"Put the *GAUGE* back in the game"

The B377 Accu-Sim Expansion Pack

ABOUT THIS MANUAL

While much of the information in this manual is basic to many of our readers, we assume that the reader has no knowledge of combustion engine theory. This manual is for ***everyone***, and uses colorful illustrations to teach the basics. The Accu-Sim system however is not basic, but is programmed with advanced physics which the professional pilot will appreciate. If you are an advanced pilot you can likely just briefly skim over the contents of this manual, however, if you are eager to learn how these great big engines work, welcome and read on.

The B377 Accu-Sim Expansion Pack

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Chapter 1: Welcome

INSTALLATION

Once your Wings of Silver Boeing Stratocruiser is installed, run the B377 Accu-Sim expansion pack installer and follow on screen prompts. The installer should find both Flight Simulator X and the Wings of Silver Boeing 377 Stratocruiser automatically. If not, it will ask you to BROWSE for the correct location. Keep in mind, if Microsoft Flight Simulator X is properly installed, the Accu-Sim installation should be simple and straight forward.

Refer to your B377 Stratocruiser Pilot's Manual

Included with your Wings of Silver Stratocruiser is a detailed pilot's manual. The Accu-Sim upgrade is built into this product from the ground up, so refer to your pilot's manual for specific systems operation and limitations.

DESIGNER'S NOTES

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

Accu-Sim is about believing you are there. It's knowing that in the real world certain truths exist. However, we also expect the unexpected because in life, things do not always fall right into place. When you hit the starter for a great big radial engine, it doesn't always just say, "yes sir" and start right up. Sometimes is does, and when that happens you may think, “that was a nice startup.” Other times, the engine does something else – it turns over, it sputters, it coughs, and when just enough things happen to line up, brrrrroooom, the engine fires up. It is not a whole lot different than starting your cold lawn mower engine, but a large aircraft engine just has a lot more going on.

Accu-Sim understands that engine #1 is never the same as engine #2. It also understands that if we do things exactly the same way as we did before, things will not always respond in kind. Most of the time, yes, things will go as we expect. But there is a tolerance we watch for in all things. For example, if an engine tends to run at a specific temperature, say 220 degrees, and that engine is running at 225 degrees, we may consider that normal, or acceptable. Maybe 230 degrees is the point when you think, “that is a little too high,” or maybe 230 degrees is again considered OK by someone else. This is because you, the pilot, are considering not just the temperature of that engine, but all the other factors that go into what makes that engine heat up. Perhaps it's a bit warmer outside the aircraft or you want a little more speed that day so you've closed your cowl flaps an extra inch, trading speed for a little hotter temperature. Maybe the temperature gauge is off a bit, or perhaps you, the captain, become a bit concerned. Maybe these indicators mean something more is at play. Perhaps you let the engine run a bit too hot on takeoff or maybe something else, completely out of your control, is at work. No matter what it is, the world is not run by absolute numbers; it's run by real things we can see and touch. It's observing the behavior of such things and making decisions based upon what we know to be true. With Accu-Sim, one thing is for certain, no two flights will ever be the same again.

Welcome to the world of Accu-Sim.

Scott Gentile
Accu-Sim Project Manager

The B377 Accu-Sim Expansion Pack Features

- **Piston** combustion engine modeling.
    - Real-world conditions affect system conditions, including engine temperatures. Manage temperatures with engine cowl flaps and oil cooler flaps.
    - Use intercooler flaps to cool Carburetor Air Temperatures (CAT) as high temperatures can adversely affect engine performance while low temperatures can lead to gradual carburetor icing.
    - Spark plugs can clog and eventually fowl if engines are allowed to idle too low for too long. Throttling up an engine with oil-soaked spark plugs can help clear them out and smoke will pour out of exhausts as oil is burned off.
    - Overheating can cause scoring of cylinder head walls including ultimate failure if warnings are ignored and overly abused.
    - Realistic water injection (ADI) turns on gradually when enabled. Pushing the engine too hard without water injection automatically injects more fuel to keep cylinders cooler, creating realistic black smoke from unburned fuel.
    - Experience authentic asymmetrical drag when operating various flap systems in flight.
    - On hot summer days you will need to pay very close attention to your systems, possibly expediting your takeoff to avoid overheating due to radiant ground heat.
- **Systems** are influenced based on real world conditions.
- **Experience** realistic startups with an engine that can cough and sputter until it catches and turns over.
- **Naturally speaking crew (American and British crews included).** Your crew can help you, the captain, fly the plane by giving you critical information when you need it. For example, the Stratocruiser has a built-in takeoff flap warning system that sounds if you apply more than 3/4 throttle and the flaps are not set to takeoff position. If you apply throttle with flaps not properly set and hear this warning, your copilot will make a comment like, "Captain, you need to set your flaps to 25 degrees for takeoff." Your flight engineer gives you advanced updates on systems, giving you time to react. Crew speech is not robotic but quick and natural. This system was created to help you fly the plane, just like a real crew, and to make your experience more pleasurable.
- **Environmental sounds** including everything from passengers to brakes squealing to the aircraft creaking.

Chapter 2: Accu-Sim and The Combustion Engine

THE COMBUSTION ENGINE

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

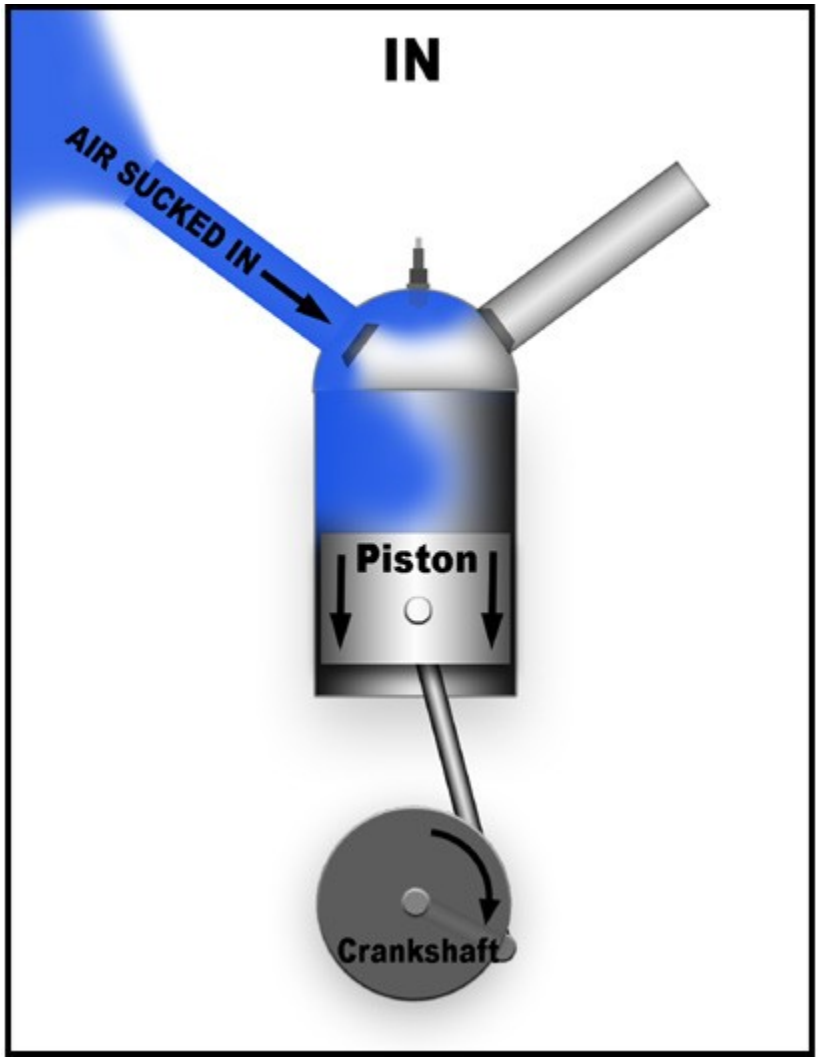
The main difference between an engine designed for an automobile and one designed for an aircraft is the aircraft engine will have to produce power up high where the air is thin. To function better in that high, thin air, a supercharger can be installed to push more air into the engine.

