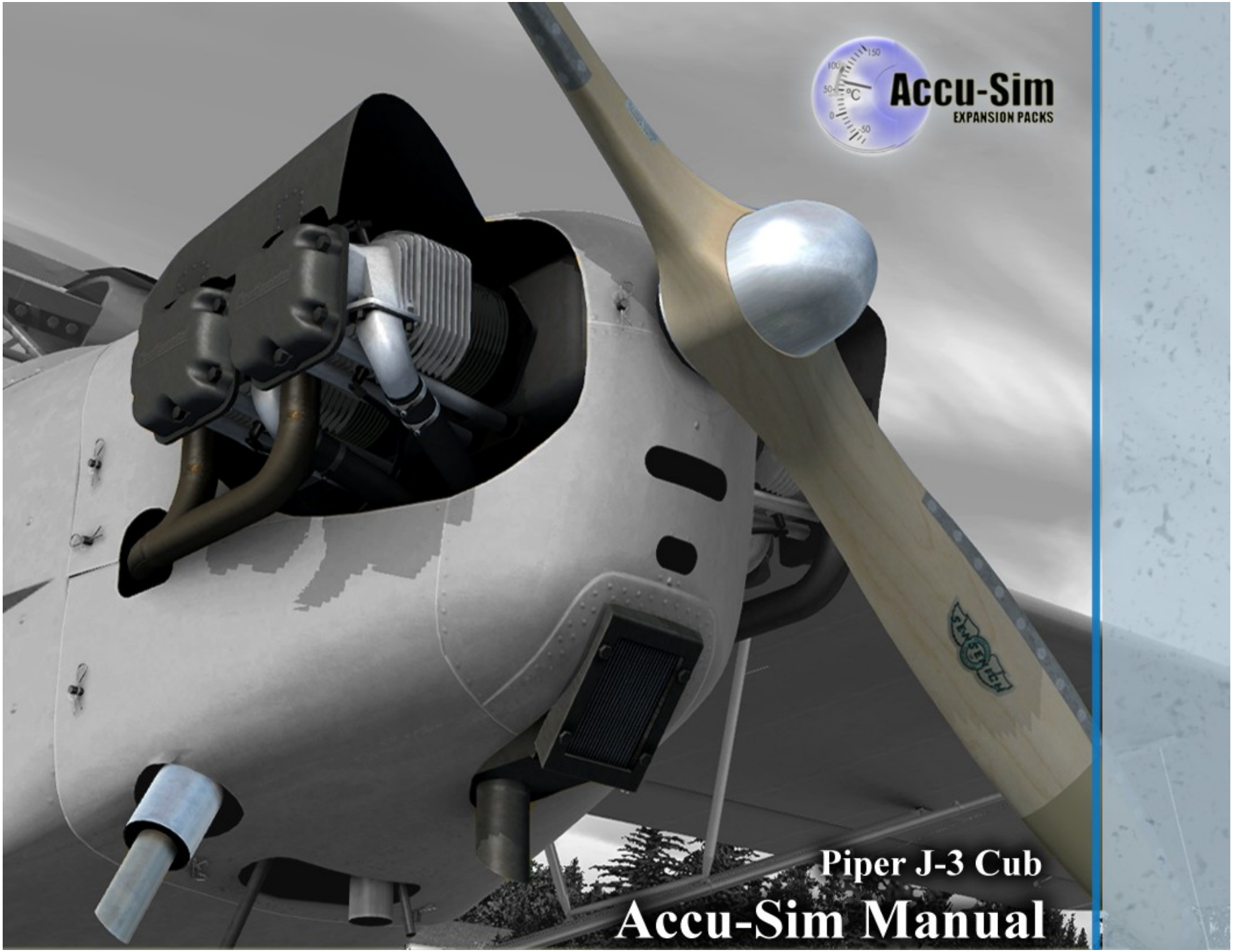

Accu-Sim
EXPANSION PACKS
Piper J-3 Cub
Accu-Sim Manual

WINGS OF SILVER PIPER J-3 Cub Accu-Sim Manual

(this Manual and the POH is not intended for flight and is intended only for flight simulation use)

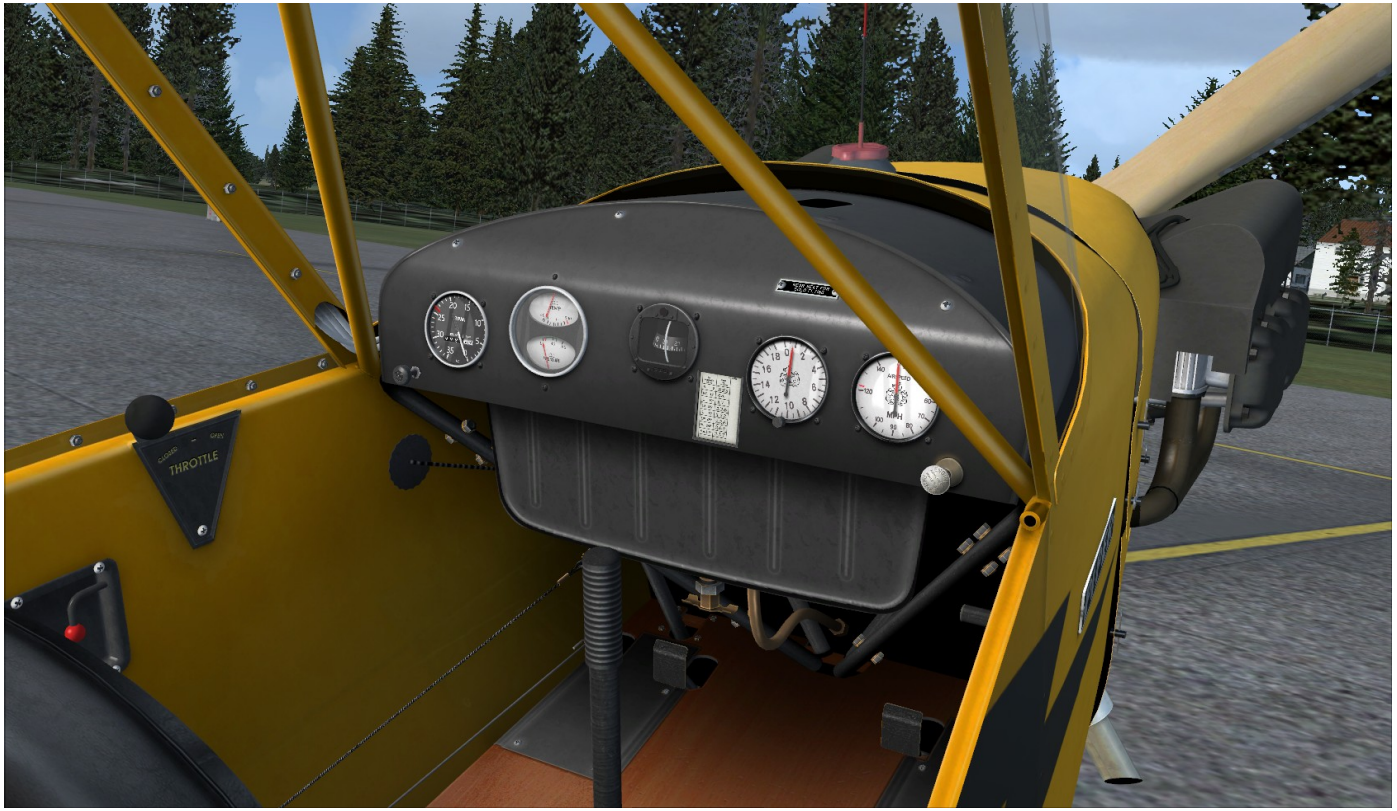
CONTENTS

WINGS of SILVER

The A2A Simulations J-3 Piper Cub Accu-Sim Expansion Pack Features

- **Accu-Sim physics** creates an entirely new world including true wing, airframe, engine, ground, water, and internal systems behavior.
- **Passenger On Board™** adds a new dimension of piloting realism with an intelligent passenger that is aware of the surroundings, talks when appropriate, including being able to spot and call out traffic.
- **Third generation Accu-Sound** now allows for a direct connection to the Accu-Sim and FSX physics engine with airflow through the airframe, window, and door, structural creaks, bumps, jolts etc. with three hundred and ninety sounds in all.
- **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 most accurate combustion engine simulation available.
- Engine has an actual life. **Good piloting skills are rewarded** with longer life and more reliable performance.
- **New propeller physics** means the propeller is constantly active and allows for both hand and air starting the engine.
- **Ground physics** realistically rock your wings and buck your tail. Regular tires, skis, and large tundra tires all have their own distinctive ground handling benefits and limitations. Each aircraft comes with its own sound set which is tied in with the physics of the airframe.
- **Tundra tires** demand respect for the size and weight of the larger tires. 3-point landing on tarmac is highly recommended.
- **Water physics** simulate waves, water drag, and creates an authentic “on the step” experience.
- **Total audible cockpit experience** made with professional recordings from three actual Piper J-3 aircraft.
- **Fuel System** allows for an authentic primer system with fuel in lines, tank, and authentic gravity-fed fuel-air mixture.
- **Third generation engine wear and oil system** including an engine that sputters, spits, and runs rough when damaged.
- **Both engine and airframe physically vibrate and shake,** based on real world conditions.
- **Latest generation carburetor icing modeling**, which is critical for the proper management of the Continental A-65-8 engine.

DESIGNERS NOTES



The philosophy behind Accu-Sim was born many years ago. This has all been a dream for us, until now. After many years of hard work, we are proud to present our dream to you, our customer.

If you throw a baseball, a paper airplane, and a stick into the air, each would behave differently based on it's weight, density, and shape. Each will interact with the air and ultimately the ground very differently, just as we would expect. But what if you dropped a tennis ball on a hard surface, and instead of bouncing, it just hit the ground with a loud 'clunk' and stopped? We are physical beings that live in a world that has certain truths we take for granted, that is until they are gone. However, in a simulated world, nothing can be taken for granted. In fact, if the physics in a simulated world are not specifically created by someone, they simply do not exist. With Accu-Sim, we have built-in to this simulation many of the physical rules that we know to be true and which we expect to exist in the real physical world.

