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C172

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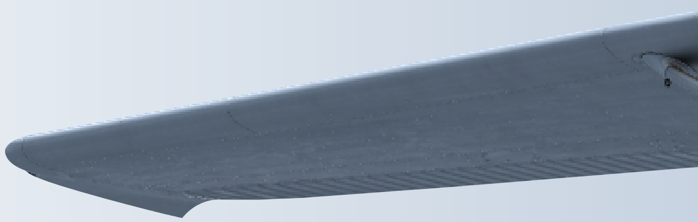


F-GOAP

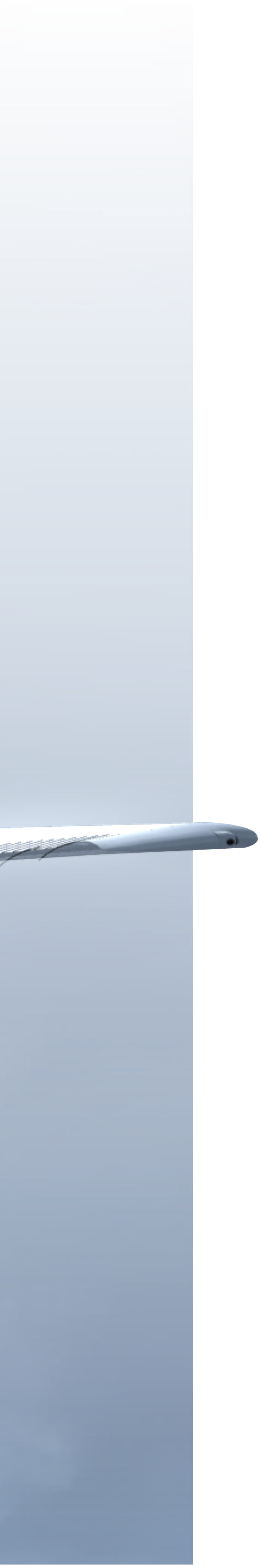
FOREWORD

by Mitchell Glicksman ©2013

Cessna 172/Skyhawk – the very definition of a classic aeroplane.

Merriam /Webster's dictionary defines "classic" as:

a : serving as a standard of excellence, of recognized value.
b : traditional, enduring, i.e., a classic design.



IF ANY AEROPLANE ever deserved to be called “classic”, then the venerable and ubiquitous Cessna 172 in all of its many variations surely deserves that title. It is a time-tested benchmark of aircraft efficiency, utility and excellence; it is one of the most recognizable aeroplanes (although sometimes mistaken for its larger and more powerful brother, the Cessna 182/Skylane and vice versa); its value has been and continues to be well-established and constant. The Cessna 172 has endured going- on six decades, and is an undisputedly traditional design. Classic? Q.E.D.

If Piper aircraft are “Fords”, based upon William T. Piper having been called “The Henry Ford of Aviation”, then Cessna aircraft are surely at least “Chevys”. Of course, in both instances I am referring to the smaller, lower powered, single-engine examples, the types of aeroplanes that most private pilots rent or fly as members of a club — Piper’s Tomahawks and Cherokees, and Cessna’s 152s, 162s and, particularly, the venerable 172/Skyhawk.

These Pipers and Cessnas are the aviation industry’s entry-level aeroplanes, just as lower-priced Fords and Chevys are their automotive equivalent (No slight or disrespect is intended towards any of the other automobile manufacturers who also offer excellent entry- level automobiles). It might be hard to find a private pilot who has not taken some dual and/or soloed in a Cessna 172. It is not unusual for many examples of the C-172 to be seen at just about any and every general aviation airport, and this is no surprise. After all, in its fifty-seven year production history, since November 1955 when the first C-172 was introduced to the public, over 60,000 of these versatile aeroplanes have been built, making it the most numerous aeroplane ever produced, by far.

All during its 57 year run (with no sign of going away) it has been one of the most economical, utilitarian, versatile, affordable, safe and easy to fly aeroplanes ever produced, not to mention one of the most popular, most reliable and relied upon of all general aviation aeroplanes. This, too, is no surprise. For all of these years the Cessna 172 has been a relaxing, fun, simple and relatively inexpensive aeroplane to fly and operate. Additionally, the C-172 in its various forms has and still serves in the U. S. Border Patrol and Civil Air Patrol for search and rescue missions as well as in over a dozen foreign air forces since its introduction.

All of this has not come about by chance. The Cessna 172 is an example of what can be achieved by intelligent compromise and attention to what is required as well as to what is desired in a basic four-seat aeroplane. While many Cessna aeroplanes have been ground - breaking and highly significant markers in the history of aviation, the simple, straight-forward, and distinctly unspectacular C-172 may be Clyde Cessna’s and his company’s greatest achievement.

If this is so it is not because the 172 exhibits blinding performance or is so extraordinarily lovely to behold. No, the 172 is a modest and ordinary looking aeroplane, an efficient short-hauler with moderate-payload and range. Stable and pilot-friendly it is also surprisingly nimble and quick on the controls when needs be. The 172 is a mostly docile (except for a sharp stall break under certain conditions), some might say pedestrian aeroplane, purposely designed to be able to be flown safely even by the dimmest bulb on the pilot tree. Not a fast cruiser or a rapid climber, it is, however, an honest, solid and reliable aircraft, neither overly forgiving

Photos of the 1937-38 Luscomb 8a

nor overly challenging. Accordingly, it is one of the best choices for both VFR and IFR training. With its high wing, granting an unobstructed downwards view, it is ideal for sightseeing, aerial photography and for patrol and surveillance duties.

FBOs and flying clubs love 172s because there are always excellent examples available in the market for purchase/lease, they are reasonably priced, cost effective to operate, are durable, and if well-maintained, hold their value well. Parts are plentiful and available but, as it is with all aeroplanes, they may be expensive depending upon which part(s) is/are needed. Pilots new to the 172 find that they offer no unpleasant surprises, are a quick study and require little time to check out in. They have an excellent safety record, keeping hull and liability insurance premiums to the minimum. They are not fuel guzzlers and can withstand a lot of pilot abuse. Renters find that they are not walletbusters, either.

On the debit side, 172s cabins are snug with limited shoulder and headroom for all but the smallest and slightest people. "Full sized" adults will find them an uncomfortable or even prohibitively small environment. Like many "four-seat" GA aeroplanes, the 172's average 900 lb. useful load does not permit full tanks plus four hefty adults on board. With standard tanks (43 gal.) on board, only 642 lbs. of available load remains. Of course, if you and your friends weigh an average of no more than 160 lbs. or so each, no worries. In the real world (my world, anyway) this may not be the case.

172s are slow; there is no way around it. It's a 120k (138 m.p.h.) aeroplane and that is all. Fully loaded it may climb at 600-700 fpm at sea level. The cabin is loud, even at cruise settings the engine produces a distinctive and pervasive low-midrange drone that makes casual conversation in the air without an intercom system somewhat difficult. However, from the "R" model forward, some attention to cabin soundproofing has been addressed.

Of the 60K Cessna172/Skyhawks that have been built since its debut in November 1955, more than 20,000 of those which remain are based and flying in the United States; the rest are scattered over virtually every corner of the world.

THE RISE OF A CLASSIC AEROPLANE

So then, from where and whence did this ubiquitous work horse of the general aviation fleet come?

Anyone seeking proof that evolution exists need look no further than the Cessna 172. Its design is a mélange, hybrid and accumulation of those designs of a number of previously successful aeroplanes. Many histories of this aeroplane start from the point when Cessna decided to put a nose wheel on their popular 170 model; but that does not go back far enough. It is clear that many of the specific design characteristics of the 172 gradually took shape and form from its immediate predecessors going back to just after World War II. The 172's real forefathers are the humble 120/140/140A models, the elementary, 85-90 h.p., single engine, high wing, two seat tail wheel aeroplanes which came into this world in 1946 as part of the virtually universally predicted General Aviation (GA) boom which so many supposed would blossom and thrive after World War II as a matter of course, but which never happened.

You see, the makers of general aviation aeroplanes thought and to be fair, not without sound reason, that thousands of returning military pilots would be more than anxious to jump at the chance of owning and flying their own aeroplanes now that they had experienced (on Uncle Sam's dime, if you please) the "wonderful world of flying". Sounds good, right? Wrong.

The real story which the virtually drooling after-war aeroplane manufacturers did not ken was that for all too many of these brave and valiant pilots their experiences in the air during the war ran from deadly dull to just deadly; and with not much in between. Fortunately, most service pilots' closest brush with the Grim Reaper whilst flying came from being bored to death on seemingly endless flights of all kinds in all kinds of turbulence and rough weather during which their most ardent, fervent wish was to return safely, and soon to terra firma, the more firma the less terra.

For those far fewer souls who found themselves, mostly by oft - regretted choice, in harms way at altitude, the experience of flying was mostly as described by U. S. M. C. Colonel Gregory “Pappy” Boyington: “Flying is hours and hours of boredom sprinkled with a few seconds of sheer terror.” Enough said.

So, between the recently bored and/or terrified ex-aeroplane jocks a far smaller realistic potential clientele for Pipers, Taylorcrafts, Cessnas, Stinsons and the like than had been so optimistically imagined actually existed. Still, after the enthusiastic, if unrealistic, post-war glut on the market of various GA aircraft types and makes, a few managed to survive, some by virtue of the brilliance of their design, most by virtue of the fact that they were relatively inexpensive to own and operate.

In 1946, aviation fuel cost around US .20 per gallon (worth approximately US$2.50 in 2013). This was not too bad; better anyway than the just over US$6.00 for 100LL in most places in the U.S. in 2013. In 1946, a brand new Cessna 120 cost a bit over US$3,000.00 (worth approximately US$37,198.00 in 2013); just about the price of a new, well-equipped BMW 3-Series 328i Sedan or Buick LaCrosse Hybrid Sedan (before taxes, etc.) in 2013.

For comparison, in 2013 1946 Cessna 120s in good condition were advertised for between a low of US$17,000.00 and a high of US$30,000 depending upon engine and propeller TBO, radios, etc. installed.

THE CESSNA 120/140 -WHERE IT BEGINS.

Piper, Taylorcraft, Stinson and others had been producing light, two-seat, high wing aeroplanes before the war slightly altering these aeroplanes for military use by the services to great effect. Cessna, however, which had seen its T-50 light twin used to great effect by the services as the AT-17 multi-engine trainer as well as building 750 Waco CG-4A-CE assault gliders of D-Day fame, had no similar light single of its own at war’s end and therefore has to start from scratch to catch up to the others. Looking around for ideas, Cessna was sure to notice Don Luscomb’s excellent 1937 “8” series “Silvaire”, an aeroplane widely used in the pre-war and wartime Civilian Pilot Training Program. (unimportant information: the very first aeroplane I ever flew and trained in was a Luscomb 8A on floats). Numerous distinct design similarities between the Luscomb 8 and the 120/140 are surely more than coincidental.

So, the great controversy continues; was the Cessna 120 a budget model of the 140, or was the 140 the deluxe model of the 120? While there are some distinct differences between them - the original 140 has flaps (albeit somewhat questionable as to effectiveness), and small “D” windows aft of the main side windows, as well as an electrical system which includes a starter - it was not long before many 120s got retrofitted with, you guessed it, “D” windows, an electrical system w/ starter, and in some cases, flaps.

All original 120/140s had C-85 Continental four cylinder horizontally opposed engines and fixed-pitch propellers of the cruise (lower pitch) or climb (higher pitch) variety.

As they came from the factory in 1946, the wings of the Cessna 120/140 were fabric covered; however, most

Photos of the 1946 Cessna 120

1948 Cessna 140

have by now been since converted to metal covering. Lift struts extending from the bottom of the fuselage to the wing s were of the "V" two-strut design. In 1948 the 140's instrument panel was updated from the old 30's/40's central cluster (clutter?) to something resembling a useful layout.

THE CESSNA 140A - THE TRUE ANCESTOR OF THE 172 EMERGES.

In 1949, disappointed by the poor sales and the short customer lines of returning aviators (see above) Cessna updated the 140 and the "A" model was introduced. The fuselage and interior were left unchanged; however some real aerodynamic improvements were included such as an entirely new semi- tapered wing for better roll response; and still a bit later, replacement of the original thin-chord, ineffectual flaps (which is why there is little practical aeronautical difference between the 120 and the 140) with slightly shorter but deeper real Fowler flaps, which finally gave the 140's flaps some authority.

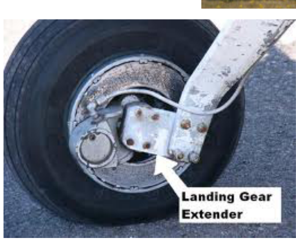
(The Fowler type flap's trailing edge flap extends rearward of the wings as it descends on special tracks. When deployed, wing area, camber and chord are increased and if there is a slot, or opening at the hinge line to allow airflow over the top of the flap, boundary-layer control may be improved. Fowlers provide the most lift per sq. ft. of surface of any type of flap; however, they require a complicated linkage system and mechanism.)

At the same time that Fowler flaps were installed, the powerplant was upgraded to the Continental C-90, 90 h.p. engine.

A big step on the way to the 172 was the new wing. The fabric covering of the 140A's original wing was replaced with a new design which was covered with stressed aluminum, stiffening the entire structure and thus permitting a single lift strut per wing rather than the dual "V", two-strut design of the 120/140. Additionally, the ailerons were lengthened and ran the length of the tapered outer-wing section and the wing tips were changed from rounded to what was thought to be a more modern-looking squared off shape.

Also, the 140A received an improvement in its landing gear. The 1946 120/140s already had the familiar Cessna flat spring leaf steel, main landing gear legs. While the materials used and the exact design of

The 1950C-140A



Landing Gear Extender

1948 Cessna 170

Cessna's landing gear legs have changed from steel leaf to tapered tubular spring over time, their profile and general appearance have remained essentially unchanged. The 140A had toe brakes which were not at all common in light aeroplanes at that time. Cessna was afraid that pilots new to this kind of brake control system would nose the 140A over too easily by braking too hard. Accordingly, the main gear was moved forward to put the C. G. farther behind the main wheels. Later, some 120s and 140s were retrofitted with landing gear extension modifications which moved their wheels forward as well. Pilots being the myriad, multifarious, magpies that they are, some have managed to nose over their 140As anyway.

Around 525 140As were built, including a few C-140A "Patroller" types, anticipating the 1949 L-19 (O-1) "Birddog", a derivative of the C-170. The "Patroller" was designed for use by police departments, who had vast areas of highway to patrol, such as are found in and around the deserts of the southwest U.S. They had see-through Plexiglas doors, 42 gallon fuel tanks for long range/long loitering time; and most curiously, a tube in the floor which could ostensibly be utilised for dropping messages and/or for more basic biological necessities.

The Cessna 140 has a special place in the hearts of all of those (me) who were first introduced to the reality that we could actually go flying by the late and much missed Frank Kingston Smith who, amongst his many books and magazine articles, wrote the delightful "Weekend Pilot". Therein he tells of how as a much beleaguered young Philadelphia attorney in the mid 1950s he almost succumbed to a depressing syndrome of ulcers and emotional dysfunction but for his accidental, but literally life-saving and life-changing introduction to and involvement with aviation. The airplane he bought and learned to fly in was a Cessna 140.

The Cessna 120/140 is one of the most gentle and forgiving of the classic tailwheel aeroplanes; however, interestingly (bafflingly), a few 140As have been spotted with nose wheel conversions, turning them into sort-of Cessna 150s. Most ironically, there are and have been for some time a number of companies offering a tailwheel conversion for the Cessna 150/152 turning them into sort-of Cessna 140A's! Madness, I say; madness.

THE CESSNA 170 - GETTING CLOSER TO HOME.

Given the time it takes for design development and prototype testing, the C-170, introduced to the public on 27 February 1948, a year before the debut of the C-140A, it is clear that as early as 1947 that Cessna was already committed to producing a four-seat version of their 120/140 models.

Like the 120/140, the new C-170 was initially produced with an all-metal fuselage and fabric-covered wings which had no dihedral and were called "straight-wings". The fin/rudder had no dorsal fin. The engine was upgraded to the reliable flat, six-cylinder, horizontally opposed 145 hp Continental C-145-2 (later the O -300A) with three of the C-140's fuel tanks totaling 42 US gallons installed in the wings to accommodate the larger engine. The lift struts were the same "V", two- strut design as on the 120/140. In every way, this new aeroplane was just a slightly larger 120/140; but changes were to come soon which would transform this aeroplane into the father of the 172.

Photos of 1950 Cessna 170A

THE CESSNA 170A - ARE WE THERE YET?

There is every reason to suspect that the initial C-170 was a temporary and somewhat hastily produced aeroplane because before the year was out, Cessna introduced the much slicker and more sophisticated C-170A. The fin/rudder now had a dorsal fin and was identical to that of the already established C-190/195 aircraft which were introduced in 1947. This aeroplane sported a new wing, now covered with metal and with slightly larger flaps. While these flaps were not yet the more effective "Fowler" flaps to come on the C-170B, they could be lowered to a whopping 50º! Like the C-170's wing, this new wing had no dihedral; accordingly, the C-170 and C-170A are called the "straight-wing" 170s.

In 1952 the pen-ultimate variant of the 170, the C-170B was introduced and production of this aeroplane continued until 1956, the year of the first C-172. The C-170B was a massive and distinct refinement of the 170 model and set the stage for all of the subsequent C-172 s which were soon to begin to appear.

Larger "Fowler" flaps, first seen on the C-140A and which were also used on the L-19 'Birddog" introduced in 1950 were installed in the C-170B's new wing. These were termed "Para-Lift flaps" by Cessna, but are more commonly called "barn door flaps". They initially could be lowered to 20º, 30º and 40º; however, beginning in 1955 an additional 10º flap setting for short-field take-offs was added.

Other aerodynamic refinements included a newly designed stabilizer/elevator with an increased aerodynamic balance area at the tips which incorporated within them an internal mass balance which reduced elevator control pressure. Also, in 1955, the rounded rear side windows were changed to be more square shaped, and a new, more durable type of tailwheel bracket was installed.

All of these refinements much improved the C-170; however the most significant and longest lasting refinement was the wing. The "B"'s new wing became the standard wing of all Cessna light single-engine aircraft, including the C-172, and is still incorporated to this day. The wing incorporated all of the previous refinements such as a stressed- skin metal covering, etc., and consists of a constant 64" chord NACA 2412 centre section from centerline outward to 100", at that point tapering to 44-

TOP: Photo of 1952 C-170B

BOTTOM LEFT: Photo of early 1960's era Army L-19 Birddog

BOTTOM RIGHT: Photo of Vietnam-era Air Force L-19/0-1 Birddog

inch chord NACA 2412 section at 208" from centerline. This new wing also now had 3º of dihedral with threeº washout (forward twist) across the tapered section only to prevent wing-tip from stalling before the wing-root. All of these refinements were carried over to the C-172 and have appeared on all subsequent 172 models. The 172 was now only one step away from birth.

THE CESSNA 170C - ALMOST THERE, KIDS.

In January 1955, while the scene was set and lit and the curtain seemed just about ready to rise on the Cessna 172, there was one more slight detour; the C-170C. Not quite ready to abandon its latest and most successful aeroplane, Cessna modified the C-170 one more time creating the C-170C. The 145 hp Continental C-145-2 engine used in all previous C-170s was replaced with the more modern flat six-cylinder, horizontally opposed, Continental 0-300-A. The O-300 is essentially a modernized C-145 and has the same dimensions, weight, bore, stroke, displacement, compression ratio and output. Both the C-145 and O-300 use a direct, un-geared drive to the propeller and produce approximately 145 h.p. Many pilots appreciate and are pleased by the smoothness of the six-cylinder O-300, but are less than pleased at their increased overhaul bill caused by the extra two cylinders.

The tail surfaces were once again revised to incorporate an even larger stabilizer/elevator (still with the same aerodynamic and mass balances of the C-170B) and a very businesslike, "modern" squared-off fin/rudder. This became the C-172's tail section.

While this aeroplane was promoted as the latest and the greatest of the C-170 series, Cessna had a trick card up its sleeve, and it was an ace. On 12 June 1955, Cessna unveiled what it had undoubtedly been working on for a long time -- the first tricycle gear Cessna -- the C-170C now had a nosewheel!

The 170's FAA type certificate initially included an additional provision for a "C-172" , which was done to reduce usual bureaucratic certification time and fees. After overwhelming approval of the tricycle geared 170 by the aviation community, a separate type certificate was applied for and received for the new Cessna 172.

Photos of 1955 Cessna 170C

THE CESSNA 172/SKYHAWK - HOME AT LAST.

"Everything old is new again."

The early to mid -1950's were yet another in the long series of periods of change in aviation since the Brothers started the whole shabang at Kitty Hawk on a frigid morning on December 17, 1903. It sometimes seems that there are no periods other than periods of change in aviation; but no matter. This time the big change was from GA aircraft with tailwheels to those with nosewheels.

While some of the pioneering and innovative Curtiss pushers of the early 1900s most presciently sported tricycle landing gear, i.e., having a wheel at the nose instead of one at the tail, that particular landing gear configuration was difficult to design into an airframe where the engine and its systems take up virtually all of the available space in the very front of the fuselage. The first military aircraft with a nosewheel produced in large numbers is believed by this author to have been the Consolidated PBY "Catalina" amphibious light bomber/patrol aircraft, which first flew in March, 1935. However, there was an even earlier GA aeroplane with a nosewheel (after the early Curtiss'), the W-1 designed by Fred Weick and flown in 1934. Other early GA aeroplanes with a nosewheel were the Stearman-Hammond Y-1 of 1936, followed by another, more famous Fred Weick design, the "Ercoupe" first flown in October. 1937.

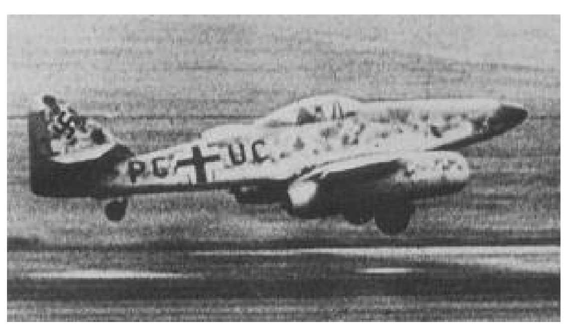
By 1938 after thousands of expensive and sometime fatal nose - overs of their tailwheel aircraft, the U. S. Army Air Corps was ready to try a new idea in a military

aeroplane; it was ready for aeroplanes with nose wheels and the beginning of a new era in aviation commenced. What followed were the P-38 “Lightning” -27 Jan. 1939; the P-39 “Airacobra” -April, 1939; the B-24 “Liberator”-mid-1939 (the first A. A. C. bomber with a nosewheel, the B-17 being the last A. A. C. bomber without one); B-25 “Mitchell” - late 1939; the B-26 “Marauder”-Nov. 1940. Of course, once the jet-age began, tailwheels were as useful as…well, whatever is not very useful (although, interestingly, the first operational jet fighter, the Messerschmitt Me-262 was first designed and test - flown with conventional tailwheel landing gear).

After World War II makers of GA aircraft soon followed the lead of the military. In 1951 Piper introduced its it’s first tricycle landing gear aeroplane, the four-seat PA-22 Tri-Pacer. It was a huge success and it surely challenged

Early nosewheeled aircraft:

- **Replica 1910 Curtiss “Pusher”**
- **W.W. II era Consolidated PBY”Catalina”**
- **1934 Weick W-1**
- **1936 Stearman-Hammond Y-1**
- **1937 Weick (Forney) “Ercoupe”**
- **An early Me-262**



1951 Piper "Tripacer"

and tasked Cessna to step up and to introduce a tricycle geared aeroplane of its own. Additionally, the impetus for Cessna to produce a factory tri - gear 170 possibly came because of the well - known tri - gear STC (Supplemental Type Certificate) for the 172 developed by Met-Co-Air in Fullerton, California, a modification which was being made by many C-170 owners.

In July 1955 the aeroplane destined to become one of the most beloved in its class, the Cessna 172, was introduced to the public, touted to now be equipped with "Land - O - Matic" (tri - cycle) landing gear. An overnight sales success, more than 1,400 were built and sold during the first year after its unveiling. Cessnas all-metal and far sleeker - appearing entry into the tri - gear race was more appealing to many than the fabric - covered, and to many stodgy and foreshortened - looking Piper Tri - Pacer.

After the C-172's appearance and huge success, the GA "nosewheel revolution" continued throughout the rest of the '50s and into the 60's until very few GA aircraft, except for special types intended for aerobatics, crop dusting, bush and rough country flying and other specific utility purposes were still being manufactured with tailwheels.

1960 saw a new swept - back tail on the C-172A which looked rakish, but didn't actually increase performance in any way. In 1961 the first C-172 was available as a "Skyhawk", an upscale, more luxurious version of the C-172B. However, after a short while, all C-172s were popularly called "Skyhawks" and the distinction gradually dissolved until 1977, when all C-172s were then and thereafter officially and simply named "Skyhawks".

A major change in the fuselage structure and in the overall appearance of the C-172/Skyhawk came in 1963, one year after the same modification was made

Photo of 1961 C-172A/Skyhawk

Cessna 172/Skyhawk w/ new fuselage

to the C-182 and to Cessna's single-engine flagship, the C-210 with the dropped rear fuselage and inclusion of a wraparound rear-view window. Not being an aeroplane likely to ever be involved in aerial combat, unobstructed vision to the rear might be seen by some as being somewhat superfluous in the 172; but it looked modern, added welcome light and a feeling of extra spaciousness to what is in the fastback versions of the aeroplane a fairly cramped and formerly claustrophobic environment.

While the original C-172 evolved and was altered over the years as to its appearance (swept fin/rudder, rear view window), available equipment, electronics, soundproofing, landing gear length and construction, control refinements, engine swops, experiments with cantilever wings, retractable landing gear, as well as plans for diesel and electric power; it has always remained what it was from the first: a reliable, utilitarian and good- mannered flying machine for four moderately sized people to fly for moderate distances at moderate altitudes and airspeeds.

Not an aeroplane which exhibits spectacular performance numbers, the C-172 nevertheless just keeps on doing what it has done from the first, which is to provide the ordinary private pilot with an excellent, if most moderate way to go aviating; and you know, sometimes moderation is the wisest practice after all, which during its 43 years and counting, the ever-popular Cessna 172 has well and truly proved.