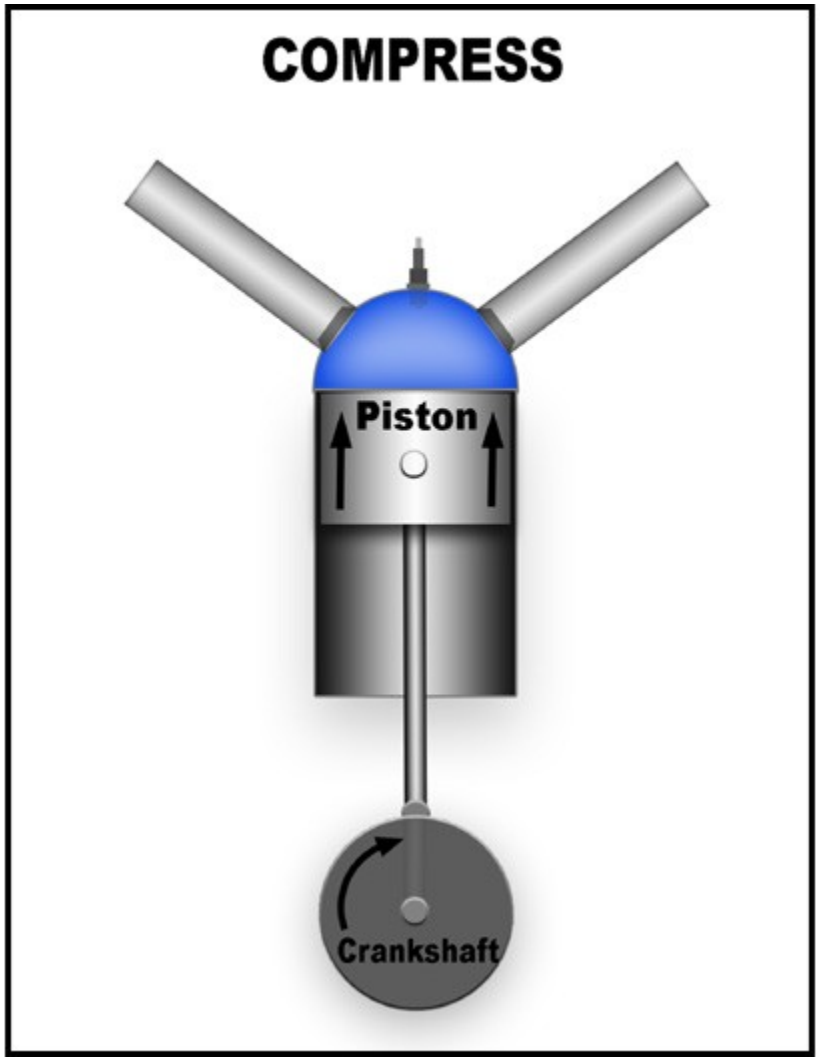
OVERVIEW OF HOW THE ENGINE WORKS AND CREATES POWER

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

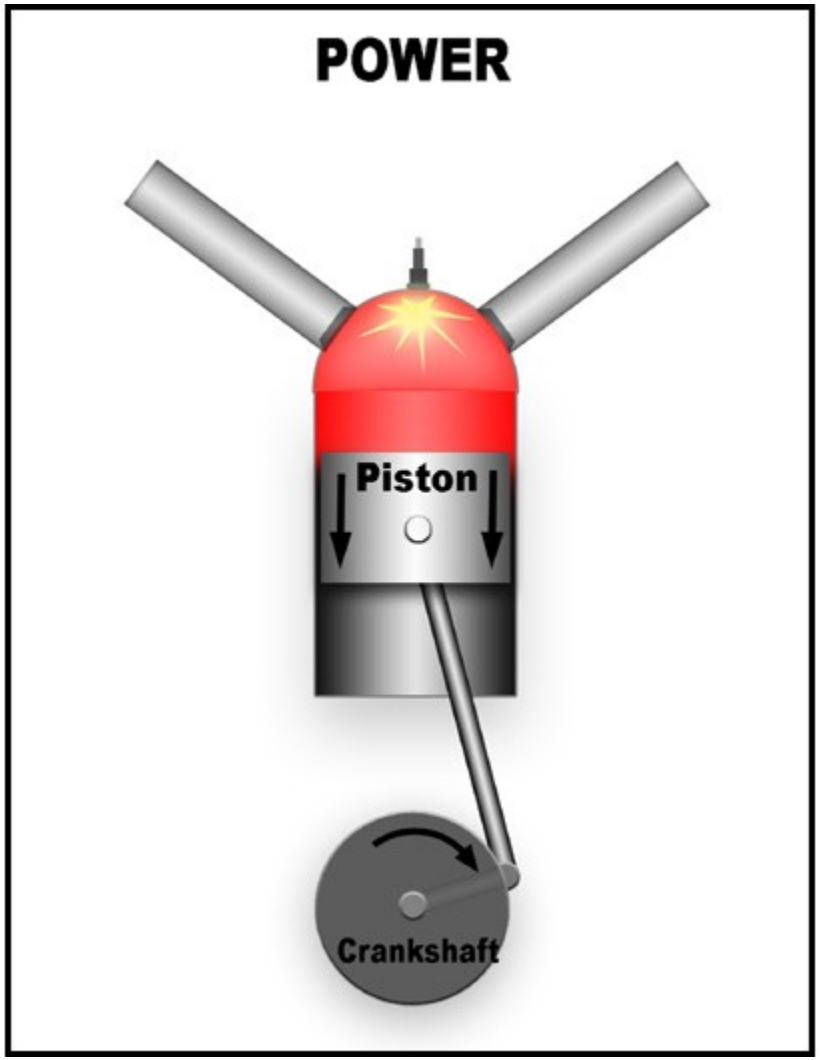
Look at the four pictures below and you will understand basically how an engine operates.

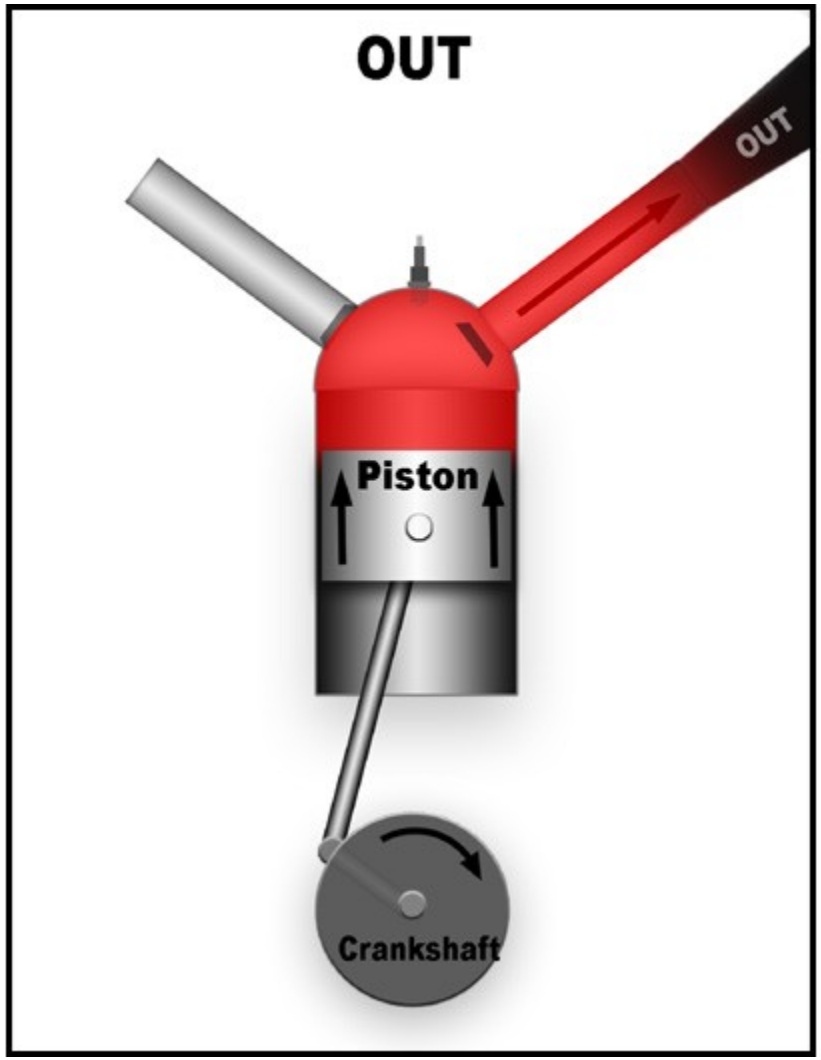
The piston pulls in the fuel / air mixture, then compresses the mixture on its way back up.





