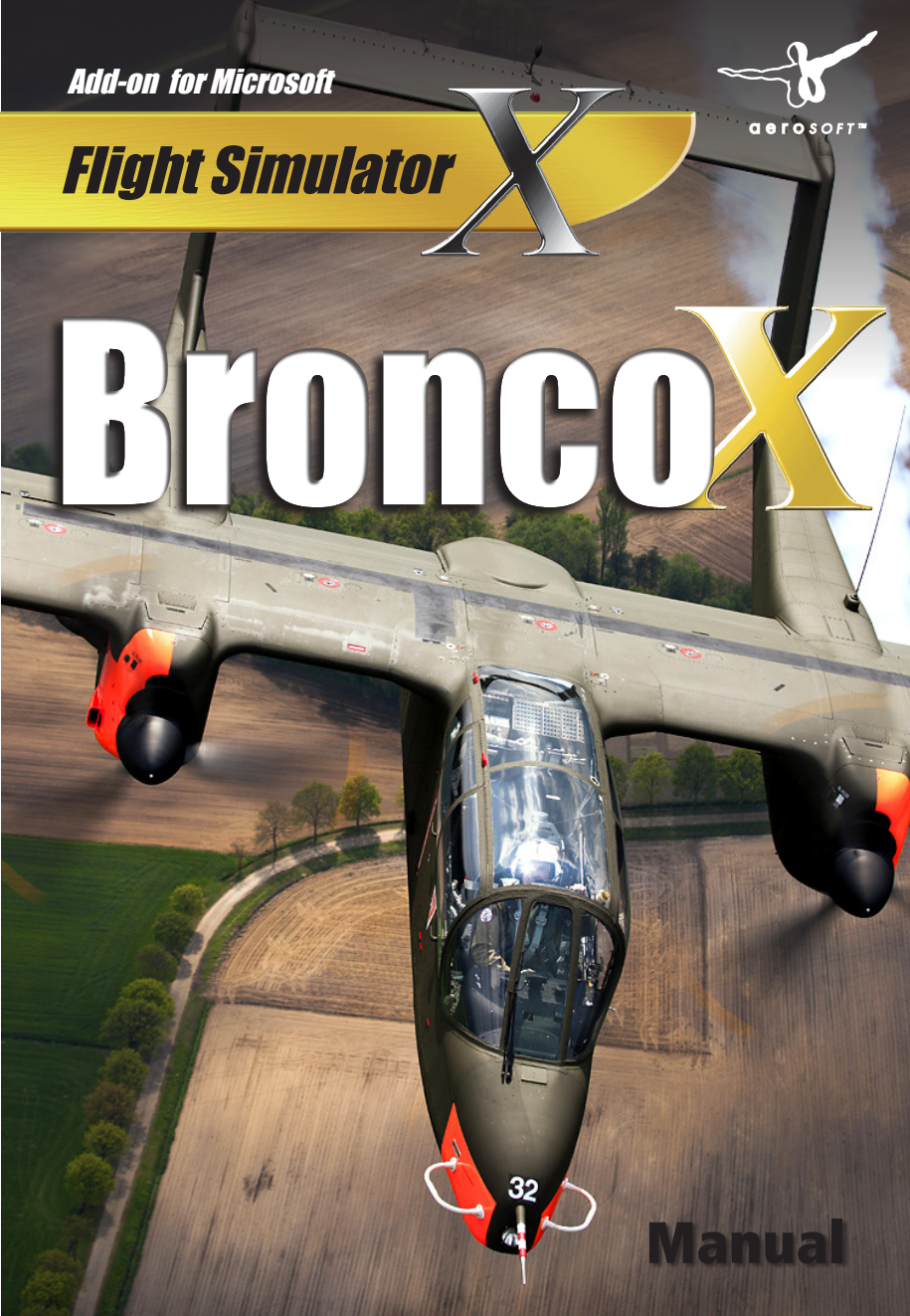
Add-on for Microsoft
Flight Simulator X
aerosoft™
BroncoX
32
Manual

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Images:	Nick Churchill
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Testing:	Several good folks who will all be getting a free copy

A special thanks to the OV-10 Bronco Association, German Wing, very cool people (Tony DeBruyn, Thomas Viertbauer, Tom Houquet, Michael Vaeremans, Peter Junior, Heinz-Dieter Rheinländer, Ela Gedl, Markus Rheinländer) who fly a very cool aircraft. Without their help this aircraft would not be half as good.

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BroncoX

Manual

Add-on for

Microsoft Flight Simulator X

Content

Introduction

Almost all aircraft designed for a COIN (counter-insurgency) are great fun to fly. They have to be sturdy and have loads of power to get out of trouble and they also have got to be agile and easy to fly low to the ground. So they are all the opposite of airliners that draw straight lines high in the sky, they feel most at ease when the hug the ground and pull G. The OV-10 Bronco is perhaps the finest example of this class of aircraft.

The Bronco has its roots deep in the 1960s when most military aircraft were getting bigger, more complex and way faster. These aircraft did not work well in harsh conditions found in jungles and even on carrier decks. The concept of a rugged close air support aircraft that would be ideal to operate in limited scale conflicts and operate from improvised airfields was proven by the Cambodia and Vietnam conflicts that were developing at the time. The North American (later Rockwell) developed the concept into prototypes that were soon in service with the U.S. Marines Corps, U.S. Air Force and the U.S. Navy. In Vietnam the aircraft was introduced in a Forward Air Control role, guiding large attack aircraft onto targets but soon the Bronco's went into battle with a large array of ground attack weapons. Medium bombs, rocket and gun pods all proven to be effective and even Sidewinders against air targets were used. To increase loiter time over 'Indian' country external fuel tanks were added. All this additional weight and drag caused the aircraft to feel underpowered, even though it has ample power when it is flown without external stores.

The Bronco has a small fuselage but if comfort was not important and the backseat removed it could carry 5 passengers. In fact the Bronco was soon used in every possible role. It was one of those aircraft that seemed to grow in potential over time, and as can be seen with other aircraft (the A10 Warthog for example) it seems hard to find a modern replacement. That's why there are still plans to build a updated version using the same basic design. When the Bronco was pulled from front line duty it was still in demand in military and civil roles.

Countries like Colombia, Indonesia, Philippines, Thailand, Venezuela, Lebanon and Germany used them for many tasks including drug interdiction, firefighting and target tugs. Many are still flying and they are welcome guests at airshows with their distinct shape and sound.

Our standard version is based on the OV-10B that was last in service in Germany as a target tug (dragging air targets for other fighters) and now fly as part of the German Wing of the OV10 Bronco Association (GWOBA). That organization and especially its founder Tony De Bruyn and press Officer Markus Rheinländer cannot be thanked enough. Do visit their website at http://www.germanwing.de/Start.htm.

System Requirements

- Windows XP, Vista, 7 (fully updated)
- Microsoft Flight Simulator FSX (with SP2 or Acceleration Pack)
- Dual Core CPU
- 2 GB RAM internal memory
- 512 MB graphic card
- Adobe Acrobat® Reader 8 minimal to read and print the manual (1)

(1) Available for free, download at: http://www.adobe.com/prodindex/acrobat/readstep.html

Contact Support

Support for this product is offered by Aerosoft. We prefer to have a support forum for the simple reason that it is fast and efficient because customers help customers when we are sleeping.

There are special forums for this product at: http://forum.aerosoft.com/index.php/forum/474-ov10-bronco/

We feel strongly about support. Buying one of our products gives you the right to waste our time with questions you feel might be silly. They are not.

Versions

The Broncos came in various variants:

- OV-10A - Original production version
- OV-10B - German broncos used as target tugs (the Aerosoft Bronco cockpit is based on this version)
- OV-10C – Export version for Thailand
- OV-10E – Export version for Venezuela
- OV-10F – Export version for Indonesia
- OV-10D – Second generation Bronco with modernized systems

Specifications(OV-10A)

Crew:	2
Length:	41 ft 7 in (12.67 m)
Wingspan:	40 ft 0 in (12.19 m)
Height:	15 ft 2 in (4.62 m)
Wing area:	290.95 ft² (27.03 m²)
Empty weight:	6,893 lb (3,127 kg)
Max takeoff weight:	14,444 lb (6,552 kg)
Powerplant:	2 × Garrett T76-G-410/412 turboprop, 715 hp (533 kW) each

Performance

Maximum speed:	281 mph (452 km/h)
Range:	576 mi (927 km)
Service ceiling:	24,000 ft (7,315 m) even though 18.000 ft seemed always more accurate

Armament

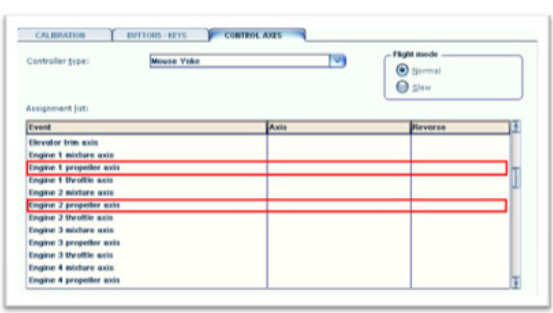
Guns:	4 × 7.62x51mm M60C machine guns
Hard points:	5 fuselage and 2 under wing and provisions to carry combinations of:
Rockets:	7- or 19-tube launchers for 2.75" FFARs or 2- or 4-tube launchers for 5" FFARs
Missiles:	AIM-9 Sidewinder (Wing pylons only)
Bombs:	Up to 500 lb
Other:	SUU-11/A or Mk 4 Mod 0 gun pods

FSX Limitations and Settings

Unfortunately FSX has some limitations that are hard to overcome, it also has some bugs that that are simply not possible to avoid. Some limitations (like Landing Lights and the complete Electrical System) have been circumvented by replacing what FSX has to offer and writing our own code, but some other things are not so easy. We like to mention them.

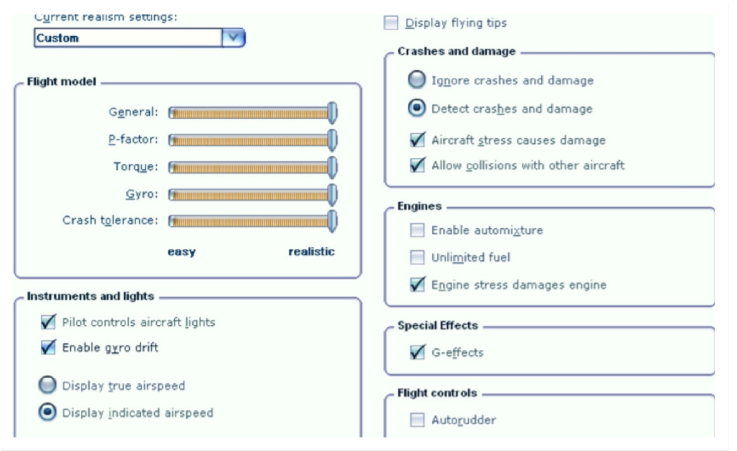
Almost all lights are not very solid in FSX. They always seem to wander around the airframe. Even stranger, this effect depends on where you are on the globe. We have avoided this effect in some cases by not using effects but modeled 'balls' of light. These are not easy to see at long distances but look better close up.

