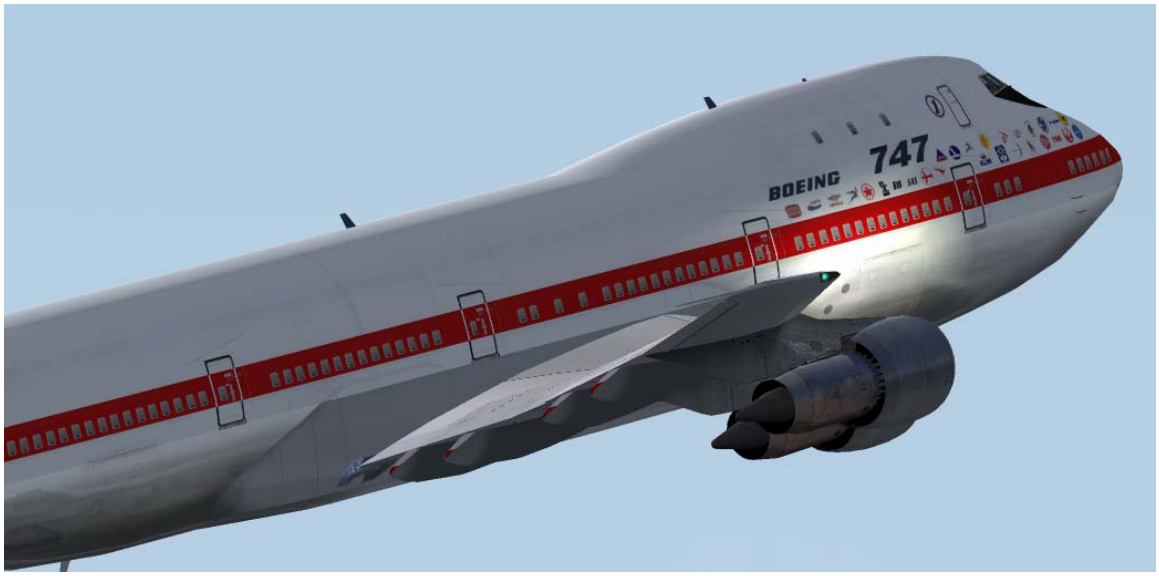
OPERATIONS MANUAL
FLT CREW TRAINING

PROJECT OPENSKY
B747

TAXI, TAKEOFF, CLIMB, CRUISE, DESCENT & LANDING



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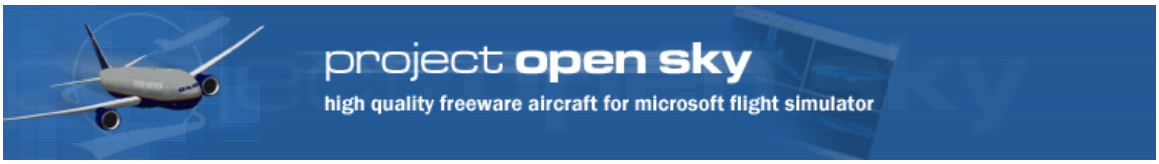

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The procedures contained within are this author's interpretation of generic flight operations. These procedures are not always accurate in all situations.

All diagrams have been recreated to mimic actual procedures or scenarios, however, are not taken from actual materials whatsoever.

This manual is not intended for real world flight.

Project Opensky Boeing 747-100, 747-200, 747-300, 747-400, 747-400ER, VC-25A Series
Versions 1, 2, 3, and 4

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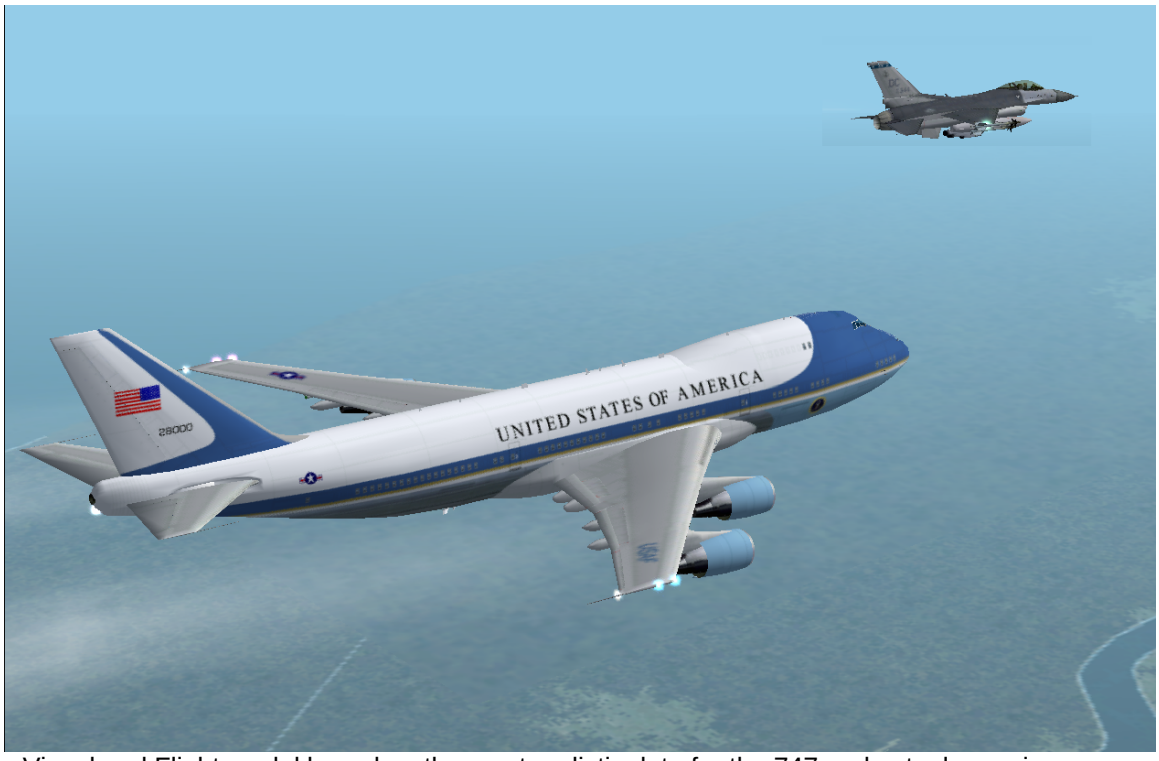


Visual and Flight model based on the most realistic data for the 747 and actual experiences on 747 flight decks. **Simon Ng** has provided many tireless hours of instruction, feedback and advice. **Without Simon and Kitaguchi-san, the 747 could not have taken place.** Also many thanks to several other friends who will remain anonymous.