1959 Cessna 175/Skylark

Photo of 1957 Cessna 180

SIBLINGS AND RELATIONS

THE CESSNA 175/SKYLARK

By 1958, the popularity and commercial success of the C-172/Skyhawk was firmly established. Cessna perceived that there was market for a more powerful C-172 but was unwilling to risk its star seller's reputation and "brand" recognition by going too far in altering the basic design. Accordingly a new Cessna, the C-175 was developed.

Intended to take its place between the heavier and more powerful Cessna 180 and the C-172/Skyhawk, the C-175 and the "Skylark", a more luxurious version, was intended to be both close enough and different enough to the "Skyhawk" to maintain a familial connection. The powerplant chosen was the Continental GO-300 which is a geared and beefed up 175 h.p. version of the 145 h.p. Continental C-145 engine which powered the Skyhawk. This turned out to be a poor choice of engine. Because it is essentially a 145 h.p. engine pushed to put out 30 more horsepower by gearing the propeller, its TBO (time between overhaul) is only 1,200 hours of operation, whist the un-geared C-145 (O-300)'s TBO is within the industry standard at 1,800 hours.

While there are a number of structural details that differ from the C-172/Skyhawk to accommodate its greater power and weight, the C-175/Skylark looks much like the C-172/Skyhawk, except for a distinct bulge in the cowling to make room for the rather large and bulky engine gear box. This at least makes the C-175/Skylark an excellent choice for a rather tricky "name that plane" contest.

The C-175/Skylark was not a successful aeroplane for Cessna. Firstly, it did not much improve the C-172/Skyhawk's performance all that much. Those who desired the spectacular and legendary performance of a C-180 simply chose it instead, and those who desired a C-180 with tricycle gear chose the C-182/Skylane. Secondly, the C-175/Skylark's ill-starred GO-300 engine was, perhaps hastily and unfairly perceived to be unreliable, possibly because of its low TBO, and accordingly the C-175/Skylark was largely ignored. Eventually realising that it had clearly made a serious marketing mistake, Cessna wisely dropped the aeroplane from its production lines after only four years of tepid sales.

THE CESSNA REIMS - FR172J "REIMS ROCKET"

Built in the mid '60s through the mid '70s by the French aviation company known alternatively as "Societè Nouvelle Max Holste, and "Reims Aviation", the pleasantly named FR172J "Reims Rocket" is essentially a heavily modified C-172F. Reims Aviation also produced modifications of other Cessna aircraft: F150 , F152, F172, F177, F182, F337, and the Reims-Cessna F406 "Caravan".

The Rocket was powered by a fuel-injected, Continental IO-360D of 210 h.p. (takeoff), 195 h.p. (continuous) which was built by Rolls Royce, with a constant speed, controllable propeller, which is also basically the same powerplant that is installed in the twin-engined Cessna 336/337 series.

It was the first 172 to have electrically operated flaps instead of the former manual, lever-operated flaps (which I personally like a lot better). The Reims Rocket was the prototype aircraft for the further modified U. S. A. F. T-41A “Mescalero” primary trainer (see below).

1972 Cessna “Reims Rocket

1965 T-41A,B “Mescalero”

1980 R172K Hawk XP on floats

THE T-41A,B “MESCALERO” – U.S. AIR FORCE PRIMARY TRAINER

In 1964 the U.S. Air Force chose the C-172A to be the aeroplane used for Undergraduate Pilot Training (UPT), later called Initial Military Flight Screening (IMFS) aircraft, naming it the T-41A. The Air Force rightly figured that if a prospective Flight Training Cadet could not learn to fly this most docile and forgiving aeroplane in a fairly short time, then he or she was not a likely candidate for their most rigourous flight - training program, of which your author has some practical knowledge.

The T-41A “Mescalero”, named after the “Mescalero Apache” tribe of New Mexico, was initially a stock 172. The following year the Air Force, influenced by the increased performance of the Cessna Reims - FR172J “Reims Rocket”, modified the T-41A with the installation of the same 210 h.p. (takeoff), 195 h.p. (continuous) Continental IO-360 engine, with a constant-speed controllable propeller in place of the stock 145 hp Continental O-300 and its 7654 fixed-pitch propeller, as was installed in the factory C-172A. This was the T-41B.

Additionally, in 1968 the U. S. Air Force acquired 52 T-41Cs, which had the same engine as the T-41B but with a fixed-pitch climb propeller for the Air Force Academy in Colorado Springs, Colorado, a climb propeller being most useful in that largely vertical territory. Three of these remain at the school and are used by, among others, the Academy’s prestigious show -flying team. A later “D” model of this aeroplane included more sophisticated avionics including a proprietary military TACAN (Tactical Air Navigation System) receiver; essentially a hyper-accurate VOR/DME.

The T-41 in its various incarnations was the U.S. Air Force’s Initial Military Flight Screening (IMFS) aircraft until 1993, when it was gradually phased out in place of the ill-fated and too-occasionally deadly Slingsby T-3A Firefly. The Air Force has since utilised the Diamond DA20 for this purpose.

R172K HAWK XP

Built both in Wichita and Reims between 1977 and ’81, had a fuel injected, Continental IO-360K (IO-360KB) a 210 h.p. engine which was soon derated to 195 h.p. to increase its TBO from 1,500 hours in 1977/ early ’78 to 2,000 hours thereafter, with a constant speed, controllable propeller. The Hawk XP was basically Cessna’s homegrown answer to the French Reims Rocket and could cruise at 131 knots as opposed to the plain-jane 172’s 120 k cruise. This slight increase in speed was not considered by some to be worth the extra purchase price and operating costs.

However, the one place that the R172K Hawk XP really shines is on the water. A standard 172 is not powerful enough to be an effective four-passenger floatplane;

Photos of 1980 Cessna 172RG “Cutlass

however, the Hawk XP on floats is one of GA’s nicest four-seat floatplanes, with its excellent takeoff performance and cruise speed of around 125K, which is very good for a floatplane in its class. (more unimportant information; I often flew a Hawk yea’ years ago from the old, now long gone and much missed “Suburban Seaplane Base” in Island Park, N.Y., located near the Long Beach /Island Park Bridge; and it was a class act with lots of get up and go).

THE CESSNA 172RG “CUTLASS”

Sometimes humourously (or maybe, not so humourously) called the 172 “RRR” (Pirates, Cutlass…whatever), the “RG” stands for the fact that this 172’s landing gear retracts. Introduced in 1980 and actually appearing on the Cessna 175’s FAA type certificate, the 172 RG is officially considered to be a variant of the C-175 and not of the C-172. It is powered by the venerable Lycoming O-360-F1A6 engine of 180 h.p. (also the familiar powerplant of the Piper “Comanche 180”, “Archer” and many others), with a constant-speed, controllable propeller. The idea was to make the 120 knot C-172 go faster. To do so cost US$19,000 more than the standard 172 so that the landing gear would get out of the way of the oncoming air. However, at the end of the day, the RG’s best cruise speed is only 140 knots compared to the 120 or so knots cruise of the standard and much less expensive 172. The extra expense of purchase, maintenance and annual inspection of a C-172 with retractable gear was not greeted with enthusiasm by many. Additionally, for some, the idea of an aeroplane with wing struts hanging out in the breeze and retractable gear seems and looks preposterous, and perhaps it is.

In any event, the C-172RG was a case of not enough go for the buck; and, accordingly, it did not find much favour in the mass GA market. The beginning of a worldwide slump in new GA aircraft sales in 1980 didn’t help, either. The RG found a small niche for itself, however, in flight schools which found it to be a relatively low-cost aeroplane for giving pilots the requisite complex aircraft (controllable propeller - retractable landing gear) experience necessary to obtain a Commercial Pilot’s Certificate in the U.S.

AOPA PILOT 50 years

Endurance test, circa 1958

150,000 miles without landing in a Cessna 172

BY STEVEN W. ELLS

During the months of December 1958 and January and February 1959, two young men flew a mission-modified Cessna 172 around and around over the desert Southwest for 64 days, 22 hours, and 19 minutes. The world endurance record in a propeller-driven airplane was set in that little Cessna almost 50 years ago.

Remember 1958? Arnold Palmer had 24 cents a gallon. *TIME* magazine predicted that the electronic eyes of satellites would help forecast the weather, and President Eisenhower deployed the U.S. Marines to Lebanon.

In the 1920s, endurance

Bob Timm, Preston Foster, Warren "Doc" Bailey, and John Cook

and Lt. Oakley Kelly on October 5 and 6, 1922, in a Fokker T-2. In June and July 1935, aerial refueling permitted Fred and Al Key to stay aloft above Meridian, Mississippi, for 653 hours, 34 minutes (over 27 days) in *Ole Miss*, a Curtiss J-1 Robin. Both the Fokker T-2 and

NOTEWORTHY FLIGHTS

LONGEST TIME IN THE AIR

WORLD'S RECORD FLIGHT

As part of a clever and spectacular fund- raising scheme for the Damon Runyon Cancer Fund, Robert Timm and John Cook took off from McCarran Airfield, Las Vegas, NV in Cessna 172 N9172B on December 4, 1958. What was different and newsworthy about this particular takeoff was that the next landing did not occur until 64 days, 22 hours, 19 minutes and 5 seconds had elapsed when they landed back at McCarran Airfield on February 4, 1959.

Timm and Cook pulled up all personal necessaries, such as food, water with buckets on ropes and through the specially made accordion door on the passenger's side from a truck, which drove at full throttle down a long, straight road with the Cessna flying overhead and matching its speed. Fuel was taken on board through a hose, which first fed a special auxiliary fuel tank in the belly of the aeroplane which, in turn, fed the two wing tanks. Extra oil was carried on board and fed to the engine through a hole in the instrument panel and firewall.

To accommodate all those cans of oil and other living necessaries, there was only room in the snug and crowded cabin for the pilot's seat. A soft, roll-up pad was used as sleeping accommodations for the pilot not on duty.

Problems arose early in the flight when the electric generator, which was driven by the engine, failed. Undaunted by this setback, the innovative Timm and Cook called for and hauled up a wind - driven generator from an Aeronca Champion, duct-taped it to the right wing strut and plugged it into the aeroplane's cigarette lighter receptacle, thereby providing electric power for the remainder of the flight, which went without a further hitch.

Once they knew that they had broken the world's record for endurance in flight, the pilots wisely decided to end their flight as their faithful Cessna's beleaguered and tired engine was, after over 1,500 hours of continuous operation, starting to lose power. Near the end of the flight, the exhausted 172 could hardly climb away after refueling and before all ended in tragedy, the time to call it quits was clearly on hand.

This world's record breaking Cessna 172 can be seen on display in the passenger terminal at McCarran International Airport, Las Vegas, Nevada.

TO RUSSIA WITH LOVE

On 28 May 1987 at approximately 7:00 p.m., 18 (or possibly 19) year - old Mathias Rust, a German pilot with only around 50 hours of flight experience, flew a rented German - registered Reims Cessna F172P, D-ECJB from Helsinki-Malmi Airport through Soviet airspace to a landing on a bridge near St. Basil's Cathedral in Red Square, Moscow, U. S. S. R. Rust was detected by but not stopped by Soviet air defense forces.

As it happens, Mr. Rust was luckier than he could have hoped for in that the overhead electric trolly wires that usually run along and above the bridge were under repair and had been taken down on the morning of the day he landed there and were replaced the next day. After a successful landing, Rust then taxied off the bridge, past the famous Cathedral and came to a stop about 100 metres from the entrance to Red Square. His approach and landing was videotaped by a British doctor. Rust was promptly arrested, tried and sentenced to 4 years in a labour camp. However, he did not actually serve out his sentence in a labour camp, but instead at the far less rigourous high security Lefortovo temporary detention facility in Moscow. Rust had served less than one year of his sentence, when he was released by order of General Secretary Mikhail Gorbachev in August 1988 as a gesture of good will to the west.

YOUR CESSNA 172R SKYHAWK

This is the aeroplane that almost never was. In fact, there almost were never any more light Cessna aeroplanes built after 1985. In the mid 1980s, the economy in the United States was in very bad shape, something we know all about again today. Also, a spate of what some might consider unwise, unreasonable and draconian decisions by various courts regarding product liability had crippled manufacturers of light aircraft such as Cessna and had rendered their businesses untenable. Accordingly, unable to thrive in such a hostile insurance climate, Cessna simply closed up shop. Almost ten years went by, but in 1994 President Clinton signed the General Aviation Revitalization Act, which eased and limited the manufacturer's liability with regard to accidents in which there occurred monetary or property damage and/or personal injury as a result of the operations of a light GA aeroplane.

The result was that in 1995, a new C-172, the "R" model would be produced. This new 172 was an improvement over the last 172, the "N", built in 1985, in that the "R" has the larger fuel injected Textron Lycoming IO-360-L2A engine. The last 172, the "N" had the smaller, carburetted Lycoming O-320. This Lyc 360 was de-rated from its usual average 180 h.p. to produce only 160 h.p., which means that it lasts longer and has a greater TBO. Also, the injected Lyc I0-360 produces maximum power at only 2,400 r.p.m. ,making it quieter and more fuel efficient than the faster- turning Lyc 320.

The "R" got a complete interior make-over with vertically adjustable, contoured, reclining, 26g seats and an inertia-reel seat belt/harnesses (a responsive echo from the old product liability lawsuits), an efficient multi-level ventilation system (always an important feature for flight simmers), an intercom system for all four seats, and extensive soundproofing which was sorely needed in the aeroplane's previously overly-loud interior environment.

Structurally, the "R" received stainless steel control cables, dual vacuum pumps, epoxy corrosion protection, larger fuel tanks, tinted windows, better, back-lit, non-glare instruments, a systems annunciator panel, optional wheel fairings, and more radio package choices including GPS or IFR GPS.

An upgraded version, the 172S Skyhawk SP was offered in 1998 with the full-power Lyc IO-360 rated at 180 h.p., a larger propeller and a leather interior.

Not a generic "C-172", A2A has specifically modelled every aspect of the C-172R in every detail using the tremendous amounts of information of all kinds which were derived from the pilots on our staff's extensive real-world flying of an excellent example of the Cessna 172R. Taking all of that information, we modelled the most authentic and accurate flight-sim Cessna 172R available, both visually and in its flight characteristics. We do this because we have a passion for flying which we want to share with you. Enjoy!

DESIGNER'S NOTES

OVER TEN YEARS ago, A2A (then Shockwave Productions) entered the flight simulation scene with strong opinions of what was needed in our flight simulation industry. And thus, began our quest to unwind and re-define what the word "simulation" truly means. Today and over a decade later, we have released a new airplane, the Accu-Sim C172 Trainer. This is one of our most ambitious and important projects to date.

The month preceding the public release of this aircraft brought a new challenge, and that was “how do we show our customers what this product is?” Everywhere we look, we see brand new substance. While the Cessna 172 is a simple aircraft to operate, reproducing and simulating all of the building blocks of this machine is not. The conversations we’ve been having with many companies and people in aviation were different than most were used too, because here comes this ambitious company A2A having to understand aspects of an airplane that pilots, mechanics, and even many engineers don’t have to know. But we do, because we must produce the exact same product in a different world. The wonderful and magical world of flight simulation.

Soon you will be reading and possibly participating in discussions within our simulation community that are virtually identical to the conversations taking place right now throughout the aviation communities, with questions like “what oil do you recommend during the winter months?” “How do you like that propeller?” “Do you lean your engine by ear or using the EGT gauge (exhaust gas temperature)?”

Your Accu-Sim airplane has been developed as we go back and forth from the airport to our development workstations. Not only does the aircraft and its systems persist from flight to flight, even engine temperatures persist. So if you land at an airport on a cold day, park the plane, turn your computer off, grab lunch and return an hour later, you will find an engine that is still warm. If you wait until the next morning to fly, it will be what is known as “cold soaked.” However, if you plugged in your electric engine heater you can come back anytime and find a nice, warm engine waiting for you. Warm up times will be much shorter, and your engine will actually last longer. This is what aircraft owners talk about, and do.

However, probably the most ambitious new feature in the Accu-Sim C172 Trainer is the Pre-Flight Inspection (a virtual walk-around). You can now, more than ever, visually see the state of the airplane. You can check for water in the fuel, inspect various hinges, check the oil, tires, and even wiggle the flaps by hand to see how secure they are. In fact, this walk around system is so complete, that we could hand this product to a future pilot who has never even gotten close to a Cessna 172 and a week later, ask him or her to perform a pre-flight inspection on the real aircraft. The result would be a person with a solid understanding of what parts and systems need to be checked and why, and this would have all been learned without realizing it since it was, in this case, interactive and fun.

“Fun” is a key word to learning and has been the core of Accu-Sim since its inception. To be truly immersed in a simulation, is to truly have fun. This is who we are, flight simmers. We block out the world around us and want to get ourselves lost in an alternate reality. This is simulation. But it must be true. When you do something as simple as turn an ignition key and engage a starter, there are things you can expect to happen…. physical things. Much of our interpretation of the physical world around us is known to us, subconsciously. We instinctively know when something looks and feel right and conversely, when something “just doesn’t seem right.” During our development of our Accu-Sim aircraft, we are continually looking, probing, and testing all kinds of combinations of things to make sure the physical world in Accu-Sim is as true as we can make it to the natural world we all live in.

Pilots and aircraft enthusiasts are a discerning, sensitive bunch. We’re tough to please, which helps define who we are. We welcome everyone to the new Accu-Sim C172 Trainer. We hope you get not just hours, but months if not years of growth and enjoyment from it.

A2A simulations

THE AIR TO AIR SIMULATIONS TEAM

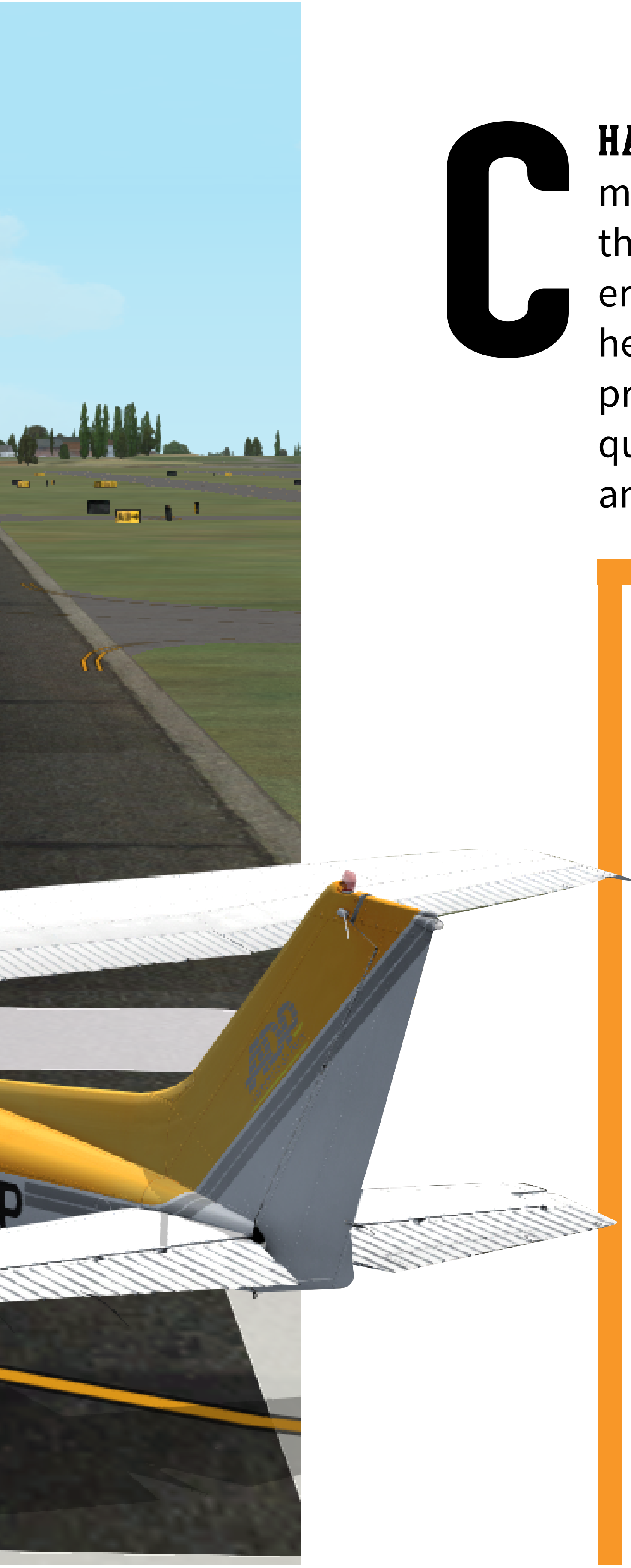
FEATURES

What you can expect from your A2A Accu-Sim C172 Trainer.

- Experience one of the world's most popular trainer airplanes.
- Designed for both professional commercial pilot training and entertainment.
- Immersive pre-flight inspection system designed by pilots while operating the actual Cessna 172.
- A true propeller simulation.
- 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 Lycoming 360 engine. Now the gauges look beneath the skin of your aircraft and show you what Accu-Sim is all about.
- Authentic Bendix King Avionics stack including the KMA 26 Audio Panel, two KX 155A NAV/COMMS, KR 87 ADF, KT 76C Transponder, KN 62A DME, and KAP 140 Two Axis Autopilot with altitude pre-selection.
- Three in-sim avionics configurations including no GPS, GPS 295, or the GNS 400. Built-in, automatic support for 3rd party GNS 430 and 530.
- 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).
- Pure3D Instrumentation now with natural 3D appearance with exceptional performance.
- A total audible cockpit and ound 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 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.

QUICK-START GUIDE

Everything you need to get cleared for take-off as soon as possible.



CHANCES ARE, IF you are reading this manual, you have properly installed the A2A Accu-Sim C172 Trainer. 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 C172 Trainer requires the following to run:

- Requires licensed copy of **Lockheed Martin Prepar3D**
- **Service Pack 2** (**SP2**) required

NOTE: while the A2A Accu-Sim C172 Trainer 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

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:

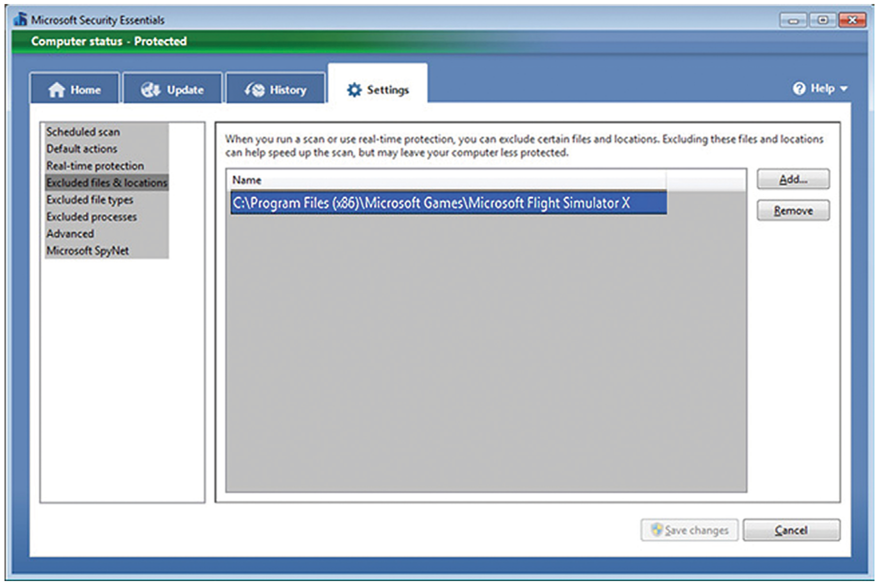
- DirectX 9 hardware compatibility and audio card with speakers and/or headphones

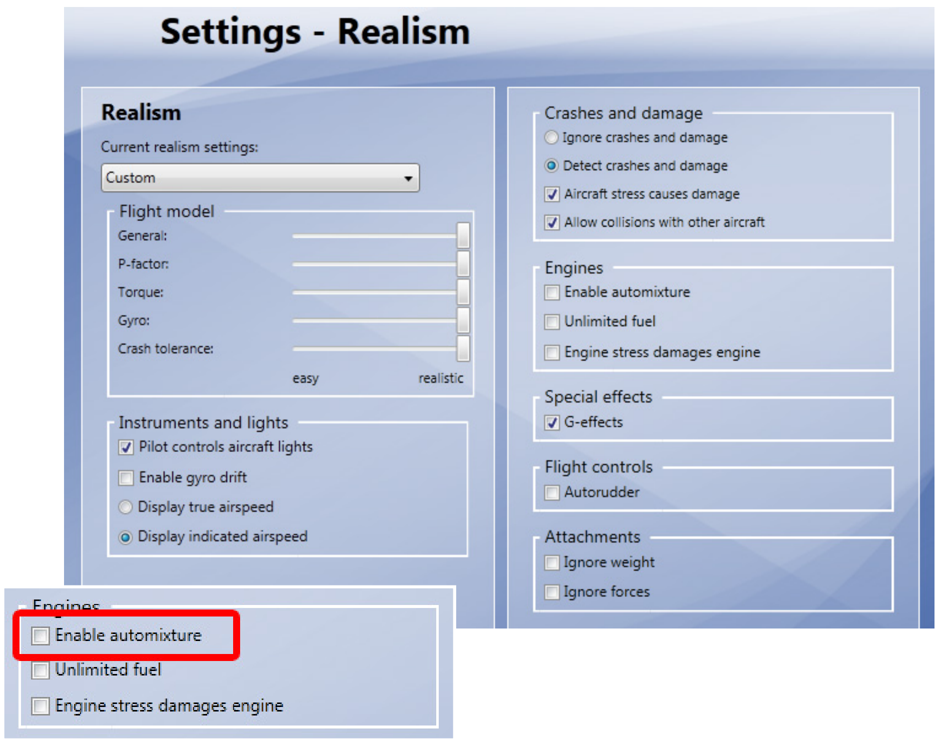
INSTALLATION

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 Lockheed Martin Prepar3D as shown on the right.





REALISM SETTINGS

The A2A Simulations Accu-Sim C172 Trainer 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 C172 Trainer.

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 above. The only exception would be "Crash tolerance."

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. The Spitfire has a fully working automatic mixture control and this will interfere with our extensively documented and modeled mixture system.

FLIGHT CONTROLS

It is recommended you have "Autorudder" 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.**

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 stick 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 engines is to re-load your aircraft while running.

