DELTA VIRTUAL AIRLINES

Boeing 747-400
Aircraft Operations Manual
First Edition
January 28, 2009

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Welcome

Welcome to the Delta Virtual Airlines' Aircraft Operating Manual (AOM) for the Boeing 747-400

The AOM is based upon the DVA Fleet Installer. We are always seeking to improve the accuracy of the AOM.

Should you have questions about the specifics of this airplane or this manual, you should create a Help Desk issue at our website, www.deltava.org

Should you have questions about aviation in general, creating a Help Desk issue is the best course of action to take. The training department and Flight Academy personnel will do their best to answer your questions.

If you are new to flying and would like to learn training that is modeled after real world training, you can sign up for flight instruction in the DVA Flight Academy.

History and Overview

The Boeing 747 is one of the most easily recognized commercial aircraft in the world today. Its distinctive "humped" forward fuselage, double passenger decks and sheer size place this aircraft into a class by itself. The 747 revolutionized airline transport by dramatically cutting cost per seat mile and therefore the cost of long-haul international jet travel.

The 747 was originally conceived as a transport aircraft in response to a United States Air Force contract, hence the raised cockpit and second deck to accommodate a swing-up nose for cargo loading. Although the contract was ultimately awarded to Lockheed for their C-5 aircraft, Boeing lost the battle but ultimately won the war. The experience gained during this competition was put to good use creating the 747, the first wide-body and largest airliner ever built.

Contrary to popular opinion, design of the 747 was well under way before the winner of the C-5 competition was announced in 1965. Airlines had been exploring larger jetliners, and the success of Douglas' stretched "Super 60" series DC-8s had demonstrated the value of a larger airliner for trans-continental and intercontinental routes. Pan American was already requesting a larger airliner than the existing 707-320, but Boeing found it difficult to stretch this airframe any further.

Boeing therefore took a giant leap forward and adapted its cargo design to passenger transport, culminating in a brilliant design that could seat several hundred passengers eleven-abreast, powered by the thrust of four turbofan engines, each of which producing more thrust (without smoke) than all four engines on an early model Boeing 707 or Douglas DC-8!

The success of the 747 changed the airline industry. Airports across the world needed to be expanded to accommodate the rush of up to a thousand passengers deplaning at once when a pair of 747s landed within minutes of each other. Spreading the cost of an intercontinental flight between 375 passengers reduced ticket costs, and inexpensive flights to Europe and Asia from North America were now within reach.

Over the years, the Boeing 747 was produced in a number of variants. The early model Series 100 aircraft was produced in a special version for the Japanese market – the Series 100SR that could seat up to 530 passengers. The higher payload Series 200 was introduced in 1971, providing expanded engine choices including the Rolls-Royce RB211-524 engine, which allowed a maximum takeoff weight around 840,000 pounds!

To support long-range trans-Pacific flights, Boeing produced an extremely unusual variant of the 747 – the 747SP (for Special Performance). The 747SP was shrunk in length, with modified control surfaces, and this "baby 747" was able to cross the Pacific non-stop, at unusually high altitudes of 41,000 to 43,000 feet. A 747SP was able to reach speeds of Mach .92 without significant turbulence.

These variants (along with the short-lived stretched upper deck Series 300) have all been superseded by the definitive Boeing 747 – the Series 400, which was last produced in 2005, to be replaced by the 747-800 in 2009.

BOEING 747-100

The first Boeing 747 to be produced was the 100 series and it remained in production from 1969 to 1978.

BOEING 747-200

The original Series 100 remained in production from 1969 to 1978. However, almost immediately after the introduction of the 747, Boeing announced plans for a higher-weight variant known as the 200B. Higher aircraft takeoff weights allow the transport of more payload (revenue-generating passengers or freight) or more fuel (longer range).

The Series 200 is visually identical to the Series 100, but a strengthened structure and landing gear allowed an increase in maximum takeoff weight from 710,000 to 785,000 pounds. This substantial increase in maximum takeoff weight was made possible by equipping the Series 200 with newer and significantly more powerful engines.

One visual clue to the Series 200 is the increase in upper deck windows from 3 to 10, but this should not be considered definitive. Although almost all Series 200 aircraft had an internally larger upper deck from the Series 100, the additional windows were entirely at the discretion of the purchasing airline, and many Series 200 aircraft were ordered with the trio of upper deck windows.

BOEING 747-400

The Boeing 747-400 delivers more range, better fuel economy, lower noise and lower operating costs than the previous 747 models. The 747-400 has a range of approximately 8,349 miles (13,450 kilometers) and the lowest per-seat cost of any twin-aisle airliner in service today. The Series 400 also set new standards for reliability meeting 99% of its scheduled flights. Boeing delivered the first 747-400 in 1989 to Northwest Airlines. Since the first 747 delivery in 1969, Boeing delivered nearly 1,300 747s, of which 555 are high- technology 747-400s. As of December 2001, nearly 40 customers ordered 630 747-400s, making it the most popular wide-body airplane in history. The 747's longevity and popularity are based on its unbeatable low seat-mile costs, flexibility, long-range dominance, unmatched comfort options and ability to integrate new technology.

IMPROVED AERODYNAMIC PERFORMANCE

The 747-400's most noticeable aerodynamic improvement is the 6-foot (1.8 m) longer wing with a winglet angled upward and slightly outward. This change reduces fuel burn and extends the airplane's range. While designing the 747-400, Boeing engineers discovered that the kind of wing shape needed by the airplane created a whirling pattern, called a vortex, at the wing tip while the airplane moved through the air at cruising speed. The top part of that whirling movement of air actually pushed down on the top of the wing, creating drag. Initially, it was thought that the problem could be solved by adding several feet to the wing, but that would make it difficult to navigate increasingly crowded airport taxiways and ramps. Longer wings also would reduce the number of airport terminal gates available to the 747-400.

The acceptable solution came in the form of a compromise that involved lengthening the wing by 6 feet and adding the winglet. The winglet provides the effect of having an even greater wingspan without outgrowing the standard airport slot. The wingtip extension and winglet offer a fuel mileage improvement of about 3 percent, which during the life span of an airplane amounts to considerable savings for the airlines and their passengers. The durable and lightweight winglets are made of graphite-epoxy materials, currently used on all modern Boeing airplanes, save 60 pounds (27 kg) per airplane compared to an all-aluminum structure.

FLIGHT DECK IMPROVEMENTS

The 747-400 flight deck provides the same flexibility that is being incorporated in all models across the Boeing commercial fleet. The 747-400's predecessor, the 747-300, had a three-crew analog cockpit; on the 747-400 it has been transformed into a fully digital, two-crew flight deck with cathode ray tube (CRT) displays.

Six 8-inch square (200mm x 200mm) CRTs are used to display airplane flight control, navigation, engine and crew-alerting functions. They allow more information to be displayed with fewer instruments. At the end of 2002, the CRTs were replaced with Liquid Crystal Displays (LCDs) on all new 747-400s. The LCDs provide higher reliability and more capability for new functions to be incorporated in the future.

Flight crew workload is designed to be one-half to one-third that of former 747 models, with the number of flight deck lights, gauges and switches reduced to 365 from the 971 on the 747-300. The Engine Indicating and Crew Alerting System (EICAS) can call up the status or schematics of various systems at any time on one of the CRTs or LCDs. Crews now can obtain an update of the airplane's mechanical condition while in flight, whereas before the information only was available to maintenance workers when the airplane was parked.

ADVANCED STRUCTURAL MATERIALS

Boeing also re-contoured the wing-to-body fairing for drag improvement, and achieved additional efficiency from newly designed nacelles and struts for the airplane's advanced engines: the General Electric CF6-80C2B5F, the Pratt & Whitney PW4062 and the Rolls-Royce RB211-524H. These engines provide up to 63,000 pounds of thrust.

Use of advanced materials allows considerable structural weight reductions throughout the 747-400. Light and tough graphite composite floor panels have replaced metal flooring previously used in the passenger cabin. Structural carbon brakes are standard on the 747-400's 16 main landing-gear wheels. They provide improved energy absorption characteristics and wear resistance, as well as an estimated 1,800-pound (816 kg) weight savings over previous brakes. The 747-400 also achieved weight savings of approximately 4,200 pounds (1,900 kg) by using higher strength aluminum alloys with improved fatigue life. These alloys, introduced on the 757 and 767, are incorporated in the 747-400's wing skins, stringers and lower-spar chords.

Aircraft Milestones

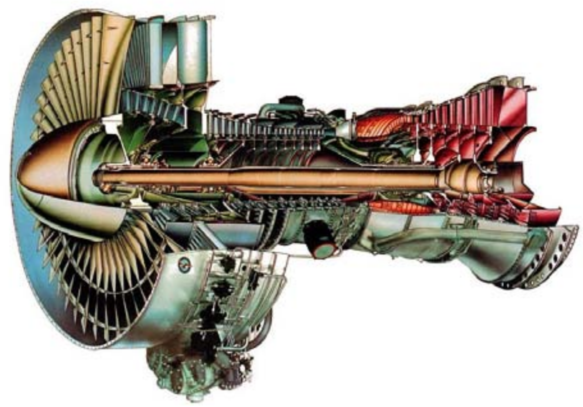
Spring 1963	Boeing forms engineering group to develop large airplane to meet passenger and cargo growth predicted for the 1970s.
March 1966	Boeing's Board of Directors decides to proceed with the 747 program.
June 1966	Boeing purchases 780 acre, adjacent to Paine Field in Everett, Washington, to build 747 production plant.
September 30, 1966	First 747-100 rolls out of the factory.
February 9, 1969	First flight of the Boeing 747-100.
December 30, 1969	The U. S. Federal Aviation Administration certifies the 747-100 for commercial service.
July 16, 1970	The Boeing 747 worldwide fleet carries its millionth passenger.
October 11, 1970	First 747-200 rolls out of the factory.
January 1971	The Boeing 747 worldwide fleet accumulates 71 million miles in its first year of service.
July 4, 1975	First flight of the first 747SP; attains top speed of Mach 0.92.
October 1975	The Boeing 747 worldwide fleet carries one hundred millionth passenger.
February 18, 1977	A specially equipped Boeing 747 carries the US space shuttle "Enterprise" for the first time.
September 21, 1982	First flight of the Boeing 747-300.
October 1985	Boeing announces the 12th version of its jumbo jet family, the advanced technology 747-400.
June 5, 1986	U. S. Air Force orders two specially equipped 747-200s to transport the President of the United States to replace the Boeing 707-320s previously used for VIP transport as "Air Force One".
January 26, 1988	Boeing rolls out the first Boeing 747-400 on same day as the first Boeing 737-400.
April 29, 1988	First flight of the Boeing 747-400.
February 9, 1989	The first Boeing 747-400 enters commercial service with Northwest Airlines.
September 10, 1993	Boeing rolls out line No. 1,000, a 747-400.
November 15, 1999	U. S. Postal Service unveils a 747 stamp, which Boeing places on its factory door: world's largest stamp on world's largest building that produces world's largest commercial airplane.

Powerplants

Each variant of the Boeing 747 has spurred the development of a new generation of high-bypass, high-thrust turbofan engines. Some of the engines used in earlier 747 variants are profiled below, as well as the three main engine choices for the 747-400.