For example, if you start a simple engine that is cold, you expect that it will run rougher and less reliably than when it is warmed up. If one morning you start your cold engine and something seems different, if it does not behave as you expect it to, you will notice this and your senses will tell you, "something is not right." This is because you have become accustomed and comfortable with how your aircraft responds at all times, not just in the behavior of a single gauge, but in subtle ways -- the way the engine sounds and responds to the throttle, the way the body squeaks, or even in the way the air sounds as it passes by your airframe at different airspeeds. More obviously, if you taxi on the grass, you expect your aircraft to buck and dip as it moves over bumps and depressions in the ground. Similarly, you would also expect to sway and rock if sitting on unsettled water in floats. All of this, and much more, will be experienced and brought to you more accurately and realistically by Accu-Sim. Now it's an entirely new and more real world. It's a world that makes you believe you literally have a physical piece of equipment stuffed inside your computer monitor because all of these little physical truths which cause actions and reactions, and which you notice when they are there or not there, have been created in Accu-Sim. It is all of these little clues which we experience and observe, and which we take for granted in our real world, which make things seem real to us. When they are missing or portrayed inaccurately, things just don't seem right. You know it; you sense it, and so do we.

Perhaps the most important thing this little airplane will bring to you is honest, true-to-life stick-and-rudder flying, something pilots often forget after flying large, heavy, fast, complex aircraft for a while. You will be actively engaged in flying this Cub almost all of the time. After just flying it for a very short while you will start to feel like a better pilot, and you will be.

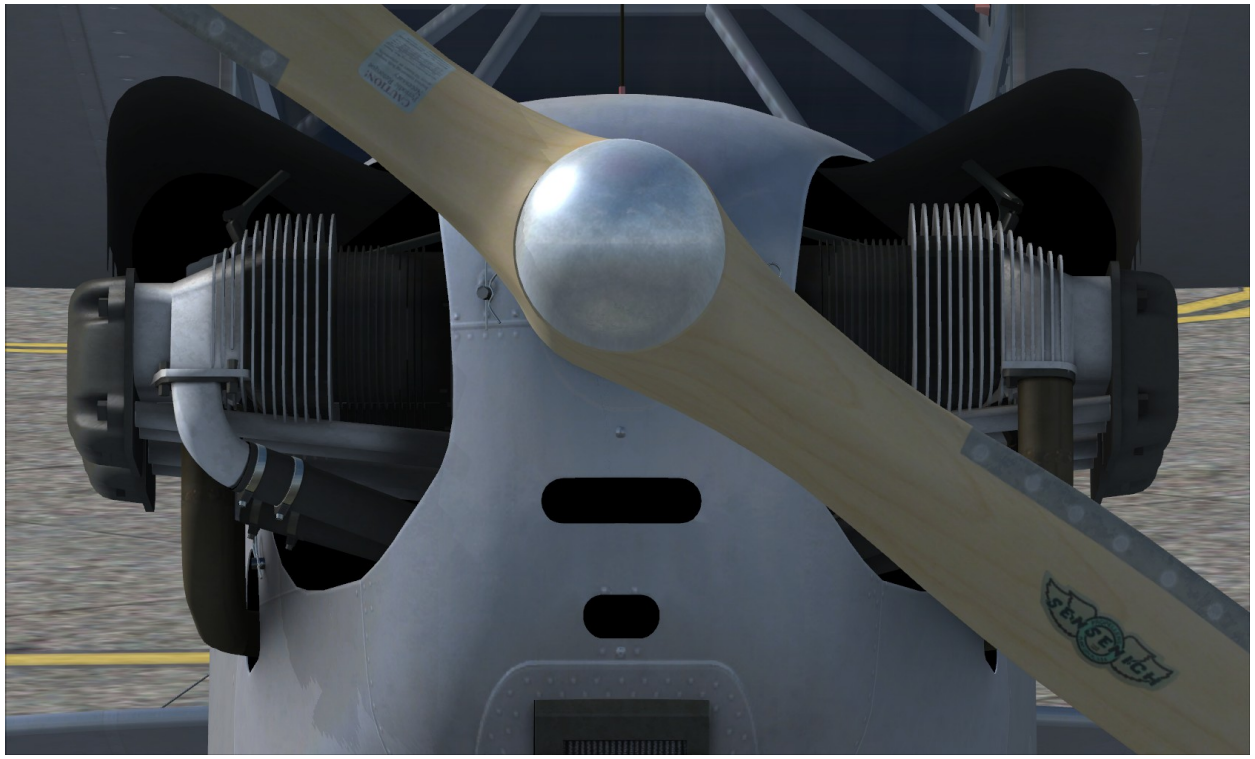
This little Cub represents the most complete and accurately flying aircraft which we have created to date. With it, A2A proudly delivers to you the "Total Flying Experience".

Scott Gentile
Accu-Sim Project Manager

The Combustion Engine

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 in the form of thrust comes when that spinning propeller takes a bite of the air and pulls the aircraft forward.

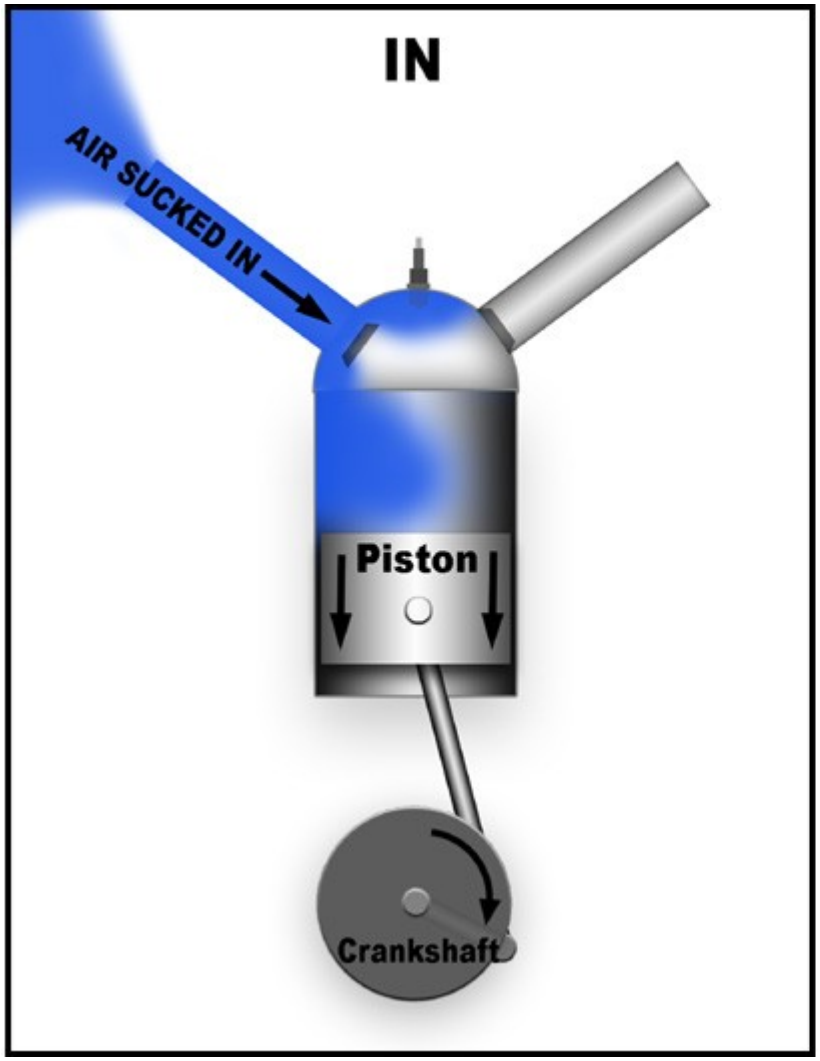
OVERVIEW OF HOW THE ENGINE WORKS AND CREATES POWER

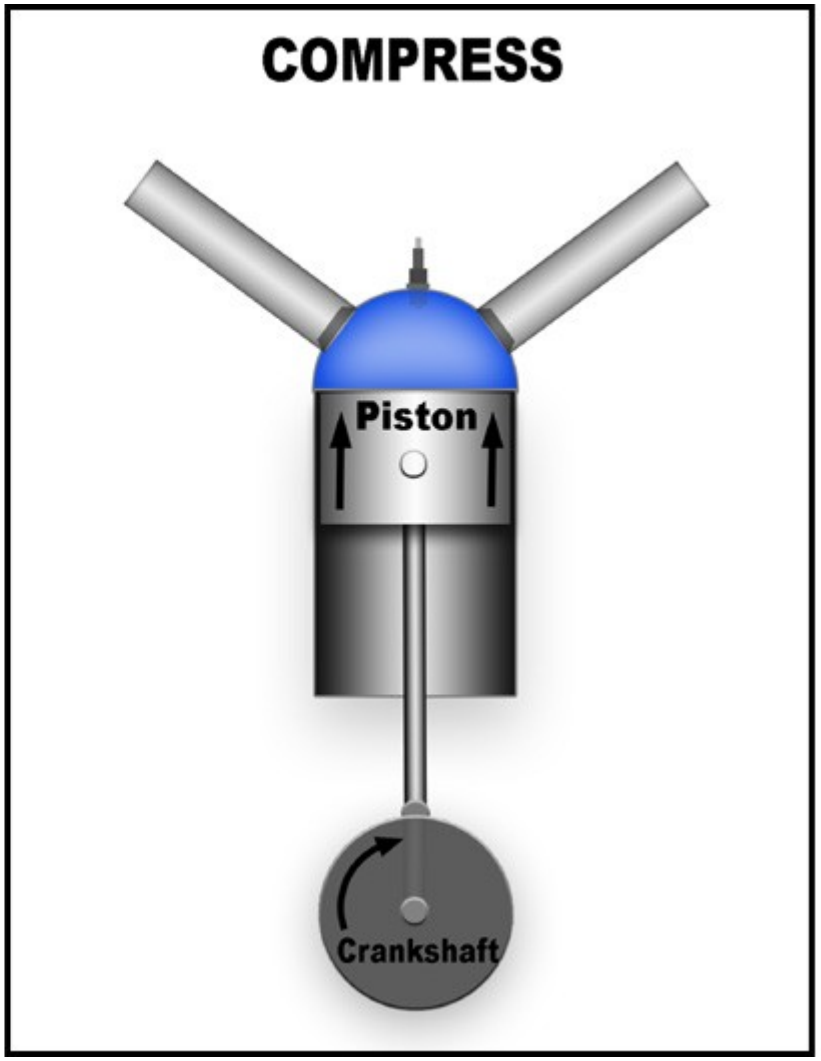


Fire needs air. We need air. Engines need air. Engines are just like us as they need oxygen to work. Why? Because fire needs oxygen to burn. If you cover a fire, it goes out because you starved it of oxygen. If you have ever used a wood stove or fireplace, you know when you open the vent to allow more 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.