ACCU-SIM AND THE C172 TRAINER

ACCU-SIM IS A2A Simulations' growing flight simulation engine, which is now connectable to other host simulations. In this case, we have attached our Accu-Sim C172 Trainer to Lockheed Martin Prepar3D to provide the maximum amount of realism and immersion possible.

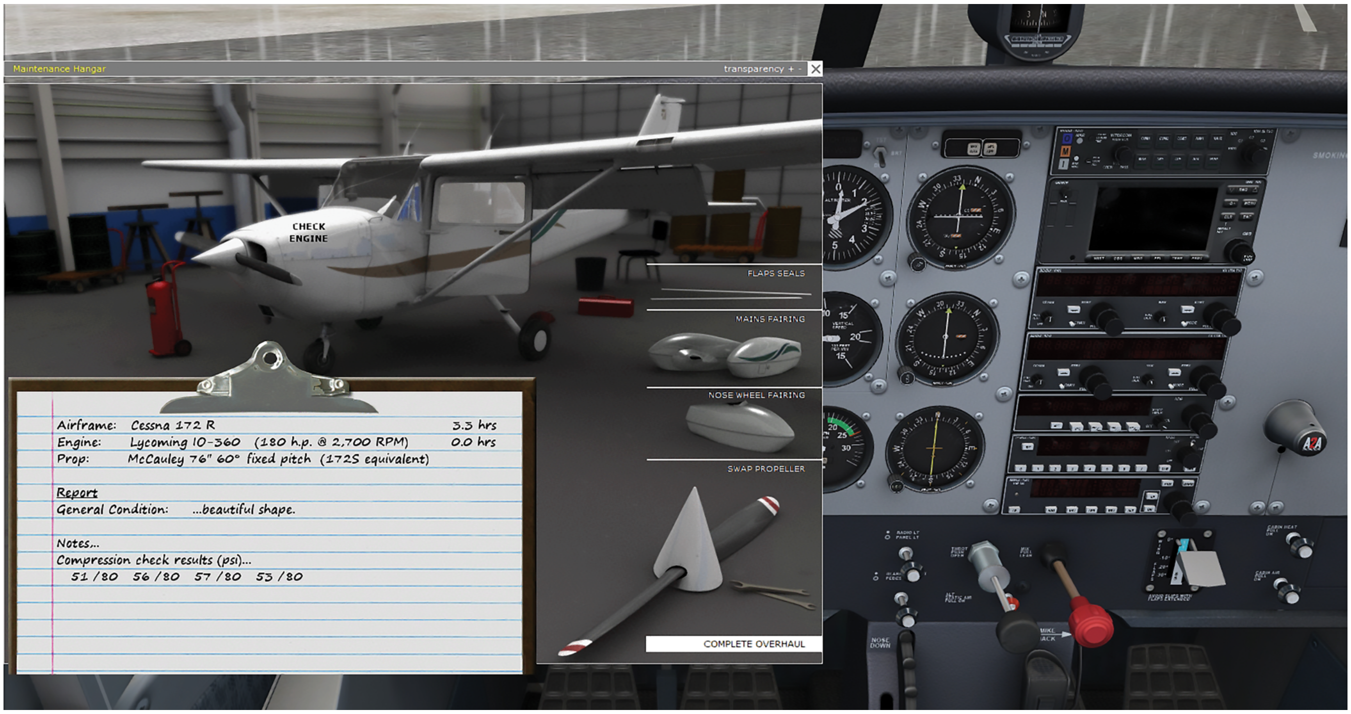
WHAT IS THE PHILOSOPHY BEHIND ACCU-SIM?

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 Accu-Sim 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.

Aircraft persistence is one of the key features of Accu-Sim. Maintain your C172 from flight to flight in the Maintenance Hanger.

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 120psi.

PERSISTENT AIRCRAFT

Every time you load up your Accu-Sim C172 Trainer, you will be flying the continuation of the last aircraft which includes fuel, oil, coolant levels 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

Lockheed Martin 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 C172 Trainer 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.

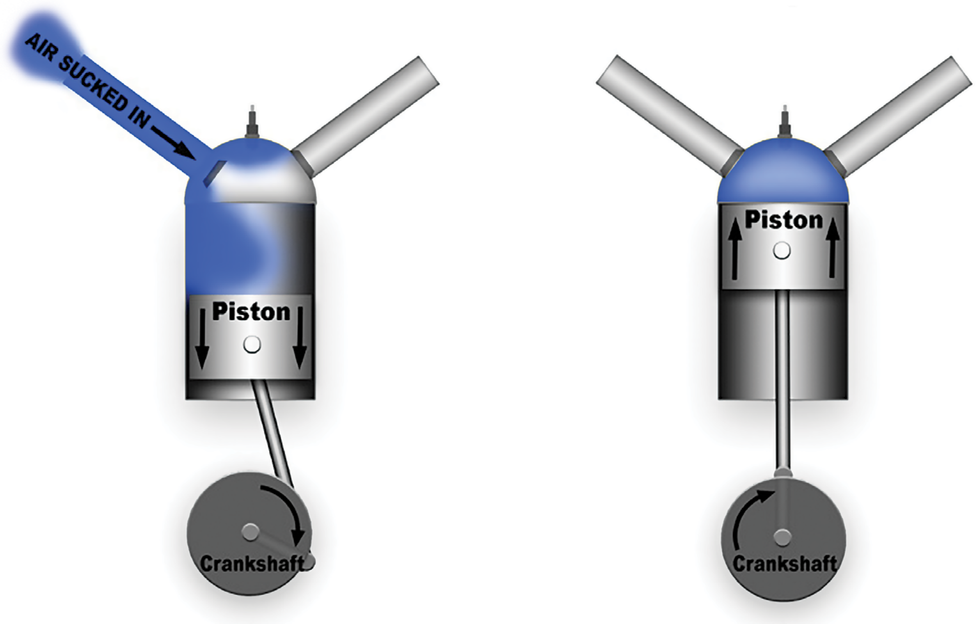
The gauges are the windows into your aircraft's systems and therefore Accu-Sim requires these to behave authentically.

Don't get lazy on approach! Every landing is a challenging with Accu-Sim.

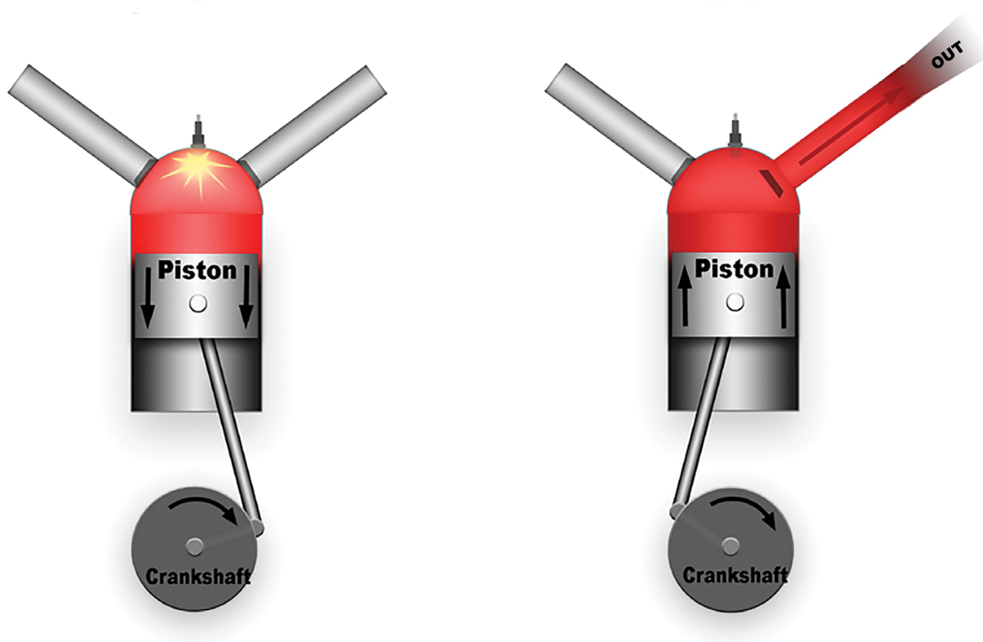
YOUR TURN TO FLY SO ENJOY

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 both the A2A Simulations Accu-Sim C172 Trainer, and its accompanying Accu-Sim expansion pack. 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 it's 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 basic principles of how your engine produces power and allows you to fly.

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 it's 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.

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 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.

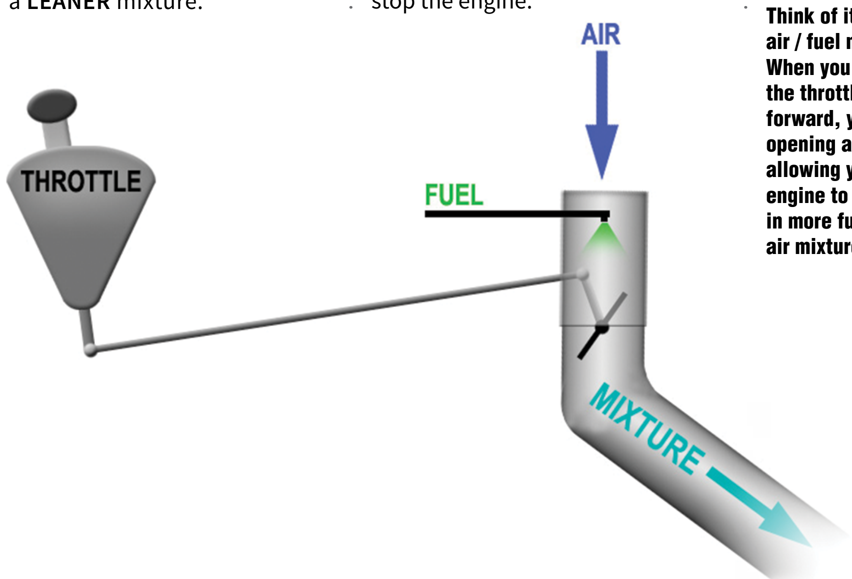
Cold air is denser and so provides more oxygen to your engine. More oxygen means more power.

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.



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.

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 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 29.92Hg **BAROMETRIC PRESSURE**. To keep things simple, let's say 30Hg 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.

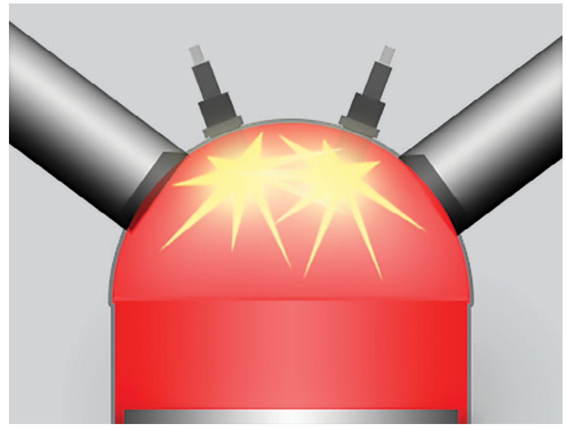
Why does your manifold pressure decrease as you climb?
Because manifold pressure is air pressure, only it's measured inside your engine's intake manifold. Since your engine needs air to breath, manifold pressure is a good indicator of how much power your engine can produce.

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".

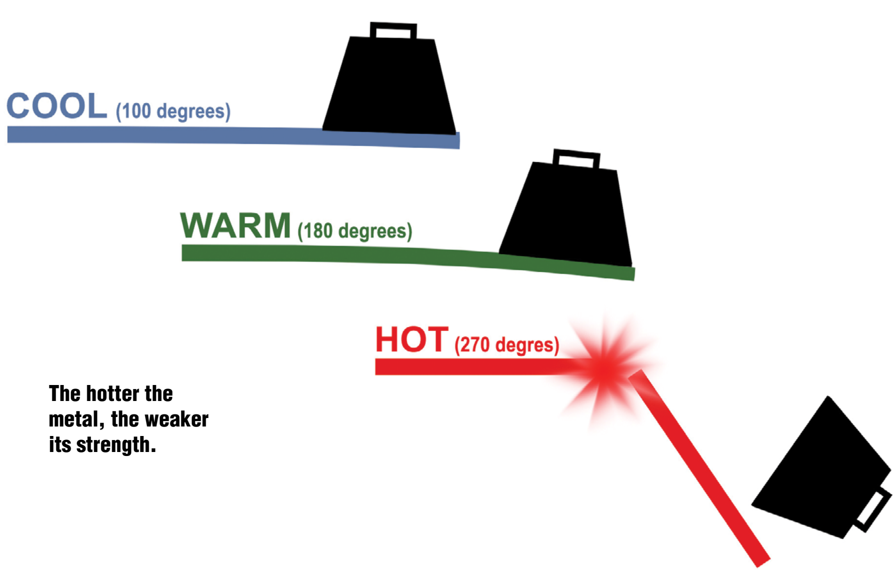
IGNITION

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.



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

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.



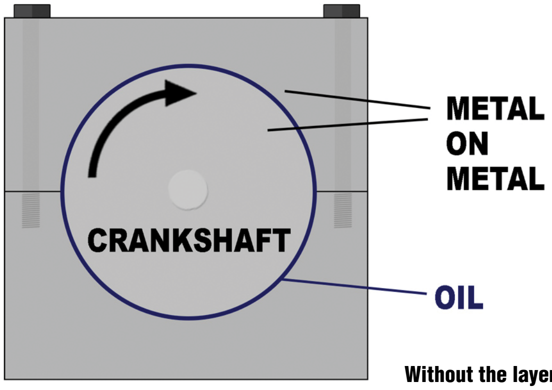
The hotter the metal, the weaker its strength.

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 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.



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

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.

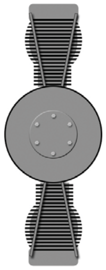
Below are some illustrations to show how an engine may be configured as more cylinders are added.

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.

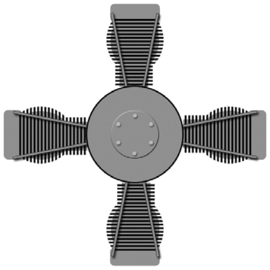
THE PRATT & WHITNEY R4360

Pratt & Whitney took this even further, creating the R4360, 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.

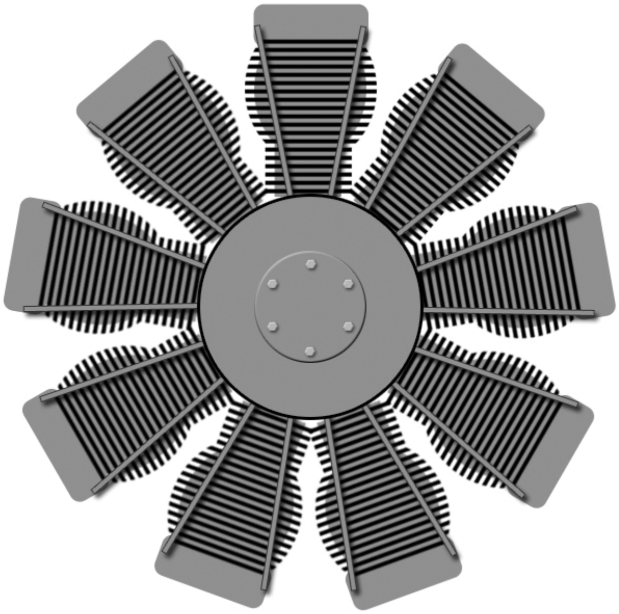
2 Cylinders

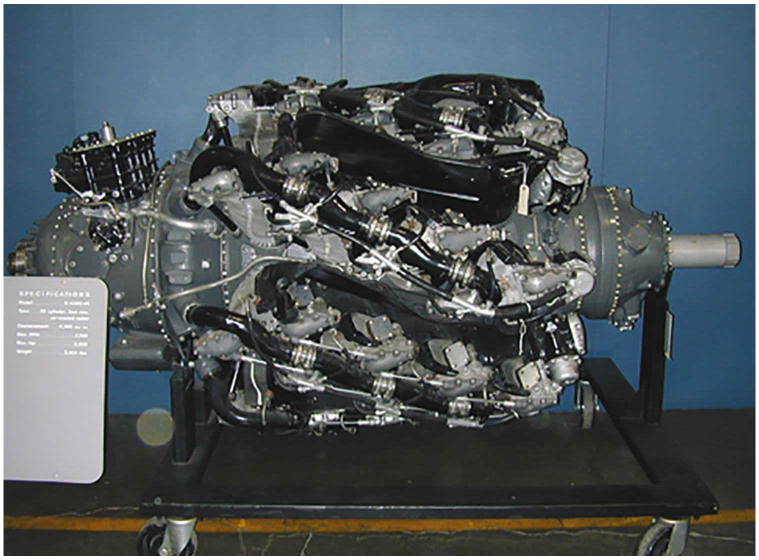


4 Cylinders



9 Cylinders





The "Corn Cob," the most powerful piston aircraft engine to reach production.

TORQUE VS HORSEPOWER

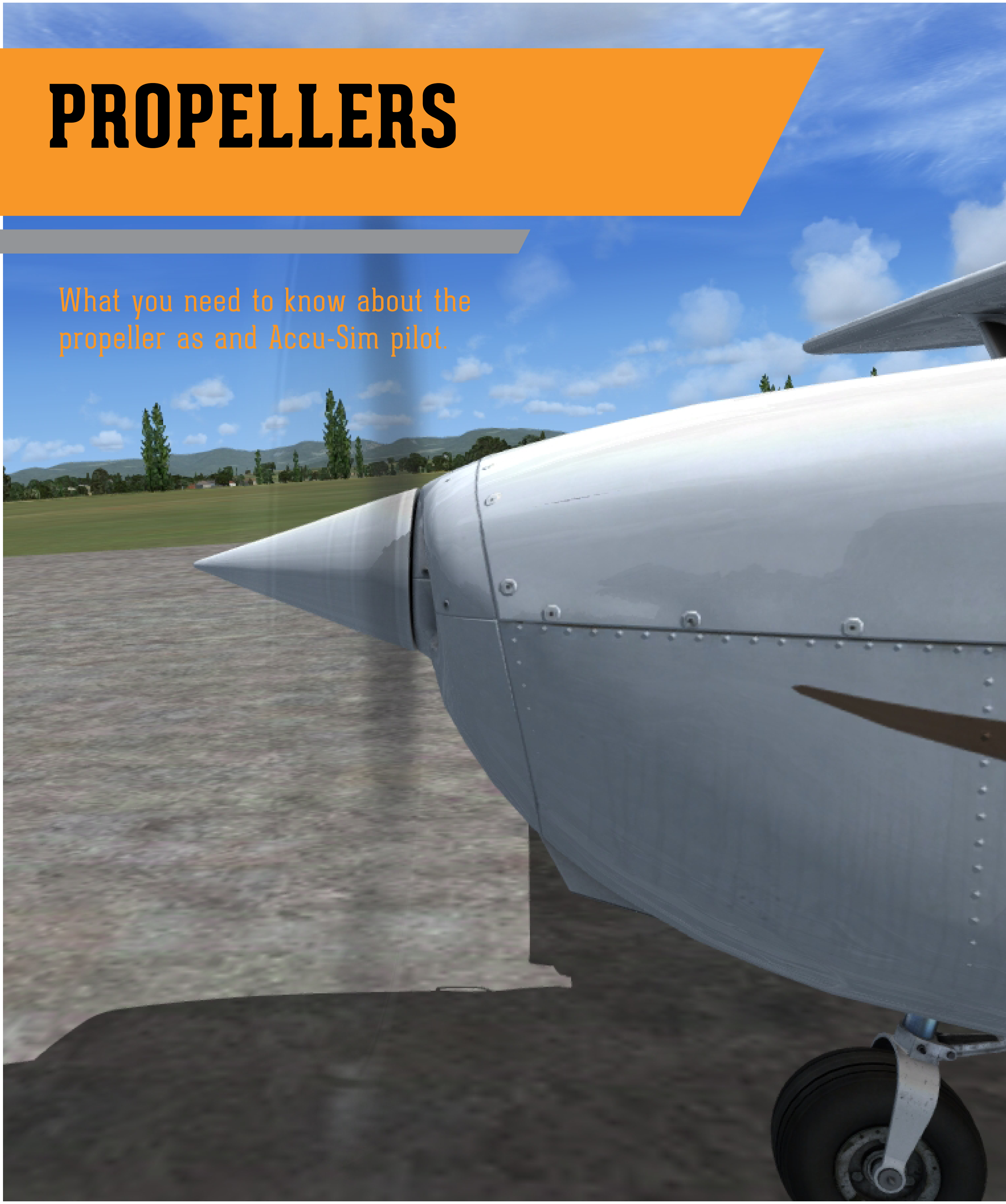
Torque is a measure of twisting force. If you put a foot long wrench on a bolt, and applied 1 pound of force at the handle, you would be applying 1 foot-pound of torque to that bolt. The moment a spark triggers an explosion, and that piston is driven down, that is the moment that piston is creating torque, 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.

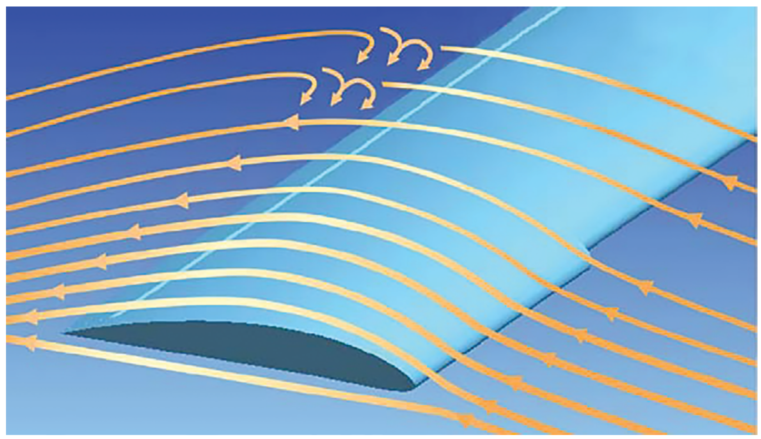
If your airplane has a torque meter, keep that engine torque within the limits or you can break internal components. Typically, an engine produces the most torque in the low to mid RPM range, and highest horsepower in the upper RPM range.

PROPELLERS

What you need to know about the propeller as and Accu-Sim pilot.



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 above 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.

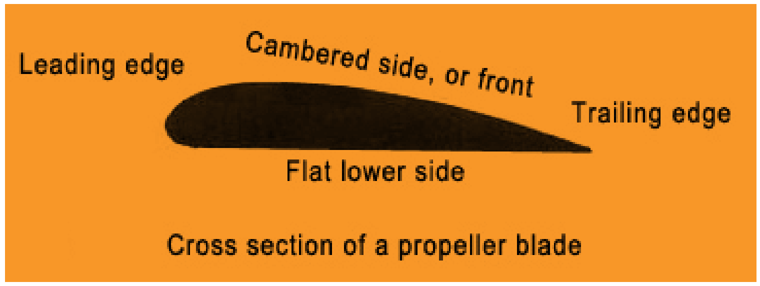
Unfortunately over time, the Bernoulli theory specifically has been misrepresented in many textbooks causing some confusion in the pilot and flight training community. Misrepresentations of Bernoulli such as the "equal transit theory" and other incorrect variations on Bernoulli have caused this confusion. 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.

For the purposes of this manual, A2A just wants you to be aware that both Bernoulli and Newton represent complete explanations for how lift is created.

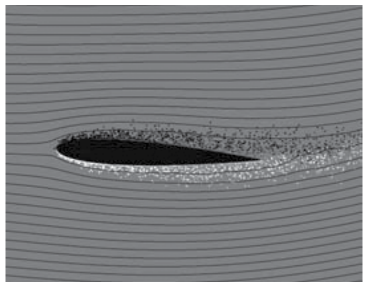
The main thing we want to impress upon you here is that when considering lift and dealing with Bernoulli and Newton, it is important and indeed critical to understand that **BOTH** explanations are **COMPLETE EXPLANATIONS** for how lift is created. Bernoulli and Newton do **NOT** add to form a total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

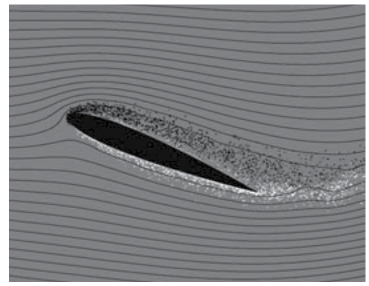
BOTH Bernoulli and Newton are in fact in play and acting simultaneously on an airfoil each responsible completely and independently for the lift being created on that airfoil.

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



Look at the cross section of a propeller blade. Essentially, the same process creates lift.





LEFT: Level Flight. A wing creating moderate lift. Air vortices (lines) stay close to the wing. RIGHT: Climb. Wing creating significant lift force. Air vortices still close to the wing.

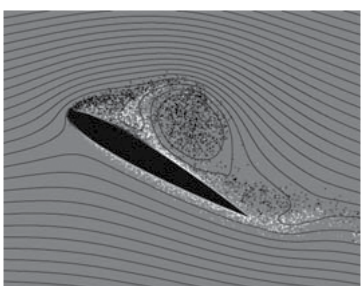
WHAT IS A STALL?

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."

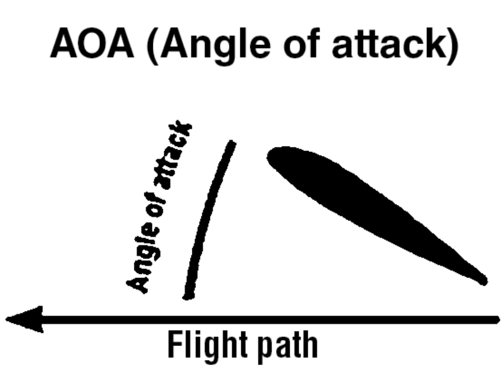
Typically, stalls in aircraft occur when an airplane loses too much airspeed to create a sufficient amount of lift. A typical stall exercise would be to put your aircraft into a climb, cut the throttle, and try and maintain the climb as long as possible. You will have to gradually pull back harder on 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).

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.



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



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 it's peak. The lift typically starts when the wing is level, and increases until the wing reaches its optimum angle, lets 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 next page, how the airfoil creates more lift as the angle of attack increases. Ideally, your wing (or propeller) will spend most of it's 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 "Hershy bar wing" because it is uniform from the root to the tip, just like an Hershy chocolate bar. Later, Piper introduced the tapered wing, which stalled more gradually, across the wing. The Hershy 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.

