AMPLIFIED CHECKLIST

BEFORE START

NOTE: The Before Start Checklist will prepare the aircraft for engine start and flight. It is a Preparatory Checklist.
The Before Start Checklist should generally be initiated and completed to the line after the Flight Engineer's Preflight is complete, the Flight Release has been completed, and the fuel is on board. The remainder of the checklist will be completed once aircraft doors are closed.
All crewmembers should have ATIS information prior to the accomplishment of this checklist.

OPERATIONAL FLOW PATTERN

Accomplishment of Flight Engineer's, Captain's and First Officer's Pre-flight Inspection will satisfy the flow patterns for this checklist.
The complex situations to be satisfied prior to the Before Start Checklist is read are: GPS position, waypoint programming, and setting flight instruments.

PUSHBACK

Prior to pushback, the before start checklist will be completed in its entirety and the starting engines checklist will be completed to the line.

BEFORE START CHECKLIST

If the airplane is pushed back before start, place No. 1 ADP TO AUTO (only after ground clearance is received) to provide nose and body gear steering. Turn #4 Hydraulic electric pump on for brake pressure.

1. Cockpit Prep Complete C,F,E
2. Rudder, Aileron Trim Set C
   - Rudder Trim set to zero.
   - Aileron Trim set to zero.
3. Radios Set C,F
   - VHF NAV receivers tuned for departure.
   - ADF receivers tuned for departure or emergency return.
   - RADAR Range and Tilt set for Departure. Standby selected.
   - TRANSPONDER select Standby, position R/T switch to 1 on odd days and 2 on even days.
4. CDI's
   - Course Selectors – SET FOR DEPARTURE
   - Course Transfer Switch – DUAL
   - Heading – SET
   - Navigation Mode – HDG
   - Back Beam Switch – DISENGAGED
   - State the course set.
     C,F

5. Airspeed, N1 / EPR Bugs Set C,F,E

- Set the computed takeoff airspeeds.
- N1 / EPR BUGS should be set to computed T/O N1 / EPR.

NOTE: (FFRATS) Check TOD mode appears in MODE window, N1 limit readout appears in N1% window and N1 bugs are in agreement with readout N1.
If the FFRATS is inoperative, manually set bugs to charted N1.
NOTE: The Flight Engineer should reset the N1 Limit Selector panel after engine start and all generators are on line.

6. Altimeters

- Current altimeter setting (QNH) set in all altimeters.
- Indicated altitude – all altimeters crosschecked.
- F/E sets QNH in BARO SET window and cabin altimeter. ___ft C,F,E

7. Window Heat On F
Check Window Heat Switches in ON position.
8. Anti-Ice Off F

- Nacelle Anti-Ice Switches OFF and associated Nacelle Valve Open lights extinguished.
- Wing Anti-Ice Switch OFF and Valve lights extinguished.

9. Seat Belt Sign On C
10. Fuel Quantity _____ lbs / _____req'd E,C
Confirm fuel load corresponds to dispatch fuel requirements and verify aircraft gross weight is entered on totalizer. The FE responds with total usable fuel on board. The Captain responds with fuel required per the flight release plus taxi fuel.
11. Reserve Brake System 2 Closed C

- Check Reserve Brake System 2 in Guarded position.
- Check Valve Open light extinguished.

12. Speed Brake Handle Forward Detent C
Ensure Speed Brake Handle is in Forward and Down Detent.
13. GPS / TAWS / INS Initialized / Programmed / NAV C, F

- Present position in all GPS units. Flight plan activated and checked. All three GPS units on NAV Page 1 (See Supplemental Procedures).

TAWS set (See Supplemental Procedures).
INS: Observe amber ALIGN light out. (If any ALIGN light is illuminated, see Abnormal Procedures.)
14. APU, Electrical System Set E
APU bleed air valve open and pressure normal, generator(s) on line.
15. Takeoff Brief Understood ... NFP, E

- The Briefing is normally given by the Flying Pilot prior to Engine Start.
- For Briefing content, see Briefings at the beginning of this Chapter.

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16. Tail Stand Removed E
17. Gear Doors / Pins Closed / Removed E

- Gear doors should be closed after the completion of the exterior walk-around inspection.