The sound is a special problematic area for this project because FSX does not know this type of engine. When we would have used the standard turboprop sound the startup would be rather unrealistic as the propellers would be heard while they would not be moving. So we are using a combination of FSX sounds and some played by our own sound module. We even switch off the default FSX sound during start-up otherwise it would be even more problematic. So don't worry if you see the SOUND OFF message appear for a moment.



The OV-10 Bronco does use special coding to handle the props and the Engine 1 propeller axis and Engine 2 propeller axis should be left unassigned in FSX. If you do have hardware assigned on those axis leave the levers fully forward when using the Bronco.

We decided not to model the back seat as it really is useless in FSX. You can't fly the aircraft from there as visibility is almost zero. Note that the aircraft is now mostly flown with just the pilot. The Bronco does not have an Autopilot but we left the standard FSX Autopilot key commands on so when you do need to make a long flight you can use it. We strongly recommend FSX REALISM settings as shown in the image. If you prefer to fly without rudder activating the Autorudder is an acceptable option.



Because this aircraft is modeled with detailed system using a non-standard startup situation could cause some systems to be in an incorrect initialization state. We provided a startup situation called Aerosoft - OV10 Bronco that places the aircraft at the airport where it is normally found (Wevelgem Belgium) with all FSX settings as they should be. Feel free to change the weather and location but do not change any of the other settings.

To handle some of the more complex systems we need to overwrite certain parameters in FSX. This causes the standard select engine and select doors commands to be less reliable. We added a small panel that can be called up with [SHIFT] + [4] that makes these functions easy to access.

The Bronco does not have a standard spoiler system so we took advantage of this to include an invisible spoiler that makes ground maneuvering and STALL landings far more realistic. If you notice that you are not able to reach sufficient speed in flight (at least 200 knots without any problem) check if there is you have the spoiler assignment handled by FSUIPC or have it linked to a hardware button. In the air the code will set the spoilers to retracted a few times every second.

Flying the Bronco

You will find that the Bronco is an amazingly easy aircraft to fly; it has almost no nasty features you should be aware of. There are however a few things that are special. For starters the very wide speed range, it has been clocked at 400 knots (okay that is over the 350 knots red limit and in a dive) and with full flaps it will land at 44 knots (!) without problems. It will basically feel very happy at any speed between 100 and 300 knots. If you consider the role of the aircraft it makes sense. It needs to get somewhere fast and then loiter for as long as possible. That loitering was often done at low altitudes and between the trees and hills where the aircraft seems to be happy. As long as you keep in mind the engines need a bit of time to spool up (and the aircraft is not loaded up with weapons) you will have ample power to get out of tricky situation.

The German OV10 Bronco we used as our base model flies at many airshows and it used to fly this demo in 2010:

1. Take off360° climb
2. High speed pass followed by a 45° steep climb
3. Slow speed pass with landing gear down
4. Top side pass
5. Horizontal 360° turn
6. Bottom pass
7. Wing waggle
8. Stoll Landing

Don't be afraid to pull some G in the Bronco, it loves tight turns. It also loves steep dives. As one Bronco driver told us:

"…very much a pilot's aircraft. Named after a type of horse and that makes a lot of sense. You sit in it like you sit on a horse, in a very high seating position with great visibility all around and it seems to understand what you want to do. A good Bronco driver can put her anywhere he likes in any attitude. It's a shame they are getting old now and the pilots have now got more sense than we did. We pulled stuff you will never see at airshows now and most of my friends landed after all that. If you lose an engine though, better be prepared to bail out because things get out of hand real fast."

Tony de Bruyn, who has to be one of the current Bronco pilots with the most experience, sent us this when we asked about what it is like to fly this aircraft:

"Flying the Bronco is like feeling to be on top of the world, such is the fantastic view all around, the responsiveness on the controls, the speed range and its versatility. There seem to be no limits in where you want the aircraft to take you and it does it in such a way that you are continuously wondering whether the airplane is reading your mind rather than you making control inputs. It flies with such magnificent ease that one soon feels very privileged in handling the thoroughbred and bring the very best out. Some additional personal comments/ thoughts. The people at NAA were probably at the pinnacle of airplane development at the time when the Bronco was conceived in the mid 1960's:

- The engineering is out right brilliant - no doubt building on a long and highly successful legacy (just to name a few: AT6 Texan, P51 Mustang, B25 Mitchell, F86 Sabre, X15, etc...)
- The flying characteristics are just magnificent; unbelievably well harmonized and light controls throughout the full speed range from 70 to 350 KIAS (note: KIAS), very direct and snappy response to control inputs make it very well liked by everyone who ever got their hands on it.

- Operationally the Bronco is incredibly versatile feeling at home in and out of any environment - jungle to dessert, unprepared dirt strips, carrier deck, you name it, it has been there...
- Maintainability; it was designed to be maintained out in the field with just a standard tool set at hand, no special tools are required.
- Even when it came to giving the airplane a name, they absolutely got it right: bronco: A wild or half-tamed horse, esp. of the western U.S. From Spanish, literally 'rough, rude.' The Bronco is not too large, just as the wild horses out on the prairies. It's got a little way of it's own, but in a good natured way; you will need to keep it in control - tame it - all the time but this is easily done.
- It's got a purposeful rough appearance, some say it's beautiful others think differently. It definitely has got CHARACTER and it shows!

A very likable airplane altogether and I have never come across anyone who has expressed any dislike or displeasure about the OV10 Bronco, which is probably also unique and a good indication of its quality."

If you want to get an idea how the Bronco should be flown, check out this video: http://player.vimeo.com/video/28244509. It shows the Bronco in its element, flying low and fast, twisting and turning.

What ever you do, don't be hung up on charts and speeds. The Bronco will tell you when it is about to stall (keep an eye on the airspeed indicator, before the stall happens the buffeting airstream will make it jitter) and when it wants to fly. One mistake however that is easy to make is to lose too much speed at landing, although you can fly at very low speeds it is strongly advised to stay over 100 knots. See the landing chart that is added at appendix A. Also listen to the aircraft, you hear the airframe groan when you put G-load on it, the wind noise will give you good indications on the speed.

The Garrett Turboprop Engine

The turboprop model in FSX is poorly modeled, the same is true for torque and EGT readouts from FSX. Air-starting the engines by wind milling is not featured by FSX, but through coding around the FSX "engine", we managed to correct all these deficiencies.

The turboprop available in FSX is based on the Pratt and Whitney PT6 type of engines. The PT6 is a free turbine engine. This means that the core engine - the gas producer is a self-sustained gas turbine. The propeller is driven through a gearbox connected to a separate turbine placed after the gas producer. This means that the gas producer is allowed to start and spool up independently of the propeller and it´s turbine. Since propeller blade pitch angle is controlled via a hydraulic governor, which uses engine oil pressure, the propeller will move into feathered position when engine oil pressure is lost or if the condition lever is moved fully back into the SHUTDOWN and FEATHER position. A feathered propeller needs a huge amount of torque to overcome the drag when spinning. Since a free turbine turboprop allows the gas producer to spool up without turning the prop, sufficient engine oil pressure will build up to un-feather the propeller.

The turboprop engines used on the Rockwell OV-10A Bronco are the Garret T-76 types of engines. They are known as single shaft geared turboprop, in which there is no separate turbine for the propeller. This means that the propeller is directly linked to the gas producer via the gearbox. With a feathered propeller, the engine starter will have to both turn the gas producer as well as the propeller up to speed during start up. As explained, a feathered propeller needs a lot of torque to overcome the drag induced when the propeller starts spinning. This is not desirable. To prevent this, a mechanism called Start latches are built into the propeller. The start latches locks the propeller blades in their beta range so with flat pitch position (between full fine and reverse). In that position the propeller blades produce very little drag, but also no forward thrust - or at least very little.

To engage the start latches, the pilot needs to pull the throttles into the reverse range right after shutdown of the engines but before Ng RPM drops below approximately 50%. This will keep the propeller blades in the beta range enabling the start latches to "snap in" and lock the blades. To disengage the start latches, the pilot only need to move the throttle into reverse range after engine startup has occurred and Ng RPM is above approximately 60%. Throttling up with start latches engaged will be noticed because of the lack of forward thrust and little torque readout on the gauges.

In the case where the pilot fails to move the throttles into reverse range, the propeller will feather, just like on the free turbine types of engine. In such cases the propellers will need to be un-feathered. This is done via the Airstart switches. The airstart switches have 3 positions CRANK, AUTO, ON. AUTO is the normal position and will automatically control fuel and ignition in accordance to the engine RPM sensing switches. CRANK will turn on a pump called the un-feather pump. This pump supplies oil pressure to the propeller governor forcing the propeller blades towards full fine and beta range - no fuel or ignition is introduced. Crank is somewhat misleading - it won´t crank the engine by the Starter, but merely points to the fact that in air, the un-feathering of the propeller will cause these to start wind-milling. ON means that the un-feather pump as well as fuel and ignition is introduced for an air-start. After un-feathering / air-start the Airstart switch must be returned to AUTO. Note the Bronco has two additional ignition switches for continuous ignition.

The description might sound complex, but is actually very straight forward. For starting the engines on the Bronco follow this procedure:

- Power levers: GROUND IDLE
- Condition levers: SHUT OFF (NOT SHUT OFF & FEATHER)
- Primary DC bus: POWERED (BATT DISC & BATT MAIN SWITCHES ON OR GRND PWR ON)

If propellers not feathered:

- Start switch: ON
- At 10% Ng RPM : CONDITION LEVER NORMAL FLIGHT

If propellers feathered:

- Power levers: MOVE INTO REVERSE RANGE
- Airstart switch: CRANK
- Prop at flat pitch set
  Airstart switch: AUTO
- Power Levers: GROUND IDLE
- Start switch: ON
- At 10% Ng RPM: CONDITION LEVER
  NORMAL FLIGHT

Failures

The engines in the Aerosoft OV-10 Bronco will fail if they are not treated with respect. They are very well maintained but they are a few decades old, so be nice to them. All failures can be switched off in the checklist configurator.

- Engine flameouts might occur when flying in icing conditions without having switched on the continuous ignition switches.
- Starter motors will fail if run too long with feathered propellers due to over torque.
- Continuous torque should be limited to 1875 foot/lb and only exceeded for short amounts of time. When this limit is exceeded the chance of a failure increases dramatically. Keep in mind the overtorque warning light will only be lit at 2200 foot/lb so do not wait for them to light up.

