"The Inaugural Flight"
by Mel J. Ott

This chapter describes the preflight and departure procedures of the first Tokyo - New York flight on a 747-400. This "Inaugural Flight" was flown with Northwest Airlines in 1989.

While this chapter presents the preparation and departure in detail, it doesn't attempt to explain all details of the following cruise and arrival portion of this particular "Inaugural Flight" but it rather discusses general aspects of flying and operating the 747-400.

The author of this chapter, Mel J. Ott, has used the fictitious name of "Cap'n Tarmack" for the past 15 years, representing a "character" pilot that when not flying, is either writing or pontificating about aviation experiences gathered over the span of a 35 year professional pilot career. Comedian Johnny Carson, host of the NBC "Tonight Show" for over 20 years often presented a character known as "Carnac the Magnificent". This character knew all, saw all, and often could "divine" an answer even before he heard a specific question. The character wore a long robe complete with a "turbin" head gear and afforded Mr. Carson the ability to step out of his personal character and become a bit ridiculous while at the same time presenting a very entertaining new character. Additionally, almost every news story about an aviation incident or accident contains the word "tarmac" as a description of the runway surface at every airport. With that rather convoluted reasoning for a choice of a name, Cap'n Tarmack became a very familiar name throughout the Air Line Pilot Association (ALPA) group due to a monthly magazine column written by Mel, entitled "Another Crossing with Cap'n Tarmack". This column presented the world of the tragic, intermixed with the world of humor of an airline pilot's life, if that pilot did not take himself too seriously.

Inaugural procedures: "Cap'n Tarmack" (2. from right) and colleagues.

Photograph: Archive

Introduction

Gentlemen,

Welcome to the world of the 747-400!

As a new owner of Precision Simulator 1.3 (short: "PS1") you are about as close to as "real as it gets" as you ever will be!

I would like to first, before we begin the "nuts and bolts" of flying this airplane to use some words to describe what THIS airplane meant to me, and to so many other pilots. So, please take a few moments to read this recall of an airplane that is still able to create GOOSEBUMPS in an old pilot!

The 747-400 is a massive airplane that really put the meaning into "The Aluminium Overcast". An airplane, that due to its size, "tricks" the mind while watching it fly an approach that seems to be way TOO slow for physical flight.

While flying at 160 knots it LOOKS like it is flying at a 100 knots. While landing at that same 160 knot speed, to the PILOT, in the cockpit, it looks as if he is landing an airplane only traveling at 100 knots due to his almost 8 story height above the runway at touchdown.

With FOUR HUNDRED TONS OF AIRPLANE under his seat, the pilot can use finger tip pressure to change her direction. While in "shirt sleeve" comfort for hours on end that airplane is plying her way through temperatures of MINUS 70 degrees or below and that, at times, cold soak her fuel in the tanks to temperatures that threaten to "gel" that fuel and turn it into slush rather than a burnable liquid.

After a 12 hour ocean crossing with over 400 passengers on board, it can "loiter" for another hour or TWO, in a holding pattern at the destination and the Flight Attendants can offer an "hitherto" unplanned "snack" to those same 400 passengers, (and cockpit crew of 4!) if so authorized by the Captain. Grin.

Having already served 1200 meals while en route the galleys can be asked to provide "one more round" of meals!

The most visible demonstration of her power and majesty on a fully loaded takeoff is at an airport in the winter. While the runways have been plowed full length and width and while those runways have been in use for hours by smaller 757's, 737's, 727's, etc., when the "Queen" takes her position onto the far end of the runway for takeoff, few ground workers, few off duty pilots, and few Control Tower personal are NOT watching.

Her initial acceleration from the runway end will be unremarkable, again due to her size. She will begin to "lumber" down the runway at a speed that would allow any old Edsel to easily beat her in the Quarter mile.

However, at about 100 knots she begins to get serious!

Her wings have now come to life and they are causing a span-wise flow of air off of those wings into a "vortex" that continues out from those wings to the runway edges, and further, that begins to "swirl" the snow that has been deposited there by the snow plows.

Continuing along now at 140 knots her engines have finally been able to GET air into their frontal zones, for free, rather than have to SUCK air into that same area. The "ram" of her forward speed allow those engines to now really put out some "mustard". Grin.

At about 150 knots, and with 8000 feet of runway behind, the airplane is getting very impatient about wanting to fly. Her "ground-speed" at this time is such that she COULDN'T, even if she wanted to, in the remaining 4000 feet of runway be able to endure an "aborted" takeoff. She is now committed for flight and as the pilot "gently" pulls back on the control column those wings take a bigger bite of that cold and thick air.

By now, on the far end of the runway where she began her takeoff roll an observer can only see a "snowstorm" at her present position. The vortex from her wings is now approaching tornado force and snow that is more than a 100 feet from either wingtip is now in motion and is creating a cloud that obscures her view from either rear quarter and to her rear.

She initially begins her ascent with her nose rising and gaining altitude while her main body remains firmly on the runway. The wings are now at a feeding frenzy with the abundant air and the engines have changed their tone to a

deep growl as they also gobble delicious gulps of air.

She finally rises off of the "tarmac"(!) at an almost impossible angle of climb that will exceed 14 degrees of pitch when at full gross weight. She will seem to hang there, almost suspended in slow motion flight, as she continues to gather speed. The obscured view from behind now changes into a sparkling view of a leviathan taking her rightful place into the atmosphere while leaving behind a visible record of the work that was needed to gain that position and to enable flight.

The "snowstorm" left behind will be her last visible and physical notice at that airport until she returns in about 28 hours and after crossing the Pacific Ocean twice, and while transporting 800 human beings over 12000 nautical miles.

On her landing she will announce her presence to all of those that have been "ground-bound" since she last departed with the same "snowstorm" on her arrival as those wings relinquish their lift and slow to speeds that finally end their vortex generation.

She will return to her original departure almost as if she is "tip toeing" back home, after being out too late at night. She will almost "whisper" her way back on to the runway. Her engines will be at levels that produce only a fraction of the growl that they were required to generate on her original departure.

She will turn off the runway, most times, onto taxiways that are yet unmarked by other aircraft tires. She will actually land shorter, at her arrival weight, than will many DC-9's and 727's. She will seem to creep to the ramp at a speed that make many think the pilot's are "padding" their flight times and eventually their wallets. Grin.

But, that taxi speed of a maximum of 20 knots is to ensure that she does not slide off of that taxiway due to slippery spots created by the "horde" of smaller airliners that have brought into the hub another huge "loading" for her return to the air.

With over a million and a half dollars, in revenue, generated for EACH of her two legs, the outbound and the inbound, she will be allowed a maximum of 2 hours on the ground to have her tanks re-filled, her engines topped off with oil, and for the ground cleaners to prepare her interior for a new set of fresh passengers, before she is tasked with doing all over again.

After the 12 hour inbound flight, her inbound flight crew will be in various boarding areas, in attempts to "commute" back to their respective homes. If they are lucky enough their, "views" from that boarding area, will allow them to watch the next "snowstorm" as she departs and for that same and very tired Captain to experience one more GOOSEBUMP!

Okay, with the "flowery" words out of the way, let's get to the airplane and setup for a flight that I flew on June 2nd, 1989, which was the Inaugural Flight of the 747-400 between Tokyo Narita and New York's John F Kennedy airport. I was the Senior pilot on this crew and have a picture to prove it! That picture is published in the first page of this chapter.

I have prepared a flight plan, with routing that attempts to take the same path as did that flight, the only thing that might be different are some of the names of some waypoints that have been changed over the years by the FAA Route authorities.

The first section of this Chapter will attempt to take you through a complete cockpit preparation with as little distraction as possible. In other words, I will keep the stories and "bull sessions" to a minimum. Later, as we get to cruise altitude and have about 10 to 11 hours ahead of us to either "twiddle our thumbs" or take a small nap, I will get into more in depth discussion of this airplane and her systems. And, hopefully there will be enough time left over, before landing, to get some of my most favorite stories told to you also. One of the best parts of Airline flying was that you often got to fly with a new copilot, or at the least an old copilot that you hadn't flown with for some time, and therefore your favorite stories could either be told for the first time, or repeated again with the hope that the First Officer had forgotten that he had heard them before!

So now….let's get to the airplane! I suggest that you load up PS1 and follow along with the various clipping panels as we prepare for departure.

Flight Deck Preparation

The preflighting of the 747-400 is a two man job for the Airline Pilot and each of the crew members, the Captain and the First Officer have specific duties to perform during the preflight. Normally, and specifically on my airline, the First Officer completed the exterior inspection while I went straight to the cockpit to set up the electronics and to "wake up" the airplane.

On the way to the cockpit I would stop by the First Class Galley section, and there in a drawer, two levels down from the top, I would find the Cabin Attendant Log Book. A quick review of that was required of the Captain as this logbook was just as official and required proper sign-off's of the Mechanics on a regular basis to ensure that all Safety items, First Aid Kit's and Emergency systems were in proper order, as did the Ship's Logbook that was stored in the cockpit.

If any such items were placarded "Inop" I then needed to check the Minimum Equipment List (MEL) to ensure that those items were not required for this particular flight. In some cases, oxygen systems or oxygen bottles were not required to be in working order, depending upon the total passenger load for this particular flight. In other words, if there were 20 Emergency Oxygen bottles normally on the aircraft, but on this flight only 16 bottles had an adequate charge, and additionally the flight was only booked for 250 passengers, the number of passengers per "charged" Oxygen bottle would be adequate according to the charts in the MEL.

I always liked the shortened name of that Minimum Equipment List!

Finally, I looked very closely to see if the coffee makers were all in working condition.

After that inspection it was up the stairs to the office where normally I found a dark and cold cockpit with everything turned OFF.

The First Checklist of the day, was about to be used, and I would always pick up the Flight Deck Preparation Checklist to follow these procedures.

1) Place BATTERY Switch ON. Verify the OFF light is extinguished.
2) Check STANDBY POWER selector to AUTO
3) Check HYDRAULIC DEMAND PUMPS selectors OFF
4) Check ALTERNATE FLAPS selector OFF
5) Check that the FLAP POSITION indication and FLAP LEVER agree.

Below this area on the checklist was this WARNING:
IF FLAP LEVER POSITION AND FLAP INDICATION ARE NOT IN AGREEMENT DO NOT APPLY ELECTRICAL POWER TO THE AIRCRAFT UNTIL BOTH THE LEADING AND TRAILING FLAP AREA IS CLEARED. APPLICATION OF POWER WILL CAUSE IMMEDIATE MOVEMENT OF THE FLAPS ELECTRICALLY AND COULD CAUSE INJURY TO PERSONNEL WHO MIGHT BE IN THE AREA OF THE FLAPS.

Let us NOT forget that the First Officer, right now, is outside doing this exterior inspection, and we don't want to injure him in any way!

6) Check LANDING GEAR lever DOWN
7) SAFETY CHECKLIST COMPLETED

So, with that checklist out of the way, and with the knowledge that the next steps will not cause any injury or any damage to the airplane, it is now time to bring "on line" electrical power.

Normally, the APU will be OFF, and there will be Ground or External Power available for use.

If External Power is desired:

1) Check EXTERNAL POWER 1 and/or EXTERNAL POWER 2 AVAILABLE light(s) are illuminated.
2) Place EXTERNAL POWER 1 and/or EXTERNAL POWER 2 switches ON. Verify the ON light(s) are illuminated.

Note: It may take as long as four seconds after the ON switches are selected before external power connects to the sync-bus.

If APU Power is desired accomplish the following:
1) Rotate the APU selector to START and release. The APU selector will automatically return to ON.
2) Check APU GENERATOR 1 and 2 AVAILABLE LIGHTS illuminated.

3) Place APU GENERATOR 1 and APU GENERATOR 2 switches ON. Verify that the ON lights are illuminated.

