FlightSim Developers

Flying high in digital aviation

Pilot Operating Handbook

Revised October 2010

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Turbine Toucan for Microsoft Flight Simulator

THANK YOU ... for displaying confidence in us by selecting our Turbine Toucan for Microsoft Flight Simulator. Our design and technical team have utilized their skills and years of experience to ensure that the Toucan meets the high standards of quality and performance for which FlightSim Developers airplanes have become famous throughout the world.

IMPORTANT NOTICE

This handbook must be read carefully by the owner and operator in order to become familiar with the operation of the Turbine Toucan. The handbook presents suggestions and recommendations to help enhance your simulation experience and efficiently operate the aircraft.

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USE OF THE HANDBOOK

The Pilot's Operating Handbook is designed to maintain documents necessary for the safe and efficient operation of the Bonanza.

Aircraft Specifications

General Dimensional Specifications:

Length: 21ft.4in
Span: (upper): 22ft.
Span: (lower): 21ft.
Total Wing Area: 150.00 sq. ft.
Wing Loading: 15.0lb/sq.ft.
Empty Weight: 1675lbs.
Gross Weight: 2550lbs.

General Performance Specifications:

VNE : N/A
Cruise : N/A
Rate of Climb : 9500/fpm.
Roll Rate : 350 degrees/sec.
Stall Speed : 64mph
G loading : +6/-4 routine
G loading Ultimate : +9/-7.5
Horsepower : 750shp
Propeller : 4 blade composite 100" dia.
Fuel Capacity : 94 Gal. Jet-A
Thrust : 3300lbs.
600 Mile Range w/reserves

The overall weight has been reduced due to composites and newer avionics but this is close enough for modeling purposes. Let's just say the total weight is a tad under 1650lbs now.

Though the aircraft cowling is fairly long, the majority of the engine weight is aft to the back third of the engine. Propeller is composite and very light. Polar moments are not a big influence to spin characteristics. The aircraft spins beautifully as the CG of the plane falls into the first third of MAC (Mean Aerodynamic Cord).