- Another source for engine failure is overheating. To monitor engine temperatures there is a EGT gauge for each engine. During startup they show EGT (Exhaust Gas Temperature), but when Ng (RPM) passes 50% they shift to read TIT (Turbine Inlet Temperature). EGT is measured with a probe in the exhaust gas, while TIT is calculated from EGT, since no probe would last very long at the TIT temperature. The TIT is further altered by the SRL computer (Single Red-Line) also called the "Pilot Lier", since the temperature shown is different from the real TIT. Under ISA conditions the T76 engines are limited by torque until approximately 17.000 feet where Max Allowable EGT normally is reached). With higher OAT this altitude becomes lower. To be honest, the Bronco is not happy when flown that high, it's an aircraft designed to be flown low. Max Allowable EGT is not a fixed value, but is a function of Ng (RPM), OAT, Altitude and Airspeed. Using EGT to determine if you are running the right temperatures is complex and involves many tables and charts. That's where TIT with the SRL correction comes is, Max allowable TIT, compensated by the SRL, is always approximately 1000 °C , so the pilot only needs to verify that the needles don´t get higher than that. The TIT Warn lights are also set to light at 996 °C. Some Broncos (the German OV-10B's for example) were later changed to always display EGT, but still have the TIT warn lights that will light when the temperatures are too high. Keep an eye on these lights. They are important.

Accumulative Engine Wear

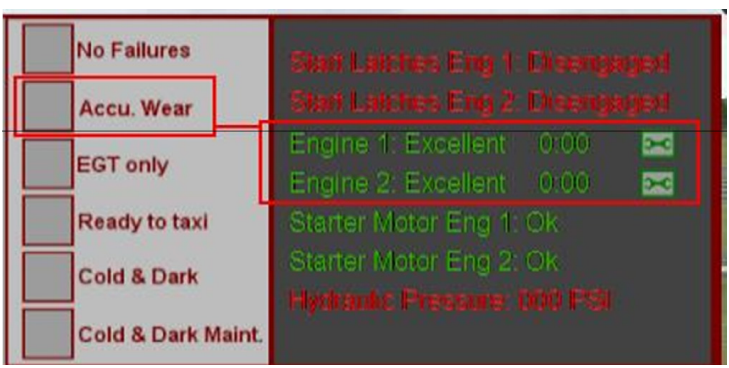
If this option is enabled the engines will start to wear. They will degrade over time by this schedule:

- 0-80 hours = Excellent
- 80-120 hours = Good
- 120-140 hours = Ok
- 140-160 hours = Poor
- 160 -> hours = INOP (not functional)

This schedule only holds true if the engines are operated within their limits. This means that the engines won´t be over torqued or overheated! If they are being run outside their limits the degradation happens faster as a function of how much and how long they have been run above their limits. With increased degradation the engines will start to run hotter over time until INOP state is reached, then they will stop running and cannot be started.

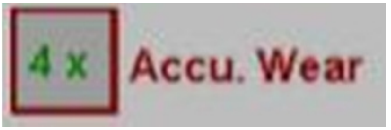
The real Bronco has a time between overhaul at 1600 hours (Some even extended to 3400 hours). Since no flightsimmer ever well reach that figure this time has been reduced to 1/10 of this i.e 160 hours. This is still a lot of flight simming time, and since degradation happens exponentially you won´t see any change before reaching 80 hours.

For those who want to speed up degradation further the option has been added to decrease this time even further by selecting 2x or 4x this rate. This option is disabled by default. To enable – click to cycle between disabled, 1x, 2x & 4x.

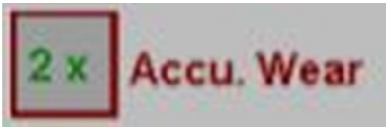


On the above figure the selection box labelled "Accu. Wear" can be seen. It is disabled. Engine health state can be seen to the right together with their operating time Hours:Minutes. Clicking on the small "Wrench" symbol for each engine will overhaul it and reset the timer. The Wrench symbol will also repair the engine(s) if they have failed and reset the fire extinguishing system for the affected engine.

When the "No failures" checkbox is checked the engines will not stop running and can still be started, but the EGT gauge will still show the increased operating temperature due to degradation. When clicking the "Accu. Wear" checkbox the following symbols will appear instead of a checkmark:



Symbol for normal wear (0-160 hours)



Symbol for 2x wear (0-80 hours)

Symbol for 4x wear (0-40 hours)

When you use the engines correctly you should be able to reach the 160 (or 80 or 40) hours without much problems. Your mechanics will love you.

Electrical System

One of the most important systems of an aircraft is the electrical system as most parts of an aircraft rely on electrical supply, such as fuel pumps, hydraulic pump, engine controllers, various instruments and radios as well as lighting. The electrical system has faithfully been simulated in the Aerosoft OV-10 Bronco. The default FSX electrical system has been scrapped and replaced by our custom coded system. Everything that depends on electricity, down to the smallest light bulb, will add a load to the system.

The main type of electrical power supply on the Bronco is 24VDC. This is supplied from the two batteries, the two generators or ground power. The generators also act as engine starter motors. To manage the power distribution, the electrical system is divided into several busses (busbars). This is also done to preserve electrical power in the event of generator failures. For example the secondary bus, supplying non-essential systems as lights and radios will be turned off if both generators fail. The generators, which also act as starter motors, and can fail if not used right.

Some equipment requires 115VAC. This is made available by converting 24VDC into 115VAC through the inverters. The Bronco has two inverters, one primary and a backup inverter. Both are powered under normal conditions though.

Battery Busses

Primary DC bus 24 VDC:

- Start ignition advisory light
- Engine fire warn sys
- Fuel boost pumps
- Hydraulic pump
- Gear / Flap indicator
- Alternate flaps
- Unfeather pumps
- Pitot heat
- Windshield wiper

- Smoke generator
- Trim motors
- Trim indicator
- Warn and caution lights
- Turn and Slip indicator

Start Control DC bus 24 VDC:
- Engine 1 Utilities
- Engine 2 Utilities
- Engine 1 Starter
- Engine 2 Starter
- Engine 1 ignition
- Engine 2 ignition
- Fuel shutoff valves

Secondary DC bus 24 VDC:
- Landing lights
- Taxi lights
- Formation lights
- Position lights
- Anti-collision lights
- Panel lights
- Communication radio
- Nav radio
- ADF radio
- Transponder

Monitored DC bus 24 VDC:
- Yaw damper

Primary AC bus 115 VAC:
- Attitude indicator
- Standby Attitude indicator
- Fuel quantity indicator
- Engine 1 EGT indicator
- Engine 2 EGT indicator

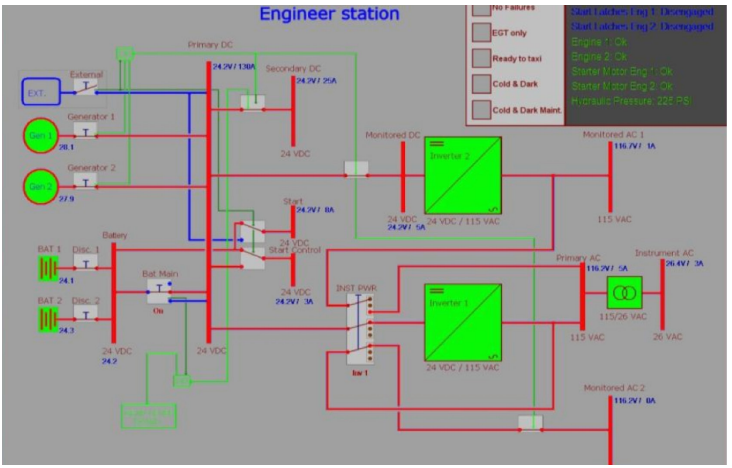
Monitored AC 1 bus 115 VAC:
- TACAN
- Strike camera

Monitored AC 2 bus 115 VAC:
- TACAN (Alt pwr)

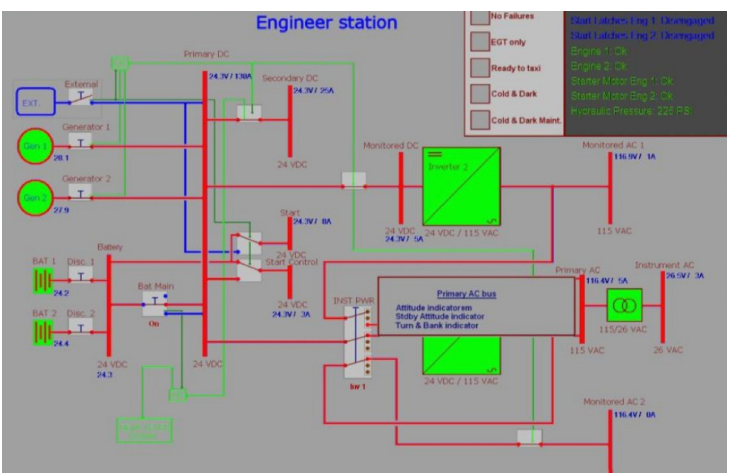
Instrument AC bus 26 VAC:
- VOR/ILS indicator
- Directional Gyro/VOR/ADF ind.
- Marker beacon
- Engine 1 torque indicator
- Engine 2 torque indicator
- Oil pressure indicator

Engineer Station Gauge

During the development of the Bronco it was hard to understand exactly how the system interacted so the systems coder Finn decided to make a simple schematic instrument that shows how it works. We have gotten so used to it we decided to keep it in the released code. We even decided not to make it look refined so you get an idea of how we code these complex systems. You can open it with [SHIFT]-[3] and when you move your mouse over the switches and busses you will see where you can click. Most switches can be operated (sometimes with left and right mouse buttons) and when you click on a bus (vertical thick red line) you will see what's connected to it. When a bus or supply "string" is unpowered it is blue, while being red when powered. Actual voltage and ampere load can be read for each bus as well as batteries and generators.The best way to see it in action is to open it, select Cold & Dark and then select ready to taxi. The aircraft will go through the whole startup sequence and you see the generators and busses come online. When all is running, start disconnecting things and see how the systems are affected. The real Bronco drivers would have loved something like this!



In the upper right corner various engine related items can be checked for their state. There are also checkboxes for setting aircraft state and user preferences like found in the Interactive Checklist gauge. When clicking on the various bus bars a list with the equipment that it supplies will be shown as long as the mouse button is pressed.



Fuel System

The fuel system consists of two inboard, two outboard tanks and one center tank plus an optional external fuel tank. Fuel from the outboard tanks flows to the inner tanks and then both inner tanks feed the center tank all by gravity. From the center tank is pumped by the engine driven boost to the low/high pressure fuel pumps. These supply the fuel control units that feed the engines. Fuel from the optional external tank is pumped with an electrical transfer pump to the centre tank. The external fuel transfer switch operates the transfer pump at about 845 pound an hour. When all internal tanks are full and the transfer pump is used the fuel is dumped via the wing tank vents. Normally the transfer pump is started when the wing tanks are partially emptied and then used for half an hour. Do not forget to switch it off, there is no indication about the quantity of fuel in the external tank!

CAUTION: As part of the system uses gravity it has only limited inverted capacity.