I always WANTED to use APU power, rather than Ground Power during my "setup" of the FMS equipment. The APU is a superb electrical generator with excellent "excitation" and "phase" controllers, much more so than the average ground power generator on a tug. The FMS likes "clean" and "pure" electrical power and I always selected APU power NO LATER than 20 minutes prior to departure, to ensure that I had a good FMS system and one that would be free of "spurious" EICAS messages due to a much more "unregulated" power supply of the ground tug with its contained electrical generator.

Now that we have electrical power on the airplane, the next steps in the cockpit preparation are to select STATUS on the EICAS glareshield control panel. We want to see if there are any systems that might showing up here with a problem, (things can break or fail overnight!) and that may not have been entered in the Ship's logbook by the preceding flight crew. Those items, if any, will show up on the lower EICAS indicator just to the left of the flight control graphics.

Additionally, we need to check the hydraulic, oxygen, and oil quantities so that we may advise the Mechanics if any of these fluids or pressures need to be "topped" off prior to departure of our flight.

Next, if the aircraft requires either heating or cooling this is an excellent time to turn ON the Air Conditioning Packs (all THREE are okay on the 747-400!) to set the Flight Deck/Cabin Temperature Selectors as required.

Okay, let's stow our flight bag along the left side area of the pilot's seat and then before we sit down and really get to work, we need to step back a bit, and take a good and LONG look at the entire Circuit Breaker panel area on the overhead panels to see if any circuit breakers are out of their normal position. By standing in the middle of the cockpit and looking, at eye level, at this "slanted" panel area that slopes toward the windshield, a circuit breaker when "popped" will permit a bit of "white" area to show, and it is very easy, if you are still standing to look at this area and with ONE glance be able to see any circuit breaker out of position. This same "duty" is much more difficult if you are sitting in your seat and looking up at the same circuit breaker area.

Now that everything is in order, it is time to take our seat(s)! I would like to take this opportunity to tell you that SOME of the items that we need to attend to for preflight and en route operation are those of the FIRST OFFICER. However, in PS1 this is normally a ONE MAN SHOW! So, our workload WILL be higher than it would be in the airplane, but, since a Captain must KNOW all of the "flow patterns" and "duties" of the First Officer, it is not above the ability of any Captain to run the entire airplane all by himself, providing he can REACH everything without having to leave his seat!

We begin in the very left upper corner area of the Overhead panel, and we check that the ELECTRONIC ENGINE CONTROL switches are in the NORMAL position.

1) IRS selectors OFF, then NAV

On a "through flight", one that had you bring the airplane in to the airport, and then having you fly the next leg out of the airport, without a total shutdown of the cockpit to the "dark" state, rotate the IRS selectors to ALIGN prior to entering in present position. After entering present position, return the IRS selectors to NAV and observe IRS ALIGN MODE C, L, R memo messages extinguishing within 30 seconds. IRS ALIGN MODE memo messages must be extinguished prior to moving the airplane.

2) Now bring up the CDU onto the screen (Tab key) and select FMC. Check the identification page and verify that the airplane model number and engine number are displayed. Verify navigation data (2L) first three digits indicate NW4 (this was what I DID, in PS1 there may be other characters presented here!). The NW4 told me that this was a 747-400 database and NOT one for an Airbus or a 757!). Finally verify that the ACTIVE date is the most current.

3) Select POS INIT page and enter either your known Latitude/Longitude for the current position of the airplane or the LAST POS as presented on this page. Observe that the GMT time is correct.

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********   C O M P U T E R   F L I G H T   P L A N   ********

NWA FLIGHT PLAN COMPUTED 14:36:29        JUNE 2, 1989 NRT -JFK

RELEASED TO DTW, SUBJECT TO RE-RELEASE ON TO JFK OVER ALPHE

TAXI       2.0    :20  OEW     407.2      SHIP  6301     CLBBRN +2.5%
BURNOFF  294.1  12:21  PAYLD    78.6      B747-400       CRZBRN +2.5%
ALTN      11.2    :26  ZFW     485.8      PW4056         DSCBRN +2.5%
10PCT      3.1    :10  PTOG    809.9      OCW             CLB  CRZ  DSC
RESERVE    8.6    :30  LDW     515.8      AVG WND CMP: +44  +39  +30
CONT       7.1    :25  FOA      30.0      AVG TMP DEV: +08  +03  +05
TANKER     0.0         ROUTE  5Y   6392 NM
TOTAL    326.1      ALTERNATE(S):  EWR

CLB TO FL330 INITIALLY              CRUISE MACH .850 / TAS 505
CLB TO FL350 266 NM PRIOR TO CUDDA        STEP CLB WT  682.8

CLB TO FL370 100 NM PRIOR TO EPH          STEP CLB WT  601.6
DSC TO LAND   53 NM PRIOR TO LVZ

(FPL-NWA18-IS
-B744/H-SXWYDHIR/C
-RJAA1500
-N0505F330 DCT CVC OTR11 KAGIS/M085F330 OTR11
 COMFE G344 CAMBO/M085F350 G344 CUDDA DCT PDN DCT
 56N150W 54N140W DCT MANJO DCT KURTT DCT SPONJ TR13
 TOU/N0491F350 J523 SEA/N0492F370 J70 MLP J36
 DIK J70 ABR J90 RWF J34 BAE J70 LVZ LENDY4
-KJFK1221 KEWR
-EET/PAZA0208 KZAK0533 CZVR0653 KZAK0721 KZSE0740
 REG/N661US SEL/EGJP)
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Type in:
CVC on R4
OTR11 on L5
COMFE on R5
G344 on L1 (Page 2/5)
CUDDA on R1
PDN on R2
N56W150 on R3
N54W140 on R4
MANJO on R5
KURTT on R1 (Page 3/5)
SPONJ on R2
TOU on R3
J523 on L4
SEA on R4
J70 on L5
ABR on R5
J90 on L1 (Page 4/5)
RWF on R1
J34 on L2
BAE on R2
J70 on L3
LVZ on R3

Select DEP/ARR and chose ARR for JFK.

Select LENDY4 ARR and RWY 31 R.

With all of that done, NOW go to the LEGS page, and there should be a total of 12 Legs pages! The magic of the computer, the FMS system and of PS1!

4) Select ROUTE page and enter the route of this flight. Begin by entering RJAA into the ORIGIN line and KFJK into the DEST line and the FLT NO. In this case I would enter NWA 018. Next I would go to the DEP/ARR page and select DEP for RJAA. I selected Runway 34 for Departure. I then return to the Route page to enter the ENTIRE route of this flight in this manner. Please refer to the ICAO Flight page for this entry. This is the flight plan filed with the "authorities" and this is the flight plan routing that I used on the Inaugural Flight on June 2nd 1989.

The flight plan has long been mis-placed, but my Brother in Law, Mr. Donald Doroff is a current and active Flight Dispatcher from Northwest Airlines and has graciously provided me with a copy of that old flight plan, run through today's computers in order to make the routing current with the current Airways and Waypoint names in use today! I thank Don VERY much for this help! Don also flies, at home, with PS1!

5) After the route is entered VERIFY the active route with the planned route by selecting the LEGS function of the CDU and VERIFY each segment waypoint, heading and distance as compared with the master flight plan routing.

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DPWM    18-10MAY NRT    6301 661US
PLA 78.6  -5.6   TOG      ZF-54.79 TG-65.69  PRE/HIST B  MBV        C
1D OEW   401580          11 FOB-TAXI 324100          NDD58 324100
 2 CARGO  33266          14 TOG      804306          OBOD 326100
 3 F   7   1260             PTOG     809900
 4 C  43   7740          15 XTOG     870000
 5 Y 202  36360          16 REAR
 6 ZFW   480206          17 % MAC
 FPWM 18-10MAY NRT /FUEL:
    TANK      NORMAL  /NON-STD  /UNUSE-12/BALST-7  /PAYLD-8  /NWA-MAX  /MAN-MAX
TANK 2 RES     8750 / ..... / ..... /                 /   8750 /   8750
TANK 1 MAIN   29600 / ..... / ..... /                 /  29600 /  29600
TANK 2 MAIN   82900 / ..... / ..... /                 /  82900 /  82900
CENTER TANK   70100 / ..... / ..... / ..... / ..... / 113500 / 113500
TANK 3 MAIN   82900 / ..... / ..... /                 /  82900 /  82900

TANK 4 MAIN   29600 / ..... / ..... /                 /  29600 /  29600
TANK 3 RES     8750 / ..... / ..... /                 /   8750 /   8750
TAIL TANK     13500 / ..... /                        /  21800 /  21800
OBOD:        326100
             -------/
TAXI:          2000..          XZFW:    .....   MAX STRUCT ZFW  535000
CLEARED FUEL 324100            FDENS:   6.61    XMIT FROM HERE -->
                                                    TEST
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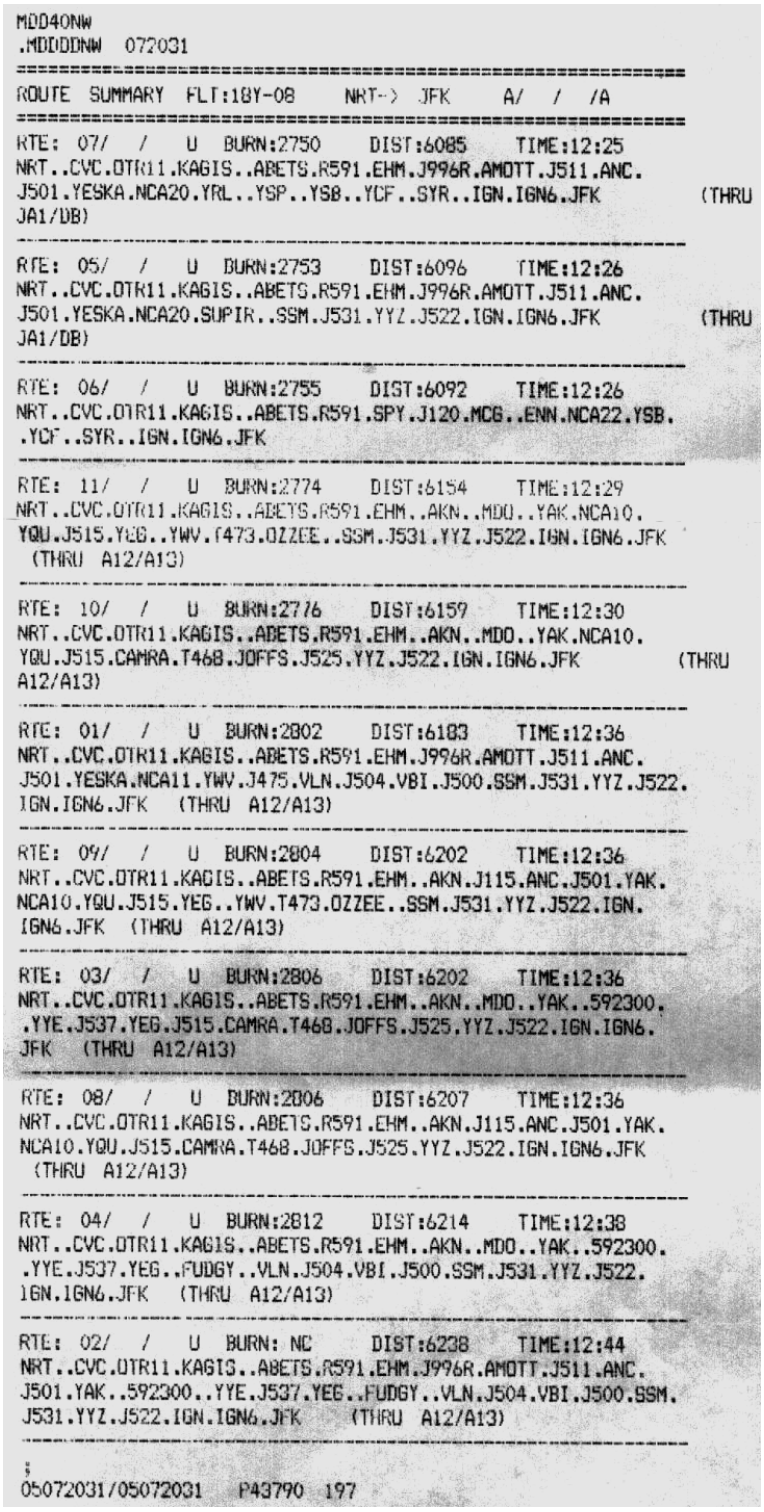
Also, in the flight plan package are a page that shows HOW your fuel system should be loaded for this flight, with a total fuel load of 326,100 pounds of fuel (see previous page).