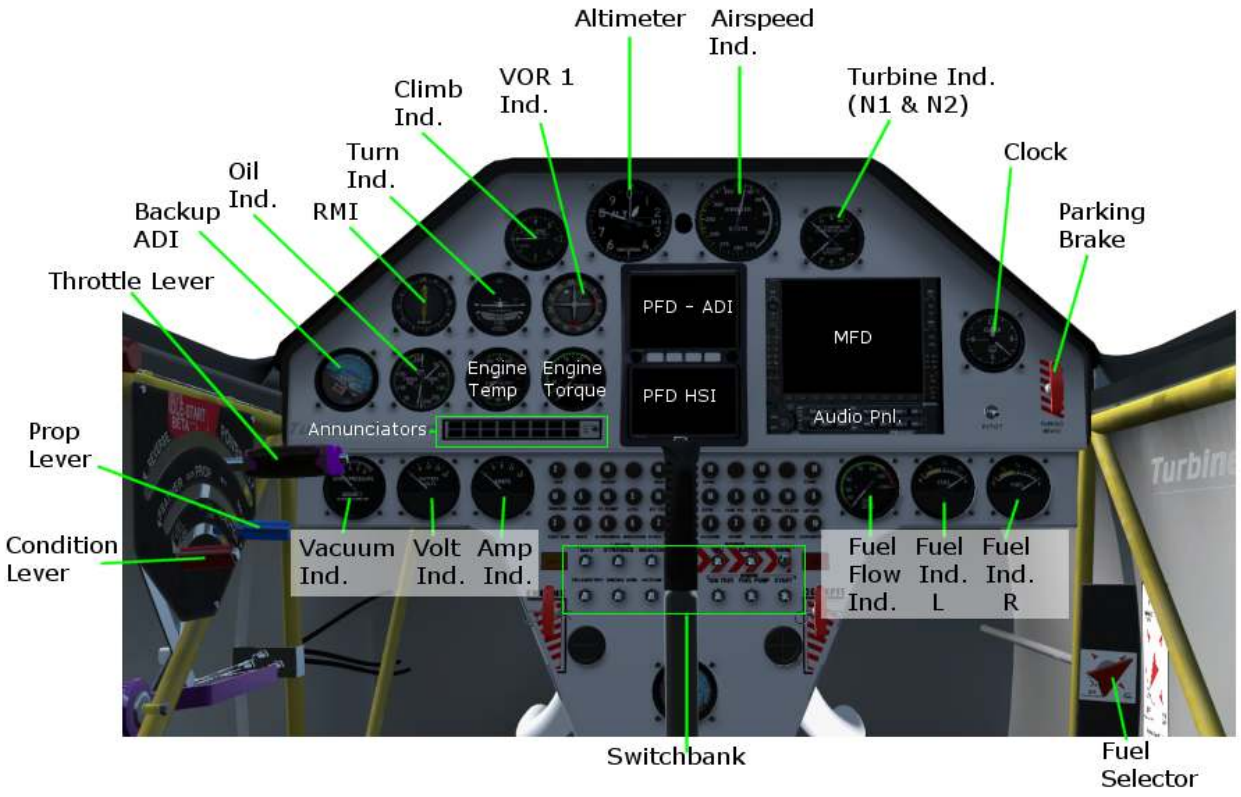
Cockpit

The Turbine Toucan is an open cockpit with canopy design. The virtual version consists of the following:

- 3D Cockpit - Contains the instrument panel, HUD, flight controls, displays and switches. It is recommended that all saved Flights be saved in the 3d Cockpit (Virtual Cockpit) mode to insure that all systems initialize properly.
- 2D View - Consists of the Head Up Display (HUD).
- Pilot Log - Available as a popup panel. This contains data on the aircraft usage, systems, and if necessary, can perform repairs due to engine/prop gearbox failure.

Popup (zoom) views are also available for the MFD and HSI. Simply touch the center of their screens for this expanded view.

COCKPIT DIAGRAM



Avionics

Electronic Flight Instrument System (EFIS)

The Avionics System consists of three glass cockpit displays: the Primary Flight Display (PFD) and the Multi Function Display (MFD). This display system is designed to increase your situational awareness at all times, providing information on the aircraft's attitude, performance, and position. Each of these displays will be described in more detail in the **General Operation** Section.

PFD

MFD

General Operation

Power Control

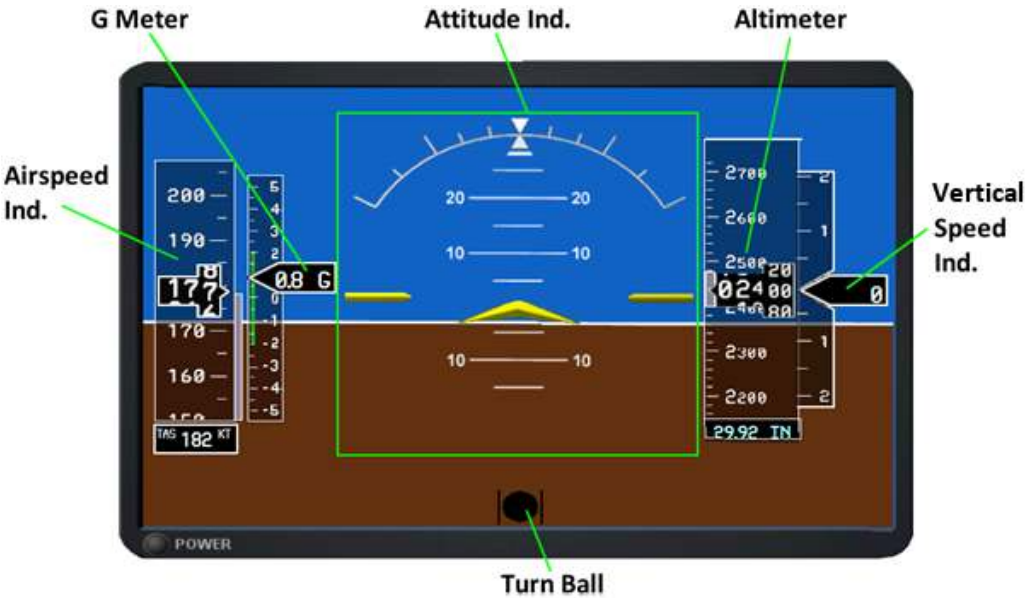
Each unit has a power on/off button. When you depress the power button the system will go through a few different display screens while the system initializes.

Note:
If you load your aircraft when the master power and master avionics switches are on the displays will already be on and ready to operate.

The Primary Flight Display (PFD)

The Primary Flight Display (PFD) provides all the information displayed on a traditional airspeed indicator, attitude indicator, altimeter, vertical speed indicator, horizontal situation indicator, and turn coordinator in a modern, easy-to-scan format featuring a large horizon that's easy to see. The PFD also displays communication and navigational radio information, flight plan data, an inset moving map, outside air temperature, transponder status, and time of day.