Pratt & Whitney JT9D

The Pratt & Whitney JT9D-1 was the original (and only) engine type available on the original Series 100 Boeing 747. The JT9D-1 was the first high-bypass turbofan engine used in a civilian transport aircraft, and was a dramatic leap from the early JT3D and Conway turbofans used at the time in the Douglas DC-8 and Boeing 707. The JT9D-1 could produce 41,000 pounds of thrust, almost three times as much as the JT3D fitted to the stretched DC-8 and 707-320C.



The Series 200 used more powerful variants of the JT9D. The original Series 200 aircraft were powered by the JT9D-3AW, which was able to produce 45,000 pounds of thrust with the assistance of relatively smokeless water injection. Later variants used the JT9D-7AW, which produced 48,750 pounds of thrust (again with water injection). The unusual and rare history of water injection in the JT9D family ended soon afterwards, with the JT9D-7 and JT9D-7R that were able to produce up to 56,000 pounds of thrust without water injection.

Production of these engines ceased in 1990, but they are used throughout the world in the 747 Classic, Boeing 767-200 and the Airbus A300 and A310.

GENERAL ELECTRIC CF6-50D

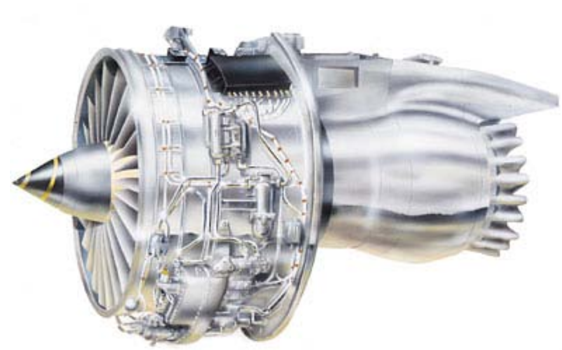
In 1974, Boeing added the GE CF6-50D to the available engine types on the 747. Although Boeing had offered a choice of engine types in the 707, these changes were the result of technical innovation (JT3C turbojets to JT3D turbofans) and customer requests (the Rolls-Royce Conway by BOAC). For the first time, marketing was behind the decision. The CF6-50D was originally introduced as an engine for the McDonnell-Douglas DC-10-30, but Boeing believed that increased engine choices would spur additional sales and innovation. They were right.

The original CF6-50D generated 51,000 pounds of thrust when fitted on the Series 200. Further refinements increased total power to 54,000 pounds per engine, and this engine helped prod Pratt & Whitney into developing higher-power variants of the JT9D.

The use of military versions of this power plant factored in the decision of the United States Air Force to use the CF6-50D in their E-4 airborne command post 747-200 variants, as well as the two Series 200 aircraft used as Presidential and VIP transports. The CF6-50D is also used in the Series 300, the DC-10-30, its KC-10 military tanker variant, and the Airbus A300B.

ROLLS-ROYCE RB211-524

In 1976, Rolls-Royce adapted the RB211 engine (that had almost bankrupted it and Lockheed during the L-1011's gestation) for use in the Series 200. The RB211-524B was a unique three-spool design (and "stubby" appearance) that generated 50,000 pounds of thrust. Further variants were produced with higher thrust ratings, such as the 524C2 (51,500 pounds) in 1980, the 524D4 (53,000 pounds) in 1981, and with the creation of the Series 400 a new class of RB211 was created, with the definitive RB211-524H/T variant producing 60,600 pounds of thrust.



Although the RB211's design was a financially calamitous time for Rolls-Royce, it has over 1,100 engines in service and was the forerunner of the Trent series of massive turbofans currently in use on the Boeing 777. This descendant continues to influence its parent – the 524H/T variant combines the RB211-524H with the highly efficient fuel burners of the Trent to provide unmatched power and efficiency – critical in a long-range airliner or freighter such as the 747.

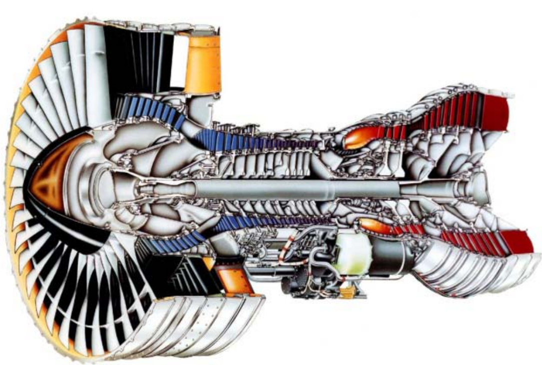
General Electric CF6-80C2

Almost all turbine engines used in civil airliners are modified and enhanced over their lifespan to allow use in a variety of larger or smaller aircraft than originally planned. The CF6 was no exception, and in October 1985 General Electric introduced the CF6-80C2. This engine was originally rated at 52,500 pounds of thrust, with further variants developing up to 63,500 pounds of thrust.

The CF6-80C2 was first used in the Series 300, and carried over to the Series 400. In addition to use in the later 747 variants, the CF6-80C2 is used in the McDonnell-Douglas MD-11 as well as a number of "big twin" airliners such as the 767-200, -300 and –400, the Airbus A300-600 and A310-200/300. In such a configuration the CF6-80C2 has received 180-minute ETOPS certification from the Federal Aviation Administration.

Pratt & Whitney PW4062

Pratt & Whitney was not idle during the 1980s. Once the limits of the JT9D were reached, Pratt & Whitney developed the PW4000 family of turbofan engines, which first entered service in 1987. PW4000 comes in three main variants, with 94, 100 and 112-inch fan diameters. The 94-inch diameter version is used in the Series 400, and develops between 52,000 and 62,000 pounds of thrust.



The PW4000 introduced significant technological advances such as a Full Authority Digital Engine Controller (FADEC), and was one of the first Pratt & Whitney turbofans rated for 180-minute ETOPS operation. As a direct competitor to the CF6-80C2 and RB11-524, it is no surprise to see similar thrust ratings and implementations – besides the Series 400, the PW4000/94 is used in the McDonnell-Douglas MD-11, Boeing 767-200/300, and the Airbus A300-600 and A310-300.

Aircraft Specifications

The chart below displays technical specifications of the Boeing 747 variants in use at Delta Virtual Airlines.

TYPE	747-100	747-200	747-300	747-400
DIMENSIONS				
Length	231 ft 10 in	231 ft 10 in	231 ft 10 in	231 ft 10 in
Height	63 ft 5 in	63 ft 5 in	63 ft 5 in	63 ft 8 in
Wingspan	195 ft 8 in	195 ft 8 in	195 ft 8 in	211 ft 5 in
Cabin Width (Main Deck)	20 ft	20 ft	20 ft	20 ft
Cabin Height (Main Deck)	7 ft 11 in	7 ft 11 in	7 ft 11 in	7 ft 11 in
Cabin Width (Upper Deck)	16 ft 6 in	16 ft 6 in	16 ft 6 in	16 ft 6 in
Cabin Height (Upper Deck)	7 ft 4 in	7 ft 4 in	7 ft 4 in	7 ft 4 in
POWERPLANTS				
Engine Type Maximum Rated Thrust	JT9D-7A 46,500 lb	JT9D-7R4 54,750 lb	JT9D-7R4 54,750 lb	PW4062 63,300 lb
Engine Type Maximum Rated Thrust	RB211-524 50,100 lb	RB211-524 53,000 lb	RB211-524 53,000 lb	RB211-524 59,500 lb
Engine Type Maximum Rated Thrust	CF6-45A2 46,5000 lb	CF6-50E2 52,200 lb	CF6-80C2 55,640 LB	CF6-80C2 62,100 LB
WEIGHTS				
Empty Weight	358,000 lb	351,147 lb	385,420 lb	398,440 lb
Maximum Gross Weight	738,000 lb	836,000 lb	836,000 lb	877,000 lb
Maximum Takeoff Weight	735,000 lb	833,000 lb	833,000 lb	875,000 lb
Maximum Landing Weight	564,000 lb	630,000 lb	574,000 lb	630,000 lb
Max Zero Fuel Weight	526,500 lb	545,000 lb	535,000 lb	542,500 lb
CAPACITES				
Maximum Fuel	324,581 lb	351,147 lb	351,147 lb	379,000 lb
Max Seating	452	452	496	524
Unusable Fuel	120.6 LB	120.6 LB	120.6 LB	120.6 LB
Cockpit Crew	3	3	3	2
Maximum Payload	145,020 lb	150,330 lb	149,520 lb	148,412 lb
OPERAIONAL LIMITS				
Service Ceiling	45,720 ft	45,720 ft	45,720 ft	45,000 ft
Normal Cruise Speed	Mach 0.84	Mach 0.84	Mach 0.85	Mach 0.85
Maximum Range	5,300 NM	6,865 NM	6,691 NM	7,260 NM
Takeoff Distance (Max takeoff weight)	9,200 ft	10,200 ft	10,200 ft	10,600 ft
Landing Distance (Max landing Weight, Flaps 25)	6,800 ft	7,300 ft	7,300 ft	7,400 ft
Flaps up Stall Speed (Max landing Weight)	192 KIAS	192 KIAS	192 KIAS	192 KIAS
Flaps 30 Stall Speed (Max landing Weight)	142 KIAS	142 KIAS	142 KIAS	142 KIAS
Maximum Indicated Airspeed	362 KIAS	362 KIAS	362 KIAS	362 KIAS

Cockpit Checkout

The DVA Fleet Installer B744 uses the iFLY panel. There is a 332 page manual that accompanies the fleet installer. Here you will find an expanded cockpit layout and FMC tutorial that covers everything in the aircraft. You should refer to this for cockpit familiarization. There are just a few items we'll point out to get you started.

NOTE: To ensure proper operation, load the default Cessna and turn on the Master Power, Avionics and Fuel Pump switches then load the fleet B-747.