WARNING
WHEN ANY GEAR DOOR IS OPEN, CHECK THAT RESPECTIVE DOOR RELEASE HANDLE IS IN "DOORS OPEN" POSITION. IF HANDLE IS IN "DOORS CLOSED" POSITION AND DOORS ARE OPEN, PRESSURIZING THE NO. 1 OR 4 HYDRAULIC SYSTEMS WILL CLOSE DOORS AND CAN RESULT IN PERSONNEL INJURY.

- Gear Pins – REMOVED

18. Papers, Log, Fuel Card On Board F, E

- The First Officer verifies that all paperwork for the flight (i.e., Flight Release, Weight & Balance data, Navigation Logs, General Declarations, Aircraft Security Checklist, etc.) are on board and correct.
- The Flight Engineer verifies that the Fuel Slip, Fuel Card, and Aircraft Logbook are onboard.

19. All Doors Closed, Locked E
Check F/E Door Annunciator Panel.
20. Before Start Check Complete E
NOTE: When cabin check is complete, F/E will make public address announcement, "Grooms prepare for departure".

STARTING ENGINES

This procedure must be completed to the line prior to pushback. Captain will call for Starting Engines Checklist after communications (hand signals or service interphone) have been established with the ground crew. The First Officer will ensure ATC start clearance is obtained. The normal cue for engine start (When ground crew cannot communicate by interphone) is the illumination of the anti-collision light; they will issue clearance to start. Upon accomplishment of the last item in the Starting Engines Checklist, the engines will be started in the normal sequence of 1, 2, 3, and 4. If using different starting sequence it must be coordinated with maintenance. The Captain will monitor the ground crew and handle cockpit-ground communications.
The First Officer will ensure the Captain and Flight Engineer are notified of any abnormal conditions or aircraft movement during start.
The Captain and Flight Engineer will monitor all engine indications during start and ensure that limitations are not exceeded. The First Officer will monitor and time all engine starts.
NOTE: The Captain may delegate the starting of the engines to the First Officer. In this case, the Captain would assume all First Officer duties until the engine start is complete.
Minimum recommended unloaded (start valve closed) starting air pressure for engine start is 30 psi. Values less than 30 psi may decrease to insufficient values for starter operation when the start valve is open. A .7 psi pressure decrease per one thousand feet pressure altitude is considered maximum normal air supply deterioration.

JT9D ENGINES

If any of the following conditions occur during start, immediately abort the start and complete the appropriate Abnormal Procedure:
Hot Start – If EGT is climbing rapidly through 500°C or exceeds 650° limit.
Hung Start – If N2 RPM fails to accelerate beyond 30%, or reach idle RPM 90

seconds after actuating start lever. No Start / Wet Start

- No fuel flow observed or fuel flow with no EGT rise within 20 seconds after actuating start lever.
- No rise in oil pressure.
- No positive indication of N1.
- Dense fogging (vaporized fuel) from the tailpipe prior to start lever movement.
- Instantaneous Light Off when start lever is placed to IDLE / RICH.
- Tailpipe Fire.
- If start lever is inadvertently returned to CUTOFF.
- If start valve fails to close when ignition switch is positioned to OFF.
- After engine has stabilized at idle RPM, if CSD oil low PRESS light is not extinguished, or engine oil pressure is not within the green band.

RESTART

Engine restart is permissible if EGT has not exceeded the Takeoff EGT Limit. Continue to motor the engine for 30 seconds or until the EGT is below 100"C, whichever is longer. If lower than normal fuel flow (as compared to other engines which started normally in IDLE) is observed on aborted start, the RICH position may be used for restart. Record in aircraft logbook the difference in starting parameters using RICH position.
NOTE: If peak EGT exceeded 650°C start limit enter peak EGT and time above 650°C in aircraft logbook as an item. If peak EGT was below the Takeoff EGT limit and duration was less then 5 minutes during initial start attempt, sign off discrepancy as follows: "No maintenance action is required per B-747 MM 71-00-00". If peak EGT was above Takeoff EGT limit and/or duration was longer then 5 minutes, or EGT exceeded 650°C on second start attempt contact Tech Center for further information.
NOTE: If EGT exceeded the Takeoff Limit, a restart should not be made until the appropriate maintenance action has been accomplished. Record the duration of any over temperature and the peak temperature reached in the aircraft logbook.