Electronic Automatic Direction Indicator (EADI)



Airspeed Indicator

The Airspeed Indicator displays airspeed on a moving tape. The speed is displayed both numerically and as tick marks on the tape, and speed ranges are shown on a color-coded strip. True airspeed (TAS) is indicated digitally on the bottom of the display.

Attitude Indicator

The aircraft's attitude relative to the horizon is displayed via the large blue sky, brown ground, and white horizon line that extends the width of the PFD. The Attitude Indicator indicates degrees of pitch and degrees of roll.

The Turn Ball (Slip/Skid Indicator) is the small bar under the Roll Pointer. It moves away from the Roll Pointer to indicate slip or skid, just like the ball on a traditional Turn Coordinator.

Altimeter

The Altimeter displays barometric altitude in feet on a moving tape. The altitude is displayed both numerically and as tick marks on the tape. An altitude trend vector (magenta line) on the left side of the altitude tape indicates the approximate altitude that will be reached in six seconds given the current vertical speed. The selected barometric pressure is displayed below the altitude tape.

To set the altimeter barometric pressure, rotate the outer ring of the CRS/BARO knob.

Vertical Speed Indicator

The Vertical Speed Indicator displays climb/decent speed on a moving tape. The speed is displayed both numerically and as tick marks on the tape, and speed ranges are shown on a color-coded strip.

G Meter

The G Meter Accelerometer displays current G force on a moving tape. Gs are displayed both numerically and as tick marks on the tape, and speed ranges are shown on a color-coded strip.

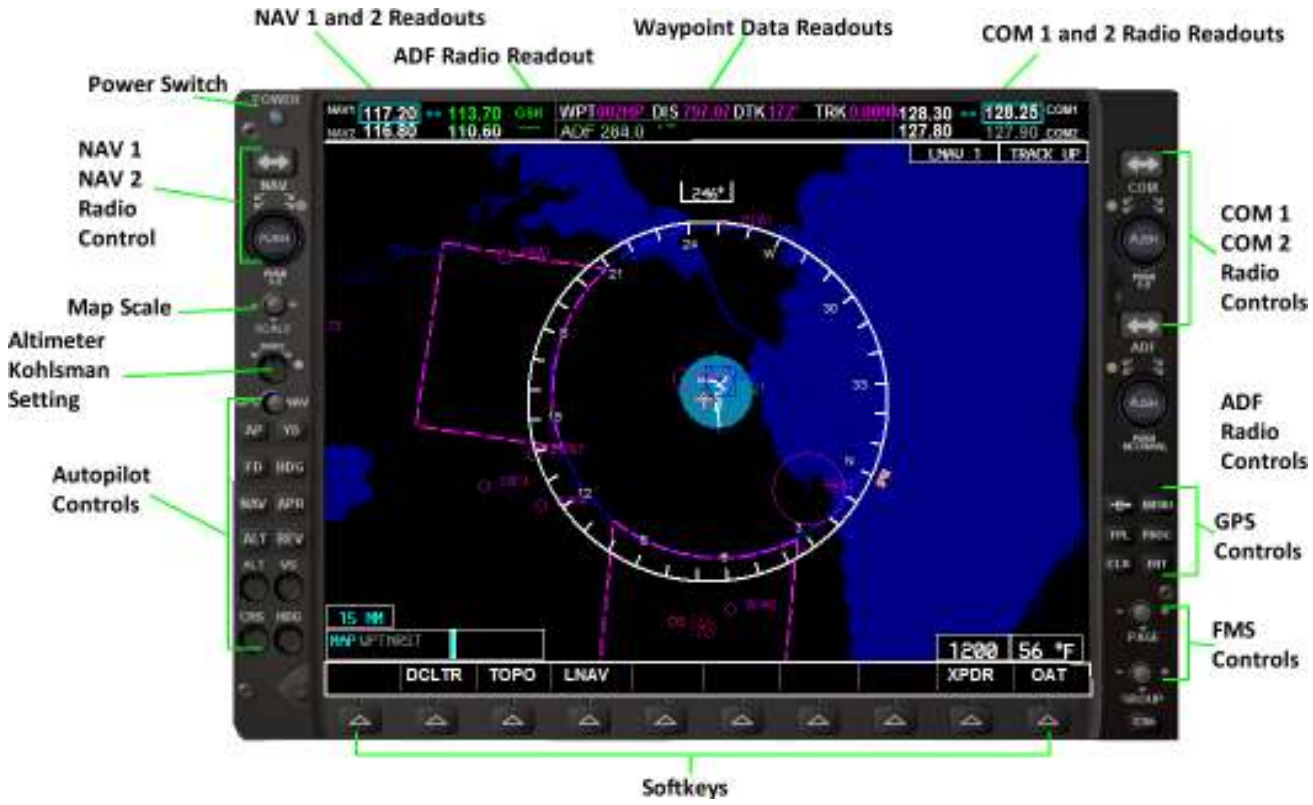
Electronic Horizontal Situation Indicator (EHSI)