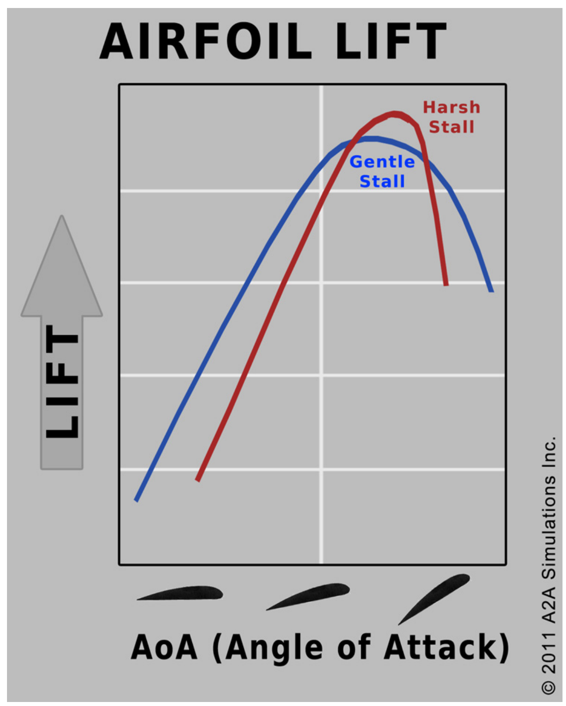
FROM STALL TO FULL POWER

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 it's 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 speed prop spends almost all of it's life out of it's 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. Lets 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 it's 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).



SPECIFICATIONS

As a pilot you must always be aware of what your aircraft can do … and what it can't.

THIS SECTION OUTLINES the capabilities and limitations of your Accu-Sim C172 aircraft. Learning this information is of vital importance if you are to successful master the aircraft, while ignoring it will likely lead to many trips to the Maintenance Hanger for repairs.

PERFORMANCE SPECIFICATIONS

Note that high speed figures are with wheel fairings. Subtract 2 kias when removed. Performance data is supplied for the "R" (or "160 HP") model only.

SPEEDS

- Maximum at Sea Level: 123 ktas
- Cruise, 80% Power at 8000 ft: 122 ktas

RANGE

Recommended lean mixture with fuel allowance for engine start, taxi, takeoff, climb and 45 minutes reserve.

- 80% Power @ 8000 ft (max): 580 nm / 4.8 hrs
- 60% Power @ 10000 ft (econ):
  Range 687 nm / 6.6 hrs
- Rate Of Climb At Sea Level: 720 fpm
- Service Ceiling: 13,500 ft

TAKEOFF

- Ground Roll: 945 ft
- Total Distance Over 50 ft Obstacle: 1685 ft

LANDING

- Ground Roll : 550 ft
- Total Distance Over 50 ft Obstacle : 1295 ft

STALL SPEED

- Flaps Up, Power Off: 51 kcas
- Flaps Down, Power Off: 47 kcas

SPECIFICATIONS

GENERAL

ENGINE

- Textron Lycoming, IO-360-L2A, Normally aspirated, direct drive, air-cooled, horizontally opposed, fuel injected, four cylinder engine with 360 cu. in. displacement.
- Horsepower Rating and Engine Speed:
  - 160 rated BHP at 2,400 RPM.

PROPELLER

- Two blade, Fixed pitch, 75” 70° pitch McCauley, Model Number 1C235/LFA7570.

FUEL

- **Fuel Capacity:**
  - Total Capacity: 56.0 U.S. gallons.
  - Total Usable: 53.0 U.S. gallons.
  - Total Capacity Each Tank: 28.0 U.S. gallons.
  - Total Usable Each Tank: 26.5 U.S. gallons.
- 100LL Grade Aviation Fuel

OIL

- **Oil Capacity:**
  - Sump: 8 U.S. Quarts
  - Total: 9 U.S. Quarts
- **Recommended Viscosity for Temperature Range:**

Above 16°C (60°F)	50 (w100)
-18°C (0°F) to 32°C (90°F)	20W-50
All Temperatures	15W-50

MAX WEIGHTS

- Max Takeoff Weight: 2450 lbs.
- Max Baggage Area Weight: 120lbs

STANDARD AIRPLANE WEIGHTS

- Standard Empty Weight: 1639 lbs.
- Maximum Useful Load (total fuel, passengers, and baggage): 818 lbs

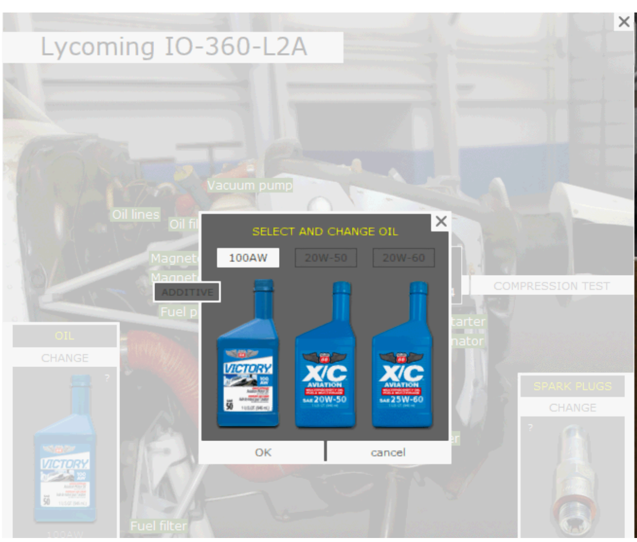
LIMITATIONS

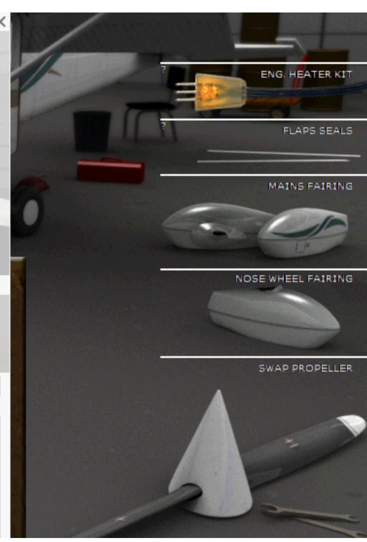
- **VNE** (Never Exceed)
  Do not exceed 163 kias in any speed operation.

- **VNO** (Maximum Structural)
  Do not exceed 129 kias except in smooth air, and then only with caution.

- **VA** (Maneuvering Speed)
  Do not make full or abrupt control movements above this speed.
  - 2,450 lbs.: 99 kias
  - 2,000 lbs.: 92 kias
  - 1,600 lbs.: 82 kias

- **VFE** (Maximum Flap Speed)
  Do not exceed this speed with flaps
  - 10° Flaps: 110 kias
  - 10° to 30° Flaps: 85 kias





AIRSPEED INDICATOR MARKINGS

- **WHITE ARC** (flaps extended)
  - Full Flap Operating Range (33 – 85 kias)
  - Lowest speed at maximum weight with full flaps is 33 kias
  - Maximum speed permissible with flaps extended beyond 10° is 85 kias
- **GREEN ARC** (flaps retracted)
  - Normal Operating Range (44 – 129 kias)
  - Lowest speed at maximum weight with is 44 kias
  - Maximum structural cruising speed is 129 kias
- **YELLOW ARC**
  - Operations must be conducted with caution and only in smooth air (129-163 kias)
- **RED LINE**
  - Maximum speed for all operations is 163 kias

POWERPLANT LIMITATIONS

- Maximum Engine Speed: 2400 RPM.
  NOTE: The static RPM range (full throttle when stopped at sea level) is 2,065 – 2,165 RPM.
- Maximum Oil Temperature: 245°F (118°C).
- Oil Pressure, Minimum: 20 PSI, Maximum: 115 PSI.

CENTER OF GRAVITY LIMITS

- **Center of Gravity Range:**
  - Forward: 35.0 inches aft of datum at 1950 lbs. or less, with straight line variation to 40.0 inches aft of datum at 2450 lbs.
  - Aft: 47.3 inches aft of datum at all weights.
  - Reference Datum: Lower portion of front face of firewall.

MANEUVER LIMITS

- **Maneuvers And Recommended Entry Speed***

Chandelles	105 kias
Lazy Eights	105 kias
Steep Turns	95 kias
Stalls (Except Whip Stalls)	Slow Deceleration

** Abrupt use of the controls is prohibited above 99 kias.*

Aerobatics that may impose high loads should not be attempted. The important thing to bear in mind in flight maneuvers is that the airplane is clean in aerodynamic design and will build up speed quickly with the nose down. Proper speed control is an essential requirement for execution of any maneuver, and care should always be exercised to avoid excessive speed which in turn can impose excessive loads. In the execution of all maneuvers, avoid abrupt use of controls.

FLIGHT LOAD FACTOR LIMITS

- **Flight Load Factors**
  (Maximum Takeoff Weight - 2450 lbs.):

*Flaps Up	+3.8g, -1.52g
*Flaps Down	+3.0g

**The design load factors are 150% of the above, and in all cases, the structure meets or exceeds design loads.*

- **Flap Limitations**

Approved Takeoff Range:	0° to 10°
Approved Landing Range:	0° to 30°

NORMAL OPERATIONS

Airspeeds for normal operation of the C172.

HERE IS A brief summury of the airspeeds required for normal operations of the Accu-Sim C172 aircraft.

AIRSPEEDS FOR NORMAL OPERATION

Unless otherwise noted, the following speeds are based on a maximum weight of 2450 pounds and may be used for any lesser weight.

TAKEOFF

- Normal Climb Out: 70-80 kias
- Short Field Takeoff, Flaps 10°, Speed at 50 Feet: 57 kias

ENROUTE CLIMB, FLAPS UP

- **NORMAL**
  - Sea Level: 75-85 kias
  - 10,000 Feet: 70-80 kias
- **BEST RATE-OF-CLIMB**
  - Sea Level: 79 kias
  - 10,000 Feet: 71 kias
- **BEST ANGLE-OF-CLIMB**
  - Sea Level: 60 kias
  - 10,000 Feet: 65 kias

LANDING APPROACH

- Normal Approach, Flaps Up: 65-75 kias
- Normal Approach, Flaps 30°: 60-70 kias
- Short Field Approach, Flaps 30°: 62 kias

BALKED LANDING

- Maximum Power, Flaps 20°: 55 kias

MAXIMUM RECOMMENDED TURBULENT AIR PENETRATION SPEED

- 2450 lbs: 99 kias
- 2000 lbs: 92 kias
- 1600 lbs: 82 kias

MAXIMUM DEMONSTRATED CROSSWIND VELOCITY

- Takeoff or Landing: 15 kts

CHECKLISTS

Normal operations checklists and procedures for the Accu-Sim C172 Trainer.

CABIN

1. Pitot Tube Cover — **REMOVE**. Check for pitot blockage.
2. Pilot's Operating Handbook — **AVAILABLE IN THE AIRPLANE**
3. Airplane Weight and Balance — **CHECKED**
4. Parking Brake — **SET**
5. Control Wheel Lock — **REMOVE**
6. Ignition Switch — **OFF**
7. Avionics Master Switch — **OFF**

WARNING: When turning on the master switch, using an external power source, or pulling the propeller through by hand, treat the propeller as if the ignition switch were on. Do not stand, nor allow anyone else to stand, within the arc of the propeller, since a loose or broken wire or a component malfunction could cause the propeller to rotate.

8. Master Switch — **ON**
9. Fuel Quantity Indicators — **CHECK QUANTITY AND ENSURE LOW FUEL ANNUNCIATORS (L LOW FUEL R) ARE EXTINGUISHED**
10. Avionics Master Switch — **ON**
11. Avionics Cooling Fan — **CHECK AUDIBLY FOR OPERATION**
12. Avionics Master Switch — **OFF**
13. Static Pressure Alternate Source Valve — **OFF**
14. Annunciator Panel Switch — **PLACE AND HOLD IN TST POSITION** and ensure all annunciators illuminate

NOTE: When Master Switch is turned ON, some annunciators will flash for approximately 10 seconds before illuminating steadily. When panel TST switch is toggled up and held in position, all remaining lights will flash until the switch is released.

15. Fuel Selector Valve — **BOTH**
16. Fuel Shutoff Valve — **ON** (Push Full In)
17. Flaps — **EXTEND**
18. Pitot Heat — **ON** (Carefully check that pitot tube is warm to the touch within 30 seconds)
19. Pitot Heat — **OFF**
20. Master Switch — **OFF**
21. Elevator Trim — **SET** for takeoff
22. Baggage Door — **CHECK**, lock with key
23. Autopilot Static Source Opening (if installed) — **CHECK** for blockage

BEFORE STARTING ENGINE

1. Preflight Inspection — **COMPLETE**
2. Passenger Briefing — **COMPLETE**
3. Seats and Seat Belts — **ADJUST** and **LOCK** Ensure inertia reel locking.
4. Brakes — **TEST** and **SET**
5. Circuit Breakers — **CHECK IN**
6. Electrical Equipment — **OFF**

   NOTE: the avionics master switch must be off during engine start to prevent possible damage to avionics.

7. Avionics Master Switch — **OFF**
8. Fuel Selector Valve — **BOTH**
9. Fuel Shutoff Valve — **ON** (push full in)
10. Avionics Circuit Breakers — **CHECK IN**

STARTING ENGINE (WITH BATTERY)

1. Throttle — **OPEN ¼ INCH**
2. Mixture — **IDLE CUTOFF**
3. Propeller Area — **CLEAR**
4. Master Switch — **ON**
5. Flashing Beacon — **ON**

   NOTE: If engine is warm, omit priming procedure of steps 6, 7, and 8 below.

6. Auxiliary Fuel Pump Switch — **ON**
7. Mixture — **SET** to **FULL RICH** (full forward) until stable fuel flow is indicated (usually 3 to 5 seconds), then set to **IDLE CUTOFF** (full aft) position.
8. Auxiliary Fuel Pump — **OFF**
9. Ignition Switch — **START** (release when engine starts)
10. Mixture — **ADVANCE** smoothly to **RICH** when engine starts.

    NOTE: If engine floods (engine has been primed too much), turn off auxiliary fuel pump, set mixture to idle cutoff, open throttle 1/2 to full, and motor (crank) engine. When engine starts, set mixture to full rich and close throttle promptly.

11. Oil Pressure — **CHECK**
12. Navigation Lights — **ON** as required
13. Electrical System – **CHECK FOR PROPER OPERATION:**
    - **a.** Master Switch — **OFF**
    - **b.** Taxi and Landing Light Switches – ON (provides an initial electrical load on the system).
    - **c.** Engine RPM — **REDUCE** to idle (Minimum alternator output occurs at idle)
    - **d.** Master Switch — **ON** (taxi and landing lights on)

      NOTE: (The ammeter should indicate in the negative direction, showing that the alternator output is below the load requirements, but the battery is supplying current to the system.)

    - **e.** Engine RPM — **INCREASE** to approximately 1500 RPM (as engine RPM increases, alternator output should increase to meet the system load requirements)
    - **f.** Ammeter and Low Voltage Annunciator – **CHECK** (the ammeter should indicate in the positive direction, showing that the alternator is supplying current and the Low Voltage Annunciator (VOLTS) should not be lighted)

      NOTE: If the indications, as noted in Step "d" and Step "f", are not observed, the electrical system is not functioning properly. Corrective maintenance must be performed to provide for proper electrical system operation before flight.

14. Avionics Master Switch — **ON**
15. Radios – **ON**
16. Flaps — **RETRACT**
17. Mixture — **LEAN** for ground operations.

BEFORE TAKEOFF

1. Parking Brake — **SET**
2. Passenger Seat Backs — **MOST UPRIGHT POSITION**
3. Seats and Seat Belts — **CHECK SECURE**
4. Cabin Doors — **CLOSED** and **LOCKED**
5. Flight Controls — **FREE** and **CORRECT**
6. Flight Instruments — **CHECK** and **SET**
7. Fuel Quantity — **CHECK**
8. Mixture — **RICH**
9. Fuel Selector Valve — **RECHECK BOTH**
10. Throttle — **1800 RPM**
    a. Magnetos — **CHECK** (RPM drop should not exceed 150 RPM on either magneto or 50 RPM differential between magnetos).
    b. Vacuum Gage — **CHECK**
    c. Engine Instruments and Ammeter — **CHECK**
11. Annunciator Panel — Ensure no annunciators are illuminated
12. Throttle — **CHECK IDLE**
13. Throttle — **1000 RPM** or **LESS**
14. Throttle Friction Lock — **ADJUST**
15. Strobe Lights — **AS DESIRED**
16. Radios and Avionics — **SET**
17. NAV/GPS Switch (if installed) — **SET**
18. Autopilot (if installed) — **OFF**
19. Elevator Trim — **SET** for takeoff
20. Wing Flaps — **SET** for takeoff (0°-10°)
21. Brakes – **RELEASE**

NORMAL TAKEOFF

1. Wing Flaps — **0°-10°**
2. Throttle — **FULL OPEN**
3. Mixture — **RICH** (above 3000 feet, **LEAN** to obtain maximum RPM)
4. Elevator Control — **LIFT NOSE WHEEL** (at 55 kias)
5. Climb Speed — **70-80 KIAS**
6. Wing Flaps — **RETRACT**

SHORT FIELD TAKEOFF

1. Wing Flaps — **10°**
2. Brakes — **APPLY**
3. Throttle — **FULL OPEN**
4. Mixture — **RICH** (above 3000 feet, **LEAN** to obtain maximum RPM)
5. Brakes — **RELEASE**
6. Elevator Control — **SLIGHTLY TAIL LOW**
7. Climb Speed — **57 KIAS** (until all obstacles are cleared)
8. Wing Flaps — **RETRACT** slowly after reaching 60 kias

ENROUTE CLIMB

1. Airspeed — **70-85 KIAS**

   NOTE: If a maximum performance climb is necessary, use speeds shown in the Rate Of Climb chart later in this manual.

2. Throttle — **FULL OPEN**
3. Mixture — **RICH** (above 3000 feet, **LEAN** to obtain maximumRPM)

CRUISE

1. Power — **2000-2400 RPM** (No more than 80% is recommended)
2. Elevator Trim — **ADJUST**
3. Mixture — **LEAN**

DESCENT

1. Power — **AS DESIRED**
2. Mixture — **ADJUST** for smooth operation
3. Altimeter — **SET**
4. NAV/GPS Switch — **SET**
5. Fuel Selector Valve — **BOTH**
6. Wing Flaps — **AS DESIRED** (0° - 10° below 110 kias, 10° - 30° below 85 kias)

BEFORE LANDING

1. Pilot and Passenger Seat Backs — **MOST UPRIGHT POSITION**
2. Seats and Seat Belts — **SECURED AND LOCKED**
3. Fuel Selector Valve — **BOTH**
4. Mixture — **RICH**
5. Landing/Taxi Lights — **ON**
6. Autopilot (if installed) — **OFF**

NORMAL LANDING

1. Airspeed — **65-75 KIAS** (flaps **UP**)
2. Wing Flaps — **AS DESIRED** (0°-10° below 110 kias, 10°-30° below 85 kias)
3. Airspeed — **60-70 KIAS** (flaps **DOWN**)
4. Touchdown — **MAIN WHEELS FIRST**
5. Landing Roll — **LOWER NOSE WHEEL GENTLY**
6. Braking — **MINIMUM REQUIRED**

SHORT FIELD LANDING

1. Airspeed — **65-75 KIAS** (flaps UP)
2. Wing Flaps — **FULL DOWN** (30°)
3. Airspeed — **62 KIAS** (until flare)
4. Power — **REDUCE** to idle after clearing obstacle
5. Touchdown — **MAIN WHEELS FIRST**
6. Brakes — **APPLY HEAVILY**
7. Wing Flaps — **RETRACT**

BALKED LANDING

1. Throttle — **FULL OPEN**
2. Wing Flaps — **RETRACT TO 20°**
3. Climb Speed — **55 KIAS**
4. Wing Flaps — **10°** (until obstacles are cleared), **RETRACT** (after reaching a safe altitude and 60 kias)

AFTER LANDING

1. Wing Flaps — **UP**

SECURING AIRPLANE

1. Parking Brake — **SET**
2. Electrical Equipment, Autopilot (if installed) — **OFF**
3. Avionics Master Switch — **OFF**
4. Mixture — **IDLE CUT OFF** (pulled full out)
5. Ignition Switch — **OFF**
6. Master Switch — **OFF**
7. Control Lock — **INSTALL**
8. Fuel Selector Valve – **LEFT** or **RIGHT** to prevent cross feeding

PROCEDURES EXPLAINED

A more in-depth look at the normal operation procedures.

THIS SECTION WILL give you a more detailed look at the normal operating procedures covered by the checklists.

STARTING ENGINE

The Lycoming IO-360 engine in your Cessna 172R is fuel injected, and priming is done using both the electric fuel pump and the mixture control. Turn the electric fuel pump on (pumps fuel through the lines and builds up pressure). Carefully watch your fuel flow gauges and push the mixture control in. You will hear a slight difference in the fuel pump as the primer starts to flow and the fuel flow gauge will rise just slightly. Once you see an indication, wait 3-5 seconds, then pull back on the mixture control and turn off the electric fuel pump. The engine is now primed.

To start the engine, in the real aircraft make sure you clear the area with a loud "CLEAR PROP", wait a few seconds and scan the area. Crack the throttle then turn the starter key to the START position. Once the engine begins to catch, push the mixture control IN and adjust the throttle to maintain about 1,000 RPM.

When the engine starts, smoothly advance the mixture control to full rich and retard the throttle to desired idle speed. If the engine is under primed (most likely in cold weather with a cold engine) it will not start at all, and additional priming will be necessary. After starting, if the oil pressure gauge does not begin to indicate pressure within 30 seconds in the summer time and approximately one minute in very cold weather, stop the engine and investigate. Lack of oil pressure can cause serious engine damage.

NOTE: Additional details concerning cold weather starting and operation may be found under COLD WEATHER OPERATION paragraphs in this section.

RECOMMENDED STARTER DUTY CYCLE

Crank the starter for 10 seconds followed by a 20 second cool down period. This cycle can be repeated two additional times, followed by a ten minute cool down period before resuming cranking. After cool down, crank the starter again, three cycles of 10 seconds followed by 20 seconds of cool down. If the engine still fails to start, an investigation to determine the cause should be initiated.

LEANING FOR GROUND OPERATIONS

- For all ground operations, after starting the engine and when the engine is running smoothly:
  - **a.** Set the throttle to 1200 RPM.
  - **b.** Lean the mixture for maximum RPM.
  - **c.** Set the throttle to an RPM appropriate for ground operations (800 to 1000 RPM recommended)

NOTE: If ground operation will be required after the BEFORE TAKEOFF checklist is completed, lean the mixture again (as described above) until ready for the TAKEOFF checklist.

TAXIING

When taxiing, it is important that speed and use of brakes be held to a minimum and that all controls be utilized to maintain directional control and balance. Taxiing over loose gravel or cinders should be done at low engine speed to avoid abrasion and stone damage to the propeller tips.

BEFORE TAKEOFF

WARM UP

If the engine idles (approximately 600 RPM) and accelerates smoothly, the airplane is ready for takeoff. Since the engine is closely cowled for efficient in-flight engine cooling, precautions should be taken to avoid overheating during prolonged engine operation on the ground. Also, long periods of idling may cause fouled spark plugs.

MAGNETO CHECK

The magneto check should be made at 1800 RPM as follows. Move ignition switch first to R position and note RPM. Next move switch back to **BOTH** to clear the other set of plugs. Then move switch to the L position, note RPM and return the switch to the **BOTH** position. RPM drop should not exceed 150 RPM on either magneto or show greater than 50 RPM differential between magnetos. If there is a doubt concerning operation of the ignition system, RPM checks at higher engine speeds will usually confirm whether a deficiency exists. An absence of RPM drop may be an indication of faulty grounding of one side of the ignition system or should be cause for suspicion that the magneto timing is set in advance of the setting specified.

ALTERNATOR CHECK

Prior to flights where verification of proper alternator and alternator control unit operation is essential (such as night or instrument flights), a positive verification can be made by loading the electrical system momentarily (3 to 5 seconds) with the landing light or by operating the wing flaps during the engine runup (1800 RPM). The ammeter will remain within a needle width of its initial reading if the alternator and alternator control unit are operating properly.

LANDING LIGHTS

If landing lights are to be used to enhance the visibility of the airplane in the traffic pattern or enroute, it is recommended that only the taxi light be used. This will extend the service life of the landing light appreciably.

TAKEOFF

POWER CHECK

It is important to check full throttle engine operation early in the takeoff roll. Any sign of rough engine operation or sluggish engine acceleration is good cause for discontinuing the takeoff. If this occurs, you are justified in making a thorough full throttle static runup before another takeoff is attempted. The engine should run smoothly and turn approximately 2100 RPM with mixture leaned to provide maximum RPM. Prior to takeoff from fields above 3000 feet elevation, the mixture should be leaned to give maximum RPM in a full throttle, static runup. After full throttle is applied, adjust the throttle friction lock clockwise to prevent the throttle from creeping back from a maximum power position. Similar friction lock adjustments should be made as required in other flight conditions to maintain a fixed throttle setting.

WING FLAP SETTINGS

Normal takeoffs are accomplished with wing flaps 0°-10°. Using 10° wing flaps reduces the ground roll and total distance over an obstacle by approximately 10 percent. Flap deflections greater than 10° are not approved for takeoff. If 10° wing flaps are used for takeoff, they should be left down until all obstacles are cleared and a safe flap retraction speed of 60 kias is reached. On a short field, 10° wing flaps and an obstacle clearance speed of 57 kias should be used.

Soft or rough field takeoffs are performed with 10° flaps by lifting the airplane off the ground as soon as practical in a slightly tail low attitude. If no obstacles are ahead, the airplane should be leveled off immediately to accelerate to a higher climb speed. When departing a soft field with an aft C.G. loading, the elevator trim should be adjusted towards the nose down direction to give comfortable control wheel forces during the initial climb.

CROSSWIND TAKEOFF

Takeoffs into strong crosswind conditions normally are performed with the minimum flap setting necessary for the field length, to minimize the drift angle immediately after takeoff. With the ailerons partially deflected into the wind, the airplane is accelerated to a speed slightly higher than normal, then pulled off briskly to prevent possible settling back to the runway while drifting. When clear of the ground, make a coordinated turn into the wind to correct for drift.