The fuel quantity indicator indicates the weight of the fuel in pounds x 100 in part of the fuel tanks depending on the setting of the fuel gauge select switch. In the FEED position it shows the weight of the fuel in the centre feed tank. At INT setting the weight of the fuel in the internal wing tanks is shown Note the 230 gallon external tank does NOT have any indication so the EXT setting will show zero., the EXT setting on the fuel gauge does not function with this tank. The fuel gauge test button will rotate the needle fully clockwise and counter clockwise to indicate full freedom of movement.

	TANK CAPACITY		USABLE	
	GALLONS	POUNDS	GALLONS	POUNDS
WING OUTBOARD	75.3	489	72.4	471
WING INBOARD	134.5	874	130.6	849
CENTER / FEED	37.1	241	36.0	234
EXTERNAL	230	1494	220	1427
TOTAL	476.9	3098	459	2981

The FUEL EMERGENCY SHUT-OFF switches cut the fuel flow (and the fire T-handles) cut all fuel flow to an engine. The engine might operate for up to a minute on the fuel remaining in the feed lines.

The FUEL LOW caution light illuminates when the centre tank holds less than 220 pounds. The FUEL FEED warning light will illuminate when there is less the 50 pound left in the centre tank.

Hydraulic Power System

Hydraulic power is used to power the landing gear, nose wheel steering and the flaps. It is supplied on demand by the electrical hydraulic pump. The pump does not provide enough pressure to operate flaps and gear at the same time at normal rate.

CAUTION: The hydraulic pump needs a 3 minute cool down period after extensive use (5 minutes of nosewheel steering or three consecutive gear or flap cycles.

A green hydraulic indicator light on the center pedestal will be lit when the hydraulic pump is activated. An amber warning light illuminates when pressure is too low for normal operation.

Oil System

Each engine has its own independent dry sump oil system. The oil system will provide engine lubrication, provide pressure for the propeller control system and will serve as an additional cooling system using a ram-air cooler. When the gear is extended the oil cooler doors are mechanically opened to provide greater cooling capacity during ground operations.

Power Levers/ Condition Levers

The power levers control the thrust output of the engines and are marked into 4 sections:

- FULL REVERSE: provide maximum reverse thrust. Selection of reversed thrust in flight is prevented by a switch linked to the gear. Only when the gear is compressed can reverse be selected.
- GROUND START: give minimal torque at idle RPM because the propeller will be set flat pitch position.
- FLIGHT IDLE: sets the engine and propeller to inflight minimum fuel flow and torque.
- MILITARY: provides maximum torque.

The condition levers control the fuel flow to the engines and are marked in 4 sections:

- FEATHER AND FUEL SHUT-OFF (normally referred to as FEATHER): will feather the propellers and cut the fuel to the engine.
- FUEL SHUT-OFF: fuel is shut off but the propeller control systems stay pressurized and propellers will NOT feather.
- NORMAL FLIGHT: open fuel flow to the engines and sets minimal engine RPM (on ground 60%, inflight 70%).
- T.O./LAND: open fuel flow to the engine and sets minimal engine RPM (on ground 94%, inflight 96%). These higher settings allow the rapid response to commands given via the power levers.

CAUTION: if the condition lever is set to Normal Flight with the engine not running fuel WILL be injected into the combustion chambers. This can result in an engine fire when the engine is hot!

Propeller control is automated and controlled as a function of the power levers and condition levers.

Landing Gear

The tricycle-type landing gear of the OV-10 Bronco is hydraulically operated with the main gear retracting backwards and the nose gear forward. When on the ground the Ground Safety Switch will deactivate the pitot heater, stall warning, and store emergency release systems. IFF hold feature, nose wheel steering will be activated.

The landing gear unsafe light will be illuminated if the gear is not locked in the position of the gear handle. The landing gear position indicator (integrated with the flaps position indicator) shows the position of the gear. A red wheels warning light will warn the pilot of a possible unsafe gear position when the gear is not extended and the power levers are retarded, engine condition lever is at T.O./LAND and the flaps are extended 30 degrees or more. An audible warning horn will sound when the wheels warning light is illuminated.

CAUTION: There is NO protection against retraction of the gear using a ground safety switch. The gear WILL retract when the gear lever is operated on the ground and the aircraft is powered up.

Nosewheel Steering

The nosewheel can move 55 degrees left or right using a hydraulic nose wheel steer-damping system. As soon as the landing gear carries any weight the nose wheel steering is operational. In the real Bronco the pilot has to keep a button on the stick pressed, this is not needed in the simulated version.

Wheelbrakes/ Parking Brakes

The wheel brakes are operated by a separate manually operated hydraulic system on each wheel. Using the rudder pedals the pilot can apply the brakes on each wheel separately. When the park brake handle is pulled and when the brakes are applied the pressure is trapped in the system. To release parking brakes the pilot just needs to apply the brakes

Flight Control Systems

The elevator and aileron/spoiler are operated by a balanced mechanical system using boost tabs. The rudders are mechanically linked directly to the rudder pedals. Trim surfaces are moved by electrically operated trim bungees.

- Pitch is controlled with a horizontal stabilizer and tab-boosted elevator.
- Yaw is controlled by two vertical stabilizers, twin rudders and a yaw damping system. The yaw damper, powered by the d-c bus, prevents unwanted tail oscillations and is operated with a three position switch. ON, OFF, TEST. In test mode the deactivation of the systems on the ground is bypassed for ground tests.
- Roll control uses ailerons and is augmented by 4 spoiler plates inn each wing. These spoilers rotate upwards and create additional drag and remove lift that will lower the wing.

The control stick includes a roll/pitch trim switch, the nose wheel steering button, bomb release button and gun trigger. None of these are functional in the simulated model as they are near impossible to use in the simulator.

Trims

The flaps / trim panel hold the controls for aileron, elevator and rudder trim. When trims are in neutral green, press -to-test, lights will be illuminated.

Wing Flaps

There are two slotted wing flap sections on each wing, normally operated by hydraulic power, and an electrical backup system is available. The flaps are controlled by the flap handle and can be set to any position between 0 degrees and 40 degrees. This is not possible in FSX and therefore we decided to default to 0, 20 and 40 degrees. The flaps position Indicator will show the flaps setting and movement.

Aerosoft GPS Unit

The GPS instrument has its own internal battery so it can be used when the Master switch is still off. It's charged by the Primary DC electrical bus when the Battery master switch is on. To turn the GPS on, press the button with the red logo and the start-up screen will be displayed.

CAUTION: The framerate of the sim is affected by the amount of details shown!

Map Mode

After initialization the GPS will be in Map Mode showing an aircraft symbol in the centre of a map. North is always up. In the four corners of the display, current ground speed, distance to next waypoint, estimated time to next waypoint and a pointer depicting relative bearing to the next waypoint are shown. If the pointer points up, the aircraft is heading straight towards the next waypoint.

Use the IN / OUT buttons to zoom the map in or out. The GPS can show Airports, VOR's, NDB's, Intersections and Airspace boundaries. To toggle the display of these items press the MENU button and use the UP / DOWN cursor key (the large button) to highlight the Class (Airport, VORs, NDBs, Intersection or Airspace). Use the LEFT / RIGHT cursor key to toggle the display of these items. Use the QUIT button to return to the MAP page.

Standard FSX flight plans can be loaded via the normal FSX dialog and will be automatically displayed on the MAP page.

Direct To Mode

Using the GOTO button will allow the input of a DIRECT TO location. Use the UP / DOWN cursor keys to change the character on the blinking field. Use the LEFT / RIGHT cursor key to move to the next or previous field. Enter an ICAO identifier for airport, VOR or NDB.

NOTE: Intersections are not supported in the GOTO mode.

Once an identifier is recognized, it will show facility name and nearby city – if possible. Press ENTER and the GPS will return to the Map mode with the flight plan leg from the current aircraft position to the selected identifier. As everywhere using the QUIT button will halt the action and return to the MAP screen.

Cursor Mode

Another option to make a DIRECT-TO flight plan, is with the help of the "Cursor Mode". When the GPS is in map mode, pressing either the UP / DOWN / LEFT or RIGHT cursor key, will put the GPS into "Cursor mode". A small cursor (blinking circle) will appear instead of the aircraft symbol. Using the cursor keys the circle can be moved on the map and the map will centre on the cursor position. A line will be drawn from the current aircraft position to the cursor.

Press ENTER to select the cursor position as a Direct-To flight plan. If the ENTER button is not pressed within a few seconds or by pressing QUIT, cursor mode will be suspended and the GPS will return to Map mode. By using the cursor mode any global position can be selected as a waypoint. This is the easiest way to make a very simple flight plan, certainly if the desired waypoint isn't too far away. In cursor mode finer adjustments can be made by zooming in on the map first.

Nearest Station

Using the NRST button will open the NEAREST STATION list and the LEFT / RIGHT cursor keys will change between Airports, VORs, NDBs and Intersections. Use the UP / DOWN cursor keys to highlight an identifier and press ENTER to select it as DIRECT-TO, or press QUIT to cancel the selection.

HSI Page

Pressing the ENTER key while being in Map mode will bring up the HSI page. The HSI page shows:

- Compass rose, showing ground track, which is the true track over ground, taking crosswinds and sideslip into account. It does NOT show magnetic nor true heading, like a normal gyro based HSI.
- Course Needle, showing the active flight plan leg bearing.
- Course deviation indicator bar (middle part of the Course needle), showing the cross track error. Each dot represents 1 nautical mile.
- TO/FROM flag showing the position relative from the active flight plan leg.

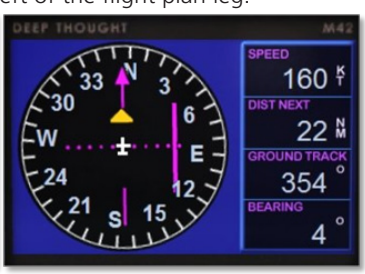
Right part of the screen shows Ground speed, Distance to next waypoint, Ground track (same as Compass rose) and next waypoint bearing.

If the Ground track value and the Bearing value are equal, this indicates that the aircraft is heading straight towards the next waypoint, but not necessarily following the flight plan leg.

HSI Samples:

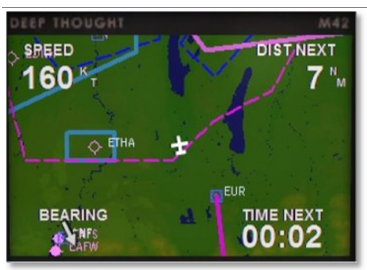
On track direct towards the active waypoint, TO / FROM flag shows TO:

Correct heading but 3 miles to the left of the flight plan leg:



Still 3 miles left of the flight plan leg, but on an intercept heading of 40°:

Flight plan leg behind the aircraft, note the TO/FROM flag has changed to FROM:



Becker BXP 6401 Transponder

The Becker BXP 6401 transponder is a Mode S transponder which enables ATC to locate, identify and track the aircraft by responding to ATC radar interrogations. In Mode S it will conduct altitude reporting, used by other aircrafts TCAS systems for collision warnings. Remember to turn the Transponder to STD-BY after landing when leaving the runway.