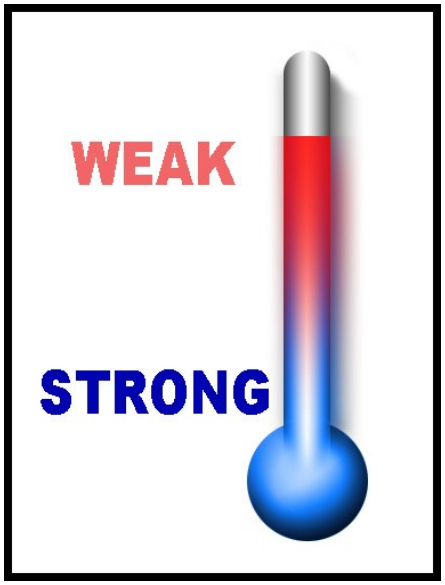
The spark plug ignites the compressed air / fuel mixture, driving the piston down (power), then on its way back up, the burned mixture is forced out the exhaust.





AIR TEMPERATURE

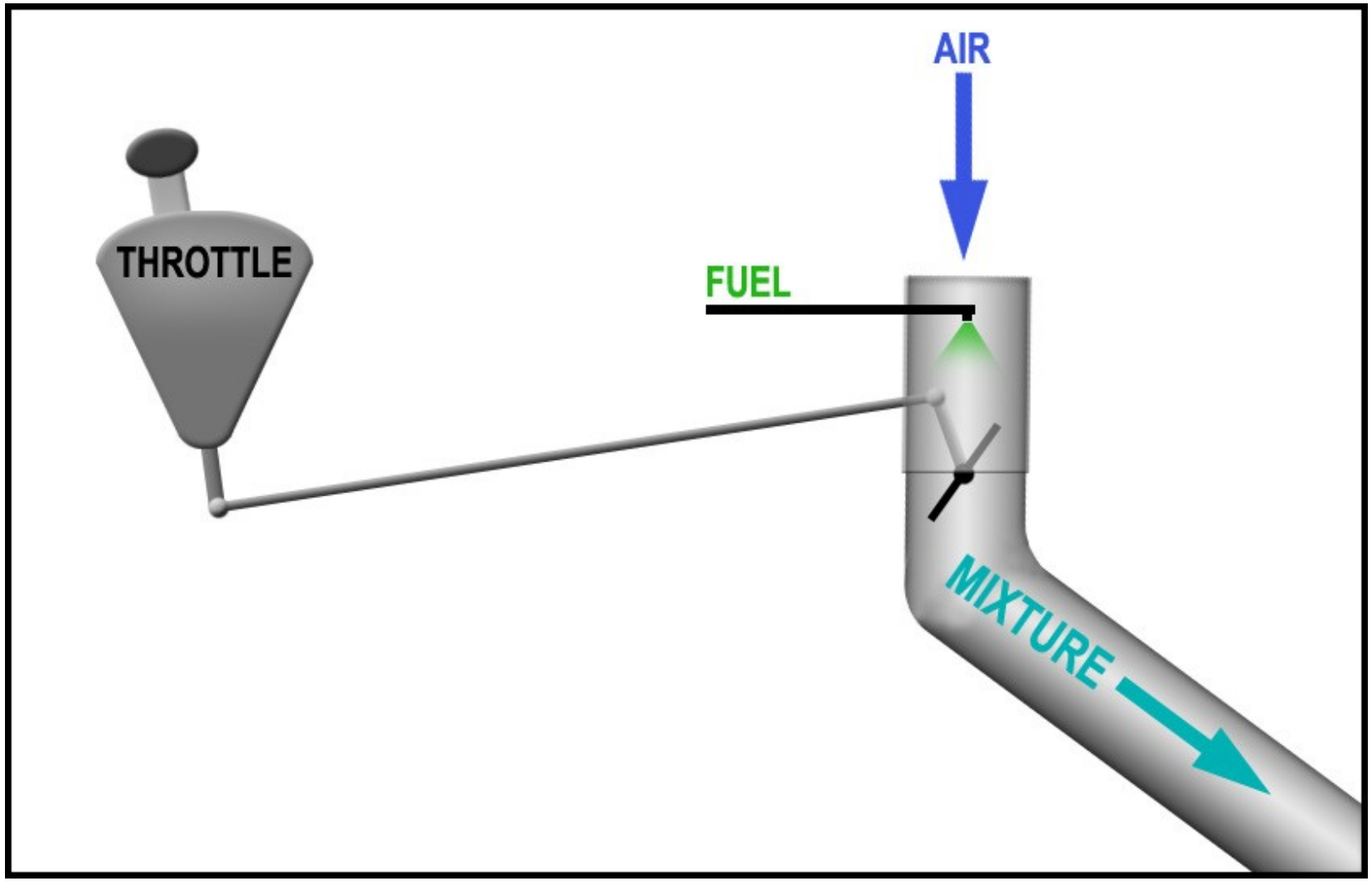
Have you ever noticed that your car engine runs smoother and stronger in the cold weather? This is because cold air is denser than hot air, and has more oxygen. Hotter air means less power.



Carburetor Air Temperature (CAT). Your CAT is the temperature of the air just before it enters the engine. If you have intercooler flaps on your engine that can control this temperature, you can cool your CAT by opening these flaps. However, the more you open these flaps, the increased drag can slow down your aircraft. The key is finding the magic balance between keeping your CAT low and keeping your intercooler flap drag low.

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 more rich 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 RICH mixture.
For LOW POWER, use a LEAN mixture.

THE MIXTURE LEVER

Most piston aircraft have a mixture lever in the cockpit that the pilot can operate. Forward is usually rich, and backwards is usually lean. 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.