ENROUTE CLIMB

Enroute climbs are performed with flaps up and full throttle and at speeds 5 to 10 kias higher than best rate-of-climb speeds for the best combination of performance, visibility and engine cooling. The mixture should be full rich below 3000 feet and may be leaned above 3000 feet for smoother operation or to obtain maximum RPM. For maximum rate of climb, use the best rate-of-climb speeds shown in the Rate of Climb chart later in this manual. If an obstruction dictates the use of a steep climb angle, the best angle-of-climb speed should be used with flaps up and maximum power. Climbs at speeds lower than the best rate-of-climb speed should be of short duration to improve engine cooling.

CRUISE

Normal cruise is performed between 60% and 80% power. The engine RPM and corresponding fuel consumption for various altitudes can be determined by using the cruise charts later in this manual.

The Cruise Performance charts provide the pilot with detailed information concerning the cruise performance of the Model 172R in still air. Power and altitude, as well as winds aloft, have a strong influence on the time and fuel needed to complete any flight. **The Cruise Performance Table** illustrates the true airspeed and nautical miles per gallon during cruise for various altitudes and percent powers, and is based on standard conditions and zero wind. This table should be used as a guide, along with the available winds aloft information, to determine the most favorable altitude and power setting for a given trip. The selection of cruise altitude on the basis of the most favorable wind conditions and the use of low power settings are significant factors that should be considered on every trip to reduce fuel consumption. In addition to power settings, proper leaning techniques also contribute to greater range and are figured into cruise performance tables. To achieve the recommended lean mixture fuel consumption, the mixture should be leaned using the exhaust gas temperature (EGT) indicator as noted.

LEANING USING THE EGT INDICATOR

At or below 80% power in level cruise flight, the exhaust gas temperature (EGT) indicator is used to lean the fuel-air mixture for best performance or economy. The Cruise Performance charts are based on the EGT to adjust the mixture to Recommended Lean per EGT Table below.

Use the mixture control to slowly lean, from full rich or maximum RPM mixture, while monitoring the EGT indicator. As the EGT indication begins to increase, continue to slowly lean the mixture until an EGT indication decrease is just detectable.

CRUISE PERFORMANCE TABLE

ALTITUDE	80% POWER KTAS	80% POWER NMPG	70% POWER KTAS	70% POWER NMPG	60% POWER KTAS	60% POWER NMPG
Sea Level	113	12.3	108	13.4	100	14.5
4000 feet	117	12.8	111	13.9	103	14.9
8000 feet	122	13.3	115	14.3	105	15.3

RECOMMENDED LEAN PER EGT TABLE

MIXTURE DESCRIPTION	XHAUST GAS TEMPERATURE
Recommended Lean	50° Rich of Peak EGT
Best Economy	Peak EGT

Reverse the adjustment slowly in the rich direction until an EGT indication decrease is again just detectable, then set the EGT index pointer to match the peak indication. The mixture may be leaned slightly to return to peak EGT or may be further richened to Recommended Lean mixture as desired. **Continuous operation at mixture settings lean of peak EGT is prohibited.** Any change in altitude or throttle position will require that peak EGT be redetermined and the desired mixture be reset. Under some conditions, engine roughness may occur at peak EGT. In this case, operate at Recommended Lean mixture.

As noted in EGT Table, operation at peak EGT provides the best fuel economy. Operation at peak EGT results in approximately 4% greater range and approximately a 3 knot decrease in airspeed from the figures shown in the Performance section of this handbook. Recommended Lean mixture provides best level cruise performance(generally close to "best power" or maximum RPM).

NOTE: The EGT indicator requires several seconds to respond to mixture adjustments and changes in exhaust gas temperature. More rapid changes in EGT indication are neither necessary nor desirable. Determining peak EGT and setting the desired mixture should take approximately one minute when the adjustments are made sufficiently slowly and accurately.

FUEL SAVINGS PROCEDURES FOR FLIGHT TRAINING OPERATIONS

For best fuel economy during flight training operations, the following procedures are recommended.

1. After engine start and for all ground operations, set the throttle to 1200 RPM and lean the mixture for maximum RPM. Leave the mixture at this setting until beginning the **BEFORE TAKEOFF** checklist. After the **BEFORE TAKEOFF** checklist is complete re-lean the mixture as described above until ready for the **TAKEOFF** checklist.

2. Lean the mixture for maximum RPM during full throttle climbs above 3000 feet. The mixture may remain leaned (maximum RPM at full throttle) for practicing maneuvers such as stalls and slow flight.

3. Lean the mixture for maximum RPM during all operations at any altitude, including those below 3000 feet, when using 80% or less power.

NOTE: When cruising or maneuvering at 80% or less power, the mixture may be further leaned until the EGT indicator needle peaks and is then enriched 50°F. This is especially applicable to cross-country training flights, but should be practiced during transition flight to and from the practice area as well. Using the above recommended procedures can provide fuel savings in excess of 5% when compared to typical training operations at full rich mixture. In addition, the above procedures will minimize spark plug fouling since the reduction in fuel consumption results in a proportional reduction in tetraethyl lead passing through the engine.

STALLS

The stall characteristics are conventional and aural warning is provided by a stall warning horn which sounds between 5 and 10 kias above the stall in all configurations.

LANDING

NORMAL LANDING

Normal landing approaches can be made with power on or power off with any flap setting desired. Surface winds and air turbulence are usually the primary factors in determining the most comfortable approach speeds. Steep slips should be avoided with flap settings greater than 20° due to a slight tendency for the elevator to oscillate under certain combinations of airspeed, sideslip angle, and center of gravity loadings.

Actual touchdown should be made with power off and on the main wheels first to reduce the landing speed and subsequent need for braking in the landing roll. The nose wheel is lowered to the runway gently after the speed has diminished to avoid unnecessary nose gear loads. This procedure is especially important in rough or soft field landings.

SHORT FIELD LANDING

For a short field landing in smooth air conditions, make an approach at 62 kias with 30° flaps using enough power to control the glide path. (Slightly higher approach speeds should be used under turbulent air conditions.) After all approach obstacles are cleared, progressively reduce power and maintain the approach speed by lowering the nose of the airplane. Touchdown should be made with power off and on the main wheels first. Immediately after touchdown, lower the nose wheel and apply heavy braking as required. For maximum brake effectiveness, retract the flaps, hold the control wheel full back, and apply maximum brake pressure without sliding the tires.

CROSSWIND LANDING

When landing in a strong crosswind, use the minimum flap setting required for the field length. If flap settings greater than 20° are used in sideslips with full rudder deflection, some elevator oscillation may be felt at normal approach speeds. However, this does not affect control of the airplane. Although the crab or combination method of drift correction may be used, the wing low method gives the best control. After touchdown, hold a straight course with the steerable nose wheel and occasional braking if necessary.

The maximum allowable crosswind velocity is dependent upon pilot capability as well as airplane limitations. Operation in direct crosswinds of 15 kts has been demonstrated.

BALKED LANDING

In a balked landing (go-around) climb, reduce the flap setting to 20° immediately after full power is applied. If obstacles must be cleared during the go-around climb, reduce the wing flap setting to 10° and maintain a safe airspeed until the obstacles are cleared. Above 3000 feet, lean the mixture to obtain maximum RPM. After clearing any obstacles, the flaps may be retracted as the airplane accelerates to the normal flaps up climb speed.

COLD WEATHER OPERATION

When air temperatures are below 20°F (-6°C), the use of an external preheater and an external power source are recommended whenever possible to obtain positive starting and to reduce wear and abuse to the engine and electrical system. Preheat will thaw the oil trapped in the oil cooler, which probably will be congealed prior to starting in extremely cold temperatures.

HOT WEATHER OPERATION

Avoid prolonged engine operation on the ground.

PERFORMANCE CHARTS

What you need to know to plan your flights.

PERFORMANCE DATA CHARTS on the following pages are presented so that you may know what to expect from the airplane under various conditions, and also, to facilitate the planning of flights in detail and with reasonable accuracy. The data in the charts has been computed from actual flight tests with the airplane and engine in good condition and approximating average piloting techniques.

It should be noted that performance information presented in the range and endurance profile charts allows for 45 minutes reserve fuel at the specified power setting. Fuel flow data for cruise is based on the recommended lean mixture setting at all altitudes. Some indeterminate variables such as mixture leaning technique, fuel metering characteristics, engine and propeller condition, and air turbulence may account for variations of 10% or more in range and endurance. Therefore, it is important to utilize all available information to estimate the fuel required for the particular flight and to flight plan in a conservative manner.

STALL SPEEDS AT 2450 POUNDS

MOST REARWARD CENTER OF GRAVITY

FLAP SETTING	ANGLE OF BANK 0°	30°	45°	60°
UP	44	48	53	63
10°	35	38	42	50
30°	33	36	40	47

MOST FORWARD CENTER OF GRAVITY

FLAP SETTING	ANGLE OF BANK 0°	30°	45°	60°
UP	44	48	53	63
10°	37	40	44	53
30°	33	36	40	47

CONDITIONS
Power Off

NOTES
1. Altitude loss during a stall recovery may be as much as 230 feet.
2. KIAS values are approximate.
3. Maximum demonstrated crosswind component is 15 kts (not a limitation).

SHORT FIELD TAKEOFF DISTANCE AT 2450 POUNDS

Pressure Altitude (ft.)	0°C Ground Roll (ft.)	0°C Total ft. to Clear 50ft. Obstacle	10°C Ground Roll (ft.)	10°C Total ft. to Clear 50ft. Obstacle	20°C Ground Roll (ft.)	20°C Total ft. to Clear 50ft. Obstacle	30°C Ground Roll (ft.)	30°C Total ft. to Clear 50ft. Obstacle	40°C Ground Roll (ft.)	40°C Total ft. to Clear 50ft. Obstacle
Sea Level	845	1510	910	1625	980	1745	1055	1875	1135	2015
1000	925	1660	1000	1790	1075	1925	1160	2070	1245	2220
2000	1015	1830	1095	1970	1185	2125	1275	2290	1365	2455
3000	1115	2020	1205	2185	1305	2360	1400	2540	1505	2730
4000	1230	2245	1330	2430	1435	2630	1545	2830	1655	3045
5000	1355	2500	1470	2715	1585	2945	1705	3175	1830	3430
6000	1500	2805	1625	3060	1750	3315	1880	3590	2020	3895
7000	1660	3170	1795	3470	1935	3770	2085	4105	2240	4485
8000	1840	3620	1995	3975	2150	4345	2315	4775	- - -	- - -

CONDITIONS
Flaps 10°
Full Throttle Prior to Brake Release
Paved, level, dry runway
Zero Wind
Lift Off: 51 kias
Speed at 50 ft: 57 kias

NOTES
1. Short field technique as specified.
2. Prior to takeoff from fields above 3000 feet elevation, the mixture should be leaned to give maximum RPM in a full throttle, static runup.
3. Decrease distances 10% for each 9 kts headwind. For operation with tail winds up to 10 kts, increase distances by 10% for each 2 kts.
4. For operation on dry, grass runway, increase distances by 15% of the ground roll" figure.
5. Where distance value has been deleted, climb performance is minimal.

MAXIMUM RATE-OF-CLIMB AT 2450 POUNDS

Pressure Altitude (ft.)	Climb Speed (KIAS)	RATE OF CLIMB (FPM)			
		-20°C	0°C	20°C	40°C
Sea Level	79	830	770	705	640
2000	77	720	655	595	535
4000	76	645	585	525	465
6000	74	530	475	415	360
8000	72	420	365	310	250
10,000	71	310	255	200	145
12,000	69	200	145	- - -	- - -

CONDITIONS
Flaps Up
Full Throttle

NOTE
Mixture leaned above 3000 feet for maximum RPM.

TIME, FUEL AND DISTANCE TO CLIMB AT 2450 POUNDS

Pressure Altitude (ft.)	Temp. (°C)	Climb Speed (KIAS)	Rate of Climb (FPM)	FROM SEA LEVEL		
				Time (min.)	Fuel Used (gal.)	Distance (nm.)
Sea Level	15	79	720	0	0.0	0
1000	13	78	670	1	0.4	2
2000	11	77	625	3	0.7	4
3000	9	76	575	5	1.2	6
4000	7	76	560	6	1.5	8
5000	5	75	515	8	1.8	11
6000	3	74	465	10	2.1	14
7000	1	73	415	13	2.5	17
8000	-1	72	365	15	3.0	21
9000	-3	72	315	18	3.4	25
10,000	-5	71	270	22	4.0	29
11,000	-7	70	220	26	4.6	35
12,000	-9	69	170	31	5.4	43

CONDITIONS
Flaps Up
Full Throttle
Standard Temperature

NOTES
1. Add 1.1 gallons of fuel for engine start, taxi and takeoff allowance.
2. Mixture leaned above 3000 feet for maximum RPM.
3. Increase time, fuel and distance by 10% for each 10°C above standard temperature.
4. Distances shown are based on zero wind.

CRUISE PERFORMANCE

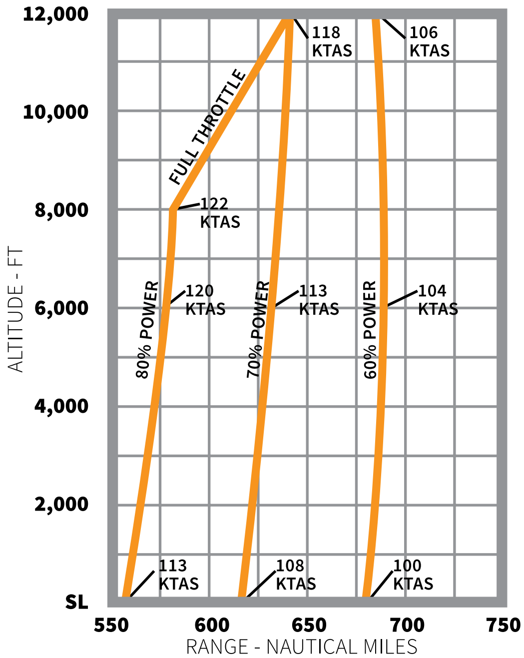
Pressure Altitude (ft.)	RPM	20°C BELOW STANDARD TEMPERATURE			STANDARD TEMPERATURE			20°C ABOVE STANDARD TEMPERATURE		
		% BHP	KTAS	GPH	% BHP	KTAS	GPH	% BHP	KTAS	GPH
2000	2250	- - -	- - -	- - -	79	115	9.0	74	114	8.5
	2200	79	112	9.1	74	112	8.5	70	111	8.0
	2100	69	107	7.9	65	106	7.5	65	105	7.1
	2000	61	101	7.0	58	99	6.6	55	97	6.4
	1900	54	94	6.2	51	91	5.9	50	89	5.8
4000	2300	- - -	- - -	- - -	79	117	9.1	75	117	8.6
	2250	80	115	9.2	75	114	8.6	70	114	8.1
	2200	75	112	8.6	70	111	8.1	66	110	7.6
	2100	66	106	7.6	62	105	7.1	59	103	6.8
	2000	58	100	6.7	55	98	6.4	53	95	6.2
	1900	52	92	6.0	50	90	5.8	49	87	5.6
6000	2350	- - -	- - -	- - -	80	120	9.2	75	119	8.6
	2300	80	117	9.2	75	117	8.6	71	116	8.1
	2250	76	115	8.7	71	114	8.1	67	113	7.7
	2200	71	112	8.1	67	111	7.7	64	109	7.3
	2100	63	105	7.2	60	104	6.9	57	101	6.6
	2000	56	98	6.4	53	96	6.2	52	93	6.0
8000	2400	- - -	- - -	- - -	80	122	9.2	76	121	8.7
	2350	81	120	9.3	76	119	8.7	71	118	8.2
	2300	76	117	8.7	71	116	8.2	68	115	7.8
	2200	68	111	7.7	64	110	7.3	61	107	7.0
	2100	60	104	6.9	57	102	6.6	55	99	6.4
	2000	54	96	6.2	52	94	6.0	51	91	5.9
10,000	2350	76	119	8.8	72	118	8.2	68	117	7.8
	2300	72	116	8.3	68	115	7.8	65	113	7.4
	2250	68	113	7.8	65	112	7.4	61	109	7.1
	2200	65	110	7.4	61	108	7.0	59	105	6.7
	2100	58	102	6.6	55	100	6.4	54	97	6.2
	2000	52	94	6.1	51	91	5.9	50	88	5.8
12,000	2350	73	119	8.3	69	117	7.9	65	115	7.5
	2300	69	115	7.9	65	113	7.5	62	111	7.1
	2250	65	112	7.5	62	109	7.1	59	107	6.8
	2200	62	108	7.1	59	105	6.8	57	103	6.6
	2100	56	100	6.4	54	97	6.2	53	94	6.1

CONDITIONS
2450 Pounds Recommended Lean Mixture At All Altitudes.

NOTE
Performance is shown for an airplane equipped with speed fairings, which increase the cruise speeds by approximately two kias.

RANGE PROFILE

45 MINUTES RESERVE
53 galLONS USABLE FUEL

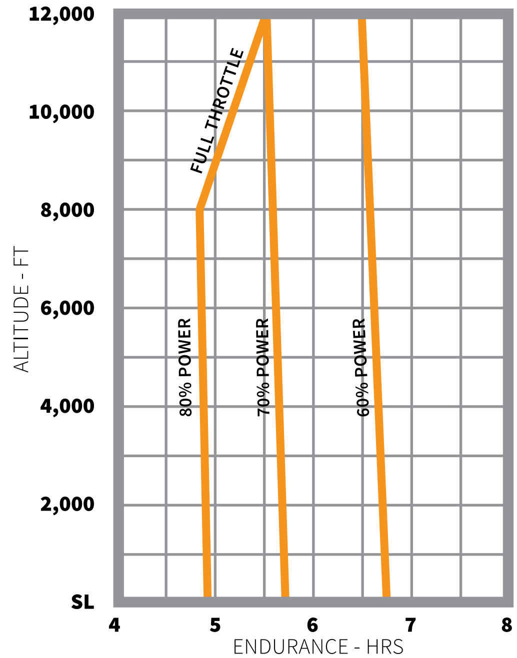


CONDITIONS
2450 Pounds
Recommended Lean Mixture for Cruise At All Altitudes Standard Temperature Zero Wind

NOTES
1. This chart allows for the fuel used for engine start, taxi, takeoff and climb, and the distance during climb.
2. Performance is shown for an airplane equipped with speed fairings, which increase the cruise speeds by approximately two kias.

ENDURANCE PROFILE

45 MINUTES RESERVE
53 galLONS USABLE FUEL



CONDITIONS
2450 Pounds
Recommended Lean Mixture for Cruise At All Altitudes Standard Temperature

NOTE
1. This chart allows for the fuel used for engine start, taxi, takeoff and climb, and the time during climb.

SHORT FIELD LANDING DISTANCE AT 2450 POUNDS

Pressure Altitude (ft.)	0°C		10°C		20°C		30°C		40°C	
	Ground Roll (ft.)	Total ft. to Clear 50ft. Obstacle	Ground Roll (ft.)	Total ft. to Clear 50ft. Obstacle	Ground Roll (ft.)	Total ft. to Clear 50ft. Obstacle	Ground Roll (ft.)	Total ft. to Clear 50ft. Obstacle	Ground Roll (ft.)	Total ft. to Clear 50ft. Obstacle
Sea Level	525	1250	540	1280	560	1310	580	1340	600	1370
1000	545	1280	560	1310	580	1345	600	1375	620	1405
2000	565	1310	585	1345	605	1375	625	1410	645	1440
3000	585	1345	605	1380	625	1415	650	1445	670	1480
4000	605	1380	630	1415	650	1450	670	1485	695	1520
5000	630	1415	650	1455	675	1490	700	1525	720	1560
6000	655	1455	675	1490	700	1530	725	1565	750	1605
7000	680	1495	705	1535	730	1570	755	1610	775	1650
8000	705	1535	730	1575	755	1615	780	1655	810	1695

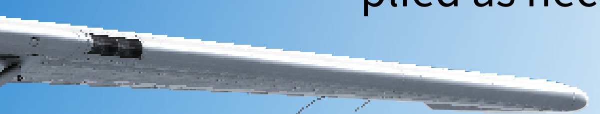
CONDITIONS
Flaps 30°
Power Off
Maximum Braking
Paved, level, dry runway
Zero Wind
Speed at 50 ft: 62 kias

NOTES
1. Short field technique as specified in.
2. Decrease distances 10% for each 9 kts headwind. For operation with tail winds up to 10 kts, increase distances by 10% for each 2 kts.
3. For operation on dry, grass runway, increase distances by 45% of the "ground roll" figure.
4. If landing with flaps up, increase the approach speed by 7 kias and allow for 35% longer distances.

EMERGENCIES

Emergency procedures and checklists.

THIS SECTION PROVIDES checklist and explained procedures for coping with emergencies that may occur. Emergencies caused by airplane or engine malfunctions are extremely rare if proper preflight inspections and maintenance are practiced. En-route weather emergencies can be minimized or eliminated by careful flight planning and good judgment when unexpected weather is encountered. However, should an emergency arise, the basic guidelines described in this section should be considered and applied as necessary to correct the problem.



AIRSPEEDS FOR EMERGENCY OPERATION

- Engine Failure After Takeoff
  - Wing Flaps Up: 65 kias
  - Wing Flaps Down: 60 kias
- Maneuvering Speed
  - 2450 lbs: 99 kias
  - 2100 lbs: 92 kias
  - 1600 lbs: 82 kias

  Maximum Glide: 65 kias

  Precautionary Landing With Engine Power: 60 kias
- Landing Without Engine Power
  - Wing Flaps Up: 65 kias
  - Wing Flaps Down: 60 kias

ENGINE FAILURE DURING TAKEOFF ROLL

1. Throttle — **IDLE**
2. Brakes — **APPLY**
3. Wing Flaps — **RETRACT**
4. Mixture — **IDLE CUT OFF**
5. Ignition Switch — **OFF**
6. Master Switch — **OFF**

ENGINE FAILURE IMMEDIATELY AFTER TAKEOFF

1. Airspeed — **65 kias** (flaps UP)- 60 kias (flaps **DOWN**)
2. Mixture — **IDLE CUT OFF**
3. Fuel Shutoff Valve — **OFF** (Pull Full Out)
4. Ignition Switch — **OFF**
5. Wing Flaps — **AS REQUIRED**
6. Master Switch — **OFF**
7. Cabin Door — **UNLATCH**
8. Land — **STRAIGHT AHEAD**

ENGINE FAILURE DURING FLIGHT (RESTART PROCEDURES)

1. Airspeed — **65 KIAS**
2. Fuel Shutoff Valve — **ON** (push full in)
3. Fuel Selector Valve — **BOTH**
4. Auxiliary Fuel Pump Switch — **ON**
5. Mixture — **RICH** (if restart has not occurred)
6. Ignition Switch — **BOTH** (or **START** if propeller is stopped)

   NOTE: If the propeller is windmilling, the engine will restart automatically within a few seconds. If the propeller has stopped (possible at low speeds), turn the ignition switch to START, advance the throttle slowly from idle and lean the mixture from full rich as required for smooth operation.

7. Auxiliary Fuel Pump Switch — **OFF**

   NOTE: If the fuel flow indicator immediately drops to zero (indicating an engine-driven fuel pump failure), return the Auxiliary Fuel Pump Switch to the ON position.

EMERGENCY LANDING WITHOUT ENGINE POWER

1. Passenger Seat Backs — **MOST UPRIGHT POSITION**
2. Seats and Seat Belts — **SECURE**
3. Airspeed — **65 KIAS** (flaps UP) - 60 kias (flaps **DOWN**)
4. Mixture — **IDLE CUT OFF**
5. Fuel Shutoff Valve — **OFF** (Pull Full Out)
6. Ignition Switch — **OFF**
7. Wing Flaps — **AS REQUIRED** (30° recommended)
8. Master Switch — **OFF** (when landing is assured)
9. Doors — **UNLATCH PRIOR TO TOUCHDOWN**
10. Touchdown — **SLIGHTLY TAIL LOW**
11. Brakes — **APPLY HEAVILY**

PRECAUTIONARY LANDING WITH ENGINE POWER

1. Passenger Seat Backs — **MOST UPRIGHT POSITION**
2. Seats and Seat Belts — **SECURE**
3. Airspeed — **60 KIAS**
4. Wing Flaps — **20°**
5. Selected Field — **FLY OVER**, noting terrain and obstructions, then retract flaps upon reaching a safe altitude and airspeed
6. Avionics Master Switch and Electrical Switches — **OFF**
7. Wing Flaps — **30°** (on final approach)
8. Airspeed — **60 KIAS**
9. Master Switch — **OFF**
10. Doors — **UNLATCH PRIOR TO TOUCHDOWN**
11. Touchdown — **SLIGHTLY TAIL LOW**
12. Ignition Switch — **OFF**
13. Mixture — **IDLE CUTOFF**
14. Brakes — **APPLY HEAVILY**

ENGINE FIRE DURING START ON GROUND

1. Ignition Switch — **START**, Continue Cranking to get a start which would suck the flames and accumulated fuel into the engine

If engine starts:

2. Power — **1700 RPM** for a few minutes
3. Engine — **SHUTDOWN** and inspect for damage

If engine fails to start:

4. Throttle — **FULL OPEN**
5. Mixture — **IDLE CUT OFF**
6. Cranking — **CONTINUE**
7. Fuel Shutoff Valve — **OFF** (Pull Full Out)
8. Auxiliary Fuel Pump — **OFF**
9. Fire Extinguisher — **OBTAIN** (have ground attendants obtain if not installed)
10. Engine — **SECURE**
    a. Master Switch — **OFF**
    b. Ignition Switch — **OFF**
11. Parking Brake — **RELEASE**
12. Airplane — **EVACUATE**
13. Fire — **EXTINGUISH** using fire extinguisher, wool blanket, or dirt
14. Fire Damage — **INSPECT**, repair damage or replace damaged components or wiring before conducting another flight

ENGINE FIRE IN FLIGHT

1. Mixture — **IDLE CUT OFF**
2. Fuel Shutoff Valve — **OFF** (Pull Full Out)
3. Auxiliary Fuel Pump Switch — **OFF**
4. Master Switch — **OFF**
5. Cabin Heat and Air — **OFF** (except overhead vents)
6. Airspeed — **100 KIAS** (If fire is not extinguished, increase glide speed to find an airspeed - within airspeed limitations - which will provide an incombustible mixture)
7. Forced Landing — **EXECUTE** (as described in Emergency Landing Without Engine Power)

AMMETER SHOWS EXCESSIVE RATE OF CHARGE (FULL SCALE DEFLECTION)

1. Alternator — **OFF**
2. Nonessential Electrical Equipment — **OFF**
3. Flight — **TERMINATE** as soon as practical

LOW VOLTAGE ANNUNCIATOR (VOLTS) ILLUMINATES DURING FLIGHT (AMMETER INDICATES DISCHARGE)

NOTE: Illumination of "VOLTS" on the annunciator panel may occur during low RPM conditions with an electrical load on the system such as during a low RPM taxi. Under these conditions, the annunciator will go out at higher RPM. The master switch need not be recycled since an overvoltage condition has not occurred to deactivate the alternator system.

