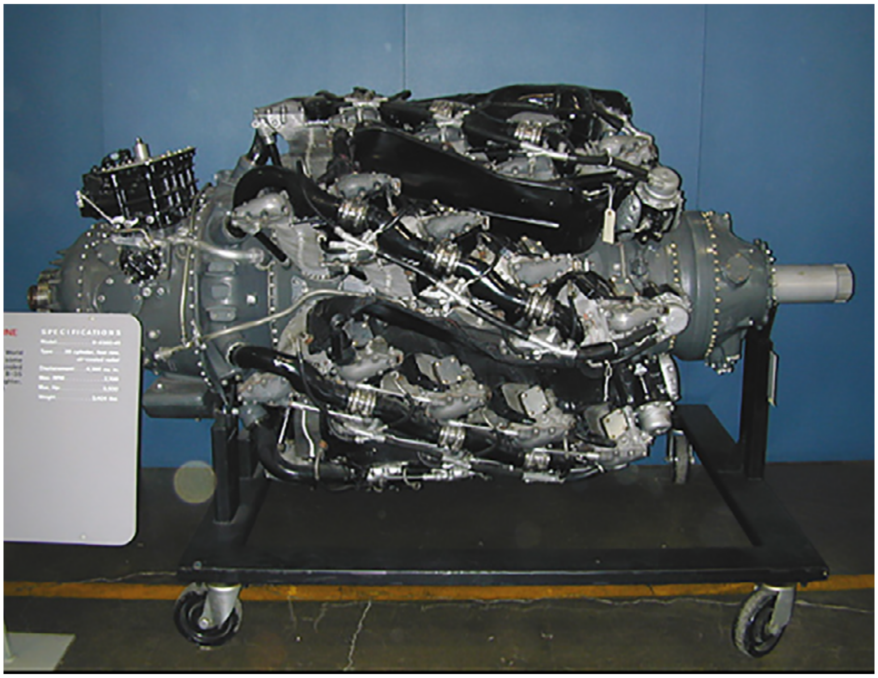
The very first combustion engines were just one or two cylinders. Then, as technology advanced, and the demand for more power increased, cylinders were made larger. Ultimately, they were not only made larger, but more were added to an engine.

Below are some illustrations to show how an engine may be configured as more cylinders are added.

The more cylinders you add to an engine, the more heat it produces. Eventually, engine manufacturers started to add additional "rows" of cylinders. Sometimes two engines would literally be mated together, with the 2nd row being rotated slightly so the cylinders could get a direct flow of air.







THE PRATT & WHITNEY R-4360

Pratt & Whitney took this even further, creating the R-4360, with 28 Cylinders (this engine is featured in the A2A Boeing 377 Stratocruiser). The cylinders were run so deep, it became known as the "Corn Cob." This is the most powerful piston aircraft engine to reach production. There are a LOT of moving parts on this engine.

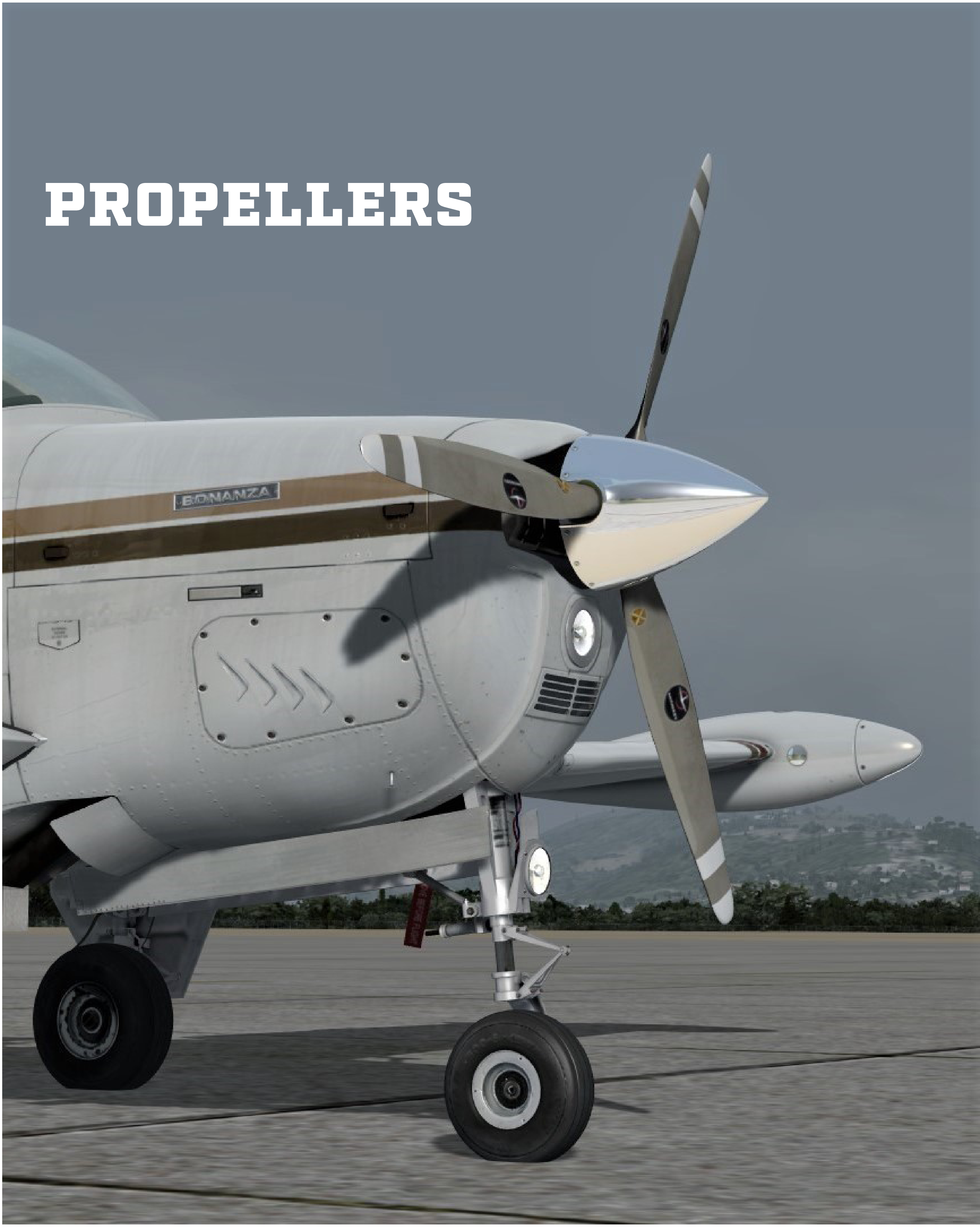
TORQUE VS HORSEPOWER

Torque is a measure of twisting force. If you put a foot long wrench on a bolt, and applied 1 pound of force at the handle, you would be applying 1 foot-pound of torque to that bolt. The moment a spark triggers an explosion, and that piston is driven down, that is the moment that piston is creating torque, and using that torque to twist the crankshaft. With a more powerful explosion, comes more torque. The more fuel and air that can be exploded, the more torque. You can increase an engine's power by either making bigger cylinders, adding more cylinders, or both.

Horsepower, on the other hand, is the total power that engine is creating. Horsepower is calculated by combining torque with speed (RPM). If an engine can produce 500 foot pounds of torque at 1,000 RPM and produce the same amount of torque at 2,000 RPM, then that engine is producing twice the horsepower at 2,000 RPM than it is at 1,000 RPM. Torque is the twisting force. Horsepower is how fast that twisting force is being applied.

If your airplane has a torque meter, keep that engine torque within the limits or you can break internal components. Typically, an engine produces the most torque in the low to mid RPM range, and highest horsepower in the upper RPM range.

PROPELLERS



Before you learn about how different propellers work, first you must understand the basics of the common airfoil, which is the reason why a wing creates lift, and in this case, why a propeller creates thrust.

It is interesting to note when discussing Bernoulli and Newton and how they relate to lift, that both theories on how lift is created were presented by each man not knowing their theory would eventually become an explanation for how lift is created. They both were dealing with other issues of their day.

THE BERNOULLI THEORY

This has been the traditional theory of why an airfoil creates lift. Look at the image below which shows you how the shape of an airfoil splits the oncoming air. The air above is forced to travel further than the air at the bottom, essentially stretching the air and creating a lower pressure, or vacuum. The wing is basically sucked up, into this lower pressure. The faster the speed, the greater the lift.

THE NEWTON THEORY

As the air travels across the airfoil's upper and lower surfaces, lift is created by BENDING the air down with great force at its trailing edge, and thus, the Newtonian force of opposite and equal reaction apply.

WHAT WE DO KNOW (AND WHAT THE PILOT NEEDS TO KNOW)

The airfoil is essentially an air diverter and the lift is the reaction to the diverted air. An airfoil's lift is dependent upon its shape, the speed at which it is traveling through the air, and its angle to the oncoming air (angle of attack)."

It is important that you note that we have deliberately not entered into the details and complete aerodynamics involved with either of the above explanations for lift as they go beyond the scope of this manual.

Unfortunately over time, the Bernoulli theory specifically has been misrepresented in many textbooks causing some confusion in the pilot and flight training community. Misrepresentations of Bernoulli such as the "equal transit theory" and other incorrect variations on Bernoulli have caused this confusion. Rather than get into a highly technical review of all this we at A2A simply advise those interested in the correct explanation of Bernoulli to research that area with competent authority.

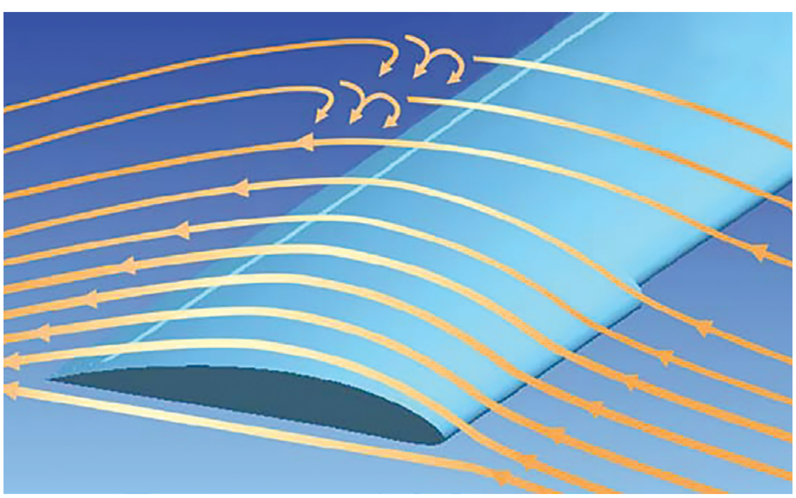
The main thing we want to impress upon you here is that when considering lift and dealing with Bernoulli and Newton, it is important and indeed critical to understand that BOTH explanations are COMPLETE EXPLANATIONS for how lift is created. Bernoulli and Newton do NOT add to form a total lift force. EACH theory is simply a different way of COMPLETELY explaining the same thing.

BOTH Bernoulli and Newton are in fact in play and acting simultaneously on an airfoil each responsible completely and independently for the lift being created on that airfoil.

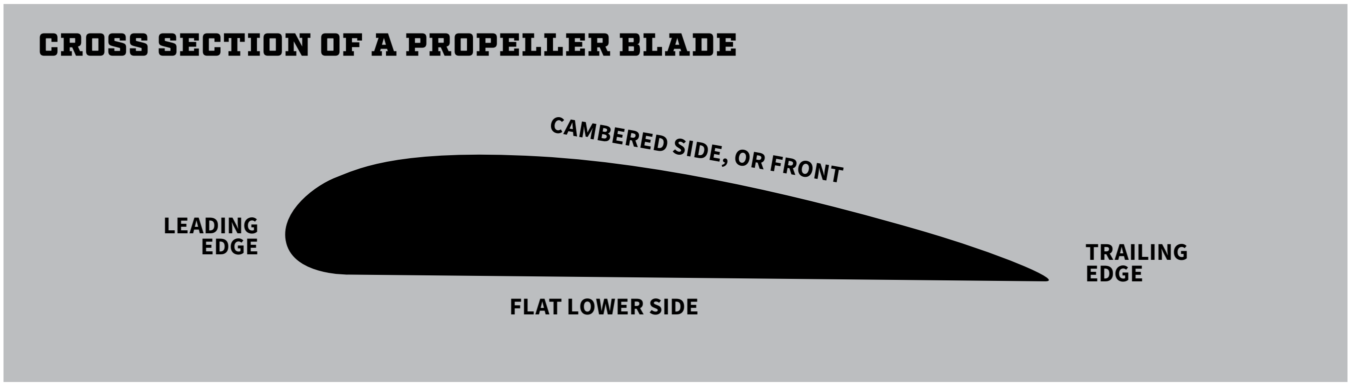
Hopefully we have sparked your interest in the direction of proper research.

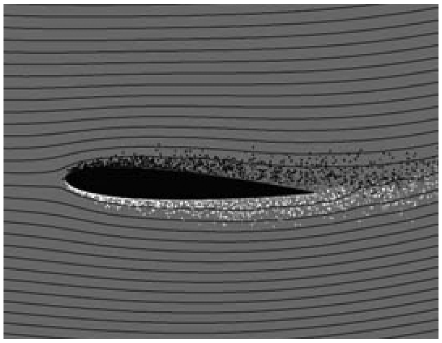
WHAT IS A STALL?

In order for a wing to produce efficient lift, the air must flow completely around the leading (front) edge of the wing, following the contours of the wing. At too large an angle of attack, the air cannot contour the wing. When this happens, the wing is in a "stall."

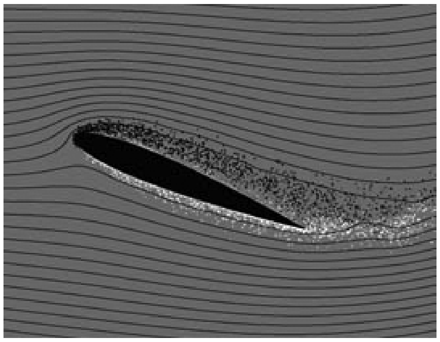


Typically, stalls in aircraft occur when an airplane loses too much airspeed to create a sufficient amount of lift. A typical stall exercise would be to put your aircraft into a climb, cut the throttle, and try and maintain the climb as long as possible. You will have to gradually pull back harder on the stick to maintain your climb pitch and as speed decreases, the angle of attack increases. At some point, the angle of attack will become so great, that the wing will stall (the nose will drop).

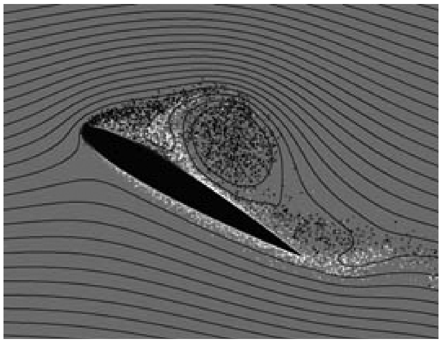




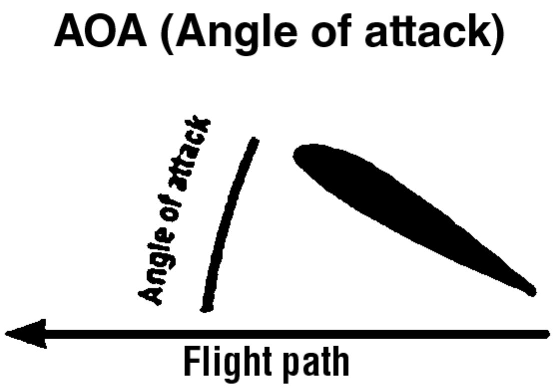
Level Flight. A wing creating moderate lift. Air vortices (lines) stay close to the wing.



Climb. Wing creating significant lift force. Air vortices still close to the wing.



Stall. A wing that is stalled will be unable to create significant lift.



STALL

The angle of attack has become too large. The boundary layer vortices have separated from the top surface of the wing and the incoming flow no longer bends completely around the leading edge. The wing is stalled, not only creating little lift, but significant drag.

Can a propeller stall?

What do you think? More on this below.

LIFT VS ANGLE OF ATTACK

Every airfoil has an optimum angle at which it attacks the air (called angle of attack, or AoA), where lift is at its peak. The lift typically starts when the wing is level, and increases until the wing reaches its optimum angle, let's say 15-25 degrees, then as it passes this point, the lift drops off. Some wings have a gentle drop, others can actually be so harsh, as your angle of attack increases past this critical point, the lift drops off like a cliff. Once you are past this point of lift and the angle is so high, the air is just being plowed around in circles, creating almost no lift but plenty of drag. This is what you experience when you stall an aircraft. The buffeting or shaking of the aircraft at this stall position is actually the turbulent air, created by your stalling wing, passing over your rear stabilizer, thus shaking the aircraft. This shaking can sometimes become so violent, you can pop rivets and damage your airframe. You quickly learn to back off your stick (or yoke) when you feel those shudders approaching.

Notice in the diagram on the right, how the airfoil creates more lift as the angle of attack increases. Ideally, your wing (or propeller) will spend most of its time moving along the left hand side of this curve, and avoid passing over the edge. A general aviation plane that comes to mind is the Piper Cherokee. An older version has what we call a "Hershey bar wing" because it is uniform from the root to the tip, just like a Hershey chocolate bar. Later, Piper introduced the tapered wing, which stalled more gradually, across the wing. The Hershey bar wing has an abrupt stall, whereas the tapered wing has a gentle stall.

A propeller is basically a wing except that instead of relying on incoming air for lift, it is spinning around to create lift, it is perpendicular to the ground, creating a backwards push of air, or thrust. Just remember, whether a propeller is a fixed pitch, variable pitch, or constant speed, it is always attacking a variable, incoming air, and lives within this lift curve.

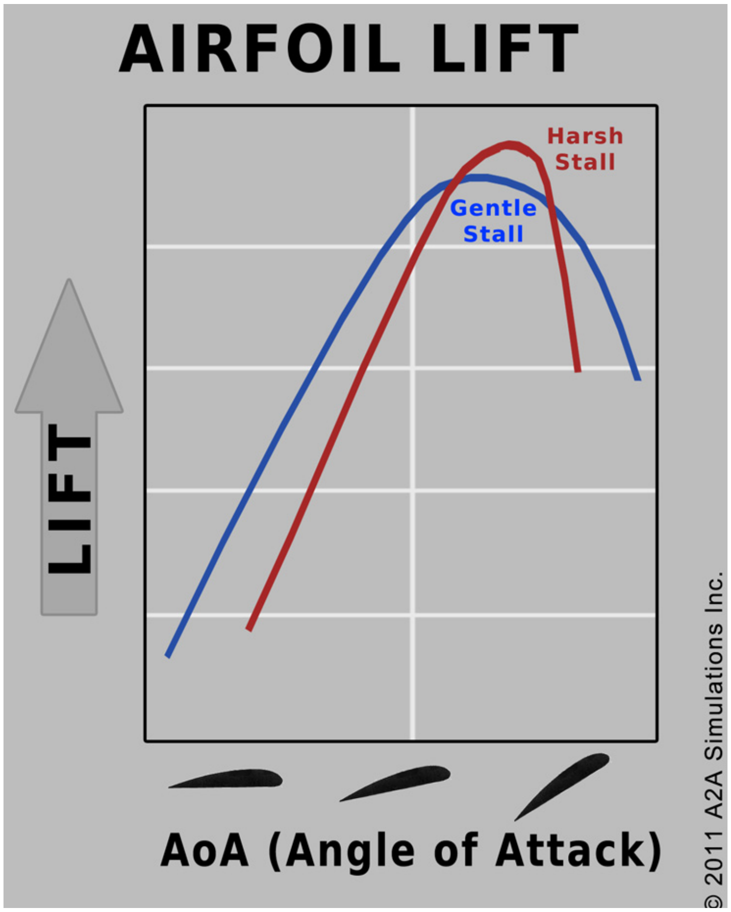
FROM STALL TO FULL POWER

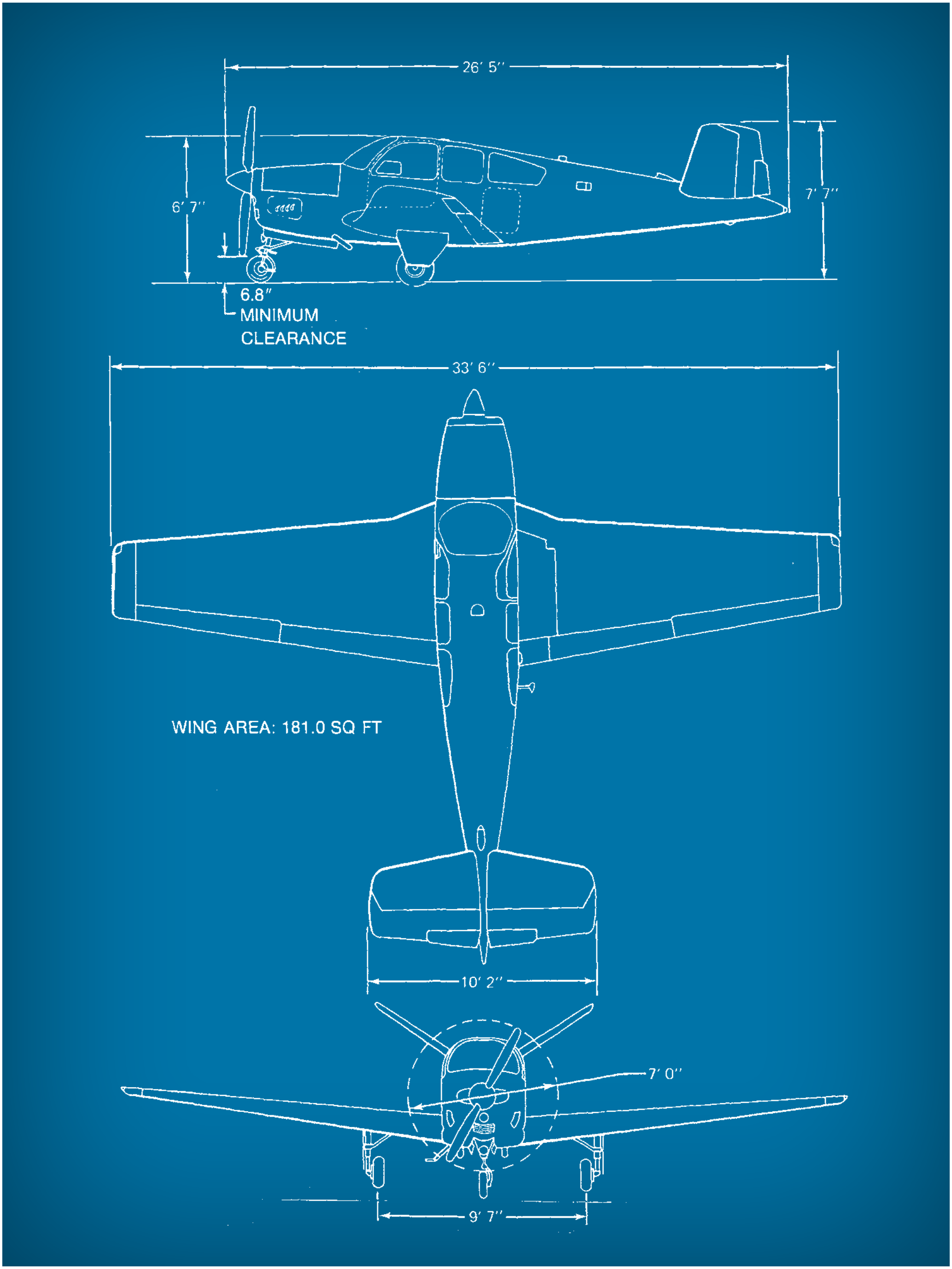
With brakes on and idling, the angle at which the prop attacks the still air, especially closer to the propeller hub, is almost always too great for the prop to be creating much lift. The prop is mostly behaving like a brake as it slams its side into the air. In reality, the prop is creating very little lift while the plane is not moving. This effect is known as prop stall, and is part of the Accu-Sim prop physics suite.

Once done with your power check, prepare for takeoff. Once you begin your takeoff run, you may notice the aircraft starts to pull harder after you start rolling forward. This is the propeller starting to get its proper "bite" into the air, as the propeller blades come out of their stalled, turbulent state and enter their comfortable high lift angles of attack it was designed for. There are also other good physics going on during all of these phases of flight, that we will just let you experience for the first time yourself.