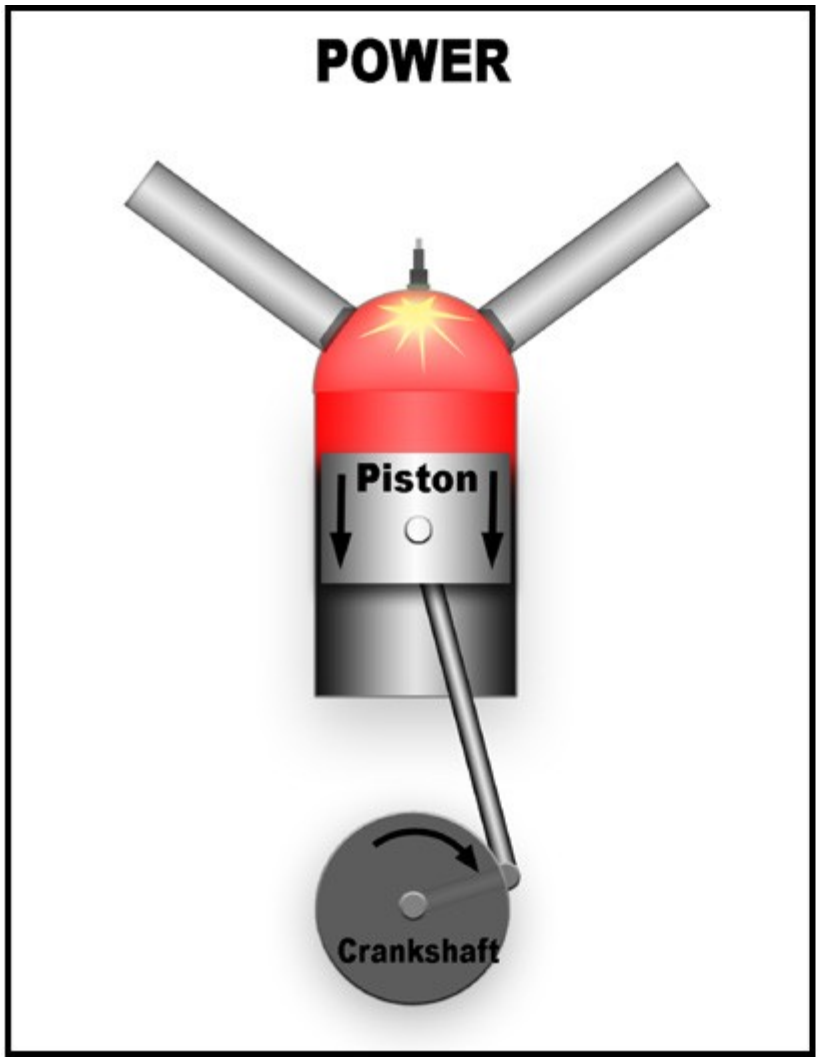
Look at the four pictures below and you will understand basically how an engine operates.

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



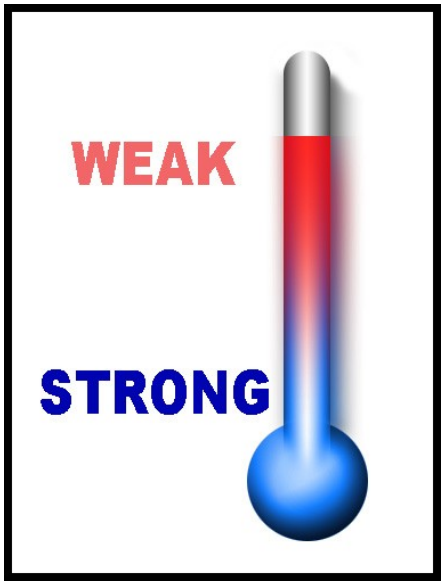


The spark plug ignites the now compressed air / fuel mixture, driving the piston down (power), then on its way back up, the burned mixture is forced out of the exhaust.



AIR TEMPERATURE

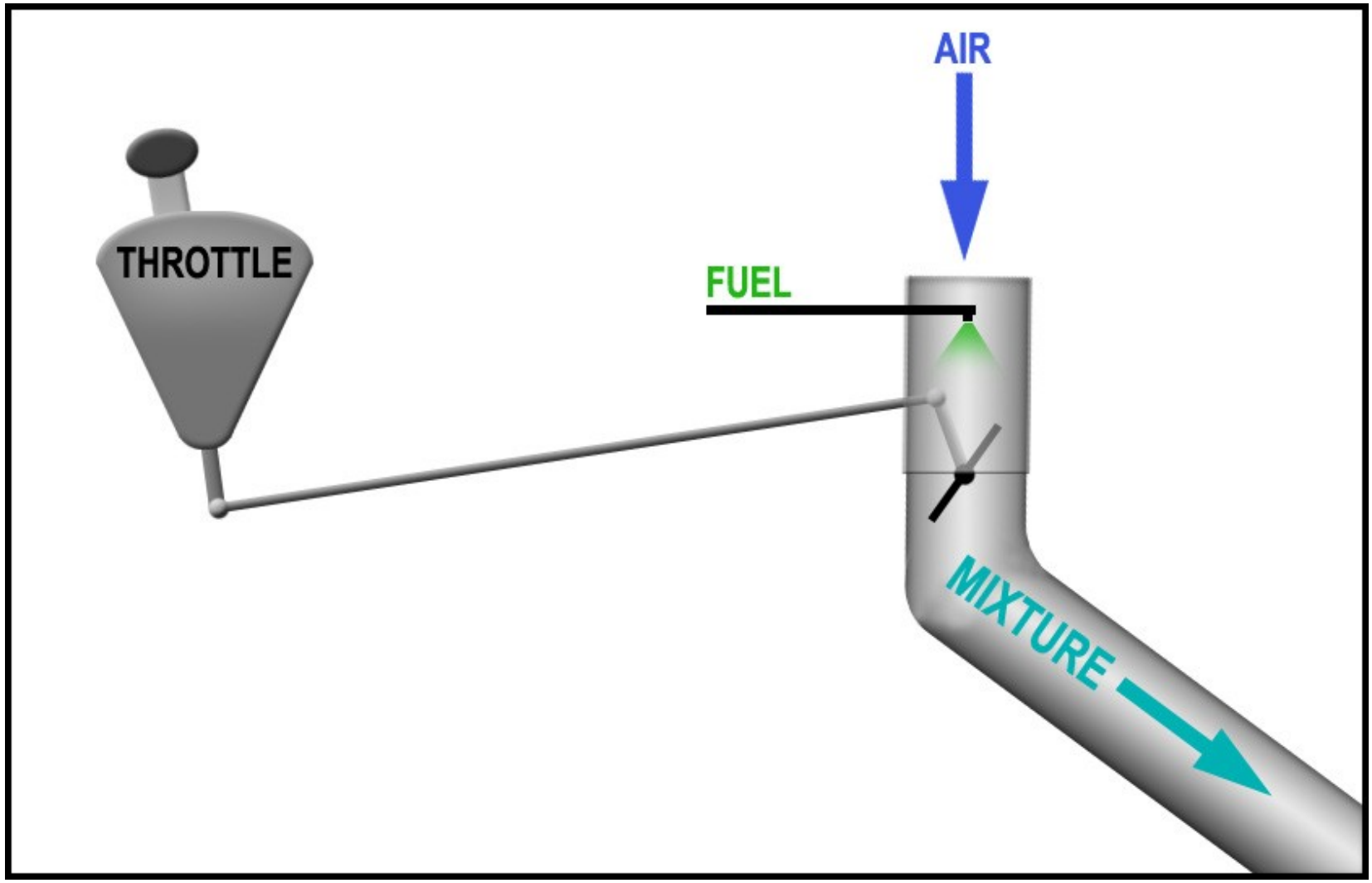
Have you ever noticed that your car engine runs smoother and stronger in the cold weather? This is because cold air is denser than hot air and contains a higher percentage of oxygen. Hotter air = less power.



Carburetor Air Temperature (CAT). Your CAT is the temperature of the air just before it enters the engine. While your J-3 Cub does not have a CAT gauge, the temperatures and moisture in the air as it enters the carburetor are very real. It is very important that whenever you pull your throttle back, you first turn on your Carb Heat to avoid carb icing, even in warm weather. Details of carb icing are included further down in this manual.