The Horizontal Situation Indicator (HSI) displays a rotating compass card with the aircraft's current heading at the top. A heading bug on the compass rose can be set to a desired heading, and the selected heading appears in a box to the left of the HSI.

To set the Heading bug, rotate the Heading Selector knob or press the Heading Selector knob to synchronize with the aircraft's current heading.

Desired navigational course is indicated by a course pointer arrow just like a traditional HSI, and the selected course appears to the right of the HSI. The Course Deviation Indicator (CDI) moves to the left or right of the course pointer to indicate the aircraft's position relative to the course.

The Multi Function Display



The Multi Function Display (MFD) combines engine information with a full-featured GPS and moving map display. You can obtain a zoom in view of the MFD by clicking the moving map area.

Softkeys

Softkeys are keys that can be reconfigured via software to do different things in different situations. One button can serve multiple purposes. Softkeys along the bottom of both the PFD and MFD provide you with access to numerous functions and pages in the AVIONICS. If there is text above a softkey button, then it is an active softkey, and pressing the button will have an effect.

Display/Declutter

Use the declutter (DCLTR) softkey to change the detail of the moving map. Declutter will remove aircrafts and navigation symbols as you sequentially press this softkey.

LNAV Mode

Sequentially pressing the LNAV softkey will control the LNAV displays superimposed on the moving map.

The LNAV display mode is annunciated on the upper right of the display area

There are four LNAV display modes:

Mode 0 - No LNAV Display

Mode 1 - Compass Only

Mode 2 - Compass and NAV/CDI 1

Mode 3 - Compass, NAV/CDI 1 and Bearing to WPT Track *

*FS Flight Plan must be loaded to display waypoint track needle.

Other controls, for the radios, HSI, autopilot and display functions are controlled by conventional rotary knobs. Many of these knobs have an outer ring and an inner knob, each controlling different functions. For example, a radio knob's outer ring would control the decimal frequency values, while the inner knob will control the whole numbers of the radio frequency.

In the case of radio knobs, pressing the inner knob via right mouse click will switch control between frequency 1 and frequency 2 (NAV or COM).

NAV/COM Radio Operation

1. Frequency Window
2. Inner and outer control knobs
3. Frequency swap key

The NAV radios are on the upper left corner of the PFD. The COM radios are in the upper right corner. The radio frequency window (1) displays active and standby frequencies for dual receivers for both NAV and COM, as well as the identifier of a valid, identified navigation aid. The active frequency of each radio is on the right and the standby frequency is on the left. The cyan-colored tuning box indicates which standby frequency will be set using the NAV knob.

To swap the standby frequency and the active frequency, press the Frequency swap key (3):

To tune the standby frequencies for the NAV receivers, rotate the NAV Frequency Selector knobs (2). The inner knob tunes whole MHz values and the outer ring tunes decimal values.

	To toggle the cyan-colored indicator box, and control between transceivers 1 and 2, push the inner knob in using a right mouse click.

Navigation Status Bar The Navigation Status Bar displays flight plan information when flying a route created using the Flight Planner or the AVIONICS Direct-to function:

- Next waypoint
- Distance to the next waypoint (DIS)
- Desired track to the next waypoint (DTK)
- Current track (TRK)
- Navigation annunciations

Outside Air Temperature

The outside air temperature is displayed in degrees Celsius at the bottom right of the MFD. Press softkey 10 to toggle the display on/off. Temperature is expressed in either Celsius or Fahrenheit depending on how the International Setting is selected in your Flight Simulator X **General Options** menu.

Transponder

The selected transponder code is displayed in a box at the bottom right of the PFD.
To select a transponder code:

Press the XPDR softkey. This will display the current transponder code.

Press the softkey again and enter a code sequentially. The code is entered into the transponder automatically once the 4th digit is selected.

Nearest Airports

Press the NRST softkey, and the Nearest Airports window will display above the Transponder Status and Local Time boxes.