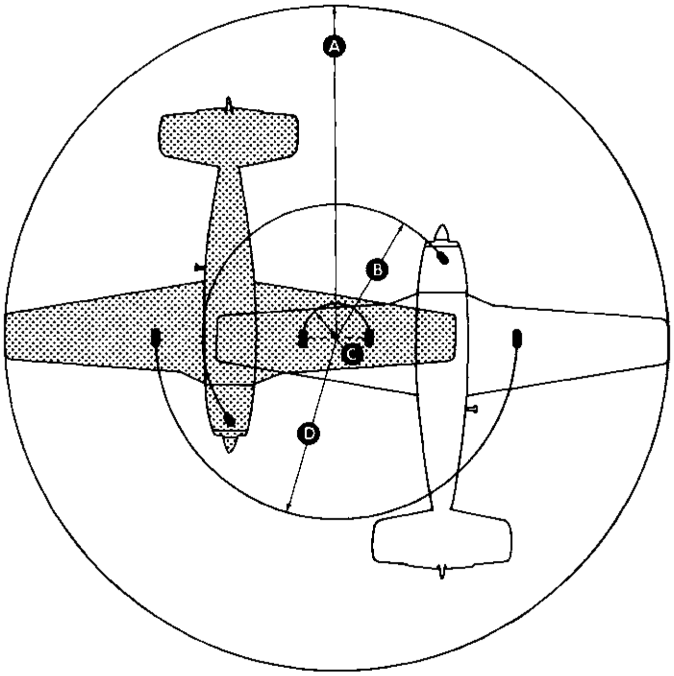
PROP OVERSPEED

A fixed pitch prop spends almost all of its life out of its peak thrust angle. This is because, unless the aircraft is travelling at a specific speed and specific power it was designed for, it's either operating too slow or too fast. Let's say you are flying a P-40 and have the propeller in MANUAL mode, and you are cruising at a high RPM. Now you pitch down, what is going to happen? The faster air will push your prop faster, and possibly beyond its 3,000 RPM recommended limit. If you pitch up your RPM will drop, losing engine power and propeller efficiency. You really don't have a whole lot of room here to play with, but you can push it (as many WWII pilots had to).




26′ 5″
6′ 7″
7′ 7″
6.8″
MINIMUM
CLEARANCE
33′ 6″
WING AREA: 181.0 SQ FT
10′ 2″
7′ 0″
9′ 7″

GENERAL



GROUND TURNING CLEARANCE

A Radius for Wing Tip	26 feet 4 inches
B Radius for Nose Wheel	12 feet 2 inches
C Radius for Inside Gear	5 feet 1 inch
D Radius for Outside Gear	14 feet 8 inches

Turning radii are calculated using full steering, one brake and partial power.

ENGINE

One Teledyne Continental Motors Corporation engine model IO-520-BA or IO-520-BB. These are fuel-injected, direct-drive, air-cooled, horizontally opposed, 6-cylinder, 520-cubic-inch-displacement, 285-horsepower-rated engines.

TAKE-OFF AND MAXIMUM

Continuous Power: Full Throttle, 2700 rpm
Maximum Normal Operating Power: Full Throttle, 2550 rpm

PROPELLER

One McCauley constant-speed, 3-blade propeller using 3A32C406 hub with 82NDB-2 blades.

FUEL

Aviation Gasoline Grade 100LL (blue),or Grade 100 (green) minimum grade.

Main Tanks Capacity	80 Gallons
Main Tanks Usable	74 Gallons
Tip Tanks Capacity	40 Gallons
Tip Tanks Usable	40 Gallons
Total Capacity	120 Gallons
Total Usable	114 Gallons

OIL

Oil Capacity	12 Quarts

MAXIMUM CERTIFICATED WEIGHTS

Max. Ramp Weight	3412 lbs
Max. Take-off Weight	3400 lbs
Max. Landing Weight	3400 lbs
Max. Zero Fuel Weight	No Structural Limit
Max. Weight in Baggage Compartment	270 lbs

CABIN AND ENTRY DIMENSIONS

Cabin Width (max.)	3 ft 6 in.
Cabin Length (max.)	10 ft 1 in.
Cabin Height (max.)	4 ft 2 in.
Cabin Door	37 in. wide by 36 in. high

BAGGAGE SPACE AND ENTRY DIMENSIONS

Compartment Volume	35 cu ft
Door Width (min.)	18.5 in.
Door Height (min.)	22.5 in.
Volume Above Hat Shelf	1.7 cu ft

SPECIFIC LOADINGS

Wing Loading at Max. Take-off Weight	18.8 lbs/sq ft
Power Loading at Max. Take-off Weight	11.9 lbs/ hp

SYMBOLS, ABBREVIATIONS AND TERMINOLOGY

GENERAL AIRSPEED	
CAS	Calibrated Airspeed is the indicated speed of an airplane, corrected for position and instrument error. Calibrated airspeed is equal to true airspeed in standard atmosphere at sea level.
KCAS	Calibrated Airspeed expressed in knots.
GS	Ground Speed is the speed of an airplane relative to the ground.
IAS	Indicated Airspeed is the speed of an airplane as shown on the airspeed indicator when corrected for instrument error. IAS values published in this handbook assume zero instrument error.
KIAS	Indicated Airspeed expressed in knots.
TAS	True Airspeed is the airspeed of an airplane relative to undisturbed air which is the GAS corrected for altitude, temperature, and compressibility.
V_A	Maneuvering Speed is the maximum speed at which application of full available aerodynamic control will not overstress the airplane.
V_{FE}	Maximum Flap Extended Speed is the highest speed permissible with wing flaps in a prescribed extended position.
V_{LE}	Maximum Landing Gear Extended Speed is the maximum speed at which an airplane can be safely flown with the landing gear extended.
V_{LO}	Maximum Landing Gear Operating Speed is the maximum speed at which the landing gear can be safely extended or retracted.
V_{NE}	Never Exceed Speed is the speed limit that may not be exceeded at any time.
V_{NO} V_C	Maximum Structural Cruising Speed is the speed that should not be exceeded except in smooth air and then only with caution.
V_S	Stalling Speed or the minimum steady flight speed at which the airplane is controllable.
V_{SO}	Stalling Speed or the minimum steady flight speed at which the airplane is controllable in the landing configuration.
V_X	Best Angle-of-Climb Speed is the airspeed which delivers the greatest gain of altitude in the shortest possible horizontal distance.
V_Y	Best Rate-of-Climb Speed is the airspeed which delivers the greatest gain in altitude in the shortest possible time.

METEOROLOGICAL	
ISA	International Standard Atmosphere in which: 1. The air is a dry perfect gas; 2. The temperature at sea level is 15° Celsius (59° Fahrenheit); 3. The pressure at sea level is 29.92 inches Hg (1013.2 millibars); 4. The temperature gradient from sea level to the altitude at which the temperature is -56.5°C (-69.7° F) is -0.00198°C (-0.003566° F) per foot and zero above that altitude.
OAT	Outside Air Temperature is the free air static temperature, obtained either from inflight temperature indications adjusted for instrument error and compressibility effec ts or ground meteorological sources.
Indicated Pressure Altitude	The number actually read from an altimeter when the barometric subscale has been set to 29.92 inches of mercury (1013.2 millibars)
Pressure Altitude	Altitude measured from standard sealevel pressure (29 .92 in. Hg) by a pressure or barometric altimeter. It is the indicated pressurealtitude corrected for position and instrument error. In this handbook, altimeter instrument errors are assumed to be zero. Position errors may be obtained I from the Altimeter Correction graph.
Station Pressure	Actual atmospheric pressure at field elevation.
Wind	The win9 velocities recorded as variables on the charts of this handbook are to be understood as the headwind or tailwind components of the reported winds.

POWER	
Take-off and Maximum Continuous	Highest power rating not limited by time.
Maximum Normal Operating Power (MNOP)	Highest power rating within the normal operating range. Noise characteristics requirements of FAR 36 have been demonstrated at this power rating.
Cruise Climb	Power recommended for cruise climb.

ENGINE CONTROLS AND INSTRUMENTS	
Throttle Control	Used to control power by introducing fuel-air mixture into the intake passages of the engine. Settings are reflected by readings on the manifold pressure gage.
Propeller Control	This control requests the propeller governor to maintain engine/propeller rpm at a selected value by controlling propeller blade angle.
Mixture Control	This control is used to set fuel flow in all modes of operation and cuts off fuel completely for engine shut down.
EGT (Exhaust Gas Temperature Indicator)	This indicator is used to identify the lean and best power fuel flow mixtures for various power settings during cruise.
Tachometer	Indicates the rpm of the engine/propeller.
Propeller Governor	Regulates the rpm of the engine/propeller by increasing or decreasing the propeller pitch through a pitch change mechanism in the propeller hub.

AIRPLANE PERFORMANCE AND FLIGHT PLANNING	
Climb Gradient	The ratio of the change in height during a portion of a climb, to the horizontal distance traversed in the same time interval.
Demonstrated Crosswind Velocity	The demonstrated crosswind velocity is the velocity of the crosswind component for which adequate control of the airplane during takeoff and landing was actually demonstrated during certification tests. The value shown is not limiting.
MEA	Minimum enroute IFR altitude.
Route Segment	A part of a route. Each end of that part is identified by: (1) a geographical location; or (2) a point at which a definite radio fix can be established.
GPH	U.S. Gallons per hour.

WEIGHT & BALANCE	
Reference Datum	An imaginary vertical plane from which all horizontal distances are measured for balance purposes.
Station	A location along the airplane fuselage usually given in terms of distance from the reference datum.
Arm	The horizontal distance from the reference datum to the center of gravity (C.G.) of an item.
Moment	The product of the weight of an item multiplied by its arm (Moment divided by a constant is used to simplify balance calculations by reducing the number of digits.)
Airplane Center of Gravity (CG)	The point at which an airplane would balance if suspended. Its distance from the reference datum is found by dividing the total moment by the total weight of the airplane.
CG Arm	The arm obtained by adding the airplane's individual moments and dividing the sum by the total weight.
CG Limits	The extreme center of gravity locations within which the airplane must be operated at a given weight.
Usable Fuel	Fuel available for flight planning.
Unusable Fuel	Fuel remaining after a runout test has been completed in accordance with governmental regulations.
Standard Empty Weight	Weight of a standard airplane including unusable fuel, full operating fluids and full oil.
Basic Empty Weight	Standard Empty Weight plus optional equipment.
Payload	Weight of occupants, cargo and baggage.
Useful Load	Difference between Take-off Weight (or Ramp Weight, if applicable) and Basic Empty Weight.
Maximum Ramp Weight	Maximum weight approved for ground maneuvering. {It includes weight of start, taxi, and take-off fuel).
Maximum Take-off Weight	Maximum weight approved for liftoff.
Maximum Landing Weight	Maximum weight approved for the landing touchdown.
Maximum Zero Fuel Weight	Maximum weight exclusive of usable fuel.
Tare	The weight of chocks, blocks, stands, etc., used on the scales when weighing an airplane.
Leveling Points	Those points which are used during the weighing process to level the airplane.
Jack Points	Points on the airplane identified by the manufacturer as suitable for supporting the airplane for weighing or other purposes.

LIMITATIONS

AIRSPEED LIMITATIONS

SPEED	KCAS	KIAS	REMARKS
Never Exceed V_{NE}	195	196	Do Not Exceed This Speed in Any Operation.
Maximum Structural Cruising V_{NO} or V_C	165	167	Do Not Exceed This Speed Except in Smooth Air and Then Only With Caution.
Maneuvering V_A	132	134	Do Not Make Full or Abrupt Control Movements Above This Speed.
Maximum Flap Extension/Extended V_{FE} Approach (15°) Full Down (30°)	152 122	154 123	Do Not Extend Flaps or Operate With Flaps Exended Above This Speed.
Maximum Landing Gear Operating/Extended V_{LO}/V_{LE}	152	154	Do Not Extend, Retract or Operate With Gear Extended Above This Speed, Except in Emergency.

POWER PLANT LIMITATIONS

Engine

One Teledyne Continental Motors Corporations model IO-520-BB engine.

Operating Limitations

Take-off & Max. Continuous Power: Full Throttle, 2700 rpm
Cylinder Head Temperature 238°C
Oil Temperature 116°C

- Oil Pressure
  Minimum 30 psi
  Maximum 100 psi
- Fuel Pressure
  Minimum 1.5 psi
  Maximum 17.5 psi
- Fuel Flow
  Maximum 24.3 gph

Fuel Grades

Aviation Gasoline 100 LL (blue) or 100 (green) minimum grade.

Oil Specifications

Ashless dispersant oils meeting Teledyne Continental Motors Corporation Specification MHS-248 or the latest revision of MHS-24.

Propeller Specifications

On 10-520-88 engines only, one McCauley constant-speed, three-blade propeller using 3A32C406 hub with 82ND8-2 blades. Pitch setting at 30-inch station: low, 13.3° ± .2° ; high, 29.0° ± .5°.

Diameter: Maximum, 80 in.; Minimum, 78-1/2 in.

AIRSPEED INDICATOR MARKINGS*

MARKING	KCAS VALUE OR RANGE	KIAS VALUE OR RANGE	SIGNIFICANCE
White Arc	53-122	52-123	Full Flap Operating Range
Green Arc	67-165	64-196	Normal Operating Range
Yellow Arc	165-195	167-196	Operate With Caution, Only in Smooth Air
Red Line	195	196	Maximum Speed For All Operations

*The airspeed indicator is marked in IAS values.

POWER PLANT INSTRUMENT MARKINGS

Oil Temperature

Caution (Yellow Radial) 38°C
Operating Range (Green Arc) 38° to 116°C
Maximum (Red Radial) 116°C

Oil Pressure

Minimum Pressure (Red Radial) 30 psi
Operating Range (Green Arc) 30 to 60 psi
Maximum Pressure (Red Radial) 100 psi

Tachometer

Operating Range (Green Arc) 1800 to 2700 rpm
Maximum rpm (Red Radial) 2700 rpm

Cylinder Head Temperature

Operating Range (Green Arc) 93° to 238°C
Maximum Temperature (Red Radial) 238°C

Manifold Pressure

Operating Range (Green Arc) 15 to 29.6 in. Hg
Maximum (Red Radial) 29.6 in. Hg

Fuel Flow

Minimum (Red Radial) 1.5 psi
Operating Range (Green Arc) 6.9 to 24.3 gph
Maximum (Red Radial) 24.3 gph

MISCELLANEOUS INSTRUMENT MARKINGS

Instrument Pressure

Operating Range (Green Arc) 4.3 to 5.9 in. Hg

Fuel Quantity

Yellow Band E to ½ full (44-gallon system)
Yellow Band E to ⅜ full (74-gallon system)

WEIGHT LIMITS

Maximum Ramp Weight	3412 lbs
Maximum Take-off Weight	3400 lbs
Maximum Landing Weight	3400 lbs
Zero Fuel Weight	No Structural Limit
Max. Baggage Compartment Load	Refer to Weight and Balance Section

NOTE: With tip tanks gross weight is increased to 3600 lbs

CENTER OF GRAVITY LIMITS (LANDING GEAR EXTENDED)

Loading calculations shall be checked before each flight to ensure that the Weight and Center of Gravity remain within the approved limits during flight.

Forward Limits

77.0 inches aft of datum to 2900 pounds with straight line variation to 82.1 inches at 3400 pounds.

Aft Limits

85.7 inches aft of datum to 3000 pounds with straight line variation to 84.4 inches at 3400 pounds.

Reference Datum

Datum is 83.1 inches forward of center line through forward jack points.
MAC leading edge is 66.7 inches aft of datum.
MAC length is 65.3 inches.

MANEUVER LIMITS

This is a utility category airplane. Spins are prohibited. No acrobatic maneuvers are approved except those listed below. Maximum slip duration is 30 seconds.

APPROVED MANEUVERS (3400 POUNDS)

MANEUVER	ENTRY SPEED	
	KCAS	KIAS
Chandelle	132	134
Steep Turn	132	134
Lazy Eight	132	134
Stall (Except Whip)	Use Slow Deceleration	

Minimum fuel for above maneuvers-10 gallons each main tank

FLIGHT LOAD FACTOR LIMITS (3400 POUNDS)

Positive Maneuvering Load Factors:

Flaps Up	4.4 G
Flaps Down	2.0 G

MINIMUM FLIGHT CREW

One (1) Pilot

KINDS OF OPERATION LIMITS

1. VFR day and night
2. IFR day and night

FUEL

Capacity	80 gallons
Usable	74 gallons

FUEL MANAGEMENT

Do not take off when Fuel Quantity Gages indicate in Yellow Band or with less than 13 gallons in each wing fuel system.

Maximum slip duration is 30 seconds.

SEATING

All occupied seats must be in the upright position for takeoff and landing.

EMERGENCY PROCEDURES

All airspeeds quoted in this section are indicated airspeeds (IAS)

EMERGENCY AIRSPEEDS (3400 LBS)

Emergency Descent	154 KTS
Maximum Glide Range	105 KTS
Emergency Landing Approach	83 KTS

The following information is presented to enable the pilot to form, in advance, a definite plan of action for coping with the most probable emergency situations which could occur in the operation of the airplane. Where practicable, the emergencies requiring immediate corrective action are treated in check list form for easy reference and familiarization. Other situations, in which more time is usually permitted to decide on and execute a plan of action, are discussed at some length.

ENGINE FAILURE

DURING TAKE-OFF GROUND ROLL

1. Throttle – CLOSED
2. Braking – MAXIMUM
3. Fuel Selector Valve – OFF
4. Battery and Alternator Switches – OFF

AFTER LIFTOFF AND IN FLIGHT

Landing straight ahead is usually advisable. If sufficient Altitude is available for maneuvering, accomplish the followmg:

1. Fuel Selector Valve – SELECT OTHER TANK (feel for detent)
2. Auxiliary Fuel Pump – ON
3. Mixture – FULL RICH, then LEAN AS REQUIRED
4. Magnetos – CHECK RIGHT, LEFT, then BOTH ON

NOTE: The most probable cause of engine failure would be loss of fuel flow or improper functioning of the ignition system.

If No Restart:

1. Select most favorable landing site.
2. The use of landing gear is dependent on the terrain where landing must be made.

ENGINE DISCREPANCY CHECKS

CONDITION: ROUGH RUNNING ENGINE

1. Mixture – FULL RICH, then LEAN as required
2. Magneto/Start Switch – "BOTH" position (check to verify)

CONDITION: LOSS OF ENGINE POWER

1. Fuel Flow Gage – CHECK
   If fuel flow is abnormally low:
   a. Mixture – FULL RICH
   b. Auxiliary Fuel Pump – ON (then OFF if performance does not improve in a few moments)
2. Fuel Quantity Indicator – CHECK for fuel supply in tank being used
   If tank being used is empty:
   a. Fuel Tank Selector Valve – SELECT OTHER FUEL TANK (feel for detent)

AIR START PROCEDURE

1. Fuel Selector Valve – SELECT TANK MORE NEARLY FULL (feel for detent)
2. Throttle – RETARD
3. Mixture Control – FULL RICH
4. Auxiliary Fuel Pump – ON until power is regained, then OFF (Leave On if Engine Driven Fuel Pump is inoperative.)
5. Throttle – ADVANCE to desired power
6. Mixture – LEAN as required

ENGINE FIRE

IN FLIGHT

The red FIREWALL AIR control on the outboard side of the left lower subpanel should be pulled to close off all heating system outlets so that smoke and fumes will not enter the cabin. In the event of engine fire, shut down the engine as follows and make a landing:

1. Firewall Air Control - PULL TO CLOSE
2. Mixture - IDLE CUT-OFF
3. Fuel Selector Valve - OFF
4. Battery, Alternator, and Magneto/Start Switches - OFF (Extending the landing gear can be accomplished manually if desired.)
5. Do not attempt to restart engine. (See GLIDE and LANDING WITHOUT POWER Procedures)

ON THE GROUND

1. Fuel Selector Valve - OFF
2. Mixture - IDLE CUT-OFF
3. Battery, Alternator and Magneto/Start Switches - OFF
4. Fire Extinguisher - USE TO EXTINGUISH FIRE

EMERGENCY DESCENT

1. Power - IDLE
2. Propeller - HIGH RPM
3. Landing Gear - DOWN
4. Airspeed - ESTABLISH 154 KTS

MAXIMUM GLIDE CONFIGURATION

1. Landing Gear - UP
2. Flaps - UP
3. Cowl Flaps - CLOSED
4. Propeller - PULL for LOW RPM
5. Airspeed - 105 KTS

Glide distance is approximately 1.7 nautical miles (2 statute miles) per 1000 feet of altitude above the terrain.

LANDING EMERGENCIES

LANDING WITHOUT POWER

When assured of reaching the landing site selected, and on final approach:

1. Airspeed - ESTABLISH 78 to 83 KTS
2. Fuel Selector Valve - OFF
3. Mixture - IDLE CUT-OFF
4. Magneto/Start Switch - OFF
5. Flaps - AS REQUIRED
6. Landing Gear - DOWN or UP (depending on terrain)
7. Battery and Alternator Switches - OFF

LANDING GEAR RETRACTED - WITH POWER

If possible, choose firm sod or foamed runway. Make a normal approach, using flaps as necessary. When sure of reaching the selected landing spot:

1. Throttle - CLOSED
2. Mixture - IDLE CUT-OFF
3. Battery, Alternator and Magneto/Start Switches - OFF
4. Fuel Selector Valve - OFF
5. Keep wings level during touchdown.
6. Get clear of airplane as soon as possible after it stops.

SYSTEMS EMERGENCIES

PROPELLER OVERSPEED

1. Throttle- RETARD TO RED LINE
2. Airspeed - REDUCE
3. Oil Pressure - CHECK

WARNING: If loss of oil pressure was the cause of overspeed, the engine will seize after a short period of operation.

4. Land - SELECT NEAREST SUITABLE SITE and follow LANDING EMERGENCIES procedure.

STARTER ENERGIZED WARNING LIGHT ILLUMINATED (IF INSTALLED)

After engine start, should the starter relay remain engaged, the starter will remain energized and the starter energized warning light will remain illuminated. Continuing to supply power to the starter will result in eventual loss of electrical power.

On the Ground:

1. Battery and alternator switches - OFF
2. Do not take off.

In Flight After Air Start:

1. Battery and alternator switches - OFF
2. Land as soon as practical.

ALTERNATOR-OUT PROCEDURE

An inoperative alternator will place the entire electrical operation of the airplane except engine ignition on the battery. An alternator failure will be indicated by illumination of the warning light, located on the instrument panel below the flight instruments.

The warning light will not illuminate until the alternator output is almost zero. A verification of alternator malfunction would be a discharge shown on the ammeter. There is no indication of overvoltage except that the warning light will illuminate as though the alternator is out.

Alternator Warning Light Illuminated:

1. Verify alternator out with ammeter – will show discharge.

   NOTE: If the ammeter does not show a discharge, a malfunction in the warning light system is indicated, and the alternator switch should be left ON.

2. If ammeter shows a discharge, Alternator Switch OFF MOMENTARILY, THEN ON (this resets the overvoltage relay). If the warning light does not illuminate, continue to use the alternator.
3. If the warning light illuminates, Alternator Switch – OFF
4. Nonessential Electrical Equipment – OFF to conserve battery power

LANDING GEAR MANUAL EXTENSION

Manual extension of the landing gear can be facilitated by first reducing airspeed. Then proceed as follows:

1. LOG GR MOTOR Circuit Breaker (Right Subpanel) – OFF (pull out)
2. Landing Gear Switch Handle – DOWN position
3. Handcrank Handle Cover (at rear of front seats) – REMOVE
4. Handcrank – ENGAGE and TURN COUNTERCLOCKWISE AS FAR AS POSSIBLE (approximately 50 turns)

   CAUTION: The manual extension system is designed to lower the landing gear only. DO NOT ATTEMPT TO RETRACT THE GEAR MANUALLY.

5. If electrical system is operative, check landing gear position lights and warning horn (check LOG GR RELAY circuit breaker engaged).
6. Handcrank – DISENGAGE. Always keep it stowed when not in use.

   WARNING: Do not operate the landing gear electrically with the handcrank engaged, as damage to the mechanism could occur.

After emergency landing gear extension, do not move any landing gear controls or reset any switches or circuit breakers until airplane is on jacks, as failure may have been in the gear-up circuit and gear might retract.

LANDING GEAR RETRACTION AFTER PRACTICE MANUAL EXTENSION

After practice manual extension of the landing gear, the gear can only be retracted electrically, as follows:

1. Handcrank – CHECK, STOWED
2. Landing Gear Motor Circuit Breaker – IN
3. Landing Gear Switch Handle – UP

SPINS

Spins are prohibited. If a spin is entered inadvertently: Immediately move the control column full forward and simultaneously apply full rudder opposite to the direction of the spin; continue to hold this control position until rotation stops and then neutralize all controls and execute a smooth pullout. Ailerons should be neutral and throttle in idle position at all times during recovery.