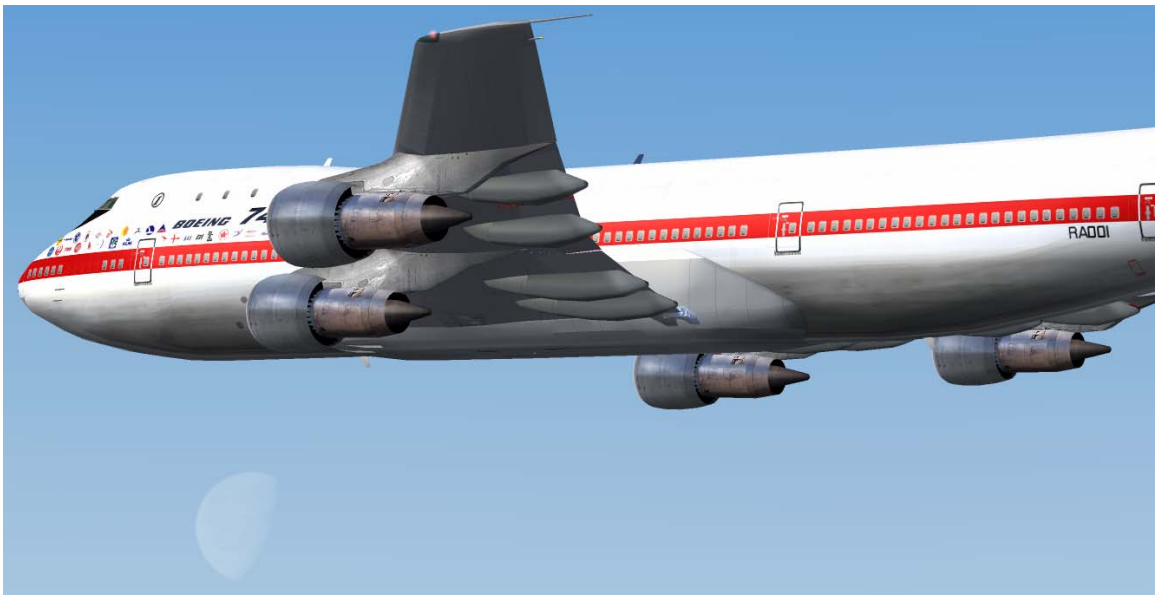
PREFACE

This manual serves as a reference for operating procedures and training maneuvers. The flight profiles show the basic recommended configuration during flight. The maneuvers should normally be accomplished as illustrated. However, due to airport traffic, ATC distance separation requirements, and radar vectoring, modifications may be necessary. Exercise good judgment.

PRINCIPLE DIMENSION AND AREAS

Boeing 747-100, -200, 300, -400, VC-25 – Aircraft Reference Manual

Flight Simulator X



1) Height – 63 ft 5 in

2) Length -- 231 ft 10 in

3) Span -- 195 ft 8 in (211 ft 5 in, 213 ft – fueled – 747-400, not including –400D)

4) Engine to Ground Distance:
Minimum -- 3 ft and 9 in
Maximum -- 4 ft and 6 in

5) Fuselage to Engine Distance: (fuselage centerline to engine centerline)
39 ft and 9 in (255 in)

6) Landing Gear:
Track -- 12 ft 7 in (inner main gear)
36 ft 1 in (outer main gear)
Wheelbase -- 84 ft and 0 in

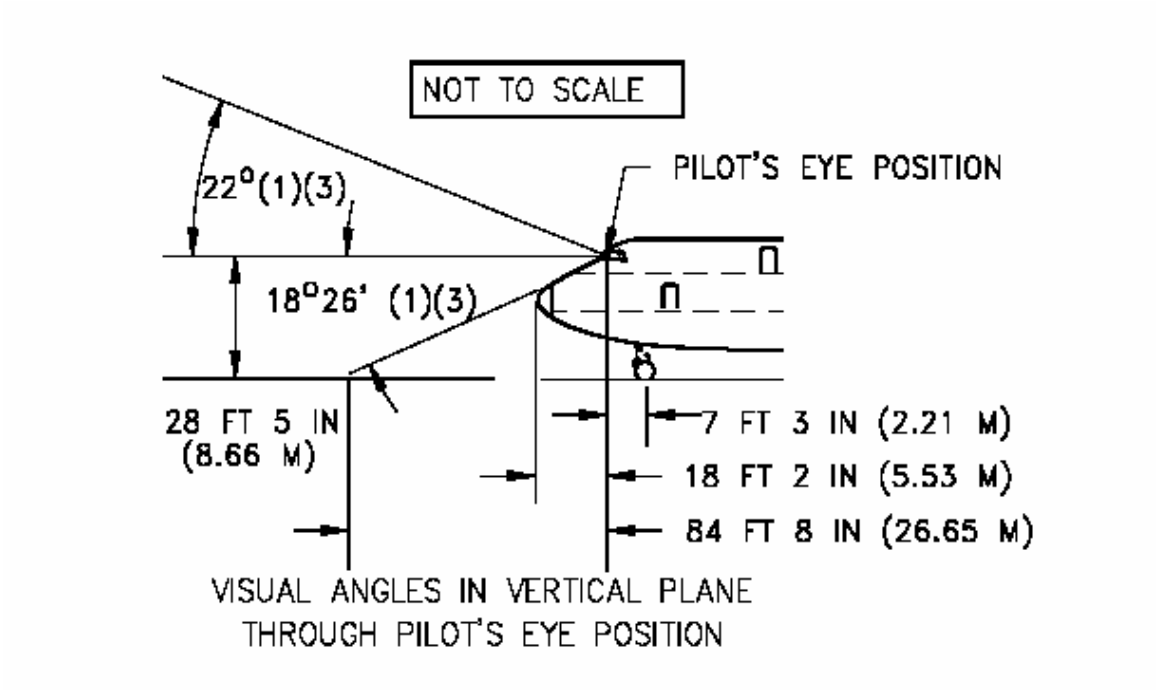
7) Cruising Speed: M.84 (-100, -200, -300), M.85 (-400)

8) Range and Target Fuel Burn:

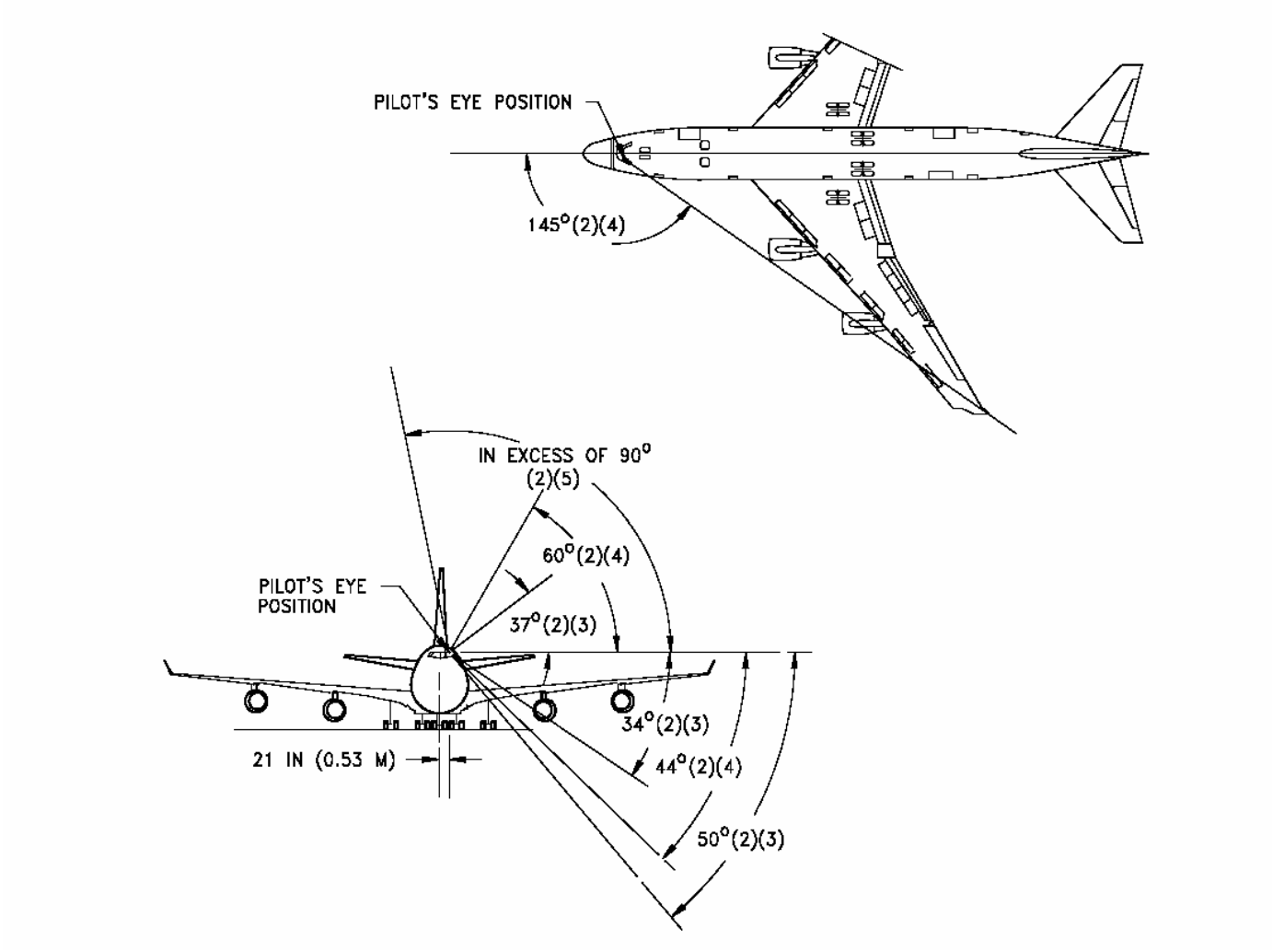
747 Type	PW	GE	RR
741 (Fuel Burn - 4 Engines - PPH)	22628		
Range	5300 nm		
742 (Fuel Burn - 4 Engines - PPH)	22628	23320	22440
Range	6560 nm	6370 nm	6620 nm
743 (Fuel Burn - 4 Engines - PPH)	23468	24192	23620
Range	6330 nm	6140 nm	6290 nm
744 (Fuel Burn - 4 Engines - PPH)	21436	20336	20576
Range	6930 nm	7305 nm	7220 nm