Additionally, there is a page that shows the other route choices for this flight. As you can see there are or were several other choices of routing, however the one selected and the one we are using is the SHORTEST time flight plan for that day, due to the upper air winds!



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MDD40NW
.MDDDNW  072031
============================================================
ROUTE  SUMMARY  FLT:18Y-08     NRT--> JFK      A/   /   /A
============================================================
RTE:  07/   /    U   BURN:2750      DIST:6085      TIME:12:25
NRT..CVC.OTR11.KAGIS..ABETS.R591.EHM.J996R.AMOTT.J511.ANC.
J501.YESKA.NCA20.YRL..YSP..YSB..YCF..SYR..IGN.IGN6.JFK            (THRU
JA1/DB)
------------------------------------------------------------
RTE:  05/   /    U   BURN:2753      DIST:6096      TIME:12:26
NRT..CVC.OTR11.KAGIS..ABETS.R591.EHM.J996R.AMOTT.J511.ANC.
J501.YESKA.NCA20.SUPIR..SSM.J531.YYZ.J522.IGN.IGN6.JFK            (THRU
JA1/DB)
------------------------------------------------------------
RTE:  06/   /    U   BURN:2755      DIST:6092      TIME:12:26
NRT..CVC.OTR11.KAGIS..ABETS.R591.SPY.J120.MCG..ENN.NCA22.YSB.
.YCF..SYR..IGN.IGN6.JFK
------------------------------------------------------------
RTE:  11/   /    U   BURN:2774      DIST:6154      TIME:12:29
NRT..CVC.OTR11.KAGIS..ABETS.R591.EHM..AKN..MDO..YAK.NCA10.
YQU.J515.YEG..YWV.T473.OZZEE..SSM.J531.YYZ.J522.IGN.IGN6.JFK
 (THRU  A12/A13)
------------------------------------------------------------
RTE:  10/   /    U   BURN:2776      DIST:6159      TIME:12:30
NRT..CVC.OTR11.KAGIS..ABETS.R591.EHM..AKN..MDO..YAK.NCA10.
YQU.J515.CAMRA.T468.JOFFS.J525.YYZ.J522.IGN.IGN6.JFK              (THRU
A12/A13)
------------------------------------------------------------
RTE:  01/   /    U   BURN:2802      DIST:6183      TIME:12:36
NRT..CVC.OTR11.KAGIS..ABETS.R591.EHM.J996R.AMOTT.J511.ANC.
J501.YESKA.NCA11.YWV.J475.VLN.J504.VBI.J500.SSM.J531.YYZ.J522.
IGN.IGN6.JFK   (THRU  A12/A13)
------------------------------------------------------------
RTE:  09/   /    U   BURN:2804      DIST:6202      TIME:12:36
NRT..CVC.OTR11.KAGIS..ABETS.R591.EHM..AKN.J115.ANC.J501.YAK.
NCA10.YQU.J515.YEG..YWV.T473.OZZEE..SSM.J531.YYZ.J522.IGN.
IGN6.JFK   (THRU  A12/A13)
------------------------------------------------------------
RTE:  03/   /    U   BURN:2806      DIST:6202      TIME:12:36
NRT..CVC.OTR11.KAGIS..ABETS.R591.EHM..AKN..MDO..YAK..592300.
.YYE.J537.YEG.J515.CAMRA.T468.JOFFS.J525.YYZ.J522.IGN.IGN6.
JFK   (THRU  A12/A13)
------------------------------------------------------------
RTE:  08/   /    U   BURN:2806      DIST:6207      TIME:12:36
NRT..CVC.OTR11.KAGIS..ABETS.R591.EHM..AKN.J115.ANC.J501.YAK.
NCA10.YQU.J515.CAMRA.T468.JOFFS.J525.YYZ.J522.IGN.IGN6.JFK
 (THRU  A12/A13)
------------------------------------------------------------
RTE:  04/   /    U   BURN:2812      DIST:6214      TIME:12:38
NRT..CVC.OTR11.KAGIS..ABETS.R591.EHM..AKN..MDO..YAK..592300.
.YYE.J537.YEG..FUDGY..VLN.J504.VBI.J500.SSM.J531.YYZ.J522.
IGN.IGN6.JFK   (THRU  A12/A13)
------------------------------------------------------------
RTE:  02/   /    U   BURN: NC       DIST:6238      TIME:12:44
NRT..CVC.OTR11.KAGIS..ABETS.R591.EHM.J996R.AMOTT.J511.ANC.
J501.YAK..592300..YYE.J537.YEG..FUDGY..VLN.J504.VBI.J500.SSM.
J531.YYZ.J522.IGN.IGN6.JFK     (THRU  A12/A13)
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05072031/05072031   P43790  197
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We have a flight plan time of 12 hours and 21 minutes and we will plan to land at JFK with at least 30,000 pounds of fuel left in the tanks. As you taxi out, you MAY get "warnings" from the EICAS that you do not have enough fuel. DISREGARD these warnings, as you have already checked manually your fuel load from the PS1 menu, and you can SEE that fuel load on the fuel graphic diagram from the Mode control panel. The computer does NOT yet know the actual winds that we will have on this flight, and once it discovers those winds, IN FLIGHT, it will then STOP this low fuel warning on the EICAS. The same thing happened in real world! Or at least, until the First Officer was able to enter in the actual forecast winds on the WAYPOINT WINDS pages.

As you can see this would take a LONG time, and our flight might be delayed! So, the airline practice was to get the airplane into the air, and then when enroute and when time and flight duties allowed, to then make the Wind entries into the actual FMC WAYPOINT WINDS pages.

You also do NOT need to do all of this work, as the FMS system takes PRESENT wind encountered, and computes that wind OUT to the end of the flight. In most cases this is good enough to have a reasonable ETA appear on the PROGRESS page. However, you also have ANOTHER backup! If you note the time of your Takeoff, enter that on the proper line of the FLIGHT PLAN PAPER copy, you can then add to that the Enroute Flight plan time to get YOUR OWN prediction of ETA at JFK!

Now, let's get back to the rest of the preparation, since most of the hard work is done, and now our computers know where we are going to ask them to take us!

6) Select PERFORMANCE INITIALIZATION page and enter the fuel reserves, the RESERVES should equal the sum of your planned reserve fuel on arrival at KFJK plus the fuel required to your alternate airport. I typically, with a KEWR or KPHL as an alternate, would enter 30,000 pounds

for the alternate fuel line. Next we used, on NWA, the COST INDEX of 100. Next enter your flight planned cruise altitude, and typically here I would enter the maximum altitude I could climb to with the gross weight of this takeoff. FL350 should work just fine for that entry on this flight. Finally enter in the STEP SIZE climb area the number 2000!

7) Select THRUST LIMIT page. Select thrust limit based on anticipated runway length and runway conditions. Pratt and Whitney produce great engines, and it was MY personal choice to always use TO and CLB and not the derate selections also possible with TO 1 and TO 2.

8) Select TAKEOFF REFERENCE page. Program the anticipated takeoff flap setting based upon Dispatch requirements or anticipated takeoff conditions. Since this is not going to be a maximum takeoff gross weight flight, 10 degrees of Flap is perfectly fine for this flight. Next enter the FLAP/ACCEL HT and E/O ACCEL HT. These were normally set at 1000 feet by NWA, but at Narita, due to special noise abatement procedures set in 1500 in all cases. Finally, since this Inaugural Flight was flown with the sun shining on departure, set in DRY on the RWY COND line!

We will now leave the rest of the CDU programming for the time being, and begin to accomplish the rest of the cockpit preflight. We will return to the CDU unit later to finish up its programming when we have more flight information available, usually relayed to the crew just before push back from the gate.

Check the electrical system is set by doing the following:

1) Check STANDBY POWER selector in AUTO
2) Check LEFT and RIGHT UTILITY switches ON (Coffee makers!)
3) Check BATTERY switch to ON
4) Check BUS TIE switches AUTO
5) Check GENERATOR CONTOL switches ON
6) Check DRIVE DISCONNECT switches are "safetied"

In the real airplane these switches, the DRIVE DISCONNECT, were covered by a plastic panel that was WIRED to the closed position to prevent inadvertent use.

Furthermore, the OFF and DRIVE lights will remain illuminated until the associated engine is started.

1) Check that the Hydraulic system is set.
2) Check HYDRAULIC DEMAND PUMPS OFF and verify the LOW PRESSURE lights are ON
3) Check ENGINE PUMP switches ON

Again, note that the SYSTEM FAULT and PRESSURE lights will remain illuminated until the respective engine is started.

Next move to the PS1 "MISC" clipping panel.

1) Set Panel lights as required and LANDING/ RUNWAY LIGHTS OFF
2) Check NACELLE and WING ANTI-ICE switches OFF and VERIFY the VALVE lights are OFF
3) Turn NAV lights ON

(I would then turn the WINDOW HEAT to ON and verify INOP lights extinguished, this feature is not in PS1).

Check and Set the FUEL CONTROL PANEL.

1) Check all FUEL PUMP switches OFF
2) Verify all MAIN TANK PRESSURE lights are illuminated. If the APU is operating, main tank 2 aft pump pressure light should be extinguished.
3) Verify OVERRIDE, CENTER WING, and STABILIZER PUMP PRESSURE lights are extinguished.
4) Verify/place all X-feeds to OPEN

On NWA airplanes the #2 and #3 crossfeed valves worked automatically. When ever the flaps were out of the UP position, these two valves were OPEN to allow engines 2 and 3 to burn fuel out of their respective wing tanks. Engines 1 and 4 burned fuel out of the CENTER tank. On takeoff it was required that there be TWO sources of fuel being used. When the flaps were retracted after takeoff, the Manifold/Crossfeed valves for engines 2 and 3 were CLOSED to allow them to burn fuel from the Center tank, along with Engines 1 and 4.

Check that the Ignition Panel is set (PS1 Engine Start and Fuel panel).

1) Check START switches IN, and the VALVE lights extinguished

2) Check STANDBY IGNITION selector NORMAL
3) Check CONTINOUS IGNITION switch to OFF
4) Set AUTO IGNITION selector to 1 or 2 as appropriate

We typically used 1 for Eastbound flights and 2 for Westbound flights.

Set Fuel Jettison panel.

1) Check LEFT and RIGHT FUEL JETTISON NOZZLE switches are OFF
2) Place FUEL JETTISON control selector to A or B
3) Rotate FUEL TO REMAIN selector to indicate 100.0 on EICAS

This setting will allow an immediate dump capability right after takeoff with very little extra action required of a very busy flight crew, should the need arise! By setting the value to 100.0, an aircraft loaded to the Maximum Zero Fuel weight will be at or below the Maximum Landing Weight when fuel dumping is completed!

4) Place FUEL JETTISON control selector to OFF

Check the Fire Control Panel is set.

1) Check APU FIRE handle IN
2) Check APU BOTTLE DISCHARGE light is extinguished
3) Check ENGINE FIRE switches IN
4) Check FUEL TRANSFER MAIN 1 and 4 VALVE OFF (PS1 "MISC" panel)

Check and set Pressurization panel

1) Verify OUTFLOW VALVES OPEN
2) Verify LANDING ALTITUDE AUTO
3) Check TRIM AIR switch ON
4) Place RECIRCULATING FAN switches to ON

Check and set Bleed Air panel.

1) Push APU bleed switch ON and verify VALVE light extinguished
2) Check LEFT and RIGHT ISOLATION switches ON
3) Turn pack control selectors to NORMAL
4) Verify PACK RESET SYS FAULT lights are extinguished
5) Check ENGINE BLEED switches ON

The engine bleed air OFF lights illuminated until the respective engine is started.