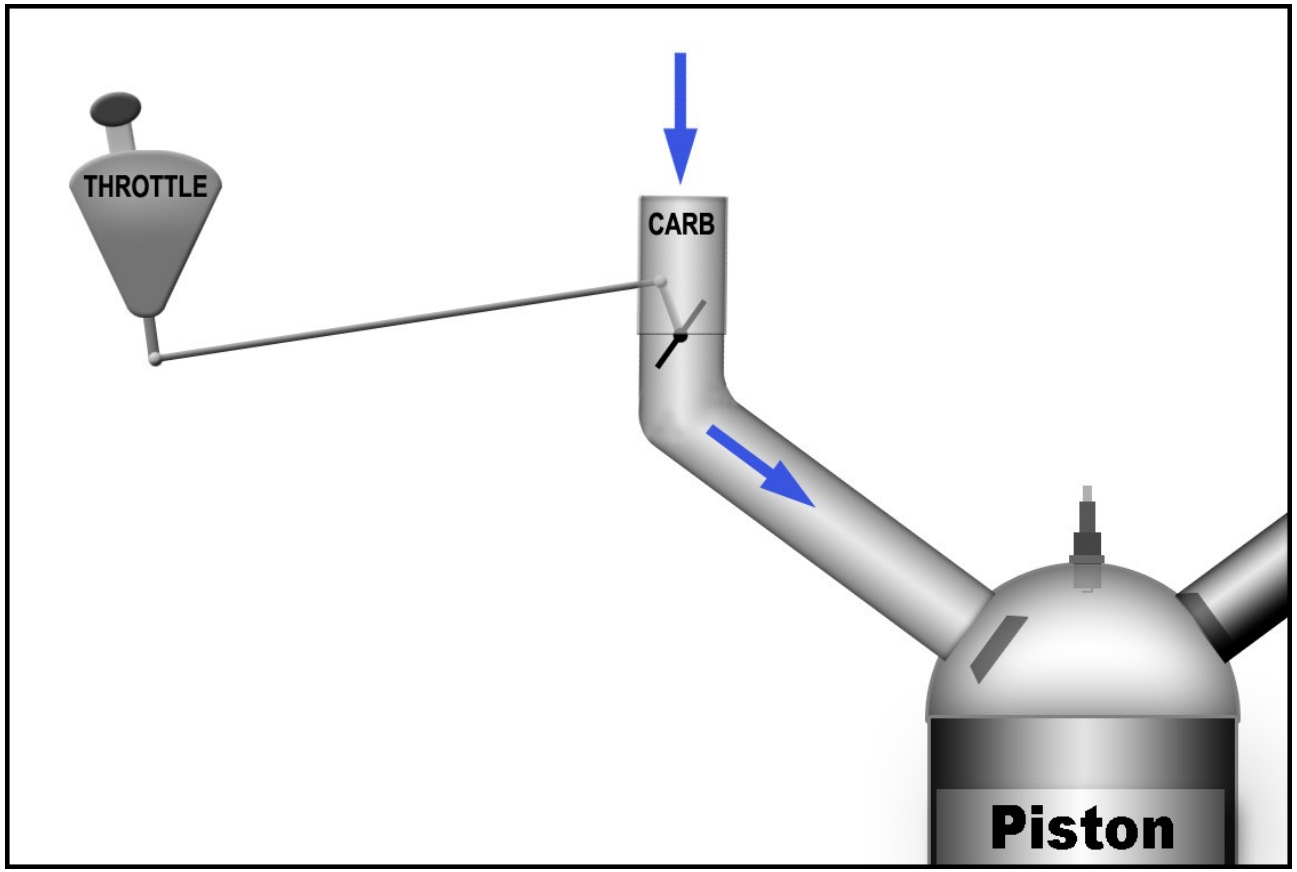
How do you know when you have the right mixture?
The standard technique to achieve the proper mixture in flight is to lean the mixture until you just notice the engine getting a bit weaker, then richen the mixture until the engine sounds smooth. It is this threshold that you are dialing into your 0.08%, 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.

AUTO-RICH and AUTO-LEAN
More advanced aircraft may have an AUTO-MIXTURE system, with AUTO-RICH and AUTO-LEAN settings. You simply select which one you want and the auto-mixture system automatically adjusts the mixture for you based on altitude and power setting. If your aircraft has AUTO-RICH and AUTO-LEAN capability, it is highly recommended you use this system and not use manual leaning.

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 airplane engines 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. For the most part, you will be 'throttling' your motor, meaning *you* will be dictating where its limit is.



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 30 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.

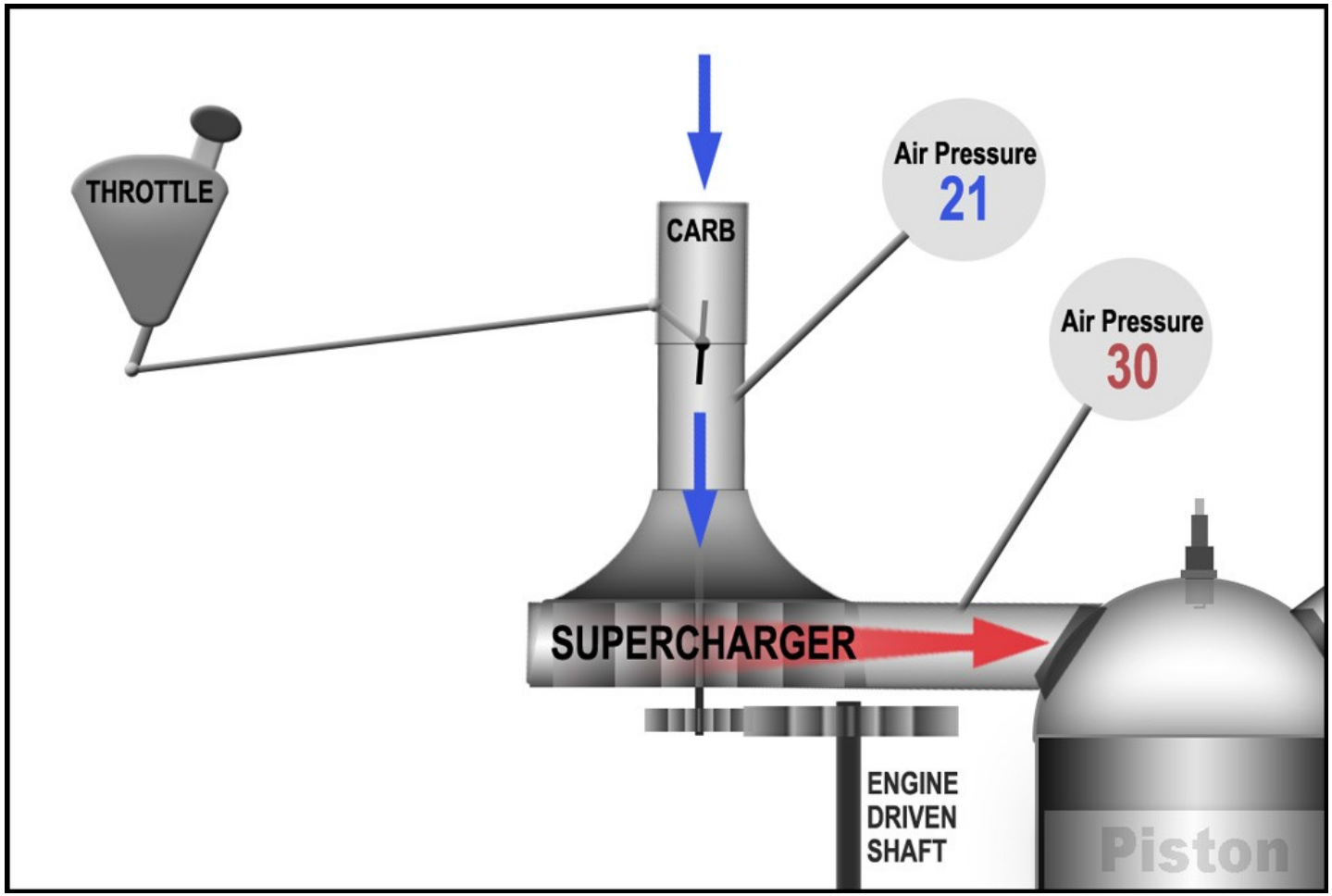
Now if you start the engine and idle, why does the manifold pressure go way down?
When your engine idles, it is being choked of air. It is given just enough air to sustain itself without stalling. If you could look down your carburetor throat when an engine is idling, those throttle plates would look 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 towards 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 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 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 opened. So if you turned your engine off, your manifold pressure would rise to the outside pressure. So on a standard day at sea level, our manifold pressure with the engine off will be 30".

So how can an engine produce more power at high altitudes where the air is so thin?
Since the power an engine can produce is directly associated with the pressure of the air it can take, at some point during your climb (above 10,000 feet or so), that engine will be producing so little power that the aircraft can no longer climb. This is the point where the engine can barely sustain level flight, and is considered the aircraft's service ceiling. A supercharger can raise this ceiling.