BASIC PILOT INFORMATION

Use caution while taxiing - Pilot's view reference point is approximately 18.26 feet from the ground, with ground visibility limited to 28.5 feet looking down at an angle of 22 degrees:



For proper engine and aircraft operations, the captain must view the EICAS as the engines and wings **are not** visible from the flight deck. Pilot's rearward view is based on the captain's eye reference point with 145 degrees of travel.



TAXI

1) The nose wheel steering and the engine thrust are used to taxi the airplane.

2) Make sure you have the necessary clearance when you go near a parked airplane or other structures.

3) Set takeoff flaps. Opensky recommended setting is Flaps 10, or Flaps 20, weight dependent. See speed reference charts.

4) When the APU in the taxi airplane or the parked airplane is on you must have a minimum clearance of 50 feet between the APU exhaust port and the adjacent airplane's wingtip (fuel vent).

5) The taxi speed must not be more than approximately 30 knots. Speeds more than 30 knots added to long taxi distances would cause heat to collect in the tires. Recommended speed is 20 knots. Beware of changing GS numbers due to tailwinds during taxi.

6) Before making a turn, decrease the speed of the airplane to a speed of approximately 8 to 12 knots. Make all turns at a slow taxi speed to prevent tire skids.

7) Do not try to turn the airplane until it has started to move.

8) Make sure you know the taxi turning radius.

9) Monitor the wingtips and the horizontal stabilizer carefully for clearance with buildings, equipment, and other airplanes.

10) When a left or right engine is used to help make a turn, use only the minimum power possible.

11) Do not let the airplane stop during a turn.

12) Do not use the brakes to help during a turn. When you use the brakes during a turn, they will cause the main and nose landing gear tires to wear.

13) When it is possible, complete the taxi in a straight-line roll for a minimum of 10 feet.
NOTE: This will remove the torsional stresses in the landing gear components, and in the tires.

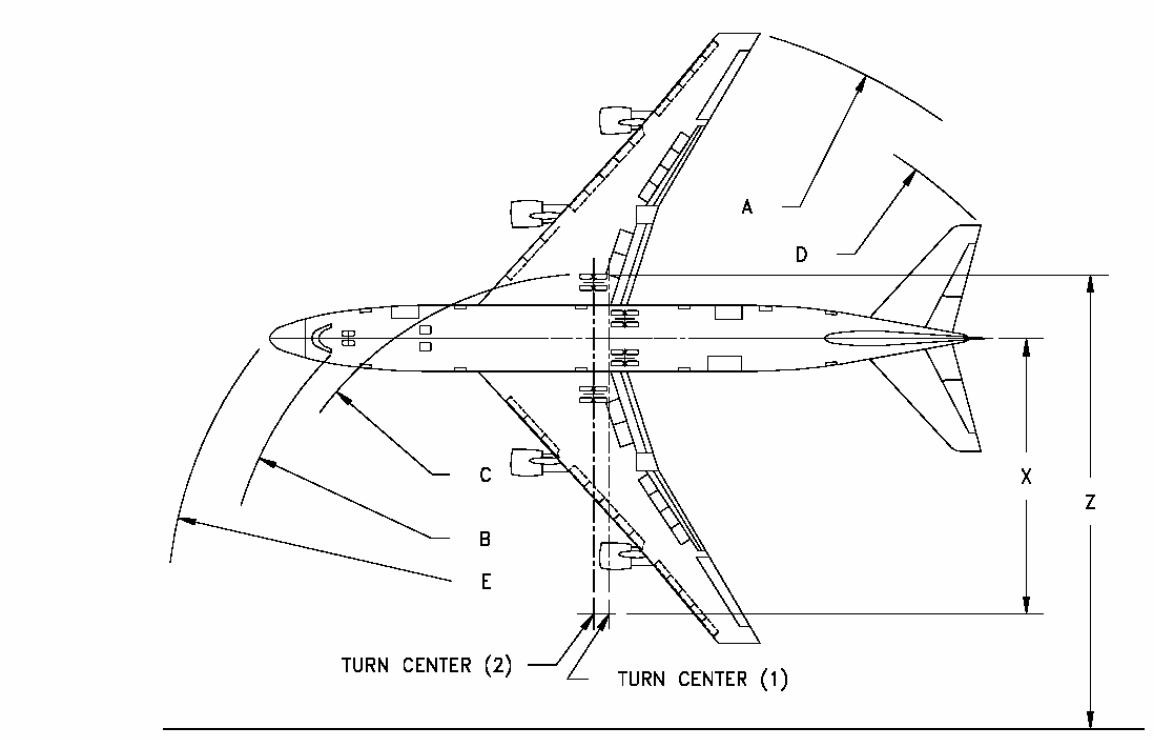
14) Use the Inertial Reference System (IRS) in the ground speed (GS) mode to monitor the taxi speed.

15) If the airplane taxi speed is too fast (with the engines at idle), operate the brakes slowly and smoothly for a short time. NOTE: This will decrease the taxi speed.

16) If the taxi speed increases again, operate the brakes as you did in the step before.

17) Always use the largest radius possible when you turn the airplane. NOTE: This will decrease the side loads on the landing gear, and the tire wear will be decreased.

18) **Extra care must be given to turn the aircraft due to the fuselage length and wingspan**. A minimum distance from the edge of the pavement must be maintained to reverse the aircraft's direction. Minimum distance is 113 FT. of pavement:



19) Operate the brakes to stop the airplane.

20) Set the parking brake after the airplane has stopped.

TAKEOFF

1) Align aircraft with runway centerline.