MAIN (CAPTAIN'S) PANEL

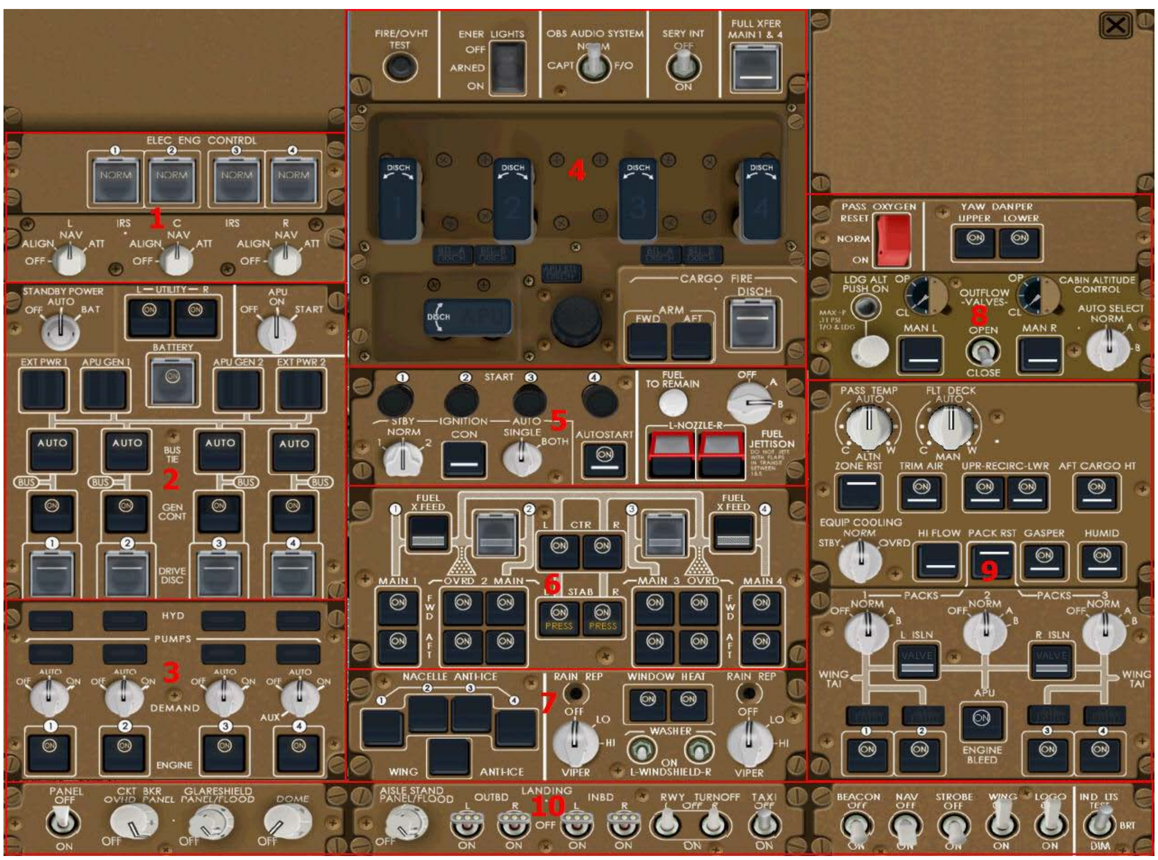
The main panel contains most of what is needed to fly the aircraft successfully. Again, because there is an extensive manual for this aircraft, we'll only point out key features but will not cover their operation.

1. Electronic Flight Information System (EFIS) control panel. This panel is used to manage the display of data on the Navigation Display.
2. Mode Control Panel (MCP). The MCP is to manage the Automatic Flight Control System, a.k.a. Autopilot.

3. Mini icon panel. This panel contains small icons that allow the selection of other panels and displays. It also contains the DVA unique ACARS, ServInfo and Runway info icons
4. Primary Flight Display (PFD). This gauge displays the relevant flight information such as airspeed, altitude, pitch/roll angle, heading, rate of climb, DH/MDA setting, and auto flight enunciators.
5. Navigation Display (ND). This gauge displays data relevant to the lateral positioning of the aircraft. Modes include Approach (APP), VOR, MAP and Flight Plan (FLN). Control is via the EFIS control panel.
6. Primary Engine Indicating and Crew Alerting System (EICAS). This gauge displays relevant engine and aircraft system status.
7. Landing gear panel. This contains controls for operation of the landing gear in its primary mode as well as alternate gear and flap extension controls.

Overhead Panel

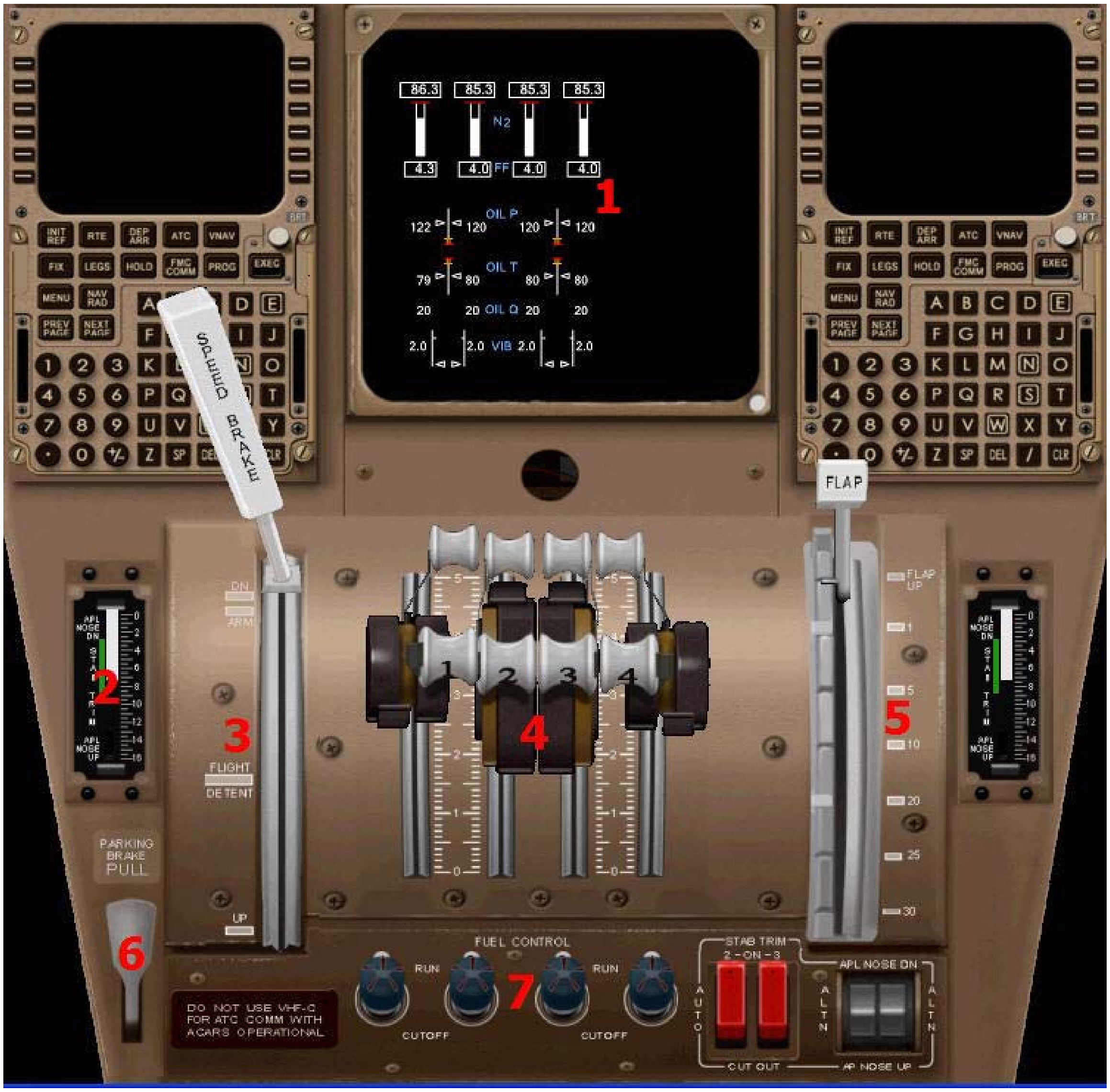
The overhead panel contains controls for most of the aircraft systems. Again, because there is an extensive manual for this aircraft, we'll only point out key area but will not cover their operation.



1. Inertial Reference System (IRS) and Electronic Engine Control (EEC) management. These switches are used to manage the IRS and EEC systems.
2. Electrical System management. The controls in this area are used to manage electrical power on the aircraft including external power, APU operation and engine driven generators.
3. Hydraulic System management. The controls in this area are used to manage the engine driven hydraulic systems.
4. Fire Detection and Suppression. Controls in this area are used detect and manage fire related events in the engines, APU and cargo areas.
5. Engine Start and Fuel Jettison. The controls in this area are used to manage the engine ignition systems, engine start values as well as the fuel dump processes.
6. Fuel System management. Use controls in this area are used to manage the many tanks and fuel pumps on the aircraft.
7. Anti-Ice Systems. These controls manage the engine, wing and windshield anti-ice systems.
8. Yaw Damper and Cabin Pressurization. The controls in this area are used to turn the YAW Damper on and off and manually manage the cabin pressure in the event of an abnormal event.
9. Air Systems. Bleed air for engine start and environment control (heat and air conditioning) can be supplied from the engines or APU. These controls are used to manage the bleed air and environmental control systems on the aircraft.
10. Aircraft Light Controls. Controls for external and internal lighting of the aircraft are controlled by the switches in this area.

Pedestal

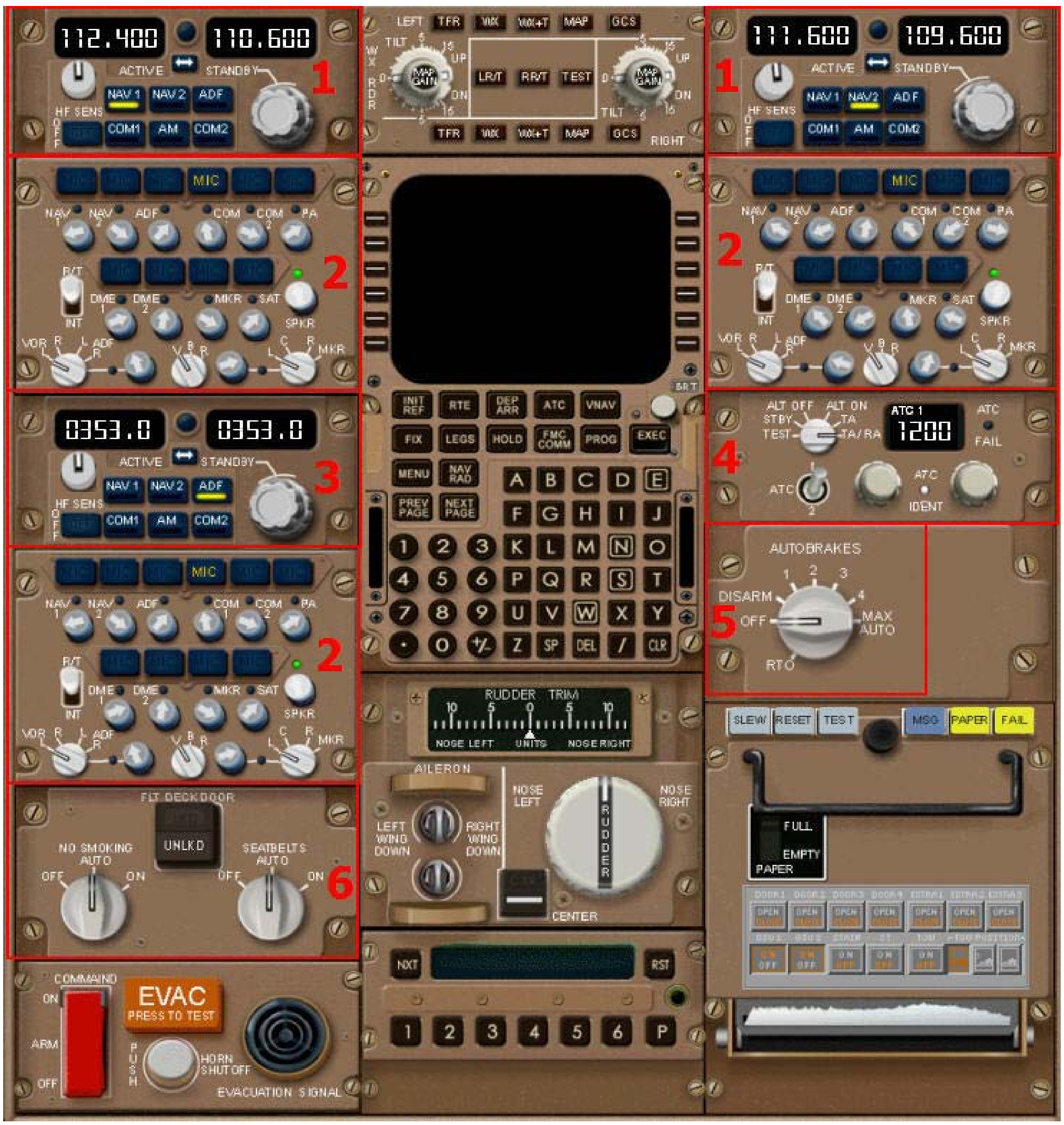
The Pedestal contains a few controls that the pilot needs to be familiar with. Again, because there is an extensive manual for this aircraft, we'll only point out key area but will not cover their operation.