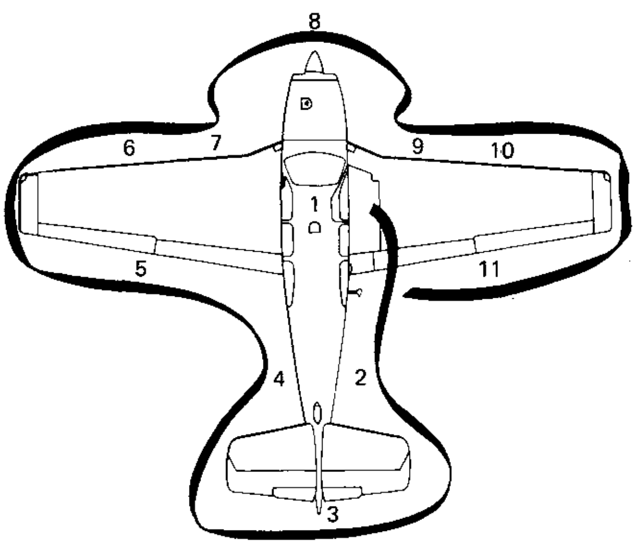
EMERGENCY SPEED REDUCTION

In an emergency, the landing gear may be used to create additional drag. Should disorientation occur under instrument conditions, the lowering of the landing gear will reduce the tendency for excessive speed buildup. This procedure would also be appropriate for a non-instrument rated pilot who unavoidably encounters instrument conditions or in other emergencies such as severe turbulence.

Should the landing gear be used at speeds higher than the maximum extension speed, a special inspection of the gear doors in accordance with maintenance manual procedures is required,with repair as necessary.


CAUTION
DO NOT OPEN ABOVE
145 MPH (126 KNOTS)
REMOVE BEFORE FLIGHT

NORMAL PROCEDURES



All airspeeds quoted in this section are indicated airspeeds (IAS)

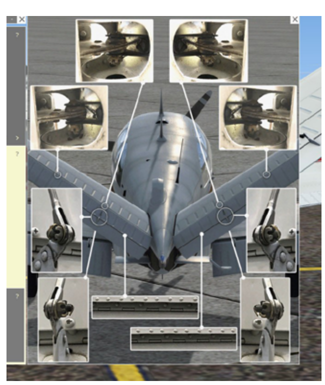
AIRSPEEDS FOR SAFE OPERATION (3400 LBS)

Maximum Demonstrated Crosswind Component	17 KTS
Takeoff:	
Lift-off	71 KTS
50-ft Speed	77 KTS
Best Angle-of-Climb (Vx)	77 KTS
Best Rate-of-Climb (Vy)	96 KTS
Cruise climb	107 KTS
Turbulent Air Penetration	134 KTS
Landing Approach	70 KTS
Balked Landing Climb	70 KTS

PRE-FLIGHT INSPECTION

The Pre-Flight Inspection is another advancement in bringing real life standard operating procedures into FSX and P3D.

The inspection system is done in such a way as to emulate making your walkaround inspection prior to flight. For more information for how to peform your Pre-Flight Inspection, please see the 2D Panals Section.



BEFORE TAKEOFF

UPON ENTERING CABIN

1. Preflight – Complete
2. Passengers – Briefed
3. Seat belts, shoulder harness – ON
4. Flaps – UP
5. Radios – OFF
6. Circuit breakers – IN
7. All Electrical Switches – OFF
8. Auto Pilot – OFF
9. Roatating Beacon – ON
10. Fuel Selectors – Desired Tank
11. Gear Switch – DOWN

ENGINE STARTING

1. Mixture – RICH
2. Prop – FULL
3. Throttle – FULL
4. BAT and ALT switches – ON
5. Check Gear Lights – GREEN
6. AUX Pump – ON until ff goes into the green then OFF
7. Throttle – Cracked ¼" (Clear prop!)
8. Mag/Start Switch – START
9. Oil Pressure – CHECK
10. Ammeter – CHECK
11. Mixture – LEAN
12. Avionics – ON
13. Cowl Flaps – OPEN

TAXI

1. Radios – ON
2. Transponder – ALT
3. Altimeter – SET
4. Heading Indicator – SET
5. Landing Gear Indicator – GREEN
6. Radio – ATIS
7. Parking Brake – RELEASE
8. Breaks – Test on Inital Roll
9. Lights – AS REQUIRED

RUNUP

1. Brakes – HOLD
2. Fuel Quantity – CHECK
3. Fuel Selectors – DESIRED TANK
4. Mixture – SET
5. Throttle – 1700 rmp
6. Engine Instruments – CHECK
   Oil press., Oil temp., Fuel Flow, Ammeter, Vacuum, CHT, EGT
7. Magnetos – CHECK
   Max drop: 150 rpm / max diff.: 50 rpm
8. Prop Cycle – 1 to 3 times

TAKEOFF

BEFORE TAKEOFF
1. Controls – FREE and CORRECT
2. Fuel Selectors – Desired Tank
3. Fuel Pump – ON
4. Mixture – RICH or as req. for elevation
5. Prop – FULL IN
6. Engine Gauges – CHECK
7. Trim Tab – Neutral
8. Flaps – SET
9. Cowl flaps – OPEN
10. Doors and Windows – SECURE
11. Slowly advance throttle
12. Manifold, FF, RPM – CHECK

TAKEOFF
1. Throttle – FULL
2. Rotate – 77 kts
3. Positive Climb – CHECK
4. Gear – UP
5. Flaps Up – CHECK
6. Climb Out at Vy – 96 kts
7. Verify safe landing area

FLIGHT

CLIMB
1. Fuel Pump at 1000 feet AGL – OFF
2. Fuel Pressure – CHECK
3. MAX – 2,500 rpm, 25 MP
4. SPEED: Best angle – 77 kts
   Best rate – 96 kts
   Best en route – 107 kts
5. CHT – CHECK
6. Mixture – SET FUEL FLOW

CRUISE
1. Cowl Flaps – CLOSED
2. Power – SET
3. RPM – AS DESIRED (2,100-2,500)
4. Mixture – SET FUEL FLOW

LANDING

APPROACH/LANDING
1. Autopilot – OFF
2. Fuel Pump – ON
3. Fuel Selectors – Desired Tank
4. Fuel Levels – CHECK
5. Mixture – RICH
6. Altimeter – SET
7. Cowl Flaps – CLOSED
8. If airport elevation is over 4,000 ft -LEAN
9. Gear – DOWN (max. speed 154 kts)
10. GUMP – CHECK
11. Flaps – FULL DOWN (max. speed 123 kts)
12. Propeller – HIGH RPM
13. Final – GEAR DOWN CHECK

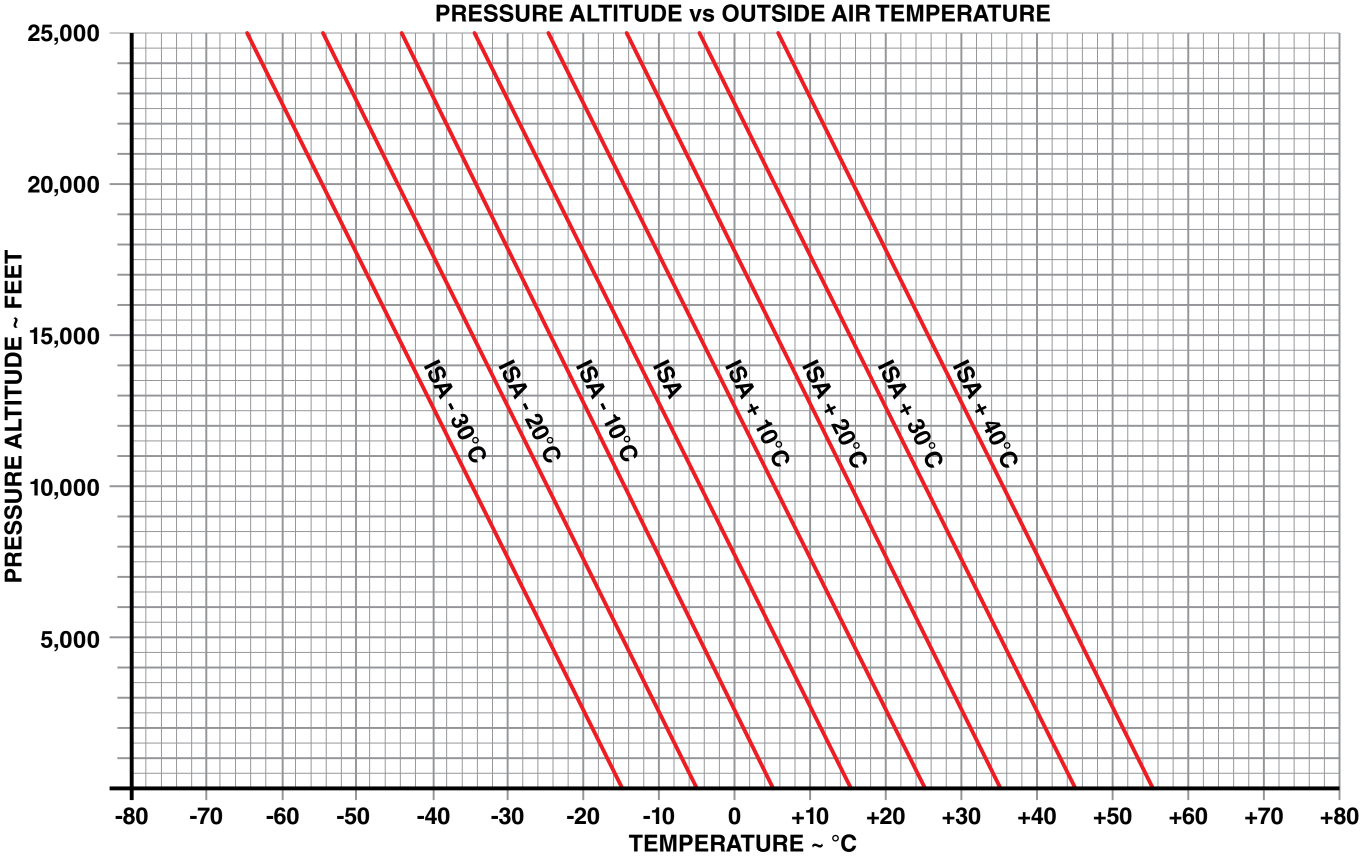
AFTER LANDING
1. Landing and Taxi lights – AS REQIRED
2. Flaps – UP
3. Trim – Neutral
4. Cowl Flaps – OPEN

SHUTDOWN
1. Breakes – SET
2. Electrical and Radios – OFF
3. Throttle – CLOSE
4. Mixture – OFF
5. Magnetos – OFF
6. Battery and Alternator – OFF
7. Controls – LOCK
8. Parking Brake – RELEASE
9. Wheel Chocks – INSTALL

PERFORMANCE CHARTS

ISA CONVERSION

PRESSURE ALTITUDE vs OUTSIDE AIR TEMPERATURE



TAKE-OFF DISTANCE

Associated Conditions:

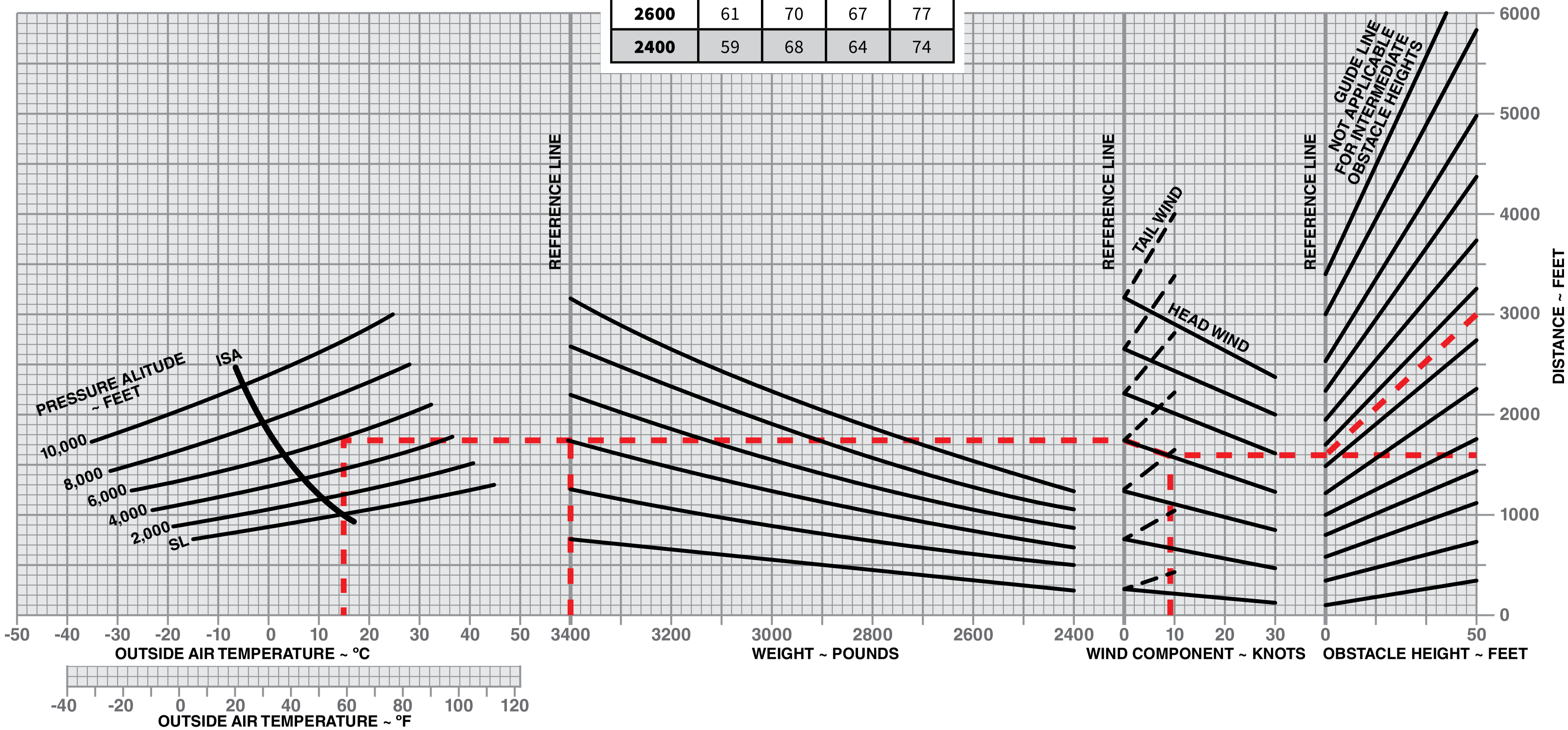
Power. . . . . Full Throttle at 2700 RPM
Mixture. . . . . Lean to Appropriate Fuelflow
Flaps. . . . . UP
Landing Gear . . . . Retracted After Positive Climb Established
Cowl Flaps . . . . . . OPEN

Weight (lbs.)	Take-Off Speed			
	Lift-Off		50 FT	
	KTS	MPH	KTS	MPH
3400	71	82	77	89
3200	69	79	75	86
3000	66	76	73	84
2800	64	74	70	81
2600	61	70	67	77
2400	59	68	64	74

EXAMPLE:

OAT . . . . 15°C (59°F)
Pressure Altitude . . . . 5650 FT
Take-Off Weight . . . . 3400 LBS
Head Wind Component . . . . 9.5 KTS

Ground Roll . . . . 1600 FT
Total Distance Over A 50 FT Obstacle . . . . . . 3000 FT
Take-Off Speed At Lift-Off . . . . 71 KTS (82 MPH)
At 50 FT . . . . 77 KTS (89 MPH)



CLIMB

CLIMB SPEED 96 KNOTS (110 MPH) IAS (ALL WEIGHTS)

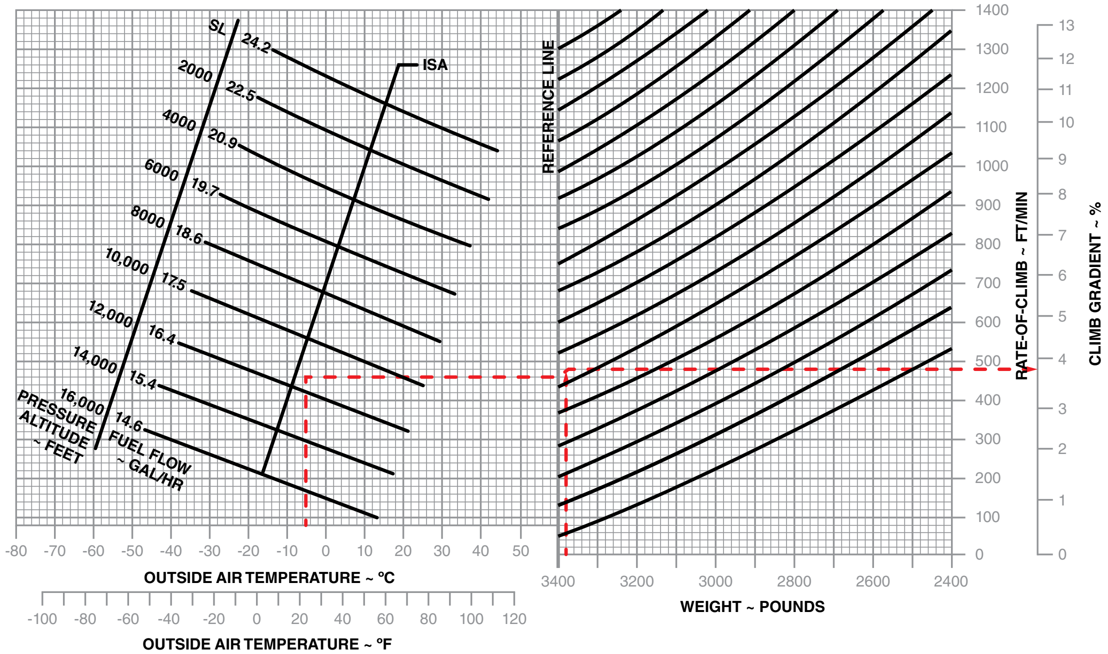
(SERIALS D-9948 THRU D-10312 WITH 2- OR 3-BLADE PROPELLER INSTALLED AND D-10313 AND AFTER WITH McCAULEY 3-BLADE PROPELLER INSTALLED)

ASSOCIATED CONDITIONS:

POWER	FULL THROTTLE AT 2700 RPM
MIXTURE	LEAN TO APPROPRIATE FUEL FLOW
FLAPS	UP
LANDING GEAR	UP
COWL FLAPS	AS REQUIRED

EXAMPLE:

OAT	-5°C (23°F)
PRESSURE ALTITUDE	11,500 FT
WEIGHT	3380 LBS
RATE-OF-CLIMB	470 FT/MIN
CLIMB GRADIENT	3.8%
CLIMBSPEED	96 KTS (110 MPH)



CLIMB

CLIMB SPEED 96 KNOTS (ALL WEIGHTS)

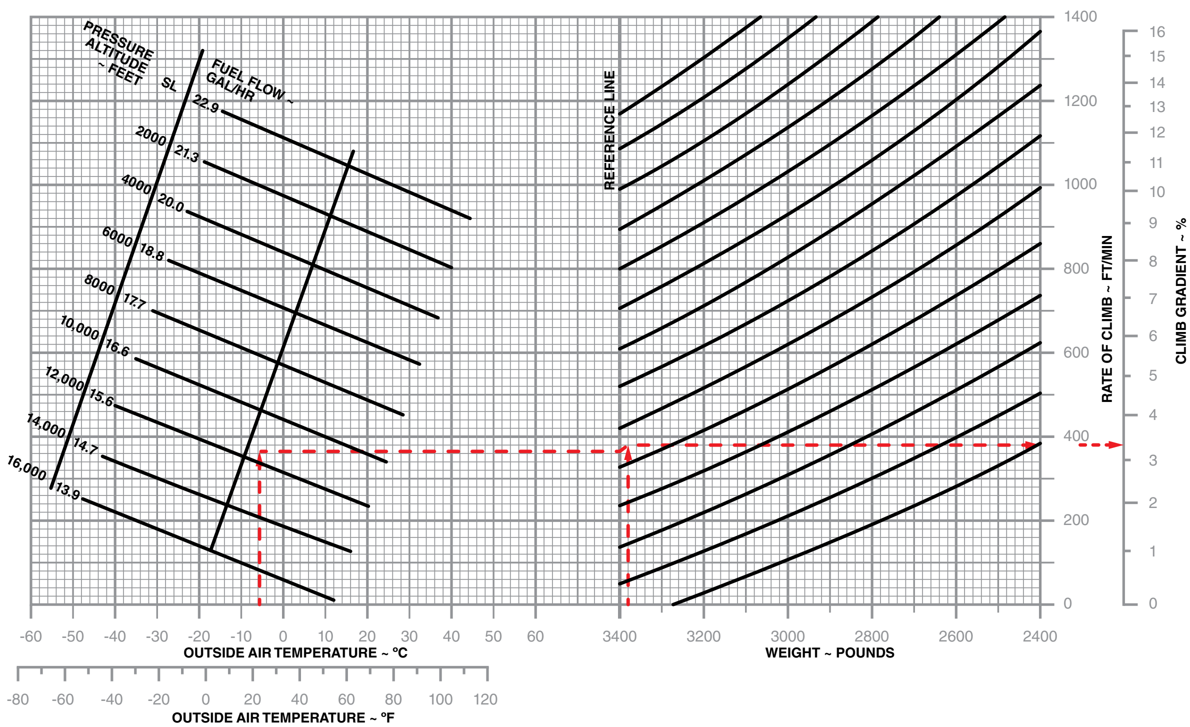
(SERIALS D-10313 AND AFTER WITH 2-BLADE PROPELLER INSTALLED)

ASSOCIATED CONDITIONS:

POWER	FULL THROTTLE AT 2550 RPM
MIXTUE	LEAN TO APPROPRIATE FUEL FLOW
FLAPS	UP
LANDING GEAR	UP
COWL FLAPS	AS REQUIRED

ASSOCIATED CONDITIONS:

OAT	-5°C (23°F)
PRESSURE ALTITUDE	11,500 FT
WEIGHT	3380 LBS
RATE OF CLIMB	375 FT/MIN
CLIMB GRADIENT	3.3%



TIME, FUEL AND DISTANCE TO CLIMB

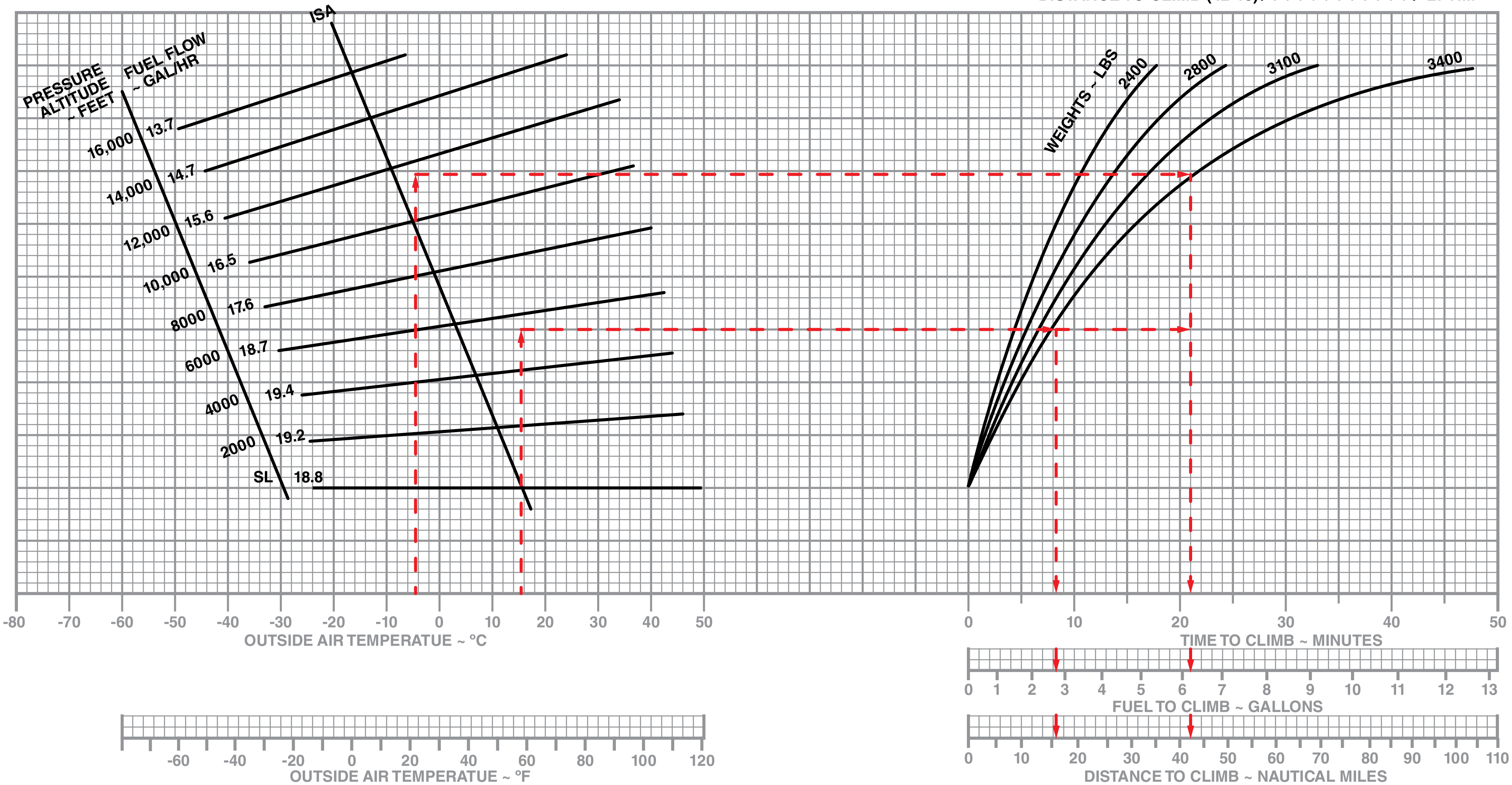
ASSOCIATED CONDITIONS:

POWER	25 IN. HG OR FULL THROTTLE, 2500 RPM
FUEL DENSITY	6.0 LBS/GAL
MIXTURE	LEAN TO APPROPRIATE FUEL FLOW
COWL FLAPS	CLOSED

CLIMB SPEED - 107 KNOTS (123 MPH)

EXAMPLE:

OAT AT TAKE-OFF	15ºC
OAT AT CRUISE	-5ºC
AIRPORT PRESSURE ALTITUDE	5650 FT
CRUISE PRESSURE ALTITUDE	11,500 FT
INITIAL CLIMB WEIGHT	3400 LBS
TIME TO CLIMB (21-8)	13 MIN
FUEL TO CLIMB (6.25-2.65)	3.6 GALS
DISTANCE TO CLIMB (42-15)	27 NM



CRUISE POWER SETTINGS

75% MAXIMUM CONTINUOUS POWER (OR FULL THROTTLE) 2500 RPM, 3200 POUNDS

PRESS ALT. FEET	ISA - 36°F (-20°C)								STANDARD DAY (ISA)								ISA +36°F (+20°C)							
	IOAT		ENGINE SPEED RPM	MAN. PRESS. IN. HG	FUEL FLOW		TAS KTS	CAS KTS	IOAT		ENGINE SPEED RPM	MAN. PRESS. IN. HG	FUEL FLOW		TAS KTS	CAS KTS	IOAT		ENGINE SPEED RPM	MAN. PRESS. IN. HG	FUEL FLOW		TAS KTS	CAS KTS
	°F	°C			PPH	GPH			°F	°C			PPH	GPH			°F	°C			PPH	GPH		
SL	27	-3	2500	23.9	91.4	15.2	159	165	63	17	2500	24.6	91.4	15.2	163	163	100	38	2500	25.1	91.4	15.2	166	161
1000	24	-5	2500	23.6	91.4	15.2	161	164	60	16	2500	24.3	91.4	15.2	164	162	96	36	2500	24.8	91.4	15.2	168	160
2000	20	-7	2500	23.4	91.4	15.2	162	163	56	14	2500	24.1	91.4	15.2	166	161	93	34	2500	24.6	91.4	15.2	169	159
3000	17	-8	2500	23.1	91.4	15.2	164	163	53	12	2500	23.8	91.4	15.2	167	160	89	32	2500	24.3	91.4	15.2	171	158
4000	13	-10	2500	22.8	91.4	15.2	165	162	49	10	2500	23.5	91.4	15.2	169	159	86	30	2500	24.0	91.4	15.2	172	157
5000	10	-12	2500	22.5	91.4	15.2	167	161	46	8	2500	23.2	91.4	15.2	170	158	82	28	2500	23.7	91.4	15.2	173	156
6000	6	-14	2500	22.2	91.4	15.2	168	160	43	6	2500	23.0	91.4	15.2	172	157	79	26	2500	23.5	89.7	15.0	174	153
7000	3	-16	2500	22.0	91.4	15.2	169	159	39	4	2500	22.6	89.7	15.0	172	155	75	24	2500	22.6	86.7	14.5	172	150
8000	-1	-18	2500	21.7	89.4	14.9	169	156	35	2	2500	21.7	89.5	14.4	170	151	71	22	2500	21.7	83.6	13.9	171	147
9000	-4	-20	2500	20.8	86.5	14.4	168	153	32	0	2500	20.8	83.7	14.0	169	148	68	20	2500	20.8	81.0	13.5	170	143
10000	-8	-22	2500	20.0	83.7	14.0	167	150	28	-2	2500	20.0	81.0	13.5	168	145	64	18	2500	20.0	78.3	13.1	168	140
11000	-12	-24	2500	19.2	80.9	13.5	166	146	24	-4	2500	19.2	78.3	13.1	167	142	60	16	2500	19.2	75.7	12.6	167	137
12000	-15	-26	2500	18.3	76.2	13.0	165	143	21	-6	2500	18.3	75.7	12.6	165	138	57	14	2500	18.3	73.1	12.2	165	133
13000	-19	-28	2500	17.6	75.4	12.6	163	139	17	-8	2500	17.6	73.0	12.2	164	135	53	12	2500	17.6	70.6	11.8	163	129
14000	-23	-30	2500	16.8	72.9	12.2	162	136	13	-10	2500	16.8	70.6	11.8	162	131	49	10	2500	16.8	68.3	11.4	162	126
15000	-28	-32	2500	16.1	70.4	11.7	160	133	10	-12	2500	16.1	68.2	11.4	160	127	46	8	2500	16.1	66.0	11.0	159	122
16000	-30	-34	2500	15.4	68.1	11.4	158	129	8	-14	2500	15.4	65.9	11.0	158	124	42	6	2500	15.4	63.7	10.6	156	118

Full throttle manifold pressure settings are approximate.
Red shaded area represents operation with full throttle

CRUISE POWER SETTINGS

65% MAXIMUM CONTINUOUS POWER (OR FULL THROTTLE) 2300 RPM, 3200 POUNDS

PRESS ALT. FEET	ISA - 36°F (-20°C)								STANDARD DAY (ISA)								ISA +36°F (+20°C)							
	IOAT		ENGINE SPEED RPM	MAN. PRESS. IN. HG	FUEL FLOW		TAS KTS	CAS KTS	IOAT		ENGINE SPEED RPM	MAN. PRESS. IN. HG	FUEL FLOW		TAS KTS	CAS KTS	IOAT		ENGINE SPEED RPM	MAN. PRESS. IN. HG	FUEL FLOW		TAS KTS	CAS KTS
	°F	°C			PPH	GPH			°F	°C			PPH	GPH			°F	°C			PPH	GPH		
SL	27	-3	2300	23.3	80.0	13.3	150	156	63	17	2300	23.9	80.0	13.3	154	153	99	37	2300	24.5	80.0	13.3	156	151
1000	23	-5	2300	23.1	80.0	13.3	152	155	59	15	2300	23.6	80.0	13.3	155	153	96	35	2300	24.2	80.0	13.3	158	150
2000	20	-7	2300	22.8	80.0	13.3	153	154	56	13	2300	23.4	80.0	13.3	156	152	92	33	2300	24.0	80.0	13.3	159	149
3000	16	-9	2300	22.5	80.0	13.3	154	153	52	11	2300	23.1	80.0	13.3	157	151	89	31	2300	23.7	80.0	13.3	160	148
4000	13	-11	2300	22.3	80.0	13.3	155	152	49	9	2300	22.9	80.0	13.3	159	150	85	29	2300	23.5	80.0	13.3	161	147
5000	9	-13	2300	22.0	80.0	13.3	157	151	45	7	2300	22.6	80.0	13.3	160	148	82	28	2300	23.2	80.0	13.3	163	146
6000	6	-15	2300	21.8	80.0	13.3	158	150	42	6	2300	22.4	80.0	13.3	161	147	78	26	2300	23.0	80.0	13.3	164	145
7000	2	-17	2300	21.5	80.0	13.3	159	149	38	4	2300	22.1	80.0	13.3	162	146	75	24	2300	22.6	79.0	13.2	164	143
8000	-1	-18	2300	21.3	80.0	13.3	160	148	35	2	2300	21.7	80.0	13.3	163	144	71	22	2300	21.7	76.3	12.7	163	139
9000	-5	-20	2300	20.9	78.1	13.0	160	145	31	0	2300	20.9	76.4	12.7	161	141	67	20	2300	20.9	73.9	12.3	161	136
10000	-8	-22	2300	20.0	76.2	12.7	159	153	28	-2	2300	20.0	73.8	12.3	160	138	64	18	2300	20.0	71.4	11.9	159	132
11000	-12	-24	2300	19.2	73.8	12.3	159	139	24	-4	2300	19.2	71.4	11.9	158	134	60	16	2300	19.2	69.1	11.5	158	129
12000	-16	-27	2300	18.4	71.3	11.9	157	136	20	-7	2300	18.4	69.0	11.5	157	131	56	13	2300	18.4	66.8	11.1	156	125
13000	-19	-29	2300	17.6	68.8	11.5	155	132	17	-9	2300	17.6	66.6	11.1	155	127	53	11	2300	17.6	64.5	10.8	153	121
14000	-23	-31	2300	16.9	66.4	11.1	153	129	13	-11	2300	16.9	64.4	10.7	152	123	49	9	2300	16.9	62.4	10.4	151	117
15000	-27	-33	2300	16.1	64.0	10.7	151	125	9	-13	2300	16.1	62.1	10.4	150	119	45	7	2300	16.1	60.2	10.0	147	113
16000	-30	-35	2300	15.5	61.9	10.3	148	121	6	-15	2300	15.5	60.0	10.0	147	115								

Full throttle manifold pressure settings are approximate.
Red shaded area represents operation with full throttle

CRUISE POWER SETTINGS

55% MAXIMUM CONTINUOUS POWER (OR FULL THROTTLE) 2100 RPM, 3200 POUNDS

PRESS ALT. FEET	ISA - 36°F (-20°C)								STANDARD DAY (ISA)								ISA +36°F (+20°C)							
	IOAT		ENGINE SPEED RPM	MAN. PRESS. IN. HG	FUEL FLOW		TAS KTS	CAS KTS	IOAT		ENGINE SPEED RPM	MAN. PRESS. IN. HG	FUEL FLOW		TAS KTS	CAS KTS	IOAT		ENGINE SPEED RPM	MAN. PRESS. IN. HG	FUEL FLOW		TAS KTS	CAS KTS
	°F	°C			PPH	GPH			°F	°C			PPH	GPH			°F	°C			PPH	GPH		
SL	26	-3	2100	23.0	68.8	11.5	140	145	62	17	2100	23.6	68.8	11.5	143	143	99	37	2100	24.2	68.8	11.5	145	140
1000	23	-5	2100	22.8	68.8	11.5	141	144	59	15	2100	23.3	68.8	11.5	144	142	95	35	2100	24.0	68.8	11.5	146	139
2000	19	-7	2100	22.5	68.8	11.5	142	143	55	13	2100	23.1	68.8	11.5	145	141	91	33	2100	23.7	68.8	11.5	147	138
3000	16	-9	2100	22.3	68.8	11.5	143	142	52	11	2100	22.9	68.8	11.5	146	140	88	31	2100	23.5	68.8	11.5	148	137
4000	12	-11	2100	22.1	68.8	11.5	144	141	48	9	2100	22.6	68.8	11.5	147	138	84	29	2100	23.2	68.8	11.5	149	135
5000	9	-13	2100	21.8	68.8	11.5	145	140	45	7	2100	22.4	68.8	11.5	148	137	81	27	2100	23.0	68.8	11.5	150	134
6000	5	-15	2100	21.6	68.8	11.5	146	139	41	5	2100	22.1	68.8	11.5	148	136	77	25	2100	22.7	68.8	11.5	150	133
7000	2	-17	2100	21.3	68.8	11.5	147	138	38	3	2100	21.9	68.8	11.5	149	135	74	23	2100	22.5	68.8	11.5	151	132
8000	-2	-19	2100	21.1	68.8	11.5	148	137	34	1	2100	21.6	68.8	11.5	150	133	70	21	2100	21.9	67.5	11.3	151	129
9000	-5	-21	2100	20.9	68.4	11.4	149	135	31	-1	2100	21.0	67.3	11.2	149	131	67	19	2100	21.0	65.6	10.9	149	126
10000	-9	-23	2100	20.1	68.0	11.3	149	133	27	-3	2100	20.2	65.8	11.0	148	126	63	17	2100	20.1	63.8	10.6	147	122
11000	-13	-25	2100	19.3	66.0	11.0	147	130	23	-5	2100	19.3	64.0	10.7	147	124	59	15	2100	19.3	62.0	10.3	145	119
12000	-16	-27	2100	18.5	64.0	10.7	146	126	20	-7	2100	18.5	62.1	10.4	145	121	56	13	2100	18.5	60.2	10.0	142	114
13000	-20	-29	2100	17.7	62.0	10.3	144	123	16	-9	2100	17.7	60.2	10.0	142	117	52	11	2100	17.7	58.4	9.7	139	110
14000	-24	-31	2100	16.9	59.8	10.0	141	119	12	-11	2100	16.8	57.9	9.7	139	112								
15000	-27	-33	2100	16.2	57.6	9.6	138	114																
16000	-31	-35	2100	15.6	55.6	9.3	135	110																

Full throttle manifold pressure settings are approximate.
Red shaded area represents operation with full throttle

CRUISE POWER SETTINGS

45% MAXIMUM CONTINUOUS POWER (OR FULL THROTTLE) 2100 RPM, 3200 POUNDS

PRESS ALT. FEET	ISA - 36°F (-20°C)								STANDARD DAY (ISA)								ISA +36°F (+20°C)							
	IOAT		ENGINE SPEED RPM	MAN. PRESS. IN. HG	FUEL FLOW		TAS KTS	CAS KTS	IOAT		ENGINE SPEED RPM	MAN. PRESS. IN. HG	FUEL FLOW		TAS KTS	CAS KTS	IOAT		ENGINE SPEED RPM	MAN. PRESS. IN. HG	FUEL FLOW		TAS KTS	CAS KTS
	°F	°C			PPH	GPH			°F	°C			PPH	GPH			°F	°C			PPH	GPH		
SL	26	-4	2100	20.4	57.6	9.6	127	132	62	17	2100	20.8	57.6	9.6	130	130	98	37	2100	21.2	57.6	9.6	132	127
1000	22	-5	2100	20.1	57.6	9.6	128	131	58	15	2100	20.5	57.6	9.6	131	129	94	35	2100	20.9	57.6	9.6	133	126
2000	19	-7	2100	19.8	57.6	9.6	129	130	55	13	2100	20.2	57.6	9.6	131	128	91	33	2100	20.6	57.6	9.6	133	125
3000	15	-9	2100	19.4	57.6	9.6	130	129	51	11	2100	19.9	57.6	9.6	132	127	87	31	2100	20.3	57.6	9.6	134	124
4000	12	-11	2100	19.1	57.6	9.6	161	128	48	9	2100	19.6	57.6	9.6	133	126	84	29	2100	20.0	57.6	9.6	135	123
5000	8	-13	2100	18.8	57.6	9.6	162	127	44	7	2100	19.3	57.6	9.6	134	124	80	27	2100	19.7	57.6	9.6	136	122
6000	5	-15	2100	18.5	57.6	9.6	133	126	41	5	2100	19.0	57.6	9.6	135	123	77	25	2100	19.4	57.6	9.6	136	120
7000	1	-17	2100	18.2	57.6	9.6	134	125	37	3	2100	18.7	57.6	9.6	135	122	73	23	2100	19.1	57.6	9.6	137	119
8000	-3	-19	2100	17.9	57.6	9.6	134	124	34	1	2100	18.4	57.6	9.6	136	121	70	21	2100	18.8	57.6	9.6	137	118
9000	-6	-21	2100	17.6	57.6	9.6	135	123	30	-1	2100	18.1	57.6	9.6	137	120	66	19	2100	18.5	57.6	9.6	138	116
10000	-10	-23	2100	17.3	57.6	9.6	136	122	26	-3	2100	17.8	57.6	9.6	1374	118	63	17	2100	18.2	57.6	9.6	138	115
11000	-13	-25	2100	17.0	57.6	9.6	136	120	23	-5	2100	17.5	57.6	9.6	138	117	59	15	2100	17.9	57.6	9.6	138	113
12000	-17	-27	2100	16.7	57.6	9.6	137	119	19	-7	2100	17.1	57.6	9.6	138	115	55	13	2100	17.6	57.6	9.6	138	111
13000	-20	-29	2100	16.4	57.6	9.6	137	117	16	-9	2100	16.8	57.6	9.6	138	113								
14000	-24	-31	2100	16.0	57.6	9.6	138	116	12	-11	2100	16.5	56.6	9.6	136	110								
15000	-27	-33	2100	15.7	57.6	9.6	138	114																
16000	-31	-35	2100	15.4	55.6	9.3	135	110																

Full throttle manifold pressure settings are approximate.
Red shaded area represents operation with full throttle

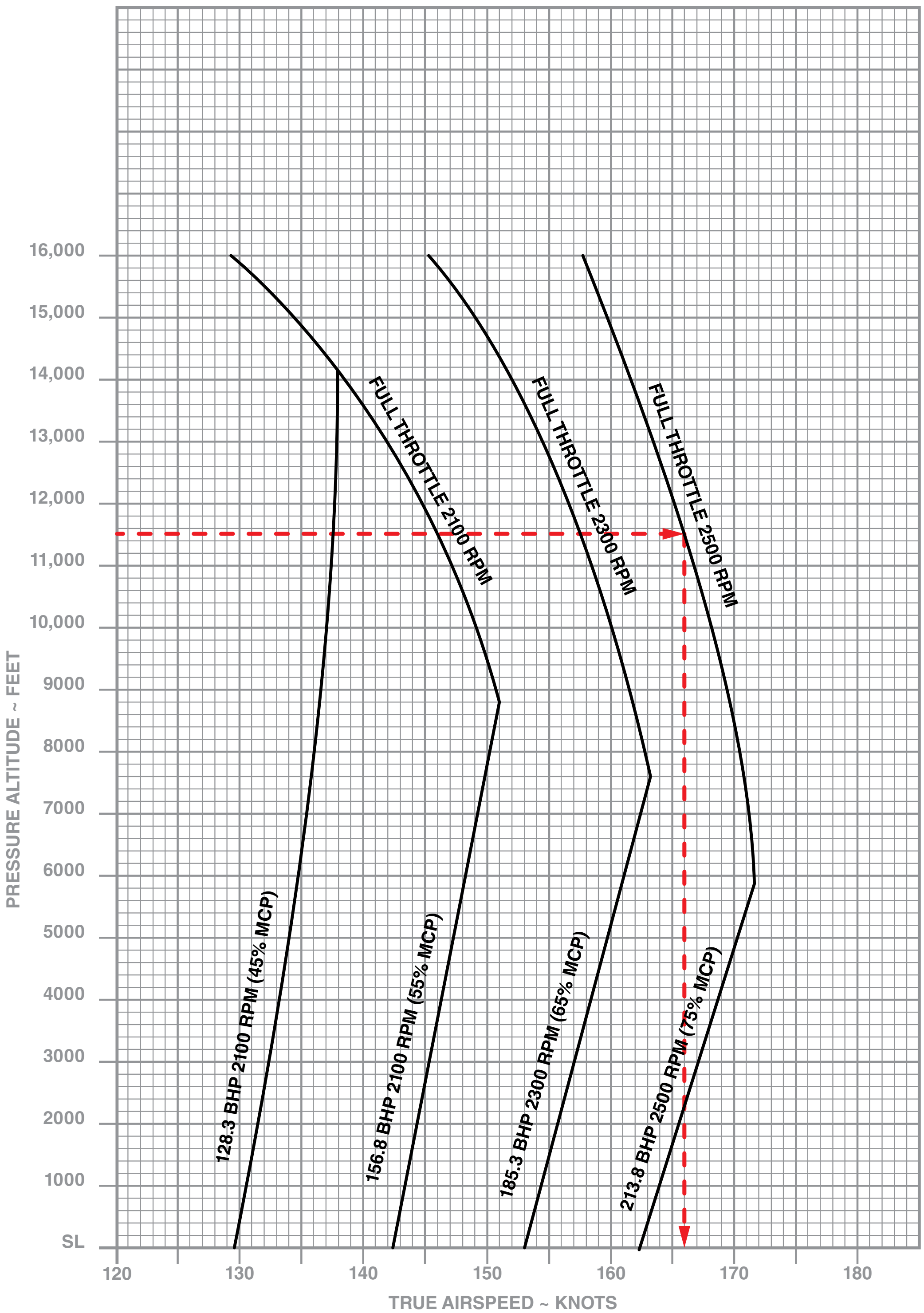
CRUISE SPEEDS

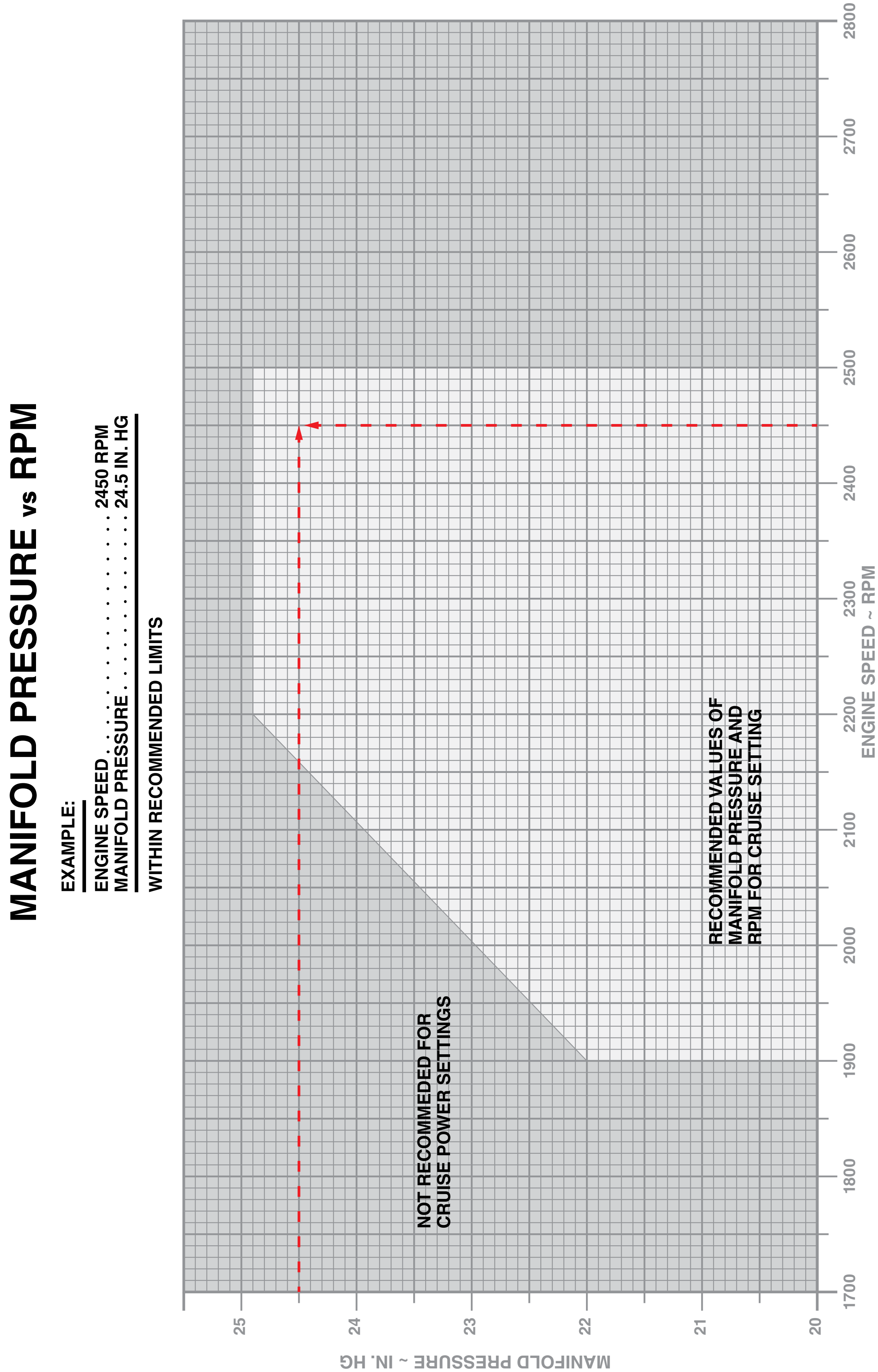
ASSOCIATED CONDITIONS

AVERAGE CRUISE WT. 3200 LBS
TEMPERATURE STANDARD DAY (ISA)