SUPERCHARGING

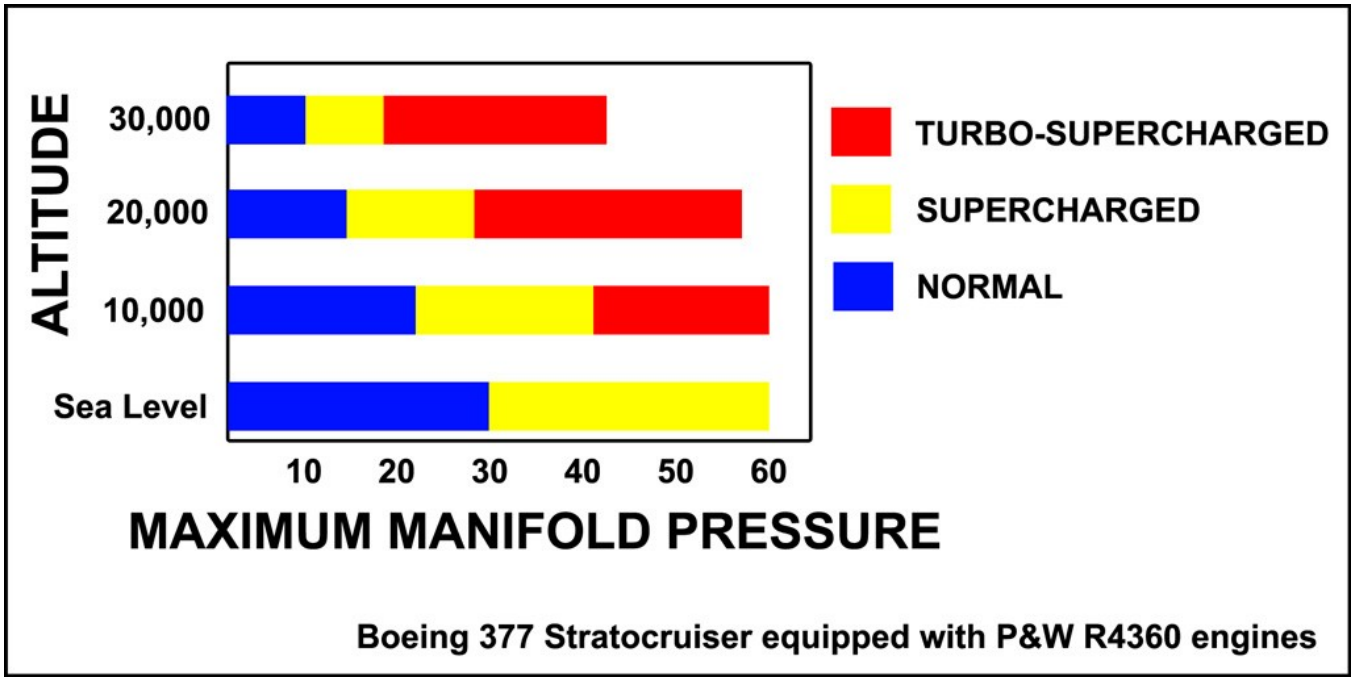
The supercharger has a powerful fan installed in your intake system that forces *more* air into the engine. As you fly higher and the air pressure decreases, your supercharger will help to compensate and keep air pressure higher than it would be otherwise.



Let's say while air pressure at sea level is 30", it is 21" at 10,000. At 10,000 feet, your supercharger fan pushes in more air to increases your manifold pressure to 30". Now your engine will produce the same power at 10,000 feet as it would at sea level. It would feel every bit as strong as it did when you took off.

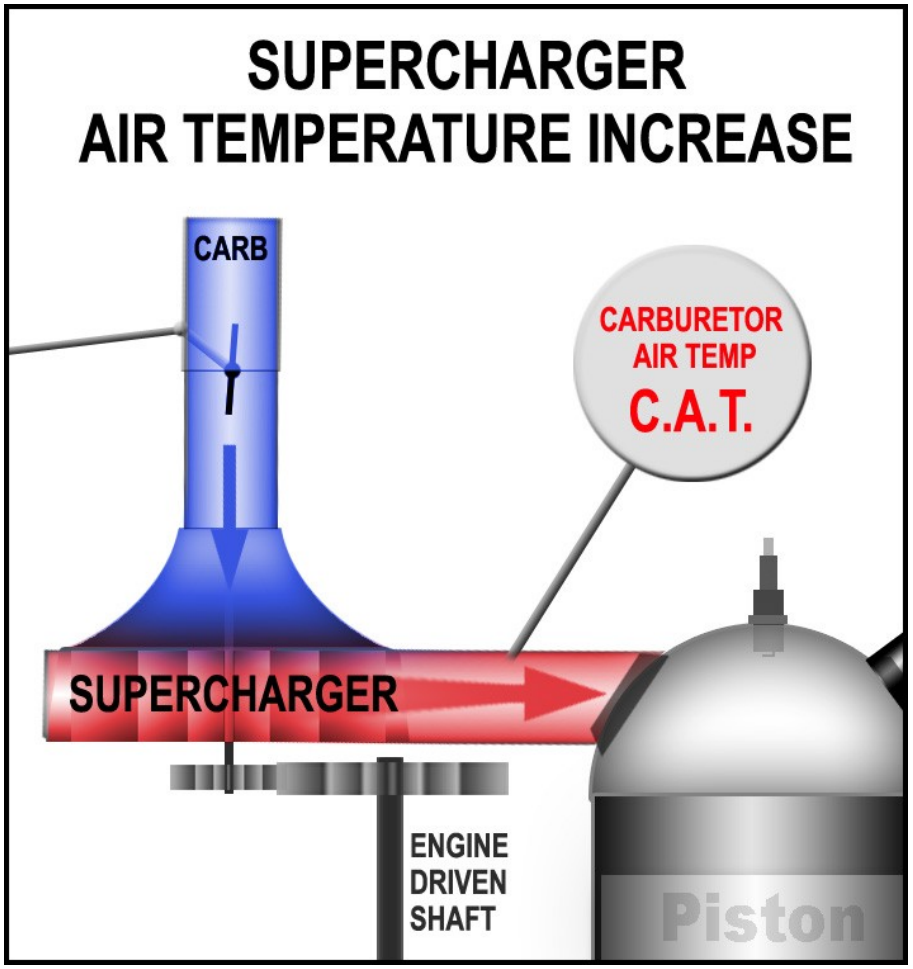
However, even a supercharger has its limitations. At some point, it will hit its own limit of how much air it can force and manifold pressure will again start to drop off. Some aircraft include a second stage supercharger, this is basically a HIGH / LOW gear. Some planes may automatically kick into HIGH at a certain altitude. When you hit this altitude, you will notice a nice punch of power. Other planes, like the Boeing 377, use both a turbocharger and a supercharger. A turbocharger does the exact same thing as a supercharger, except while a supercharger is driven directly off the engine by mechanical gears, a turbocharger is driven by the power of the exhaust pressure. This is where the term 'turbo lag' comes from. Turbo lag is the time delay after you apply power and before the exhaust has enough pressure to spin the turbo charger hard enough to push more air into your engine. The turbo, being driven off exhaust, is only applying power when the engine is *producing* power. So the turbo process is a cycle – engine power produces more turbo power that produces more engine power and so on. It's like rolling a snowball down a hill, this is your turbo 'spooling' up. Since the supercharger is gear driven, it moves perfectly in step with engine RPM – it's there and ready when you apply throttle.

While turbo and superchargers can be used to compensate for lost air pressure up high, they can also be used to *overboost* the power at sea level. This is called "ground boosting." Ground boosting adds more air pressure (and power) at sea level than would normally be available.



If you add power and see your manifold pressure rise above 30", then you have some form of supercharging or turbocharging adding more air into the engine than would normally be available. A normal engine that is producing 1,000 horsepower at 30" will produce 2,000 horsepower at 60", since it is twice the pressure. 45" produces 1,500 horsepower and so on.

SUPERCHARGING HEATS THE AIR



The downside to supercharging is heat. The more you compress air, the more the temperature increases, therefore more supercharging = higher CAT temperatures. The increase in temperature can be extreme. -40 deg air coming into the intake system can be 100 degrees hotter after it exists the supercharger. This is where your INTERCOOLER comes into play. The INTERCOOLER is a heat exchange, and is basically a radiator taking heat out of the incoming air. Use your INTERCOOLER FLAPS to transfer heat out of your intake manifold and out the flap doors. The more you open your intercooler flaps, the more heat you remove. Use your intercooler flaps to keep CAT temps nice and low for a strong and healthy running engine.