STARTER DUTY CYCLE

Three consecutive start attempts can be made without disengaging the starter. After the third attempt, place the ignition switch to OFF (after cooling the engine) and allow N2 to decrease to zero before attempting another start. Motoring time on the starter should not exceed 15 minutes.
NOTE: In the event a starter control valve remains open following engine ignition switch release, the Flight Engineer will call, "NO STARTER CUTOUT, FUEL OFF" and the Captain will position the start lever to CUTOFF, the FE will then close the PYLON VALVE.

ENGINE START PROCEDURE

Normal procedure will be to use air obtained from the APU for engine start on all four engines. However, if air from the APU is not available, an external air start or cross-bleed start can be made; see Abnormal Procedures chapter.
CAUTION: DO NOT START ENGINES UNTIL GROUND CREW GIVES THE ALL

CLEAR SIGNAL. IF A CROSS-BLEED START IS UTILIZED, ENSURE AREA BEHIND THE AIRPLANE IS CLEAR.

NOTE: Select the Engines Digital page to monitor N1 and N2 RPM during engine start.

1. START PRESSURE CHECK E

Observe Duct pressure 30 psi. If duct pressure is below 30 psi or if starting with an external air source, see Abnormal Procedures chapter.

2. IGNITION SWITCH GROUND START E

Upon Captain's command, hold ignition switch in Ground Start. Observe that the bleed air VALVE CLOSED light extinguishes and the starter VALVE OPEN light illuminates. Call, "Starter Valve Open". (Start toggle switches should be used as follows: No. 1 switch on odd numbered days and No. 2 on even numbered days, alternating thereafter for a series of flights).

3. N2 ROTATION MONITOR AND CALLOUT "N2" E

4. OIL PRESSURE CALLOUT "OIL PRESSURE" E

Observe the oil pressure gauge for rise within. a few seconds after rotation.

5. N1 ROTATION MONITOR AND CALLOUT "N1" C

6. N2 ROTATION CALLOUT INCREMENTAL VALUES 15%, 20%, and MAX MOTOR E

If unable to attain 20% N2, call "MAX MOTOR".

NOTE: If starting in high tailwind, see Abnormal Procedures chapter.

7. START LEVER IDLE / RICH C

After FE calls "Max Motor", ascertain EGT is below 100"C, then move the Start Lever to IDLE. Observe Fuel Flow and EGT for a rise indicating that a light-off has occurred. The Captain will call, "Fuel On, Fuel Flow, Light Off." FO will start clock when Captain calls, "Fuel On." If N1 rpm has not been verified by a ground crewman, and is not indicating immediately after an indication of EGT, or if any other irregularity is noted, discontinue the start. If OAT is below 32°F and EGT indicates 0°C or below, put the Start Lever in RICH until the engine stabilizes, then move Start Lever to IDLE.

NOTE: N2 acceleration and EGT increase should rise proportionately (i.e. at 30% N2 n EGT of approximately 300°C, at 40% N2 - 400°C, etc.)An aborted start may be re-attempted in accordance with Abnormal Procedures chapter.

8. N2 RPM 25% CALL "25%", and CALL EACH 5% N2 THEREAFTER E

9. N2 RPM 50% RELEASE IGNITION SWITCH E

To prevent possible damage to the air starter, release ignition at 50% N2. Observe VALVE OPEN light extinguishes, indicating Starter Valve has closed. Call "STARTER CUTOUT". Check that the bleed air VALVE CLOSED light illuminates.

10. ENGINE INSTRUMENTS MONITOR C, F

Check Engine Oil Pressure light out and forward engine instruments stabilize within proper limits.

11. CSD LIGHT EXTINGUISHED E

12. ENGINE INSTRUMENTS MONITOR E

Check oil pressure, oil temperature and oil quantity indicates normal. Repeat the previous steps for starting other engines.

CF6 ENGINES

If any of the following conditions occur during start, immediately abort the start and

complete the appropriate Abnormal Procedure.