EXAMPLE:

PRESSURE ALTITUDE	11,500 FT
POWER SETTING	FULL THROTTLE 2500 RPM
TRUE AIRSPEED	166 KTS




MANIFOLD PRESSURE vs RPM
EXAMPLE:
ENGINE SPEED . . . . 2450 RPM
MANIFOLD PRESSURE . . . . 24.5 IN. HG
WITHIN RECOMMENDED LIMITS
NOT RECOMMEDED FOR
CRUISE POWER SETTINGS
RECOMMENDED VALUES OF
MANIFOLD PRESSURE AND
RPM FOR CRUISE SETTING
ENGINE SPEED ~ RPM
1700
1800
1900
2000
2100
2200
2300
2400
2500
2600
2700
2800
MANIFOLD PRESSURE ~ IN. HG
20
21
22
23
24
25

FUEL FLOW vs BRAKE HORSEPOWER

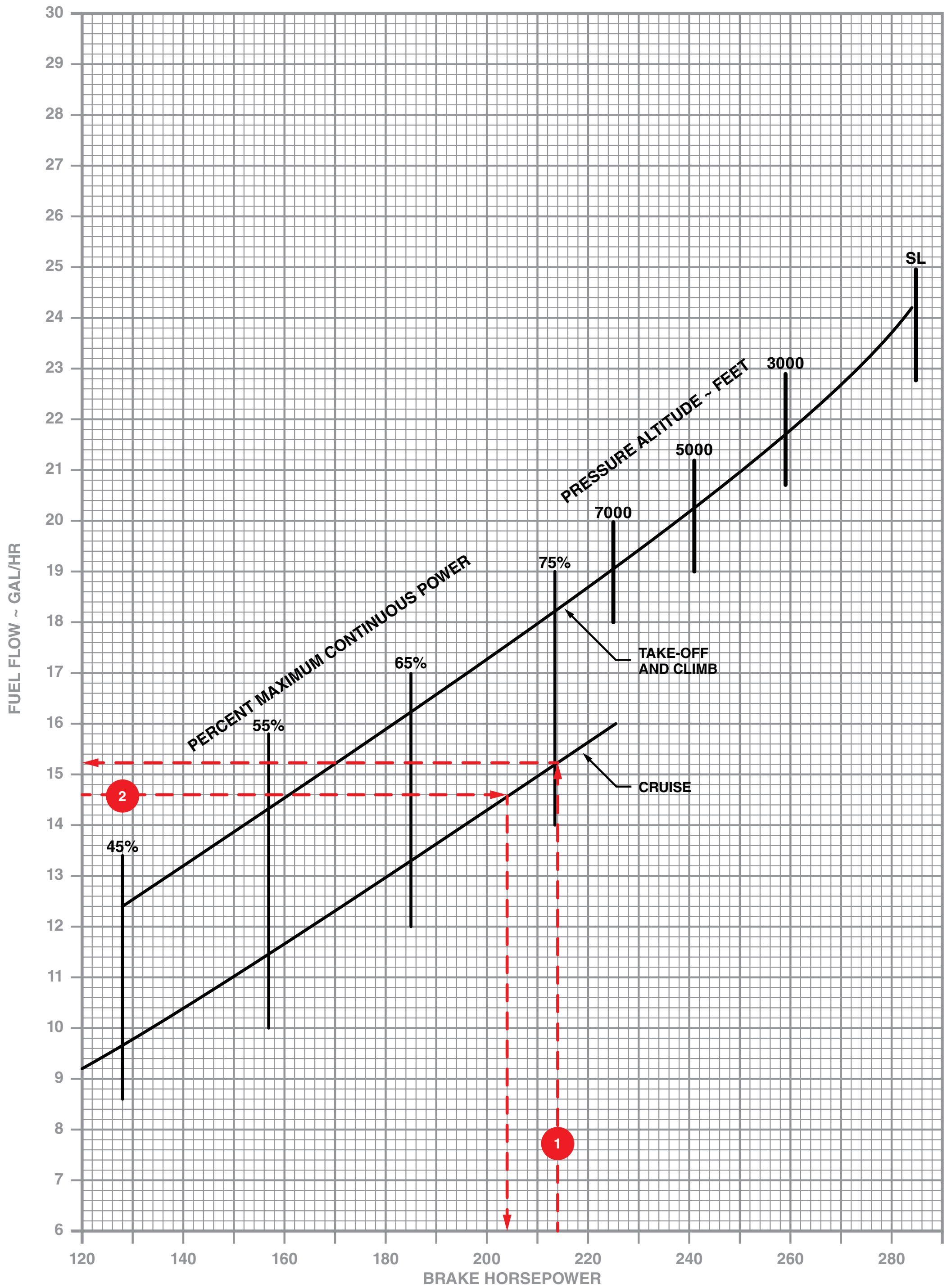
EXAMPLE:

1 BRAKE HORSEPOWER 213.75
75% MCP
CONDITION . . . . LEVEL FLIGHT CRUISE

FUEL FLOW . . . . 15.25 GAL/HR

2 FUEL FLOW . . . . 14.6 GAL/HR
CONDITION . . . . LEVEL FLIGHT CRUISE

BRAKE HORSEPOWER 204



RANGE PROFILE — 74 GALLONS

STANDARD DAY (ISA)

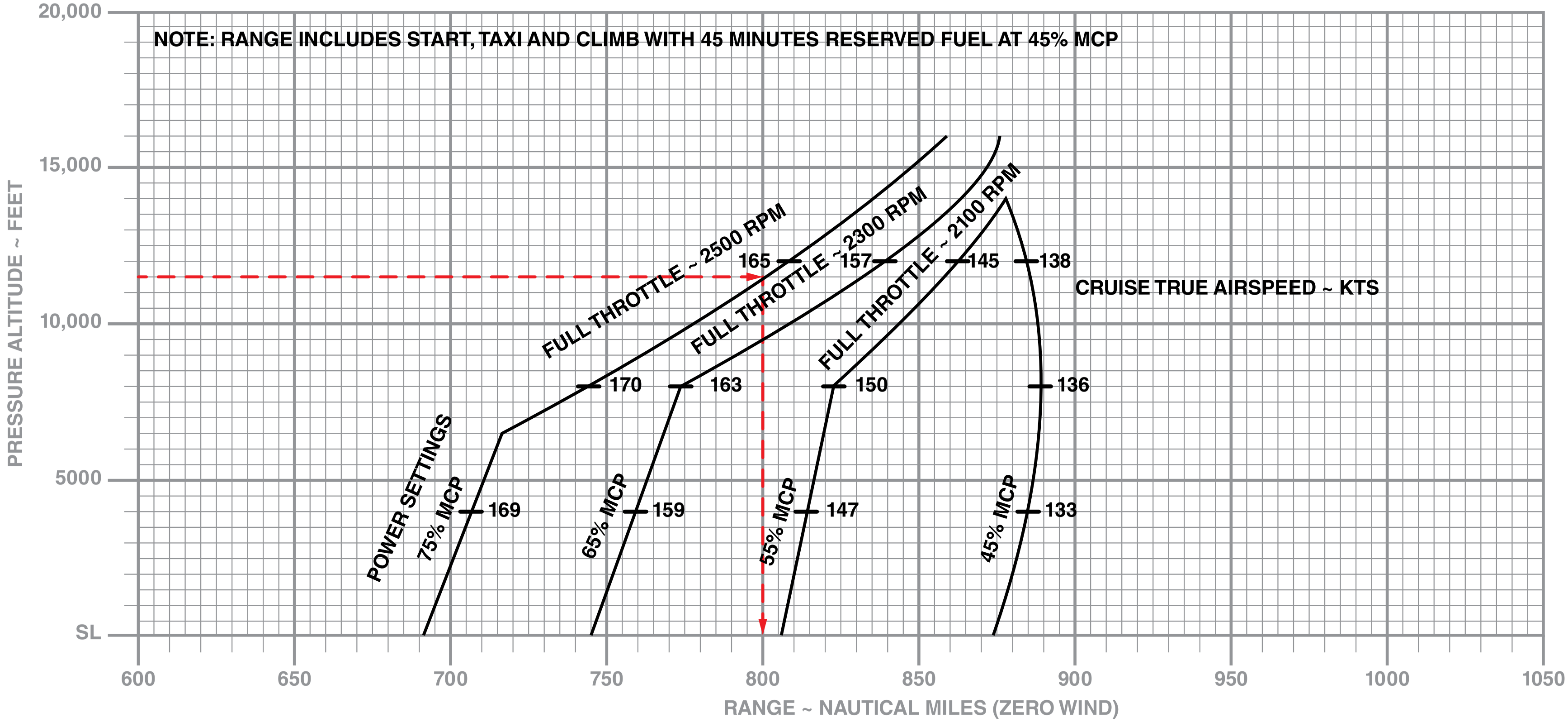
ASSOCIATED CONDITIONS:

WEIGHT .... 3412 LBS BEFORE ENGINE START
FUEL .... AVIATION GASOLINE
FUEL DENSITY..................... 6.0 LBS/GAL
INITIAL FUEL LOADING............ 74 U.S. GAL (444 LGS)

EXAMPLE:

PRESSURE ALTITUDE .... 11,500 FT
POWER SETTING......................... FULL THROTTLE, 2500 RPM

RANGE .... 800 NM



ENDURANCE PROFILE — 74 GALLONS

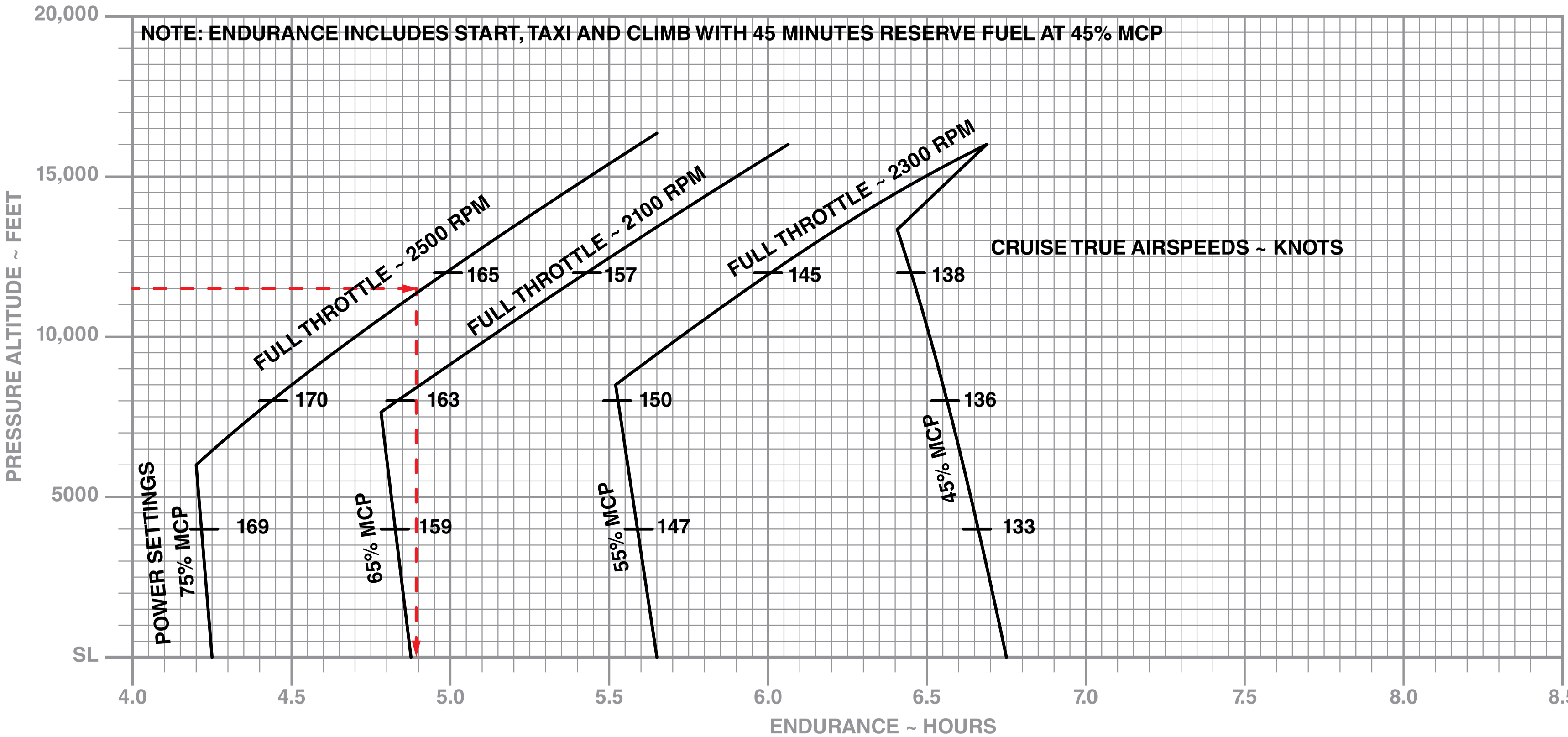
STANDARD DAY (ISA)

ASSOCIATED CONDITIONS

WEIGHT	3412 LBS BEFORE ENGINE START
FUEL	AVIATION GASOLINE
FUEL DENSITY	6.0 LBS/GAL
INITIAL FUEL LOADING	74 U.S. GAL (444 LBS)

EXAMPLE:

PRESSURE ALTITUDE	11,500 FT
POWER SETTING	FULL THROTTLE, 2500 RPM
ENDURANCE	4.9 HRS (4 HRS 54 MIN)



LANDING DISTANCE

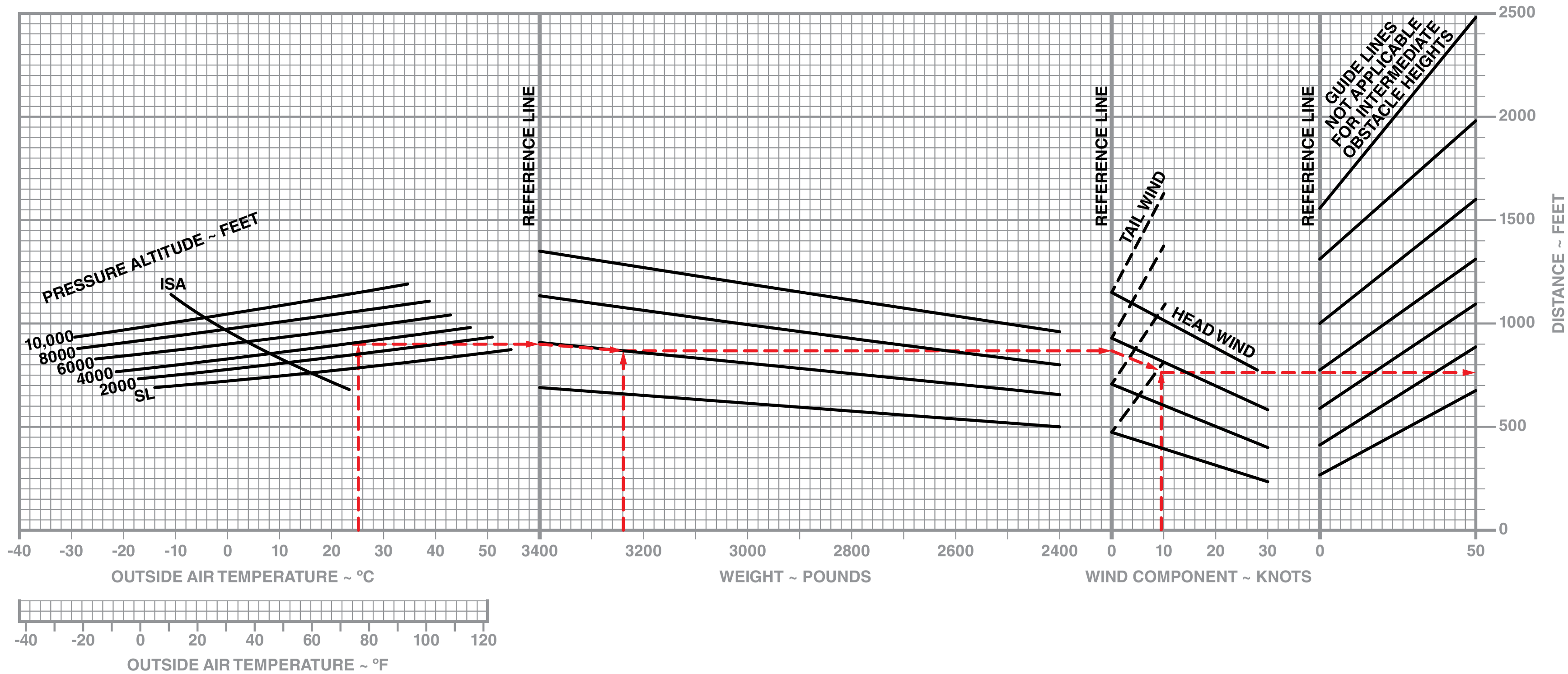
ASSOCIATED CONDITIONS:

POWER	RETARDED TO MAINTAIN 900 FT/MIN ON FINAL APPROACH
FLAPS	DOWN
LANDING GEAR	DOWN
RUNWAY	PAVED, LEVEL, DRY SURFACE
APPROACH SPEED	IAS AS TABULATED
BRAKING	MAXIMUM

WEIGHT ~ LBS	SPEED AT 50 FT	
	KTS	MPS
3400	70	81
3200	68	79
3000	66	76
2800	63	73
2600	61	71
2400	59	68

EXAMPLE:

OAT	25°C (77°F)
PRESSURE ALTITUDE	3965 FT
WEIGHT	3242 LBS
HEADWIND COMPONENT	9 KTS
GROUND ROLL	763 FT
TOTAL OVER 50 FT OBSTACLE	1324 FT
APPROACH SPEED	69 KTS (80 MPH)



WEIGHT AND BALANCE

LOADING INSTRUCTIONS

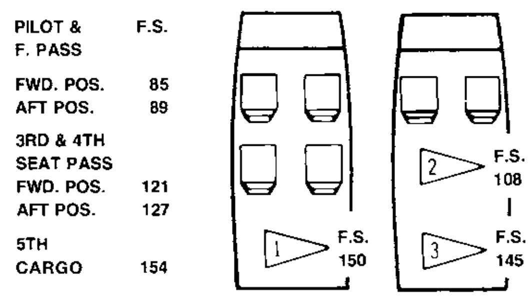
WARNING
This airplane is easily loaded above the maximum take-off weight and/or beyond the aft center of gravity flight limits. Flight safety dictates that the airplane weight and center of gravity be within the approved envelope during flight.

Passengers, baggage and fuel should not be loaded indiscriminately. The operator is directed to the following loading instructions. A total airplane incremental weight and center of gravity loading for each flight should be prepared. In addition, it is recommended that additional loadings be computed to explore the potential problems associated with using the aft seats and compartments.

It is the responsibility of the airplane operator to ensure that the airplane is properly loaded. At the time of delivery, Beech Aircraft Corporation provides the necessary weight and balance data to compute individual loadings. All subsequent changes in airplane weight and balance are the responsibility of the airplane owner and/or operator.

The basic empty weight and moment of the airplane at the time of delivery are shown on the airplane Basic Empty Weight and Balance form. Useful load items which may be loaded into the airplane are shown on the Useful Load Weight and Moment tables. The minimum and maximum moments are indicated on the Moment Limits vs Weight table. These moments correspond to the forward and aft center of gravity flight limits for a particular weight. All moments are divided by 100 to simplify computations.

SEATING, BAGGAGE AND EQUIPMENT ARRANGEMENTS



NOTE: The floor structure load limit is 100 pounds per square foot, except for the area between the front and rear spars, where the floor structure load limit is 50 pounds per square foot.

NOTE: All baggage/cargo must be secured with an approved cargo net.

1 Maximum weight 270 pounds including equipment and baggage.

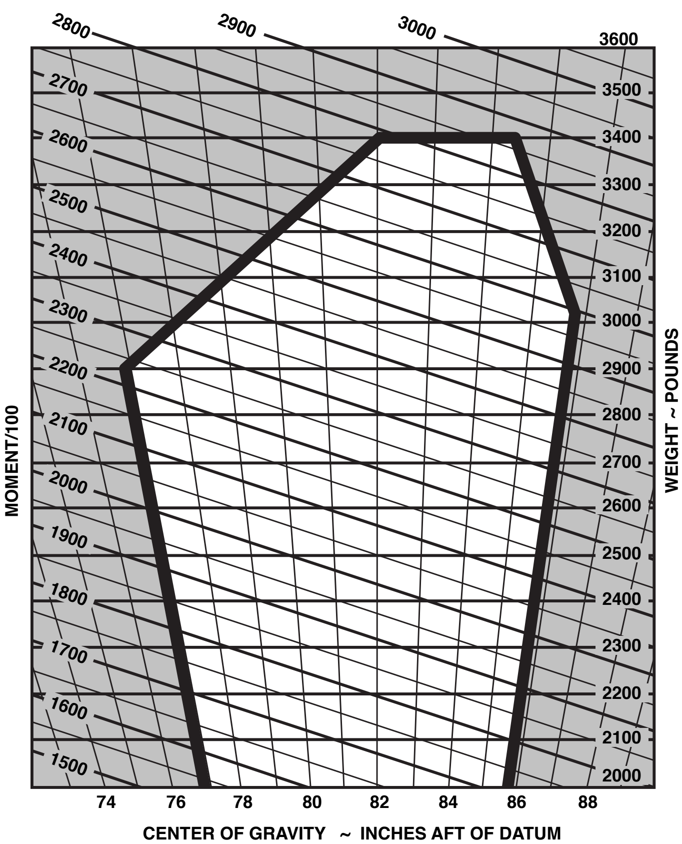
2 Maximum weight 200 pounds forward of rear spar including equipment and cargo with 3rd and 4th seats removed.

3 Maximum weight 270 pounds aft of rear spar including equipment and cargo with 3rd and 4th seats removed.

WEIGHT AND BALANCE RECORD

Serial No.			Registration No.				Page No.	
	Item No.			Weight Change Added (+) or Removed (-)			Running Basic Empty Weight	
Date	IN	OUT	Description of Article or Change	WT (lbs)	ARM (in.)	MOM/100	WT (lbs)	MOM/100

MOMENT LIMITS VS WEIGHT



Envelope Based on the following Weight and Center of Gravity Limit Data (Landing Gear Down)

Weight Condition	Forward C.G. Limit	AFT C.G. Limit
3400 LB. (MAX. TO & LDG)	82.1	84.4
3000 LB.	78.0	84.7
2900 LB. OR LESS	77.0	85.7

COMPUTING PROCEDURE

1. Record the Basic Empty Weight and Moment from the Basic Empty Weight and Balance form (or from the latest superseding form) under the Basic Empty Condition block. The moment must be divided by 100 to correspond to Useful Load Weights and Moments tables.
2. Record the weight and corresponding moment from the appropriate table of each of the useful load items (except fuel) to be carried in the airplane.
3. Total the weight column and moment column. The SUBTOTALS are the Zero Fuel Condition.
4. Determine the weight and corresponding moment for the fuel loading to be used. This fuel loading includes fuel for the flight, plus that required for start, taxi, and takeoff. Add the Fuel Loading Condition to Zero Fuel Condition to obtain the SUB-TOTAL Ramp Condition.
5. Subtract the fuel to be used for start, taxi, and take-off to arrive at the SUB-TOTAL Take-off Condition.
6. Subtract the weight and moment of the fuel in the incremental sequence in which it is to be used from the take-off weight and moment. The Zero Fuel Condition, the Take-off Condition, and the Landing Condition moments must be within the minimum and maximum moments shown on the Moment Limit vs Weight graph for that weight. If the total moment is less than the minimum moment allowed, useful load items must be shifted aft or forward load items reduced. If the total moment is greater than the maximum moment allowed, useful load items must be shifted forward or aft load items reduced. If the quantity or location of load items is changed, the calculations must be revised and the moments rechecked.