Okay, with the Overhead panel preflight complete, let's proceed to the Forward Glare shield panel for our cockpit setup.

Set up the AFDS mode control panel.

1) Check autopilot DISENGAGE BAR UP
2) SET Altitude in the MCP window if you have your ATC clearance
3) Set initial desired HDG
4) Set BANK LIMIT to AUTO
5) Check AUTOTHROTTLE switch ARMED
6) Place left FLIGHT DIRECTOR switch to ON
7) Check and set L ADF/VOR and R ADF/VOR switches appropriate to ATC clearance

Check and set Primary Flight Display.

1) Verify Autothrottle mode is blank
2) Verify roll mode TO/GA
3) Verify pitch mode TO/GA
4) Verify AFDS mode FD
5) Verify no flags displayed
6) Verify NO V SPD displayed until V speeds selected
7) Verify ND heading-compare to Compass
8) Set Primary Altimeter to Field Elevation or ATIS barometric pressure
9) Set MDA to 1000 feet above takeoff elevation

Check and set additional items on PS1 "MISC" panel.

1) Check ALTERNATE FLAPS selector OFF
2) Check ALTERNATE FLAP ARM switch OFF
3) Check ALTERNATE GEAR switches OFF

Check lower area of Main Instrument Display.

1) Check Gear Handle DOWN
2) Check Stabilizer Trim

This was a tricky one here! If you had a flight that needed to carry fuel in the horizontal stabilizer you had to have the stabilizer setting at the 6 mark to provide the means to fuel that area. In order to do that you had to pressurize Hydraulic Systems 2 and 3 to reposition the stabilizer. We then had to get clearance from ground personnel before activating any hydraulic system, so the WORD was to our

buddies, that when they left the airplane, LEAVE that STABILIZER at the 6 setting!

3) Check speedbrake lever DOWN
4) Check flap lever position and flap indication in agreement
5) Check thrust levers IDLE
6) Check FUEL CONTROL switches CUTOFF(PS1 "FIRE" clipping panel)

7) Set Parking Brake and verify PARKING BRAKE SET displayed on upper EICAS
8) Set PASSENGER SIGNS - NO SMOKING ON and SEAT BELTS switch OFF
9) Test Weather Radar (Glareshield)
10) Verify all flight controls centered (Status)
11) Place AUTOBRAKES selector to RTO

Okay, we are done! By now the First Officer is in his seat! He has completed the exterior inspection and is preflighting his own set of instruments and has performed VHF and HF radio checks with the appropriate controlling agencies to ensure that our radio transmitters are all working. He has also checked all the safety items like medical kit, crash axe etc. to be present in the cockpit and in working order.

From here the First Officer would perform his panel checks exactly as did the Captain in the earlier text, but additionally since he brought UP to the cockpit the "fuel slip" that had been handed to him during the preflight inspection, he now performed a fuel validation, in that he checked each tank for its quantities to compare to those of the "planned" pumping of that fuel into each respective tank.

At this time, if the First Officer was not known to you, it is a good time to discuss the flight with him, after asking him his recent flight experience, total time on the airplane, and if he has any special requests. A discussion also would include the complexity of the SID, any significant terrain in the departure area, a review of aborted takeoff procedures, Altimeter settings to be used (whether in inches, millibars, or hectopascals). Finally, a short discussion of the current weather at the departure airport and with weather to be encountered during the initial climb.

With all of the "hard work" done, it is time to order up a round of fresh coffee and to get a chance to meet the Lead Flight Attendant!

Doors

Let's take on a very SIMPLE system here now, but one that is ESSENTIAL for this large sized airplane.

One of the MOST important areas of the EICAS system to check before pushback are the DOORS section! Other than the fact that we wouldn't want to take off with an open cabin door, we also NEVER want to take off with an "unlocked" cargo door.

Let's discuss both types of doors on this airplane.

The cargo doors are complex for several reasons. The most important design feature is that with a door as large as they are on the 747, that it be designed to be able to withstand the huge amount of air-pressure that is pushing against that door when the airplane is pressurized and in flight.

Consider this. If the door is 16 feet wide and 12 feet high (rough guess it could be more, it could be less), it has an "area" of about 27,648 inches. With a normal pressurization setting of 8.6 POUNDS PER SQUARE INCH you can see that there are over 250,000 POUNDS of PRESSURE pushing against that door when the airplane is in flight.

Time for something more substantial than a padlock, wouldn't you say?!

In order to move, open, and close such a door, electrical drive mechanisms must be installed and there must be safeguards to ensure that those same "motors" don't decide to turn on, when they shouldn't!

To provide power to those motors there must be an accessible power supply AT the door, in case the airplane is not manned by a flight crew with no generators turned on or the APU off (early morning departures with an even early morning loading of the cargo bay). And, for the times that the flight crew doesn't want the door to be operated there must be ways to disable that power supply from being used on the exterior portion of the airplane.

In its earlier years Boeing INSISTED upon building "plug-type" cargo doors... in other words the door was LARGER than the opening and therefore could NOT ever swing open

THROUGH that smaller opening when pressurized. This type of design took up a lot of space though as the door had to SLIDE from either side and remain within the interior of the airplane when being opened and closed.

For the 747 series Boeing joined Douglas with doors that simply swing open and allow access to the cargo bay with, usually, the doors overhead and providing a canopy for the loaders. When that design mode was chosen it was very necessary to ensure that when the door was closed that MULTIPLE latches be utilized to ensure integrity of the entire mechanism. I am sure you remember the several instances of cargo doors coming open in flight on the DC-10 series of airplanes, several years ago. That also happened to a flight on a 747 out of Honolulu some time ago.

Since that instance on the 747 a re-design was done with a means to VISUALLY insure that the door was, in fact, locked, and to not have to rely on the electronic sensing that, as with anything else, CAN fail sometimes!

The passenger doors are still plug type doors in most cases. The door has a unique "swivel" arrangement where it moves in a bit first, turns slightly, and then can "fit" through the door opening to go out that opening and be latched along side the exterior of the airplane. Other passenger doors are motorized entirely and retract into the ceilings mechanically. Each door MUST have the ability to be locked and unlocked BOTH internally and externally, so that requires switching and controls in an outside panel and with an inside panel that holds the switches.

Additionally, the doors of most large airplanes are no required to not only open automatically, they must also be able to deploy an inflatable set of "stairs" for emergencies and passenger evacuations. As you can see, there must be some sort of safe guards for inadvertent triggering of these automatic functions while in the air and pressurized.

Hence, even a door gets to be complicated on a 747!

Except when you get to the cockpit!

I, proudly, still have the SAME cockpit key that was "issued" to me on March 15th, 1965! That same key has allowed me to enter into a 707, 727, and all of the 747 fleets. It is kind of worn smooth after all of those years and there was NO way that I was giving it back when I retired. Grin!

The cockpit door itself is rather flimsy in nature and a couple of good whacks with a "fire ax" ought to soon take it down. Good thing is that WE have the fire ax IN the cockpit so that we can get OUT if the there is such an instance that requires that.

The cockpit door swings OUT from the cockpit so it would be fairly hard to try to kick it IN by an unruly passenger.

Another reason why we are supposed to stay AWAKE at all times in the cockpit!

Manual Engine Start

With all cockpit preparations completed, with the initial flight briefing accomplished, and with a fresh cup of coffee in our hands, we await word from the Gate Agent that all passengers are onboard and seated. The First Officer will then request pushback and engine start clearance from ATC.

If there are any extra crew or deadheading passengers onboard and in the cockpit, the Captain will have "briefed" them to ensure that they were aware of the location of their Emergency Oxygen masks, how to operate the Intercom system, and the location of the emergency exits. Additionally, the Captain would have instructed them of the Sterile Cockpit procedures that prohibit any conversation below 10,000 feet, not pertinent to the flight.

When the Ground Crew, via the Interphone announces that Pushback is beginning, the Captain will...

1) Place the Flight Attendant advisory light to OFF signal a Sterile cockpit environment.
2) Turn the SEAT BELT sign to ON.
3) Place the HYDRAULIC DEMAND pump selector 4 to AUX and number 1 to AUTO.

He then checks Brake Pressure is in the green band and verifies that the brake source light is extinguished. This light will take about 5 seconds to go out as the hydraulic pressure builds up.

4) Select DOORS on the synoptic display and verify that all doors are closed.
5) Select ENGINE on SECONDARY ENGINE DISPLAY to display the engine indications for the engine start.
6) Verify that all passengers are seated through a VERBAL "affirmative" from the Lead Flight Attendant.
7) Turn the beacon ON.

Meanwhile, over the First Officers seat on this TWO MAN crewed airplane, the First Officer is also VERY busy. Since we are going to have to fly this airplane all by ourselves(!) tonight, we must do HIS duties too!

1) Push all fuel pump switches to tanks containing fuel to ON. Verify pump low pressure lights are extinguished.
2) With fuel quantity in tanks 2 and 3 greater than the quantity in 1 and 4, verify all X-FEED switches are ON.

Both Pilots then respond to the BEFORE START CHECKLIST.

Once this is completed the Captain will advise the ground crew that the flight crew is ready for push back and engine start, and he will release the PARKING BRAKE at this time. The First Officer will turn TWO Pack selectors OFF, as one pack may remain on during the engine start. Of course, since Pack 1 supplies the air conditioning to the cockpit, this is the Pack that remains ON. Grin.

After "noting" that the pneumatic pressure in the Manifold is at least 25 psi (look at the UPPER EICAS screen and just below the EGT indicators) the Captain will announce, Start Four, as the normal starting sequence (NWA) is 4,1,2, and 3.

Now things begin to get VERY busy in the cockpit, and they are about to get even BUSIER here in PS1! The engine start sequence is a "two man show", but you and I are going to have to do it all by ourselves!

1) Select ENGINE START-FUEL overhead panel.
2) Announce Starting 4 and PULL the #4 Start switch.
3) Announce ROTATION with the first indication of N2 RPM.
4) Switch to the PS1 FIRE panel and move the #4 FUEL CONTROL switch to RUN at 15% N2.
5) Monitor engine displays for normal indications until the engine is stabilized at idle.

LEAVE YOUR HAND (or "mouse") on the FUEL CONTROL SWITCH until the EGT peaks and begins to drop. During this time EGT should rise within 20 seconds after selecting RUN. N1 rotation must be indicated by the time N2 reaches 40%. If any of these indications are not observed place FUEL CONTROL SWITCH to OFF, and attempt a restart of the same engine.

6) Switch back to the Engine Start-Fuel Panel and start the remaining engines. Follow the same above procedures.

If conditions require, after the last engine is started turn ON the ENGINE ANTI ICE.

Taxi

Call for and respond to the BEFORE TAXI CHECK.

With all 4 engines running, with a "wave off" received from the ground crew, we are finally on our way to New York!

Once the aircraft begins its taxi movement, the Captain will call for or place the Flap handle to the 10 degree position for this flight. He will then select STATUS on the Secondary EICAS and perform a control check by moving the control wheel full left then full right, and then full forward and aft. He will then move the rudder full left then full right. He can hold the nose wheel steering tiller during this rudder check to prevent nose wheel movement. This is hard to do in PS1, but a little bit of "swerving" of our tail won't hurt anything!

Return the lower EICAS to the secondary engine display.

With at all times having at least ONE pair of eyeballs LOOKING outside of the cockpit, the two man crew will accomplish the following, and again since we are making this flight in a "solo" mode, we are going to get REAL busy again!

1) Verify/Enter proper weight and balance information entered into the CDU
2) Verify proper thrust selected in THRUST LIMIT page of CDU.

3) Verify proper flap setting, climb thrust command, and V speeds ACTIVATED!
4) ARM LNAV and VNAV
5) Verify Flight Director turned ON
6) Verify Stabilizer setting in GREEN BAND
7) Enter V2 speed from the CDU into the IAS window of the AFDS mode control panel

And, now in the real airplane was a good time to put the SHOULDER HARNESS on! Tonight we can leave it off. Grin.