1. Lower Engine Indicator and Crew Alerting System (EICAS). The status of several aircraft systems can be displayed here. Display selection is via the EICAS control panel on the First Officer's panel. Display pages include Status, Fuel, Hydraulics, Electrical, Air, Engines/Flight Controls, Doors and Gear.
2. Elevator trim position indicator.
3. Speed Brake lever. Possible positions are DN –Down, ARM – Armed, FLIGHT DETENT and UP.

4. Throttle Levers.
5. Flap lever.
6. Parking Brake.
7. Fuel Controls.

AFT ISLE STAND



1. Radio Control Panel. Click the NAV1, NAV2, COM1 or COM2 to control the frequencies for the desired radio.
2. Audio Control Panels
3. ADF radio control panel
4. Transponder control panel. Includes TCAS
5. Auto brake control
6. Passenger signs

FLIGHT MANAGEMENT COMPUTER (FMC)/CONTROL DISPLAY UNIT (CDU)

The FMC/CDU is the heart of the aircraft with regards to lateral and vertical management. This system feeds control inputs to the auto pilot based on current configuration, weight and lateral/vertical position. The FMC/CDU is used to program for lateral navigation (LNAV), Vertical navigation (VNAV) takeoff speeds (V1, Vr, V2), landing speeds (Vref), holding pattern entry and exit, optimum and maximum altitudes, route definition including SIDs and STARs. In the case of this aircraft, certain simulation setting are available including the selection of 'units of measure', start up states and the ability to save and load aircraft a states. While this is similar to other free and payware products, there are significant differences. Some of the more relevant differences are discussed later in this manual but it is strongly recommend that some time is taken to study the included manual to learn the proper operation and use of these systems.

Flying the aircraft – Tutorial

The purpose of this tutorial is to familiarize the pilot with the operation of the Delta Virtual Airlines fleet B-747-400. The starting point will be in a 'cold and dark' cockpit parked at the gate. We will also assume fuel planning and loading is complete – see the Fuel Planning section of this manual for detailed fuel planning and loading guidance.

Because the B-744 is a Stage 4 aircraft, we will assume a certain level of competency in the pilot and thus will not go into detail with basic procedures such as communicating with ATC, determining taxi routes or runways to use. By this time, you should be able to do these tasks.

Let's get started. Load your flight simulator with the fleet B-747-400. Make sure appropriate payload and fuel loading is complete using the Flight Simulator fuel and payload menus. At this point you should be in the aircraft at the Captain's "Main" panel. Before applying power to the aircraft certain safety checks must be completed.

On the Main Panel

1. Gear Handle DOWN
2. ALTN FLAPS OFF
3. F/D OFF
4. A/T ARM OFF

Throttle Quadrant panel

1. PARKING BRAKE SET
2. Fuel Control switches 1 thru 4 CUTOFF
3. SPEED BRAKES DN
4. FLAPS UP
5. Throttles CLOSED

Now it's time to apply power and continue preflight checks

Overhead

1. Battery ON
2. Standby power AUTO
3. External Power 1 and 2 ON
4. Utility BUS L and R ON
5. NAV lights ON
6. HYD DEMAND pumps 1 thru 3 AUTO
7. HYD Demand pump 4 AUX
8. FIRE/OVHT TEST Click and Release. Fire warning lights ON then OFF
9. APU Start as Desired
10. If APU Started and AVAIL APU GEN 1 and 2 ON
11. IRS L, C, R NAV (Alignment time takes approx 10 minutes)
12. Auto Start ON
13. YAW DAMPER Upper and Lower ON
14. OUT FLOW VALVES L and R OFF
15. APU BLEED ON
16. L and R isolation Values CLOSED (Straight line)
17. PACKS 1 thru 3 NORM
18. TRIM AIR ON
19. RECIRC UPR and LWR ON
20. GASPER ON
21. ENGINE BLEED 1 thru 4 ON
22. Fuel PUMPS FWD and AFT ON for all tanks holding fuel

Main Panel

1. Autopilot DISENGAGE BAR DOWN then UP
2. CMD Lights OUT

Aft Isle Stand

1. No Smoking Sign ON
2. Seat belt Sign AUTO
3. Transponder STBY
4. AUTOBRAKES RTO

If you are flying online, obtain your ATC Clearance. Now that we have our clearance and should know the departure runway, it is time to program the FMC. Open the Control Display Unit using the icon on the lower left corner of the main panel. The use of the FMC is complex. We will not do a walk through at this time. Please refer to the iFly B747-400 manual that was installed along with the fleet installer for detail instruction on how to use the FMC. A few key points will be made that are unique to this aircraft and beyond DVA's ability to fix.

1. Make sure you choose the units of measure you want to use. This manual refers to everything in standard or US measure…pounds/gallons. The default is metric…kilos and liters.
2. Each and every fix ***must*** have airspeed entries. Any entry with a "---" will cause the auto throttle to roll back and allow deceleration to 0 KIAS. Use your best judgment and populate these values. You will need to enter the altitude along with speed. You can use the 'A' suffix to allow climb above that altitude. Example 340/14000A means a speed of 340 KIAS and an altitude at or above 14,000' MSL.
3. Progress page fix Estimated Time of Arrival (ETA) and Fuel remaining calculations are not reliable.

Once the FMS is configured, we can prepare for the next phases of the flight. Pushback is next but, before we actually push let's make sure we are ready.

1. Verify IRS Alignment is complete
2. Verify V speeds have transferred to the PFD
3. MCP Set Altitude as necessary
4. IAS/MACH Set to 250 or lower as dictated by the departure procedure
5. Set Initial Altitude
6. Set Initial Speed
7. F/D ON
8. If not already Running, On Over Head Panel

a. APU Start

b. APU Started and AVAIL APU GEN 1 and 2 ON

9. BEACON ON

The aircraft is now ready for pushback and engine start. If flying online with ATC, obtain push pack and engine start clearance. Now, release the parking brake and pushback using the method you prefer. When the push back is complete, set the parking brake. Once stopped and the brake is set, it is time to start engines. Because the 747 is an advanced aircraft, there is an Auto Start capability. In addition, the APU produces enough bleed air pressure to start two engines at a time. We will use the two-engine auto start process. Time to turn some jet fuel into horsepower.

Throttle Quadrant

1. Fuel Control switches 1, 2, 3, 4 to RUN

Overhead

1. HYD DEMAND 1, 2, 3 AUTO
2. Verify APU and Engine Bleeds 1 thru 4 ON
3. Packs OFF
4. **FSX must use CRTL-E to start engines**.

   FS9 - Start Button 3 and 4 PULL (White light illuminates and will go out when start sequence complete.)

Close the Over Head and monitor start via the EICAS display. FS9 - When engines 3 and 4 are started and engine indications are stable, repeat the process for engines 1 and 2. When the all engines are stable, return to the Overhead panel and complete these items.

1. PACKS 1, 2, 3 NORM
2. HYD DEMAND 4 AUTO
3. APU GEN OFF
4. GEN CONT ON, OFF light Extinguished
5. APU OFF
6. Set Anti Ice as needed

Return to the Captain's panel and set A/T ARM to ON. Set flaps for takeoff (normally 10 degrees but make sure it matches what you entered into the FMC.) If flying with ATC, obtain your taxi clearance. Turn on the taxi lights if needed. The B747-400 is a heavy aircraft with very powerful engines. When taxiing, caution must be used on the ramp to prevent damage to structures, vehicles, personnel and other aircraft when taxiing.

Advance the throttles to start moving using only enough power to get the job done. At max gross weight this will require about 50% N_1. Taxi to the departure runway. Remember straight ahead taxi speeds should not exceed 30 knots ground speed and turning speeds should not exceed 12 knots ground speed. In heavy weight situations sharp turns should be made in the 6 to 8 knot speed range or the nose wheel will become ineffective. Further, use of nose wheel steering cannot be simply "hard over" At any speed a full deflection turn will cause the nose wheel to skid. The result is the aircraft continuing straight ahead. If you get into the skid center the nose wheel and reapply the turn command but not as aggressively. Once at the runway obtain your takeoff clearance if flying on line. Once cleared complete these tasks.

1. Strobe ON
2. TAXI Lights OFF
3. LANDING Lights ON
4. Transponder TA/RA

Now taxi onto the runway and line up on the centerline. Use as little runway as possible for during line up if you are in a heavy weight condition. Once aligned, set the brakes and advance the throttles to about 60% N_1. Verify engine response and release brakes. Click the TO/GA button on the MCP to allow the FMC to set takeoff power. Maintain runway alignment and monitor engine performance during takeoff roll. Monitor your speed and at Vr apply back pressure and smoothly rotate to an approximate 8 degree nose up attitude. Rotation rate should be about 3 degrees per second. Maintain this attitude until liftoff. Continue rotation to achieve and hold a speed of V_2+20 knots. V_2 at Max Gross takeoff weight is about 188 knots. Your target speed after liftoff will be about 208 KIAS. Once a positive rate of climb is established and the altitude has increased beyond 35' AGL, retract the gear. Because of inconsistent VNAV performance, I recommend using SPD and V/S during initial climb out. Once safely airborne, click any one of the CMD buttons followed by LNAV, SPEED and V/S. Adjust the V/S to maintain an initial climb rate at V_2+20. When passing 1500 feet, the "acceleration altitude", adjust the rate of climb to allow for a reasonable rate of speed increase and while maintaining good rate of climb of at least 1500 FPM.

Maintain these conditions while allowing the speed to build to what is necessary to comply with any departure restrictions. Retract the flaps following the cues on the PFD. Remember on departure, the cues are 'backwards'. When you pass the '10' select FLAPS 5, '5' select FLAPS 2, '2' select FLAPS 1 and '1' select FLAPS UP. As workload eases, be sure to set the Gear handle to the off position to relieve strain on the hydraulic systems. As your speed stabilizes at the target speed, you can increase the rate of climb. Don't be too aggressive or your speed will decay. Continue your climb out complying with any departure restrictions. Passing 10,000 feet set the target speed to 330 knots unless your departure procedure dictates otherwise. Adjust your rate of climb to allow your speed to increase to your new target. Your enroute climb rate should be between 1000 and 2500 FPM. Remember to change your speed values to MACH when passing FL230 to FL280 and maintain a MACH .76 climb speed.

I have found the VNAV function to become reliable around 13,000feet MSL. At your discretion, you can select VNAV but closely monitor your pitch and speed to make sure nothing goes awry.