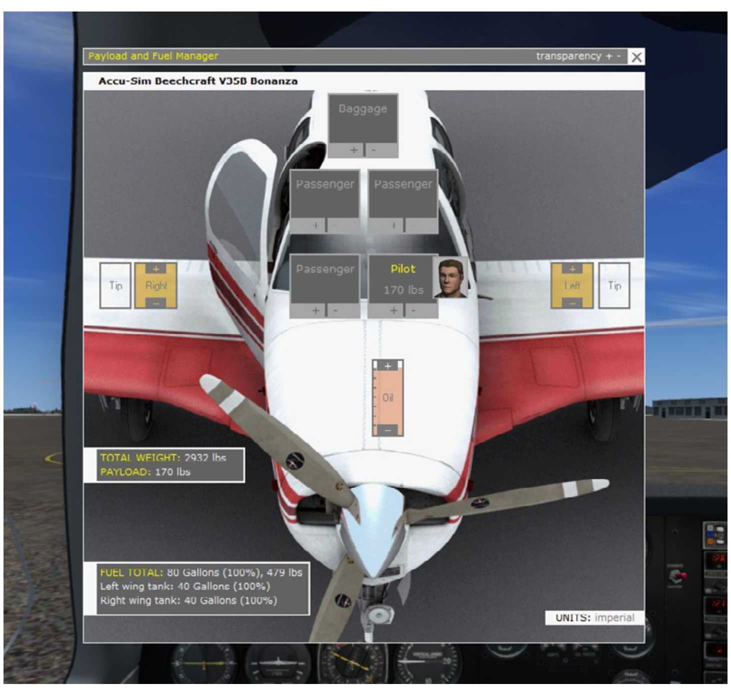
WEIGHT AND BALANCE LOADING FORM

Bonanza: **Date:**

Serial No.: **Reg No.:**

Item	Weight	MOM/100
1. Basic Empty Condition		
2. Front Seat Occupants		
3. 3rd and 4th Seat Occupants		
4. Baggage		
5. Cargo		
6. Sub Total Zero Fuel Condition		
7. Fuel Loading		
8. Sub Total Ramp Condition		
9. Less Fuel For Start Taxi, and Takeoff*		
10. Sub Total Takeoff Conditon		
11. Less Fuel to Destination		
12. Landing Conditon		

*Fuel for start, taxi and take-off is normally 12 lbs. at an average MOM/100 of 9.



USEFUL LOAD WEIGHTS AND MOMENTS

	OCCUPANTS			
	FRONT SEATS		3RD & 4TH SEATS	
	FWD. POSITION ARM 85	AFT POSITION ARM 89	FWD. POSITION ARM 121	AFT POSITION ARM 127
WEIGHT	MOMENT/100			
120	102	107	145	152
130	110	116	157	165
140	119	125	169	178
150	128	134	182	190
160	136	142	194	203
170	144	151	206	216
180	153	160	218	229
190	162	169	230	241
200	170	178	242	254

NOTE: Occupant Positions for Adjustable Seats are shown at their extreme positions. Intermediate Positions will require interpolation of the Moment/100 Values.

USEFUL LOAD WEIGHTS AND MOMENTS

USABLE FUEL		
LEADING EDGE TANKS ARM 75		
GALLONS	WEIGHT	MOM/100
5	30	23
10	60	45
15	90	68
20	120	90
25	150	113
30	180	135
35	210	158
40	240	180
44	264	198
50	300	225
55	330	248
60	360	270
65	390	293
70	420	315
74	444	333

SAMPLE LOADINGS

The following sample loading show some of the problems associated with loading the aft seats and compartments. Similar loadings should be made for your airplane. Follow the loading instructions in this chapter plus those on the sample loading form.

Sample Loading Only
Do Not Fly With This Loading

Item	Weight	ARM (C.G.*)	MOM/ 100*
1. Basic Empty Condition**	2088	77.9	1626
2. Occupant - Front (1)	190 2278	87.0 78.6	165 1791
3. Occupant - Front (1)	1970 2468	87.0 79.3	165 1956
4. Occupant - Center (1)	190 2658	123.0 82.4	234 2190
5. Occupant - Center (1)	190 2848	123.0 85.1	234 2424
6. Baggage	120 2968	150.0 87.7	180 2604

*Use the C.G., MOM/100 for the occupants as they are positioned in your airplane. Consult the POH Weight and Balance Section for the latest occupant positions. If the seats are adjustable fore and aft, use the position in which that seat is located during flight.

**The Basic Empty Weight Data shall be current and accurate for the airplane as equipped.

NOTE: The addition of fuel to the above loading will move the center of gravity (C.G.) forward. Conversely, using fuel during flight will move the airplane center of gravity aft. Flight safety requires that during flight the airplane weight and center of gravity be within the approved limits.

NOTE: Four 190-pound occupants plus 30 pounds of baggage per person cannot be loaded and remain within the aft C.G. limit of F.S. 85.7. Ninety-four pounds of baggage must be removed to place the airplane C.G. on the aft C.G. limit.

SYSTEMS DESCRIPTION

AIRFRAME

The BEECHCRAFT V35B Bonanza is an all-metal, low-wing, single-engine airplane with retractable tricycle landing gear.

The Bonanza V35B has all the control surfaces of a conventional airplane, except the vertical tail surface.

The “Vee” tail movable control surfaces are arranged to act as both elevator and rudder. The two surfaces work together for elevator action and opposite each other in rudder action. The “Vee” tail operates like a conventional tail in response to elevator and rudder control action.

SEATING ARRANGEMENTS

The Bonanza V35B is a 4-place airplane.

FLIGHT CONTROLS

CONTROL SURFACES

Control surfaces are operated through push-pull rods and conventional cable systems terminating in bellcranks.

CONTROL COLUMN

The throw-over type control column for elevator and aileron control can be placed in front of either front seat. Pull the T-handle latch at the back of the control arm and position the control wheel as desired. The aileron trimmer on the control column hub should be held until the column is repositioned.

RUDDER PEDALS

To adjust the rudder pedals, press the spring-loaded lever on the side of each pedal and move the pedal to its forward or aft position. The adjustment lever can also be used to place the right set of rudder pedals against the floor (when the copilot brakes are not installed) when not in use.

TRIM CONTROLS

Elevator trim is controlled by a handwheel located to the left of the throttle. An elevator tab position indicator dial is located above and to the left of the trim control.

The aileron trimmer on the control column hub displaces the ailerons. Displacement is maintained by cable loads imposed by the trimmer.

ELECTRIC ELEVATOR TRIM

The optional electric elevator trim system controls include the ON-OFF switch located on the instrument panel, a thumb switch on the control wheel and a circuit breaker on the right subpanel. The ON-OFF switch must be in the ON position to operate the system. The thumb switch is moved forward for nose down, aft for nose up, and when released returns to the center OFF position. When the system is not being electrically actuated, the manual trim control wheel may be used.

INSTRUMENT PANEL

The standard instrument panel of the Bonanza V358 consists of the floating instrument panel on the upper left portion, the engine instrument grouping on the center of the panel above the control wheel yoke, a radio grouping to the right of the engine instruments, and a subpanel which provides tor a compact circuit breaker group on the right side and switching panel on the left.

FLIGHT INSTRUMENTS

The floating instrument panel contains all flight instruments except the magnetic compass. On this panel are the airspeed indicator, gyro horizon, altimeter, turn coordinator, directional gyro, and vertical speed indicator, with provisions tor an ADF indicator and a clock. Additional navigation equipment, such as dual omni indicators, can be mounted in the panel directly below the flight instrument grouping.

ENGINE INSTRUMENTS

The engine instruments, located on the center panel, include a fuel flow/manifold pressure indicator, an engine tachometer, a fuel quantity indicator tor each side, and a cluster which includes an oil pressure indicator, an oil temperature indicator, a cylinder head temperature indicator, and an ammeter.

CLUSTER TYPE ENGINE INSTRUMENTS

The cluster type instruments, as shown in the accompanying illustration, are located in the center of the panel just below the fuel flow/manifold pressure indicator and tachometer. Included in the square cluster are the cylinder head temperature and oil temperature (both calibrated in degrees centigrade), ammeter, and oil pressure. A fuel quantity indicator is located on each side of the cluster, the left indicator tor the left wing fuel and the right indicator tor the right wing fuel.

MANIFOLD PRESSURE AND FUEL FLOW INDICATOR

The manifold pressure portion of this instrument indicates the pressure in the engine manifold and is calibrated in inches of mercury. By observing the manifold pressure indication and adjusting the propeller and throttle controls, the power output of the engine can be adjusted. To avoid excessive cylinder pressures during cruise operations, observe the maximum recommended rpm and manifold pressure limits as indicated on the Manifold Pressure vs RPM graph in the PERFORMANCE Section.

The fuel flow portion of the indicator senses fuel pressure at the fuel distributor and is calibrated to indicate fuel flow in gallons per hour. The green arc indicates the normal fuel flow operating range while the red radials indicate the minimum and maximum allowable fuel pressures.

The higher end of the green arc includes a sawtooth segment to indicate the approximate fuel flow required for takeoff and climb at sea level, 3000, 5000 and 7000 feet. The pilot should use performance charts for the exact fuel flow requirements.

The lower end of the green arc includes a sawtooth segment labeled"% CRUISE POWER" which indicates the approximate fuel flows for powers ranging from 45% to 75% of max continuous power. The lower fuel flow of each sawtooth corresponds to the cruise - lean fuel flow while the higher fuel flow of each sawtooth corresponds to the best power fuel flow. When power is set in accordance with the cruise power setting tables in the PERFORMANCE section, these sawtooth markings provide approximate percent power information.

The fuel flow portion of the indicator is controlled electrically and indicates fuel flow in gallons per hour. A turbine meter installed in the fuel line rotates in proportion to the fuel flow. The speed of rotation is converted into an electrical signal which is then interpreted by the fuel flow indicator. The green arc indicates the normal operating range while the red radial indicates the maximum allowable fuel flow.

Fuel flow values at the higher end of the green arc are labeled "TAKEOFF AND CLIMB" and indicate the approximate fuel flow required for takeoff and climb at sea level, 3000, 5000 and 7000 feet. The pilot should use these markings as a guide only and refer to the tables in the PERFORMANCE section for the exact fuel flow requirements.

AVIONICS PANEL

Tuning and selecting equipment for the radios, adjacent to the engine instrument grouping, is mounted in block form with switching on the left edge of the block and radio heads and tuning on the right.

SWITCHES

The magneto/start switch and switches for the battery, alternator, pitot heat, propeller deicer, and lights are located on the left end of the subpanel. Flap and tab position indicators, the cowl flap control, and the flap switch are near the center of the subpanel. On the right end of the subpanel are the circuit breakers, as well as the landing gear switch and landing gear position indicator lights. Attached to the lower center section of the subpanel are the power plant controls and auxiliary fuel pump switch.

ANNUNCIATOR SYSTEM

WARNING LIGHTS

A warning light placarded ALT OUT is located on the pilot's floating instrument panel below the flight instruments. The warning light for the alternator will illuminate when the output from the alternator is nearly zero or when an alternator overvoltage occurs.

WARNING LIGHTS (D-10354 AND AFTER)

Two warning lights, placarded ALT and STARTER ENERGIZED, are located on the pilot's floating instrument panel below the flight instruments.

The warning light for the alternator will illuminate when the output from the alternator is nearly zero or when an alternator overvoltage occurs.

The starter energized warning light will remain illuminated after starting if the starter relay remains engaged after starting.

WARNING LIGHT CONTROL SWITCH

Located on the pilot's floating instrument panel near the warning light(s) is a switch placarded TEST-BRT-DIM-WARN LIGHTS. When the switch is held upward in the spring-loaded TEST position, the warning light(s) and the four landing gear position indicator lights will illuminate if none of the lamps require replacement. When released, the switch will return to the BRT position.

If the switch is in the bright (BRT) position, the warning light(s) and the landing gear position indicator lights will illuminate at high intensity. This position should be selected during the daytime and at other times when high ambient light levels are present in the cabin.

The DIM position allows the lamps to illuminate to a lower intensity. This position is generally reserved for night operations.

GROUND CONTROL

Steering is accomplished by use of the rudder pedals through a linkage arrangement which connects the nose gear to the rudder pedal shaft. Nose wheel straightening is accomplished by engagement of a roller with a track as the nose wheel is retracted. The steering link attaches to the steering mechanism on the nose gear with a swivel connection which permits the mechanism to disengage when the nose gear is retracted and operation of the rudder pedals will have no tendency to turn the nose wheel with the gear retracted.

The minimum wing tip turning radius, using full steering, one brake and partial power, is 26 feet 4 inches.

WING FLAPS

On airplanes prior to D-10179 the wing flaps are controlled by a three-position switch, UP, OFF and DOWN, located in the subpanel, above the power quadrant. The switch must be pulled out of detent before it can be repositioned. A dial type indicator has markings for UP, 10° , 20° and DN. The indicator is located to the left of the control column.

Limit switches automatically turn off the electric motor when the flaps reach the extremes of travel. Intermediate flap positions can be obtained by placing the switch in the OFF position as the flaps reach the desired position during flap extension or retraction.

On airplanes D-10179 and after the wing flaps have three positions; UP (0°), APPROACH (15°), and DOWN (30°), with no intermediate positions. A flap position indicator and a control-switch are located on the subpanel, above the power quadrant. The switch must be pulled out of a detent to change the flap position.

LANDING GEAR

The landing gears are operated through adjustable linkage connected to an actuator assembly mounted beneath the front seats. The actuator assembly is driven by an electric motor. The landing gears may be electrically retracted and extended, and may be lowered manually.

CONTROL SWITCH

The landing gear is controlled by a two-position switch on the right side of the subpanel. The switch handle must be pulled out of the safety detent before it can be moved to the opposite position.

POSITION INDICATORS

The landing gear position indicator lights are located adjacent to the landing gear switch handle. Three green lights, one for each gear, are illuminated whenever the landing gears are down and locked. The red light illuminates any time one or all of the landing gears are in transit or in any intermediate position. All of the lights will be out when the gears are up.

Testing of the landing gear position indicator lamps, as well as selection of either bright or dim illumination intensity, is accomplished with the warning light control switch located on the pilot's floating instrument panel.

1. Annunciator Panel
2. Clock
3. Airspeed Indicator
4. Attitude Indicator
5. Altimeter
6. ADF Indicator
7. Turn and Slip
8. Compass System
9. Vertical Speed Indicator
10. Warning Light Test Switch
11. Outside Air Temperature
12. Autopilot Altitude Selector
13. Autopilot Mode Controller
14. VOR Indicator
15. Altimeter
16. Slave and Align
17. Ignition
18. Battery and Altenator
19. Propeller De-Ice and Pitot Heat
20. Exterior Lights
21. Interior Lights
22. Elevator Trim Wheel
23. Cowl Flap
24. Firewall Air
25. Wing Shield Defrost
26. Cabin/Rear Heat
27. Parking Brake

Fuel Tank Selector

SAFETY SWITCH

To prevent inadvertent retraction of the landing gear on the ground, two main strut safety switches open the control circuit when the struts are compressed.

WARNING

Never rely on the safety switch to keep the gear down during taxi or on takeoff, landing roll, or in a static position. Always make certain that the landing gear switch is in the down position during these operations.

CIRCUIT BREAKER

The landing gear circuit breaker is located on the right subpanel. This circuit breaker is a pull-and-reset type breaker. The breaker will pop out under overload conditions.

BRAKES

The brakes on the main landing gear wheels are operated by applying toe pressure to the top of the rudder pedals. The parking brake T-handle control is located just left of the elevator tab wheel on the pilot's subpanel. To set the parking brakes, pull the control out and depress each toe pedal until firm. Push the control in to release the brakes.

NOTE

The parking brake should be left off and wheel chocks installed if the airplane is to be left unattended. Changes in ambient temperature can cause the brakes to release or to exert excessive pressures.

On serials D-9948 through D-10208 with shuttle valve brake system installed only the pilot's brake pedals can be used in conjunction with the parking brake system to set the parking brake.

CAUTION

On serials D-9948 through D-10208 with shuttle valve brake system installed, continuous brake application of either the pilot's or copilot's brake pedals, in conjunction with an overriding pumping action from the opposite brake pedals could result in the loss of braking action on the side which continuous pressure is being applied.

MANUAL EXTENSION

The landing gear can be manually extended by operating a handcrank at the rear of the front seats. This procedure is described in the EMERGENCY PROCEDURES Section.

WARNING HORN

With the landing gear retracted, if the throttle is retarded below approximately 12 in. Hg manifold pressure, a warning horn will sound intermittently.

BAGGAGE COMPARTMENT

The baggage compartment is accessible through the baggage door on the right side of the fuselage. This area extends aft of the pilot and copilot seats to the rear bulkhead. Because of structural limitations, this area is divided into two sections, each having a different weight limitation. Loading within the baggage compartment must be in accordance with the data in the WEIGHT AND BALANCE Section. All baggage must be secured with a Beech approved cargo net.

POWER PLANT

The BEECHCRAFT V358 Bonanza is powered by a Continental 1O-520-BA or 1O-520-8B six- cylinder, horizontally opposed, fuel-injected engine rated at 285 horsepower.

ENGINE CONTROLS

THROTTLE, PROPELLER, AND MIXTURE

The push-pull throttle, propeller, and mixture controls are located on the control console below the center of the upper subpanel. These controls are released for repositioning by pushing a button on the knob. With the button extended, fine adjustments are accomplished by rotating the knob, clockwise to increase and counterclockwise to decrease.

COWL FLAPS

The push-to-close, pull-to-open cowl flap control is located above and to the left of the control console on the subpanel. Except in extremely low temperatures, the cowl flaps should be open during ground operation, takeoff, and as required during flight.

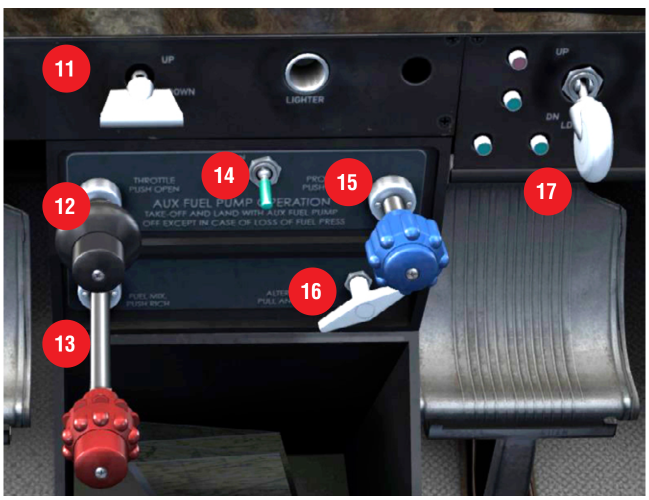
LUBRICATION SYSTEM

The engine oil system is the full-pressure, wet sump type and has a 12-quart capacity. Oil operating temperatures are controlled by an automatic thermostat bypass control. The bypass control will limit oil flow through the oil cooler when operating temperatures are below normal and will permit the oil to bypass the cooler if it should become blocked.

STARTER

The starter is relay controlled and is actuated by a rotary-type, momentary-on switch incorporated in the magneto/start switch. To energize the starter circuit, rotate the magneto/start switch beyond the BOTH position to START. After starting, release the switch to the BOTH position.

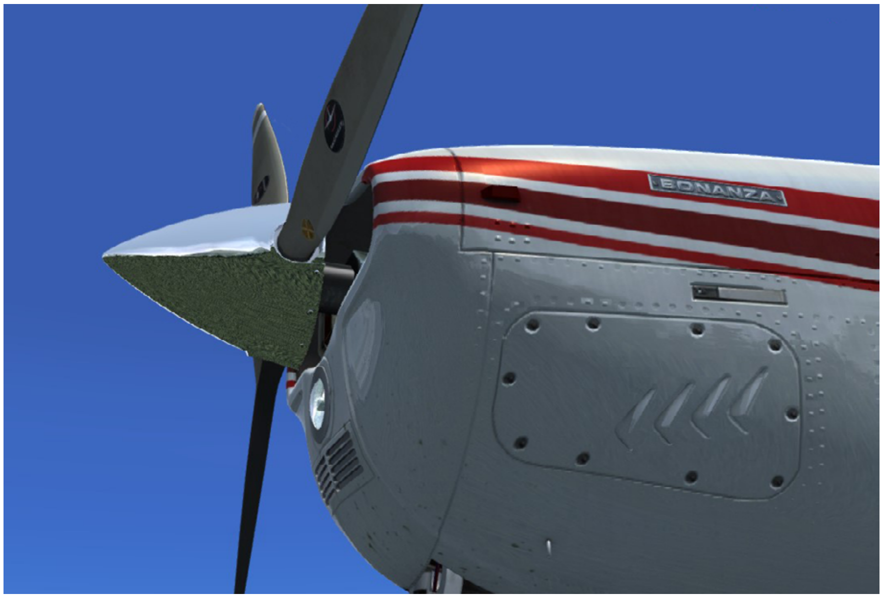
The warning light placarded STARTER ENERGIZE D (D-10354 and after) will illuminate whenever electrical power



1. Manifold Pressure/ Fuel Flow
2. Tachometer
3. Left Fuel Tank
4. Cylinder Head Tempurature
5. Oil Temperature
6. Ammeter
7. Oil Pressure
8. Right Fuel Tank
9. DME Mode
10. Exhaust Gas Temperature
11. Flaps Lever
12. Throttle
13. Mixture
14. Fuel Pump
15. Engine RPM
16. Alternator Air
17. Landing Gear Level

18. Avionics Master
19. NAV/GPS Mode
20. Audio Control Panel
21. Nav / Com Radio #1
22. Nav / Com Radio #2
23. ADF Receiver
24. Transponder
25. Fuel Tip Tank
26. Suction
27. Tip Tank Selector
28. Left/Right Tip Tank Fuel Pump

29. GPSMAP 295
30. GPS 400



is being supplied to the starter. If the light remains illuminated after starting, the starter relay has remained engaged and loss of electrical power may result. The battery and alternator switches should be turned off if the light remains illuminated after starting. If the light does not illuminate during starting, the indicator system is inoperative and the ammeter should be monitored to ensure that the starter does not remain energized after starting. The starter energized warning light can be tested with the TEST-BAT-DIM-WARN LIGHTS switch adjacent to the warning lights on the floating instrument panel.

PROPELLER

Installed as standard equipment on the Bonanza is a constant speed, variable pitch, 84”-diameter propeller with two aluminum alloy blades. The pitch setting at the 30-inch station is 13.3° low and 29.2° high pitch.

Propeller rpm is controlled by a governor which regulates hydraulic oil pressure to the hub. A push-pull knob on the control console allows the pilot to select the governor’s rpm range.

If oil pressure is lost, the propeller will go to the full high rpm position. This is because propeller low rpm is obtained by governor boosted engine oil pressure working against the centrifugal twisting moment of the blades.

FUEL SYSTEM

The airplane is designed for operation on 100/130 grade (green) aviation gasoline. However, the use of 1 00LL (blue) is preferred.

FUEL CELLS

The 74-gallon usable (80-gallon capacity) system only is available on D-10303 and after. The fuel system consists of a rubber fuel cell in each wing leading edge with a flush type filler cap. A visual measuring tab is attached to the filler neck of the optional system. The bottom of the tab indicates 27 gallons of usable fuel and the detent on the tab indicates 32 gallons of usable fuel in the tank. The engine driven fuel injector pump delivers approximately 1 0 gallons of excess fuel per hour, which bypasses the fuel control and returns to the tank being used. Three fuel drains are provided, one in each fuel sump on the underside of each wing and one in the fuel selector valve inboard of the left wing root. These points should be drained daily before the first flight. An additional 40 gallons of fuel and 200lbs of gross weight capacity can be added when tip tanks are installed.

FUEL QUANTITY INDICATION SYSTEM

Fuel quantity is measured by float operated sensors, located in each wing tank system. These transmit electrical signals to the individual indicators, which indicate fuel remaining in the tank. There are sensors in each wing tank system connected to the individual wing tank indicator.

AUXILIARY FUEL PUMP

The electric auxiliary fuel pump is controlled by an ON-OFF toggle switch on the control console and provides pressure for starting and emergency operation. Immediately after starting, the auxiliary fuel pump can be used to purge the system of vapor caused by an extremely high ambient temperature or a start with the engine hot. The auxiliary fuel pump provides for near maximum engine fuel requirements, should the engine driven pump fail.

FUEL TANK SELECTION

The fuel selector valve handle is located forward and to the left of the pilot’s seat. Takeoffs and landings should be made using the tank that is more nearly full.