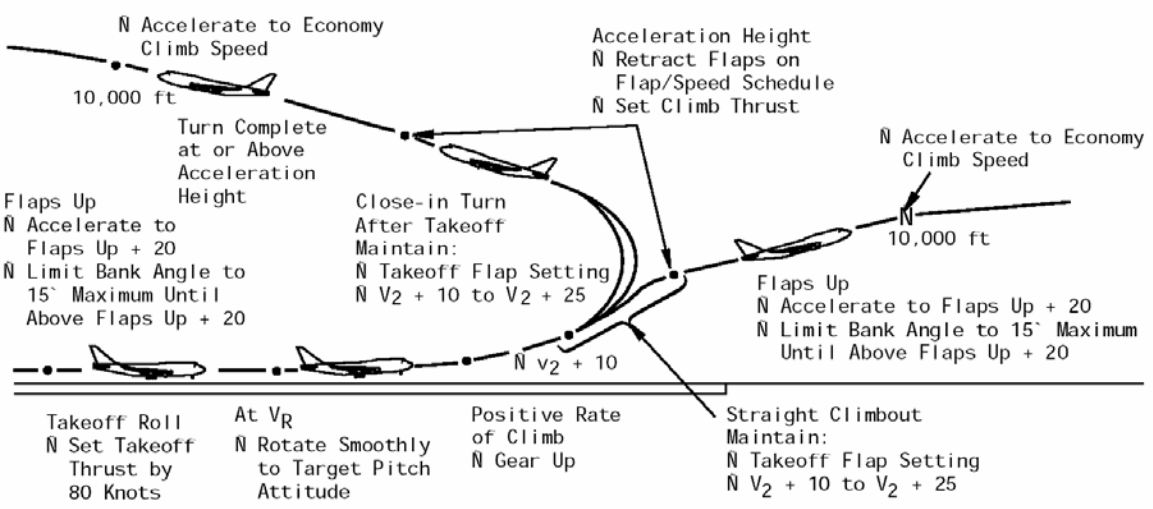
2) Increase power to approximately 60% N1, pause briefly to verify that engines have stabilized.

3) Watch EICAS indicator for engine problems or aircraft alarms.

4) Increase power smoothly to pre-determined N1 speeds based on aircraft takeoff weight, (85% - 105% N1). This can either be done manually or using the autothrottle with the autopilot engaged.

5) At Vr, smoothly rotate aircraft 8 degrees upwards at a pitch rate of 2 – 3 degrees per second. **DO NOT rotate more than 8 degrees to avoid tail strike. Tail strike will occur at 11 degrees** rotation. (For V-Speed Table, 747PERFORMANCE.PDF, or calculate on FMC.)

6) Hold nose at +10 - 12 degrees after positive rate of climb is confirmed, then raise landing gear after V2 (see below).



7) Set initial climbout speed to V2+10 KTS.

8) Maintain +10 - 12 degrees climb to 1500 FT, or obstacle clearance, whichever is higher. +10 degrees climb after 1500 FT.

9) At 1500 FT above field elevation, begin slat retraction per retraction table. Maximum slat speed limits are:

Slat Position	Max Speed
1	280
5	260
10	240
20	230
25	205
30	180

10) Increase speed to 230 – 250 in accordance with ATC instructions (max 250 KTS below 10,000 FT).

11) For full maneuverability beneath 10,000 FT, slats must be fully retracted with aircraft at minimum safe airspeed.

CLIMB

1) Select highest CLB N1 setting. Once climb thrust or airspeed is set, the autopilot will compensate for environmental condition changes automatically during the climb.

2) It is recommended that the aircraft be flown manually up to 15,000 FT, weather and ATC traffic conditions permitting. However, in high traffic conditions, to easy the workload of the pilot, the autopilot MCP altitude intervention may be engaged above a minimum altitude of 80 FT with the landing gear up.

3) Climb settings use a 10 – 20% derate of thrust up to 10,000 FT, then increases linearly to max thrust at 30,000 FT.

4) For **enroute climb**, climb at a rate of 1800 - 3000 FPM, pursuant to ATC and traffic conditions. If there is no altitude or airspeed restrictions, accelerate to the recommended speed. The sooner the aircraft can be accelerated to the proper climb speed, the more fuel and time efficient the flight.

5) As **engine and wing icing** may occur during the climb and descent, the engine anti-icing system should be in the AUTO or ON position whenever icing is possible. NOTE: Failure to do so may result in engine stall, overheating, or engine damage.

6) **For normal economy climb**, follow ATC speed restrictions of 250 KTS below 10,000 FT. If permitted by ATC and no speed restriction below 10,000 FT, increase speed to 290 KTS. Above 10,000 FT, climb at 330 KTS or . 85 MACH. Climb speed table is as follows:

ALTITUDE	**SPEED**
Sea Level to 10,000 FT	250 KTS
Above 10,000 FT	330 KTS/.85 MACH

7) **Max climb speed** is 330 knots until reaching .85 MACH at initial cruise altitude.

8) **For engine out climb**, speed and performance various with gross weight and altitude, however 260 knots at 1000 – 1500 FPM may be used.

9) Set **standard barometer** above airport transition level (depends on local airport geography).

CRUISE

1) **Cruise above crossover** at . 84 - .85 MACH for 747 Classic. M.85 – M.86 for 747-400.

2) **Cruise below crossover** at 340 knots IAS or M.82.

3) **Headwinds** will increase engine power, reduce cruise speed and decrease range.

4) **Tailwinds** will decrease engine power, increase cruise speed and increase range.

5) Follow previously entered FMC waypoints.

6) **Fuel Freeze --** Extended operation at cruise altitude will lower fuel temperature. Fuel cools at a rate of 3 degrees C per hour, with a max of 12 degrees C in extreme conditions. Fuel temperatures tend to follow TAT (total air temperature). To raise fuel temperature/TAT, a combination of factors can be employed:

   - Descend into warmer air.
   - Deviate to warmer air.
   - Increase Mach speed.

   An increase of 0.01 MACH will increase TAT by 0.5 – 0.7 degrees C.

7) **Increased fuel burn** can result from:
   - High TAT
   - Lower cruiser altitude than originally planned.
   - More than 2,000 FT above the optimum calculated altitude.
   - Speed faster or slower than .85 MACH cruise.
   - Strong headwind.
   - Unbalanced fuel.
   - Improper aircraft trim.

8) **Fuel penalties** are:

   - 2000 FT above optimum – 3 percent increase in fuel usage
   - 4000 FT below optimum – 5 percent increase in fuel usage
   - 8000 FT below optimum –12 percent increase in fuel usage
   - M.01 above M.85 – 3 percent increase in fuel usage
   - Higher climb rates, 3000 fpm over 29,000 – increased fuel usage

9) In the case of **engine out cruise**, it may be necessary to descend. NOTE: For 747 **three engined** limitations, divert to the nearest available airfield to avoid overstressing engines and unnecessary risk. Use good judgement to select an airfield that can accommodate an aircraft of this size. Consideration must also be giving to ground facilities to accommodate number of passengers on board.

10) Trim aircraft for proper elevator alignment.

11) In case of engine out cruise, trim rudder for directional alignment.

12) Deviate from flight plan for weather, turbulence, or traffic as necessary after receiving clearance from ATC.

DESCENT

1) Descent at pre-determined TOD (Top of Decent)

2) Descend at 320 KT above 10,000 FT.

3) Use speedbrakes or thrust to minimize vertical path error.

4) Proper descent planning is necessary to ensure proper speed and altitude at the arrival point. Distance required for descent is 3NM/1000FT. Descent rates are as follows:

Intended Speed	**Decent Rate**	
	CLEAN	WITH SPEEDBRAKES
.85 MACH/320 KTS	2300 FPM	5500 FPM
250 KTS	1400 FPM	3500 FPM
VREF 30 + 80 KTS	1300 FPM	2400 FPM

5) Plan to descend so that aircraft is at approximately 10,000 FT above ground level, 250 KTS, 30 miles from airport.

6) At average gross weights, it requires 80 seconds and 7 NMs to decelerate from 290 KTS to 250 KTS for level flight without use of the speedbrakes. It requires 120 seconds to slow from 290 KTS to minimum clean airspeed. Using speedbrakes will reduce the times and distances by half.

7) Arm speedbrakes and autobraking to position 2 or 3 on initial descent.

8) Set airport altimeter below transition level.

9) Avoid using the landing gear for drag above 180-200 KTS to avoid damage to doors or passenger discomfort.