1. Avionics Master Switch — **OFF**
2. Alternator Circuit Breaker (ALT FLD) — **CHECK IN**
3. Master Switch — **OFF** (both sides)
4. Master Switch — **ON**
5. Low Voltage Annunciator (VOLTS) — **CHECK OFF**
6. Avionics Master Switch — **ON**

If low voltage annunciator (VOLTS) illuminates again:

7. Alternator-- **OFF**
8. Nonessential Radio and Electrical Equipment — **OFF**
9. Flight — **TERMINATE** as soon as practical

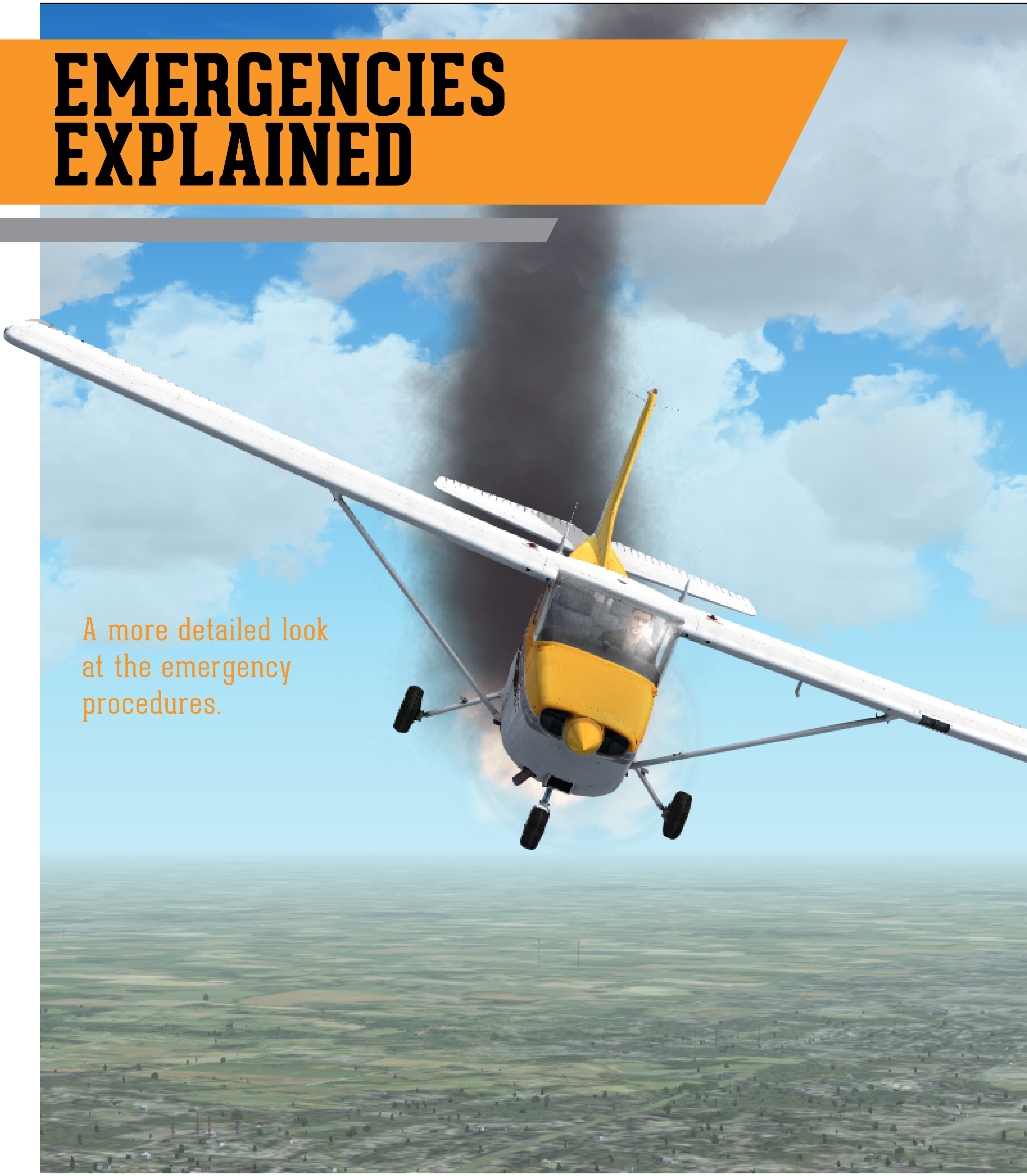
LEFT VACUUM (L VAC) ANNUNCIATOR OR RIGHT VACUUM (VAC R) ANNUNCIATOR ILLUMINATES.

NOTE: If vacuum is not within normal operating limits, a failure has occurred in the vacuum system and partial panel procedures may be required for continued flight.

1. Vacuum Gage — **CHECK** to ensure vacuum within normal operating limits.

EMERGENCIES EXPLAINED

A more detailed look at the emergency procedures.



THE FOLLOWING AMPLIFIED Emergency Procedures elaborate upon information contained in the Emergency Procedures Checklists portion of this section. These procedures also include information not readily adaptable to a checklist format, and material to which a pilot could not be expected to refer in resolution of a specific emergency. This information should be reviewed in detail prior to flying the airplane, as well as reviewed on a regular basis to keep pilot's knowledge of procedures fresh.

ENGINE FAILURE

If an engine failure occurs during the takeoff roll, the most important thing to do is stop the airplane on the remaining runway. Those extra items on the checklist will provide added safety after a failure of this type. Prompt lowering of the nose to maintain airspeed and establish a glide attitude is the first response to an engine failure after takeoff. In most cases, the landing should be planned straight ahead with only small changes in direction to avoid obstructions. Altitude and airspeed are seldom sufficient to execute a 180° gliding turn necessary to return to the runway. The checklist procedures assume that adequate time exists to secure the fuel and ignition systems prior to touchdown. After an engine failure in flight, the most important course of action is to continue flying the airplane. Best glide speed should be established as quickly as possible. While gliding toward a suitable landing area, an effort should be made to identify the cause of the failure. If time permits, an engine restart should be attempted as shown in the checklist. If the engine cannot be restarted, a forced landing without power must be completed.

FORCED LANDINGS

If all attempts to restart the engine fail and a forced landing is imminent, select a suitable field and prepare for the landing as discussed under the Emergency Landing Without Engine Power checklist. Transmit Mayday message on 121.5 MHz giving location and intentions and squawk 7700. Before attempting an "off airport" landing with engine power available, one should fly over the landing area at a safe but low altitude to inspect the terrain for obstructions and surface conditions, proceeding as discussed under the Precautionary Landing With Engine Power checklist. Prepare for ditching by securing or jettisoning heavy objects located in the baggage area and collect folded coats for protection of occupants' face at touchdown. Transmit Mayday message on 121.5 MHz giving location and intentions and squawk 7700. Avoid a landing flare because of difficulty in judging height over a water surface. The checklist assumes the availability of power to make a precautionary water landing. If power is not available, use of the airspeeds noted with minimum flap extension will provide a more favorable attitude for a power off ditching. In a forced landing situation, do not set the **AVIONICS MASTER** switch or the airplane **MASTER** switch to the **OFF** position until a landing is assured. When these switches are in the **OFF** position, the airplane electrical systems are de-energized. Before performing a forced landing, especially in remote and mountainous areas, activate the ELT transmitter by positioning the cockpit-mounted switch to the **ON** position.

LANDING WITHOUT ELEVATOR CONTROL

Trim for horizontal flight (with an airspeed of approximately 65 kias and flaps set to 20°) by using throttle and elevator trim controls. Then do not change the elevator trim control setting; control the glide angle by adjusting power exclusively. At the landing flare (round-out), the nose down moment resulting from power reduction is an adverse factor and the airplane may land on the nose wheel. Consequently, at flare, the elevator trim control should be adjusted toward the full nose up position and the power adjusted so that the airplane will rotate to the horizontal attitude for touchdown. Close the throttle at touchdown.

FIRES

Although engine fires are extremely rare in flight, the steps of the appropriate checklist should be followed if one is encountered. After completion of this procedure, execute a forced landing. Do not attempt to restart the engine. The initial indication of an electrical fire is usually the odor of burning insulation. The checklist for this problem should result in elimination of the fire.

TOTAL VACUUM SYSTEM FAILURE

If both the vacuum pumps fail in flight, the directional indicator and attitude indicator will be disabled, and the pilot will have to rely on the turn coordinator if he inadvertently flies into clouds. If an autopilot is installed, it too may be affected. The following instructions assume that only the electrically powered turn coordinator is operative, and that the pilot is not completely proficient in instrument flying.

SPINS

NEVER INTENTIONALLY SPIN an aircraft that is not designed and built to be spun (aerobatic aircraft).

Should an inadvertent spin occur, the following recovery procedure should be used:

1. Retard throttle to idle position.
2. Place ailerons in neutral position.
3. Apply and hold full rudder opposite to the direction of rotation.
4. Just after the rudder reaches the stop, move the control wheel briskly forward far enoughto break the stall. Full down elevator may be required at aft center of gravity loadings to assure optimum recoveries.
5. Hold these control inputs until rotation stops. Premature relaxation of the control inputs may extend the recovery.
6. As rotation stops, neutralize rudder, and make a smooth recovery from the resulting dive.

NOTE: If disorientation precludes a visual determination of the direction of rotation, the symbolic airplane in the turn coordinator may be referred to for this information.

ROUGH ENGINE OPERATION OR LOSS OF POWER

SPARK PLUG FOULING

A slight engine roughness in flight may be caused by one or more spark plugs becoming fouled by carbon or lead deposits. This may be verified by turning the ignition switch momentarily from **BOTH** to either **L** or **R** position. An obvious power loss in single ignition operation is evidence of spark plug or magneto trouble. Assuming that spark plugs are the more likely cause, lean the mixture to the recommended lean setting for cruising flight. If the problem does not clear up in several minutes, determine if a richer mixture setting will produce smoother operation. If not, proceed to the nearest airport for repairs using the **BOTH** position of the ignition switch unless extreme roughness dictates the use of a single ignition position.

MAGNETO MALFUNCTION

A sudden engine roughness or misfiring is usually evidence of magneto problems. Switching from **BOTH** to either **L** or **R** ignition switch position will identify which magneto is malfunctioning. Select different power settings and enrichen the mixture to determine if continued operation on **BOTH** magnetos is possible. If not, switch to the good magneto and proceed to the nearest airport for repairs.

ENGINE-DRIVEN FUEL PUMP FAILURE

Failure of the engine-driven fuel pump will result in an immediate loss of engine power, similar to fuel exhaustion or starvation, but while operating from a fuel tank containing adequate fuel. A sudden reduction in indicated fuel flow will occur just before loss of engine power. If the engine-driven fuel pump fails, immediately set the auxiliary fuel pump switch (**FUEL PUMP**) to the **ON** position to restore engine power. The flight should be terminated as soon as practical and the engine-driven fuel pump repaired.

LOW OIL PRESSURE

If the low oil pressure annunciator (**OIL PRESS**) illuminates and oil temperature remains normal, the oil pressure sending unit or relief valve may be malfunctioning. Land at the nearest airport to inspect the source of trouble. If a total loss of oil pressure is accompanied by a rise in oil temperature, there is good reason to suspect an engine failure is imminent. Reduce engine power immediately and select a suitable forced landing field. Use only the minimum power required to reach the desired touchdown spot.

ELECTRICAL POWER SUPPLY SYSTEM MALFUNCTIONS

Malfunctions in the electrical power supply system can be detected by periodic monitoring of the ammeter and low voltage annunciator (**VOLTS**); however, the cause of these malfunctions is usually difficult to determine. A broken alternator drive belt or wiring is most likely the cause of alternator failures, although other factors could cause the problem. A defective alternator control unit can also cause malfunctions. Problems of this nature constitute an electrical emergency and should be dealt with immediately. Electrical power malfunctions usually fall into two categories: excessive rate of charge and insufficient rate of charge. The following paragraphs describe the recommended remedy for each situation.

EXCESSIVE RATE OF CHARGE

After engine starting and heavy electrical usage at low engine speeds (such as extended taxiing) the battery condition will be low enough to accept above normal charging during the initial part of a flight. However, after thirty minutes of cruising flight, the ammeter should be indicating less than two needle widths of charging current. If the charging rate were to remain above this value on a long flight, the battery would overheat and evaporate the electrolyte at an excessive rate. Electronic components in the electrical system can be adversely affected by higher than normal voltage. The alternator control unit includes an overvoltage sensor which normally will automatically shut down the alternator if the charge voltage reaches approximately 31.5 volts. If the overvoltage sensor malfunctions, as evidenced by an excessive rate of charge shown on the ammeter, the alternator should be turned off, nonessential electrical equipment turned off and the flight terminated as soon as practical.

INSUFFICIENT RATE OF CHARGE

The low voltage annunciator (**VOLTS**) may come on and ammeter discharge indications may occur during low RPM conditions with an electrical load on the system, such as during a low RPM taxi. Under these conditions, the annuciator will go off at higher RPM.

If the overvoltage sensor should shut down the alternator and trip the alternator circuit breaker (**ALT FLD**), or if the alternator output is low, a discharge rate will be shown on the ammeter followed by illumination of the low voltage annunciator (**VOLTS**). Since this may be a "nuisance" trip out, an attempt should be made to reactivate the alternator system. To reactivate, set the avionics master switch to the **OFF** position, check that the alternator circuit breaker (**ALT FLD**) is in, then set both sides of the master switch to the **OFF** position and then to the **ON** position. If the problem no longer exists, normal alternator charging will resume and the low voltage annunciator (**VOLTS**) will go off. The avionics master switch may then be returned to the **ON** position. If the annunciator illuminates again, a malfunction is confirmed. In this event, the flight should be terminated and/or the current drain on the battery minimized because the battery can supply the electrical system for only a limited period of time. Battery power must be conserved for later operation of the wing flaps and, if the emergency occurs at night, for possible use of the landing lights during landing.

AIRPLANE & SYSTEMS DESCRIPTION

A detailed look at the various parts and systems of the C172.

THIS SECTION PROVIDES description and operation of the airplane and its systems.

FLIGHT CONTROLS

The airplane's flight control system consists of conventional aileron, rudder, and elevator control surfaces. The control surfaces are manually operated through cables and mechanical linkage using a control wheel for the ailerons and elevator, and rudder/brake pedals for the rudder.

TRIM SYSTEM

A manually operated elevator trim system is provided. Elevator trimming is accomplished through the elevator trim tab by utilizing the vertically mounted trim control wheel in the cockpit. Forward rotation of the trim wheel will trim nose down; conversely, aft rotation will trim nose up.

INSTRUMENT PANEL

The instrument panel is of all-metal construction, and is designed in segments to allow related groups of instruments, switches and controls to be removed without removing the entire panel. For specific details concerning the instruments, switches, circuit breakers, and controls on the instrument panel, refer to related topics in this section.

PILOT PANEL LAYOUT

Flight instruments are contained in a single panel located in front of the pilot. These instruments are designed around the basic "T" configuration. The gyros are located immediately in front of the pilot, and arranged vertically over the control column. The airspeed indicator and altimeter are located to the left and right of the gyros, respectively. The remainder of the flight instruments are clustered around the basic "T". An annunciator panel is located above the altimeter and provides caution and warning messages for fuel quantity, oil pressure, low vacuum and low voltage situations.

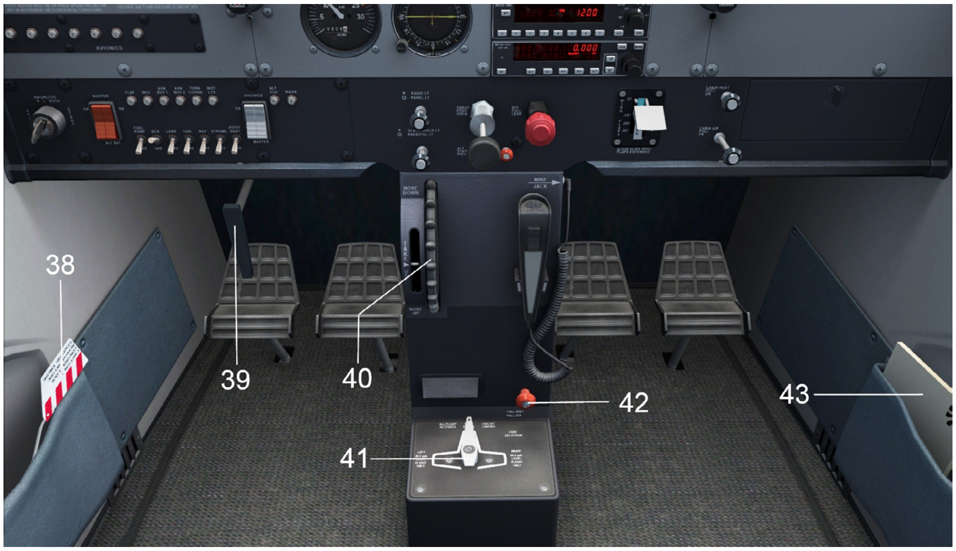
To the right of the flight instruments is a sub panel which contains engine tachometer and various navigational heading instruments. To the left of the flight instruments is a sub panel which contains a left/right fuel quantity indicator, an oil temperature/oil pressure indicator, a vacuum gage/ammeter, an EGT/fuel flow indicator, a digital clock/OAT indicator and the avionics circuit breaker panel.

Below the engine and flight instruments are circuit breakers and switches for the airplane systems and equipment. Master, Avionics Master and Ignition Switches are also located in this area of the panel. The parking brake control is positioned below the switch and circuit breaker panel.

COCKPIT FAMILIARIZATION

The center panel contains various avionics equipment arranged in a vertical rack. This arrangement allows each component to be removed without having to access the backside of the panel. Below the panel are the throttle, mixture, alternate static air and lighting controls.

1. Oil Temp and Oil Pressure Indicator.
2. Fuel Quantity Indicator.
3. Vacuum Gauge and Ammeter.
4. EGT/Fuel Flow Indicator.
5. Digital Clock/O.A.T. Indicator.
6. Turn Indicator.
7. Airspeed Indicator.
8. Directional Gyro.
9. Attitude Indicator.
10. Tachometer.
11. Vertical Speed Indicator.
12. Altimeter.
13. Annunciator Panel.
14. ADF Bearing Indicator.
15. Course Deviation and Glide Slope Indicators.
16. GPS Receiver.
17. Audio Control Panel.
18. NAV/COM Radio #1
19. NAV/COM Radio #2
20. ADF Receiver.
21. Transponder.
22. Autopilot.
23. Hour Meter.
24. Cabin Air Control.
25. Cabin Heat Control.
26. Flap Switch and Position Indicator.
27. Mixture Control.
28. Alternate Static Air Control.
29. Throttle Control.
30. Radio and Panel Dimming Control.
31. Glareshield and Pedestal Dimming Control.
32. Avionics Master Switch.
33. Pitot Heat Switch.
34. External Lighting Switches.
35. Fuel Pump Switch.
36. Battery Master Switch.
37. Ignition Switch.



38. Controls Lock.

39. Parking Brake.

40. Elevator Trim Control and Position Indicator.

41. Fuel Selector.

42. Fuel Shutoff Valve Control.

43. Pilots Manual.

GROUND CONTROL

Effective ground control while taxiing is accomplished through nose wheel steering by using the rudder pedals; left rudder pedal to steer left and right rudder pedal to steer right. When a rudder pedal is depressed, a spring loaded steering bungee (which is connected to the nose gear and to the rudder bars) will turn the nose wheel through an arc of approximately 10° each side of center. By applying either left or right brake, the degree of turn may be increased up to 30° each side of center.

WING FLAP SYSTEM

The single-slot type wing flaps, are extended or retracted by positioning the wing flap switch lever on the instrument panel to the desired flap deflection position. The switch lever is moved up or down in a slotted panel that provides mechanical stops at the 10°, 20° and 30° positions. To change flap setting, the flap lever is moved to the right to clear mechanical stops at the 10° and 20° positions. A scale and pointer to the left of the flap switch indicates flap travel in degrees. The wing flap system circuit is protected by a 10- ampere circuit breaker, labeled FLAP, on the left side of the control panel.

LANDING GEAR SYSTEM

The landing gear is of the tricycle type, with a steerable nose wheel and two main wheels. Wheel fairings are optional equipment for both the main and nose wheels. Shock absorption is provided by the tubular spring steel main landing gear struts and the air/oil nose gear shock strut. Each main gear wheel is equipped with a hydraulically actuated disc type brake on the inboard side of each wheel.

CONTROL LOCKS

A control lock is provided to lock the aileron and elevator control surfaces to prevent damage to these systems by wind buffeting while the airplane is parked. The lock consists of a shaped steel rod and flag. The flag identifies the control lock and cautions about its removal before starting the engine. To install the control lock, align the hole in the top of the pilot's control wheel shaft with the hole in the top of the shaft collar on the instrument panel and insert the rod into the aligned holes. Installation of the lock will secure the ailerons in a neutral position and the elevators in a slightly trailing edge down position. Proper installation of the lock will place the flag over the ignition switch. In areas where high or gusty winds occur, a control surface lock should be installed over the vertical stabilizer and rudder. The control lock and any other type of locking device should be removed prior to starting the engine.

ENGINE

The airplane is powered by a horizontally opposed, four cylinder, overhead valve, air cooled, fuel injected engine with a wet sump lubrication system. The engine is a Lycoming Model IO-360-L2A and is rated at 160 horsepower at 2400 RPM. Major accessories include a starter and belt driven alternator mounted on the front of the engine, and dual magnetos, dual vacuum pumps, and a full flow oil filter mounted on the rear of the engine accessory case.

ENGINE CONTROLS

Engine power is controlled by a throttle located on the switch and control panel above the center pedestal. The throttle is open in the full forward position and closed in the full aft position. A friction lock, which is a round knurled knob, is located at the base of the throttle and is operated by rotating the lock clockwise to increase friction or counterclockwise to decrease it.

The mixture control, mounted adjacent to the throttle control, is a red knob with raised points around the circumference and is equipped with a lock button in the end of the knob. The rich position is full forward, and full aft is the idle cutoff position.

ENGINE INSTRUMENTS

Engine operation is monitored by the following instruments: oil pressure/oil temperature indicator, tachometer and exhaust gas temperature (EGT) indicator. In addition, the annunciator panel contains a red OIL PRESS annunciator which comes on when the oil pressure is low.

Oil pressure signals are generated from an oil pressure line/transducer combination. An oil pressure line is routed from the upper front of the engine case to the rear engine baffle. At the baffle, the oil pressure line is connected to a transducer. This transducer produces an electrical signal which is translated into a pressure reading by the oil pressure gage located on the LH instrument panel.

In addition, a separate low oil pressure indication is provided through the panel annunciator. This annunciator is wired to a pressure switch located on the rear of the engine accessory case.

When oil pressure is below 20 PSI, the switch grounds and completes the annunciator circuit, illuminating the red OIL PRESS light. When pressure exceeds 20 PSI, the ground is removed and the OIL PRESS annunciator goes out.

NOTE: The low oil pressure switch is also connected to the hour (Hobbs) meter. When pressure exceeds 20 PSI, a ground is supplied to the hour meter, completing the hour meter circuit.

Oil temperature signals are generated from a resistance-type probe located in the engine accessory case. As oil temperature changes, the probe resistance changes. This resistance is translated into oil temperature readings on the cockpit indicator.

The engine driven mechanical tachometer is located on the in-

strument panel to the right of the pilot's control wheel. The instrument is calibrated in increments of 100 RPM and indicates both engine and propeller speed. An hour meter in the lower section of the dial records elapsed engine time in hours and tenths. Instrument markings include the normal operating range (green arc) from 1900 to 2400 RPM.

The exhaust gas temperature (EGT) indicator is located on the LH instrument panel as part of the EGT/Fuel Flow indicator. Since exhaust gas temperature varies with fuel-air ration (mixture), density altitude, throttle position and RPM, the instrument is a useful aid in adjusting the mixture for best economy or performance. The EGT indicator allows the pilot to lean (reduce the proportion of fuel in the fuel-air mixture) to a known value using the maximum or "peak" exhaust gas temperature as a reference. An index pointer which can be positioned manually is provided for the pilot to mark the location of the peak. Never lean using EGT when operating at more than 80% power

The EGT system uses a thermocouple in the in the engine exhaust (tailpipe) to supply a voltage proportional to exhaust gas temperature. The EGT indicator responds to the voltage developed by the thermocouple. As the mixture is leaned (from full rich), the exhaust gas temperature will increase to a maximum value as the stoichiometric (most chemically efficient) fuel-air ratio is achieved and will decrease if the mixture continues to be leaned.

MY ENGINE IS SMOKING

Remember, your engine is a piston-powered air pump. Valves open, a piston sucks in air / fuel, ignites it, another valve opens on the next stroke, and it ejects the burned mixture out the exhaust. During this time, oil below is lubricating those cylinder walls and piston rings keep that oil below and out of the combustion chamber. Well, all the above is how things are supposed to work, but as all things in life, nothing is perfect.

BLUE SMOKE

If your cylinders are worn or damaged, the cylinders can suck oil up past these rings. This oil is then present when the chamber combusts, burning it, and ejecting it. Two things happen. You will see blue smoke coming out the exhaust and oil sediments will build inside your combustion chamber, slowly degrading that cylinder's ability to properly work.

BLACK SMOKE

Your engine is a vacuum pump, sucking in an air / fuel mixture, igniting it, then ejecting the burned remains. However, if you have a bad cylinder, a faulty ignition, fouled plugs, or fuel injection issues, the complete burning of the air / fuel mixture can be compromised. The result is black smoke (unburned fuel) seen coming out of the cylinders. If you see black smoke, get the aircraft on the ground and to a maintenance facility to find the cause of the problem.