On airplanes D-10404 and after, the pilot is cautioned to observe that the short, pointed end of the handle aligns with the fuel tank position being selected. The tank positions are located on the aft side of the valve. The OFF position is forward and to the left. An OFF position lock-out feature has been added to prevent inadvertent selection of the OFF position. To select OFF, depress the lock-out stop and rotate the handle to the full clockwise position. Depression of the lock-out stop is not required when moving the handle counterclockwise from OFF to LEFT MAIN or RIGHT MAIN. When selecting the LEFT MAIN or RIGHT MAIN fuel tanks, position handle by sight and feeling for detent.

If the engine stops because of insufficient fuel, refer to the EMERGENCY PROCEDURES Section for the Air Start procedures.

FUEL REQUIRED FOR FLIGHT

It is the pilot's responsibility to ascertain that the fuel quantity indicators are functioning and maintaining a reasonable degree of accuracy, and to be certain of ample fuel for a flight. Takeoff is prohibited if the fuel quantity indicators do not indicate above the yellow arc. An inaccurate indicator could give an erroneous indication of fuel quantity. A minimum of 13 gallons of fuel is required in each tank before takeoff. The caps should be removed and fuel quantity checked to give the pilot an indication of fuel on board. The airplane must be approximately level for visual inspection of the tank. If it is not certain that at least 13 gallons are in each tank, fuel shall be added so that the amount of fuel will be not less than 13 gallons per tank at takeoff. Plan for an ample margin of fuel for any flight.

ELECTRICAL SYSTEM

The system circuitry is the single-wire, ground-return type, with the airplane structure used as the ground return. The battery ON-OFF switch, the alternator ON-OFF switch and the magneto/start switch are located on the left subpanel. The circuit breaker panel is located on the right subpanel and contains circuit breakers for the various electrical systems. Some switch-type circuit breakers are located on the left subpanel.

BATTERY

A 15.5-ampere-hour, 24-volt battery is located on the right forward side of the firewall. Battery servicing procedures are described in the HANDLING, SERVICING, AND MAINTENANCE Section.

ALTERNATOR

The airplane is equipped with a 50-, 60- or 100-ampere, gear-driven alternator. The alternators are designed to maintain approximately 50-, 60- or 100-amperes output respectively at 1700 rpm, to provide airplane electrical power.

A transistorized electronic voltage regulator adjusts alternator output to the required electrical load, including battery recharge. Charging or discharging of the battery is indicated by the ammeter. A zero reading, which is normal for cruising flight, indicates that the battery is fully charged and that alternator output has been adjusted by the voltage regulate to balance the load of the electrical equipment in use. The alternator-out warning light, located on the instrument panel, can be tested with the TEST WARN LIGHTS switch adjacent to the warning lights.

INTERIOR LIGHTING

Lighting for the instrument panel is controlled by thumb-rotated, disc-type rheostats, located on the pilot's subpanel to the left of the control column. The first rheostat is labeled RADIO and ENG and controls the lighting of the avionics panel and the multiple readout engine instrument. The second rheostat, labeled INST, is optional and controls the lighting for the flight instruments and the instrument pressure gage.

On the lower subpanel are two more lighting rheostats. The first, labeled SUB, controls the intensity of the complete subpanel lighting. The second rheostat is labeled FLOOD and controls the glare shield lighting, which illuminates the full upper panel.

The cabin dome light is operated by an ON-OFF switch adjacent to the light. The optional reading lights above the rear seats have individual switches at the lights. The optional map light has a press-type switch on the control wheel. The OAT, map, and compass lights are controlled by a push-on, push-off switch located adjacent to the OAT or on the control wheel.

EXTERIOR LIGHTING

The switches for all of the exterior lights are located on the pilot's left subpanel. Each switch is a circuit-breaker-type switch, which will open if it becomes overloaded or shorted.

The exterior lights consist of navigation lights on the wing tips and tail cone, a landing light in the fuselage nose section, and a taxi light attached to the nose strut. The landing light can be used for approach and taxiing. Use the landing light for approach and the taxi light for taxiing. For longer battery and lamp life, use the landing light and the taxi light sparingly; avoid prolonged operation which could cause overheating during ground maneuvering.

NOTE

Particularly at night, reflections from anti-collision lights on clouds, dense haze or dust can produce optical· illusions and intense vertigo. Such lights, when installed, should be turned off before entering an overcast; their use may not be advisable under instrument or limited VFR conditions.

ENVIRONMENTAL SYSTEMS

CABIN HEATING

A heater muffler on the right exhaust stack provides for heated air to five outlets in the forward and aft areas of the cabin. The two forward outlets are located above and forward of each set of rudder pedals. The two aft outlets are installed behind the right front seat and the right rear seat. The fifth outlet provides heated air for windshield defrosting.

In flight, ram air enters an intake on the right side of the nose, passes through the heater muffler, then into a mixer valve on the forward side of the firewall. In the mixer valve, the heated air is combined with a controlled quantity of unheated ram air picked up at an intake at the rear engine baffle. Air of the desired temperature is then ducted from the mixer valve to the outlets in the cabin.

HEATER AND DEFROSTER OPERATION

The heater controls are located on the lower left pilot's subpanel. To obtain heated air to the cabin outlets, pull the CABIN HEAT control. The control regulates the amount of cold air that is mixed with the air from the heater muff. When the control is pulled fully out, the cold air is shut off and only heated air enters the cabin. The forward vents, located on the firewall forward of the rudder pedals, deliver heated air to the forward cabin when the CABIN HEAT control is pulled out. To deliver heated air to the aft seat outlets pull the AFT CABIN HEAT control. For maximum heat, the control is pulled fully out. To obtain heated air for defrosting the windshield pull the DEFROST control out. It may be necessary to vary or close the AFT CABIN HEAT control to obtain maximum air flow for defrosting. To close off all air from the heater system, pull the red FIREWALL AIR control located to the extreme left of the pilot's lower subpanel.

CABIN VENTILATION

In moderate temperatures, ventilation air can be obtained from the same outlets used for heating, by pushing the CABIN HEAT control full forward. However, in extremely high temperatures, it may be desirable to pull the red FIREWALL AIR control and use only the fresh air outlets described in the following paragraphs.

CABIN FRESH AIR OUTLETS

A duct in each wing root is connected directly to an adjustable outlet in the upholstery panel forward of each front seat. Airflow from each outlet is controlled by a center knob. The direction of airflow is controlled by rotating the louvered cover with the small knob on the rim.

OPTIONAL FRESH AIR VENT BLOWER

An optional fresh air vent blower controlled by an ON-OFF switch on the subpanel is available on serials D-10348, D-10364 and after. It provides ventilation through the individual overhead outlets during both ground and in-flight operations.

INDIVIDUAL OVERHEAD FRESH AIR OUTLETS

Fresh ram air from the air intake on the upper side of the aft fuselage is ducted to individual outlets above each seat. Each outlet can be positioned to direct the flow of air as desired. The volume of incoming air can be regulated by rotating the outlet. A system shutoff valve is installed in the duct between the overhead fresh air scoop and the individual fresh air outlets. The valve is operated by turning a knob on the overhead panel.

EXHAUST VENT

A fixed exhaust vent is located in the aft cabin.

PITOT AND STATIC SYSTEMS

PITOT SYSTEM

The pitot system provides a source of impact air for operation of the airspeed indicator. The pitot mast is located on the leading edge of the left wing.

PITOT HEAT

The pitot mast is provided with an electric heating element which is turned on and off with a switch on the instrument panel. The switch should be ON when flying in visible moisture. It is not advisable to operate the pitot heating element on the ground except for testing or for short intervals of time to remove ice or snow.

NORMAL STATIC AIR SYSTEM

The normal static system provides a source of static air to the flight instruments through a flush static fitting on each side of the airplane fuselage. Aft of the rear closure bulkhead (rear seat panel) is a drain plug, located at the low point of the normal static system. It is provided in order to drain moisture accumulations from the system. The closure bulkhead is held in place with Velcro and may be removed by pulling forward. The drain plug should be removed and the moisture drained from the clear plastic line every 100 hours and after exposure to visible moisture, either in the air or on the ground.

EMERGENCY STATIC AIR SYSTEM

An emergency static air source may be installed to provide air for instrument operation should the static ports become blocked. Refer to the EMERGENCY PROCEDURES Section for procedures describing how and when to use this system.

INSTRUMENT PRESSURE SYSTEM

Instrument pressure is supplied by an engine driven pressure pump. Pressure is controlled by an adjustable pressure regulator on the forward side of the firewall.

A gage located in the upper right corner of the instrument panel indicates the system pressure in inches of mercury. The pressure should be maintained within the green arc for proper operation of the pressure operated instruments.

STALL WARNING

A stall warning horn on the forward side of the instrument panel sounds a warning signal (the battery switch must be ON for serials 0-10097, 0-10120 and after) as the airplane approaches a stall condition. The horn is triggered by a sensing vane on the leading edge of the left wing and is effective at all attitudes. The warning signal will become steady as the airplane approaches a complete stall.

AUTOPILOT

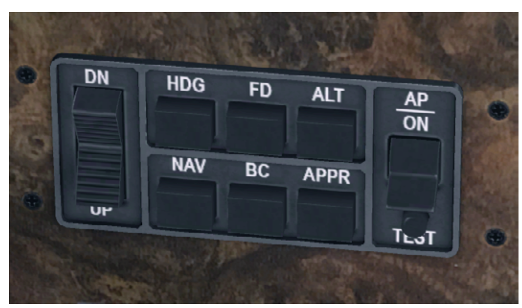

N41G
ALT
VERTICAL SPEED
AIR SPEED LIMITATION
FUEL
CYL TEMP
OIL TEMP
AMPS
OIL PRESS
TEST
ON
OFF

The TSO'd King KFC 200 Flight Director/ Autopilot is a complete 2-axis (pitch and roll with altitude hold) integrated system with professional 3-inch Flight Director displays. An optional 3-axis configuration with yaw damper mode is available for some aircraft at slightly higher cost. (Not included in A2A V35 Bonanza).

The basic 2-axis system provides all standard operating modes and functions, plus important pilot-oriented features usually found only in larger, more expensive equipment.

The "brain" behind this whole system is the solid-state KC 295 Flight Computer. It provides computed pitch and roll commands which are displayed as visual guidance commands on the V-bar of the KI 256 Flight Command Indicator.

Electric trim is also provided, along with an automatic autopilot trim system.



SYSTEM PANEL

1. The KA 285 Annunciator Panel annunciates all vertical and lateral Flight Director/Autopilot system modes, including all "armed" modes prior to capture. It tells the pilot when his selected mode has been received and accepted by the system and if an "armed" mode is selected when capture has been initiated It also has integral marker beacon lights and trim failure warning.
2. The KI 256 Flight Command Indicator (FCI) displays the following information:
   - Pitch and roll attitude.
   - Flight Director pitch and roll commands.
   - DH (decision height) annunciation when used with a radar altimeter.

   The KI 256 contains an air-driven vertical gyro. Engine must be running, pressure or vacuum system operating and gyro up to speed before the system will operate.
3. The KI 525A is the display portion of the KCS 55A Slaved Compass System and displays the following:
   - Slaved gyro magnetic heading information.
   - Selected heading (HDG "bug").
   - VOR/LOC/RNAV course deviation.
   - Glideslope deviation.
4. The KC 290 Mode Controller contains six pushbutton switches for turning on the Flight Director and selection of all FD modes; a solenoid-held switch for Autopilot engagement; a vertical trim rocker switch and a preflight test button.
5. The KAS 297 Altitude Selector allows the pilot to select an altitude and, upon approaching that selected altitude, obtain an automatic visual pitch command on the FCI to capture and hold the preselected altitude. It also provides altitude alerter.

OPERATING THE KFC 200 SYSTEM

There are eleven (11) modes of operation that are provided, by the KFC 200 system to offer the pilot Flight Director/ Autoprlot commands in response to his selection of desired modes on the Mode Controller.

Most of these modes are activated by pushbutton switches on the Mode Controller. These pushbuttons operate with alternate action. The first depression of the pushbutton activates a mode; the second depression cancels it, if it has not already been automatically deactivated. Annunciation of the mode selected appears on the annunciator panel.

Any operating mode not compatible with a newly-selected mode will be automatically cancelled in favor of the pilot's latest selection. This lets the pilot advance along his flight sequence without the inconvenience of having to manually cancel modes. For example, if in NAV CPLD mode, selection of Heading will automatically cancel NAV.

The system will be in the Basic Attitude Reference or "Gyro" mode with engine running and aircraft "power on," but no modes selected (Annunciator Panel blank). This provides indication of aircraft heading on the Pictorial Navigation Indicator. and roll and pitch attitude on the Flight Command indicator. The FCI Command V-bar is biased out of view.

PREFLIGHT TEST

With power on, ail circuit breakers in, and engine running, allow 3 minutes for the gyros to come up to speed.

Check the slaving switch position on the KA 51 B Slaving Meter, making sure you are in slaved gyro mode, and compare the compass card on the KI 525A with your magnetic compass. With no modes engaged, depress the Preflight Test button on the Mode Controller. All modes will be annunciated on the Annunciator Panel, including Marker lights, and the red Autotrim light will flash. At least four flashes are needed to indicate proper Autotrim monitor operation.

The pilot first engages the Flight Director, either by depressing the FD button or Pitch Sync (CWS) button. This will synchronize the Command Bars with the existing aircraft pitch and command wings level. Next, engage the Autopilot and apply force to the controls to determine if the Autopilot can be overpowered.

NOTE: The Autopilot will not engage when the Flight Director is not operating.

To confirm proper operation of all servos synchronize the Flight Director for wings level. Command nose up with FD Vertical Trim control. After 3 seconds you should observe the elevator trim wheel turning in the direction commanded. Re-synchronize the FD for wings level by using the CWS button, then command nose down with FD Vertical Trim control. After 3 seconds you should again observe the elevator trim wheel turning in the direction commanded. Re-sync the FD. Now set the heading bug under the lubber line on your PNI and engage HDG SEL mode. Move the heading bug to the right and to the left and observe if the controls operate as commanded.

Disengage the AP and check aircraft manual pitch trim. Set trim to takeoff position.

This concludes the preflight test.

FLIGHT DIRECTOR MODE (FD)

The Flight Director mode is activated by depressing the "FD" button on the Mode Controller.

The FCI Command V-bar will appear and provide the pilot with steering commands to maintain wings level and the pitch attitude that existed at the time of Flight Director engagement. To fly the Command V-bar, the pilot will bank and pitch the aircraft to put the orange delta wing 'aircraft" into the V-bar. The command is satisfied when the V-bar aligns symmetrically at the top of the orange delta wing If pitch attitude is changed, recycling the FD button will synchronize the Command V-bar to the new pitch attitude. If a change only in the commanded pitch attitude is desired, the Control Wheel Steering (CWS) button installed on the pilot's control wheel allows the pilot to synchronize the Command V-bar (in the FD mode with Autopilot disengaged) without removing his hand from the control wheel. The Flight Director can also be activated by direct selection of any specific mode which will activate the Command V-bar. Such selection will illuminate both FD and the appropriate annunciator mode.

Special note: The FD mode must be activated before the Autopilot can be engaged.

The Vertical Trim switch may be used to adjust the selected pitch attitude up or down at 1 degree/second.

AUTOPILOT ENGAGEMENT (AP)

The Autopilot is engaged by moving the solenoid-held AP switch on the Mode Controller to the "ON" position.

CAUTION Prior to Autopilot engagement, the pilot should make sure the V-bar commands are satisfied This will prevent any changes in the aircraft's flight path when the Autopilot is engaged.

The Autopilot provides two-axis (pitch and roll) stabilization and automatic elevator trim as well as automatic response to all selected Flight Director commands Installation of optional 3rd axis (rudder command) will damp out yaw oscillations and provide automatic tum coordination. Upon Autopilot disconnect, an Aural Alerter will sound a Sonalert for 2 seconds while the AP light on the Annunciator Panel flashes.

HEADING SELECT / PRESELECT MODE (HDG)

Select a desired heading by positioning the heading "bug" on the PNI. This is done with the HDG knob on the PNI. Depress the HDG button on the Mode Controller to activate the HDG mode. 'HDG" will light on the Annunciator Panel and a computed, visually displayed bank command is shown on the FCI. Following this bank command, the aircraft will bank and roll out on the desired preselected heading.

The Command V-bar on the FCI will deflect in the direction of the shortest turn to satisfy the commanded turn of the preselected heading. The aircraft may be manually banked to realign the V-bar and satisfy the command or, if the Autopilot is engaged, the aircraft will automatically bank, turn to, rollout and hold the preselected heading. As the aircraft approaches the selected heading the V-bar will command a rollout to wings level.

With the HDG mode in operation, subsequent changes made in the heading "bug" position on the PNI will immediately cause the V-bar on the FCI to call for a turn to the new heading, unless the HDG button on the Mode Controller has been depressed again to cancel the HDG mode.

The HDG mode is cancelled when NAV or APPR coupling occurs, or when FD mode button is pushed to "OFF"

NAVIGATION (NAV ARM AND NAV CPLD) MODE

The NAV mode provides visual bank commands on the Flight Command Indicator and deviation guidance on the PNI to intercept and track a VOR course or an RNAV course.

Operation of the NAV mode requires the pilot to:

1. Tune to the frequency of the selected VOR (or VORTAC) station. For RNAV operation, set in waypoint distance and bearing from the VORTAC station.
2. Set the PNI course pointer on the desired course.
3. Establish angle of intercept by setting heading bug and activate "HDG" mode.
4. Depress the NAV button on the Mode Controller.

When the "NAV" button on the Mode Controller is depressed, "NAV/ARM" will be lighted on the Annunciator Panel and the automatic capture circuit is armed. Heading select, if operating, is retained until capture occurs.

The VOR or RNAV "course-capture" point is variable to prevent overshoot and depends on angle of intercept and the rate the course deviation is changing. Upon capture, a bank command will be displayed on the FCI; the HDG, if on, will be cancelled and 'NAV/CPLD" will be lighted on the Annunciator Panel.

The pilot can manually bank the aircraft to satisfy the command display which will call for a rollout to wings level when on course centerline to track the course. Crosswind compensation is provided in the "track" state.

If the NAV mode is selected with the aircraft level within 4 degrees of bank and within three dots of course deviation, NAV/ARM will be bypassed and NAV/CPLD will engage directly

If the Autopilot is engaged, the aircraft will bank to satisfy the command display and rollout on course automatically. Upon station (or waypoint) passage, an outbound course other than the inbound reciprocal can be selected by resetting the NAV course arrow on the PNI. This will cause an immediate V-bar deflection on the FCI directing a turn to the new course

The NAV mode is cancelled by depressing the NAV button, or selecting HDG (when in NAV coupled) or APPR modes, or pushing FD to "OFF". Going back to HDG while adjusting OBS is desirable.

APPROACH (APPR/ARM AND APPR/CPLD, GS/CPLD) MODE

The APPR mode provides visual roll and pitch commands on the FCI V-bar to capture and track precision ILS (LOC and Glideslope) beams, or non-precision VOR or RNAV radials. Lateral and vertical deviation can be monitored on the PNI.

Operation of the APPR mode requires the pilot to:

1. Set the NAV receiver frequency.
2. Set the PNI course pointer to the inbound runway heading or the front course in case of ILS precision approach. Do this even on back course approach.
3. Set the HDG SEL "bug" on the PNI to the desired intercept angle and activate "HDG" mode.
4. Depress the "APPR" button on the mode controller.

The automatic APPR capture function will be immediately armed. "APPR/ARM" will be lighted on the Mode Annunciator Panel. In APPR/ARM mode, prior to capture, HDG is retained to allow the pilot to adjust heading to Approach Control vectoring instructions.

The LOC beam or VOR/RNAV "capture" point will vary, depending on angle of intercept and rate of change of deviation indication. Upon capture, a bank command will be introduced on the FCI, the existing heading mode will be cancelled and APPR/CPLD will be lighted on the Annunciator Panel.

The pilot may manually bank the aircraft to satisfy the command display, which will command a rollout to wings level when the aircraft is on course. Automatic crosswind compensation will provide precise tracking.

VOR/LOC deviation is shown on the PNI, and actual crab angle will be shown by offset of the course arrow from the lubber line.

Throughout APPR,mode operation LOC and Glideslope deviation or VOR/RNAV deviation are displayed on the PNI.

If the Autopilot is engaged during operation in the APPR mode, automatic steering response will follow the command display on the FCI. The Glideslope mode is armed for automatic capture if LOC front course capture has occurred. Automatic Glideslope capture occurs as the aircraft approaches the glide path from above or below. Upon interception of the Glideslope, capture occurs and "GS is lighted on the Annunciator Panel. A smooth capture pitch command is displayed by the Command V-bar. The pilot (or Autopilot) controls the aircraft to satisfy the Command V-bar. Slewing ALT at time of GS centering will inhibit GS capture.

Upon GS capture, the ALT HOLD mode (if active) is cancelled. However, ALT HOLD may be manually reselected to maintain altitude upon reaching MDA if visual contact is not established.

During VOR or RNAV approaches, Glideslope capture will not occur because the NAV receiver is channelled to a VOR station, not an ILS, and this locks out the Glideslope function.

APPR/CPLD mode is cancelled by selection of HDG, NAV. or Go-Around modes, or pushing FD or APPR to "OFF."

BACK COURSE (BC) MODE

Whenever a LOC or ILS frequency is selected, the BC mode may be activated by depressing the BC button on the Mode Controller, after selecting APPR. When in BC mode and

Localizer capture occurs, the system will turn and track outbound on the front course or inbound on the back course. "BC" is lighted on the Annunciator Panel.

Operation on BC is identical to front course operation, except that automatic Glideslope capture is "locked out" by the switching circuitry. Localizer deviation on PNI will have the proper sensing if the front inbound Localizer course was set on the PNI.

ALTITUDE SELECT (ALT ARM) MODE

This mode allows the pilot to select an altitude and, upon approaching that selected altitude, obtain an automatic visual pitch command on the FCI to capture and hold the preselected altitude. To operate in this mode the pilot must:

1. Set the desired altitude into the "selected altitude" window of the KAS 297 Altitude Selector.
2. Establish a climb or descent as appropriate.
3. Depress the ARM button on the Altitude Selector. This may be done at any time during the climb or descent before the selected altitude has been attained. "ARM" will light on the Altitude Selector.
4. The Altitude "ALERT" annunciator in the KAS 297 will illuminate 1000 ft. prior to reaching selected altitude and will cancel at 300 ft. prior. An aural tone will sound upon reaching altitude.

As the aircraft approaches the selected altitude, an "adaptive" pitch rate command will automatically guide the pilot through it at a low rate. As the aircraft reaches the selected altitude, ALT HOLD will automatically engage, "ALT " will light on the Annunciator Panel and "ARM" will disappear on the KAS 297. The command bars on the FCI will call for level flight at the selected altitude. If autopilot is engaged, the system will perform the required manoeuvrers.

ALT ARM is disengaged by depressing the ALT ARM button, by engaging ALT HOLD, by GS capture, or selecting FLT DIR to OFF.

ALTITUDE HOLD (ALT HOLD) MODE

This mode will cause a computed visual pitch command on the FCI command bars to hold the aircraft at the pressure altitude existing at the time it was activated. The mode is activated either automatically by the ALT ARM function, or manually by depressing the ALT button on the Mode Controller.

If the autopilot is engaged, it will automatically hold the aircraft at that altitude.

The Vertical Trim switch may be used to adjust the selected altitude up or down at a constant rate of 500 fpm without disengaging the mode. This enables the pilot to conveniently adjust the aircraft altitude to match resetting of the altimeter, or to make short descent segments during a nonprecision approach. The ALT HOLD mode is cancelled by automatic Glideslope capture or selection of ALT ARM, or GO-AROUND modes, or selection of FLT DIR to OFF.

MANUAL ELECTRIC TRIM

Manual Electric Trim switch on the yoke automatically disengages the AP (roll and pitch, but not yaw) in all installations, but will not affect the FD. Use of the AP DlSClTRlM INTERRUPT switch on the control wheel will disengage the AP, Yaw Damper and, in some installations, the Flight Director.

CONTROL WHEEL STEERING (CWS) MODE

When the Autopilot is engaged, Control Wheel Steering provides the pilot with the capability for natural and convenient manual maneuvering of the aircraft without the need to disengage and reengage the Autopilot, or reselect any modes of operation. The CWS mode is engaged by continuous pressure on the CWS button, normally located on the left hand horn of the control wheel. Operation of the CWS button causes immediate release of Autopilot servos and allows the pilot to assume manual control, while Autopilot control functions and Pitch Command and Altitude Hold modes are synchronized so that, upon release of the CWS mode button, the Autopilot will smoothly reassume control of the aircraft to the original lateral command and existing vertical command.