10) **Recommended approach planning**, ATC and airport rules permitting:

- 250 KTS below 10,000 FT, 30 miles from airport.
- 180-230 KTS, 23 miles from airport.
- 160 KTS, 16 – 17 miles from airport.
- VREF, 5 – 7 miles from airport.

11) **In case of rapid descend due to depressurization**, bring aircraft down to a safe altitude as smoothly as possible. Using the autopilot is recommended. Check for structural damage. Avoid high load maneuvering.

12) **Bank Angle Protection (BAP)** is not available on the 747. Over 36 degrees of bank, an audio “bank angle” alarm will sound.

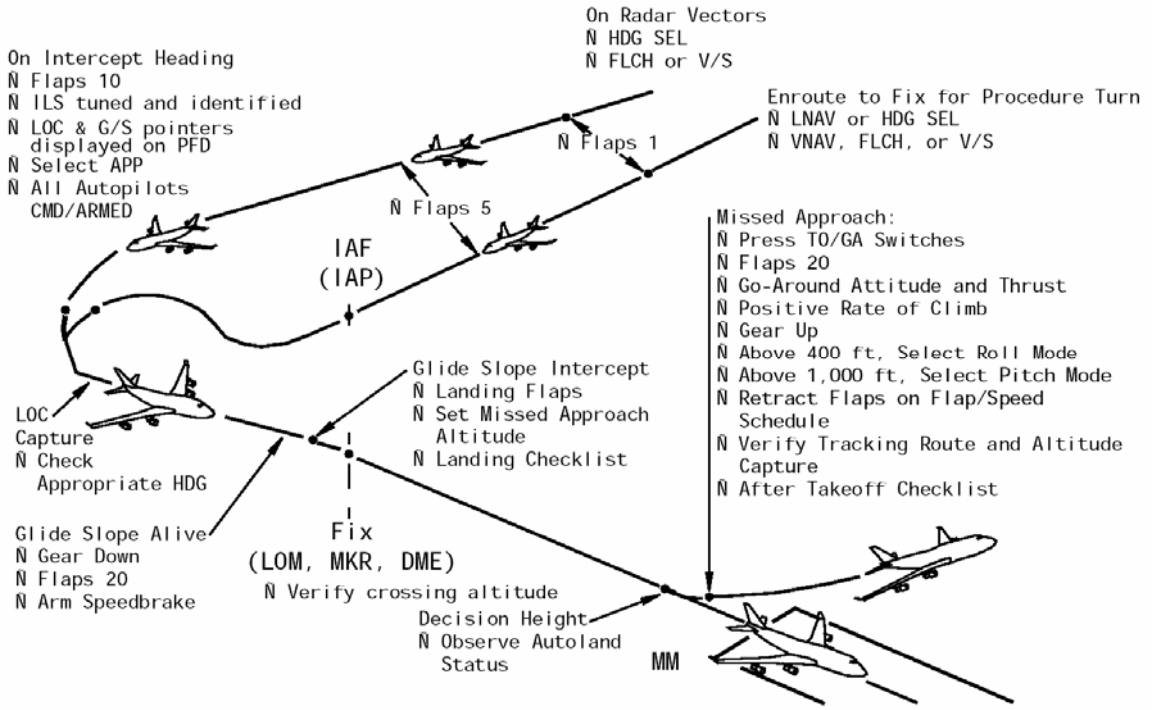
13) **Stall recovery** can be accomplished by lowering the aircraft's nose and increasing power at once to gain airspeed. Beware of terrain. Accelerate to VREF 30 + 80 KTS. Do not retract gear until confirmed stall recovery and positive rate of climb. Keep nose at 5 degrees above the horizon or less.

14) If deployed, do not retract slats during the recovery, as it will result in altitude loss.

15) In the event of engine out approach, approach at VREF+5 @ flaps 20.

16) Under normal conditions land at VREF @ flaps 30. (For V-Speed Table, 747PERFORMANCE.PDF, or calculate on FMC.)

17) **ILS Approach** - During initial maneuvering for the approach, extend flaps to 5. On runway intercept heading, slow to 180-200kts and flaps 10. When the localizer is alive, extend flaps to 20 and maintain 180kts. At one dot below glideslope intercept, extend the landing gear and flaps to 25. Begin slowing to final approach speed. At the final approach fix, extend flaps to 30 and slow to Vref + 5. Be stabilized by 1000 feet above field level. This means, gear down, flaps 30, Vref +5 and engines spooled. Plan to cross the runway threshold at Vref.



18) **Visual Approach** - Similar to the ILS approach. The major difference is that aircraft must be stabilized by 500 feet above field level, as opposed to 1000 feet.

19) A stabilized approach at Vref +5 will result in a pitch attitude of 2-3 degrees nose up. Cross the threshold at Vref. Begin the landing flare at about 30ft. Only about 1-2 degrees of pitch up is necessary. The tail will strike at approximately 9 degrees. Slowly reduce thrust to nearly idle. Landing with thrust at idle will result in a firm touchdown. Set thrust just above idle. At touchdown, fly the nosewheel on. At touchdown, autospoilers should deploy. Deploy reverse thrust. Normally, autobrakes 1 is sufficient stopping power. 2 is sufficient for short or wet runways. Be out of reverse thrust by 80kts to prevent foreign object damage to the engines.

20) For **wind correction**, add ½ the steady state wind plus all of the gust factor to the Vref. Do not add more than 20 kts. When landing in a crosswind, do not bank excessively as wingtip or engine pod strike may occur.

21) The Project Opensky 747 is a CATII/III aircraft, meaning the aircraft is capable of landing on autopilot in conditions where visibility is down to 50ft AGL.

22) Land the aircraft.

23) Disengage (autopilot autothrottle will disengage) reverse thrust at 80 knots.

24) Disengage autobraking at 60 knots or as necessary.

25) Turn off onto high-speed taxiways at 30 knots or less.

26) Reverse thrust is most effective at higher speeds. Slow to safe taxi speed with braking and exit the runway.

27) Decelerate to 8 – 12 knots for 90 degree turns.

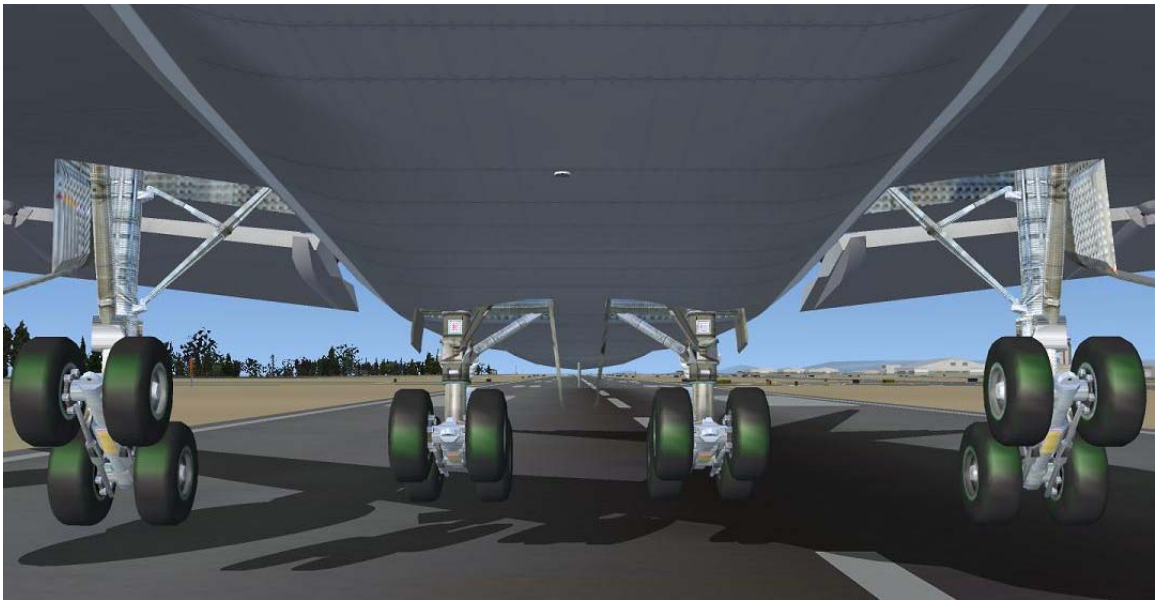
28) Taxi to gate.