MIXTURE

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

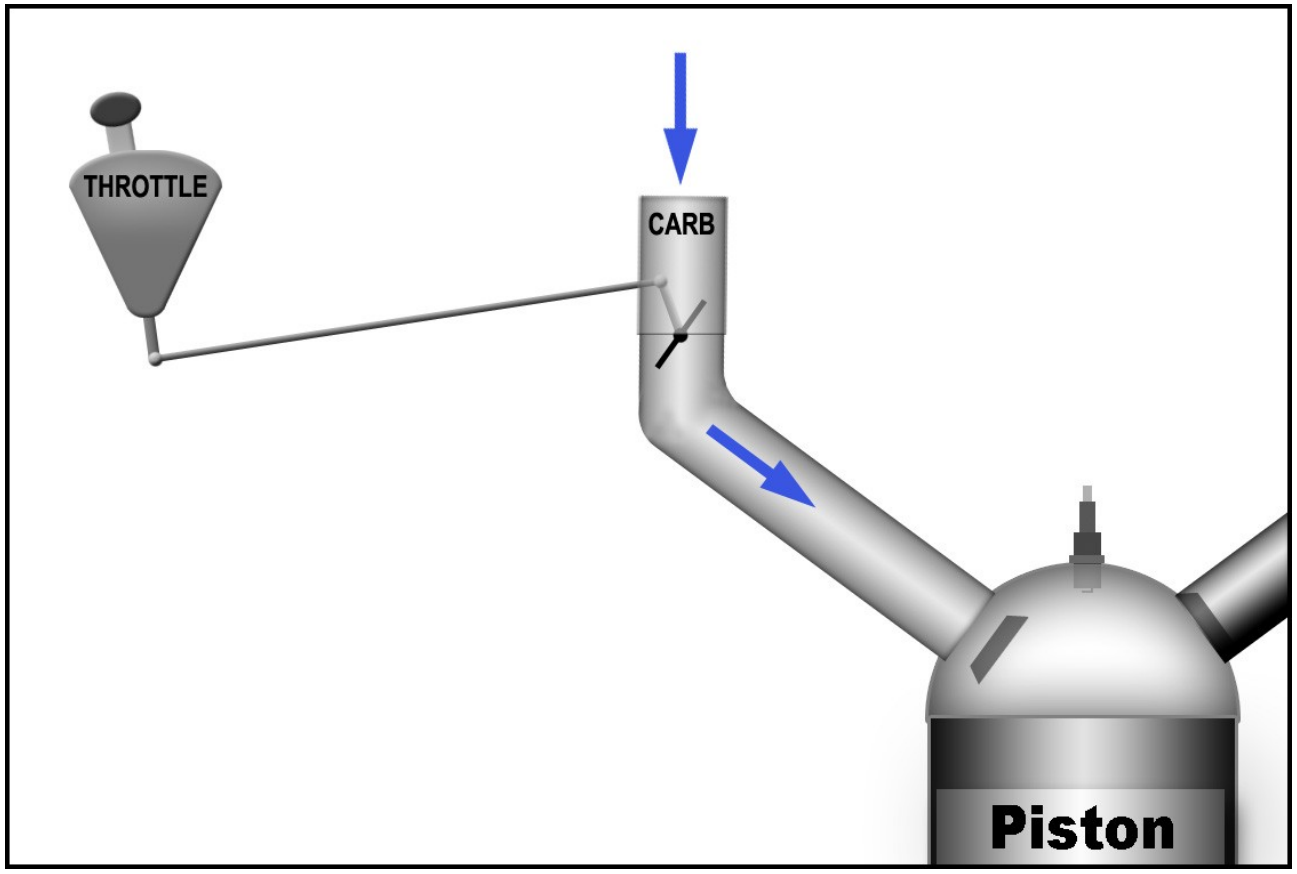


The J-3 Cub has a fixed mixture so no mixture lever is installed, however, the air-fuel system is fully modeled and operational.

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. At full throttle your engine is pulling in as much air as your intake system will allow. It's similar to a watering hose – you crimp the hose and restrict the water. Think of full power when you open that water valve and let the water run free. This is 100% full power.

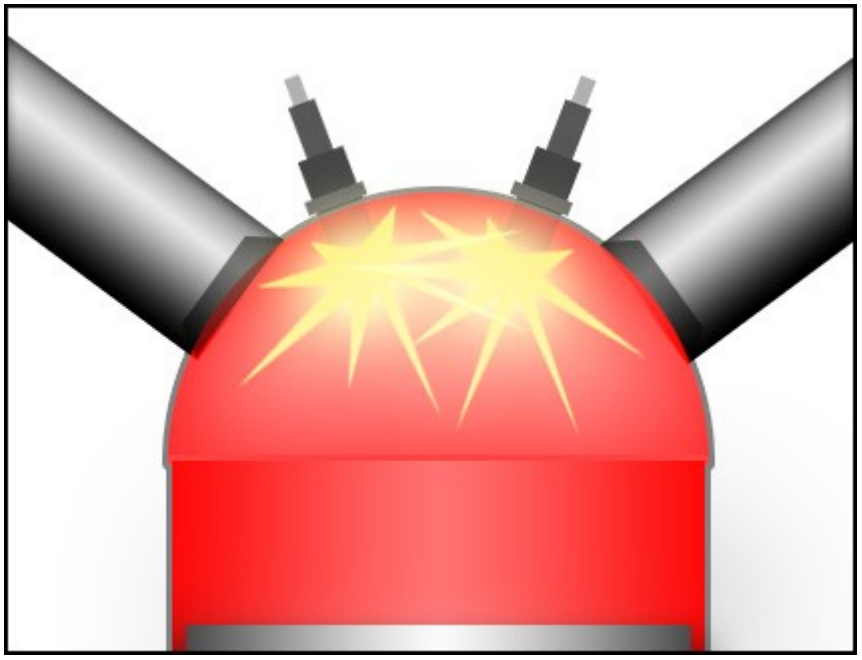
In general, we don't run an airplane engine at full power for extended periods of time. Full power is only used when it is absolutely necessary, as it sometimes is on takeoff or when climbing, and otherwise in an emergency. Most of the time, you will be "throttling" your motor, meaning that *you* will be dictating what its limit is.



IGNITION

The ignition system provides timed sparks which 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 has two spark plugs installed.

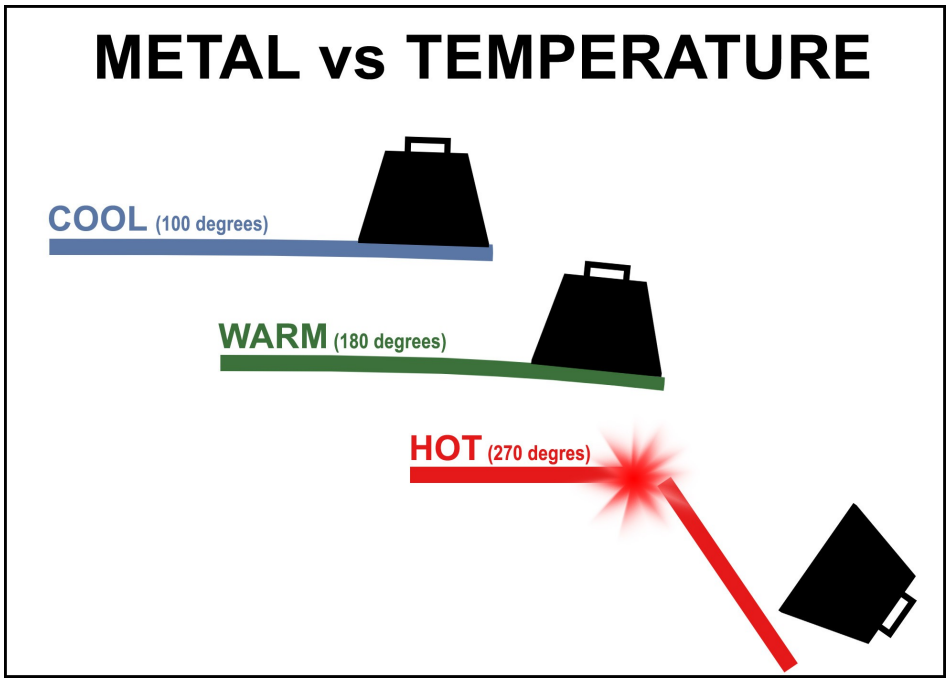
An added advantage to having two sparks instead of one is that more sparks means that you'll get a little more power. The pilot can select Ignition (Magneto) 1, Ignition (Magneto) 2, or BOTH by using the MAGNETO (Mag) switch. During your runup on the ground before takeoff you can test that each ignition (magneto) is working by selecting each one and observing how your engine RPM changes. If all is well, there will be a slight RPM drop when you go from BOTH to either single ignition system. This is normal, provided that the drop is within the limits stated in your pilot's manual.



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.