ENGINE LUBRICATION SYSTEM

The engine utilizes a full pressure, wet sump-type lubrication system with aviation grade oil used as the lubricant. The capacity of the engine sump (located on the bottom of the engine) is eight quarts. Oil is drawn from the sump through an oil suction strainer screen into the engine-driven oil pump.

An oil filler cap/oil dipstick is located at the right rear of the engine. The filler cap/ dipstick is accessible through an access door on the top right side of the engine cowling. The engine should not be operated on less than five quarts of oil. For extended flight, fill to eight quarts (dipstick indication only). For engine oil grade and specifications, refer to of this handbook.

OIL PRESSURE

Oil is the lifeblood of your engine. The countless metal parts in motion depend on constantly having a film of oil covering and separating them. Theoretically, there should be no metal on metal contact, but pressurized oil in between. Some times simply having oil continuously splashed on the part is enough, yet other times actual pressure is required to keep these metal parts separated. The heavy crankshaft that is responsible for twisting the propeller is one part that is in critical need of this pressure at all times. Running the engine without oil pressure for just minutes is enough to seize up the engine.

OIL TEMPERATURE

Understanding how temperature affects the viscosity of the lubricant is very important (viscosity is the term used to describe the lubricants resistance to flow). As your engine oil increases in temperature, it's viscosity decreases, which means that it flows more freely. And vice-versa, as the lubricant cools down, it's viscosity increases, making it more resistant to flow.

Accusim models this effect of oil viscosity, so understanding how it affects you, the pilot, is important.

When you start your engine on a cold morning, know that the oil inside your engine has a high viscosity. You must be respectful of this, as pushing an engine with thick, cold oil can cause premature oil system leaks or worse.

If you must start a very cold engine, give it just enough throttle to keep it running (not so low that it is struggling to run). Hold the idle at the lowest possible RPM and wait for the oil temperature to rise. As it rises, the oil will thin, and you may also notice the RPM actually increase due to the thinner oil being easier to push through all those small areas. So ultimately, as the oil temperature rises the oil pressure drops.

IGNITION AND STARTER SYSTEM

Engine ignition is provided by two engine-driven magnetos, and two spark plugs in each cylinder. The right magneto fires the lower right and upper left spark plugs, and the left magneto fires the lower left and upper right spark plugs. Normal operation is conducted with both magnetos due to the more complete burning of the fuel/air mixture with dual ignition.

Ignition and starter operation is controlled by a rotary-type switch located on the left switch and control panel. The switch is labeled clockwise, **OFF**, **R**, **L**, **BOTH**, and **START**. The engine should be operated on both magnetos (**BOTH** position) except for magneto checks. The R and L positions are for checking purposes and emergency use only. When the switch is rotated to the spring loaded **START** position, (with the master switch in the **ON** position), the starter contactor is closed and the starter, now energized, will crank the engine. When the switch is released, it will automatically return to the BOTH position.

ELECTRIC STARTER

The C172 Trainer has a direct-drive, electric starter, which functions very much the same way as the starter used in automobiles.

Turning the starter on, engages the starter motor to the engine, and it cranks the engine over with electricity. As the engine is turning over, the pilot is providing the engine with all of its fuel and ignition requirements, with the expectation

the engine starts firing (combusting), and begins to run on its own power (using fuel and spark).

Once the engine reaches a certain speed, the starter motor automatically disengages and the engine runs free,

AIR INDUCTION SYSTEM

The engine air induction system receives ram air through an intake on the lower front portion of the engine cowling. The intake is covered by an air filter which removes dust and other foreign matter from the induction air. Airflow passing through the filter enters an air box. The air box has a spring-loaded alternate air door. If the air induction filter should become blocked, suction created by the engine will open the door and draw unfiltered air from inside the lower cowl area. An open alternate air door will result in an approximate 10% power loss at full throttle. After passing through the air box, induction air enters a fuel/air control unit under the engine, and is then ducted to the engine cylinders through intake manifold tubes.

EXHAUST SYSTEM

Exhaust gas from each cylinder passes through riser assemblies to a muffler and tailpipe. Outside air is pulled in around shrouds which are constructed around the outside of the muffler to form heating chambers which supply heat to the cabin.

COOLING SYSTEM

Ram air for engine cooling enters through two intake openings in the front of the engine cowling. The cooling air is directed around the cylinders and other areas of the engine by baffling, and is then exhausted through an opening at the bottom aft edge of the cowling. No manual cowl flap cooling system control is required.

PROPELLER

The Cessna 172R comes stock from the factory with a two-bladed, fixed-pitch, 75” diameter propeller.

On the real airplane (and in the Accu-Sim maintenance hangar), you can replace this with the same propeller that came installed on the Cessna 172S. This higher performance propeller has a flatter pitch, resulting in less resistance that allows the engine to run at a higher RPM under the same conditions.

So, for example, if you hold your brakes on a 172R and apply full power, the engine will peak at about 2,100RPM. Doing the same exercise on a 172S, the engine will peak somewhere between 2,300-2,400RPM. The engine therefore is creating more horsepower on your takeoff run with the flatter, higher-RPM 172S propeller.

However, on the other hand, the 172R propeller will cruise at a lower RPM, resulting in better fuel economy and a quieter cabin.

Just like you own airplane, the choice is yours.

FUEL SYSTEM

The airplane fuel system consists of two vented integral fuel tanks (one tank in each wing), a three-position selector valve, auxiliary fuel pump, fuel shutoff valve, fuel strainer, engine driven fuel pump, fuel/air control unit, fuel distribution valve and fuel injection nozzles.

FUEL DISTRIBUTION

Fuel flows by gravity from the two wing tanks to a three-position selector valve, labeled **BOTH, RIGHT** and **LEFT** and on to the reservoir tank. From the reservoir tank fuel flows through the auxiliary fuel pump, past the fuel shutoff valve, through the fuel strainer to an engine driven fuel pump.

From the engine driven fuel pump, fuel is delivered to the fuel/air control unit, where it is metered and directed to a fuel distribution valve (manifold) which distributes it to each cylinder. Fuel flow into each cylinder is continuous, and flow rate is determined by the amount of air passing through the fuel/air control unit.

FUEL INDICATING

Fuel quantity is measured by two float type fuel quantity transmitters (one in each tank) and indicated by an electrically operated fuel quantity indicator on the left side of the instrument panel. The gauges are marked in gallons of fuel. An empty tank is indicated by a red line and the number 0. When an indicator shows an empty tank, approximately 1.5 gallons remain in each tank as unusable fuel. The indicators should not be relied upon for accurate readings during skids, slips, or unusual attitudes.

Each fuel tank also incorporates warning circuits which can detect low fuel conditions and erroneous transmitter messages. Anytime fuel in the tank drops below approximately 5 gallons (and remains below this level for more than 60 seconds), the amber **LOW FUEL** message will flash on the annunciator panel for approximately 10 seconds and then remain steady amber. The annunciator cannot be turned off by the pilot. If the left tank is low, the message will read **L LOW FUEL**. If the right tank is low, the message will read **LOW FUEL R**. If both tanks are low, the message will read **L LOW FUEL R**.

In addition to low fuel annunciation, the warning circuitry is designed to report failures with each transmitter caused by shorts, opens or transmitter resistance which increases over time. If the circuitry detects any one of these conditions, the fuel level indicator needle will go to the **OFF** position (below the 0 mark on the fuel indicator), and the amber annunciator will illuminate. If the left tank transmitter has failed, the message will read L **LOW FUEL**. If the right tank transmitter has failed, the message will read **LOW FUEL** R. If both tanks transmitters have failed, the message will read **L LOW FUEL R**.

Fuel pressure is measured by use of a transducer mounted near the fuel manifold. This transducer produces an electrical signal which is translated for the cockpit-mounted indicator in gallons-perhour.

FUEL VENTING

Fuel system venting is essential to system operation. Blockage of the system will result in decreasing fuel flow and eventual engine stoppage. Venting is accomplished by an interconnecting line from the right fuel tank to the left tank. The left fuel tank is vented overboard through a vent line, equipped with a check valve, which protrudes from the bottom surface of the left wing near the wing strut. Both fuel filler caps are also vented.

REDUCED TANK CAPACITY

The airplane may be serviced to a reduced capacity to permit heavier cabin loadings. This is accomplished by filling each tank to the bottom edge of the fuel filler tab, thus giving a reduced fuel load of 17.5 gallons usable in each tank.

FUEL SELECTOR VALVE

The fuel selector valve should be in the **BOTH** position for takeoff, climb, landing, and maneuvers that involve prolonged slips or skids of more than 30 seconds. Operation from either **LEFT** or **RIGHT** tank is reserved for cruising flight.

NOTE: When the fuel selector valve handle is in the BOTH position in cruising flight, unequal fuel flow from each tank may occur if the wings are not maintained exactly level. Resulting wing heaviness can be alleviated gradually by turning the selector valve handle to the tank in the "heavy" wing. It is not practical to measure the time required to consume all of the fuel in one tank, and, after switching to the opposite tank, expect an equal duration from the remaining fuel. The airspace in both fuel tanks is interconnected by a vent line and, therefore, some sloshing of fuel between tanks can be expected when the tanks are nearly full and the wings are not level.

NOTE: When the fuel tanks are ¼ full or less, prolonged uncoordinated flight such as slips or skids can uncover the fuel tank outlets. Therefore, if operating with one fuel tank dry or if operating on LEFT or RIGHT tank when ¼ full or less, do not allow the airplane to remain in uncoordinated flight for periods in excess of 30 seconds.

FUEL DRAIN VALVES

The fuel system is equipped with drain valves to provide a means for the examination of fuel in the system for contamination and grade. The system should be examined before each flight and after each refueling, by using the sampler cup provided to drain fuel from each wing tank sump and the fuel strainer sump. If any evidence of fuel contamination is found, it must be eliminated in accordance with the Preflight Inspection checklist. If takeoff weight limitations for the next flight permit, the fuel tanks should be filled after each flight to prevent condensation.

BRAKE SYSTEM

The airplane has a single-disc, hydraulically actuated brake on each main landing gear wheel. Each brake is connected, by a hydraulic line, to a master cylinder attached to each of the pilot's rudder pedals. The brakes are operated by applying pressure to the top of either the left (pilot's) or right (copilot's) set of rudder pedals, which are interconnected. When the airplane is parked, both main wheel brakes may be set by utilizing the parking brake which is operated by a handle under the left side of the instrument panel. To apply the parking brake, set the brakes with the rudder pedals, pull the handle aft, and rotate it 90° down.

For maximum brake life, keep the brake system properly maintained, and minimize brake usage during taxi operations and landings.

With Accu-Sim, we increase the likelihood of hearing brake noise and squeals as the breaks age. Hearing the occasional squeal is normal, but if your breaks start making noise regularly, bring the plane into the maintenance hangar for a check.

ELECTRICAL SYSTEM AND BATTERY

Accu-Sim installs an authentic period battery into a feature-rich electrical system, thanks to close consultation with our own on-staff electrical engineer and high time pilots. Batteries suffer from reduced capacity as they age, have a limited output (34 amp hours), can overheat if you demand too much from them, and can even load up your entire system if you have a brand new, but dead battery on-line. (ever try to jump start a car with a dead battery and nothing happens? You have to disconnect the dead battery and try again, since the dead battery is stealing all the electricity). The physical laws governing electricity are inexorable as those which govern running water. Our latest and most sophisticated version of Accu-Sim accurately replicates those physical laws and permits you to see the electrical system at work, via the ammeter on your electrical panel and through sounds and behaviour of the various electrically driven systems.

VOLTS, AMPS, WATTS, WHAT DOES THIS ALL MEAN?

Without getting too technical, the pilot in command must understand the basics of what is happening in the aircraft's electrical system and components. Volts X Amps = watts. If we use a water hose as an analogy, volts would be the water pressure, amps would be the hose width, and watts would be the amount / rate of water coming out the end. You could have, for example, a 120 volt, 1 amp light bulb would be the same brightness as a 12 volt, 100 amp bulb. The high voltage system is sending high pressure down a small pipe, and the low voltage system is sending low pressure down a large pipe, but each putting out the same amount of water (watts).

If you take a huge draw, for example running an electric engine starter, voltage will plummet as the battery struggles to supply this current. Your Ammeter will show the current draw. However, play with your lights, pitot heat, etc. and watch how these little changes affect these systems. Remember, your electrical system has a battery and an engine driven electrical generator. The battery puts out about 24 volts, while the generator puts out a little more (about 28 volts). This allows your generator to not only drive all of the systems, but charge the battery at the same time. Remember, your generator is powered by the engine speed, and it does not reach it's full capacity until about 1,500 RPM. Watch your meters, and you will see and enjoy a genuine electrical system in action.

In addition, weather affects a battery's performance. Fortunately, you can always visit your maintenance hangar for a quick charge or replacement. If you use your battery wisely and correctly, it will last a long time.

ELECTRICAL SYSTEM DESCRIPTION

The airplane is equipped with a 28-volt, direct current electrical system. The system is powered by a beltdriven, 60-amp alternator and a 24-volt battery, located on the left forward side of the firewall. Power is supplied to most general electrical circuits through a split primary bus bar, with an essential bus wired between the two primaries to provide power for the master switch, annunciator circuits and interior lighting.

Each primary bus bar is also connected to an avionics bus bar via a single avionics master switch. The primary buses are on anytime the master switch is turned on, and are not affected by starter or external power usage. The avionics buses are on when the master switch and avionics master switch are in the ON position.

The airplane uses a power distribution module (J-Box), located on the left forward side of the firewall, to house all relays used throughout the airplane electrical system. In addition, the alternator control unit and the external power connector are housed within the module.

ANNUNCIATOR PANEL

An annunciator panel (with integral toggle switch) is located on the left side of the instrument panel and provides caution (amber) and warning (red) messages for selected portions of the airplane systems. The annunciator is designed to flash

messages for approximately 10 seconds to gain the attention of the pilot before changing to steady on. The annunciator panel cannot be turned off by the pilot.

Inputs to the annunciator come from each fuel transmitter, the low oil pressure switch, the vacuum transducers and the alternator control unit (ACU). Individual LED bulbs illuminate each message and may be replaced through the rear of the annunciator. Illumination intensity can be controlled by placing the toggle switch to either the DIM or DAY position.

The annunciator panel can be tested by turning the Master Switch On and holding the annunciator panel switch in the TST position. All amber and red messages will flash until the switch is released.

NOTE: When the Master Switch is turned ON, some annunciators will flash for approximately 10 seconds before illuminating steadily. When the annunciator panel switch is toggled up and held in the TST position, all remaining lights will flash until the switch is released.

MASTER SWITCH

The master switch is a split rocker type switch labeled MASTER, and is ON in the up position and off in the down position. The right half of the switch, labeled BAT, controls all electrical power to the airplane. The left half, labeled ALT, controls the alternator.

CAUTION: Prior to turning the master switch on or off, starting the engine or applying an external power source, the avionics power switch, labeled avionics power, should be turned off to prevent any harmful transient voltage from damaging the avionics equipment.

Normally, both sides of the master switch should be used simultaneously; however, the BAT side of the switch could be turned on separately to check equipment while on the ground. To check or use avionics equipment or radios while on the ground, the avionics power switch must also be turned on. The ALT side of the switch, when placed in the off position, removes the alternator from the electrical system. With this switch in the off position, the entire electrical load is placed on the battery. Continued operation with the alternator switch in the off position will reduce battery power low enough to open the battery contactor, remove power from the alternator field, and prevent alternator restart.

AVIONICS MASTER SWITCH

Electrical power for Avionics Bus 1 and Avionics Bus 2 is supplied through Primary Bus 2 and Primary Bus 1, respectively. A rocker switch, located between the primary and avionics buses, controls current flow to the avionics buses. Placing the rocker switch in the up (ON) position supplies power to both buses simultaneously. Placing the switch in the down (OFF) position removes power from both buses. The switch is located on the lower left side of the instrument panel.

NOTE: On some aircraft certified outside the United States, the avionics master switch may be split. They are aligned for independent operation of the buses.

With the switch in the off position, no electrical power will be applied to the avionics equipment, regardless of the position of the master switch or the individual equipment switches. The avionics power switch should be placed in the OFF position prior to turning the master switch on or off, starting the engine, or applying an external power source.

Each avionics bus also incorporates a separate circuit breaker installed between the primary bus and the avionics master switch. In the event of an electrical malfunction, this breaker will trip and take the effected avionics bus off-line.

AMMETER

The ammeter/vacuum gauge is located on the lower left side of the instrument panel. It indicates the amount of current, in amperes, from the alternator to the battery or from the battery to the airplane electrical system. When the engine is operating and the master switch is turned on, the ammeter indicates the charging rate applied to the battery. In the event the alternator is not functioning or the electrical load exceeds the output of the alternator, the ammeter indicates the battery discharge rate.

LOW VOLTAGE ANNUNCIATION

The low voltage warning annunciator is incorporated in the annunciator panel and activates when voltage falls below 24.5 volts. If low voltage is detected, the red annunciation VOLTS will flash for approximately 10 seconds before illuminating steadily. The pilot cannot turn off the annunciator.

NOTE: Illumination of the low voltage annunciator and ammeter discharge indications may occur during low RPM conditions with an electrical load on the system, such as during a low RPM taxi. Under these conditions, the light will go out at higher RPM.

CIRCUIT BREAKERS AND FUSES [NOT MODELED ATM]

All circuit breakers inside the airplane are of the “push to reset” or “switch/breaker” type. The power distribution module (J-Box) uses either “push to reset” circuit breakers or spade type (automotive style) fuses. One glass type fuse is also used to provide power to the clock.

On aircraft using spade type fuses in the power distribution module (J-Box), a spare fuse is also included. If the spare fuse is used, a replacement spare should be obtained and reinstalled before the next flight.

LIGHTING SYSTEMS

EXTERIOR LIGHTING

Exterior lighting consists of navigation lights on the wing tips and top of the rudder, a dual landing/taxi light configuration located in the left wing leading edge, a flashing beacon mounted on top of the vertical fin, and a strobe light on each wing tip. In addition, two

courtesy lights are recessed into the lower surface of each wing and provide illumination for each cabin door area.

The exterior courtesy lights (and the rear cabin dome light) are turned on by pressing the rear cabin light switch. Pressing the rear cabin light switch again will extinguish the three lights. The remaining exterior lights are operated by breaker/switches located on the lower left instrument panel. To activate these lights, place switch in the UP position. To deactivate light, place in the DOWN position.

INTERIOR LIGHTING

Interior lighting is controlled by a combination of flood lighting, glareshield lighting, pedestal lighting, panel lighting, and radio lighting. Flood lighting is accomplished using two lights in the front and a single dome light in the rear. All flood lights are contained in the overhead console, and are turned on and off with push type switches located near each light.

Glareshield lighting is accomplished using a fluorescent light recessed into the glareshield. Pedestal lighting consists of a single, hooded light located above the fuel selector. Panel lighting is accomplished using individual lights mounted in each instrument and gauge.

CABIN HEATING, VENTILATING AND DEFROSTING SYSTEM

The temperature and volume of airflow into the cabin can be regulated by manipulation of the push-pull CABIN HT and CABIN AIR controls. Both controls are the double-button locking type and permit intermediate settings. For cabin ventilation, pull the CABIN AIR knob out.

To raise the air temperature, pull the CABIN HT knob out approximately ¼ to ½ inch for a small amount of cabin heat. Additional heat is available by pulling the knob out farther; maximum heat is available with the CABIN HT knob pulled out and the CABIN AIR knob pushed full in. When no heat is desired in the cabin, the CABIN HT knob is pushed full in.

Front cabin heat and ventilating air is supplied by outlet holes spaced across a cabin manifold just forward of the pilot’s and copilot’s feet. Rear cabin heat and air is supplied by two ducts from the manifold, one extending down each side of the cabin to an outlet just aft of the rudder pedals at floor level.

Windshield defrost air is also supplied by two ducts leading from the cabin manifold to defroster outlets near the lower edge of the windshield. Two knobs control sliding valves in either defroster outlet to permit regulation of defroster airflow. Separate adjustable ventilators supply additional air; one near each upper corner of the windshield supplies air for the pilot and copilot, and two ventilators are available for the rear cabin area to supply air to the rear seat passengers. Additionally, there are ventilators located on the forward cabin sidewall area just below the windshield sill area.

PITOT-STATIC SYSTEM AND INSTRUMENTS

The pitot-static system supplies ram air pressure to the airspeed

indicator and static pressure to the airspeed indicator, vertical speed indicator and altimeter. The system is composed of a heated pitot tube mounted on the lower surface of the left wing, an external static port on the lower left side of the forward fuselage, and the associated plumbing necessary to connect the instruments to the sources. The heated pitot system consists of a heating element in the pitot tube, a 5-amp switch/breaker labeled **PITOT HEAT,** and associated wiring. The switch/breaker is located on the lower left side of the instrument panel. When the pitot heat switch is turned on, the element in the pitot tube is heated electrically to maintain proper operation in possible icing conditions. A static pressure alternate source valve is installed below the throttle, and can be used if the external static source is malfunctioning. This valve supplies static pressure from inside the cabin instead of the external static port. If erroneous instrument readings are suspected due to water or ice in the pressure line going to the standard external static pressure source, the alternate static source valve should be pulled on. Pressures within the cabin will vary with open heater/vents and windows.

AIRSPEED INDICATOR

The airspeed indicator is calibrated in kias. It incorporates a true airspeed window which allows true airspeed (ktas) to be read off the face of the dial. In addition, the indicator incorporates a window at the twelve o'clock position. The window displays true airspeed, and the window at the twelve o'clock position displays pressure altitude overlayed with a temperature scale. Limitation and range markings (in kias) include the white arc (33 to 85 kias), green arc (44 to 129 kias), yellow arc (129 to 163 kias), and a red line (163 kias). To find true airspeed, first determine pressure altitude and outside air temperature. Using this data, rotate the lower left knob until pressure altitude aligns with outside air temperature in the twelve o'clock window. True airspeed (corrected for pressure and temperature) can now be read in the lower window.

VERTICAL SPEED INDICATOR

The vertical speed indicator depicts airplane rate of climb or descent in feet per minute. The pointer is actuated by atmospheric pressure changes resulting from changes of altitude as supplied by the static source.

ALTIMETER

Airplane altitude is depicted by a barometric type altimeter. A knob near the lower left portion of the indicator provides adjustment of the instrument's barometric scale to the current altimeter setting.

VACUUM SYSTEM AND INSTRUMENTS

The vacuum system provides suction necessary to operate the attitude indicator and the directional indicator. The system consists of two engine-driven vacuum pumps, two pressure switches for measuring vacuum available through each pump, a vacuum relief valve, a vacuum system air filter, vacuum operated instruments, a suction gauge, low vacuum warning on the annunciator, and a manifold with check valves to allow for normal vacuum system operation if one of the vacuum pumps should fail.

ATTITUDE INDICATOR

The attitude indicator is a vacuum air-driven gyro that gives a visual indication of flight attitude. Bank attitude is presented by a pointer at the top of the indicator relative to the bank scale which has index marks at 10°, 20°, 30°, 60°, and 90° either side of the center mark. Pitch and roll attitudes are presented by a miniature airplane superimposed over a symbolic horizon area divided into two sections by a white horizon bar. The upper "blue sky" area and the lower "ground" area have pitch reference lines useful for pitch attitude control. A knob at the bottom of the instrument is provided for in-flight adjustment of the symbolic airplane to the horizon bar for a more accurate flight attitude indication.

DIRECTIONAL INDICATOR

The directional indicator is a vacuum air-driven gyro that displays airplane heading on a compass card in relation to a fixed simulated airplane image and index. The indicator will precess slightly over a period of time. Therefore, the compass card should be set with the magnetic compass just prior to takeoff, and readjusted as required throughout the flight. A knob on the lower left edge of the instrument is used to adjust the compass card to correct for precession. A knob on the lower right edge of the instrument is used to move the heading bug.

VACUUM INDICATOR

The vacuum indicator is part of the vacuum/amp indicator, located on the lower left corner of the instrument panel. It is calibrated in inches of mercury and indicates vacuum air available for operation of the attitude and directional indicators. The desired vacuum range is 4.5 to 5.5 inches of mercury. Normally, a vacuum reading out of this range may indicate a system malfunction or improper adjustment, and in this case, the indicators should not be considered reliable. However, due to lower atmospheric pressures at higher altitudes, the vacuum indicator may indicate as low as 4.0 in. Hg. at 20,000 feet and still be adequate for normal system operation.

LOW VACUUM ANNUNCIATION

Each engine-driven vacuum pump is plumbed to a common manifold, located forward of the firewall. From the tee, a single line runs into the cabin to operate the various vacuum system instruments. This tee contains check valves to prevent back flow into a pump if it fails. Transducers are located just upstream of the tee and measure vacuum output of each pump. If output of the left pump falls below 3.0 in. Hg., the amber L VAC message will flash on the annunciator panel for approximately 10 seconds before turning steady on. If output of the right pump falls below 3.0 in. Hg., the amber VAC R message will flash on the annunciator panel for approximately 10 seconds before turning steady on. If output of both pumps falls below 3.0 in. Hg., the amber L VAC R message will flash on the annunciator panel for approximately 10 seconds before turning steady on.

CLOCK / O.A.T. INDICATOR

An integrated clock / O.A.T. / voltmeter is installed in the upper left side of the instrument panel as standard equipment.

STALL WARNING SYSTEM

The airplane is equipped with a pneumatic type stall warning system consisting of an inlet in the leading edge of the left wing, an air-operated horn near the upper left corner of the windshield, and associated plumbing. As the airplane approaches a stall, the low pressure on the upper surface of the wings moves forward around the leading edge of the wings. This low pressure creates a differential pressure in the stall warning system which draws air through the warning horn, resulting in an audible warning at 5 to 10 kias above stall in all flight conditions.

CENTER STACK AVIONICS SUITE

We have spent much time developing extra modes and functions that you won't find in any P3D airplane, like independent DME receiver, pilot-programmable COMM channels and NAV OBS mode. For example, you should pay attention to the autopilot. Even though it may look familiar, you need to learn how to operate it properly or you may find you plane going in completely wrong direction.