To navigate directly to one of the nearest airports:

1. Press the NRST softkey
2. Turn the FMS knob to highlight the desired airport, and then press the Direct-to key. The Direct-to window will appear.
3. Press the ENT key twice.
4. Press the NAV/GPS Switch to switch to GPS navigation mode.

GPS System

The GPS/Navigation information that appears on the PFD is presented on pages, and you can only view one page at a time. Some pages are organized into groups of related pages, called page groups. Think of page groups as chapters in a book, and pages as the pages within each chapter. There are three page groups modeled in the MFD. The Map (MAP) page group includes:

Navigation Map page

Waypoint page group includes:

- Airport Information page
- Intersection Information page
- NDB Information page
- VOR Information page

The Nearest page group includes:

- Nearest Airports page
- Nearest Intersections page
- Nearest NDB page
- Nearest VOR page

Navigating the Pages

Refer to the two switches on the lower right of the unit. To move through the pages of the MFD you'll use the Page switch (+/-).

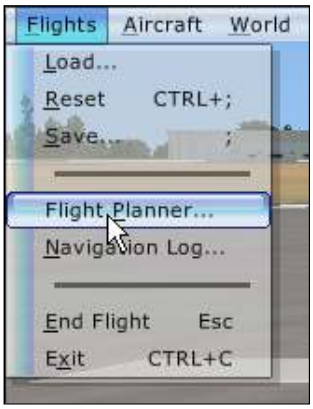
To select a page group use the group Switch (+/-).

The bottom right corner of each page provides a graphical indication of which page group and page within that group is selected. You'll also use the following keys as you work with the MFD pages:

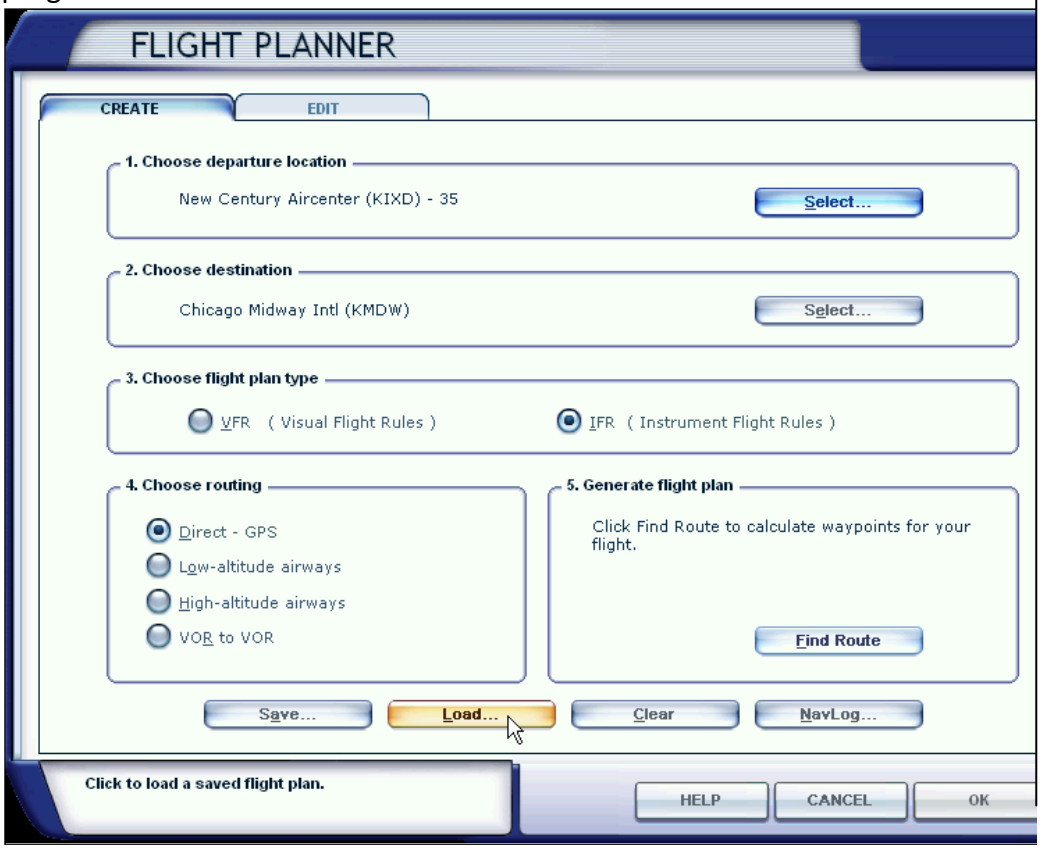
Key	Function
Clear -	Press to erase information or cancel an entry. Press and hold to return to the Navigation Map page at any time.
Enter -	Press to accept a menu selection or data entry.
Menu -	Press to display context-sensitive options.
Cursor -	Press (small FMS knob) to access and enter data.