- Hot Start – If EGT is climbing rapidly through 700°C or exceeds 750°C limit.
- Hung Start – If N2 RPM fails to reach idle RPM within 90 seconds after actuating start lever.
- No Start / Wet Start – No fuel flow observed or fuel flow with no EGT rise within 25 seconds after actuating start lever.
- Oil Pressure not in Green Band after engine has stabilized at idle RPM.
- No positive indication of N, 30 seconds after attaining idle RPM.
- Dense fogging (vaporized fuel) from the tailpipe prior to start lever movement.
- Instantaneous Light Off when start lever is placed to IDLE.
- If start lever is inadvertently returned to CUTOFF.
- Tailpipe Fire.
- If start valve fails to close when ignition switch is positioned to OFF.
- After engine has stabilized at idle RPM, if CSD oil low PRESS light is not extinguished.

RESTART

Engine restart is permissible if EGT has not exceeded the Takeoff EGT Limit. If EGT exceeded the Takeoff Limit, a restart should not be made until the appropriate maintenance action has been accomplished. Continue to motor the engine for 30 seconds.
NOTE: Record the duration of any over temperature and the peak temperature reached in the aircraft logbook.

STARTER DUTY CYCLE

Two consecutive start attempts can be made without disengaging the starter. Continue to motor the engine for 30 seconds following each aborted start attempt. Do not exceed starter duty limit of 5 minutes.
NOTE: If engine fails to start after third attempt, dry motor for an additional 2 minutes, shutdown engine and contact Maintenance Tech Center.
NOTE: In the event a starter control valve remains open following engine ignition switch release, the Flight Engineer will call, "NO STARTER CUTOUT, FUEL OFF" and the Captain will position the start lever to CUTOFF, the FE will then close the PYLON VALVE.

ENGINE START PROCEDURE

Normal procedure will be to use air obtained from the APU for engine start on all four engines. However, if air from the APU is not available, an external air source start or a cross-bleed start can be made; see Abnormal Procedures chapter.

CAUTION: DO NOT START ENGINES UNTIL GROUND CREW GIVES THE ALL CLEAR SIGNAL. IF A CROSS-BLEED START IS UTILIZED, ENSURE AREA BEHIND THE AIRPLANE IS CLEAR.

1. START PRESSURE CHECK E
Observe duct pressure is 30 psi. If duct pressure is below 30 psi or if starting with an external air source, see Abnormal Procedures chapter.
2. IGNITION SWITCH GROUND START E
Upon Captain's command, hold ignition switch in Ground Start. Observe that the bleed air VALVE CLOSED light extinguishes and the starter VALVE OPEN light illuminates. Call, "Starter Valve Open". (Start toggle switches should be used as follows: No. 1 switch on odd numbered days and No. 2 on even numbered days, alternating thereafter for a series of flights).
3. N2 ROTATION MONITOR AND CALLOUT "N2" E
4. N1 ROTATION MONITOR AND CALLOUT "N1" C
5. N2 ROTATION MONITOR AND CALLOUT 15% E
NOTE: Normal N2 RPM for start lever movement to IDLE is 15% N2.If starting in high tail wind, see Abnormal Procedures chapter.
6. START LEVER IDLE C
After FE calls 15%, move the Start Lever to IDLE. Observe Fuel Flow and EGT for a rise indicating that a light-off has occurred. The Captain will call, "Fuel On, Fuel Flow, Light Off". FO will start clock when Captain calls, "Fuel On".

NOTE: If N2 acceleration is sluggish and EGT is rapidly increasing through 700°C or exceeds 750°C, discontinue start by moving the start lever to CUTOFF and continue to motor the engine for 30 seconds. A false or aborted start may be re-attempted in accordance with Abnormal Procedure chapter.
7. N2 RPM 20% CALL "20%", and CALL EACH 5% N2 THEREAFTER E
8. N2 RPM 50% RELEASE IGNITION SWITCH E
To prevent possible damage to the air starter, release ignition at 50% N2. Observe VALVE OPEN light extinguishes, indicating Starter Valve has dosed. Call "STARTER CUTOUT". Check that the bleed air VALVE CLOSED light illuminates.
9. ENGINE INSTRUMENTS MONITOR C, F
Check Engine Oil Pressure light out and forward engine instruments stabilize within proper limits.
10. CSD LIGHT EXTINGUISHED E
11. ENGINE INSTRUMENTS MONITOR E
Check oil pressure, oil temperature and oil quantity indicates NORMAL. Repeat the previous steps for starting other engines.