Engine Failures

An engine failure is really NOT an emergency on a 4 engine or 3 engine airplane. It will cause a "diversion" but it should not affect any safety of flight. I can also state that an engine failure on a 2 engine airplane, depending upon the segment of the flight is also not an emergency, save for the fact that all of YOUR "eggs" are now in one basket!

Engine failures are more difficult to handle on airplanes that have wing mounted engines versus those that mount them on the aft fuselage. The position of the engine on the airplane and the resultant loss of that thrust during the engine failure will require the pilot to "input" rudder forces to "balance" out the asymmetrical unbalance of one side of the airplane having more thrust than does the other side.

I only had 3 "real" engine failures in my career and each was very simple to handle and caused no undue alarm. One of those failures, in a 727 on takeoff out of JFK did trigger the Engine Fire Warning, and the resultant increased heartbeat rate until we determined that after only having to "fire" one fire extinguisher, there was no continuing fire.

A Captain is required to have a checkride each 6 months and so simple math can show you that I sat through about 60 of those "events" and it is during those checkrides that the engine failures come at you fast and furious! I and most other pilots "welcomed" these planned failures as it allowed us to confidently go back to the "line" with the knowledge that the airplane and ourselves could easily handle the engine failure and the flight control inputs required to "limp" back around for a safe landing.

It was always taught, and personally utilized, that EVERY takeoff COULD be an engine failure event. So, on every takeoff, all of us in the cockpit are watching VERY closely all of the engine parameters as displayed on our instruments. Seeing that all 4 N1, N2, EGT, and FUEL FLOW gauges are in the same alignment is always reassuring and if any one of those are showing a difference, at least 4 set of eyeballs "zeroed" in on that engine, leaving the other 2 set of eyeballs to remain to fly the airplane. As the 747 transitioned to a 2 man crew, in theory, we still required an off duty crew member to be in the "observer" seat during the takeoff to add to the "viewing"!

The most "dramatic" engine failure scenario is when the simulator is programmed for a multiple engine failure and when BOTH of those engines are out on one side of the airplane. The 747-400, at FULL gross weight is entirely capable of operating right after takeoff in a safe manner with two engines failed, but it does take a lot of effort to "clean her up" with the flaps and gear and to be able to accelerate to faster airspeed as soon as possible to be able to climb to a pattern altitude that will allow you to return to the airport for a safe landing.

The "worst" time for most airplanes to experience an engine failure is right at the V1 speed. This speed is determined by calculation to be the highest speed that would still allow you to STOP in the remaining runway distance. An engine failure below this speed is a required "abort" and an engine failure after this speed is more safely handled with a continuation of the takeoff roll until Vr (Rotate) and eventual climb out at V2 speed. At V1 speed there is adequate rudder "authority" to be able to keep the aircraft flying straight ahead even with an outboard engine failure. In 4 engine airplanes it is considered to be "safer" to continue up and into the air right at V1 then it is to attempt to stop the airplane in the remaining runway distance and perhaps "go off" the far end into the runway lights/stanchions/water with more disastrous results.

So, of course, almost every engine failure in the simulator is right at V1 speed. Grin.

Surprisingly, in the 747 fleet, the actual MOST difficult time of engine failure for the pilot is at about 80 - 100 knots during the takeoff roll. At that point in the takeoff, the "mass" of the

airplane and its inertia will overcome the frictional "grip" of the nosewheel tires and not allow forward "straight ahead" travel of the airplane. Also at that time the rudder does not, yet, have enough "authority", due to the low airspeeds, to be able to hold the airplane straight either. What IS required is an IMMEDIATE reduction of ALL engines to idle and a maximum application of brakes.

Of course this is also "practiced" in the simulator and it always seems to happen when the weather is "programmed" down to very foggy conditions that only allows the pilot to see about 3 to 4 runway centerline lights ahead of the nose.

There are 5 major "segments" of the takeoff, then, that each pilot watches for, very closely, during that takeoff.

1. Initial application of "equal" thrust being "put out" by each engine.

2. The transition through the "dark zone" of 80 - 110 knots where nosewheel steering and rudder authority is not sufficient.

3. The transition through the V1 speed range where the "Go - No Go" decision is made.

4. The transition through Vr and V2 during initial climb with the gear and flaps extended where a MULTIPLE engine failure is the toughest to handle.

5. The transition through Vzf (zero flaps and acceleration to 250 knots) until established in a clean configuration where it is "feet up", light 'em up, and let's get some coffee up here!

Rest assured that an engine failure for the passengers on takeoff should not be a major concern as the flight crew has practiced those failures literally hundreds of times and would not be in the cockpit unless they could handle them!

Takeoff Procedure

Call for and respond to the TAKEOFF CHECK items.

When cleared onto the active runway the Pilot flying (that is you and me!) will "brief" OUTLOUD the initial clearance altitude and the initial assigned heading, sounding like this... "Runway Heading to Five thousand", or whatever the clearance really is.

The Captain will place the outboard landing lights to the ON position.

Now let's go FLYING!

After the aircraft is aligned with the runway, smoothly advance all four thrust levers to approximately 1.1 EPR and allow the engines to stabilize evenly. Then advance the thrust levers to approximately the takeoff thrust value and then push the TO/GA switch and VERIFY the correct thrust is set.

If a takeoff warning horn occurs at power application, do NOT continue the takeoff. The cause of the warning should be corrected before takeoff.

Begin to monitor and listen to that great VOICE of the copilot. Grin.

He will announce 80 knots, V1, Rotate, and V2.

Announce POSITIVE RATE after you have left the ground and then raise the Landing gear to the UP position. The POSITIVE RATE must be only announced after seeing BOTH the altimeter and vertical speed indicate a positive rate of climb.

Call for flap retraction on the schedule as presented on the SPEED TAPE of the PFD.

After flaps are retracted turn on the Packs that were OFF for takeoff, and of course we KNOW that Pack 1 is already ON! Watch for and observe the EICAS gear and flap position indicators are normal and then place the GEAR handle in the OFF position.

Leave the Landing Lights ON until passing through 10,000 feet on the climb.

The cockpit is still STERILE (no un-necessary conversation) and we are in the climb to cruise while following our ATC Clearance. The following are the "housekeeping" items for the climb.

1) At 10000 feet turn OFF Landing lights.
2) CARGO HEAT (not in PS1) switch ON.
3) Flight Attendant Advisory switch (not in PS1) ON (non-sterile cockpit).

4) Turn SEAT BELT sign OFF, unless required.
5) Be aware of transition altimeter altitude and set to 29.92 at the appropriate time. The FMS knows the proper time.
6) At any level off point, VERBALLY announce to yourself or to the WORLD, that you have 1000 FEET TO GO, and then 500 FEET TO GO prior to reaching your assigned intermediate level off altitude.

Enroute

We now settle down to about 10 hours or more of Cruising and maintaining the systems on the airplane.

The rules for flying enroute, not necessarily needing to be followed at your computer desk, yet important enough to mention anyway!

The Oxygen mask must be ON the pilot flying if:
a) above 25000 feet and one crew member out of seat
b) Flight is being conducted above FL410.

Monitor the FUEL PANEL as described on page 185 of this manual.

The fuel system is a WORK OF ART on this airplane. For a system with many tanks, many pumps, and so many possible fuel load situations, the designers of this system came up with a beauty!

Essentially, the system is operated like this:

1) All pumps ON for departure
2) Crew actions only require turning OFF various fuel pumps as EICAS messages appear to notify them of that action!

What could be simpler?!

As simple as it was, this system demanded the MOST time from the crews INNER thoughts of any other system. On all long haul flights, the amount of fuel left in the tanks is a paramount thought and direction for that entire flight, and it was often said that a pilot was much SMARTER with this thinking ability at the destination end of that flight, with an extra 10000 pounds in his tanks, as he had SO many MORE options of what to do if anything happened mechanically or if the weather was too bad for a landing.

Fuel Jettison

Fuel dumping is done by using the "fuel manifold" system that allows ANY tank to feed ANY engine. This "manifold" is usually installed in the front area of the wing and extends out to the wing tips where on each wing a valve is also installed to be used for fuel dumping.

On the earlier versions of the 747 the fuel dumping required the Second Officer to monitor the dumping and to halt that dumping when the required fuel to land was at that level in each tank. He had TWO switches to initiate the dump valves and then simply ran the respective tank manifold valves to ensure that each tank stayed in "balance" in relation to his partner tank on the opposite wing.

In the two-man crewed glass cockpit airplanes, other than the required manual initiation of the dump valves, the remaining part of the system is done automatically AFTER the Captain has entered into the system the amount of fuel that he wants to REMAIN after dumping.

It was common procedure for EVERY takeoff to set up the Fuel Remaining in the Dump system on the ground and the value chosen for the 747-400 was always at 100,000 pounds of fuel remaining. Our maximum Landing gross weight was 630,000 pounds so we could have an empty airplane of about 430,000 pounds, along with 100,000 pounds of "people" and cargo.

With a FULL fuel load the 747-400 would take up to ONE hour for dumping down to the 100,000 pound level, so you can see that if you had a REAL bad emergency such as a fire, that fuel dumping would not be able to be used and an overweight landing would be required. The overweight landing would be very safe as long as the touchdown was soft and smooth - the main worry being about the tires being able to absorb a hard landing with full gross weight.

According to all data that I have seen, the fuel dumped will dissipate into a harmless and unrecognizable form if it is dumped from above 7000 feet or so. It will simply be borne away by the air currents and be dissipated over such a wide area that it would be unrecognizable.

I had to dump fuel several times, once in a 727 with an indicated engine failure and twice in a

747 as we returned to land shortly after takeoff because of a seriously ill passenger. I understand that on one of the 747 incidents that because we were flying on a north and south heading over Lake Michigan, just as the sun was setting, that the passengers seated over the wings had a very beautiful "rainbow" of colors as the "oily" liquid encountered our wing tip vortices and as the fuel spiraled off of the wing due to that effect.

Depressurization

As we continue to "motor" along here, we must always be ready for another possibility, that of a need to get the airplane down to THICKER and more breathable air!

Depressurization would be a nightmare in ANY airplane, especially while over water. The highest that you could fly would be in the 12,000 to 14,000 foot range and at that altitude the fuel burn goes WAY up while the ground speed goes way down!

One of the "beauties" of flying an airplane that does not need ETOPS rules is the multiple backup systems of 4 engines, 4 sources of pneumatic bleed air, and 3 air conditioning/pressurization systems. Of course, with a large enough HOLE in your airplane, all of those systems are worthless!

I don't remember ever being more than 3 - 4 hours from any airport, even on flights between Los Angeles and Sydney. The route between Tokyo and New York or Detroit always allowed you to divert to either Honolulu or Anchorage while over water and with normal headwinds you could probably continue on to Tokyo depending upon the exact longitudinal position of your flight during the pressurization breakdown.

We planned each flight for the event of a single engine failure that included a "drift-down" to a lower altitude level and the resultant higher fuel burn required due to the added drag of an engine out during my "generic" 747 years. I was delighted to find that it was POSSIBLE to have an engine failure on takeoff out of Tokyo and STILL be able to fly to New York city on 3 engines!

We, of course would not do that in reality, we would return to Tokyo and either get a different airplane or have this one fixed... but the knowledge that the airplane had the capability was very reassuring.

Losing cabin pressurization would require an explosion of some sort that has torn out a portion of your cabin wall or several windows. The "Emergency Descent" portion of our checklist was for an immediate donning of the oxygen masks by each pilot and then to initiate a High Speed descent with full spoilers extended and the landing gear extended and by running the indicated airspeed right up to red-line. This would get us down to below 16,000 feet in less than 2 - 3 minutes from 39000 feet.

But wait a minute.

If you HAD such a hole or structural failure in your airplane, would YOU want to stress it even further with such an abrupt maneuver? The passengers ALL would have their own oxygen masks to use and enough breathing time for at least 10 - 15 minutes. Why not "tippy toe" down gently to the lower levels and keep the airplane all in one piece!