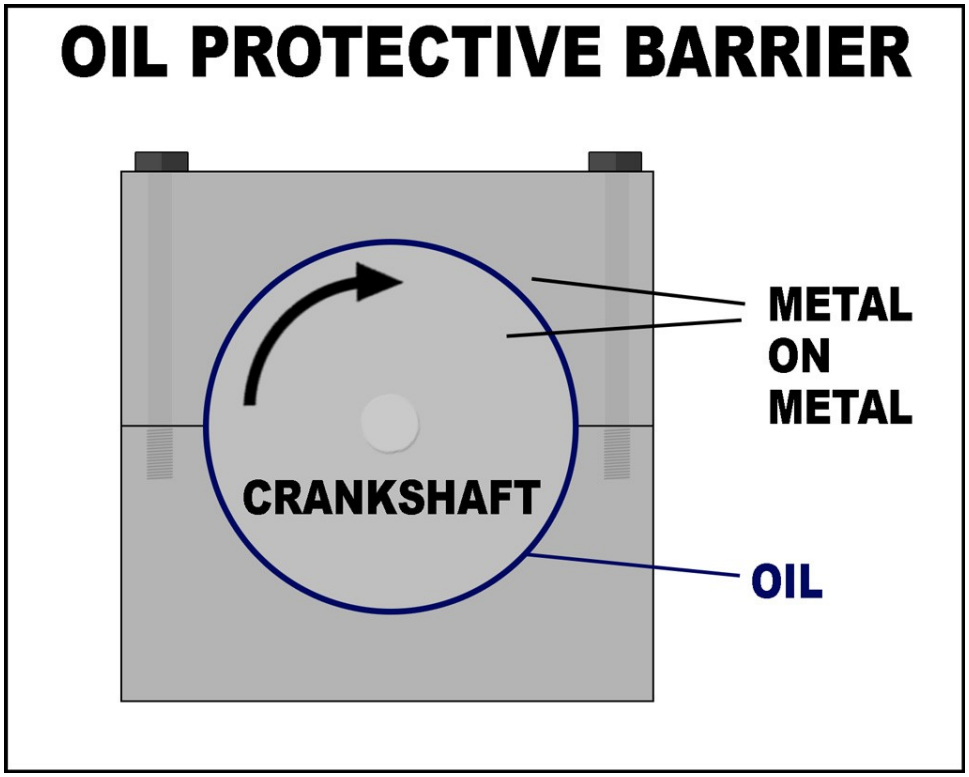
Aircraft engines are made of aluminum alloy due to its strong but lightweight properties. Aluminum maintains most of its strength up to about 150 degrees Celsius. As the temperature approaches 200 deg C, the strength starts to drop. An aluminum rod at 0 degrees Celsius is about 5X stronger than the same rod at 250 degrees Celsius, so an engine is most prone to fail when it is running hot. Keep your engine temperatures down to keep a healthy running engine. However, the J-3 Cub's engine's cylinders are open to the air, so overheating is not as great a concern as is making sure that the engine reaches it's proper warmup temperature before asking it to put out high amounts of power.

LUBRICATION SYSTEM (OIL)

An internal combustion engine has precision machined metal parts which are designed to operate right up against other metal surfaces. To keep the friction produced by this from overheating these metal parts there needs to be a lubricating layer, really a film of oil between those surfaces at all times. If you were to run an engine, pull the oil plug and let all the oil drain out, after just a few minutes the engine would begin to run hot, then get hotter and start to slow down, ultimately seizing 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 oil supply to the engine will be insufficient and the engine parts, no longer having that crucial layer of oil to lubricate them, would be in danger of making direct contact with each other and incurring serious 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 to avoid this damage.

Below is a simple illustration of a crankshaft that is located between two metal caps, bolted together. The crankshaft transmits all of the engine's power from the pistons to the propeller. 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 start-up and shutdown. The moment oil pressure drops below its minimum required pressure, these surfaces make contact. The crankshaft is the nexus of all of the engine's power. If you starve this vital component of oil, the engine can and will seize. However, this is just one of hundreds of moving parts in an engine that need a constant supply of oil to run properly and efficiently.


OIL PROTECTIVE BARRIER
METAL
ON
METAL
CRANKSHAFT
OIL

TORQUE vs HORSEPOWER

Torque is a measure of the amount, not the speed, of a 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 in the cylinder head, that piston is driven down with great force. The piston pushes the piston rod attached below it against the fitting on the crankshaft which then turns. That is how the downward moving piston creates torque, by causing the crankshaft to twist. The more fuel and air that can be exploded, the more power. The more powerful the explosion, the more torque which can be created. You can increase an engine's power by, among other things which increase efficiency in the engine, 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 the force of the torque (in foot-/pounds) with the speed at which it is turning (RPM). An engine producing 500 foot/pounds of torque at 1,000 RPM produces 95.16 horsepower. The same engine, producing the same amount of torque at 2,000 RPM produces 190.32 horsepower. We can see that the engine is producing twice the horsepower at 2,000 RPM than it is at 1,000 RPM. Torque is the twisting force. Horsepower is the power of that twisting force.

The relationship between torque, rpm and horsepower can be seen in the following formula:

$$\text{Power (horsepower)} = \frac{\text{torque (lbs- ft)} \times 2\pi \times \text{rotational speed (rpm)}}{33000}$$

If an airplane has a torque meter, you must keep the engine torque within the limits published for that engine or you will likely break internal components. In the Cub, your primary engine instrument is a Tachometer, which indicates the engine's speed of rotation. You must use that to set the throttle to avoid running the engine faster than its published RPM limit. Typically, an engine produces the most torque in the low to mid RPM range, and highest horsepower in the upper RPM range. In a fixed propeller airplane like the Cub, the higher the horsepower (indicted by the RPM being turned), the more thrust you will obtain.

Accu-Sim and the Piper J-3 Cub

Developed for:

ACCU-SIM EXPANSION PACK

Accu-Sim Expansion Pack upgrades core areas of Microsoft Flight Simulator X to provide the maximum amount of realism and immersion possible. Each pack is developed and tailored to a specific aircraft. Our third Accu-Sim pack has been created for our latest and greatest, A2A Simulations, the Piper J-3 Cub aircraft.

WHAT IS THE PHILOSOPHY BEHIND ACCU-SIM?

Real 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 on different days will result in a different experience. For example, you may notice that one day your engine is running a bit hotter than usual or it may have an odd sound or vibration. Regardless, these things should occur in a realistically created simulation just as they do in real life, but until now, they never do. This is what Accu-Sim does – it puts the gauge (and the real world) back in the game.

Putting realism in a simulation does not mean that your flying experience will be more difficult. While Accu-Sim is created by pilots, it is built for ***everyone.*** This means that you will find that Accu-Sim is presented in an intuitive layout which will enhance your flying experience, and which is easy to use. 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 Piper J-3 Cub is a complete aircraft with full system modeling inside and out. The infinite changing conditions around you and your aircraft have an impact on you and your aircraft. 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 amount of damage that you, as a pilot, may see in subsequent flights. It may not run quite as well as it did on the previous flight. You may not have given your engine a proper warm-up, and when you applied full power, some damage resulted.

However, this may just mean that your engine won't give you quite as many trouble-free hours of operation, or it could possibly mean something worse. You can't tell right away what the consequence of abusing your engine will be, just like it is in real life. 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 that when flying an aircraft with Accu-Sim engaged, it feels so real that you can almost smell the avgas.

ENGINE LIFE

You are now the proud owner of a Continental A-65-8 engine which lives inside your Cub's cowling and which breathes air and fuel. It prefers nice cold, oxygen-rich air; however, the oil and the internal engine parts are designed to run at warmer temperatures. If it's too cold, tolerances may be too close, the oil too thick, and serious damage might result. If it is too hot, the oil can become too thin, and the metal in the engine can overheat and weaken. Operating the engine in either extreme condition can result in premature engine wear and possible damage. Taking proper care of your airplane is all about maintaining proper balance (true with so many things in our lives).

Basically, if you have driven a car you should already know some basic common sense rules when it comes to operating a combustion engine. By "Common Sense" we mean:

- Allow your engine to warm up before applying power
- Only use full power when you absolutely need it
- Don't over-speed the engine

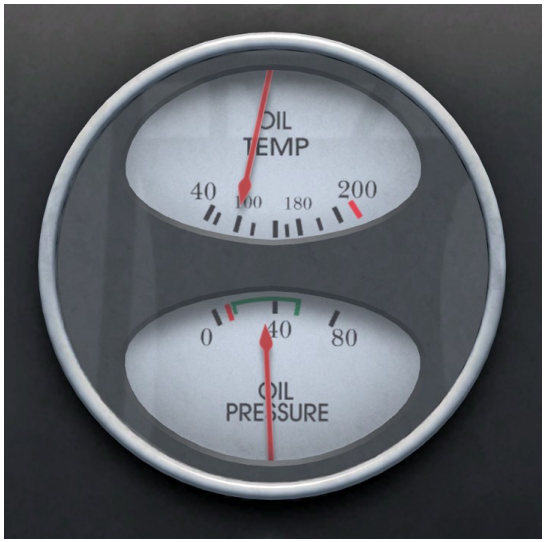
There are, however, some things that are not within your control, for example, the weather. An aircraft that is based up north in colder climates naturally will generally have to endure more than one that flies in milder weather. The open cowling of the Cub means that while the engine is unlikely to overheat, it can also be hard for it to heat up to ideal operating temperatures in colder climates. The same holds true for a Cub that lives in the high mountain elevations where the air is thin. These little Cubs have a hard life, and this will become evident with shorter TBO times (Time Between Overhauls).

Basic Truths with your Accu-Sim Piper Cub

- **Like anything with moving parts, when they move, they also wear down.** You can select your desired TBO time (engine life) in the maintenance hanger. Some diehards may want the full 1,800 hours between overhauls, while others may want a shorter 300 hours between overhauls because they want to experience a full engine life but do not have that much free time to fly.

- **There is an RPM limit.** Whenever you enter into a dive, you should pull the throttle back to insure that you do not over-speed your engine. If you do over-speed the engine, you may score internal parts, and also increase the possibility of a catastrophic failure.

- **Unexpected Failures.** As with any internal combustion engine, no matter how well maintained it is, there is always the chance something completely unexpected could happen. Perhaps the forging of a piston rod was faulty, or some part just gave way without any warning. These kinds of failures are unlikely and rare, but not entirely unheard of.



- **Complete Engine Failure.** If you experience some kind of engine damage, or simply run your engine well past its recommended TBO, it will ultimately break down at some point. When this point starts to happen, things tend to accelerate rather rapidly. Sometimes an internal failure snowballs into multiple failures. If this happens, you will know it. Any pilot knows when something is not running right. Your engine may just end up quitting at some point, or barely able to run. It may smoke, or possibly the engine might just seize up.

- **Oil Consumption.** A fresh new engine should consume little oil; but over time, as clearances open up and parts wear, oil inevitably seeps through and gets burned up. A fresh engine may burn ½ a quart of oil on a full tank of gas, while a worn engine may go through a full quart of oil, or more.

- **Engine Temps.** Over time, an older engine may run slightly warmer than a newer one due to oil and dirt buildup in the cooling fins and for other reasons.