Loading a Flight Plan

Flight plans may be loaded into the GNS 480 via the Flight Simulator X **Flights** menu. Just click **Flights** and then **Flight Planner**.

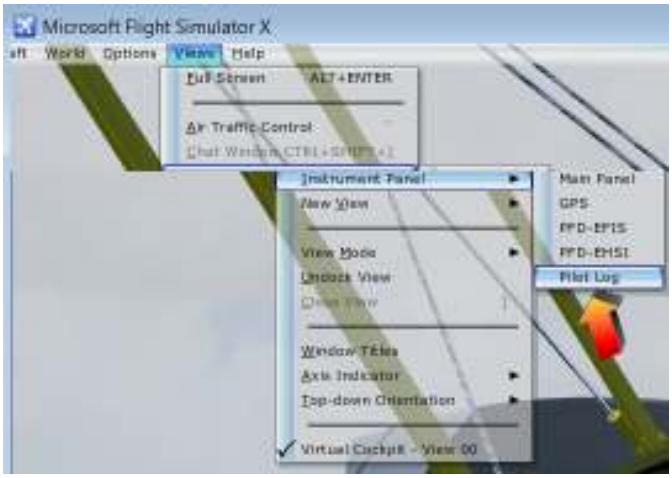


The Flight Planner menu will appear. Either create a new Flight or load and existing one. A review of this procedure can be found in the simulator's **Help** program.



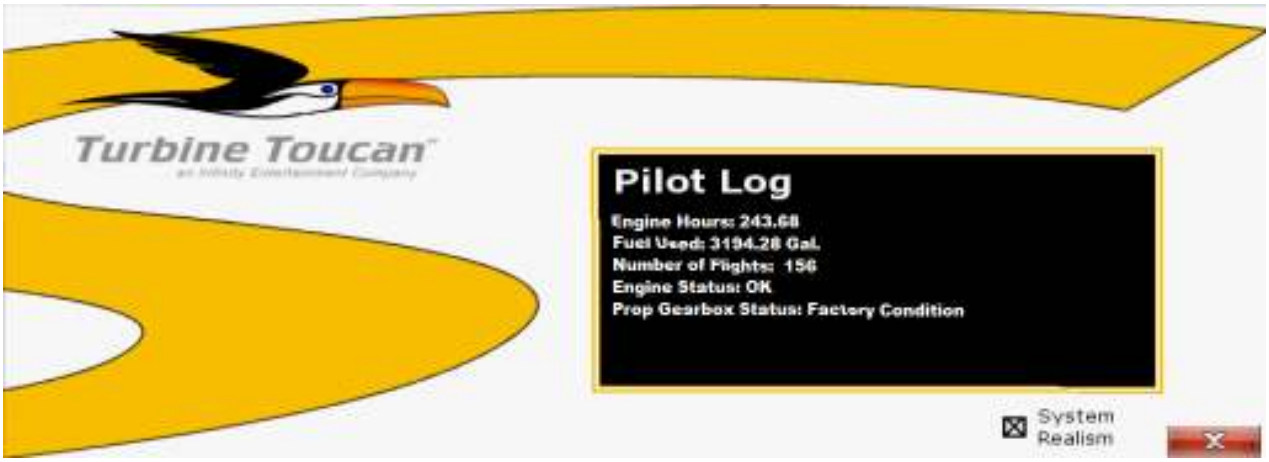
Pilot Log

The Turbine Toucan incorporates a pilot log that you can access from your Flight Simulator X Views/Instrument Panel menu.



The pilot log provides information on:

- Engine hours
- Fuel used
- Number of flights for the Toucan
- Engine status
- Prop gearbox status (amount of wear)



You can also use the pilot log to select System Realism, or to repair the prop gearbox.

Prop Gearbox Damage

The Turbine Toucan's turboprop engine is direct connected to the propeller through a gearbox. The prop can overspeed and cause propeller or gearbox damage. Operation of the Toucan with the engine firewalled will overspeed the gearbox, and cause it to heat up and to wear excessively. Continual operation of even a couple of minutes with the engine firewalled can cause the gearbox to fail and shut down the engine. Care should be taken to never do this. Some turboprops incorporate a speed governor, but as the Toucan is built to perform extraordinary acrobatic maneuvers, the limitations of the turbine/gearbox system is also *pilot controlled*.