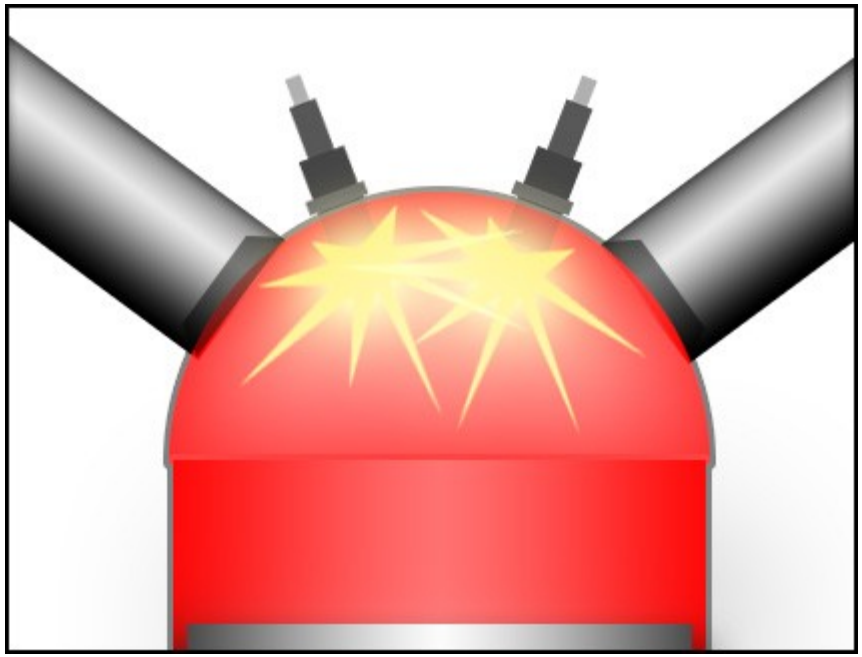
RAM AIR

Just like a drag racer with the big ram air scoop protruding from the hood, ram air uses airspeed to create more air pressure at the carburetor. If you are moving at a fast speed, and you open your RAM air flap, the air rushes in and increases the air pressure. For the Boeing 377, for example, flying at 150mph and opening your RAM air doors, will add roughly 15 psi of torque. Ram air is free power so use it often. The only time you would want to turn RAM AIR off is if you are going faster than the manual allows for using RAM air or if you are in icing conditions.

IGNITION

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

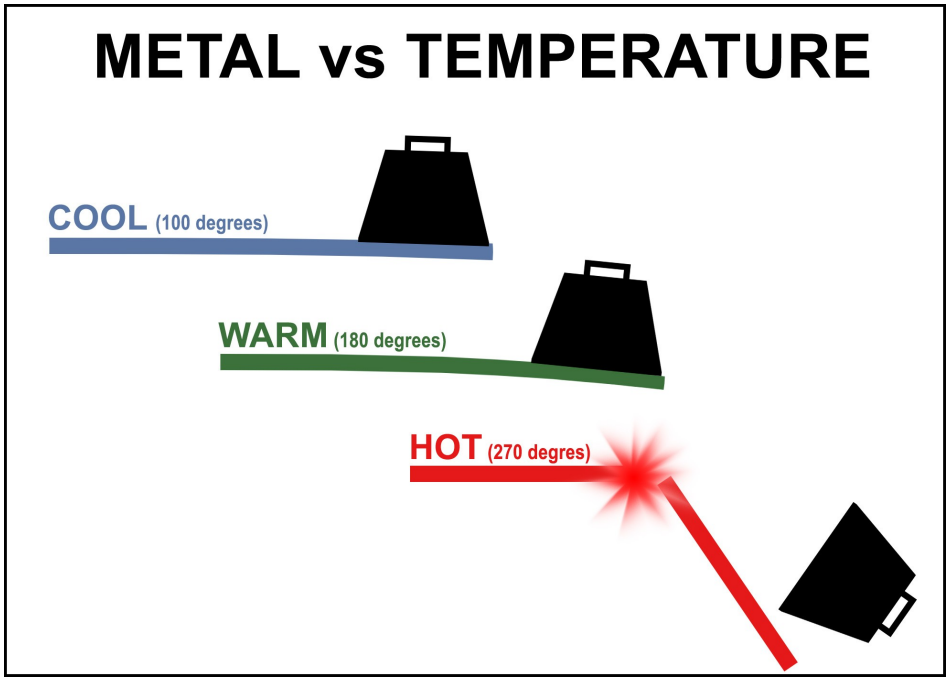
An added advantage to having two sparks instead of one is more sparks means a little more power. The pilot can select Ignition 1, Ignition 2, or BOTH by using the MAG switch. You can test that each ignition is working on the ground by selecting each one and watching your engine RPM. There will be a slight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



ENGINE TEMPERATURE

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

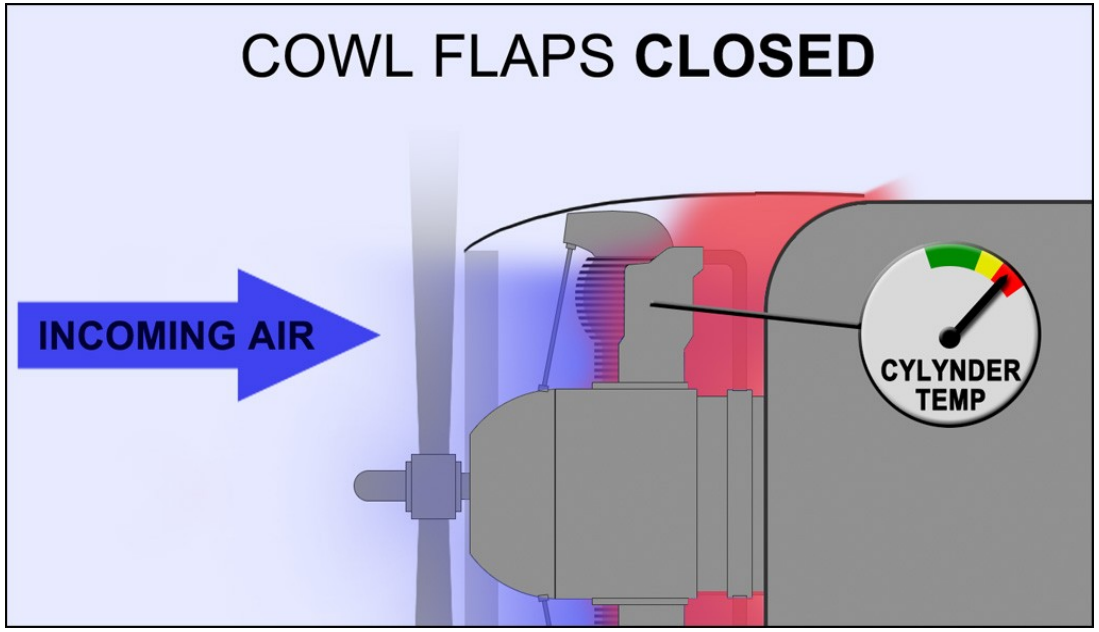
The hotter the metal, the weaker its strength.

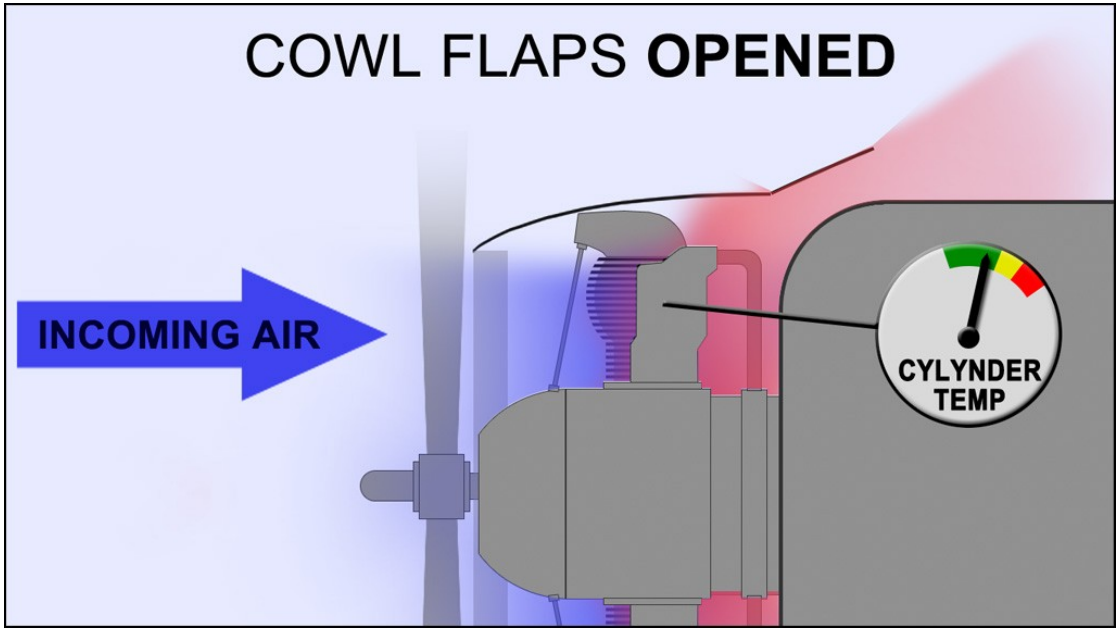


Aircraft engines are made of aluminum alloy, due to it's strong but light weight properties. Aluminum maintains most of it's strength up to about 150 degrees Celsius. As the temperature approaches 200 deg C, the strength starts to drop. An aluminum rod at 0 degrees Celsius is about 5X stronger than the 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.