STARTING ENGINES FLOW (FE)

The Flight Engineer will utilize the Starting Engines checklist to properly setup his panel for engine start.

AFTER EACH ENGINE STARTED - CHECK

1. BLEED "VALVE CLOSED" LIGHT ILLUMINATED
2. EDP PRESSURE NORMAL
3. ENGINE INSTRUMENTS STABILIZED

4. CSD OIL "PRESS" LIGHT EXTINGUISHED
5. GENERATOR FREQ'S AND VOLTS WITHIN LIMITS
6. NEXT GENERATOR PRE-SELECT

STARTING ENGINES CHECKLIST

THIS PROCEDURE MUST BE COMPLETED TO THE LINE PRIOR TO PUSHBACK
Normal procedure will be to use air obtained from the APU for engine start on all four engines. However, if air from the APU is not available, an external air source start or, if an engine is operating, a cross-bleed start can be made; see Abnormal Procedures chapter.
Starting sequence: Coordinate with ground crew.
CAUTION: DO NOT START ENGINES UNTIL GROUND CREW GIVES THE ALL CLEAR SIGNAL. IF A CROSS-BLEED START IS UTILIZED,
ENSURE AREA BEHIND THE AIRPLANE IS CLEAR.

1. Smoke Barrier Door Closed, Locked E
If any doors are open for late loading, do not start engines that would create operational difficulties or hazards. Once doors are cross checked, Flight Engineer should close and lock the smoke barrier door.
2. Galley Power Off E
No. 1 GALLEY POWER switch supplies power for upper deck galley (CARGO AIRPLANES).
3. Fuel System Set for start E
Check that amber PRESSURE lights are extinguished.
4. Hydraulic System Cleared / Press C / E
• Turn No. 4 Electric Hydraulic Pump on to provide brake pressure. When hydraulic system 4 electric pump is pressurizing the brake system, the brake source low pressure light may or may not extinguish, depending on aircraft configuration. Brake pressure should be verified using the brake pressure indicator.

WARNING: CLEARANCE FROM GROUND PERSONNEL IS REQUIRED PRIOR TO TURNING PUMP ON.

CAUTION: IF NO. 4 ENGINE START IS ABORTED, IT MAY BE NECESSARY TO RECYCLE NO. 4 ELECTRIC HYDRAULIC PUMP ON TO ENSURE BRAKE PRESSURE.
• Turn No. 1 Air-Driven Pump to AUTO or No. 1 AC Pump (if installed) ON to provide for nose and body gear steering.

WARNING: CLEARANCE FROM GROUND PERSONNEL REQUIRED PRIOR TO TURNING PUMP TO AUTO.

NOTE: If external air source or low duct pressure, do not turn on No. 1 ADP. See Abnormal Procedures.
5. Park Brake / Press Set OR Rol / Normal C

- Check Brake Pressure indication no less than system pressure.
- Park Brake and Anti-Skid Hyd lights illuminated if BRAKE SET.
- Chocks should be removed at this time.

6. NAV, Anti-Collision Lights On C
- Check Navigation lights ON.
- Turn on Anti-Collision light to serve as a signal that engines are being started.

NOTE: If engines to be started with battery power only, proceed to Battery Start checklist now.

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7. Air Conditioning Off E
Close pack valves.
8. Start Pressure psi E
30 PSI minimum recommended for engine start.
9. Start Clearance Received C
- Ground personnel will advise when cleared for start through contact on the interphone or through use of hand signals.
- Clearance to start engines may be required by ATC.

10. Starting Engines Check Complete E

NOTE: If engine started with external air source, cross-bleed start, or low duct pressure, complete appropriate checklist now.

AFTER START

During Pushback, ensure that the brakes aren't applied. All stopping must be accomplished by the tug to prevent upset. Reverse Taxi or powering back is not permitted. Do not operate Nosewheel Steering while pushback is in progress.
The Captain is primarily responsible for monitoring the forward engine instrument panel while the After Start checklist is being accomplished. This checklist should be completed prior to taxi.