If you experience gearbox failure you can repair the system by selecting the Service Button on the Pilot Log. This will restore the gearbox to factory condition. Turning OFF the System Realism checkbox will allow you to operate the Toucan without limitations or possibility of gearbox damage.

Checklists

ENGINE START:

CANOPY	CLOSED & LOCKED
RUDDER PEDALS	ADJUSTED
POWER	
APU SWITCH	SWITCH ON
BATTERY	SWITCH ON
GPU LIGHT	CHECK ON
VOLTMETER	24+ VOLTS
FUEL QUANTITY UPDATED	SET
TELEMETRY SWITCH	SWITCH ON
SMOKE SWITCH	SWITCH OFF
FUEL SELECTOR	SET BOTH
BEACON	SWITCH ON
PITOT HEAT	SWITCH ON
MAX. ITT TEMPERATURE	150°C - If temperature higher than 150°C Cold Cycle Turbine to cool
N1	ZERO
PROPELLER	FEATHER
CONDITION LEVER	FORWARD TO IDLE/RUN/START DETENT
POWER LEVER	GROUND IDLE / START DETENT
PROPELLER	CLEAR
FUEL PUMP	SWITCH ON
FUEL PRESSURE	CHECK 13 TO 40 PSI
START SWITCH	RAISE TO START POSITION

Keep pressure on the power lever against the idle stop during the procedure and then transition to the condition lever. be ready to move to cut off in case of problem.

If the is no Start after 11 second, Shut fuel off by moving condition lever to cutoff and wait for starter motor to disengage before turning power off to investigate the problem.

If Engine Lights Monitor Increasing ITT temperature: If temperature exceeds 700°C, quickly pull the condition lever to the shut off position.

GPU (no load)	CHECK 20 to 31 V
BATTERY VOLTAGE	CHECK 14 V MIN
N1	INCREASES TO 60% and monitor ITT
N1 AND ITT	CHECK STABILIZED
GENERATOR SWITCH	ON
APU SWITCH	SWITCH OFF

OIL PRESSURE	CHECK 35 PSI MIN
FUEL PRESSURE	29-35 PSI MIN
AVIONICS SWITCH	SWITCH ON

NOTES:

1. It is good practice to start the turbine with headsets off. A possible over temp can be heard quicker than the ITT gauge can respond.
2. Over temperatures MAY occur if the Power Lever is forward of the flight idle stop, the batteries are low, or there is high outside temperature and / or elevation. If there is a high turbine temperature (over 150°C) before starting, a wind from the rear, a blockage of the air intakes may also cause an overtemp.
3. The cooling cycle is never a procedure unto itself, but instead is always part of a restart. If the engine has been cold cycled be sure the N1 indication is at zero before returning the Engine Condition Lever to the Idle/Start/Run detent. Fuel pump is driven by the N1 shaft so if there is rotation, fuel is introduced at the time the Engine Condition Lever is moved to the Idle/Start/Run detent. Fuel will enter the combustion chamber any time the engine condition lever is in he run position WHENEVER N1 IS SENSED. Prior to the start after cold cycling the engine, move the battery switch to off and then back on.
4. When engaging the Start Switch, count four seconds. If you have a light off in much less than four seconds, you have an abnormal start. Don't wait to see what happens next. Shut it down!

BEFORE TAKE-OFF CHECK LIST:

CANOPY	LOCKED
FLIGHT CONTROLS	FREE
TRIM	NEUTRAL
MFD	SWITCH ON
TRANSPONDER CODE	SET AS REQUIRED
FUEL PUMP	CHECK ON
FUEL PRESSURE	CHECK NORMAL
FUEL SELECTOR	CHECK SET TO BOTH
STROBES	SWITCH ON
CAUTION LIGHTS	ALL OUT
PARKING BRAKE	RELEASE

TAKE-OFF:

Make sure the propeller has come out of beta range and stabilized before adding power. (Adding power whilst the transition is taking place from beta to normal mode will result in an over speed of the propeller stretching the blades on the power turbine wheel leading to possible failure.

Additionally, adding full power with brakes on and then released will also result in an over-speed. Believe it or not, the lack of inertia and the excessive acceleration creates a situation where the propeller governor cannot keep up. It results in a transient overspeed.

Add power gently to achieve the necessary take off power. Monitor the ITT, N1, N2 and torque. Max ITT on takeoff is 600° C. Max. Take Off Power should be limited to 30 seconds.