This type of decision is one that I had always planned to make for myself, rather than play "monkey-see monkey-do" and rush to follow the checklist. Course, the way things worked out I never had to do such a maneuver and that was just fine with me, too!

Cruise Climb

Almost all airline transports rarely ever cruise with Indicated Airspeeds above 330 knots and then only for short legs on flights of less than 2 hours of duration. The ideal way then is to climb as high as possible and to only NEED to fly in the area of 280 knots or LESS while still having TRUE airspeeds of 500 knots. That is why the airspace above 31,000 feet becomes so VALUABLE and desired in flight planning. I can state that even the mighty 747-400 could NOT travel non-stop to Tokyo from New York even with LESS headwinds at 31,000 feet than it CAN go non stop against heavy headwinds at 39,000 feet. The difference being is that the airplane needs to only INDICATE 260 knots or so at 39,000 feet while it needs to fly at least at 310 knots at 31,000 feet to maintain Mach cruise of .86. This difference of 50 knots of DRAG over a 12 - 13 hour period and the fuel

that it requires is the ruling factor.

Many times our flights would take up to an hour delay and be required to sit on a taxiway after pushback from the gate in order to receive permission from ATC to be able to cruise at or above 35,000 feet on a flight from Tokyo to the United States. While this was frustrating for the crew and passengers we would often still arrive on schedule! The higher altitudes gave us the higher tailwinds and the "wait" for routing down and along the most favorable jet stream patterns, for that night, were worth - the wait! Another factor to be considered is that most large transports need VERY cold temps to be able to climb to and cruise in the Flight Levels above 35,000. If the temperatures in those altitudes and above are too warm, flight is just not possible until much more fuel is burned off.

A good rule of thumb, to remember for winter and summer flying, and for airplanes that cruise in the .86 Mach range is that when westbound in the winter time over land that is covered by SNOW the airplane will likely travel about 6 - 7 miles a minute. Eastbound, same season, same area, about 10 miles a minute. Summer time - westbound over land that is now green with grass, about 8 miles a minute - eastbound, same area, 8 miles a minute!

Way down south where the water color turns aqua and the waves become calm... pretty much always figure on 8 miles a minute no matter the time of year!

The ability of the airplane to fly at the higher flight levels depends primarily on the weight of the airplane and secondarily on the temperature experienced at that flight level.

During the initial segment of a long haul flight with 747-400 gross weights of 870,000 lbs for takeoff, the airplane can initially be cruised at FL310 for the first 2 - 3 hours. After burning about 70,000 lbs of fuel the airplane will weigh less than 800,000 lbs and can then climb to FL330. Another couple of hours at that flight level while the airplane burns off another 50,000 lbs of fuel and it is then time to climb to FL350 with an airplane gross weight of 750,000 lbs.

This "step climbing" will continue throughout the flight and when the airplane is at the 600,000 - 640,000 lbs gross weight, FL410 will be available.

Rather than memorize all of these gross weights, charts are provided for the flight crews, in both the older 747's and newer -400 models. The -400 airplane will also alert the crew via computer messages that it is time to climb higher... just in case their minds have "wandered"! Additionally, the computer generated flight plan will have already planned the flight legs at the proper altitudes that correspond to the predicted gross weight during those waypoint passages.

The above "suggestions" of gross weight experienced before climbing to a higher altitude do have quite a bit of "slop" built into them. Those weights are the "ideal" time to climb for best fuel burn during the flight. However, if the flight crew happens to be on a very busy "track" that day with competing airliners that will also want the SAME altitudes as they do... it is often a good idea to "grab" the higher altitude SOONER to ensure that YOU get it... rather than a "friendly" competitor.

There are all kinds of "games" played by competing airline crews and it makes the day go faster if you can gain an upper hand and be able to look DOWN on that white and blue airplane below you….while your RED tail cruises into the sunset towards Japan and all of that COLD Sapporo beer awaiting you!

The cruise speed is almost exactly the same at FL310 as it is at FL410. In both cases Mach .86 is the target speed. What will differ is the Indicated Airspeed, as at 31,000 you will see about 330 knots Indicated to maintain .86 Mach while at 41,000 feet only about 250 knots IAS is needed to produce .86 Mach.

Remember as the air thins to allow less drag on the airframe for a constant mach speed it also "robs" the engine of its breathing ability to produce the power necessary to maintain the mach cruise speed. The airplanes wings must be able to create enough lift to support the airframe at altitude. That lift is created by speed. That speed is enabled by engine power. To go higher the pilot must either delay for a lighter airplane, which is just what happens as the fuel burns off, or to ask for more engine power. If he is already operating the engines at 91 - 92% N1 RPM he has to wait until the fuel burns off!

I remember that we would cruise initially at FL310 out of Detroit for Tokyo, with full loads, for about 2 - 3 hours. At that time the N1 speeds would have decreased back to about 88% N1 RPM and during the climb at climb power they would increase to 95% N1 RPM. At level off at FL330 we would be back at the 91% level. An hour or two later you'd see the 88% RPM - time to climb to FL350, etc, etc.

Manual Power Setting

Now I want to give a short discussion of an EASY way to HAND FLY the airplane at whatever SPEED you would like to fly at, with the Autothrottle OFF! My experiences with jet engines and with the 727/707/747 family and the DC-10 were all quite similar in the power readings that you can obtain from the N1 gauges. The EPR (Engine Pressure Ratio) readings were quite dis-similar as each engine seemed to measure the pressure at a different spot in the engine.

Many of us used to cheat and use fuel flow for cruise and approach settings... much to the chagrin of our Flight Ops department who only believed that EPR could give us an accurate value. However that meant always looking up numbers in a book and at times pilots who are flying the line don't have any extra time to spare!

For an example... a 727 has a fairly narrow gross weight range from high to low because it can't carry very much! Half full or full the difference between the approach weights are not that great (50 passengers times 160 pounds equals 8000 pounds versus 100 passengers equaling 16000 lbs)... so in an airplane that usually weighs around 145,000 for landing... the range between heavy and light is less than 8%. Hence, we the lowly line pilot who flew the airplane 80-85 hours a month for 10 years or more soon began to notice that the fuel flow, per engine, was usually at the 3000 lbs per hour figure when the gear and flaps were out on the final approach. Surprisingly at cruise with the gear and flaps up the fuel flow was also 3000 lbs per hour per engine!
You think anyone could make us look up some numbers to find an EPR setting that would also produce 3000 lbs per hour! Heck... we had it all figured out without the book.

It even got better.

At 10,000 feet when ATC had assigned you to fly a speed of 240 knots for vectors, we found that 2400 lbs per hour would produce 240 knots. In the same area if ATC wanted us to fly at 250 knots... 2500 lbs per hour would do the job. Once again we EARNED our right to be lazy and not have to look up the numbers in the books to get the right EPR! By simply adding an extra 0 to the speed assigned you could produce the fuel flow required to produce the power to overcome the drag to obtain the speed. By now you can figure out that if ATC wanted you to fly at 310 knots at 11000 feet... you would need to have a fuel flow of... you guessed it... 3100 lbs per hour. Love it!

Now here is the funnier part. A 747-400 will do the same ration... but you gotta DOUBLE the fuel flow. In other words each engine will burn about 6000 lbs per hour on the approach with gear and flaps out and in cruise and MID point of a long haul flight each engine will be burning about 6000 lbs per hour! At the start of the flight when you are heavy the engines will be burning over 7000 lbs per hour and later in the last 2 hours of a 14 hour flight they will be burning less than 5000 lbs per hour each. On this airplane there can be LARGE differences in the weights so you have to a bit more "creative" with your thinking. If we visit the ATC thing again and if they wanted us to fly at 300 knots at 11000 all we had to do was DOUBLE our old 727 fuel numbers. That airplane would have needed 3100 lbs per engine... the 747-400 would need 6200 lbs per engine.

Turbulences

Along the reduced workload of Cruising, comes always the possibility of enroute TURBULENCE.

We need to discuss that!

Of course the ol' Tarmack policy is to avoid severe turbulence if at all possible!

I am happy to report that the 747-400 does not have a Mach tuck problem. As speed nears MMO, drag increases rapidly and thrust is, therefore, insufficient to accelerate the airplane to this speed at the higher altitudes.

Sometimes, however, avoiding all turbulence

becomes impossible, and turbulence with intensities greater than moderate may be encountered. When the airplane is operated at its optimum altitudes based on weight, margins available to the buffet boundary will normally be greater than 0.5g. Because of this, buffet and control margins will be adequate for most conditions. However, if moderate or greater turbulence is anticipated or encountered, operating at 40,000 feet, or more, lower is advisable.

An alert pilot can be his own best source of "unexpected" turbulence. First, while it is common practice to NOT listen in on the HF freq's for the enroute portion between mandatory waypoint reports, I have found that by just keeping the volume low that I can still hear the flights that are ahead of me and I always turn up that volume a bit when they get to the portion of their report that gives turbulence in "codes".

Code 1 is very light,
Code 2 is Steady Light turbulence,
Code 3 is Light to Moderate,
Code 4 is Steady Moderate,
Code 5 is Moderate and Greater, and
Code 6 is Severe Turbulence.

By hearing a flight ahead of you some 30 minutes that is running into some Code 3 while you are sitting there with just a little bit of Code 1 "jogs" you to perhaps, pick up the interphone to the Lead Flight Attendant and suggest to her that we might be having a rougher ride ahead and if she could start to "stow" some of the serving carts and batten down the Galley's perhaps we can keep a lot of the passengers happier! The Flight Attendants always really appreciated the flight crews that took their duties into consideration and when we made suggestions that would make their job easier.

Another thing to watch while you are in the cockpit is the Outside Air Temp. Usually that gauge will sit pretty steady in the upper levels of the atmosphere... usually right at about -50°C or so. If you keep one part of that gauge in your "scan" and notice that it has changed more than 2 - 3 degrees in the past 5 minutes... you will often, and more often than not, start to experience turbulence.

This type of phenomena, abrupt changes in Outside air, are the big hope of forward scanning infra red transmitters, and for Doppler types of transmitters, to aid in predicting turbulence in front of you. Such instruments are not yet on the market but are in the planning stages.

All of the above has dealt with the Clear Air Turbulence factor, so it is also important to also consider that WHENEVER you are in clouds that have some vertical development that you should be alert for turbulent air. I realize that it is a "bother" for the passenger to wear his seatbelt for the entire flight but, shucks, we in the cockpit did that PLUS wearing our shoulder harness when below 10,000 feet.

The pilot bunkroom was just behind the cockpit and I did prefer a little bit of "chop" to rock me to sleep on those long nights in the bunk!

Weather Radar

One of the greatest advances of the 747-400 was the RADAR system, the system that placed the radar "return" right ON and INTO the ND display. Now, for the first time a pilot can SEE where that thunderstorm is, in relation to his actual route. Prior to this, the pilots had to look at the Radar screen, and then visualize where that "blob" of clouds were in relation to their present position and in relation to their track of flight.

Radar scopes all send out a "beam" from their transmitter and if that beam bounces off of anything in front of it, the beam is reflected back to the receiver and eventually makes its way to the radar scope mounted in the cockpit.

This means that you can see mountains and cities and even other large airplanes very nicely on the radar scope! Clouds will NOT show up until they have a lot of moisture in their interiors. As it seems that your favorite clouds are Thunderstorms you would be in luck with a radar scope in the cockpit on a dark and stormy night!

Most radar scopes have a maximum range of about 300 nautical miles and IF you can see "radar returns" from clouds out that far you can be sure that you are approaching some real biggies!