CHT (Cylinder Head Temperature)

CHT is a measurement of the temperature in the back of the cylinder head. The combustion is happening right inside the cylinder head, so high power will increase temperature rapidly. The key is to watch and manage your cylinder head temperature by being aware of the outside air temp, keeping your speed up, and using your cowl flaps to control how much cooling is applied. The largest CHT rise will come from sitting on a hot ramp, just after takeoff, or in a slow and steep climb.



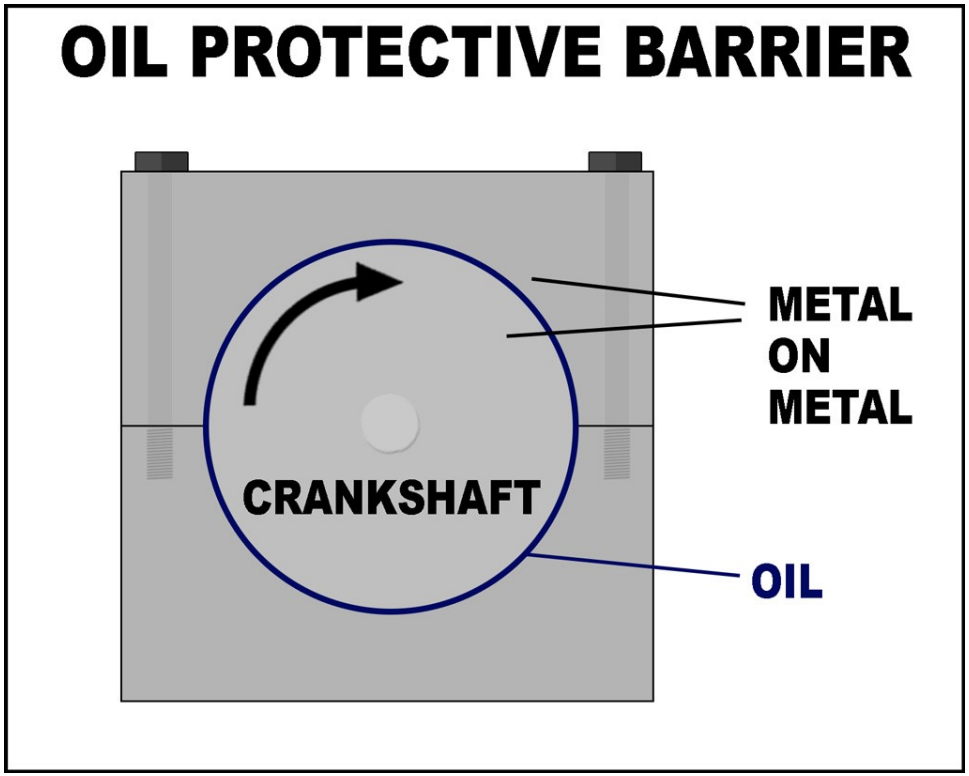


LUBRICATION SYSTEM (OIL)

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.

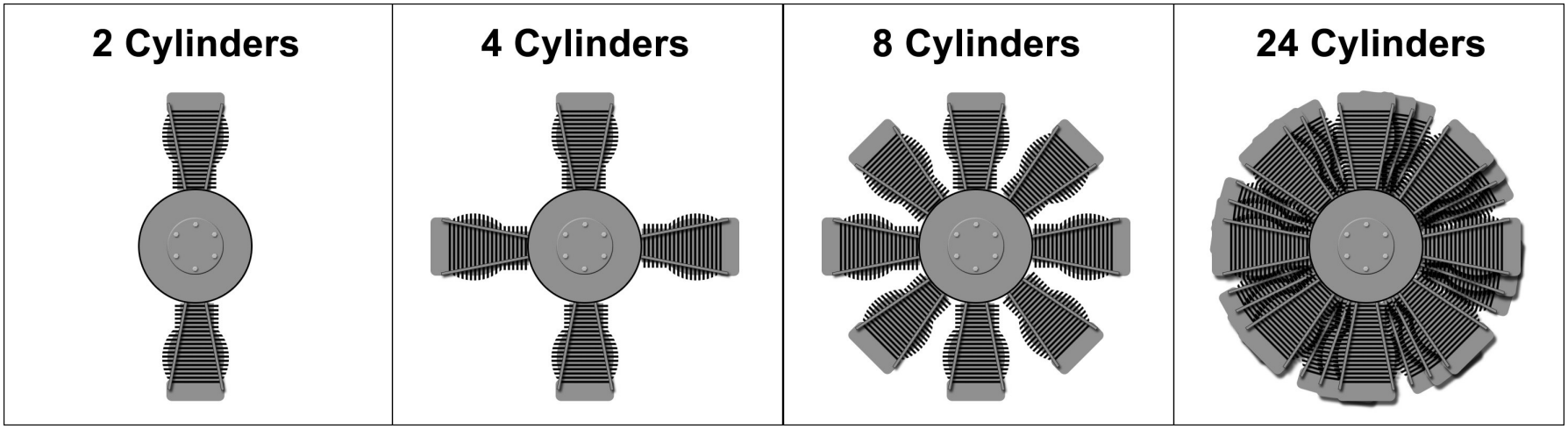
Below is a simple illustration of a crankshaft that is located between two metal caps, bolted together. This is the very crankshaft where all of the engine's power ends up. Vital oil is pressure-injected in between these surfaces when the engine is running. The only time the crankshaft ever physically touches these metal caps is at startup and shutdown. The moment oil pressure drops below it's 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.

Here 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 can get a direct flow of air.

The Pratt & Whitney R4360

Pratt & Whitney took this even further, creating the R4360, with 28 Cylinders. The cylinders were so run so deep, it became known as the "Corn Cob." This is the most powerful piston aircraft engine to reach production. There are a LOT of moving parts on this engine.

Torque vs Horsepower

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

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

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

Chapter 3: Accusim and the Boeing B377 Stratocruiser

Developed for:

Accu-Sim Expansion Packs

Accu-Sim Expansion Packs upgrade 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 very first pack has been created for our latest and greatest, Wings of Silver Boeing 377 Stratocuiser.

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 will result in a different experience. For example, you may notice one day an 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 real life. This is Accu-Sim - it puts the gauge back in the game.

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 Wings of Silver Boeing 377 Stratocruiser is a complete aircraft with full system modeling. However, flying an aircraft as large and complex as the Stratocruiser 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 the other engines. You may run a engine so hot, that it catches fire. However, it may not catch fire; it may just quit, or run really poorly. This is Accu-Sim – it's both the realism of all of these systems working in harmony, and also 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.

Why did we start with one of the worlds most complex aircraft, such as the Boeing 377 Stratocruiser? That question has been asked numerous times, and the best answer I can give is we all, at A2A Simulations, must be certifiably insane. This aircraft and the accompanying Accu-Sim system took every ounce of energy out of our team. We are now quite proud and relieved to be making the manual, for such an amazing product.

Your Crew Talks!

The Boeing 377 required a full crew to operate, so bringing them in with Accu-Sim was a priority for the success of this package. You typically will be moving back and forth between Pilot and Engineer, and sometimes shooting back to the Navigator's spot to look at your maps. For the most part, when you are Pilot, like the real pilot, you will need to manually fly the plane.