ITT	600°C MAX
Max. N1	101.5%
Max. N2	100 %
Max. Torque	105%

Unlike conventional piston engine aerobatic aircraft, you cannot just firewall power and let the propeller governor do all the work. Careful monitoring of engine parameters has to be monitored, especially during takeoff. **THE PILOT IS ULTIMATELY THE GOVERNOR OF ALL FOUR OF THE ENGINE PARAMETERS**, making it more of a challenge then the run of the mill piston aerobatic aircraft. **DAMAGE TO THE PROP GEARBOX MAY OCCUR IF SUSTAINED ENGINE TORQUE OF MORE THAN 80 % CAN OCCUR IN LESS THAN TWO MINUTES.**

Ambient weather conditions have a big effect on turbines, how they perform as well as how they need to be operated.

On a cooler day @ sea level (12.5ºC) the pilot will most likely run into torque limitation first. Running to max torque (within normal parameters) on a cold day means you will torque out. That is our operational language.

On a hot day @ seal level (29.5ºC) the pilot will most likely run into ITT limitations first. Running to max ITT (within normal parameters) on a cold day means you will temp out. That is our operational language.

Obviously the scenario gets more complex when you add ambient temps with airfield altitudes. This would make for a very neat matrix for sim pilots.

Take-Off Acceleration:

The aircraft at air show weight can accelerate from 0-120kts in just about 3 seconds @3 G's. It is comparable to a catapult launch with an aggressive takeoff power setting.

Take-Off Performance (VY):

At air show weight (25gals + pilot) the plane can perform at 10,000fpm rate of climb with the correct climb angles and keeping the wing loaded.

Take-Off Performance (VX):

At air show weight (25gals + pilot) the plane can perform a 90º vertical after only 100ft. of ground roll. Fuel of fuel (94 gals), and a big pilot on a hot day, we flew at 80º deck angle to 10,000ft in just under 2 minutes.

Cruise:

The Turbine Toucan's most efficient cruise speed is 180kts indicated. At sea level the burn will be about 42GPH. At altitude (17,500ft.) the burn is down to 32GPH. This is with prop set at 1900rpm.

Top Speed:

We don't publish top speed because if we are classified over a certain speed, we get a much different air show waiver, which pushes us way out of the flight line and we don't get a surface waiver. Since our mission is about air shows and not speed, we keep those numbers confidential. Since this is for Simulation, it is fair to say 255kts at sea level is achievable.

Aerobatics:
The Turbine Toucan does standard aerobatics very similar to any other piston aerobatic aircraft. Turbine lag or spool up does not come into play much unless you are doing gyroscopic maneuvers. Turbines don't like gyroscopic maneuvers so we stay away from them but focus on what the airplane does best, and what no other aerobatic aircraft can do: VERTICAL Performance. Fuel burn during aerobatics at near sea level altitudes are in the 65-70 GPH range.

Hovering is achieved by reducing power back behind 50% and slowly raising the nose up. As the speed decreases, pitch angle will increase to about 60º up. Airspeed will roll off to about 40kts. As the speed continues to decrease, power is slowly to about 65% as pitch is increased to 80º. As the pilot pulls pure vertical, airspeed now is almost completely rolled off to zero as power is again added to about 70%.

Once in the pure vertical, some power will have to be reduced. It is counter intuitive but even at 70%-75% the aircraft will creep up in the vertical. To accelerate in the vertical, 100% power is applied to overcome the static vertical. It will start to accelerate to about 60kts up to 10,000ft.

Vertical loops (nose always pointed up) are possible, up to the pilot to figure it out.

At zero airspeed hovering, there is enough thrust vectored across the control surfaces (thanks to full span ailerons and 100" prop) to control the plane in the roll (z) axis. Side to side maneuvering is done via rudder and forward and aft is controlled by elevator, as you well know.

The combination of excessive power, roll rates (350º a second) via oversized control surfaces creates all sorts of possibilities with never before seen maneuvers.

Creativity is what this plane will be all about as it opens up a whole suite of possibilities never before performed by a full-scale, fixed wing propeller driven aircraft.

Users should be encouraged to create new maneuvers and submit them on your site for replay or something of that nature. Anything to create dialog between users to create competition and exchanges of ideas etc….

SHUT DOWN:

PARKING BREAK	SET ON
POWER LEVER	IN DETENT
PROPELLER	FEATHER
MFD	SWITCH OFF
PFD	SWITCH OFF
AVIONICS SWITCH	SWITCH OFF
FUEL PUMP SWITCH	SWITCH OFF
CONDITION LEVER	CUTOFF

THEN SMILE……..

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