Project Opensky Boeing 747 – Frequently Asked Questions

Q) What's new for this Version 2006.9.6-FSX?

A) The FDE is now compatible for both FSX and FS9, using features and views optimized for FSX. The plane will still function in FS9. MSFS9 will simply ignore the entries for FSX.

Below is an example of the newer FSX views:



Q) The FDE now has the "true-feel" format. OMG, the FDE is much harder to fly than before. The plane is more difficult to handle. What happened?

A) After spending time in DC-10, 737, 747-400, 757, 767, and 777 Level D simulators, I realized that the performance for the previous generation of FDEs was there, however, I grossly underestimated the actual "feel" of large aircraft. In large commercial airliners the control surfaces

are effective, however, the sheer mass and inertia of the plane cause delays in how quickly the aircraft reacts to inputs.

To date, all FDEs I have flown (including my own) have failed to capture this critical element – inertia. This new generation of FDEs is designed to show the average flight simmer exactly how difficult it is to fly a large aircraft, particularly in adverse weather or emergency conditions.

I have flown small aircraft, Level D simulators, and have been designing FDEs for nearly 10 years now. I can confidently say now, THIS is how the real aircraft FEELS and PERFORMS. I feel I have captured about 95% of how the actual aircraft feels in a Commercial Level D simulator and actual flight. The remaining 5% I could not capture are things such as airframe vibration through wing flap (fueled wings which are off-center have quite a lot of inertia of their own) and control surface slip (first the control surfaces "bite" into the air, then they begin to move the aircraft after some point in time– this feeling is difficult to mimic without an actual motion sim, although I have added more "slip).

The control surfaces are heavy, but effective. If you actually take the time and LOOK at a large aircraft, you will notice the control surface, say an aileron, has only a small surface area in relation to the rest of the plane. These surfaces must "push" the aircraft in the desired direction. As in the actual aircraft, you will find yourself often "overcompensating" and correcting when you fly manually until you become used to the feel.

If you find the aircraft a challenge to fly, imagine an engine out emergency, landing in gusty or side wind conditions, or on wet/icy runways. My goal is to show you what an actual commercial pilot experiences.

Q) But the controls are SO heavy. Are you sure this is right?

A) The control surfaces require 45 – 55 lbs of force to move the yoke, control wheel and rudders. This new generation of FDEs places emphasis on both performance AND feel. I am not trying to make a video game – I'm designing flight simulator dynamics.

Q) It's hard to keep her on the runway with a stiff crosswind. What do I do?

A) Typically, you will want to crab into the wind as you approach the airport. On reaching the threshold, you want to aim at the side of the runway into the wind. As you touchdown, use the rudder to yaw the aircraft straight. You will feel the tires scrubbing across the pavement as the wind and your momentum pushes you across the runway with the direction of the wind.

Q) It's hard to stop. Reverse thrust is very un-effective. How do I stop more effectively?

A) The majority of stopping power when landing is from the brakes. The thrust reversers do almost nothing to stop the airplane. Set your auto brakes to position 3 on initial decent, but don't be afraid to use position 4. On shorter fields and higher gross weights, it may be necessary to use position 5 or max braking.

Q) What is old from the previous Version-2004-8-0?

A) <u>New features for FS2004 include:</u>

- New "zero" based re-design for 747 airframe.

- New physical entries for all physical locations including scrape points and different engine mount points for the different engine types (PW, RR, GE).

- New engine design, optimized for FS2004 with new thrust values, EGT and EGT components.

- New FS2004 features added such as weight stations for the fuel and payload editor and ATC identification codes.

- FDEs based on increasingly accurate Boeing documents, allowing for different physical dimensions and weights for the various 747 variants. (Ex: Weights and payload loading is now completely different for 747 Classic vs. 747-400 Freighter vs. 747-400 Domestic vs. 747-400 standard pax variants.)

- New appearance of a specific E-4B “Looking Glass” FDE.

Fixes included in this version:

- Fixed leading edge flap animation tied to FDE timing.

- Recaluclated effects based on changes to FS2004-sensitive temperature environments.

- Manual now refers to cruise below crossover at 340 knots IAS or M.82.

Q) If you could sum it up in a few words, why is this version better than the previous versions?

A) These are the most detailed 747 FDEs to date. They include payload and weight entries directly from Boeing documents, as well as have new physical definitions for hard areas and scrape points.

Q) What are these new ATC codes in the aircraft.cfg?

A) For repaints, when you open up the aircraft.cfg and put in your Airline name and paint, there are some new lines to edit:

Example:

[fltsim.0]
title=Project Opensky - Airbus A340-300
sim=A340-300-GE-CFM56-5C4
model=
panel=
sound=
texture=
checklists=

atc_airline=CATHAY
atc_id=B-HXI
atc_flight_number=1
atc_heavy=1
atc_parking_types=GATE, RAMP, CARGO
atc_parking_code=CPA

ui_manufacturer=Project Opensky
ui_type=A340-300
ui_variation=Cathay Pacific Airways
visual_damage=1

In this case, edit the atc_parking_code

Put in the ICAO code of your airline. This will cause FS2004 to direct the plane to the specific set of gates for that airline.

Also, atc_parking_type tells FS2004 which parking you prefer and in which order. You typically won't have to change the parking type, but you will need to change the ICAO code for the atc_parking_code.

The freighters are already designated with CARGO slots as preferred parking.

Q) How can I determine the ICAO code for my airline for my repaint?

A) For your choosing your ATC codes for your paints:

http://www1.iata.org/membership/airlines/airlinemembership.htm

Choose "Geographic area". Weight models.

Q) How do I know my 747's weight?

A) Look at the payload tool or the pull down window. **Virtually every** 747 is different. Please try not to post questions on the forums about weights. Your FDE may have a different weight and different engine type, and that weight may be **specific** to that airplane.

Q) How do I open the passenger doors?

A) CTRL+E

Q) How do I open the cargo doors?

A) You must assign a key for the tailhook function, such as “H”. Then press the key you selected.

Q) How do I open the Nose/Side Cargo door?

A) You must assign a key for the wing fold function, such as “W”. Then press the key you selected.

Q) How can I see the effects?

A) Make sure you have installed the effects to your /FS2002/effects and /FS2002/effects/Opensky directory. Also, make sure you edit your panel.cfg to include an option for the .xml:

gaugexx=Opensky!Opensky_condens, 0,0,1

<Example: in Panel.cfg>
gauge18=Opensky!Opensky_condens, 0,0,1

Make sure smoke system is disabled/unchecked.

And remember, FS must read the panel.cfg to see the effects. So, select the cockpit view first with your panel visable, then switch to look at the outside view.

Q) I see the condensation effects, even when I’m landing. Am I doing something wrong?

A) Yes. You should only see the condensation effects between 164 – 172 knots. So, you should only see the effects right as you are rotating/taking off, or as you slow for appoach. As you approach the ILS, you should be at 180 knots @ flaps 20. As you intercept the glideslope, you should be slowing to VREF. VREF depends on your landing weight, but **your target VREF should be 143 knots, flaps 30, with only 24,000 lbs fuel on board.**

Q) What sound settings do you recommend?