The transponder is turned on by rotating the left knob to STDBY. In STDBY mode the transponder will be on, but it will not respond to ATC interrogations. STDBY is normally used until the aircraft is ready for runway line-up. There is a short self-test on start up. Turning the knob to ON will make the transponder start to respond, but without altitude reporting. The blinking R symbol, indicating that the unit responds. When the knob is at either STDBY or ON the bottom line will show the aircraft identification number.

Turning the knob to ALT will make the transponder respond with altitude reporting when inquired. Current flight level will be displayed. Flight level is altitude in 100th of feet with the standard setting at 1013 mb. (1013,2 hpa)

To change the transponder code left click on the right button and the first digit will start to blink. Use the mouse wheel to change the value. Left click the right button again and the next digit will blink. Left click the right button when the last digit has been set. When all digits have not been set, the transponder code will NOT be changed. Press the VFR button to set the transponder code to the normal European VFR transponder code, 7000.

These are standard codes, otherwise set to the squawk code assigned by FSX's ATC:

- 0000: Military intercept code mode C or other SSR failure.
- 0033: Parachute dropping in progress (UK).
- 0041 to 0057: In Belgium assigned for VFR traffic under Flight Information Services
- 0100: In Australia: flights operating at aerodromes
- 1000: Instrument Flight Rules (IFR) flight below 18,000' when no other code has been assigned (Canada). Non-discrete mode A code reserved use in Mode S radar / ADS-B environment where the aircraft identification will be used to correlate the flight plan instead of the mode A code.
- 1200: Visual flight rules (VFR) flight, this is the standard squawk code used in North American airspace when no other has been assigned. In Australia civil VFR flights in class E or G airspace.
- 1201: Visual flight rules (VFR) glider flight, this is the standard squawk code used in United States airspace for transponder equipped gliders when no other has been assigned.
- 1400: VFR flight above 12,500'ASL when no other code has been assigned (Canada).
- 2000: The code to be squawked when entering a secondary surveillance radar (SSR) area from a non-SSR area used as Uncontrolled IFR flight squawk code in ICAO countries. In Canada for uncontrolled IFR at or above 18,000. In Australia: civil IFR flights in Class G airspace.
- 2100: Australia: Ground testing by aircraft maintenance staff.
- 3000: Australia: Civil flights in classes A, C and D airspace, or IFR flights in Class E airspace.
- 4000: Aircraft on a VFR Military Training Route or requiring frequent or rapid changes in altitude (US).

- 4400 to 4477: Reserved for use by SR-71, YF-12, U-2 and B-57, pressure suit flights, and aircraft operations above FL600 (USA only).
- 5000: Aircraft in Military Operations.
- 6000: Australia: Military flights in Class G airspace.
- 7000: VFR standard squawk code when no other code has been assigned (ICAO). UK: this code does not imply VFR; 7000 is used as a general squawk.
- 7001: Sudden military climb out from low-level operations (UK)
- 7004: Aerobatic and display code in some countries.
- 7010: VFR circuit traffic code in the UK.
- 707X: Paradrop activities in France (7070, 7071, 7072...).
- 7615: Australia: civil flights engaged in littoral surveillance.
- 7777: Military interception Emergency codes:
- 7500: Unlawful Interference i.e., Aircraft hijacking ("seven fife, man with knife")
- 7600: Lost Communications.
- 7700: General Emergency ("seven, seven, goes to heaven")

Tacan Receiver

TACAN is a VOR like navigation system that uses transmitters that are mainly placed on or close to military airfields. Where you tune a VOR using a frequency, a TACAN is identified by a channel.

The navigation database of FSX is not fully accurate or complete in regards to TACAN, for some countries all stations seem to be there, in some other countries there are none. You will find them on your charts marked with something like CH41X.

Setting the channel is done with the rotary control on the front and the larger rotary control hiding behind the front plate. Just move your mouse to the edge of the instrument and you will find the click zone. The smaller rotary control is used to power the radio on. In any setting except OFF the radio is activated. The volume control toggles the audio ident.

Becker AR 4201 Communication Radio

The Becker AR 4201 Coms radio is a basic two way radio for voice communication. It is turned on with the ON/OFF/VOL knob and will display a test pattern when started. The upper (large) digits show the active frequency, while the lower (smaller) show the standby frequency. Turning the lower right knob will change the frequency number before the decimal sign, while turning the right upper knob changes the numbers after the decimal sign. To swap the standby frequency with the active, press the swap button (double arrow button). Pressing the mode button (MDE) will display the supply voltage instead of the standby frequency. In this mode the swap button will toggle the display of Supply voltage, Outside temperature in °C and Outside temperature in °F. The Becker AR 4201 Coms radio is seen as COMS 2 in FSX.

Interactive Checklist Gauge

The Aerosoft Bronco X comes equipped with a highly innovative interactive checklist gauge. The checklist can be opened with [SHIFT] + [2].

When opened the left page has options for configuring the Bronco systems and to select prefabricated settings of all aircraft systems. The upper three "radio" buttons are for setting up the panel state.

- Cold & Dark Normal state: engines are shut down the panels reflects how a pilot normally will find it for the first flight of the day.
- Cold & Dark Maintenance State: engines are shut down, propellers are feathered and generators, fuel shut off valves and battery disconnect switches are off.
- Ready for Taxi state: engines are running and all systems are ready for taxi

The lower three check boxes are for setting your preferences.

- EGT gauges showing EGT only: will make the EGT gauge display EGT and not shift to TiT. Please refer to the chapters on the engine to understand the difference.
- Play sounds for checklist items: will disable the voice over in the checklist.
- No failures: will disable all failures that are not standard FSX failures.

The next pages contain the actual checklists.

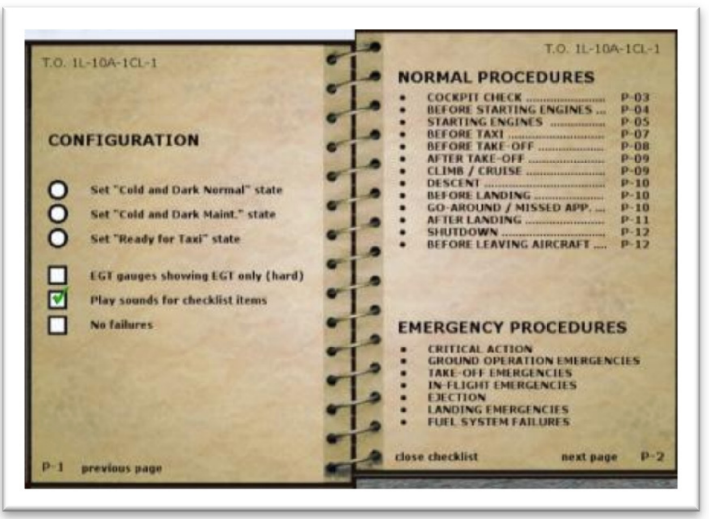
Click the checklist header (like "COCKPIT CHECK") and a red checkmark will indicate that the checklist has been started, but not finished correctly yet. Now click each checklist item and a checkmark will indicate whether it is set correctly or not. If it has been set correctly a green checkmark will be shown and a voice will also confirm the item is checked (or the action performed) and the item is completed. If the checkmark is red you have two options. Either you can manually correct the issue or right click the checklist item to have it done for you. This is especially useful if you have not yet fully mastered the aircraft and find it hard to find all the switches.

The moment the checklist has been completed the checkmark at the top will turn green and the voice will tell you the checklist is completed. If you like to start over, use the CLEAR CHECKLIST option.

It is possible to go from a cold and dark aircraft to a fully configured, ready for taxi with engines running state by just right clicking on the checklist items!

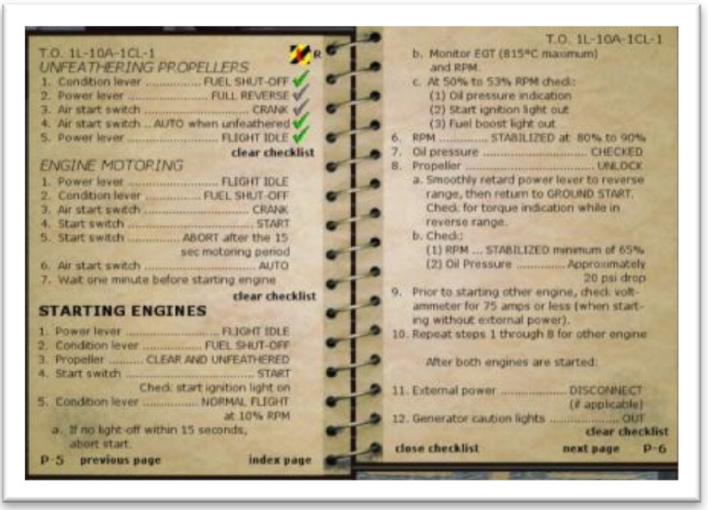
A few additional comments;

- Because some systems are mentioned more than one time in the checklist it could be a system that is set to ON in one location and has to be switched OFF further in the checklist. The first occurrence of those conflicting states will then be shown in grey instead of green or red.



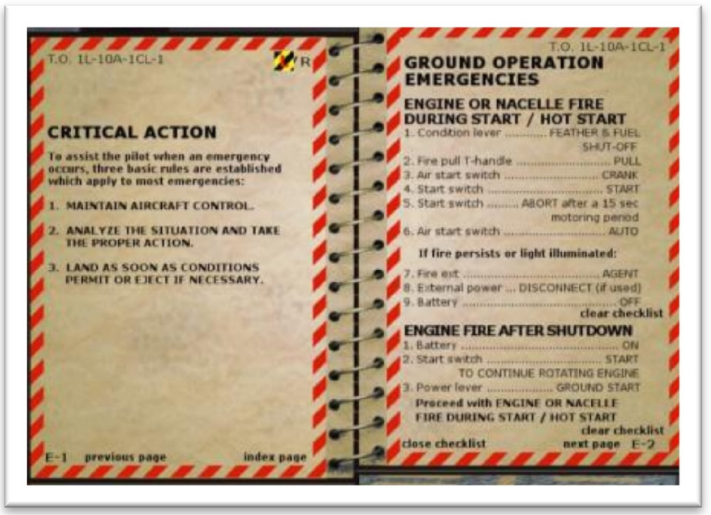
- The checkmark might blink between red and green when a control is in the progress of being set
- Where right click options are not possible (like throttle control, setting of certain speeds etc) the checkmark turns green when correct settings are detected.

- Where there are Left engine / Right engine controls, You will see a selector at the top of the Checklist section labeled L / R.



CAUTION: The "Unfeathering Propellers" and "Engine Motoring" should only be executed when required.