If using VNAV, monitor aircraft performance as you climb to your cruise altitude. When you approach your cruise altitude the aircraft should level off and capture your cruise altitude. Make sure your speed stabilizes at your expected cruise speed of between MACH 0.83 and MACH 0.86.

If you are still using SPD and V/S, reduce your climb rate to about 1000 FPM when within 1000 feet of your cruise altitude. The aircraft will capture and maintain the altitude set in the MCP. Adjust your speed to your cruise speed.

Congratulations, you are now in the cruise phase. As you progress along your route and the fuel burns off, step-climbs may become appropriate. Use the FMC to determine your optimum and maximum cruise altitudes.

Follow these simple procedures to execute a step-climb. First reset your cruise altitude in the CDU to your new value. Next set the new altitude in the MCP Altitude window. The VANV *should* execute the climb to the new altitude. If it does not, click the FL CH button or click the V/S button and set the climb rate to 1000 FPM to 1500 FPM. The aircraft should execute the climb the new altitude. If you are not using VNAV, you will have to adjust your target speed.

Continue this process until you near your destination. When approximately 200 miles from your destination obtain the current weather and determine the landing runway. Yes, you selected a landing runway during preflight but weather does change especially on a long flight. Make any changes to the arrival procedure and/or landing runway on the FMC. Be sure to remove any “Route Discontinuity” blocks on the “LEGS” page. Remember the earlier warning about the ‘---‘ for speed values. Make sure each fix has a speed value set on the “LEGS” page. The FMC will compute the Top of Descent (TOD and display this information in several places including the ND as a green circle with the letters TD next to it. The information will also display on the VNAV Page 2 and PROG page of the CDU.

Also at this time, choose the INIT/REF page on the CDU and select the FLAP and Speed targets for landing. Be sure to transfer the ‘offered’ value to the selected value. After completing this task, check the PFD to make sure “V_{ref} Not Selected” is not displayed beneath the airspeed tape.

Approaching TOD, reset the MCP as needed. This may be a crossing restriction on the arrival or ATC issued restrictions. If there are none of these, you can set the MCP to the initial approach fix altitude.

If using VNAV, the aircraft will enter an idle power descent at the current target speed when it passes the computed TOD point. The aircraft should level off at any intermediate altitudes. As the aircraft passes the restriction, it will adjust speed and continue the descent to the next fix.

If you choose to use SPD and V/S to manage your descent follow the process for climb out but in reverse. Use an enroute descent speed of 300 KIAS and you can set the vertical speed a desire as long as you meet and altitude restriction. As you descend, the ND will display a green arc. This is the projected point where the current descent rate, speed and target altitude will be reached. This a great planning tool - if the arc is beyond the point where you need to meet a restriction, increase rate of descent and/or adjust speed, or both. This will move the arc closer to the aircraft. Conversely, if the arc is before the point, you can reduce your rate of descent and give the ‘virtual passengers’ and smoother descent.

Continue your descent being sure to meet the 250 KIAS below 10,000 feet restriction. Violation of this rule on the B-744 check ride is an automatic failure. Also it is company policy to turn on the landing lights when below 10,000 feet.

We will assume you are flying an ILS approach. Continue your arrival towards the Initial Approach Fix (IAF). Plan to be there at the charted attitude and 180 KIAS. Now is also a good time to ARM the spoilers and set the auto brake function. Be judicious with the auto brake to prevent overheating the brakes. This speed may require a FLAPS 1 setting depending on weight. A good rule of thumb is to deploy FLAPS 1 when slowing thru 200 KIAS. You will see a vertical line of red dots in the airspeed section of the PFD. Above the dots is an amber bracket. Do not let the speed get down to the bracket. Deploy flaps a notch at a time to prevent this.

Once the first flap deployment occurs, the PFD will display further deployment cues next to the speed tape. As the speed decays past the ‘1’, deploy FLAPS 5, passing ‘5’ deploy FALPS 10 and so forth. Normal landing is with FLAPS 25. Short runways or heavy weight may call for a FLAPS 30 landing.

Depart the Initial Approach Fix by following the approach plate information. When you are receiving the localizer and glide slope, you can select APP on the MCP. To enable auto land, you also have to select all three CMD buttons. Aircraft speed is now your control. The FMC does not automatically manage the speed at this point; control it using the SPD window.

Maintain 180 KIAS until glide slope intercept occurs or you reach a point 10 NM from the runway. At this point, reduce your target speed to 160 KIAS deploying flaps as needed.

A note about visibility…This is a tall aircraft with a large panel. It may be necessary to make adjustments to see the runway in a landing configuration. Possible actions include

1. Resizing the panel (FS9 only)
2. Adjust your view point (FS9 only)
3. Adjusting the transparency (FSX only)
4. Switching to the mini panel using the “W” key.

Continue the approach until passing the Final Approach Fix. At this time lower the landing gear and set the speed to V_{ref}+5 knots. Deploy FLAPS 25. This is the landing configuration. Continue the approach and watch for the LAND 3 cue to be displayed in the PFD. If this cue does not display, you will have to manually land the aircraft.

In the LAND 3 mode, the aircraft will flare slightly just above the runway. Expect a firm touchdown. On touchdown, the spoilers will deploy and the auto brake will engage. Manually apply reverse thrust using the F2 key. Maintain runway alignment and slow the aircraft. When slowing thru 60 KIAS, stow the reverse thrust be pressing the F1 key. Slow to taxi speed and turn off the runway.

To land manually, fly a stabilized approach by tracking the localizer and glide slope. Manage your speed to maintain V_{ref}+5. Remember, thrust manages rate of descent and trim manages speed…the Pitch/Power/Trim concept. See the Flight Academy for more information on this concept. When approximately 50 feet off the runway, pull the throttles all the way back to idle. When about 30 feet off the runway, increase pitch about 3 degrees to flare the aircraft. Hold this attitude until touchdown. Brakes and spoilers should automatically deploy. Manually apply reverse thrust using the F2 key. Maintain runway alignment and slow the aircraft. When slowing thru 60 KIAS, stow the reverse thrust be pressing the F1 key. Slow to taxi speed and turn off the runway.

Well done, you are firmly back on ‘terra firma’ but the flight isn’t over yet. Once off the runway

1. Strobes OFF
2. Landing Lights OFF
3. Taxi Lights ON as needed
4. Transponder OFF
5. Flaps up
6. APU start

If ATC is present, obtain you taxi clearance and taxi to the gate using the same procedures you did on the way out. Once at the gate

Overhead

1. APU GEN to ON
2. Taxi Lights OFF if used

Throttle Quadrant

1. Fuel Control switches 1 thru 4 CUTOFF

Overhead

1. BEACON OFF
2. If available and desired EXT POWER 1 and 2 to ON
3. APU OFF

Congratulations. You have completed a full flight in the Queen of the Skies. Yes, she is big and fast but also quite forgiving. You are now ready to handle any flight you desire, long or short.

Fuel Planning and Weight and Balance

Detailed Fuel Planning is covered in the Flight Encyclopedia. The fuel burn data shown here was determined through flight testing in FS2004 and FSX and found to be comparable between simulators. All burn rates are ***per engine*** and were measured at the maximum aircraft gross weight for the altitude and therefore should reflect the worst case scenario.

Altitude	Indicated Airspeed	True Airspeed[1]	Fuel Burn[2]
Ground Operations	N/A	N/A	3000 PPH
12,000’	340 KIAS	390 KTAS	6800 PPH
13,000’	340 KIAS	396 KTAS	6500 PPH
14,000’	340 KIAS	401 KTAS	6300 PPH
15,000’	340 KIAS	407 KTAS	6100 PPH
16,000	340 KIAS	413 KTAS	5800 PPH
17,000’	350 KIAS	430 KTAS	5400 PPH
FL180	350 KIAS	436 KTAS	5100 PPH
FL190	350 KIAS	443 KTAS	4800 PPH
FL200	350 KIAS	450 KTAS	4700 PPH
FL210	355 KIAS	461 KTAS	4300 PPH
FL220	355 KIAS	468 KTAS	4000 PPH
FL230	355 KIAS	475 KTAS	3700 PPH
FL240	355 KIAS	482 KTAS	3500 PPH
FL250	355 KIAS	489 KTAS	4500 PPH
FL260	355 KIAS	496 KTAS	5800 PPH
FL270	350 KIAS	504 KTAS	6200 PPH
FL280	345 KIAS	500 KTAS	6500 PPH
FL290	342 KIAS	503 KTAS	7100 PPH
FL300	334 KIAS	500 KTAS	6700 PPH
FL310	326 KIAS	498 KTAS	6500 PPH
FL320	319 KIAS	496 KTAS	6400 PPH
FL330	312 KTAS	494 KTAS	6300 PPH
FL340	304 KTAS	491 KTAS	5900 PPH
FL350	297 KIAS	490 KTAS	5800 PPH
FL360	291 KIAS	490 KTAS	5700 PPH
FL370	284 KIAS	488 KTAS	5400 PPH
FL380	277 KIAS	487 KTAS	5200 PPH
FL390	270 KIAS	486 KTAS	4700 PPH
FL400	264 KIAS	487 KTAS	4600 PPH
FL410	258 KIAS	487 KTAS	4500 PPH

Notes:

1. True Airspeed determined via flight test using FSX and FS9 and does not conform to the 2% rule.
2. Fuel burn rates determined via flight test in FSX and FS9 and are **per engine**.

B747-400 Fuel Planning Example

1200 NM flight at FL300
Alternate distance of 250 NM

Flight Time 500 KTAS/60 = 8.33 NM per minute.
1200NM/8.33 = 144 minutes (round to nearest minute).
Add an additional 10 minutes fuel burn during climb and descent
144 + 10 = 154 minutes/60 = 2.56 hrs (round up to 2.6)
Total Flight Time = 2.6 hours
Zero Fuel Weight – 505,000 lbs
Unusable = 30.2 lbs
Ground Operations = 3000 lbs
Flight = 2.6 hrs * 6700 PPH = 17,420 lbs
Alternate = .5 hr * 6700 PPH = 3350 lbs
Reserves = 45 minutes (.75 hr) * 6700 PPH = 5025 lbs
Holding = .5 hr * 6700 PPH = 3350 lbs
Total fuel per engine – 32,175.2 lbs
Total fuel (32,175.2 * 4 engines) = 128701 lbs
Ramp Weight – 633701 lbs

Fuel Load: Left, Left AUX and Right and Right AUX should be filled equally until full. In this example, each tank should be loaded with 32175.25 pounds of fuel.

Note: Fuel burn tests were done at gross weight in clear weather. When flying normally, you may experience a fuel burn slightly less than those on the charts. Due to the complexity of the fuel burn chart to be worked up with different weight settings, we have simply tested it at gross weight to depict worst case scenario. Always take weather and winds aloft into consideration!

FUEL CAPACITIES:

Left Auxiliary – 38598 lbs

Left – 84004 lbs

Center – 114925 lbs

Right – 84004 lbs

Right Auxiliary – 38598 lbs

Center 2 – 11892 lbs

Unusable – 120.2 lbs

Fuel loading procedure

Follow the fuel loading procedure and keep in mind that if there is more fuel left over after loading a step in this process, proceed to the next step.

1. Load the left, left aux, right and right aux evenly.
2. With the left aux and right aux tanks full, fill the left and right main tanks
3. Next add fuel to the center tank until full
4. Lastly add fuel to the center 2.