PROFESSIONAL AUDIO

At the writing of this manual, the sound set in this Accu-Sim Cub includes three hundred and ninety professional audio recordings. Every sound is needed to deliver the proper experience. The sounds are all dynamically created to movie-quality standards, and literally nothing is canned or taken from stock sources. Every knob and switch in the cabin has been recorded from real Piper Cubs. The magnetos, fuel, carb heat, door latches, windows, and even the airframe squeaks have all been captured. Sounds like the rudder pedals have their own unique characteristic since they pull hard on the cables, as do the brakes.

Creaks, bumps, jolts, etc. all occur based on the stresses the airframe experiences. Even the wind is dynamic. You may notice you are hearing a lot of whistling wind as air is being pushed through the cracks in your airframe even when sitting still on windy days. In flight, if you crack open your side window, you will hear the air rush in. If you open the door at the same time, the air will equalize with the outside and it will therefore sound different, just as it really does.

The wind sound in a small aircraft like the Cub is critical in helping to give you that sense of how the airplane is flying. Pulling hard G's forces the air to push against the airframe, and you can hear this. Pushing this airframe past it's comfort zone will result in air very loudly rushing through. All of these cues allow you to fly this plane by your own pilot's senses. While the gauges are there to help you, if you pay attention to the sounds all around you, you will ultimately be able to fly this plane solely by the feel and sound of the engine and the airframe.

PASSENGER ON BOARD

Probably the most important responsibility for a pilot is to the passenger. Perhaps the basis of this is rooted in our human nature that tells us to take good care of our guests. However, a passenger is more than just a guest, they have placed their life with you, whom they believe to be a responsible and competent pilot.

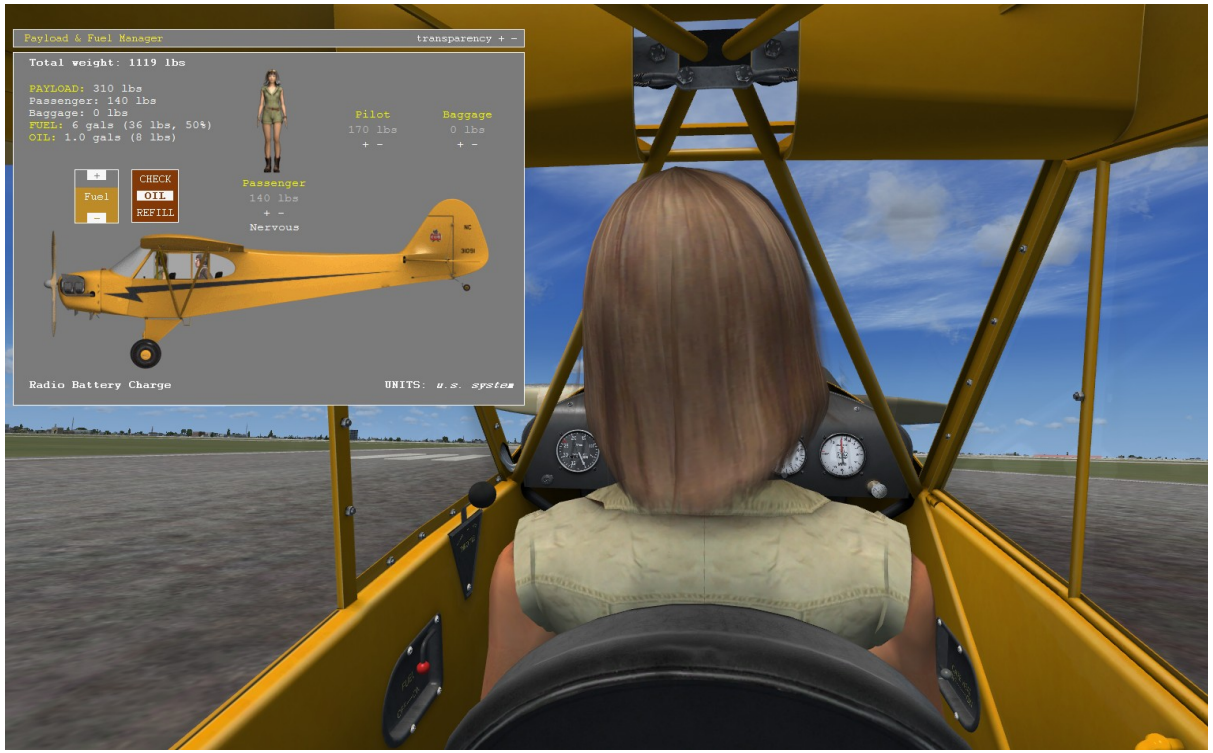
Passenger On Board Development History
Many pilots find it relaxing to fly solo. However, sometimes flying is more fun with someone else along. Your own personal flying experience between one passenger and the next can be the difference between night and day. During the development of our own Cub, we wanted to drop a passenger into the virtual cockpit, since the Cub pilot typically flies from the back seat with a passenger in front. It soon became very apparent that a static figure was just not acceptable. We then added proper body movement physics. We even gave our passenger an awareness of her own balance, and she will actually even grab a bracing bar in the cockpit with either her left, right, or both hands if she is off balance. Beyond this, we created her own ability to observe and find interest in things around her. She seems to think as she looks around. She may find something of strong interest, or she may just glance at something that catches her eye for a moment, just like real;passengers do.

So, naturally we had to give her the where-with-all to spot traffic; and of course, she has to see the traffic to spot it, meaning she can't see through a wing or a door. She can basically see what she can from her seat and what she can see through the window. However, like us, her spotting an object, like an aircraft, is based on how visible it is, how far away it is, and also just how much she happens to be paying attention at that moment. If she sees a plane, she will look at it and call out its position for you.

Ultimately, this brought us down the long road of creating an “intelligent” passenger who not only spots traffic, but is aware of her surroundings, the situation as it is, and comments on them. She actually experiences the flight with you.

Different kinds of passengers

Something that every experienced pilot quickly learns is that two people often react quite differently even when experiencing exactly the same situation. This is never more apparent than when you are flying with a person in the close quarters of a small plane, such as the Piper Cub.



Some people embrace flying with excitement, while others harbor a deep fear and insecurity towards it. Generally, the smaller the aircraft, the more intense the feeling for both the flying enthusiast, the fearful flier, and everyone in-between. This is because the flying experience becomes more intimate and intense in a smaller plane, just as sailing in a small sailboat is a more intense experience than cruising on a large ship.

We have introduced an intelligent passenger to the A2A Accu-Sim Piper Cub. She is not a pilot, but she represents a passenger who does not fly every day, so flying is quite a special experience for her.

When people are in the presence of someone who is feeling anxious, it has a profound effect on those around them. The same is true for someone who is bursting with excitement or even when someone is calm and relaxed. Emotions are highly contagious. Well, when you are piloting a small airplane with a passenger everything that happens is like electricity. Every move you make has an immediate and direct impact on the passenger who is sitting just a foot or so from you. The cockpit of an airplane is thick with shared experiences. These experiences can be filled with tension, or fun, or sometimes merely just enjoyably calm and relaxing. As a pilot, you will fly very differently based on this environment. Just think about how it would look to an outside observer. Imagine that there are three Cubs flying in proximity, each one with competent pilots. The passenger in one plane is nervous, in another one she is having fun, and in the other one she is relaxed.

The plane with the relaxed passenger would likely be flying a rather normal flight regime with moderate banks, turns, etc. The plane with the fun passenger would probably be looping, rolling, and doing negative G maneuvers (passengers who like flying love these the most). The plane with the nervous passenger would probably be flying straight and level, with the occasional and very gentle, shallow bank. This is the effect our "Passenger on Board" (has on you, the pilot (we refer to her as Heidi, but you can call her whatever you wish). Choose the personality you wish to take flying with you, and assuming that you wish to please her, watch how your flying changes.

Your passenger comes in four different, player selectable personality types (which you can choose in the load manager):

Silent
The only sounds you will hear from this passenger are the normal sounds which all people make like sniffs, coughs, clearing throat, etc.

Calm
This passenger is the laid-back type. She is more passive and observant, and doesn't get overly excited or upset in different situations. She may make the occasional comment on the weather, flying in general, may compliment you on a nice landing, and may let you know if she is not comfortable. She doesn't get overly excited when performing aerobatics, nor does she fear them. For the most part, she takes it all in her stride and is along for the ride. She trusts you.(depending upon how well you fly, we could have called her "foolish").

Nervous
All pilots are all too well aware of passengers of this personality type, and even though our passenger happens to be a female, the nervous flier is not gender specific. The presence of a nervous passenger in the cockpit will usually profoundly influence a pilot's flying technique.

This passenger gets nervous just sitting in an airplane and, because she is nervous, she tends to talk a lot. When this passenger is on board you will not open the door in flight, let alone perform an aileron roll. In fact, this passenger does not even like it when the airplane is turning. Typically, you as the pilot, will likely spend most of your time and energy making sure that this passenger is feeling alright. It won't take long before you start to feel nervous as well. After a very short time in the cockpit with this personality type, both the passenger and the pilot will be glad to get back on the ground. However, maybe if you keep your flying nice and steady, the nervous flier will be OK --you hope.

Fun
The fun flier tends to be very trusting and embraces life's experiences. You'll find these personality types at amusement parks getting in line several times for the biggest, baddest roller coaster. The more you can dish out, the happier this passenger gets. She is a bit flirtatious and complimentary, and it may go to your head if you let it. You'll have fun, along with her. However, she is not a pilot, therefore she does have her limits; but as long as you don't go into a screaming terminal dive, this passenger will be loving everything you do and every minute of the flight.

General Passenger Characteristics

All passenger personality types move and sway with the plane's movements, they may grab the windshield braces to steady themselves if you do any hard maneuvers, and they will all generally look about the world when on the ground and in the air. They will call out traffic if it is close enough to see, and they may comment on your landing/flying technique. Do a good job and you may be rewarded with a compliment. Mess things up and....