The last part of the checklist contains the emergency checklist. This works exactly like the normal checklist, but don´t have voice overs.



Panels

The cockpit of the OV-10 Bronco is rather strange. It's rather cramped in the lower sections with all gauges and controls seemingly randomly placed very close together and above that all is a very roomy glass section with near perfect visibility. In its role as reconnoiter and spotter aircraft this visibility was very usable, but it also means that you will have to look down to see the panel and instruments. As the aircraft is intended for VFR flights this is not problematic. In FSX it is a bit of a problem for people who do not use a tracking system that pans the view around as you move your head. When needed zoom out a bit [-] and lower the seat [CONTR] + [ENTER].

Main Panel

1. Left battery Hot warning light
2. Left over torque warning light
3. Left TiT/EGT high warning light
4. Gyro VOR needle / ILS source selector switch VOR / TACAN
5. Left & Right Continuous ignition switches
6. Standby artificial horizon
7. G-meter
8. Clock / stopwatch
9. Wheel up warning light
10. Alternate TACAN power switch
11. Fire detector / warning lights test switch
12. ADF radio
13. Landing gear lever
14. Landing gear and flaps indicator
15. Elevator trim indicator

16. Rudder trim neutral light
17. Aileron trim neutral light
18. Airspeed indicator
19. Altimeter
20. Artificial horizon
21. Gyro compass with VOR/TACAN & ADF needle
22. TACAN radio

Right Side Main Panel

1. Right TiT/EGT high warning light
2. Right over torque warning light
3. Right battery hot warning light
4. Fire extinguisher
5. Fire handles
6. Turn & Bank indicator
7. Vertical speed indicator

8. ILS gauge
9. Engine torque indicators
10. Turbine RPM (Ng)
11. TiT/EGT indicators
12. Oil pressure indicator
13. Fuel quantity indicator
14. Fuel qty indicator selector switch
15. External fuel transfer switch
16. Emergency fuel shut off switches

Left Rear Side Panel

1. COM radios transmit select (VHF1 / VHF2)
2. ADF ident sound to speaker
3. COM1 (VHF1) sound to speaker

4. COM2 (VHF2) sound to speaker
5. VOR ident (NAV1) sound to speaker
6. External light / Landing light switch
7. Flaps lever
8. Aileron trim / Alternate elevator trim switch
9. Alternate trim select
10. Alternate rudder trim switch
11. Normal rudder trim switch
12. Alternate flaps setting switch
13. Yaw damper
14. Voltmeter / Generator 1 or 2 ampere meter
15. Outside air temperature indicator

Left Forward Side Panel

1. Ignition and unfeather switches
2. Starter switches
3. Generator switches
4. Instrument power switch (Inverters)
5. Battery switch
6. Parking brake lever

Throttle Quadrat

1. Power levers
2. Condition levers
3. Friction lock for power and condition levers (move forward to lock)

Overhead Panel

1. Whiskey compass
2. Smoke generator switch
3. Camera power switch
4. Camera power on light
5. End of film warning light
6. Film select switch
7. Gun sight dimmer

Right Forward Side Panel

1. Pitot heat switch
2. Cockpit defroster
3. Cockpit temperature adjustment
4. Ram air adjustment
5. Windscreen wiper power switch
6. Windscreen wiper speed switch
7. Anti collision lights
8. Formation lights
9. Wing and tail lights (position lights)
10. IFF/Transponder reply light
11. IFF/Transponder test light
12. IFF/Transponder mode selector
13. IFF/Transponder code and selectors
14. Batteries disconnect switches

Right Rear Side Panel

1. Gyro compass drift index
2. Gyrocompass source
3. Gyro compass alignment knob
4. Marker beacon ident sound switch
5. Marker beacon Hi/Lo selector switch
6. Marker beacon power/test switch
7. COM1 radio frequency
8. COM1 radio power switch (Lower knob)
9. COM1 radio whole Mhz selector (Upper knob)
10. COM1 radio fractional Mhz selector
11. NAV1radio frequency

12. NAV1 radio power switch (Lower knob)
13. NAV1 radio whole Mhz selector
14. NAV1 radio ident switch
15. NAV1 radio fractional Mhz selector
16. "Becker" COM2 radio
17. "Becker" Transponder 2
18. Panel lights

Right Sidewall Switches

1. Bleed-air switches
2. Generator 1 & 2 ampere meter selector switch
3. Canopy open

Checklist

The following checklists are taken directly from the real aircraft as flown right now. Please note that the checklist gauge build into the aircraft is much easier and much more powerful than this simple list.

In the checklist the sections that have no function in FSX are shown as light grey. Just skip those.

Normal Checklist

SAFETY CHECK

1.	FORM 781	CHECK
2.	CANOPY	OPEN
3.	THRUSTER SAFETY PIN	INSTALLED
4.	EJECTION "D" RING SAFETY PIN	INSTALLED
5.	SPEED SENSOR CONNECTIONS	SECURE
6.	EJECTION SEAT QUICK-DISCON	SECURE
7.	PARACHUTE DEPL STATIC LINE	SECURE
8.	CATAPULT-ROCKET RET BOLT	SECURE
9.	DEPLOYMENT STATIC LINE	SECURE IN LINE CUTTER
10.	SEAT-MAN SEPARATOR LINK	SECURE IN PLACE
11.	OXYGEN QUANTITY	CHECK MINIMUM
12.	MASTER ARM	OFF
13.	GEAR HANDLE	DOWN

EXTERIOR INSPECTION

1.	FRONT COCKPIT CANOPY	CHECKED
2.	REAR COCKPIT	SECURE (SOLO)
3.	UPPER WING	CHECKED
4.	RIGHT PROPELLER	CHECKED
5.	RIGHT ENGINE	CHECKED
6.	RIGHT WING	CHECKED
7.	RIGHT MAIN GEAR	CHECKED
8.	RIGHT SPONSON	CHECKED
9.	EXTERNAL PWR RECEPTACLE DOOR	SECURE (IF NOT USED)
10.	CARGO BAY	CHECKED
11.	TAIL BOOM, TAIL SURFACES	CHECKED
12.	LEFT SPONSON	CHECKED
13.	ARMT SAFETY DISABLE	NORM
14.	LEFT MAIN GEAR	CHECKED
15.	LEFT WING	CHECKED
16.	LEFT ENGINE	CHECKED
17.	LEFT PROPELLER	CHECKED
18.	ANGLE-OF-ATTACK PROBE	CHECKED
19.	NOSE OF AIRCRAFT	CHECKED
20.	NOSE GEAR	CHECKED

COCKPIT CHECK

1.	GUST LOCK	REMOVED
2.	THRUSTER SAFETY PIN	REMOVED
3.	SURVIVAL KIT	ATTACHED
4.	RISER ATTACH FITTINGS	SECURED
5.	LAP BELT	SECURED
6.	PERSONAL LEADS	CONNECTED
7.	HF COMM	OFF
8.	COMPASS	SLAVED
9.	VHF/FM COMM-	OFF
10.	FLAPS	UP
11.	EXT LIGHTS MASTER	EXT LIGHTS
12.	POWER LEVERS	FLIGHT IDLE
13.	CONDITION LEVERS	FUEL SHUT-OFF
14.	BATTERY	OFF
15.	GENERATORS	ON
16.	INST PWR	OFF
17.	AIR START	AUTO.
18.	GEAR HANDLE	DOWN
19.	UHF COMM	OFF
20.	ARM MASTER	NORM[2]
21.	CLOCK	SET
22.	SIGHT FIL SEL	NO 1.
23.	SIGHT RETICLE BRIGHTNESS KNOB	OFF[2]
24.	ALTERNATE TACAN POWER	NO. 1 MSL
25.	TACAN-	OFF
26.	FIRE PULL HANDLES	IN
27.	EXT FUEL TRANS	OFF

28.	FUEL EMERG SHUT OFF	NORM
29.	PITOT HEAT-	OFF
30.	WINDSHIELD WIPER	OFF
31.	WING & TAIL LIGHTS	BRT
32.	FORM LIGHTS	AS REQUIRED
33.	OXYGEN SYSTEM	CHECKED
34.	EMERG IFF	NORMAL
35.	IFF	OFF
36.	ADF	OFF
37.	ICS	SET
38.	BLEED AIR	AS REQUIRED
39.	VHF COMM	OFF
40.	INTERIOR LIGHTS	AS REQUIRED
41.	CIRCUIT BREAKERS	CHECKED

1)Aircraft having TCTO 1L-1OA-510 incorporated

2) Aircraft 66-13552 through 67-14650 not having TCTO 1L-1OA-503

3) Aircraft 67-14651 and subs and aircraft having TCTO 1L-1OA-503

BEFORE STARTING ENGINES

1.	BATTERY-	ON
2.	ICS	CHECKED
3.	SEAT ADJ	ADJUSTED
4.	RUDDER PEDALS	ADJUSTED
5.	FLIGHT CONTROLS	CHECKED
6.	FIRE DET	CHECKED
7.	EXTERNAL POWER	IF REQUIRED
8.	INST PWR	INV NO. 1
9.	FIRE DETECTOR/WARNING LIGHTS	CHECKED
10.	RADIO	ON
11.	ATTITUDE INDICATOR	CHECKED
12.	FUEL QUANTITY INDICATOR	CHECKED

UNFEATHERING

13.	POWER LEVER	FULL REVERSE
14.	AIR START	CRANK
15.	POWER LEVER	FLIGHT IDLE

Never try to start the engines with propeller blades feathered, the starter motor might get damaged, hung start can happen, and batteries might get overheated due to the excessive torque. Never move condition levers from FUEL SHUTOFF with Ng below 10.0%, a hung or hot start might evolve. Never start both engines simultaneously, always start them one at the time or the batteries might overheat. Use ground power if available.