The Bendix King avionics suite in your Accu-Sim C172 Trainer is so complete, the best source for your information is straight from the manufacturer. Below are links to the latest manuals online:

C172 BENDIXKING SILVER CROWN PLUS AVIONICS

C172 HONEYWELL KAP140 AUTOPILOT

If these links ever change and become unavailable, visit *www.a2asimulations.com/downloads* for the latest information.

AIRPLANE HANDLING, SERVICE & MAINTENANCE

Navigating the 2D panels and taking care of your aircraft.

THIS SECTION CONTAINS factory recommended procedures for proper ground handling and routine care and servicing of your airplane. It also identifies certain inspection and maintenance requirements which must be followed if your airplane is to retain that new plane performance and dependability. It is wise to follow a planned schedule of lubrication and preventive maintenance based on climatic and flying conditions encountered in your locality.

Keep in touch with your local Cessna Service Station and take advantage of their knowledge and experience. Your Cessna Service Station knows your airplane and how to maintain it, and will remind you when lubrications and oil changes are necessary, as well as other seasonal and periodic services. The airplane should be regularly inspected and maintained in accordance with information found in the airplane maintenance manual and in company issued service bulletins and service newsletters. All service bulletins pertaining to the aircraft by serial number should be accomplished and the airplane should receive repetitive and required inspections. Cessna does not condone modifications, whether by Supplemental Type Certificate or otherwise, unless these certificates are held and/or approved by Cessna. Other modifications may void warranties on the airplane since Cessna has no way of knowing the full effect on the overall airplane. Operation of an airplane that has been modified may be a risk to the occupants, and operating procedures and performance data set forth in the operating handbook may no longer be considered accurate for the modified airplane.

FUEL CONTAMINATION

Fuel contamination is usually the result of foreign material present in the fuel system, and may consist of water, rust, sand, dirt, microbes or bacterial growth. In addition, additives that are not compatible with fuel or fuel system components can cause the fuel to become contaminated. Before each flight and after each refueling, use a clear sampler cup and drain at least a cupful of fuel from each fuel tank drain location and from the fuel strainer quick drain valve to determine if contaminants are present, and to ensure the airplane has been fueled with the proper grade of fuel. If contamination is detected, drain all fuel drain points including the fuel reservoir and fuel selector quick drain valves and then gently rock the wings and lower the tail to the ground to move any additional contaminants to the sampling points. Take repeated samples from all fuel drain points until all contamination has been removed. If, after repeated sampling, evidence of contamination still exists, the airplane should not be flown. Tanks should be drained and system purged by qualified maintenance personnel. All evidence of contamination must be removed before further flight. If the airplane has been serviced with the improper fuel grade, defuel completely and refuel with the correct grade. Do not fly the airplane with contaminated or unapproved fuel. In addition, Owners/Operators who are not acquainted with a particular fixed base operator should be assured that the fuel supply has been checked for contamination and is properly filtered before allowing the airplane to be serviced. Fuel tanks should be kept full between flights, provided weight and balance considerations will permit, to reduce the possibility of water condensing on the walls of partially filled tanks. To further reduce the possibility of contaminated fuel, routine maintenance of the fuel system should be performed in accordance with the airplane Maintenance Manual. Only the proper fuel, as recommended in this handbook, should be used, and fuel additives should not be used unless approved by Cessna and the Federal Aviation Administration.

2D PANELS

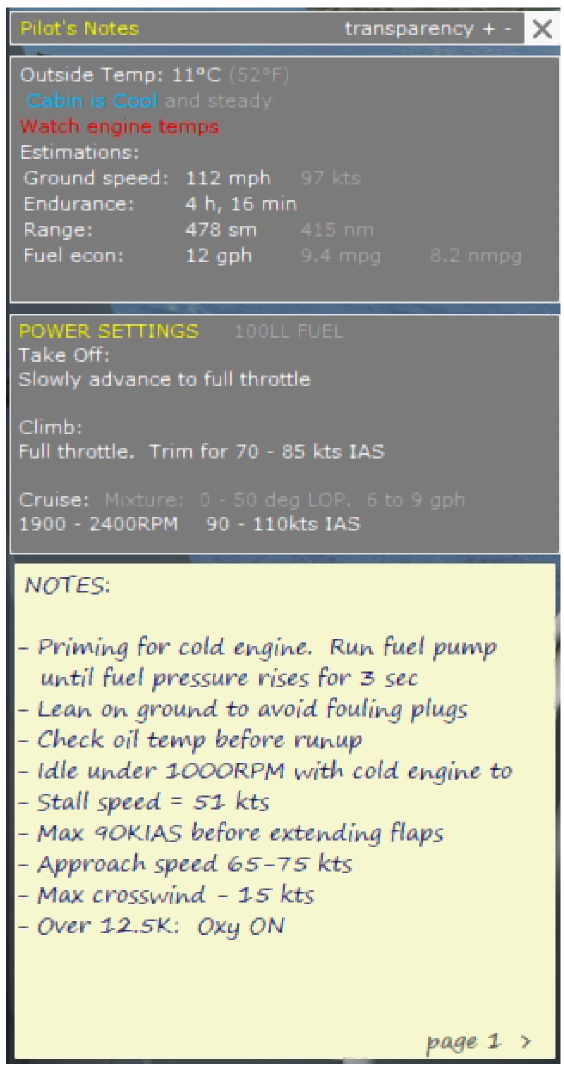
The 2D panels are there to provide the extra functionality needed when there is so much additional information available to you, the pilot.

Each 2D panel is accessed by the key-press combination in parentheses after the 2D panel title.

PILOT'S NOTES (SHIFT 2)

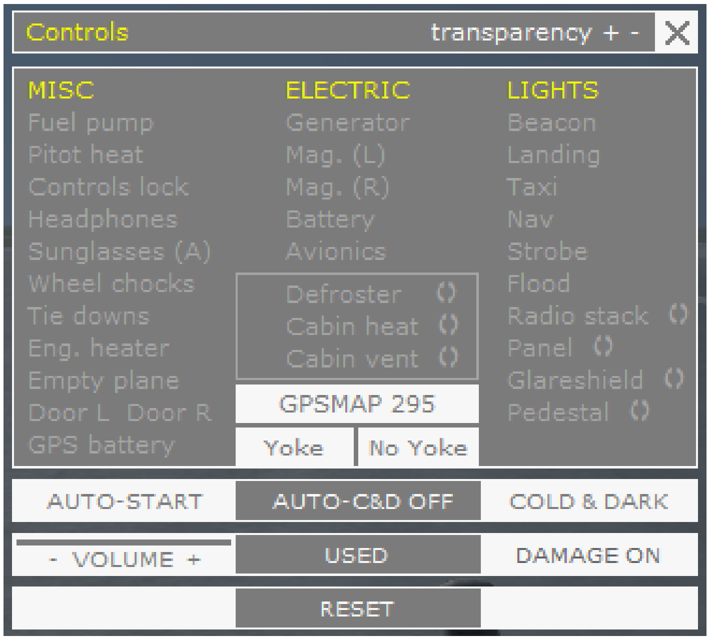
- Outside Temp: is the ambient temperature outside the aircraft.
- Watch Engine Temps: this warning will display if your engine temperature is nearing danger limits. Corrective action should be carried out immediately if this warning appears.
- Cabin Temperature: displays how comfortable the temperature 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 take off, 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.

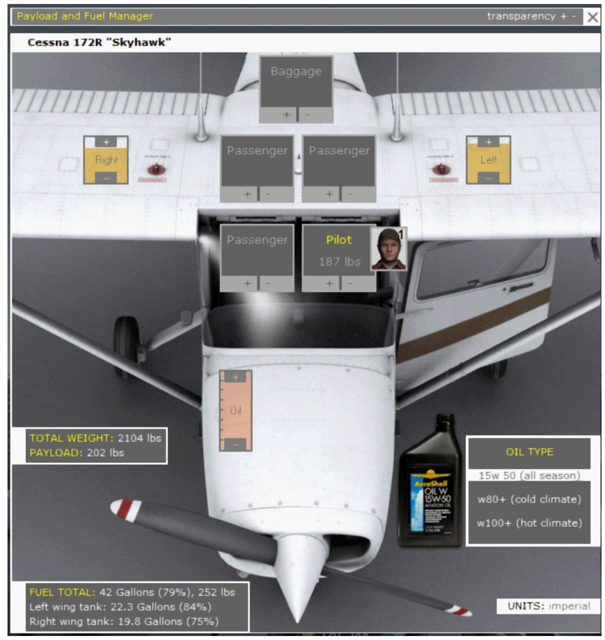
Pilot's Notes are an excellent quick reference while flying.



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.

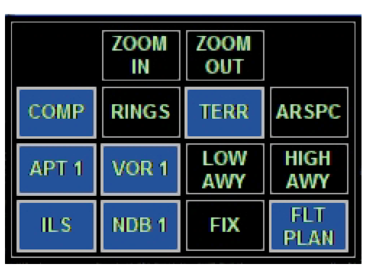
From this panel, you can:

- 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:

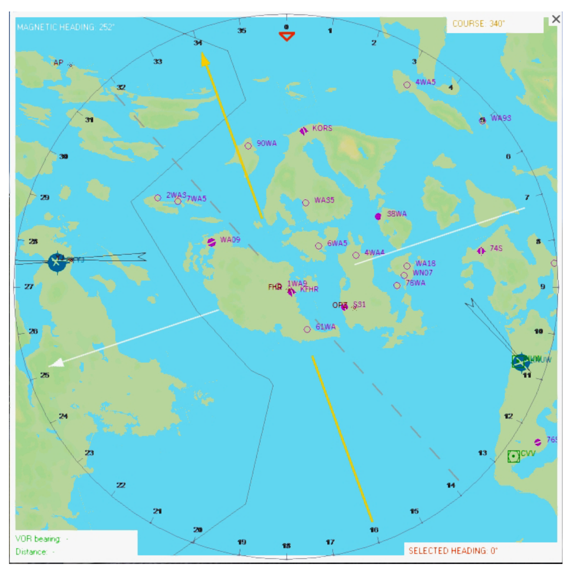
- Add and remove passengers and baggage.
- Increase or decrease pilot, passenger and baggage weights.
- Add or remove oil in the reservoir, and change the oil viscosity depending on seasonal changes.
- Add or remove fuel from the wing tanks.
- Change between viewing weights and measures in imperial or 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 Pilot's Map is updated in real-time.



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.

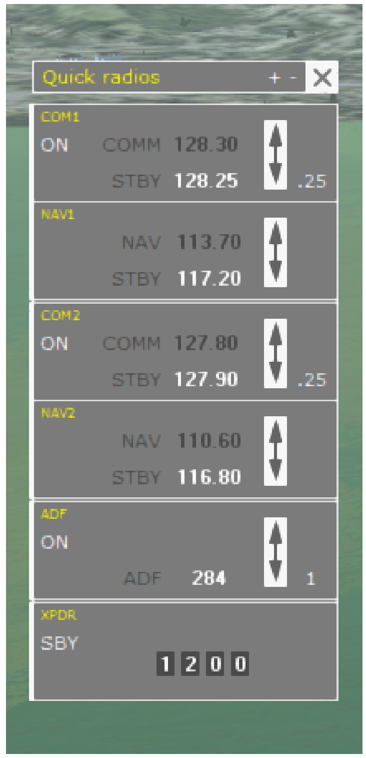
MAINTENANCE HANGAR (SHIFT 7)

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 reconditioned parts.

In this instance, our mechanic has flagged up several issues which would give us cause for concern.

Firstly, he has noted some cylinder scoring, and secondly that there is a major problem with the crankshaft.

In order to fix these issues 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.

COLOUR CODES:

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

Our mechanic has already stated that there is a serious issue with our crankshaft, as can be seen from the highlighted part in red.

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

The cylinders are shown with a yellow highlight, but these do not have to be replaced, as a yellow highlight is showing us that the components are worn, but not unserviceable.

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.

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.

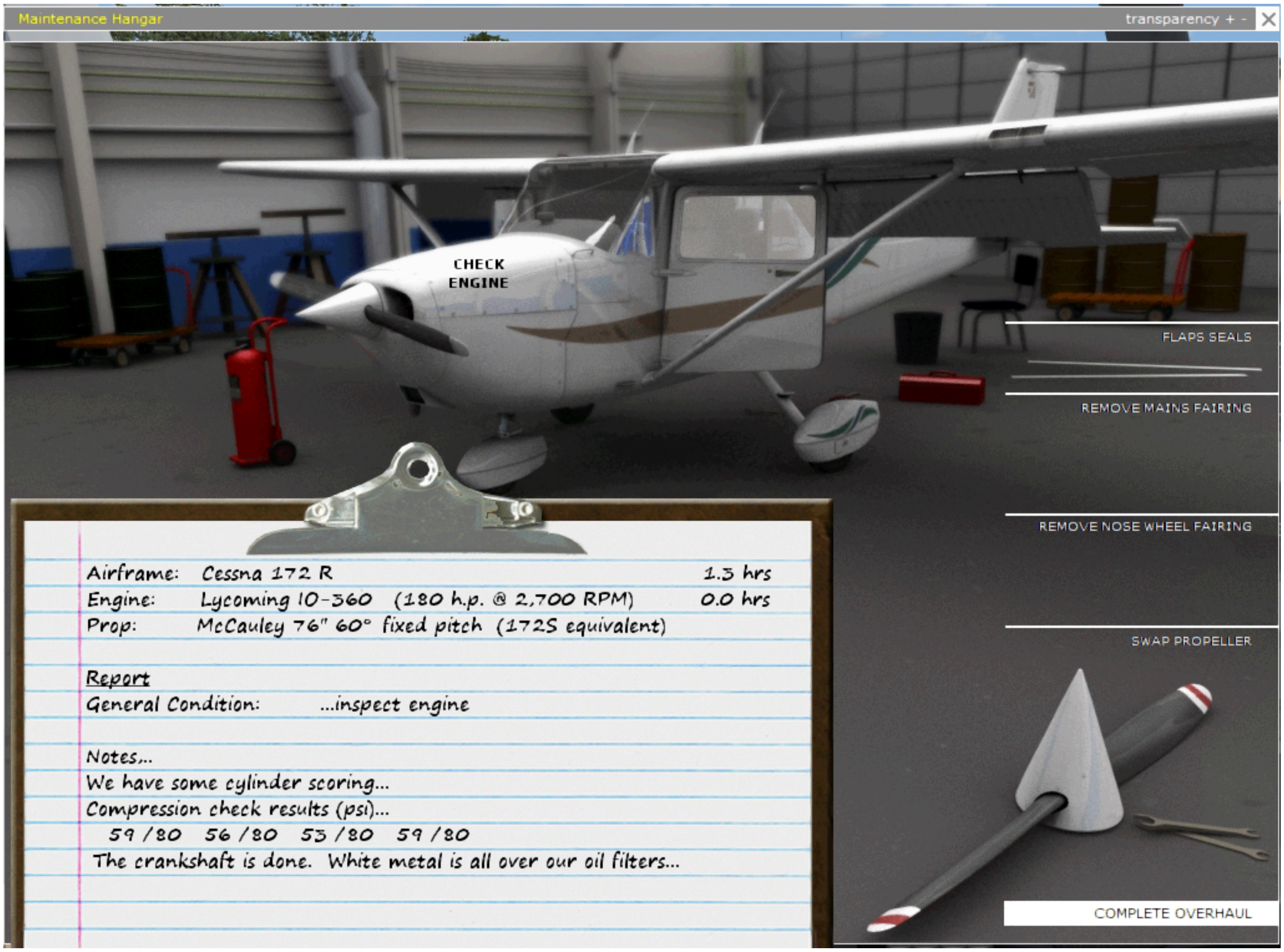
The compressed air would then pass through a calibrated restrictor and to the cylinder pressure gauge. This gauge would show the actual air pressure within the cylinder.

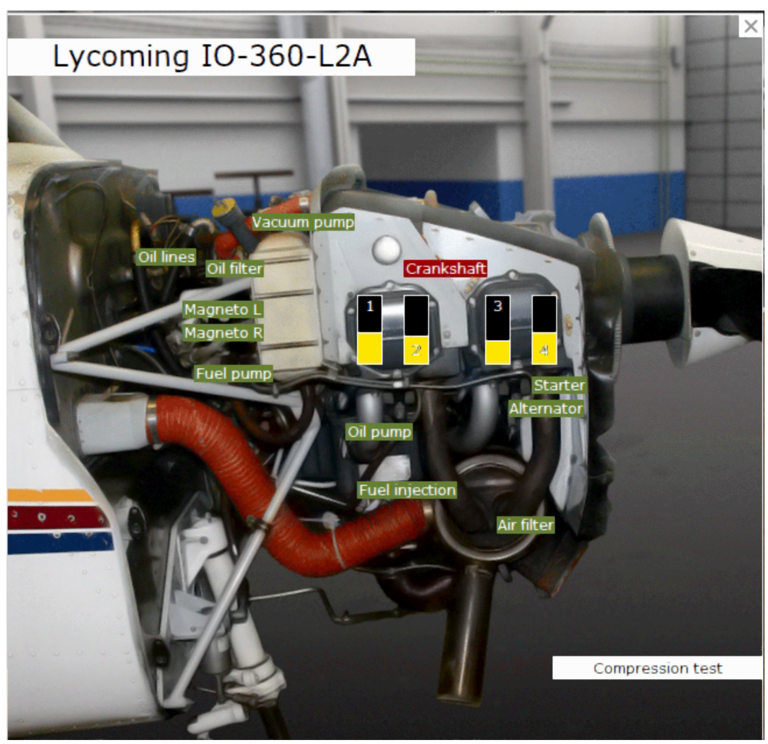
Any difference in pressure between the two gauges would indicate a leak of air past the engine components, whether that is the valves, piston rings, or even a crack in the cylinder wall itself.

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 R.P.M.'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.


Maintenance Hangar
transparency + -
CHECK ENGINE
FLAPS SEALS
REMOVE MAINS FAIRING
REMOVE NOSE WHEEL FAIRING
SWAP PROPELLER
COMPLETE OVERHAUL
Airframe: Cessna 172 R 1.3 hrs
Engine: Lycoming IO-360 (180 h.p. @ 2,700 RPM) 0.0 hrs
Prop: McCauley 76" 60° fixed pitch (172S equivalent)
Report
General Condition: ...inspect engine
Notes...
We have some cylinder scoring...
Compression check results (psi)...
59 / 80 56 / 80 53 / 80 59 / 80
The crankshaft is done. White metal is all over our oil filters...


Lycoming IO-360-L2A
Vacuum pump
Oil lines
Oil filter
Crankshaft
Magneto L
Magneto R
1
3
Fuel pump
Starter
Alternator
Oil pump
Fuel injection
Air filter
Compression test

PRE-FLIGHT INSPECTION (SHIFT 8)

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

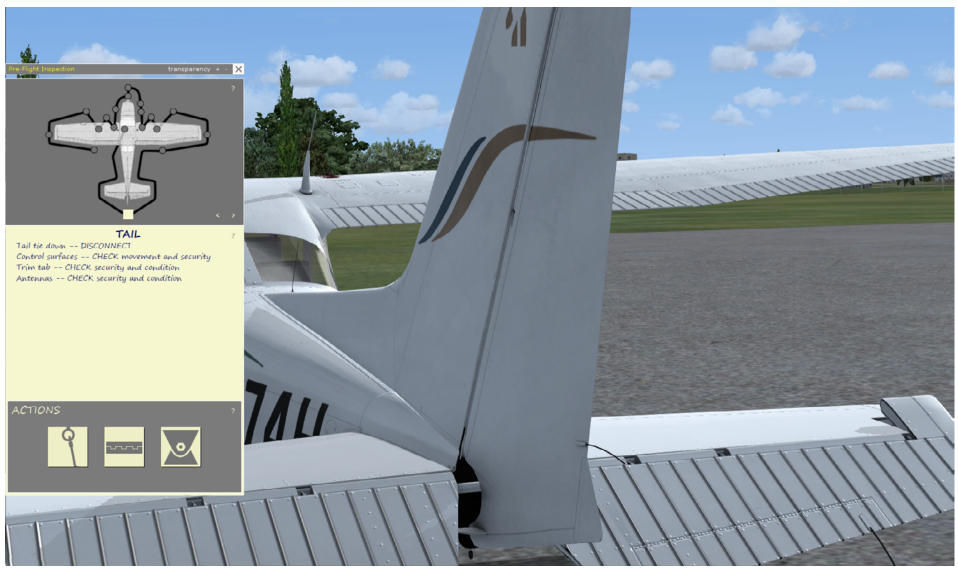
The checklist itself shows an overview of the aircraft, with your walkaround route in black, and dots to highlight the areas where subsequent checks will be carried out.

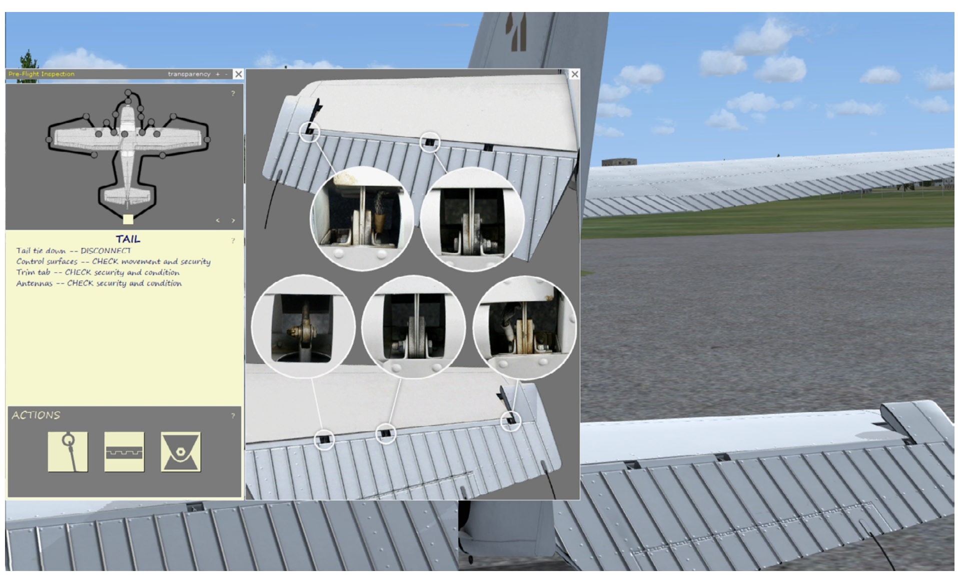
The check list starts with actions to be carried out in the cockpit, prior to your walkaround.

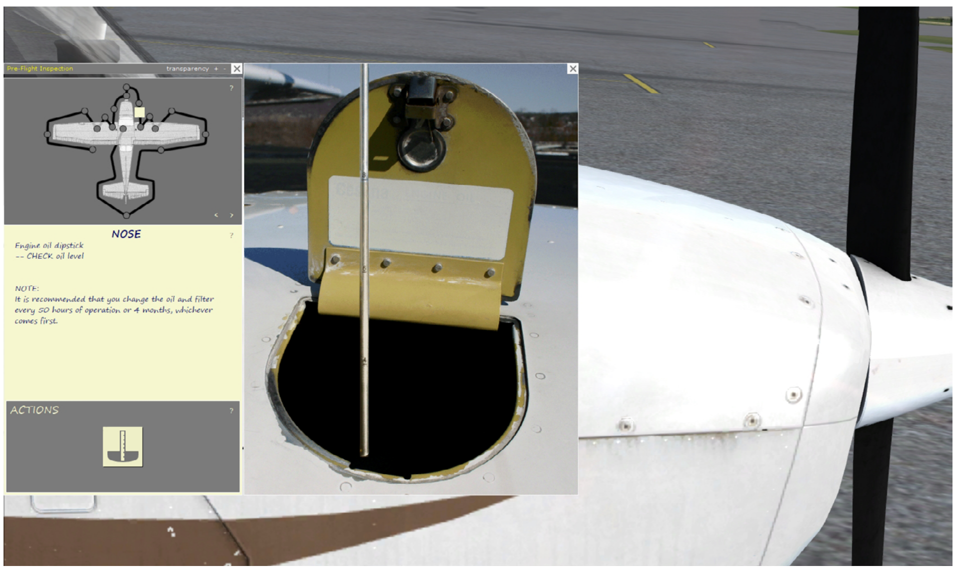
Ensure that the checklist is carried out correctly, as checks and actions missed here, will prevent you from carrying out the proper checks during your walkaround.

The first of the external checks covers the tail area. 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 elevator hinges.

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.

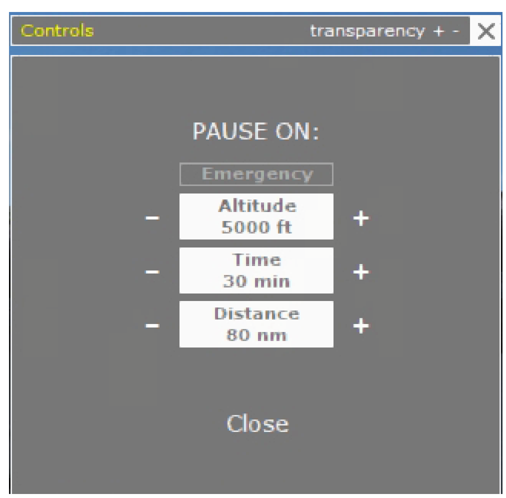
The oil dipstick is not only essential in gauging the total oil quantity, but also the condition of the oil. As you put hours on your engine, expect the oil to become darker due to suspended particulates that are too fine to be trapped by the filter. The oil also goes through chemical changes, which 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.



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ASL Camguard and Concorde Battery

QUALITY CONTROL BETA TEAM:
The world's most effective and knowledgeable flight simulation beta team, including Cody Bergland, Forest "FAC257" Crooke, Glenn Cummings (GlennC), Ryan "Hog Driver" Gann, Mitchell Glicksman, Captain Jakey, Erwin Schultze (dutch506), Guenter Steiner, Paul "Gypsy Baron" Strogen, Gunter "Snorre" Schneider, Matt "mattgn" Newton, Lewis Bloomfield & Oskar "lonewulf47" Wagner.

VERY SPECIAL THANKS TO OUR FRIENDS AND FAMILIES WHO STUCK BY US AND WORKED HARD TO SUPPORT OUR EFFORTS.

It's a misty morning, and your loyal girl patiently waits for your next flight.

She is quite the special aircraft and she is your responsibility.

Take care of her …

FROM ALL OF US AT A2A SIMULATIONS, *THANK YOU*.

A2A
simulations