▪ 

Checklist

AT GATE PARKED-BEFORE ENGINE START

o All Charts/Flight Plan	**On Board**
o Weight/Balance	**Verify** Configuration
o ACARS *(Optional)*	Connect-Flight Start (Optional)
o Battery Switch	**ON**
o Parking Brake	**ON**
o Standby Power Selector	**AUTO**
o Utility L & R	**ON**
o Bus Tie Switches (ALL)	**AUTO**
o Generator Control Switches (ALL)	**ON**
o Hydraulic Engine Pump Switches	**OFF**
o Hydraulic Demand Pump Switches	**OFF** SYS FAULT/PRESS light ON
o Alternate Flaps & Gear Selector	**SET**
o EXT PWR Switches 1 & 2 (If Available)	**ON**
o APU (if desired)	**START**
o APU GEN 1 & 2 (If APU Started)	**ON**
o NAV lights	**ON**
o IRS Selectors (ALL)	**OFF** then **NAV**
o Electronic Engine Control (ALL)	**NORM**
o Engine Fire Switches	**IN** lights out
o FIRE/OVHT TEST	**PRESS** Lights on, Alarm sounds then lights/alarm off
o Engine Start Switches (ALL)	**IN**
o Standby Ignition	**NORM**
o Continuous Ignition	**OFF** (White bar)
o Auto Ignition Selector	**SINGLE**
o AUTOSTART	**ON**
o Fuel Jettison Selector	**OFF**
o Fuel Jettison NOXXLE (BOTH)	**OFF**, Guarded, Lights off
o Fuel X FEED valves (ALL)	**ON**
o Fuel Pumps (ALL)	**OFF**
o Nacelle Anti Ice	**OFF**
o Wing Anti Ice	**OFF**
o YAW DAMPER (BOTH)	**ON**
o Outflow Valve Manual switches	**OFF** (White bar)
o Cabin Altitude Auto Selector	**NORM**
o Trim Air	**ON**
o Upper & Lower Recirculation fans	**ON**
o Equipment Cooling	**NORM**
o High Flow switch	**OFF**
o Pack Controls (ALL)	**NORM**
o Left & Right Isolation valves	**ON**
o APU Bleed Air switch	**ON**

o Engine Bleed Air switches (ALL)	**ON**
o NAV Radios	**SET IDENT**
o ADF	**SET IDENT** (if required)
o Transponder	**STBY**
o Auto Brakes	**RTO**
o Speed Brake Lever	**DOWN**
o FLAPS	Lever and Indicator **AGREE**
o Passenger Signs	**SET**
o FMC/CDU s	**PROGRAM** and verify

ATC CLEARANCE - Call for IFR/VFR Departure-Push/Start Request

o FMC/CDU	**Confirm**
o Transponder	**SET** Code/**Verify** Squawk Standby
o Crew Takeoff Briefing	**Completed**
o BEACON Lights	**ON**
o APU (If not already running)	**START**
o APU GEN 1 & 2 (If not already set)	**ON**

BEFORE ENGINE START CHECKLIST COMPLETED

ENGINE START

ATC Clearance: Obtain pushback and engine start clearance

Execute Pushback using method/tool of your choice
When pushback complete:

o Parking Brakes	**Verify** ON
o Simulator time at start	**Document**
o Hydraulic Engine Pump Switches	**ON**
o Hydraulic Demand Pump 4	**AUX** Press light remains ON
o Hydraulic Demand Pumps 1, 2, 3	**AUTO**
o Fuel Pumps (All Tanks with Fuel loaded)	**ON** Press Lights out
o Fuel Control Switches (ALL)	**RUN**
o Throttle Power Levers	**IDLE**
o PACKS - All	**OFF**

Normal Engine Start Sequence is 4,3,2,1
Engines may be started two at a time

o FSX ***must*** us CRTL-E to start engines.	
o FS9 - Engine Start Switch 4 & 3	**PULL** Lights illuminate
o EICAS	**Monitor** Start
o Engine indications Stable	Engine Start Lights out
o FS9 - Engine Start Switch 2 & 1	**PULL** Lights illuminate
o EICAS	**Monitor** Start
o Engine indications Stable	Engine Start Lights out

ENGINE START CHECKLIST COMPLETED

After Engine Start

o Parking brakes	**Verify** ON switch OFF then ON
o PACKS	**ON**
o Anti-Ice	**ON** as required
o APU	**OFF**
GEN CONT switches (ALL)	Verify **ON** If Gen is in a Fault status, cycle switch OFF then ON
o Hydraulic Demand Pumps (ALL)	**AUTO**
o Flap Selector Set Takeoff Flaps	**SET**
o MCP Heading	**SET** (Runway Heading or DP)
o MCP IAS	**SET V2+20 (SPD)**
o Altitude	**SET (ALT)**
o F/D	**ON**
o A/T	**ARMED**
o Autopilot DISENGAGE bar	**UP**
o Flight Controls (outside)	**Demonstrate** Free and Clear

AFTER ENGINE START CHECKLIST COMPLETED

Taxi

ATC TAXI CLEARANCE – Request Taxi to Active Runway

o Throttle Power Levers	**IDLE**
o Parking Brakes	**Release**
o Toe Brakes	**Verify** OPS
o Taxi Power	50% N1 until rolling – adjust for speed (Max 30 Straight, 12 Turn)
o Instrument Check-Taxi	**Verify** Compass/PFD/ND move
o Cabin Announcements	**Perform** during Taxi

Before Takeoff/Hold Short Line

o Parking Brakes	**ON**
o Flight Director	**Verify** ON
o LNAV (If Desired)	**ON**
o VNAV (If Desired)	**ON**
o MCP Heading	**VERIFY** Departure Heading
o Landing Lights	**ON**
o Taxi Lights	**OFF**

o Strobe Lights	**ON**
o Takeoff time & Fuel Amount	**DOCUMENT**
o Flap Selector & Trim	**VERIFY** Settings
o COM's, NAV's & ADF	**VERIFY** Settings
o Transponder	**TA/RA**

ATC Takeoff CLEARANCE – Request for Takeoff
BEFORE TAKEOFF CHECKLIST COMPLETED

Takeoff Cleared or Taxi into Position and Hold

o Runway	**VERIFY** Clear
o Toe Brakes	**ON**
o Auto Brakes	**Verify** RTO
o Taxi Onto Runway	**ALIGN**
o Throttle Power Levers	**Advance** 50% N1
o Engine Instruments	**VERIFY** stabilized
o Toe Brakes	**Release**
o Throttle Power Levers	**Advance** full power
o MCP TO/GA	**SELECT**
o Vr	**Rotate** to 8 degree pitch up
o Landing Gear	**UP** at V2 Positive Rate & 35' AGL
o Climb Profile	2,000-2,500 FPM at 250 KIAS
Flap Selector	**Retract on schedule**
▪ Auto Brakes	**OFF**
▪ CMD	**SELECT** (any)

TAKEOFF CHECKLIST COMPLETED

Climb to Altitude

o Engine Instruments	**MONITOR**
Climb Profile	**See Climb Profile in Charts**
o Landing Gear (after flaps up)	**OFF**
o Landing Lights (10,000 ft)	**OFF**
o Crossing transition altitude (18,000 ft MSL in USA, other countries vary)	**Reset** Altimeter to 29.92 in.

Enroute

o Flight progress, fuel flow and engine operations	**MONITOR**
o Cruise Speed	**Mach .85** @ FL300 and above
o Crew Approach Briefing	**Completed**

ENROUTE CHECKLIST COMPLETED

DESCENT

ATC Descent CLEARANCE or TOD (Top of Descent) - Descend

Weather	**OBTAIN**
Arrival and Landing Information	**VERIFY**
FMC/CDU	**VERIFY**
MCP Altitude	**RESET** within 40 NM TOD
Anti Ice	**ON** as needed
Landing Airport altimeter (below transition altitude)	**SET**
Airspeed 280 KIAS till 10,000 ft MSL	**VERIFY 2,500 FPM descent**
Airspeed 250 KIAS below 10,000 ft MSL	**VERIFY 1,500 FPM descent**
Flight Spoilers	**AS NEEDED**
Landing Lights (crossing 10,000 ft MSL)	**ON**

APPROACH

ATC Approach CLEARANCE - Approach

COMM Frequencies	**SET**
Navigation Radios	**SET** Freq/**IDENT**
Flap Selector	**SET** per schedule
MCP SPEED	**SET** per speed chart
DH/MDA	**SET**
Auto Spoilers	**ARMED**
Auto Brakes	**SET**
APP Mode (IF ILS approach)	**ARM**

FINAL APPROACH

MCP SPEED	**Set** V_{app} per speed card
Flap Selector (25° or 30°)	**SET**
Landing Gear	**DOWN**
Stabilized Approach	**Established**

APPROACH CHECKLIST COMPLETED

LANDING

ATC Landing CLEARANCE – to Land

o Cross Threshold	**ON SPEED** V_{app}
o Throttle Power Levers (if no auto land)	**50' GND IDLE**
o FLARE (increase pitch 3 degrees)	**30' AGL**
o SPOILERS after touchdown)	**VERIFY Extended**
o Engine Reverse	**Reverse** > 60 KIAS (F2 Key)
o Toe Brakes (If no auto brake)	**APPLY**

Exit high-speed taxiways at <30 knots, or 8-12 knots at any other runway turn off

LANDING CHECKLIST COMPLETED

AFTER LANDING

ATC Taxi CLEARANCE – to gate

o Transponder/TCAS	**STANDBY**
o Landing Lights	**OFF**
o Strobe Lights	**OFF**
o Taxi Lights	**ON**
o Flap Selector	**UP**
o Spoilers	**VERFIY Retract**
o APU	**START**
o APU GEN	**ON**

AFTER LANDING CHECKLIST COMPLETE

GATE SHUTDOWN

o Parking Brakes	**ON**
o Taxi Lights	**OFF**
o Hydraulic Demand pump 4	**AUX**
o Hydraulic Demand Pumps 1, 2, 3	**OFF**
o Fuel Control switches (ALL)	**OFF**
o Anti Ice	**OFF**

Record the fuel in tanks and compare to fuel plan

o SEAT BELT Signs	**OFF**

o Doors	**OPEN**
o Fuel Pumps (all)	**OFF**
o Beacon	**OFF**
o F/D	**OFF**
o A/T	**OFF**
o Hydraulic Demand Pump 4	**OFF**
o Hydraulic Engine Pumps	**OFF**
o IRS (ALL)	**OFF**
o Engine Bleeds	**OFF**
o APU Bleed	**OFF**
o PACK Switches (ALL)	**OFF**
o GASPER	**OFF**
o RECIRC UPR & LWR	**OFF**
o TRIM AIR	**OFF**
o APU	**OFF** (monitor until stopped)
o Ext PWR 1 & 2	**OFF**
o UTILITY L& R	**OFF**
o Navigation/Panel Lights	**OFF**
o Gen CONT – ALL	**OFF**
o BUS TIE	**OFF**
o STANDBY Power	**OFF**
o Battery	**OFF**
o Simulator Time at Shutdown (if you are flying online, note the real world time)	Document
o ACARS Shutdown (optional)	End Flight, File PIREP
o Exit Flight Simulator	

Emergency Procedures

Although Microsoft Flight Simulator does not do a very good job simulating emergencies, Delta Virtual Airline pilots may encounter some of the critical situations outlined in the following sections.