STARTING ENGINES

1.	BRAKES	SET
2.	PROPELLER	CLEAR
3.	STARTER	START
4.	START IGNITION LIGHT ON	CHECK
5.	CONDITION LEVER	NORM FLT 10% RPM

IF NO LIGHT-OFF WITHIN 15 SECONDS, ABORT START MONITOR EGT (815°C MAXIMUM) AND RPM AT 50% TO 53% RPM CHECK:

6.	OIL PRESSURE INDICATION	CHECK
7.	START IGNITION LIGHT OUT	CHECK
8.	EGT/T. I. T. SHIFT	CHECK
9.	FUEL BOOST LIGHT OUT	CHECK
10.	RPM	STABILIZE APPR. 85%
11.	PROPELLER	UNLOCK

SMOOTHLY RETARD POWER LEVER TO REVERSE RANGE AND NOTE INCREASE IN TORQUE, THEN RETURN TO GROUND START

12.	RPM	STABILIZED APPR. 67%
13.	OIL PRESSURE	50 PSI MINIMUM

PRIOR TO START 2ND ENGINE, CHECK VOLT FOR <75 AMPS

14. REPEAT STEPS 2 THROUGH 7 FOR OTHER ENGINE

AFTER BOTH ENGINES ARE STARTED:

15.	EXTERNAL POWER	DISCONNECT (IF APPL.)
16.	GENERATOR CAUTION LIGHTS	OUT

GROUND SHUTDOWN ABORTED/HUNG START

17.	CONDITION LEVER	FUEL SHUT-OFF
18.	STARTER	ABORT

BEFORE TAXI

1.	INST PWR	CHECKED
2.	TRIM-	CHECKED
3.	COMPASS-	SET
4.	RADIOS AND NAV EQUIPMENT	ON, AS REQUIRED
5.	ALTIMETER-	SET
6.	IFF-	STBY
7.	EJEC SEAT "D" RING SAFETY PIN	REMOVED AND STOWED
8.	CHOCKS	REMOVED

TAXI CHECK

1.	BRAKES	CHECKED
2.	NOSE WHEEL STEERING	CHECKED
3.	FLIGHT INSTRUMENTS	CHECKED
4.	YAW DAMPER	CHECKED
5.	NAVIGATION AIDS	CHECKED

BEFORE TAKE-OFF

1.	TRIM	SET
2.	FLAPS	SET
3.	NAVIGATION AIDS	SET FOR DEPARTURE
4.	SHOULDER HARNESS	AS REQUIRED

5.	PITOT HEAT	ON, AS REQUIRED
6.	IFF	AS REQUIRED
7.	ANTI COLLISION LIGHT	ON
8.	FEED TANK	CHECK 260 TO 280 LBS
9.	FLIGHT CONTROLS	CHECK
10.	CANOPY	CLOSED, LOCKED
11.	CANOPY DOOR LOCK INDICATORS	CHECK[2]

1) Aircraft having tcto 1l-10a-563 incorporated

LINE-UP CHECK

1.	FLIGHT INSTRUMENTS	CHECK
2.	CONDITION LEVERS	T.O./LAND
3.	POWER LEVERS	ADVANCE

AFTER TAKE-OFF

1.	GEAR	UP
2.	FLAPS	UP

CLIMB

1.	CONDITION LEVERS	AS REQUIRED
2.	OXYGEN	AS REQUIRED
3.	YAW DAMPER	AS REQUIRED
4.	EXT FUEL TRANS	ON, AS APPLICABLE

CRUISE

1.	CONDITION LEVERS	NORMAL FLIGHT
2.	POWER LEVERS	AS REQUIRED

DESCENT

1.	APPROACH PROCEDURES	REVIEW, AS REQUIRED
2.	CKPT AIR/DEFR	AS REQUIRED
3.	ALTIMETER	SET
4.	POWER LEVERS	AS REQUIRED

BEFORE LANDING

1.	CONDITION LEVERS	T.O./LAND
2.	SHOULDER HARNESS	AS REQUIRED
3.	YAW DAMPER	OFF
4.	HYDRAULIC SYSTEM	CHECK
5.	GEAR	DOWN
6.	FLAPS	AS REQUIRED

GO-AROUND

1.	POWER LEVERS	ADVANCE, AS REQUIRED
2.	GEAR	UP, AS REQUIRED
3.	FLAPS	UP, AS REQUIRED

TOUCH-AND-GO LANDING

1.	FLAP	T/O
2.	POWER LEVERS	MILITARY
3.	FLAP	UP, AT 110 KIAS
4.	GEAR	UP, AS REQUIRED
5.	BEFORE LANDING, PERFORM BEFORE LANDING	CHECK

AFTER LANDING

1.	FLAPS	UP
2.	CONDITION LEVERS	NORMAL FLIGHT
3.	IFF	OFF
4.	ANTI COLLISION LIGHT	OFF
5.	EXT FUEL TRANS	OFF
6.	TRIM	NEUTRAL
7.	EJECT SEAT "D" RING SAFETY PIN	INSTALLED

SHUTDOWN

1.	PARK BRAKE	SET
2.	RADIO AND NAV EQUIPMENT	OFF
3.	POWER LEVERS	GROUND START
4.	CONDITION LEVERS	FUEL SHUT-OFF
5.	POWER LEVERS	FULL REVERSE
6.	INST PWR	OFF
7.	NAVIGATION LIGHTS	OFF
8.	BATTERY	OFF
9.	CONTROL GUST LOCK	INSTALLED
10.	THRUSTER SAFETY PIN	INSTALLED

BEFORE LEAVING AIRCRAFT

1.	CHOCKS	IN PLACE
2.	PARK BRAKE	RELEASED, AS REQUIRED
3.	OXYGEN	100% AND OFF
4.	CANOPY	CLOSED, AS REQUIRED
5.	FORM 781	COMPLETE

Note:

Some Broncos were changed to always read EGT on the EGT/TIT gauge. This option is available on the Aerosoft OV-10 Bronco too through the Checklist/Config gauge .

When set to EGT readout only, the pilot is required to determine max allowable EGT with the help of EGT charts.

The TIT warn lights are hardcoded to 996°C and will not warn for any EGT over temperature situation since EGT is much lower than TIT.

TIT is not a measured value, since no temperature probe type is able to withstand the temperatures at the turbine inlet. Instead TIT is calculated and "tweaked" by the SRL computer to read a TIT value giving a single red-line value- i.e EGT is converted to TIT and this value is again compensated for Ng, OAT, Altitude and Airspeed in order to make the gauge needle read 996°C when reaching max allowable TIT, which again will lit the TIT warn light.

Options:

Included are the following:

- Set Cold & dark state.
- Set Cold & dark Maintenance.
- Set Ready for Take-Off state.
- Select EGT/TIT readout.
- Failure enable/disable.

Emergency Checklist

ENGINE OR NACELLE FIRE DURING START / HOT START

1.	CONDITION LEVER	FUEL SHUT-OFF
2.	FIRE LIGHT	PULL
3.	AIR START	CRANK

HOLD SWITCH TO SHUT OFF FUEL ENRICHMENT AND IGNITION
ALLOW STARTER TO CONTINUE ROTATING ENGINE.

4.	START SWITCH	ABORT

IF FIRE PERSISTS OR LIGHT ILLUMINATED:

5.	FIRE EXT	AGENT
6.	EXTERNAL POWER	DISCONNECT, IF USED
7.	BATTERY	OFF

ENGINE FIRE AFTER SHUTDOWN

1.	BATTERY	ON
2.	START SWITCH	TO CONT ROTATE ENG
3.	POWER LEVER	GROUND START

TWO-ENGINE ABORT

1.	POWER LEVERS	RETARD
2.	BRAKES	AS REQUIRED

ENGINE FAILURE AFTER LIFT-OFF (TAKE-OFF CONTINUED)

1.	GEAR	UP
2.	STORES	JETTISON
3.	FAILED ENG COND. LEVER	FEATHER & FUEL
4.	FLAPS	UP (ABOVE 110 KIAS)
5.	FAILED ENGINE POWER LEVER	FLIGHT IDLE

ENGINE FIRE AFTER LIFT-OFF

1.	GEAR	UP
2.	STORES	JETTISON
3.	FAILED ENG COND. LEVER	FEATHER & FUEL
4.	FIRE LIGHT	SHUT-OFF
5.	FIRE EXT	PULL
6.	FAILED ENGINE POWER LEVER	AGENT
7.	FLAPS	FLIGHT IDLE
8.	FAILED ENGINE FUEL EMERG S.O	UP (WHEN ABOVE 110 KIAS)
9.	IF STILL ON FIRE	SHUT OFF

ENGINE FAILURE DURING FLIGHT

1.	FAILED ENG COND. LEVER	FEATHER & FUEL
2.	OPERATIVE ENGINE POWER LEVER	ADVANCE, AS REQUIRED
3.	GEAR	UP
4.	FLAPS	UP

MAINTAIN MINIMUM SINGLE-ENGLNE SPEED OR ABOVE

5.	STORES	JETTISON, AS REQUIRED
6.	FAILED ENGINE POWER LEVER	FLIGHT IDLE
7.	FAILED ENGINE FUEL EMERG S.O	SHUT OFF

FAILURE OF BOTH ENGINES IN FLIGHT

1.	MAINTAIN	130 KIAS
2.	FUEL QUANTITY	CHECK

ENGINE AIR START

1.	CONDITION LEVER	FUEL SHUT-OFF
2.	POWER LEVER	HALFWAY BETWEEN FLIGHT IDLE AND MILITARY
3.	AIR START	ON
4.	CONDITION LEVER	NORMAL FLIGHT AT 10% RPM
5.	AIR START	AUTO

UNSUCCESSFUL AIR START

1.	CONDITION LEVER	FEATHER & FUEL
2.	AIR START	AUTO
3.	STORES	JETTISON, AS REQUIRED
4.	FAILED ENGINE POWER LEVER	FLIGHT IDLE

ENGINE FIRE DURING FLIGHT

1.	AFF. ENG COND. LEVER	FEATHER & FUEL SHUT-OFF
2.	FIRE LIGHT	PULL
3.	FIRE EXT	AGENT
4.	IF STILL ON FIRE	EJECT OR LAND IMMEDIATELY
5.	FAILED ENGINE FUEL EMERG S.O	SHUT OFF

ELECTRICAL FIRE

1.	GENERATORS	OFF
2.	BATTERY	OFF
3.	RAM AIR KNOB	PULL FULL OUT
4.	ALL ELECTRICAL EQUIPMENT	OFF
5.	BATTERY	ON
6.	GENERATORS	RESET
7.	VOLTAMMETER	CHECK
8.	DEFECTIVE EQUIPMENT	ISOLATE

SMOKE OR FUMES ELIMINATION

1.	BLEED AIR	EMERG OFF
2.	RAM AIR KNOB	PULL, AS DESIRED
3.	COCKPIT AIR VENTS	OPEN
4.	CKPT AIR/DEFR	FULL IN

IF ELECTRICAL FIRE IS SUSPECTED, FOLLOW ELECTRICAL FIRE PROCEDURE

GENERATORS FAILURE

1.	REDUCE ELECTRICAL LOAD	
2.	APPLICABLE GENERATOR	RESET
3.	IF GENERATOR WILL NOT RESET	TURN OFF GENERATOR AND LAND

BOTH GENERATORS OUT

1.	ALL ELECTRICAL EQUIP	OFF
2.	GENERATORS	RESET

IF NEITHER GENERATOR WILL RESET, TURN OFF BOTH GENERATORS AND LAND AS SOON AS POSSIBLE

3.	BATTERY	EMERG, AS REQUIRED

FLAP ALTERNATE OPERATION

1.	FLAP HANDLE	HOLD
2.	ALT FLAPS	AS REQUIRED

EJECTION PROCEDURE

1. NOTIFY OTHER CREW MEMBER TO EJECT	
2. EJECTION "D" RING-	PULL
3. IFF MASTER-	EMER
4. TRANSMIT MAYDAY AND IN TENTIONS	
5. OXYGEN HOSE AND COMMS CORD -	DISCONNECT
6. HELMET VISOR -	DOWN