Traffic Spotting

A role that most passengers love to play, even the calm ones, is to keep a lookout for traffic. Our passenger will keep a good lookout in your Cub, as she has the best view up front. Her view is real, meaning she cannot see through the body, wings, or nose, but if she spots a plane, she will call it out (ex: there's one, 2 o'clock), and she will even look at it.

Both the pilot and passenger also have synergy together. On the ground, they tend to look at the same things, respond to each others' movements, as if they are speaking to each other about the things that they are looking at. In the air, they will start to look at all different things. When the passenger is loaded, the pilot tends to look just past her either to the right or left.

Beyond this, perhaps the best thing about having an intelligent passenger along for the ride is that the experience is just more... human. Pilots typically fly because they are passionate about it, and people inherently love to share their passions with others. Therefore pilots are usually happiest when they are sharing their passion for flight. Passenger On Board™ allows you to share your flight experience and passion , and to truly see and find out what kind of pilot you really are.

GROUND PHYSICS

A long time area of Flight Simulator X that has remained under-developed is the physics of the aircraft when rolling on the ground. When you taxi or takeoff on grass or unpaved runways, an aircraft can bounce and rock quite a lot. Just a small depression in the ground can tip the wing a few feet.

Since Accu-Sim models airframe creaks and stresses, just taxiing can be quite an immersive experience. When you roll off a smooth, hard surface, ground bumps are modeled in the uneven earth, and pass under the wheels as you taxi. Taking off from a grass runway can get pretty bumpy, so it is advised to get your tail off the ground as soon as possible to avoid excessive bobbing of your tail wheel.

A Cub equipped with standard tires bounces about quite a lot when taxiing on other than smooth, paved surfaces. A ski-equipped Cub can also get pretty bumpy, but the snow dampens some of the larger depressions in the ground. The tundra tire Cub is also quite fun because these much larger tires are soft and springy. They absorb the small bumps, and allow for better control out in the bush country; but they have their own very specific characteristics ,and you will sway to each side a lot more during ground operations when they are installed..

WATER PHYSICS

Another long time area of Flight Simulator X that has remained under-developed is the water physics. We have utilized Accu-Sim to augment the FSX water physics and injected our own Accu-Sim water-physics engine. Accu-Sim models waves that move the aircraft about naturally. If you have ever watched someone water ski, or done so yourself, you have seen how water behaves with a ski at different speeds. At first, the ski (or float) is sort of down in the mud, deep in the water. The drag on the floats while moving slowly is tremendous. It isn't until you push the floats faster that they begins to “plane” on the water, rise up on the “step”, and really start to accelerate. When up on the float's step, water drag is greatly reduced and you actually are riding mostly on top of the water. At speed the water now feels hard beneath your floats, slapping, bucking and bumping you about. With Accu-sim you can feel it and hear it. You get the whole water experience like you have never had before in FSX. Higher winds in Flight Simulator X now, for the first time, as it does in the real world, mean a rougher sea. The Accu-Sim engine also calculates ocean temps,. So, if it is, say, 10 º Fahrenheit outside, and you are floating on 33 º F water, your aircraft will be warmed by this water. The opposite is true in the hotter climates where the water is cooler than the temperatures during the day. When you couple this realism with your passenger who enjoys a comfortable aircraft cabin environment, you will find yourself understanding the reasons why so many people retreat to the waters when the weather is extreme. These accurate water physics add so much to the enjoyment, wonder, and adventure of flying your Cub in the almost unlimited remote locations in the world.

WEIGHT and BALANCE

In a real Cub, if the trim is set at neutral, you simply advance the throttle and do nothing, the plane will accelerate down the runway, the tail will come up, and the plane will eventually lift off into a nice climb. This is true with your Accu-Sim Cub as well.

However, placing a passenger in the front seat makes for a very different feel. Takeoffs take longer, and you must use the stick or yoke differently. You can feel the heavier nose moving about. Just burning off a few gallons in the front tank will require a little forward trim. This is your Cub, and you will learn and know all of its quirks and sensitivities, especially with the way it reacts to difference weights and balances.

STICK and RUDDER

Well, we have a made the largest leap forward with this tiny little airplane. Customers who own our systems-heavy Boeing 377 or P47 Thunderbolt may be thinking, “How can this be when there are so few systems to manage? After all, it's just a Cub.”

Creating realism in a simulation is like a bottomless pit. It's really just a matter of how far you are willing to go. Now matter where you end up, you can always keep going forward. The product becomes defined by what is humanly possible within the realities of the world we live in, and not within our minds. This beautifully simple little Cub, however, has allowed us to put our full concentration on the most basic elements of flight.

Even with all the technological advancements going into this flight simulation, the most demanding aspect of the project was pushing FSX beyond it's boundaries and filling in those gaps to create a fluid, honest, real flying experience in almost any flight regime.

PROP WASH OVER THE TAIL

While Microsoft FSX is, and will continue to be the leading platform for the foreseeable future, like every piece of software, it has it's limitations. This is where Accu-Sim comes in. We used Accu-Sim to model, for the first time, the air that flows over the elevator from the propeller. This is supposed to be modeled in FSX, but you can see it is not, as no other aircraft exhibits proper elevator response when the propeller is blowing air over it, and especially at takeoff. You can see this clearly with your A2A Cub. Open the throttle and start rolling, and the tail comes up quickly, just like the real thing. In fact, you can lift your tail and balance it while standing on the brakes. This exists only because, with Accu-Sim, the proper physics exist.

STALLS and SPINS

Making proper departed flight characteristics in any flight simulation is a challenge. This means creating a wing that exhibits it's proper and fluid behavior at every possible angle of attack, even flying backwards. You may notice some quirky behavior on other flight simulator aircraft. Some aircraft will even rise at times when in a spin. For higher performance aircraft, you can get away with some of the default FSX stall and spin behavior, but for a stick and rudder aircraft like the Cub, this was just not acceptable, so we have moved the actual wing and drag properties out of FSX and into Accu-Sim. The result is smooth, honest flying.

When you push the Cub into a stall, you are actually experiencing the loss of lift and increase of drag on each wing. If you hold the aircraft in this stalled state, it will be a bit unstable, but you should have enough rudder control to keep the wings level. If you kick the rudder to one side in this unstable state, you will force your inside wing to stall and create more drag than the outside wing. With Accu-Sim, when you start to enter a spin, you will notice how it picks up momentum in the first few turns. This is because the inner wing is actually stalled, while the outer wing is anywhere from being in less of a stall to actually flying. You will feel the spin wind up and accelerate. Also, when you apply opposite rudder to stop the rotation, it will wind down slowly. There are no jerky, canned maneuvers or unnatural glitchy behaviors. It's all smooth and quite fluid because actual physics are at play, and not some set precondition. There is no more, “I am in a spin OR I am flying and nothing in between” or tricking the aircraft into a spin-like behavior. To us, at least, this has changed simulated flying and for the first time we have our internal real-world pilots telling us, “You could teach people how to spin in this aircraft.” Detailed instructions on how to properly stall and spin your Cub are included in the A2A J-3 Piper Cub Pilot's Manual.

TUNDRA TIRES

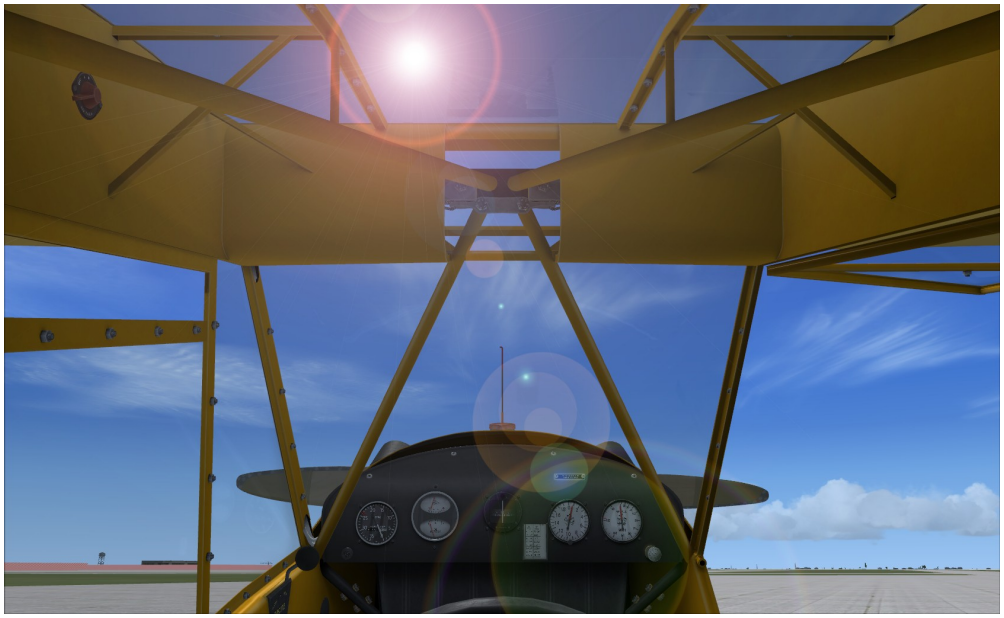
When you place large, over-sized tires on an airplane, it takes more energy to spin or stop the tire. So, for example, say you are landing and these large, still tires are just about to make contact with the tarmac. Let's also say you are coming in rather fast, so you are in a bit of a nose-down attitude. Now what do you think would happen in a real Cub the moment those large, heavy, grippy tires make contact with the pavement? They are going to grip and grab that pavement, and buck that tail up as if you just stomped on the wheel brakes. In fact, with tundra tires, you must make a tail-low or a 3-point landing on pavement, so that when you make that initial contact and those tires demand all that energy to start spinning, you will not nose over. If you understand this basic principal : that you are lugging around these heavy tires and the limitations that come with it, tundra tires can open up a world of fun with your Piper Cub as they absorb a lot of energy, making bush flying safer. Think of it as an SUV with wings. Also, the tundra tire equipped Cub comes with it's own sound set.