Your co-pilot is there to confirm things are being done. For example, he will let you know when your gear is up or down or the degree of the flaps just so you can keep your head out the window and fly the plane. He will also call out speeds as you takeoff, and even altitudes as you descend. This is what a real co-pilot does, and you will find him to be most helpful as your experience will simply be easier, and better. Your co-pilot will also warn you when you approach a dangerous limitation, like flying too fast with your flaps down, or perhaps just letting you know to turn your ADI on if you have forgotten. He will also let you know when you have really managed a great landing.

Your engineer is the heart of the plane. For the most part, you will need to be the engineer to operate the various systems. We have allowed him to take over the turbo system for you, so you can just use the single throttle for power. He will perform all turbo calibrations as well so all engines, assuming they are in proper working condition, run in synch. However, if your engineer warns you of an engine getting too hot, you should first ensure your autopilot is on then move to the engineer's seat and look over the systems. The auto pilot is a very simple and useful tool, probably even more so for a simulation, so make sure you know how to use it. Once you get the hang of it, you will be able to very quickly engage it, then pop in the back and take your time knowing the plane is under good control. You can also manipulate all engine controls from the engineer's station, and seeing that the plane for most of the flight will be using the autopilot, you may find you sit in the engineer's seat more than the pilot's seat for a full flight.

Be Prepared – Stay Ahead of Trouble

The key to successfully operating your 377 is to stay ahead of the curve, and on top of things. Your engineer will let you know well in advance so there shouldn't be any panic. Your crew watches many instruments and systems for you. We have included for you, the pilot, a little "Clipboard" panel where the engineer will list the hottest engine and turbo in the system. This is invaluable when you are flying the aircraft. You can keep this little window up and instantly see your most vulnerable system.

Key Systems To Watch

CHT (Cylinder Head Temperatures). This is a measurement of the actual cylinder heads in each of the 4 engines. This temperature is quick to heat up, and cool down (unlike your oil temperatures which take longer to change.) This is your most critical area to watch. Running these too hot can quickly result in catastrophe. Never let these temps get above 260 degrees, as you not only risk engine damage but fire. THE MOST COMMON MISTAKE for a junior pilot is FORGETTING TO REDUCE POWER AFTER TAKEOFF. If you watch your CHT temp during takeoff, through your little 2D Clipboard panel, you will see how fast those temperatures rise when full power is applied. This is why the Stratocruiser has a MINIMUM CHT TEMP BEFORE TAKEOFF of 150 Degrees. Most of the time, you should be well within this limit. If you simply follow common sense procedures, your engines should stay well within limits, and everyone should have a wonderful flight.

KEY THINGS TO KEEP CHT IN CHECK

1. Open Cowl Flaps to 3"
2. Reduce power immediately after takeoff to 49-51"
3. Do not climb too steeply to ensure adequate airflow – keep speeds over 150mph

CAT (Carburetor Air Temperature). This is the temperature of the air before it enters your engine. If it is too low, carb icing can occur. This is when you would close your INTERCOOLER flaps and turn your CARB HEAT ON. If CAT is too high, power will be much less. The biggest contributor to hot CAT is using your TurboSupercharger (high power or high altitude). The compressing of the air causes the temp to dramatically rise. Use your INTERCOOLER FLAPS to keep temps in check.

TURBO BEARING TEMPERATURE. As you climb, your turbos will work harder, and spin faster to continue to keep a good supply of air coming into your engine. The harder they work, the hotter those bearings get. Hot turbo bearing temperatures should not be an issue until you start to reach altitudes over 20,000 feet. If you are working the turbo lever yourself, you will need to be careful – you can't just run these turbos at full blast at high alt, as they will pretty much run too fast. There is a built in limiter that limits their speed for you to 22,000 RPM. This RPM is not available to you or the crew, but you can push these turbos to their maximum value only for about 15 minutes, according to the manual. You will notice, if you run them this hard, temps will eventually rise and you will have to back them off. A turbo lever value of 7 is a pretty safe max setting to keep in mind. Also, if you choose to ignore warnings and run these turbos well above their turbo bearing temperature limits, they could fail. A failed turbo at high altitude is serious, as it pretty much takes that engine completely out until you get to lower altitudes. Be careful, once a turbo fails, there is no getting it back until the ground crew can repair or replace it for you.

The turbo bearing temperature gauges should be monitored periodically while the turbos are in operation and temperature limits should be observed. The gauges will normally stabilize and indicate in the low or mid green range and may vary 10 – 15° C between turbos; however, this variation should remain constant. A variation of plus or minus 20° C on any one gauge from the next highest or lowest indication, respectively, is indicative of an impending turbo malfunction and eventual failure. A plus 20° C variation indicates rough turbo bearings or a slightly cracked nozzle box and that turbo should be shut down to prevent further damage.

The plus 20° C variation is only indicative of an impending failure. There may be a time lag of 5 minutes to an hour before complete failure occurs. If the mission requires high power on all four engines, and the turbo is left in operation, monitor the high reading gauge constantly for a rapid steady rise or a plus variation of over 30° C. If either of these indications should occur, the turbo must be shutdown immediately. A minus 20° C variation is indicative of a lubrication failure and that turbo should be shutdown to prevent further damage. There may be a time lag of 5 to 30 minutes before complete failure occurs. Usually the complete failure is preceded momentarily by a rapid steady rise in bearing temperature. If the mission requires high power on all four engines, and the turbo is left in operation, the low reading gauge must be monitored constantly for an indication of a rapid temperature rise. At the first sign of rapid rise, the turbo must be shutdown immediately.

RAM AIR. For the most part, you will want your RAM AIR to be ON. This simply ensures a nice flow of air into your engines. If RAM AIR is OFF, your turbo charger will have to work harder to produce the same power. If you are operating in icing conditions, you may want to turn your RAM AIR OFF at least until your CAT is in the green.

OIL TEMPERATURES. Oil temperatures will rise based on your power levels and RPM. Your oil cooler flaps are set to AUTO by default. They will open and close automatically to regulate the oil temperature for you. You can manually adjust these if you see fit, but for the most part, AUTO works well as intended.

ADI (Anti Detonation Fluid). Your ADI is basically water injected into the engine to keep temperatures down, so you can push the engine harder (run higher manifold pressures). If your ADI is OFF, and you are applying HIGH POWER, your engine will automatically enrich the mixture to a RICH RICH to keep engines cooler. You will notice black smoke under these conditions. Do not be alarmed, but be aware you should never apply FULL POWER with ADI OFF. Doing so can cause permanent engine damage.

ENGINE HEALTH. Every time you load up your Accu-Sim Stratocruiser, you won't get a carbon copy of the last one. Things will sometimes be different. This means you may get 4 beautiful engines that operate very close to each other but most of the time, they will all have differences. This is simply the way it was and is in any multi-engine piston aircraft. The gauges are never the same. There are just too many moving parts, variables, changes, etc. that continually alter their condition. Sometimes however, you may find only after you takeoff that one engine is not really up to par with the rest. It may be running too hot, or may just not be producing the same power. You will need to learn to keep an eye on that one engine until you get your plane on the ground so it can be looked at by maintenance.

Signs of a damaged engine may be lower RPM, lower torque values, lower manifold pressure, or possibly hotter engine temperatures.

ENVRONMENTAL SOUNDS. Microsoft Flight Simulator X, like any piece of software, has its limitations. Accu-Sim breaks this open by augmenting the sound system with our own, adding all kinds of little sounds to make things more believable, from running the defroster to turning on the seatbelt sign to scaring your passengers (and crew). We really enjoyed making these sounds.

LANDINGS. 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 the passengers just may be so impressed they applaud. This landing system part of Accu-Sim makes every landing challenging and fun.

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 Wings of Silver Stratocruiser, 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.

CREDITS

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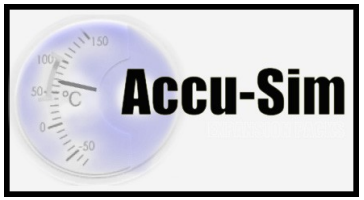
WINGS of SILVER
Stratocruiser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