Rejected Takeoff

- Only attempt a rejected takeoff before V_1. Once V_1 has been reached the aircraft is committed to flight and **must** take off.
- If auto-brakes are set properly (to RTO) braking will be automatically applied when the throttles are returned to idle.
- Apply reverse thrust as needed, and deploy spoilers to reduce lift and increase braking effectiveness.

Stall Recovery

- A stall occurs when a wing reaches a critical angle of attack. Regardless of load factor, airspeed, bank angle or atmospheric conditions, a wing always stalls at the same critical angle of attack.
- There is only one way to recover from a stall – reduce the angle of attack of the wing. Apply forward pressure on the yoke, and increase thrust to increase airspeed and minimize loss of altitude.
- At low altitudes, add full thrust for later climb and monitor altitude closely. A low altitude stall is an exceptionally dangerous situation and the loss of altitude in recovery can be fatal.
- At high altitudes and speeds, lower the nose and do not add thrust to prevent an over speed condition. After recovery, select a lower altitude.

Single Engine-Out

- Today's modern turbofan engines make engine failure an exceptionally rare situation. However, during takeoff engine failure is a critical condition that must be addressed immediately.
- Until V_1, a takeoff must be rejected. After V_1, maintain pitch and V_2 until 1000' AGL. Retract flaps and reduce climb rate to maintain airspeed while providing for adequate terrain and obstacle clearance. If turns are required, limit bank angle to 15°.

Missed Approach

- Execute Missed Approach if at minimums with no visual reference, or if uncomfortable with the landing. Never try to salvage a landing out of a poorly executed final approach.
- Call for maximum thrust and pitch up 15°.
- Landing Gear UP. Engage autopilot missed approach course.

All Engine Failure

- Boeing 747s have suffered complete engine failures in the past, in both situations due to environmental factors – volcanic ash. Despite the rarity of such an occurrence, 4-engine failure in Flight Simulator is possible due to fuel starvation.
- From FL390, a gliding 747 has a range of approximately 120 nautical miles. Pilots should aim to reach a point 30 miles from the destination airport at no lower than 12,000' MSL with the aircraft still in a clean configuration.
- In such a situation, leading-edge devices would not be available due to lack of hydraulic pressure, and the approach speed should be increased by 15 KIAS as a result.
- **You have only one attempt at the landing.** Fly over the Outer Marker at an altitude of at least 1,500' AGL, and after this point extend the landing gear and full flaps. Keep the spoilers as backup in case you are too high on the approach. The goal is to conserve altitude and airspeed, then bleed them off with flaps and spoilers when no longer needed.

Emergency Descent

- Emergency descent from high altitude must be completed within the aircraft's safe operating parameters. The maximum operating speed of Mach 0.92 must not be exceeded – bleed off airspeed before commencing descent, and use spoilers and slats/flaps to keep airspeed within a safe range during the descent.

Crew Briefings

TAKEOFF

Captain to Co-pilot

We will be taking off on RWY (*active runway*), climbing to (*altitude*). If we encounter an engine malfunction, fire or other emergency before **V_1** (critical engine failure recognition speed) KIAS, the flying pilot will retard the throttles to flight idle and bring the aircraft to a complete stop on the runway. The non flying pilot will notify the proper ATC of our intentions and assist the flying pilot as requested or needed to operate the aircraft in a safe manner.

If the aircraft has reached **V_r** (*rotate speed*) KIAS, the flying pilot will fly the aircraft per company procedures and the non flying pilot will notify the appropriate ATC of our intentions and assist the flying pilot as requested or needed to operate the aircraft in a safe manner and land the aircraft as soon as possible.

Aircraft Weight is: ________ Taxi Instructions to Active: _____________

V Speeds for this flight are (*calculated*) See prepared Flip Chart(s)

Flap Settings: Takeoff _____ Engine Failure Approach ______

Discuss the Departure Procedures for this flight (Ref Charts, SIDs)

Discuss Weather considerations (Ref ATIS, METAR, TF)

LANDING

Captain to Co-pilot

Weather conditions are (*obtain from ATIS, Metar and TF*).

Landing on RWY (*active runway*) at (airport) using the (**???**) approach (Ref STAR)

Descend at (**???**). Our Final Approach altitude will be (**???**)

V Speeds for this approach are (*calculated*) (See prepared Flip Chart(s))

Missed approach Procedures are (Ref Approach Plates)

Taxiway Turnoff _____ Taxi Route from Active ________________

Parking at Gate (**#**)

Crew Announcements

DEPARTURE

"Ladies and gentlemen, on behalf of the flight crew, this is your (*captain or first officer*) (*insert name*), welcoming you aboard Delta Virtual Airlines flight number (*flight*) with service to (*destination*). Our flight time today will be approximately (*time en route*) to (*destination*). At this time, I'd like to direct your attention to the monitors in the aisles for an important safety announcement. Once again, thank you for flying Delta Virtual Airlines."

CLIMBING ABOVE 10,000 FEET MSL

Inform cabin crew that use of approved electronic devices is authorized.

AT CRUISE ALTITUDE

"Ladies and gentlemen, this is the (*Captain or First Officer*) speaking. We've reached our cruising altitude of (altitude). We should be approximately (*time*) enroute and expect to have you at the gate on time. I've turned off the fasten seatbelt sign, however, we ask that while in your seat you keep your seatbelt loosely fastened as turbulence is often unpredicted. Please let us know if there is anything we can do to make your flight more comfortable, so sit back and enjoy your flight."

APPROACH

Inform cabin crew of approach and to discontinue use of electronic devices.

LANDING

"On behalf of Delta Virtual Airlines and your entire flight crew we'd like to welcome you to (*destination*) where the local time is (*time*). We hope you've enjoyed your flight with us today and hope that the next time your plans call for air travel, you'll choose us again. Once again, thank you for flying Delta Virtual Airlines."

Appendix 1 - Speed Card

All data reflected in these charts apply to the Delta Virtual Airlines Fleet B-747-400 for FSX and FS9

Speed Card Template

Boeing B747-400			
Gross Weight: lbs			
Takeoff			
Flaps 10		**Flaps 20**	
V_1		V_1	
V_r		V_r	
V_2		V_2	

Landing							
Flaps	**0**	**1**	**5**	**10**	**20**	**25**	**30**
Maneuvering	230	X	X	X	X	X	X
V_{ref}							
(V_{ref}+5) V_{app}							

Example:

Boeing B747-400			
Gross Weight: 550,000 lbs			
Takeoff			
Flaps 10		**Flaps 20**	
V_1	117	V_1	111
V_r	130	V_r	124
V_2	150	V_2	143

Landing							
Flaps	**0**	**1**	**5**	**10**	**20**	**25**	**30**
Maneuvering	230	X	X	X	X	X	X
V_{ref}	223	204	183	164	154	149	143
(V_{ref}+5) V_{app}	228	209	288	169	159	154	148

APPENDIX 2 - TAKEOFF AND LANDING SPEED CHARTS

Takeoff Speeds

Gross Weight (lbs)	Flaps 10			Flaps 20		
	V_1	Vr	V_2	V_1	Vr	V_2
880,000	160	178	188	155	171	181
858,000	159	176	187	153	170	180
836,000	157	174	185	152	168	178
814,000	155	171	183	149	165	176
792,000	152	168	180	147	162	174
770,000	149	165	177	144	159	171
748,000	147	162	175	141	156	169
726,000	144	158	172	138	152	166
704,000	141	155	169	135	149	163
682,000	137	151	166	132	146	160
660,000	134	148	164	129	142	158
638,000	131	144	161	126	139	155
616,000	128	141	158	123	135	152
594,000	124	137	155	119	132	149
572,000	121	133	153	115	127	146
550,000	117	130	150	111	124	143
528,000	113	126	147	107	121	141
506,000	109	123	144	104	117	138
484,000	105	119	142	100	113	136
462,000	101	115	139	96	110	133
440,000	96	111	136	92	106	130

Maneuvering and Landing Speeds

Landing Weight (lbs)	FLAPS 0 ($V_{m(lo)}$)	FLAPS 1	FLAPS 5	FLAPS 10	FLAPS 20	FLAPS 25	FLAPS 30
630,000	234	213	194	174	164	160	153
610,000	232	212	192	172	162	157	151
590,000	229	210	189	170	159	154	148
570,000	227	207	186	167	157	152	146
550,000	223	204	183	164	154	149	143
530,000	221	201	181	161	151	146	140
510,000	218	198	178	158	148	143	137
490,000	215	195	175	155	146	140	134
470,000	212	192	172	152	142	137	131
450,000	209	189	169	149	139	133	128
430,000	206	186	166	146	136	130	125
410,000	204	184	165	144	133	127	123

APPENDIX 3 - TYPICAL FLIGHT CONFIGURATION & CAPACITIES

Standard Flight Setup – 3000 NM trip

Empty Weight	**394660** lbs		**Fuel**	**213000** lbs
Payload	**110340** lbs		Left Aux (100%)	38594
1st Class Main	5600 lbs		Left (80.0%)	67906
Bus Class Main	5950 lbs		Center (0%)	0
Bus Class Upper	7350 lbs		Right (80.8%)	67906
Econ Class Main	53900 lbs		Right Aux (100%)	38594
Fwd Cargo	16270 lbs		Center 2 (0%)	0
Aft Cargo	16270 lbs			
Bulk Cargo	5000 lbs			
	Gross Weight		**718000** lbs	

Fuel Capacity

Tank	Capacity
Unusable	120 lbs
Left Aux	38576 lbs
Left	83986 lbs
Center	114907 lbs
Right	83986 lbs
Right Aux	38576 lbs
Center 2	11874 lbs
Total Fuel	**372733** lbs
Fuel Weight Lbs/gal: 6.7	

Payload Capacity

Station	Pounds
1st Class Main	5600
Bus Class Main	5950
Bus Class Upper	7350
Econ Class Main	53900
Fwd Cargo	15750
Aft Cargo	15750
Bulk Cargo	2000
Total	**106300**

APPENDIX 4 - TYPICAL FLIGHT PROFILES

Climb Profile

Speed	Altitude
V_2 + 20 KIAS	1,500 ft AFE
250 KIAS	10,000 ft
330 KIAS	FL180
.76 mach	FL240
.82 mach	FL280
.84 mach	Cruise Alt
.85 mach	Level Cruise

Standard Climb Rates

FPM	Altitude
2000 - 2500	Below 10,000 ft
1000 - 2000	10,000 ft to FL180
1000 - 2000	FL180 to FL280
500 – 1500	Above FL280

Descent Rate

Target Speed	Descent Rate	Altitude
280 KIAS	2500 fpm	Cruise to 10,000 ft MSL
250 KIAS	1500 fpm	Below 10,000 ft MSL

Approach / Landing Speed Profile

Speed	Altitude	Distance from Airport	Flaps
220 KIAS	Below 10,000 feet	30 nm	Up
200 KIAS		15 nm	Up
180 KIAS		10 nm	5°
160 KIAS	Varies	Final Approach Fix	10°
V_{ref} + 5	Varies		25°
V_{ref} + 5	Varies	Runway Threshold	25° or 30°