Since all engaged modes remain coupled (in synchronization) during operation of the CWS mode, their annunciator lights will continue to show on the Annunciator Panel. The CWS mode is not separately announciated.

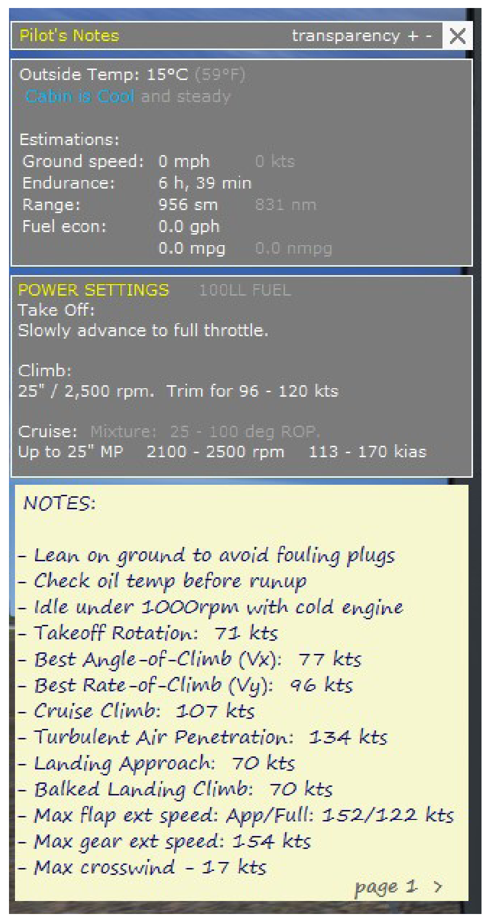
2D PANELS

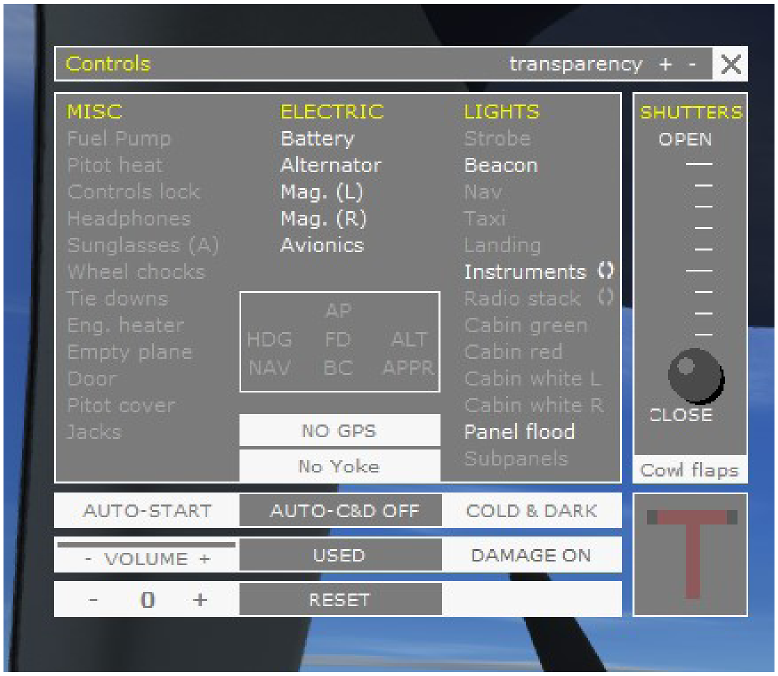
The 2D panels are there to provide the extra functionality needed when there is so much additional information available to you, the pilot.

Each 2D panel is accessed by the key-press combination in parentheses after the 2D panel title. If the default commands listed commands don't work please check the mappings in your host simulator under 'Panel Window 1 to 9'

Pilot's Notes (Shift 2)

- Outside Temp: is the ambient temperature outside the aircraft.
- Watch Engine Temps: this warning will display if your engine temperature is nearing danger limits. Corrective action should be carried out immediately if this warning appears.
- Cabin Temperature: displays how comfortable the temperature of the cabin feels.
- Ground Speed: this is your speed in relation to the ground in miles/hour and knots.
- Endurance: this figure tells you approximately how long you could remain in powered flight before running out of fuel. This figure will update throughout your flight, and as such you should take into account that during a climb phase, the endurance will be less than once the aircraft is settled in a cruise configuration.
- Range: given in statute (sm) and nautical miles (nm), this figure will give you an approximation of your maximum range under current fuel consumption and airspeed conditions. Again, this figure will change depending on your flight phase.
- Fuel Economy: is the current fuel burn rate given in gallons/hour (gph), miles/gallon (mpg) and nautical miles/gallon (nmpg).
- Power Settings: this represents your clipboard, showing you important information for the correct settings for takeoff, climb and cruise configurations.
- Notes: these are a set of pages (accessed by the small arrow to the right of the page number) that include information such as actions to be carried out when first entering the cabin, to landing checks.





Controls (Shift 3)
Initially designed to provide a means to perform various in cockpit actions whilst viewing the aircraft from an external viewpoint, this control panel now provides quick access to a number of different commands.

From this panel, you can:

- Remove the pilot figure from the external view (only available whilst the engine is not running). Note the visual change in the aircraft balance when you remove the pilot.
- Control electrical systems such as the generator or magnetos.
- Toggle aircraft lighting, both internal and external.
- Change the GPS system installed in your aircraft, from a bracket mounted handheld unit, to panel mounted units, or no GPS installed at all.
- Set whether you want the aircraft to already be in a Cold and Dark state when you first enter it.
- Have your aircraft switch to a "Used" state, where some aircraft components will immediately show signs of wear. Check your maintenance hangar before you go flying, so that you're aware of the systems and components that you'll need to keep an eye on.
- Turn Accusim damage on and off.

Payload and Fuel Manager (Shift 4)

The payload and fuel manager not only gives you an overview of your current payload, fuel and oil quantities, it is also an interactive loading screen, where you can:

- Add and remove passengers and baggage.
- Increase or decrease pilot, passenger and baggage weights.
- Fill engine oil
- Add or remove fuel from the wing tanks.
- Change between viewing weights and measures in imperial or metric format.
- View, at a glance, total aircraft weight, payload weight, and total fuel quantities.

Pilot's Map (Shift 5)

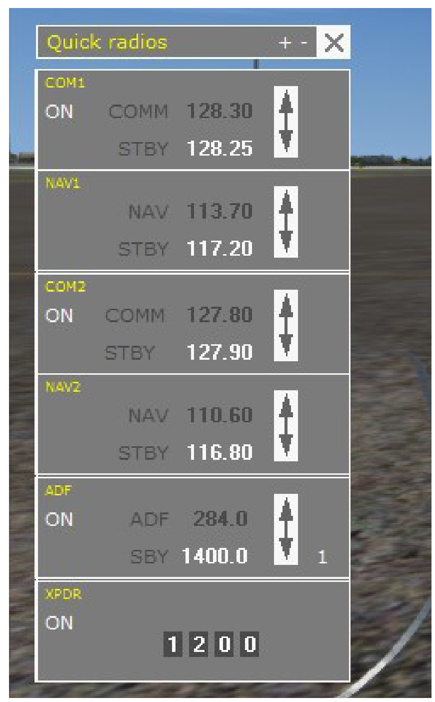
The pilot's map gives full and easy access to information that may be found on real maps, and allows this information to be accessed from the cockpit, as opposed to using the default map via the drop-down menus.

The accompanying panel to the map allows you to select what information you want to have displayed on the map, from a compass rose to low altitude airways.

Also note that some of the button selections have an increasing amount of information presented with each subsequent button press.

For example, the **APT** (Airport) button will show the following information:

- **APT 1:** Airport ID.
- **APT 2:** Airport name.
- **APT 3:** Airport elevation.
- **APT 4:** Airport radio frequencies.



Quick Radios (Shift 6)

This small popup panel provides input for your virtual cockpit radios but in a simplified and easy to use manner. This popup features all the amenities of the actual radios but in a singular unit which allows you to control your communication, navigation, ADF and transponder radios from a single source.

Maintenance Hangar (Shift 7)

The maintenance hangar is where you can review the current state of your aircraft and its major systems. It is one of the core elements to visualizing Accusim at work.

With the invaluable assistance of your local aircraft maintenance engineer/technician, a.k.a. "grease monkey", you will be able to see a full and in-depth report stating the following:

- A summary of your airframe, engine and propeller installed.
- Total airframe hours, and engine hours since the last major overhaul.
- General condition of the engine.
- Important notes provided by the ground crew.

From the maintenance hangar, you can also carry out a complete overhaul, by clicking the **COMPLETE OVERHAUL** button in the bottom right corner. This will overhaul the engine and replace any parts that are showing signs of wear or damage, with new or re-conditioned parts.

In order to fix any issues the mechanic has flagged up, we need to inspect the engine in greater detail. By left clicking the "CHECK ENGINE" text on the engine cover, it will open the following window.

COLOR CODES:

- **GREEN: OK**
- **YELLOW: WATCH**
- **RED: MUST FIX OR REPLACE**

Heavy wear or a component failure will be shown in red, and these components must be replaced.

We can choose to continue flying with the worn components, but extra care should be used and a close eye kept on those systems/components.

Any component with a yellow highlight is worn, but not unserviceable, so do not have to be replaced.

Compression Test

At the lower right hand corner is a **"COMPRESSION TEST"** button, which will tell your mechanic to run a high pressure differential compression test on the engine cylinders.

This is done by compressed air being applied through a regulator gauge to the tester in the cylinder. The gauge would show the total pressure being applied to the cylinder.

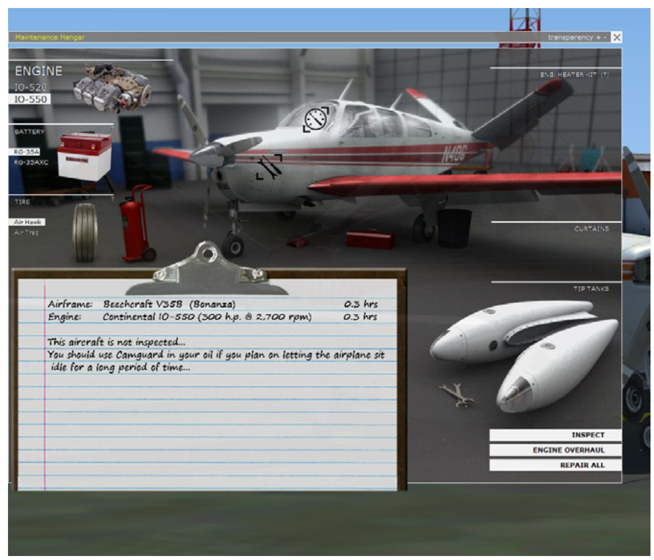
The compressed air would then pass through a calibrated restrictor and to the cylinder pressure gauge. This gauge would show the actual air pressure within the cylinder.

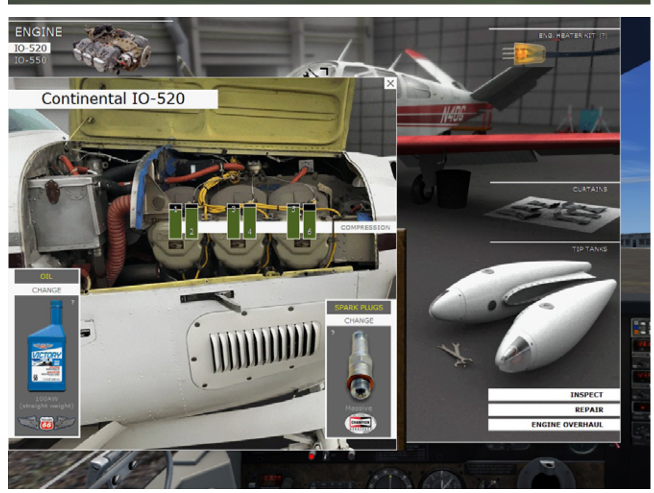
Any difference in pressure between the two gauges would indicate a leak of air past the engine components, whether that is the valves, piston rings, or even a crack in the cylinder wall itself.

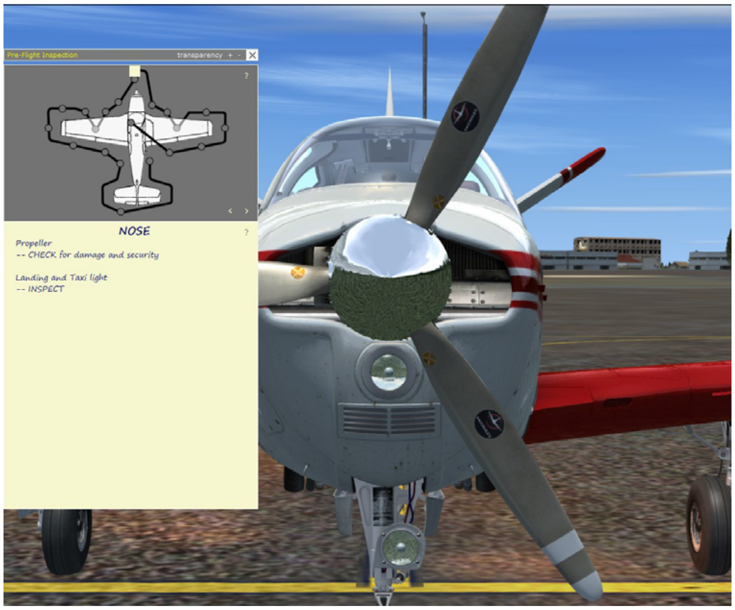
The readings that your mechanic presents to you in the "Compression Test Results" in the notes section, will be annotated with the actual amount of pressure read in the cylinder over the actual pressure that was applied to the cylinder through the regulator.

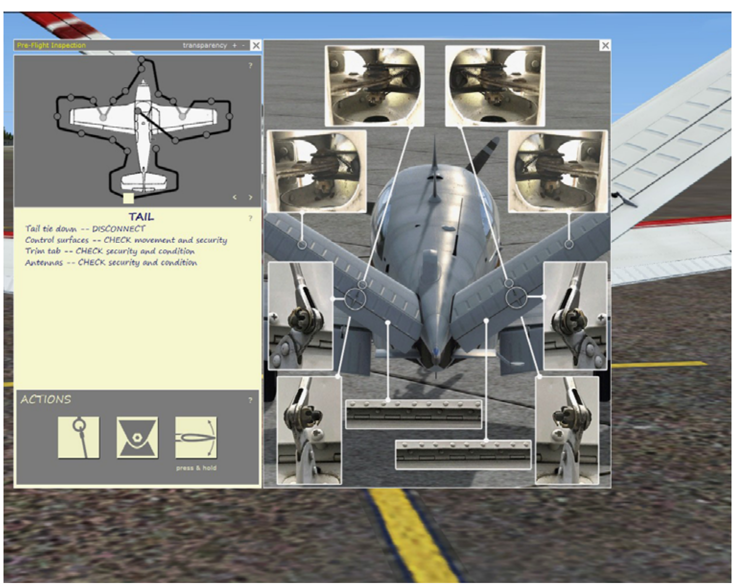
Low compression on a cylinder isn't necessarily a terrible thing, because as the engine picks up in speed, the worn cylinder becomes productive. It is mostly noticed at lower RPM's where the cylinder may have trouble firing, and also a marked increase in oil consumption may also occur (sometimes with an accompanying blue smoke out of that cylinder during flight).

However, note that this is a reading of the general condition of the cylinders, and lower condition does bring additional risks of failure, or even engine fires.









Pre-Flight Inspection (Shift 8)

The Pre-Flight Inspection is another advancement in bringing real life standard operating procedures into FSX and P3D.

The inspection system is done in such a way as to emulate making your walkaround inspection prior to flight.

There are 19 separate check sheets which are accessed by clicking the arrows in the bottom right corner of the aircraft top-down view window.

As you select the next check sheet, you will automatically be moved to the relevant view around the aircraft.

It's not just a case of clicking the next check sheet over and over again however, as there are actions to be carried out and visual checks to be made in order to complete the pre-flight correctly. If you miss something, maybe the landing light lens cover on the leading edge is smashed, expect to be notified by your mechanic in the Maintenance Hangar, as his sharp eye will pick up anything you miss.

The checklist itself shows an overview of the aircraft, with your walkaround route in black, and dots to highlight the areas where subsequent checks will be carried out.

The check list starts with actions to be carried out in the cockpit, prior to your walkaround.

Ensure that the checklist is carried out correctly, as checks and actions missed here will prevent you from carrying out the proper checks during your walkaround.

The first of the external checks covers the right wing. The checklist now has an additional bottom section in which specific actions can be carried out, or additional views can be accessed as a reference to what to look out for.

By left clicking on an action button, it will either perform an action, i.e. remove the tail tie down, or it will bring up a reference picture. In the example below, we're looking at the tail.

As part of the walkaround, checking the fuel tank sump quick drain valves is an extremely important check. If water enters the engine, expect a brief interlude of coughing and spluttering, quickly followed by the sound of silence.

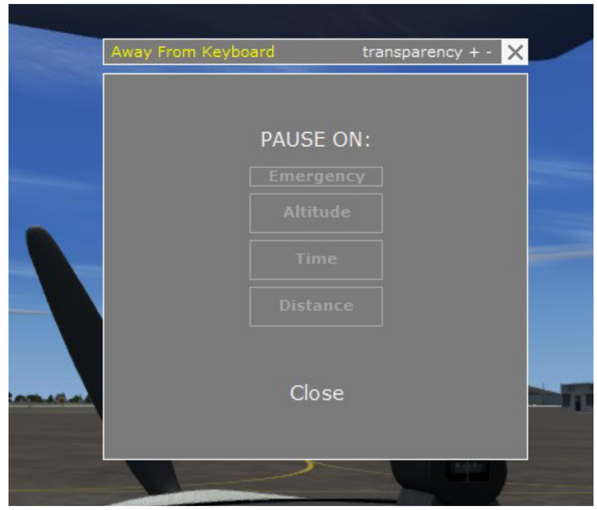
The oil dipstick is not only essential in gauging the total oil quantity, but also the condition of the oil. As you put hours on your engine, expect the oil to become darker due to suspended particulates that are too fine to be trapped by the filter. The oil also goes through chemical changes, which over time means that the oil isn't as capable of protecting your engine as it was when new.

Pause Control (Shift 9)

The pause controls are made available for those times when you need to be away from the simulation.

By left clicking the various boxes, you will turn that pause command on, and for the Altitude, Time and Distance boxes, a plus and minus arrow allow you to change the values for when the pause command will be issued.

If more than one box is switched on, the first trigger to be reached will pause the simulation.



Input Configurator

The Input Configurator allows users to assign keyboard or joystick mappings to many custom functions that can't be found in your sims controls assignments menu. It can be found in the A2A/Bonanza35/Tools folder inside your Add-ons directory.

The upper table is the axis assignment menu. From the drop down list, select joystick and axis you want to assign to each function and verify its operation in the 'preview' column. Mark the 'invert' check box if needed. The lower table is the shortcuts menu. Hover over a function name to bring up a tooltip with additional information.

To make a new shortcut, double click on a selected row to bring up the assignment window. Then press keyboard key or joystick button you want to assign to this function. For keyboard it's also possible to use modifier keys (Ctrl, Shift, Alt).

When done with the assignments, press "Save and Update" button. This will instantly update shortcuts for the aircraft. There is no need to restart FSX/P3D or even reset your flight for the changes to take effect, you can adjust shortcuts on the fly.

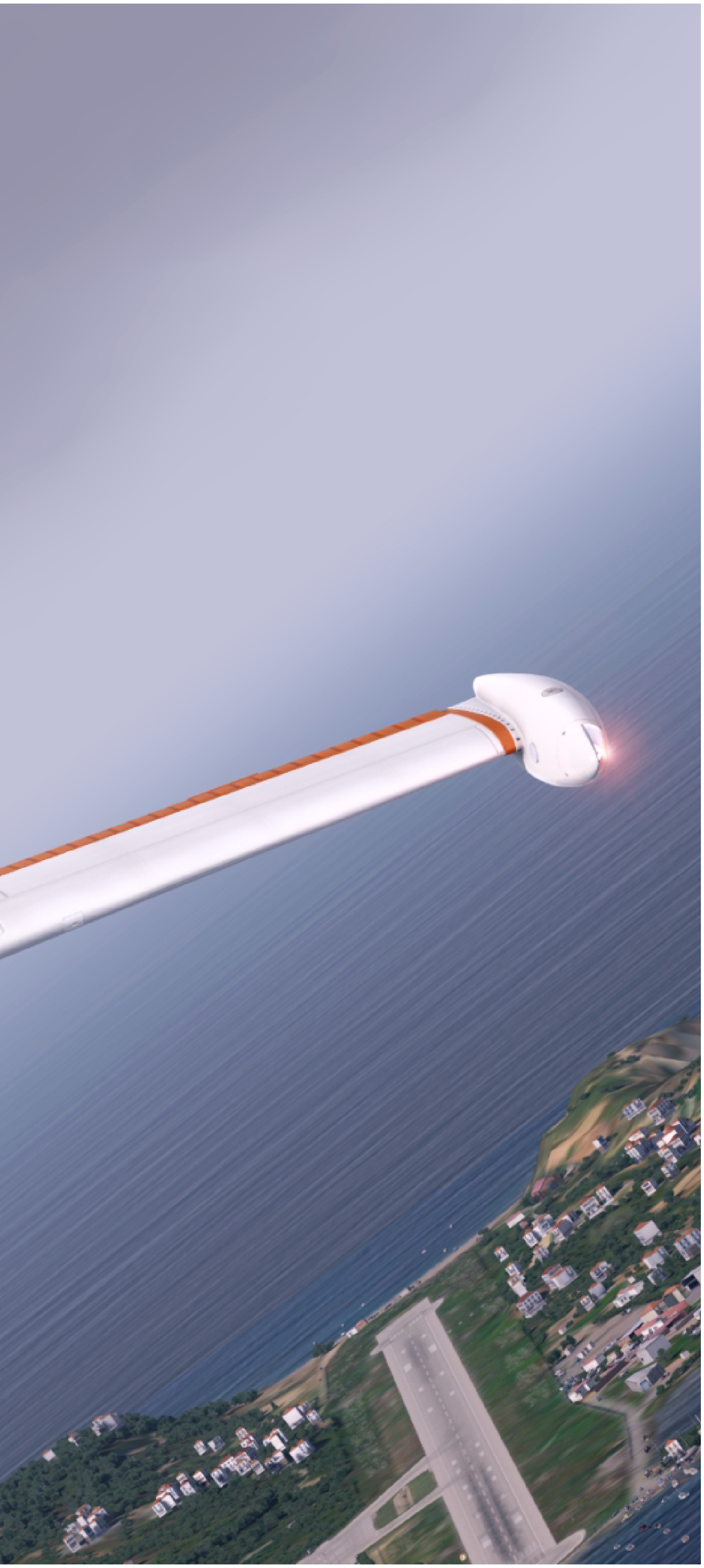
Aircraft Configurator

The Aircraft Configurator for the Accu-Sim V35B Bonanza enables the user to customize various aspects of the aircraft.

1. GPS – If you own third-party GPS products including the Flight1 and RealityXP v2 GTN and GNS units you can use this option to add them to the Bonanza's virtual cockpit. Default FSX and P3D GPS units can also be selected.
2. Dynamic Lights (Prepar3D v4 only) – This option allows you to customise dynamic lighting options to optimise frame rates in the simulator. Note that dynamic lighting in P3Dv4 does incur a performance penalty, so users with less powerful hardware may wish to leave these option unticked.
3. Landing Lights (Flight Simulator X only) – Users of FSX can choose between default landing lights or '3-D' lights which illuminate terrain textures.
4. Mirrors (Prepar3D v4 only) – The tip tanks on the Bonanza are fitted with mirrors which enable the pilot to verify the position of the landing gear. This option allows you to enable fully functional tip tank mirrors which display reflections of your own aircraft. This option is disabled by default to enhance frame rates in the simulator. However, reflections of the simulated landscape will still be shown if dynamic reflections are enabled in the Prepar3D lighting menu.
5. 4K – The '4K' option allows customers with high resolution monitors to increase the size of the 2-D panels for viewing comfort. Simply select a scaling factor from the drop down list. For example, to make the panels twice as big, choose "200%"

NOTE: these features are correct at the time of product release, but additional functionality may be added in subsequent updates.

CREDITS



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COMMUNITY AND SUPPORT FORUMS:
https://a2asimulations.com/forum/index.php

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