SKIS

Flying up in the higher latitudes and higher elevations where snow is common, some Cub owners opt to remove their wheels and bolt on skis. Your main skis have steel cables attached to the rear and front tips, and also a bungee chord on the front to keep the tips up in proper position in flight. The skis will scrape and cut into the snow, so keep your tail low whenever possible.

The skis are a lot of fun up in the colder climates, and like the float and tundra tires versions, the skis come with their own dynamic sound set that will give you better feedback about how the plane is sliding over the snow and ice.

CABIN COMFORT



Your Piper Cub has four ways to control the cabin temperatures:

- Heater control
- Window
- Door
- Awareness of the outside temperatures

There is no air conditioning in the Cub, so even for non-pilots who remember driving automobiles years ago equipped with just a single lever for heat, the Cub will feel familiar. There are three main differences:

- The Cub heater does not have an internal fan
- An aircraft is exposed to more extreme changes in temperatures
- The air is heated by the unregulated engine temperature

I am sure everyone has experienced how hot a car can get if you leave it in the direct sun, even on a mild day. The same is true for airplanes. With Accu-Sim, the sun heats the cabin as in real life. The cabin is also not perfectly sealed, so some air will always enter and escape.

Cracking a window can help to relieve some of the heat, but not as much as opening it all the way, or even opening the door as well for cross ventilation. Staying cool (or warm) is a big part of piloting a small airplane. You need to take into consideration everything from the sun, changes in the air outside, airspeed, how the air is moving through the cabin, and even sitting on hot pavement at high noon. Accu-Sim also models the ocean temperatures throughout the world, and this really adds immersion when operating the float plane in extreme weather.

Open windows to cool off

Heater Control

The air is heated as it is directed over the engine, so the temperature varies with the temperature of the engine. In a car, there is a thermostat that maintains a constant temperature, but this is not the case for the Cub. So, in colder climates where the engine itself may not be able to reach its ideal temperature, not only will it be colder outside, but the heater will also be less effective. When flying in very cold climates, don't be surprised if your cabin temperature struggles to reach even room temperature with full heat, even at full throttle. This is life with a Cub, and be thankful, because not all Cubs have heaters. So, keeping a small aircraft cabin comfortable from takeoff, to climb, cruise, descent, landing, and taxing takes more attention. Since there is no internal fan, the Cub relies on the prop and ram air to force air into the cabin. This means that engine RPM on the ground, and speed in flight changes the effectiveness of the heater, even when the heater control is left in the same position. Just imagine your car having no heater fan. This is similar to what the heater in the Cub is like.

PROPELLER PHYSICS

In flight simulations, many often think of the propeller being in one of two states: still or moving. This is natural since this is the way many simulations show the propeller, so the sim pilot is simply observing what is true in the simulation.

The propeller is to the engine as the wing is to the airplane. The prop is consistently interacting with the forces of the air and the engine (think of it as a buffer between the two). The engine power can force the prop to cut through the air, taking bites and pulling the plane forward, or no or low power can cause it to plow forward like a brake. The intensity of this depends on the power your engine is demanding or how much the prop is demanding of it.

As the prop turns, it has more resistance at the 10 o'clock position (looking at it from the cockpit) since every time a blade is at this point, one cylinder is at its peak compression stroke (squeezing the air and fuel mixture just before it is ignited). If you turn your engine off in flight, the only force keeping your prop moving is the airflow pushing on your prop. If you slow down enough, the prop will slow down and even stop. As you speed up, the prop will start to move again. You will notice how the propeller is more resistant to move as it approaches this 10 o'clock position, and how it snaps past it as that cylinder passes through its peak compression stroke.

If you are sitting on the ground just about to takeoff and you apply full throttle, you will notice that your RPM will not reach it's peak. This is because the air is still and therefor it's resistance to the propeller is high. As your speed through the air increases and you proceed down the runway and into a climb, your RPM will start to rise, but it will still settle short of it's maximum 2,300 RPM. If you level your Cub out, and apply full throttle, you should then see your peak RPM occur somewhere around 80-90mph. If you hold full throttle and push your stick forward, dropping your nose, your RPM and airspeed will begin to creep past their redlines. You need to watch this carefully, and pull back the throttle as needed to maintain a safe RPM and airspeed. Over-speeding your propeller, engine and airframe is a very serious matter, which is why you have a clearly labeled redlines on the Tachometer and Airspeed Indicator. As with every engine and airplane, you must observe these limitations scrupulously. Just know, as you fly, your trusty prop is there with you every step of the way. Don't abuse it.

CARBURETOR ICING

Accu-Sim introduces real-world carburetor icing to Microsoft Flight Simulator X.

You may think carburetor icing is most problematic in cold weather, but in many cases, the opposite is true. First, you have to understand what carburetor icing is: When the air enters your intake manifold, the passageway narrows, and the air is forced to speed up. This creates lower air pressure, and in turn, reduces the air temperature. Your Continental A-65-8 engine has an unusually long intake, which means the air pressure and temperature drop is larger than in many other aircraft. Also, the carburetor on the Continental A-65-8 engine is further away from the engine block than on many other engines, so it does not receive much heat from the rest of the engine. The temperature drop at the throttle plate can be as much as 40 degrees Fahrenheit, or more. What this means is, even on a 70 degree day, the air as it enters your carburetor can be below freezing, and therefore ice can build.

Now, you have to understand that air contains water, and the hotter the air, the more water it can hold. You may notice, when the sun goes down after a hot, humid day, grass, cars, bikes, windows, or anything outside can become moist. Also, first thing in the morning, you may see dew on the lawn. This is simply because the previous warm, saturated air was cooled, and since the cooler air cannot hold as much water as warmer air, it was rung out like a sponge.

So, if you know this, then you will understand that, on a hot, humid day, the air is thick with water. It is this hot, humid air that is most dangerous when it enters your carburetor if the air is cooled to the point of freezing. This hot, humid, water-soaked air can deposit water inside your carburetor like running water, and in a very short time, literally minutes, your carburetor can be loaded up with ice.

It is well to understand that the air is being cooled most when you pull the throttle back in flight (in a power-off glide. Greatly cooled air is then rushing in through the slightly cracked throttle plate, and this is why you are required to use carb heat every time you pull that throttle back in flight. At normal throttle settings you should not experience carb icing. However, if you are experiencing lower RPM or expected power than usual at a given throttle setting, you may have carb ice. If you suspect you do, turn on your carb heat immediately and advance the throttle slowly. If ice is the cause of the power loss, you should see normal power resume rather rapidly as the ice breaks up and dissipates.

So, when you fly your Cub, and it is hot and visibility is low, regardless of the temperature outside, think, “this is dangerous carb icing weather.”

SOLO ENGINE STARTING

The Piper Cub does not have an electronic starter, so you have to start the engine by hand. While Accu-Sim makes hand starting possible, detailed procedures for doing this are in the main A2A J-3 Cub Pilot's Manual. The main thing to know is that you have to have your fuel control and magnetos on, and give a shot or two of primer in cooler and cold weather.

Solo starting is not recommended by many and this manual does not recommend that real-world pilots hand start their aircraft without trained and experienced assistance We have simply chosen to simulate a method some Cub pilots choose to use to start their aircraft.

AIR STARTING

It is possible to stop and start your aircraft in flight. For the most part, air starting is a routine and often practiced procedure. While Accu-Sim makes air starting possible for your A2A Piper Cub, detailed instructions on how to air start are in your main A2A Piper J-3 Cub Pilot's Manual. **We do not recommend that real-world pilots intentionally shut down their engines in flight to practice air starting.** We have simply chosen to simulate the procedure used to do so in this simulation.

FINAL WORD

Perhaps the best window into our Accu-Sim physics is to look at your magnetic compass.

This is basically a top sitting in kerosine on a pin. Watch how your new Accu-Sim airplane physics moves this top about, how it rotates, banks, twists, and even vibrates. Accu-Sim has built-in variation, deviation, turn and acceleration errors, which accurately reflect how real magnetic compasses operate. You can even use the Magnetic Compass as a rough turn-coordination instrument (see details about this in the A2A J-3 Cub Pilot's Manual). This codes for this little magnetic compass were the first ones created for the Accu-Sim Cub. It was inspired by pilots who have, for almost as long as people have taken to the air, trusted their lives to this simple little device.

If you pull up your CONTROLS menu (Shift-3), try turning the Accu-Sim system on and off while watching your panel and engine at idle and in the air. See how much different the world is when you turn Accu-Sim off. Accu-Sim is about maximizing the joy of flight, and we are confident you will get countless rich hours of flying with our little aircraft.

We at A2A Simulations are passionate about aviation, and are proud to be the makers of both the A2A Simulations Piper J-3 Cub, and it's 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.

We leave you with this beautiful shot of two people enjoying the wonders of flight with the freedom of an elegant, yet simple aircraft.

CREDITS

Microsoft: Creators of Microsoft FSX and its excellent open-architecture system that allowed us to port in our Accu-Sim technology

Project Management: Scott Gentile

Technical Director: Robert Rogalski

Accu-Sim Systems Programming: Scott Gentile, Robert Rogalski

C++ Programming: Michal Krawczyk, Robert Rogalski

Audio: Scott Gentile

Public Relations, Web Design: Lewis Bloomfield

Accu-Sim Manual: Scott Gentile

Accu-Sim Manual Editing: Mitchell Glicksman

Accu-Sim Manual Proofreading: Larry Green and the Beta Team

Quality Control: Cody “Valkyrie” Bergland

Beta Testing: The world's best beta team, including Martin “ICDP” Catney, Ian “PistonPilot” Chase, Forest “FAC257” Crooke, Glenn “GlennC” Cummings, Ryan “Hog Driver” Gann, Mitchell Glicksman, Captain Jakey, Larry “Tako_Kichi” Green, Dudley Henriques, Günter "guenseli" Steiner, and Oskar “Lonewulf” Wagner.

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Thank you for being an Accu-Sim customer.