7. STEER AIRCRAFT AWAY FROM POPULATED AREAS
8. TRADE EXCESS AIRSPEED FOR ALTITUDE (100 KIAS MINIMUM)
9. EJECTION RECOMMENDED NOT LOWER THAN 2500 FEET AGL

AFTER EJECTION:

1. PARACHUTE RELEASE HANDLE-	PULL
2. OXYGEN MASK -	OFF, AS REQUIRED
3. SURVIVAL KIT RELEASE -	PULL
4. LIFE PRESERVER-	INFLATE (OVER WATER)

SINGLE-ENGINE/FLAME-OUT LANDING APPROACH TO HIGH KEY

1. GEAR	UP
2. FLAPS	UP
3. AIRSPEED	130 KIAS

HIGH KEY (2500 FEET AGL MINIMUM)

4.	GEAR	DOWN, AS REQUIRED
5.	FLAPS	AS REQUIRED
6.	SHOULDER HARNESS	LOCKED
7.	AIRSPEED	100 KIAS (MINIMUM)

LOW KEY (1500 FEET AGL MINIMUM)

8.	GEAR	DOWN
9.	FLAPS	AS REQUIRED
10.	AIRSPEED	100 KIAS (MINIMUM)

BASE (500 FEET AGL MINIMUM)

11.	GEAR	DOWN
12.	FLAPS	AS REQUIRED
13.	AIRSPEED	100 KIAS (MINIMUM)

FINAL (200 FEET AGL MINIMUM)

14.	FLAP HANDLE	T/O, AS REQUIRED
15.	AIRSPEED	100 KIAS (MINIMUM)

TOUCHDOWN

16.	AIRSPEED	80 KIAS (MINIMUM)

GO-AROUND - SINGLE ENGINE

1.	CONDITION LEVER	T.O./LAND
2.	POWER LEVER	ADVANCE
3.	GEAR	UP
4.	FLAPS	UP
5.	AIRSPEED	100 KIAS

GEAR EMERGENCY EXTENSION

1.	LANDING GEAR HANDLE	DOWN
2.	AIRSPEED	REDUCE TO 120 KIAS

INCREASE „G“ IF REQUIRED TO LOCK MAIN GEAR

DITCHING

1.	FOLLOW RADIO DISTRESS PROCEDURE	
2.	STORES	JETTISON
3.	LOOSE EQUIPMENT	STOW
4.	G-SUIT HOSE, COMS CORD	DISCONNECT
5.	STRAPS AND LAP BELT	CHECK TIGHT
6.	OXYGEN	100%, IF USED
7.	GEAR	UP
8.	FLAP HANDLE	DOWN
9.	SHOULDER HARNESS	LOCK
10.	FLY POWER-ON APPROACH, IF POSSIBLE	
11.	CONDITION LEVERS	FEATHER & FUEL SHUT-OFF, BEFORE IMPACT
12.	FLY AIRCRAFT UNTIL STOPPED	
13.	OXYGEN MASK	OFF

14.	LAP BELT	OPEN
15.	RISER FITTINGS	RELEASE
16.	CANOPY	OPEN
17.	ABANDON AIRCRAFT	

UNSAFE GEAR INDICATION IN COCKPIT

1.	STORES	
2.	SHOULDER HARNESS	
3.	NOSE GEAR STEER BUTTON	

JUST PRIOR TO TOUCHDOWN

4.	CONDITION LEVERS	FEATHER & FUEL SHUT-OFF
5.	BATTERY	OFF
6.	LAND STRAIGHT AHEAD. STOP THE AIRCRAFT AND INSTALL GEAR PIN	

MAIN GEAR COCKED WITH NOSE GEAR UP OR DOWN

1.	GEAR	UP
2.	STORES	JETTISON
3.	SHOULDER HARNESS	LOCKED
4.	BATTERY	OFF
5.	CONDITION LEVERS	FEATHER & FUEL SHUT-OFF

BRAKE FAILURE

1.	USE REVERSE THRUST TO STOP	FEATHER & FUEL
2.	CONDITION LEVERS	SHUT-OFF
3.	WHEELS	CHOCKED

OIL SYSTEM FAILURE

1.	POWER LEVER	FLIGHT IDLE
2.	CONDITION LEVER	FEATHER & FUEL SHUT-OFF
3.	LAND AS SOON AS PRACTICABLE	

FUEL BOOST CAUTION

1.	FUEL GAUGE SELECT	FEED
2.	LAND BEFORE	FUEL FEED WARNING

FUEL FEED WARNING

1.	POWER LEVERS	RETARD TO MINIMUM PRACTICAL AND SLOW TO NOSE-UP ATTITUDE

2. REMAIN AT ALTITUDE UNTIL FIELD ASSURED.
3. LAND AS SOON AS POSSIBLE USING FLAME-OUT LANDING.
4. PREPARE FOR FLAME-OUT LANDING.

INSTRUMENT POWER FAILURE

1.	INST PWR	INV NO. 2

TRIM SYSTEMS FAILURE

2.	TRIM SELECT	ALT
3.	ALTERNATE TRIM SWITCHES	TRIM, AS REQUIRED

PROPELLER/ENGINE OVERSPEED

1.	POWER LEVER	RETARD
2.	AIRSPEED	DECREASE
3.	PITCH	INCREASE ATTITUDE
4.	CONDITION LEVER	FEATHER & FUEL SHUT-OFF

ENSURE POWER LEVER IS IN FLIGHT IDLE.

CANOPY OPEN IN FLIGHT

1.	AIRSPEED	REDUCE TO 90 KIAS
2.	FLAP HANDLE	T/O
3.	CANOPY	CLOSED, IF POSSIBLE
4.	APPROACH SPEED	10 KIAS ABOVE NORMAL

STRUCTURAL DAMAGE

1. DETERMINE AIRSPEED AT WHICH CONTROL EFFECTIVENESS IS MARGINAL IN LANDING CONFIGURATION.
2. ESTABLISH AIRSPEED AT LEAST 10 KIAS HIGHER.

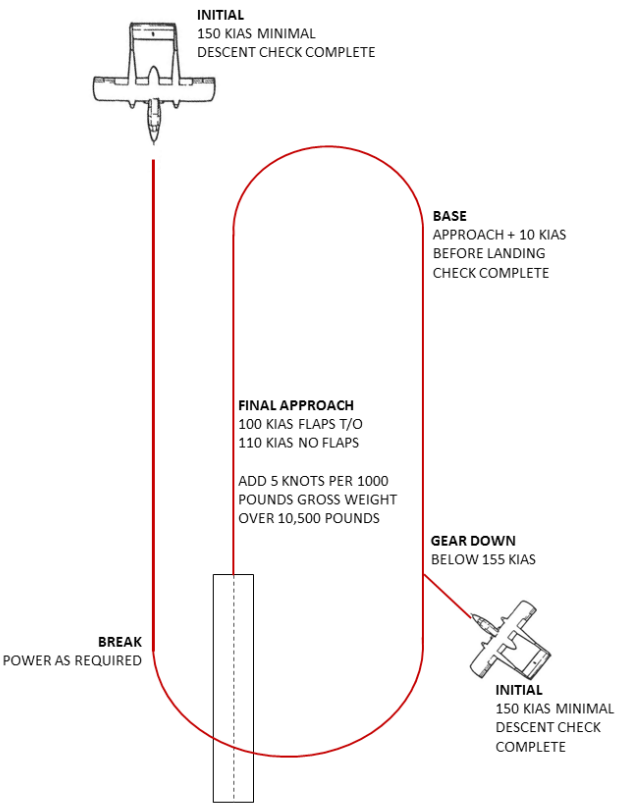
EMERGENCY JETTISON

METHODS OF JETTISON ARE AS FOLLOWS:

1. ALL EXTERNAL STORES, STORES EMER REL BUTTON	PUSH
2. STATIONS 1, 2, 4, 5, EMER ST JETT HANDLE	PULL

Appendix A: Landing Pattern

This charts shows the advised speed and configuration during the approach and landing.



Appendix B: The Making Of

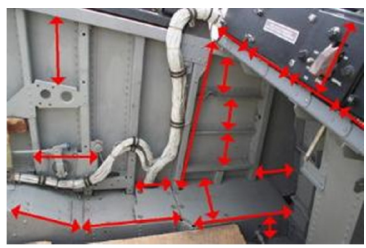
Perhaps you would like to get some idea about how a project like this starts and evolves to what you see now. It started actually years ago, when I flew the Bronco in FS98 and immediately liked the aircraft. Ever since I had the aircraft on the list of 'projects to do'. In 2010 we actually decided to start on it and as always we needed good access to the real aircraft. There was one obvious choice for that as there are not that many flying Bronco's in Western Europe, the OV-10 Bronco Association, German Wing. When we contacted them they were immediately interested and very helpful. Quickly a date was set for a photo shoot and a sound recording session.

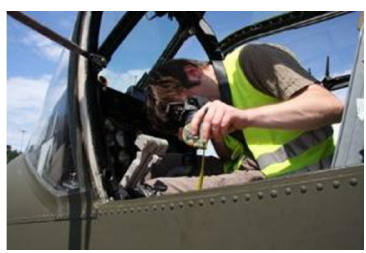
To capture all the details of an aircraft like this on photo is a lengthy process and requires a keen eye for detail. It is best if the 3d artist does the photo's as he knows what matters most. He always has a ruler in the picture so he knows what size the objects are. Even the flight suit that the pilots wears is photographed from all sides! The sound recording is more fun as the guy who does the sounds gets to sit in the cockpit and operate all the controls to get the sounds of all the switches etc. We normally do this with a video camera with a good microphone so we know what sound is what.

Then comes a period when the 3d artist starts to work. The system designer starts a bit later and tries to get a good idea of all the systems. We talk to the real pilot a lot in this stage to understand what the most important systems are, what is possible and what is just too complex for FSX and/or the intended customer. The flight mechanics people start last. They create a base file that is then test flown and compared to real data (taken from manuals and documents).

When we've got those basics right we talk to the pilots again to understand where the aircraft is different and special. It's important to get those aspects right. In this case the real Bronco was flown a few times just to confirm some of our ideas. The result has to be a flight model that is not only accurate but above all feels like the real aircraft (and believe me, this one does).

Months later all files come together and the testing starts. This is a difficult time as it often seems like there is so much to do. This time however we had little problems. In fact we never saw any CTD errors that are almost impossible to fix. Writing the manuals is time consuming as you spend most time in the sim or reading the real manuals but it also serves as a good test of all systems. Release is the easiest thing in all as making the installers and product pages are really routine for us. Training the support staff and getting the marketing and public relations is also a doddle compared to the actual development.





And there you have it. That's how the Aerosoft Bronco was made. A lot of sweat, late night hours, curses, laughter, sleepless nights, coffee and beers went into this one. Enjoy it!

Thanks to the whole team, I could not have wished for a better one.

Mathijs Kok