Each radar system has a gyro guidance function that always tries to keep the antenna of the radar in line with the horizon no matter

what the pitch attitude is of the nose of the airplane. In other words if you are climbing at 10 degrees pitch up, the antenna will move to 10 degrees down to stay on the horizon line. This is important because of the "tilt" control on the radar set. If you set the "tilt" knob (not in PS1) to 1 degree above the horizon and the display then shows no thunderstorms you can be almost certain that you will be ABOVE/HIGHER than those particular storms. If you set the "tilt" knob to about 2 degrees above the horizon and you still can see the radar return, you can be sure that you are going to have to deviate around those particular cells. This is a very good enhancement for night flying and for when you are in other clouds and can't see out of your front window. However, there is an old saying in aviation and it goes like this: "One peep is better than 10,000 sweeps"! This means that one lil' ol' look out the window can often tell you more than watching several hundred sweeps of the radar antenna and what it is reporting for weather in front of you.

It takes a couple of years of using radar to really be able to tell if you should venture into a cloud area or get the flock out of that area and make an end run around the thunderstorm line. And, you should never forget that just because your "tilt" says that at this time you are on top of the weather ahead that also during the next 10 minutes some of those clouds can "grow" another 10,000 feet of "head"!

As long as you know the upper winds from your IRS unit you are safe in flying along side a thunderstorm on the UPWIND side as close as 5 miles or so. However, if the winds at altitude are 60 knots or so, you should be at LEAST 60 miles from them if you are on the DOWNWIND side. This rule, 1 mile deviation for each knot of wind should keep you out of any hail or turbulence caused by "blow off" from upper air winds as they encounter the rising air currents of the thunderstorm itself.

I also love thunderstorms, but only when I am on the ground and am able to watch them with a cold beer in one hand.

And since this CREW PARTY is getting a bit louder in nature, let's all have ONE MORE ROUND!

Lightning

Now, back to thunderstorms... the BANE of every airline pilot! Mean son of a guns, the only force of Mother Nature that can DEFINITELY break your airplane!

Radar sets in the airplanes will usually allow you to see the worst of the weather and will permit you to alter your course to "pick" your way through the lightest areas. There are those times though that when you make your decision of where you want to "penetrate" the frontal line at, you are about 30 - 40 miles from that line of weather. And, even in the 6 to 7 minutes that it takes for you to fly to your intended "probe" of that weather, the weather that was below your target could erupt into a major new cell just as you got there.

Then it was time to FIRST turn ON every LIGHT in that cockpit. Dome lights, fluorescent lights, everything. In fact the 747 family has a "Storm Light" that does all of that for you, turns on every light. If the lights were left in the dim position that they often are when flying at night, any close lightning bolt could "blind" the pilots temporarily and with the lights on in the HIGH position this was a good prevention of that.

Once you were IN the sonofagun, it was best to ride it out and let the airplane "give" in its altitude and pitch and roll. If you fought her to keep her absolutely straight and level, YOU added a lot of flight loads to her wings and tail and that was a no-no! Again, the wonderful 747 family had a "Turb" position of the autopilot that reduced the autopilot "trim" movements to half the normal movements, to again, allow the airplane to wallow rather than be rigid and in a position to get that fatal "bend".

It was also important to NOT make any turns and proceed straight ahead for that is normally the quickest way out of the cell. If you were lucky you wouldn't enter the "hail section" of that cell and you wouldn't suffer any damage to the airplane, in fact you had a fresh wash job and she would glisten and gleam the rest of the day!

Stay out of thunderstorms!

Static electricity is always present in any airplane because as that airplane moves through the air it is rubbing against the molecules of that air. The friction of that

rubbing will set up the static electricity charge.

This is most evident when flying through "dry snow" and at night. If the snow is at the higher levels and if the outside air is well below the freeze point, the entire airplane will have a soft blue glow, while the leading edges of the wings and especially the windshield wiper attach bolts, right in front of your face, in the cockpit, will have a much brighter bluish glow. This is normally a non event and usually disappears as soon as the area of snow is left behind. Once in awhile, however, there will be a static discharge into that snow cloud FROM the airplane. This will be seen as a bright flash and perhaps some sound but not always.

Each airliner type airplane that I have flown as static discharge "wicks" mounted on the trailing edge of the wings and they are primarily designed to eliminate any static in the area of the "vent" holds for the fuel tanks. They sure worked good for me for over 32 years as I never had any trouble with fuel tanks exploding!

I experienced at least 3 lightning strikes in my career, the most memorable was in a 727 while flying an approach into Bozeman Montana from Billings. There is a mountain pass just to the East of Bozeman and the Victor Airway leads you through that pass towards the airport. There are mountains above you on both sides of the pass so it behooves you to be on centerline. This was a night flight and we were in cloud as we flew through the pass. The radar set was showing NO thunderstorms but the mountains on both sides of his produced radar returns, because of the terrain, that looked like thunderstorms. The air was bumpy so there was some convective activity in the area but not of such a size to indicate on the radar and there was not yet any rain being produced.

However, right in the middle of that pass our nose lit up like a Christmas tree and there was a sound that felt like you were inside an empty 55 gallon oil drum and someone had just struck it with all of his might with a sledge hammer!

On the ground as we inspected the airplane we could see that the entire fiberglass structure of our "radome" had been torn away by the force of the lightning strike.

I have flown around and through many thunderstorms so I was very surprised to see that even when the weather was "slight" enough to not produce an "echo" on the radar set that you could still take a lightning strike.

On the ground the airplanes are ALWAYS "grounded" by a metal strap before fueling commences and I have heard that sometimes as you roll up to the ramp after a flight and when the ground personnel open up the first cargo door, to unload your baggage, that they will sometimes get a small static "shock" when first touching the airplane. Most of them now wear rubber gloves and shoes if they are in charge of opening that first door.

I never took a lightning strike in the 747-400 but have always wondered what would happen to all of those computers if such an event would occur. It will happen sometime and I want to read about it... rather than have to write about it!

IRS

With the airplane still in Cruise, let's consider how WE are going to POINT this airplane all the way to New York and how the old-timers used to do the same thing!

Navigation over the high seas has evolved from the days of the ancient mariners with their sextants and accurate timepiece to satellite navigation that places a map of the entire world, with terrain features at the pilots disposal.

The initial navigation of the oceans by early airline transports included "navigators", crew members, that would "shoot the stars" much as did the early seamen. Along with the navigators were "radio operators" that would use ADF receivers to obtain cross bearings from powerful onshore low frequency stations and later on there were "Ocean Stations", ships anchored at sea with large radio transmitters placed at strategic places on the ocean itself to provide navigational aids to the overhead airplanes.

LORAN (Long Range Navigation) transmitters were used for a time on the airlines but by the late 50's and early 60's DOPPLER became the system of use for long range flights. This system sent a series of signals to the earth below and then recorded the "shift" in their

patterns as they reflected back up to the receivers in the airplane. The system was quite accurate for those days but there were times when an airplane would encounter a "calm state" (no waves) on the ocean below and that would often trigger a Doppler "dropout" and leave the crew to older methods.

Usually this meant that they had to wake up the navigator and ask him to do a star shot!

Even in the 707 airplanes there were still access holes in the cockpit roof for the navigator to insert his sextant for a fix! Additionally radar screens were used as "backups", especially for Pacific ocean flights up on the northernmost routes. The Russian Kuril Islands produced a very good return for our flights to Tokyo in the 60's and I can still mentally picture a couple of the "hooks" on two of the islands that told me that I was abeam of an island that I could reference on a map and this would give me a backup that the Doppler, Loran, and the Navigator were shooting me straight "skinny"!

The introduction of the 747's in the early 70's introduced a complete new system of navigation called INS. Inertial Reference System was the long hand name and as simply as possible it was a system that used "gyro's" for alignment and for measuring the effect and affect on them by acceleration sensors. If the INS knew exactly where it was at - at the start of the flight - the sensors could measure using "G" load or accelerometers and compute from "known's" of airspeed and altitude into a new position. All of the output of this computing was shown to us in the cockpit as pure numbers. The Latitudes and Longitudes of the global grid system became as familiar to us as were the old dit's and dah's of the Morse code. Instead of dialing in a VHF radio frequency for Chicago O'Hare's VOR the pilot would type in the measured Lat/Long of that navigational aid and could navigate TO it from thousands of miles away compared to the less than 300 miles of actual radio reception range.

As the 747 fleet introduced new airplanes INS was soon left behind and the IRS (Inertial Reference System) took over the main job of getting us to where we wanted to go. The IRS was part INS, with additional computers that would "sweep" the known radio aid frequencies in the area that corresponded to the position determined by the INS portion. The computers tuned 3 separate radios to known ILS and VOR freq's and took the readings of DME and Radial from those stations and by doing this could UPDATE the small but always present "creeping" errors of the INS system. "Creeping" errors are friction of the gyro's and even some "bending" of the Laser beams of later INS systems.

It was not uncommon to be off course up to 15 - 20 miles after 6 - 7 hours over water with the older INS systems - while it was rare to be off more than 1 mile by using the IRS systems.

Now and for the foreseeable future all of the above methods are obsolete as GPS and the satellite systems rule the navigational world and one more chore of the pilot has been made as simple as buttering his breakfast toast!

Descent

At TOD (Top of Descent) we may have already entered a waypoint crossing "restraint" into the FMS system via the CDU (Computer Display Unit). That entry may have looked something like this:

LENDY 280/FL190

We were telling the computer that we wanted IT to get the airplane down to FL190 feet at LENDY intersection (in the New York area) and at that time have the airspeed slowed back to 280 knots.

As the "magic" airplane purred along at 35,000 feet, say, with a couple of pilots riding like contented Cheshire Cats all curled up in their LAMBSKIN pilot seats, all we had to do was watch the "show". At about 75 nautical miles we get a message. Especially if we had already dialed in 19000 feet on our altitude selector and had "armed" the VNAV descent feature of the autopilot.

That "message" was to see the Autothrottle begin a slow and gradual movement to idle and to watch the nose begin to settle below the horizon. The "magic" had computed the actual winds aloft, the time it would take to descend the airplane at the current gross weight, and the distance it would take to slow from the descent speed of about 320 knots, OR Mach .82 back to 280 knots.

The autopilot was no dummy either. Rather than stick to a one speed setting it would often slow back to about 290 knots and keep that for quite some time. As it approached the actual LENDY intersection and if it saw that the upper air winds had changed dramatically enough so that IT was about to make a mistake and MISS its actual crossing altitude and speed assignment, it then used its "ace" and dipped the nose lower allowing the speed to build back to a normal 320 knots and to therefore increase the sink rate and to get back on its pre-determined descent schedule/angle to that waypoint.

If it had erred in the other side of the coin and found itself a bit too low too early it would VERY slowly put on a bit more power, as if it didn't want us to notice. Grin.

Now, that is the way we did it and rarely did we have to take over and correct the system because it was that good and trustworthy. There were times however that ATC would step in and issue a different clearance, such as, "Northwest 12 stop descent at FL280 feet due to opposite direction traffic, I'll call your further descent." That meant the controller would watch our "blip" on his screen until we were clear of the conflicting traffic and then tell us when to re-initiate the further descent.

So, then we would do as I would like for you to do with your request of how to get down from FL280 to 18,000 feet.

You could PRE-DIAL in the 18,000 feet number into the altitude selector while flying along at FL280. As long as you did NOT push the Altitude Selector you would remain at FL280. At the same time, the autopilot and Autothrottle would continue to maintain a normal cruise speed of about Mach .86. As soon as we were clear of traffic and told to restart the descent we would simply PUSH the round Altitude Selector and the Autothrottle would begin to retard and the descent would take place.

At this time the Autoflight system had NOT been told of just WHERE or WHEN we wanted it to level off at 18,000 feet. However, it WOULD still be PLANNING to make that crossing at FL190 and 280 knots as we had originally told it we wanted it to do.

And if we had been "held up" by that controller for enough time for the auto-system to conclude that it could NOT now make the crossing of 280/FL190, at LENDY, it would send up a digital warning that "DRAG IS REQUIRED".

Thank goodness, Autopilots do not yet have the ability to extend speed brakes!

So, something for the pilot to do!

And while helping the magic out we would direct our gaze to the ND and see a little "arc" at some point beyond LENDY that WAS the actual predicted point, without HELP from us, where the magic would finally have the airplane done to 280 knots and FL190. So, the pilot would slowly pull on speed brakes and as more were extended into the airflow we could watch that same "arc" begin to move right back until it was right on top of LENDY. That was the correct amount of speed brakes to use. And it made us look so smart. Grin.