A) Set your sound options for the engines to 1/8th maximum value. Decrease Navigation also to 1/8th bar. As for the other sounds, increase them all to 8/8th bar. In the 747, you are a long way away from the engines and the landing gear. You’re separated from the cabin by the flight deck door, and the cabin is expansive.

For the most part, you mainly hear the hiss of pressurized air and the sounds of the flight deck. You practically don’t hear the engines at all, except on takeoff, climbout, and when the thruster reverses engage. Other than that, the large PWs, RRs, or GEs are quiet as a mouse.

Q) What are the cruising speeds for the 747s?

A) 747 Classics – M.84. 747-400s – M.85.

Q) What is approximate fuel burn for 747s?

A) See fuel burn and range chart on page 6.

Q) Why is there no fuel burn or range information for 747-100B with Rolls Royce engines?

A) At the time of press, I did not have enough details. Assume specs from 747-200B RR.

Q) Why do the strobes on the wings float above the wingtips?

A) It was decided to go with FS2002 style strobes, versus smaller lights in the wingtips that were not as visable. Just keep the strobes off until you line up on the runway. The strobes are positioned correctly for wing flex in flight.

Q) Are the newer FDEs (2004.8.0) compatible with the other 747 v1s?

A) No, there are many differences which will cause visual problems. Use only 5.6 version FDEs for the 747 v2. Use version 4.6 for v1.

Q) Does 747 v1 planes have opening doors or wing flex?

A) No. Version1 planes were created with FSDS, which at the time was pushing the pylogon limit of the program. It was not possible at that time, given the limits of the programs. Version 2 was created with GMAX.

Q) How come the wings bounce up and down when I'm taxing? Why does the plane hop up and down? Why do I sometimes fall into a "hole" in FS? Is there anyway around this?

A) This is due to your scenery not being flattened or defined properly. This is more common with add-on scenery, particularly older scenery from FS2000. However, it can occur in newer FS2002 scenery and in the default MS scenery itself.

This problem is not related to the Opensky planes.

You can do several things to avoid this problem:

1) disable crash settings
2) ask your scenery designer if there is a patch, or flatten coordinates available for their scenery.
3) Use the alternate gear points contained in the FDE.

Q) What are these "alternate gear points"?

A) As time goes on, we have gotten a number of complaints, some people want more realistic feel and specs, while others are more visual driven, only concerned with not seeing the airplane float in the air.

To work around this, I developed 2 sets of gear points:

Default – the default gear points, only includes 3 points for wheels (standard on all FS default planes.) Autobraking functions work perfectly, however, the taxy ride on the ground is overly firm, unrealistic, and does not provide the redunancy of an actual 747's 18 wheels. Not having all wheels defined makes you more prone to falling into FS holes, or braking gear, wheels, or tires. The default set is for those who only want to see the plane, not for realistic feeling.

Alternate – the alternate set of gear points are my personal favorate. It allows you to have the full redunancy of all 18 wheels, realistic feel on touchdown, you can feel the wings bob side-to-side, and you can feel the tire push as they roll over on turns. However, only RTO autobraking works, autobraking on landings do not work with most panels. Also, as there is more suspension travel in the struts, there is the possibility of seeing the plane float, or sink into the ground. In addition, the visual wing droop while the plane is on the ground will not be as low. The alternate set is for those who want the ultimate feel, at the expense of full functionality. (Just remember the brakes are the "." key).

Default gear points are for basic MSFS functionality. However, for better ground handling and landing gear redundancy to prevent "falling" into MSFS holes, or breaking gear from un-flattened scenery, use the alternate gear points.

Q) How do I activate the "alternate gear points?"

A) Delete the first set of gear/scrape points:

```
point.0 = 1.000,  67.333,   0.000, -13.850, 2181.102, 0.000, 5.812, 78.480, 0.859, 0.500, 0.518, 11.000, 11.000, 0.000, 0.000, 0.000
point.1 = 1.000, -12.583, -18.000, -13.833, 2574.803, 1.000, 5.812,  0.000, 0.602, 0.500, 0.551, 14.900, 14.900, 2.000, 0.000, 0.000
point.2 = 1.000, -12.583,  18.000, -13.833, 2574.803, 2.000, 5.812,  0.000, 0.602, 0.500, 0.551, 17.100, 17.100, 3.000, 0.000, 0.000
point.3 = 2.000, -14.167, -96.167,   0.000,  787.402, 0.000, 0.000,  0.000, 0.000, 0.000, 0.000,  0.000,  0.000, 5.000, 0.000, 0.000
point.4 = 2.000, -14.167,  96.167,   0.000,  787.402, 0.000, 0.000,  0.000, 0.000, 0.000, 0.000,  0.000,  0.000, 6.000, 0.000, 0.000
point.5 = 2.000, -92.667,   0.000,  -2.000,  787.402, 0.000, 0.000,  0.000, 0.000, 0.000, 0.000,  0.000,  0.000, 9.000, 0.000, 0.000
point.6 = 2.000,  88.167,   0.000,  -5.750,  787.402, 0.000, 0.000,  0.000, 0.000, 0.000, 0.000,  0.000,  0.000, 4.000, 0.000, 0.000
point.7 = 2.000, -14.167, -96.167,   0.000,  787.402, 0.000, 0.000,  0.000, 0.000, 0.000, 0.000,  0.000,  0.000, 7.000, 0.000, 0.000
point.8 = 2.000,-132.667,   0.000,  55.500,  787.402, 0.000, 0.000,  0.000, 0.000, 0.000, 0.000,  0.000,  0.000, 8.000, 0.000, 0.000
point.9 = 2.000, -14.917, -69.500,  -7.000,  787.402, 0.000, 0.000,  0.000, 0.000, 0.000, 0.000,  0.000,  0.000, 9.000, 0.000, 0.000
point.10= 2.000,  14.917, -39.167, -11.000,  787.402, 0.000, 0.000,  0.000, 0.000, 0.000, 0.000,  0.000,  0.000, 9.000, 0.000, 0.000
point.11= 2.000,  14.917,  39.167, -11.000,  787.402, 0.000, 0.000,  0.000, 0.000, 0.000, 0.000,  0.000,  0.000, 9.000, 0.000, 0.000
point.12= 2.000, -14.917,  69.500,  -7.000,  787.402, 0.000, 0.000,  0.000, 0.000, 0.000, 0.000,  0.000,  0.000, 9.000, 0.000, 0.000
static_pitch= -1.000
static_cg_height= 13.125
```