APPENDIX 5 – OPERATING ALTITUDES

Maximum Operating Altitudes

Clean	45,000 Feet
Flaps	20,000 Feet
APU	20,000 Feet
APU Bleed Air	15,000 Feet
Take Off	10,000 Feet
Landing	10,000 Feet

Flap Speeds

Flap Position	Maximum Speed
1	280 KIAS
5	260 KIAS
10	240 KIAS
20	230 KIAS
25	205 KIAS
30	180 KIAS

Optimum / Maximum Cruise Altitudes

Altitude	Optimum Weight	Maximum Weight	Fuel Burn (Pounds)	Burn Time (Hours)
FL420	470,000 lbs	520,000 lbs	N/A	N/A
FL410	500,000 lbs	550,000 lbs	30,000	1.67
FL400	520,000 lbs	570,000 lbs	20,000	1.09
FL390	550,000 lbs	600,000 lbs	30,000	1.60
FL380	570,000 lbs	630,000 lbs	20,000	0.96
FL370	600,000 lbs	670,000 lbs	30,000	1.39
FL360	630,000 lbs	700,000 lbs	30,000	1.32
FL350	670,000 lbs	740,000 lbs	40,000	1.72
FL340	700,000 lbs	770,000 lbs	30,000	1.27
FL330	740,000 lbs	810,000 lbs	40,000	1.59
FL320	770,000 lbs	840,000 lbs	30,000	1.17
FL310	810,000 lbs	870,000 lbs	40,000	1.54
FL300	840,000 lbs	N/A	30,000	1.12

APPENDIX 6 – KNOWN AIRCRAFT ISSUES

The Delta Virtual Airlines fleet Boeing 747-400is based on the project Open Sky aircraft model merged with iFly Developer Team panel. This panel includes an operational Flight management Computer and associated Control Display unit. During extensive testing, we have discovered several issues that are beyond our control to correct. These issues, while bothersome, can be managed to allow anyone to successfully fly the B-747-400. The paragraphs provide information on the issue and, where needed, how to manage the condition. Items without a recommended mitigation are nuisance level issues that do not require any specific action but are included for informational purposes.

MEMORY USAGE

The IFly B-747 elements incorporated into the Delta Virtual Airlines fleet B-747 has an issue with memory usage. This problem causes the amount of memory used by Microsoft Flight Simulator (MSFS) 2004 and X to gradually but continually increase to the point where an Out Of Memory condition will be created. Once this occurs, MSFS will freeze and terminate. All activity and flight progress to this point will be lost. Further, this error induces data errors that will prevent an ACARS based flight restoral. Extensive testing was conducted in an attempt to find both the cause and a resolution to this problem.

The bad news is the problem is indeed an IFly problem and appears tied to the graphics display. The problem is apparent in both FSX and FS2004 in windowed and full screen modes. Further, this problem is beyond DVA's capacity to fix.

The good news is the problem is manageable.

All that has to be done is to periodically minimize FS to the task bar and then maximize/restore it. No delay is necessary between the "minimize" and "restore/maximize" actions. Simply tasking out of FS is not enough; FS must be taken off the screen. By taking these actions, a significant amount of memory is freed. Loaded at the gate establishes a base line MSFS memory usage on about 575MB. A minimize and restore action reduces the memory use to as little as 220MB after allowing the memory usage to stabilize for a few minutes. Yes the usage immediately starts to grow but because the starting point is so much smaller, the next minimize/restore sequence is not necessary until well into the flight. The rate of growth when maximized in a windowed mode is about 200MB per hour and 70MB per hour when minimized. A 2-3 hour flight may only need one 'treatment'. Longer flights will need action, as a minimum, just before TOD. I believe on a maximum range flight this sequence may be necessary 3-4 times at most with the best times probably being before takeoff, mid-flight cruise and at TOD. Long haul unattended flights can be left running minimized provided the "Pause of Task Switch" is off in the FS settings. While minimized, the memory use is at its lowest starting point and thus will allow a longer elapsed time between actions.

An 'Out of Memory' condition has been induced repeatedly when the total MSFS – as seen as fs9.exe or fsx.exe in the windows Task Manager – memory usage was in excess of 900MB with the highest being 1242MB. To quantify, testing was performed on a PC running an effective memory capacity of 3.5 GB (4GB physical on XP Pro).

Be sure to monitor memory usage using the Task Manager and perform a “minimize – maximize” sequence as needed.

FMC/CDU

1. Default units of measure are metric. The user must go to the SIMU menu to select Standard units of measure. This is a one-time setting change that is persisted from session to session.

2. Entry of a cruise altitude above the optimum (OPT) as computed by the FMS will result in an error indicating the selected altitude exceeds the maximum allowable as computed by the FMC. The Error Message is “MAX ALT FLNNN”

3. The MAX ALT FLNNN message always displays the NNN as opposed to the actual FL altitude value.

4. Progress page ETA time estimates are incorrectly computed. The error increase as the destination is approached.

5. Progress page fuel remaining values are wrong. This error decreases inverse to the distance from the destination. The closer to the destination, the smaller the error. Long flights will show insufficient fuel until long after being airborne. **Mitigation:** Manually compute fuel requirements and load accordingly.

6. Step-climb guidance is a moving target. Initial step-climb data shows an estimated time and distance to the next climb point, for instance 0120z/100NM. As the flight processes, the time and distance may slowly move outward to later time and greater distance. **Mitigation:** Manually determine optimum altitudes based on aircraft gross weight and execute step-climbs accordingly. Note: most flights can be complete without step-climbs. Yes fuel burn will be greater than necessary but we are in a virtual world. However, maximum range flights will require diligent compliance with step-climb procedures to ensure sufficient fuel.

7. Legs page. Only fixes defined in the departure or arrival procedure with crossing speeds will have speed values. All other leg speed values will be displayed with the ‘---‘ indication. If the ‘---‘ values remain, the FMC will commend the throttles to idle and allow the airspeed to decay to zero resulting in a stall. The airspeed adjustment occurs when passing the preceding fix, not as the fix is approach as other FMC equipped

aircraft do. **Mitigation:** Ensure there is an airspeed value – in KNOTS, not MACH – for each fix. Remember, the normal climb speed is 330 KIAS, the normal descent speed is 280 KIAS. Be aware that at higher altitudes these speeds may exceed the maximum allowed. Consult to fuel planning chart to determine the appropriate cruise speed at a given altitude and use this value as your maximum.

8. Leg page. The altitude at a fix is computed as the other performance factors are loaded, however, these altitudes do not update as those factors are adjusted or when a manually entered restriction is added. **MITIGATION:** Verify altitudes displayed provide for a smooth, continuous climb to altitude in compliance with any restrictions. Verify the descent profile allows for a smooth, continuous descent profile. There should be 'climb – descend' climb' or 'descend climb –descend' situations. Remember to use the "A" above and "B" below options on the altitudes. Example: 280/FL180B means a speed of 280 KIAS any altitude below FL180.

VNAV/AUTO THROTTLE

1. Altitude capture is abrupt. A full rate climb or descent is maintained until approximate 200-300 above or below the target altitude. An abrupt pitch maneuver is then executed to capture the altitude. This can result in an altitude excursion of as much as 500 feet above or below to target altitude. In extreme cases, a deviation in excess of 1000' can be seen, especially at lower altitudes where climb rats can be high. **Mitigation:** Recommend using the SPD and V/S functions to manage the climb or descent. To do so, on the MCP Set the new target altitude in the ALTITUDE, set the desired speed in the SPD and then click V/S and adjust to the vertical speed you desire. Alternatively, you can set the altitude and click the FL CH button. You will have to monitor the SPD values to make sure you do not violate aircraft speed limitations.

2. Climb and Descent profile logic. If the route of flight includes speed and altitude restrictions in either the climb or descent phase, the FMC logic commands the alteration of airspeed before the altitude change is commended. This is opposite most other FMC/FMS implementations.

3. Descents are idle power, max rate of descent events. If you do not want this for any reason, we recommend using the SPD and V/S functions to manage the descent. To do so, on the MCP Set the new target altitude in the ALTITUDE, set the desired speed in the SPD and then click V/S and adjust to the vertical speed you desire. Alternatively, you can set the altitude and click the FL CH button. You will have to monitor the SPD values to make sure you do not violate aircraft speed limitations.

4. VANV implementation is inconsistent and unreliable at lower altitudes, especially right after departure. **Mitigation:** Recommend using the SPD and V/S functions to manage the climb or descent. To do so, on the MCP Set the new target altitude in the

ALTITUDE, set the desired speed in the SPD and then click V/S and adjust to the vertical speed you desire. Alternatively, you can set the altitude and click the FL CH button. You will have to monitor the SPD values to make sure you do not violate aircraft speed limitations. Closely monitor speeds as the auto throttle may not react fast enough to prevent an over speed condition.

5. Auto Throttle response. Testing has shown auto throttle response may not be able to keep pace with the aggressive pitch rates used by the FMC to capture target altitudes, especially at lower altitudes and higher vertical velocities. **Mitigation:** Recommend using the SPD and V/S functions to manage the climb or descent. To do so, on the MCP Set the new target altitude in the ALTITUDE, set the desired speed in the SPD and then click V/S and adjust to the vertical speed you desire. As you approach the target altitude, reduce the climb rate to about 1000 FPM or less. This will allow the auto throttle to react effectively.

TRAFFIC COLLISION AND AVOIDANCE SYSTEM (TCAS)

The TCAS displays all aircraft within approximately 40 NM of the aircraft in all directions regardless of altitude. Conflict alerts and resolution advisories are issued for all aircraft when viewed in a 360 degree area. You can get Traffic Alert and Resolution Advisories (TA/RA) for an aircraft behind you going the other way.

PRIMARY FLIGHT DISPLAY (PFD)

Flap extension and retract guidance is presented on the speed tape until after FLAPS 1 is selected.

ENGINE INDICATING AND CREW ALERTING SYSTEM (EICAS)

Fuel quantity values are label in kilograms regardless of the select unit of measure. This is the *label* only. The actual quantity values are correct with regard to the unit of measure. If standard units are selected, fuel will be reported in pounds but label as Kgs.

Secondary EICAS Fuel Page does report fuel quantities in the tanks correctly. If in doubt, the fuel quantity reported on the Primary EICAS page is most accurate. Also, the PERF INT page on the CDU is accurate.

FSX ENGINE STARTING

This problem applies to FSX versions only and is beyond the ability of DVA to correct. Engine starts are not possible using the normal start procedures. Attempts to start engines with the systems are properly configured - APU running, air bleeds open and packs off – will fail. After pulling the start switch to the on position, the engine will only spool to about 1.5% N1. The light off N1 speed is about 2.8%. This occurs all the time, regardless of whether auto start is used or not. Repeated and random movement of the start switches, fuel controls and ignition switches can lead to an unstartable condition. If this occurs reload the aircraft. Mitigation: Use the built in MSFS engine start routine by pressing the CTRL+E keys.

Acknowledgements and Legal Stuff

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Phillip Rothberg and Luke Kolin created the original manual in 2003. George Lewis and Rob Morgan modified this manual for Delta Virtual Airlines in December 2008.

- Flight Sim screenshots courtesy George Lewis, Charly Azcue, David Gomez and Rob Morgan.

While we strive to mirror real-world operations, this manual is not designed for use in the operation of real-world aircraft.

NOT FOR REAL WORLD AVIATION USE