Windshears

You might be surprised to know that the airspace over Japan and out to the east over the Pacific ocean can be one of the most turbulent air areas in the world and it is the area where I had some of my worst encounters with windshear.

The sub-arctic jetstream usually lays close to the Japanese islands and this jetstream causes many intense and tight low pressure areas to form just offshore from your country. They usually move in a northeast direction and are the causes of many rainy and windy days in Narita and Yokohama!

The best way to handle windshear is to avoid it at all costs. Most airline meteorology departments spend a lot of time in the forecasting of windshear possibilities that can be caused by known weather systems approaching the major airports of the world. The right combinations of low pressure areas that are moving swiftly can produce large changes in wind patterns just a short "height" above the runway surface and it is this type of condition that is fairly well predicted. Windshears caused by large thunderstorms in the vicinity of the airport are so short lived and sporadic that they are very difficult to predict and usually the first warnings of such

conditions are relayed through pilot reports from airplanes that encountered the shears. Based upon those reports airline flights are often delayed or canceled until the thunderstorm has left the airport area.

During our 6 month flight checks in the simulator we always practiced in recovering from windshear conditions. The actual conditions that may have caused an airliner to crash are replicated in the simulator and even with the advance knowledge that a windshear is about to effect your airplane it is often very hard to fly safely out of the windshear. The poor pilot and crew that had no such warning in the real world did not have that advance alert and it is very easy to see why there was an accident.

Training procedures in today's simulators almost directly reverse what pilots used to do with windshear encounters. If you are flying an airplane that has a sudden loss of airspeed, due to a windshear, it is almost instinctive to want to LOWER the nose and attempt to regain the airspeed. That is NOT the thing to do with today's instruments and new procedures. What is taught now is that during the windshear encounter it is better to RAISE the nose and seek a HIGHER pitch attitude - right up to the nibble of an airfoil stall, while at the same time applying full, forward to the firewall, thrust lever settings. Rather than accept a "sink" in altitude and possible ground contact it is better to use the "energy" already in the airplane with its airspeed to maintain altitude or at least not descend as much as you would if you pushed the nose over to attempt to regain the lost speed.

Windshears are most dangerous close to the ground and any shear that is above 5000 feet are really not a problem other than encountering turbulence. It is the shears that are closer to the ground while the airplane is "dirty" with its flaps and gear extended that are the most dangerous.

Approach

Let's begin to plan for a Stabilized Approach to landing.

My airline always TAUGHT the "stabilized approach concept". This simply means that the airplane is fully configured for landing PRIOR to the Outer Marker with landing flaps and landing gear down and with engines set at a thrust setting that allows you to fly the SAME speed all the way down the ILS Glideslope.

Turn inbound to intercept the ILS from at least 20 miles out, and at about an altitude of 5000 feet above the GROUND!

When you are ON the ILS, watch for the Glideslope needle to begin to move down from the top of that instrument.

You should now be flying at about 180 knots with 10 degrees of Flaps.

When the needle hits "one dot" or one level ABOVE center on your Glideslope, lower the flaps to 20 degrees, and put the landing gear down and reset your airspeed to 150 knots. By the time the gear is down you will have slowed back from 180 to the 150 knot speed and you should then see that you are ON the center of the Glideslope. Now lower your flaps to 25 or 30 degrees (we used 25 degrees most of the time at NWA) and let the AUTOPILOT intercept the Glideslope and establish your 150 knot speed and to keep you on the centerline of the ILS.

By the time you get TO the Outer Marker that autopilot should have everything all "figured out"! In other words you will be in EXACT trim for all of the controls, the engines will have an EXACT N1 speed to maintain your 150 knots, and you will be ON the glideslope and on the center of the ILS.

From this point on, even if you turned the autopilot OFF, you shouldn't have to make ANY major changes in ANYTHING!

That is a stabilized approach!

Let's now turn to a discussion of the actual approach, and specifically CAT II and CAT IIIB approaches and the actions and procedures for both.

Autopilot landings are completed, routinely, every day in the airline system. They are completely safe when used within limits of crosswind and turbulence and allow the aircraft to land with forward visibility as low as 300 feet!

When an autoland is decided to be used by the Captain a separate checklist is used for the

Approach Check and the prescribed procedures are followed very closely. On my airline the approaches for CAT II and CAT III were all flown by the FIRST OFFICER. He had his hands on the control column while the Captain handled all radio communication and monitored BOTH instrument panels.

CAT II procedure:
At the Decision Height specified on the Approach plate (usually 100 or 200 feet) the Captain would have his hands also on the control column and slightly behind the First Officer's hand on the thrust levers. If there was NO visibility at the DH the Captain gives the command to "Go-Around" to the First Officer (who has NEVER looked out the window but who has continually watched his instruments) who then toggles the TOGA switch(Take-Off/Go-Around) and allows the autopilot to complete the Missed Approach procedure. If, however, there WAS runway "environment" (lights, markings, strobes, etc.) at the DH, the Captain would have announced in a loud voice - "Landing". At this time the First Officer would have relinquished any pressure he had on the control column and would have removed his hands from the thrust levers. The Captain would then pull the thrust levers to idle and complete the flare if he decided to disconnect the autopilot for a manual landing after runway sighting. His other option would be to allow the autopilot to complete the landing.

CAT III procedure:
This procedure is still the same in that the F/O is controlling the airplane through the autopilot while the Captain handles radio communication and monitors both instrument panels and the autopilot control panel for ANY warnings or flags that may indicate less than perfect alignment and that all THREE autopilots are working as a team. This time as the INNER MARKER is passed (a WHITE LIGHT and a rapid "beep beep beep" tone) and if there are NO warning flags, the Captain will announce "LANDING" and allow the autopilot to continue the approach and touchdown. The pilots will NOT be able to see ANYTHING until the nosewheel is lowered to the pavement after the flare! If there had been ANYTHING not normal or amiss during the approach the Captain, again, would have given the command to "Go-Around" and the First Officer, through the use of the autopilot would have completed the Missed Approach.

All of this is designed to have one pilot at ALL TIMES watching the airplane instruments on his panel and using the autopilot while the Captain is able to compare his instrument panel to that of the F/O and to make the decision to either continue to abandon the approach. Since the F/O has always been "inside" the airplane with his vision he is in the best condition to transition to the Missed Approach. And, since the Captain was looking out the window for the CAT II approach he was in the best position to transition for the landing.

This sounds a lot more complicated than it really was! Autolands were neat and fun to do. Not as much fun as doing it yourself, however, and that is why MOST landings are done by the pilot. Why give away the good stuff?!

Usually what determines whether an airport is CAT III or CAT II is the surrounding terrain under the approach path. This must be as level as possible to allow the aircraft's radar altimeter to get as accurate of a reading as possible as it continues on down the path to the runway from the Middle Marker. Once that condition is met, either through man made construction or natural flatness the transmitters are maintained to a higher degree of accuracy and side areas along those transmitters area kept free from ground vehicles and other obstructions that may tend to deflect the beam.

The times of weather at most airports when they are actually at CAT III minimums is actually quite small in MOST areas of the world. London, Amsterdam, in fact most European capitols would be an exception but really only Dulles Airport in the Washington DC area and Seattle in the Washington state come to mind as well known foggy airports with enough long haul flights to support maintaining a CAT III operation.

The differences between the two categories, in the airplane, require additional crew training and also a higher maintained standards for certification down to CAT IIIb (and I DON'T know if there is a CAT IIIa or not!). For actual use in Cat IIIb the airplane must have EVERTHING working, i. e. all 3 Autopilots, 2 separate Flight Directors and 2 radar altimeters. CAT II can be performed with some components inoperative.

The crew must do DIFFERENT "briefings" in

the cockpit for each category and there are different duties and CALL OUTS for each category and it is NOT permitted for a crew to "change" from a CAT II to a CAT IIIb approach UNLESS they pull back up and go out at brief themselves and reconfigure for the new approach.

However, you can "brief" for a CAT IIIb and then switch to a CAT II! So, guess what, I always briefed for the CAT IIIb and then we were set no matter what!

CAT IIIb allows an approach and landing with visibility of 600 feet and with NO ceiling requirement. A CAT II usually requires a ceiling of at least 100 feet and visibilities in the 1200 foot range.

Wheel Brakes

The "carbon brakes" of the 747-400 series are a great improvement over the older series 747's and in fact do have "torque limits" to prevent heavy braking from DAMAGING the landing gear section that is attached to the wing! In other words, if the pilot presses his foot to the brake pedal for maximum stopping effort the torque sensors in the wing mounted landing gear will "relax" their maximum effort to not exceed a value that may damage the actual structure of their installation.

A maximum effort brake use while on an aborted takeoff is about 98 percent sure to blow every tire on the main gear after a period of 10-15 minutes due to heat buildup from the stoppage. Even with a medium braking effort and while at the ramp after arrival, if you should do a walk-around of your airplane you will hear much "crinkling" and hissing as the brakes transfer their heat buildup to the metal wheel casings... and I have seen a couple of times airplanes that actually had wheels casings "glow" cherry red from the heat buildup.

Evacuation

Finally, as this party is WINDING down, and it might be time to EVACUATE the Captain's room... grin, let's consider that our landing at JFK turned into a disaster. Something went wrong, something failed, and we ended up OFF the end of the runway.

If there is an incident aboard the aircraft that would require a passenger evacuation the flight and cabin crew follow specified checklists to fully prepare the passengers for the time that the order is given to evacuate the cabin. Examples of such times would be when one or more landing gears do not extend or a loss of hydraulic pressure that may disable the aircraft's brake systems and when it is suspected that the airplane may overrun the available runway surface, or, if there is an engine fire or other fire in the airplane structure and when landing is needed as soon as possible.

In the case of an engine fire the crew will coordinate with the Cabin crew about UNUSEABLE Emergency Exits, such as those on the SIDE of the fire. Or, if there is a fairly good crosswind blowing across the runway in use most evacuations will be primarily to the upwind side.

Without going into specific airline "codes" it should suffice to say that there should be no evacuation started until the command is given from the cockpit. In airplanes with wing mounted engines you can surely see the need for them to be shut down before the evacuation over the wing positioned exit doors are started.

On occasions that a violent landing might be imminent the Cabin Crew will have the passengers practice the "brace" position for the contact on the runway. This will include the passengers leaning forward in their seats and the grasping of their ankles! Bet you have heard that one before... bend over... here it comes!

If there is time before the actual landing the Captain should always speak to the passengers and describe in at least the elementary detail of what will be involved in the actual landing. If he is too busy attending to just keeping the airplane in the air he will delegate that little "fireside" chat to the Flight Engineer or in the case of 2 man airplanes to the Lead Flight Attendant after he has briefed him/her in sufficient detail to allow the correct passage of information.

There are other coordinated efforts going on outside of the airplane in the event of serious emergencies and that is when the Airline's Dispatch Office helps assist the flight crew. They will be in direct contact with the Control

Tower via telephone lines and with the Fire Departments at each airport. Again, winds will be discussed and the fire trucks will plan to approach the airplane from the upwind side. If "foaming" of the runway is deemed necessary the planning back and forth of how long that will take versus the amount of fuel on board the airplane and of how long it can stay in the air is also taken into account.

I never had an incident or accident that required an emergency evacuation but due to the excellent flight simulators I was able to act as if I had had such an emergency at least 64 times during my 64 6 month checkrides for my airline!

This ENDS my portion of this manual, I hope that you now understand, a bit better the systems and operation of the 747-400, and I hope that you continue to enjoy the wonderful world of that airplane, that is presented to you, right at home on your computer, from Hardy Heinlin and his Aerowinx company.

I can tell you that my enjoyment of this software is almost beyond words, as whenever I get a bit homesick for the old cockpit, I simply load in PS1 and am transported back to the old "office"!

Regards,

Cap'n Tarmack