Then remove the "//" sections in your FDE so your contact points section reads:

```
[contact_points]
// Nose gear
point.0= 1.000, 67.333, -1.500, -15.333, 1181.102, 0.000, 2.000, 70.000, 1.859, 2.500, 0.518, 9.000, 11.000, 0.000, 240.000, 280.000
point.1= 1.000, 67.333,  1.500, -15.333, 1181.102, 0.000, 2.000, 70.000, 1.859, 2.500, 0.518, 9.000, 11.000, 0.000, 240.000, 280.000

// Main Wing Gear (left)
point.2= 1.000,  -7.583, -18.000, -17.133, 1574.803, 1.000, 2.000, -13.000, 2.602, 2.500, 0.551, 12.900, 14.900, 2.000, 240.000, 280.000
point.3= 1.000,  -7.583, -14.000, -17.133, 1574.803, 1.000, 2.000, -13.000, 2.602, 2.500, 0.551, 12.900, 14.900, 2.000, 240.000, 280.000
point.4= 1.000,  -2.583, -18.000, -17.133, 1574.803, 1.000, 2.000, -13.000, 2.602, 2.500, 0.551, 12.900, 14.900, 2.000, 240.000, 280.000
point.5= 1.000,  -2.583, -14.000, -17.133, 1574.803, 1.000, 2.000, -13.000, 2.602, 2.500, 0.551, 12.900, 14.900, 2.000, 240.000, 280.000

// Main Wing Gear (right)
point.6= 1.000,  -7.583, 18.000, -17.133, 1574.803, 2.000, 2.000, -13.000, 2.602, 2.500, 0.551, 15.100, 16.400, 3.000, 240.000, 280.000
point.7= 1.000,  -7.583, 14.000, -17.133, 1574.803, 2.000, 2.000, -13.000, 2.602, 2.500, 0.551, 15.100, 16.400, 3.000, 240.000, 280.000
point.8= 1.000,  -2.583, 18.000, -17.133, 1574.803, 2.000, 2.000, -13.000, 2.602, 2.500, 0.551, 15.100, 16.400, 3.000, 240.000, 280.000
point.9= 1.000,  -2.583, 14.000, -17.133, 1574.803, 2.000, 2.000, -13.000, 2.602, 2.500, 0.551, 15.100, 16.400, 3.000, 240.000, 280.000

// Main Center Gear (left)
point.10= 1.000, -18.583, -8.000, -17.133, 1574.803, 1.000, 2.000, 0.000, 2.602, 2.500, 0.551, 13.400, 14.900, 2.000, 240.000, 280.000
point.11= 1.000, -18.583, -4.000, -17.133, 1574.803, 1.000, 2.000, 0.000, 2.602, 2.500, 0.551, 13.400, 14.900, 2.000, 240.000, 280.000
point.12= 1.000, -12.583, -8.000, -17.133, 1574.803, 1.000, 2.000, 0.000, 2.602, 2.500, 0.551, 13.400, 14.900, 2.000, 240.000, 280.000
point.13= 1.000, -12.583, -4.000, -17.133, 1574.803, 1.000, 2.000, 0.000, 2.602, 2.500, 0.551, 13.400, 14.900, 2.000, 240.000, 280.000

// Main Center Gear (right)
point.14= 1.000, -18.583,  8.000, -17.133, 1574.803, 2.000, 2.000, 0.000, 2.602, 2.500, 0.551, 11.500, 17.500, 3.000, 240.000, 280.000
point.15= 1.000, -18.583,  4.000, -17.133, 1574.803, 2.000, 2.000, 0.000, 2.602, 2.500, 0.551, 11.500, 17.500, 3.000, 240.000, 280.000
point.16= 1.000, -12.583,  8.000, -17.133, 1574.803, 2.000, 2.000, 0.000, 2.602, 2.500, 0.551, 11.500, 17.500, 3.000, 240.000, 280.000
point.17= 1.000, -12.583,  4.000, -17.133, 1574.803, 2.000, 2.000, 0.000, 2.602, 2.500, 0.551, 11.500, 17.500, 3.000, 240.000, 280.000

//Scrape points
point.18= 2.000, -14.167, -96.167, 0.000, 787.402, 0.000, 0.000, 0.000, 0.000, 0.000, 0.000, 0.000, 0.000, 5.000, 0.000, 0.000
point.19= 2.000, -14.167, 96.167, 0.000, 787.402, 0.000, 0.000, 0.000, 0.000, 0.000, 0.000, 0.000, 0.000, 6.000, 0.000, 0.000
point.20= 2.000 -92.667,   0.000,  -2.000,  787.402, 0.000, 0.000,  0.000, 0.000, 0.000, 0.000,  0.000,  0.000, 9.000, 0.000, 0.000
point.21= 2.000, 88.167, 0.000, -3.750, 787.402, 0.000, 0.000, 0.000, 0.000, 0.000, 0.000, 0.000, 0.000, 4.000, 0.000, 0.000
point.22= 2.000, -14.167, -96.167, 0.000, 787.402, 0.000, 0.000, 0.000, 0.000, 0.000, 0.000, 0.000, 0.000, 7.000, 0.000, 0.000
point.23= 2.000, -132.667, 0.000, 55.500, 787.402, 0.000, 0.000, 0.000, 0.000, 0.000, 0.000, 0.000, 0.000, 8.000, 0.000, 0.000
point.24= 2.000, -14.917, -69.500,  -7.000,  787.402, 0.000, 0.000,  0.000, 0.000, 0.000, 0.000,  0.000,  0.000, 9.000, 0.000, 0.000
point.25= 2.000,  14.917, -39.167, -11.000,  787.402, 0.000, 0.000,  0.000, 0.000, 0.000, 0.000,  0.000,  0.000, 9.000, 0.000, 0.000
point.26= 2.000,  14.917,  39.167, -11.000,  787.402, 0.000, 0.000,  0.000, 0.000, 0.000, 0.000,  0.000,  0.000, 9.000, 0.000, 0.000
point.27= 2.000, -14.917,  69.500,  -7.000,  787.402, 0.000, 0.000,  0.000, 0.000, 0.000, 0.000,  0.000,  0.000, 9.000, 0.000, 0.000

static_pitch= -1.000
static_cg_height= 13.625
```

Q) I took off/landed and now I see sparks and smoke! What happened?!

A) You scraped parts of the plane. You must remember not to over-rotate the plane. Tail strike happens at 11 degrees. Also, remember, the nacelles are only about 4 feet off the ground. In a cross wind landing, try not to strike the engine pod. If you see sparks and flames, execute your emergency procedures, dump fuel and head back to the airport. In the event of an engine strike, shut down the engine.

Q) Can you please explain the fuel usage for the different 747s?

A) The base I used was 747 classics data: 743 with RR...
I took fuel burn of 10,700 kph => 23620 pph (for all 4 engines)
for cruise @ M.85:

So the scale I built was:

747 Type	PW	GE	RR
741 (Fuel Burn - 4 Engines - PPH)	22628		
Range	5300 nm		
742 (Fuel Burn - 4 Engines - PPH)	22628	23320	22440
Range	6560 nm	6370 nm	6620 nm
743 (Fuel Burn - 4 Engines - PPH)	23468	24192	23620
Range	6330 nm	6140 nm	6290 nm
744 (Fuel Burn - 4 Engines - PPH)	21436	20336	20576
Range	6930 nm	7305 nm	7220 nm

So based on my numbers, between the least thirsty 747-400s and the most thirsty 747 classic is 20336 pph vs. 24192 pph. When you compare gross weight for the 747 and the engine type, an extreme example would be to say that a 747 classic can use up to 19% more fuel per hour... Over a 14 hour trip, a classic 747 would use up to 10,800 more gallons of fuel! Or the range of a 747 classic could be as much as 1165 nms less than a 747-400...

Q) Will this version FDE work for FS2002?

A) Most likely, but untested. It is designed for FS2004. Please do not post questions on the forum related to FS2002 and this FD. The FDE is intended for FS2004.

A LITTLE BIT ABOUT THE AUTHOR

My name is Warren and I travel around 100,000 miles a year. These planes would not have turned out as they have if not for Simon Ng, Kitaguchi-san, and Nick Peterson. Simon has spent many hours teaching and instructing us in the “Art of the 747”. Simon has had all of us banging our heads on the keyboards, getting the 747 right. Also, lots of credit goes to Matt Zagoren for taking the trouble to compile his 747 documentation and allowing us to reference it.

I am not an airline captain, but love flight. Formally, I used to fly a Piper Arrow, Piper Turbo Arrow, Cessna 172 and a twin-engine Piper Cherokee. My goal is to give the flight simulator community the closest possible experience to flying a real 747.

My hobbies are flight, automobile track racing, and novel and screenwriting.

I cannot promise I’ll answer every single question, but someone at the forum will try to get an answer for you. Please send general comments to the forum at: www.projectopensky.com.

Remember that Project Opensky creates these aircraft for free, because we enjoy it. Do not bog us down with ignorant or unnecessary comments or criticism. If you feel you can do better, by all means, please do so, so that we may all benefit from everyone’s hard work.