AFTER START FLOW (FE)

After all four engines have been started and after the last engine start flow has been completed, the Flight Engineer will immediately proceed with the "After Start Flow" as depicted.

1. GENERATOR BREAKERS AND SSB CLOSE
2. APU BLEED AIR SWITCH CLOSE
3. KW / KVAR'S CHECK
Check all KW and KVAR's indications within limits.
4. ESSENTIAL POWER CHECK
On first flight of each day, select each generator to ensure it will power the essential Buss and return to "Norm" noting DC Buss isolation light illuminates and extinguishes. On subsequent flight, leave selector in "Norm".

5. CSD IN / RISE TEMPS CHECK
Check all CSD IN / RISE TEMPS normal and within limits.
6. PACKS / RECIRC FANS ON
7. NO. 1 / NO. 4 ELECTRIC PUMP OFF
8. HYD SYS CHECKED, AUTO, NORMAL
Hydraulic quantities and pressures checked, ADP's to AUTO EDP's DEPRESS, CHECK RUN light illuminates, the EDP's NORMAL.
9. FWD / AFT CARGO HEAT NORMAL

AFTER START CHECKLIST

THIS CHECKLIST MUST BE COMPLETED PRIOR TO TAXI
1. Start Levers Idle C
JT9D Engines: After all engines have stabilized, place the start lever to IDLE if initial selection was to RICH.
2. Electrical System Set E
- Generator Switches — CLOSE.

Close generator switch 1, 2, 3, and 4. Observe the GEN OPEN lights go out. Observe the APU Gen Open lights illuminate or Ext Pwr On Bus lights go out.
- Split Sys Breaker — CLOSE

Observe Open light goes out. Observe equal loads on KW meters.
- Essential Power—CHECK

On first flight of each day, select each generator to ensure it will power the Essential Bus and return to "Norm" noting DC Bus isolation light illuminates and extinguishes. On subsequent flight, leave selector in "Norm".
- AC Generators — MONITOR

Generator 4 is the normal inflight selection.
NOTE: If external power was being used, FE should advise Captain when he is ready for disconnect. After the Captain has advised the ground crew to disconnect, the FE should observe the AC Conn. Lights go out.
3. Air Conditioning Set E
- If packs are to be used during taxi, open pack valves as required. Monitor pack temperature.
- Recirculating Fans — On as required.
- Gasper Fan — On as required.
- Upper Deck Heat — As required.
- Trim Air — OPEN if previously closed.

4. Hydraulic System Ckd, Auto, Normal E
- Hydraulic quantities and pressure — CHECKED
- Air Hyd Pumps — AUTO

CAUTION: THIS CHECK MUST BE PERFORMED BEFORE THE A/C IS MOVED UNDER ITS OWN POWER AFTER START.
- Engine Driven Hyd Pumps — NORMAL
- No. 4 Electric Hydraulic Pump — OFF

5. Fwd & Aft Cargo Heat Normal OR Off E

When perishables are in lower cargo area, do not position the Aft Cargo Heat Switches to NORMAL until TOC. Turn Aft Cargo Heat Switches OFF at start of descent. The crew will be advised when perishables are aboard.

6. Ground Equipment Removed, Clear C,F

Verify with ground personnel that all equipment is clear of aircraft. Clear ground personnel off of the headset and verify that they are clear of the aircraft. Check area visible from cockpit.

7. After Start Check Complete F

TAXI

This checklist should not be completed until the aircraft is away from congested or crowded ramp areas. The Captain will call for "FLAPS_____TAXI CHECK".

The Captain will taxi the aircraft utilizing the tillers if necessary. The First Officer will keep a vigilant watch outside and assist with the Taxi Checklist. Use of sustained reverse idle thrust to control Taxi speed is not recommended due to the engines increased susceptibility to foreign object damage under such conditions. Taxi speed must be controlled by use of brakes. Recommended braking technique for controlling speed is to brake to nearly a full stop, then let engine idle thrust accelerate the aircraft to the point where brake use may be required again. CAUTION: CONSTANT USE OR DRAGGING BRAKES TO CONTROL TAXI SPEED WILL RESULT IN HIGH WHEEL AND BRAKE TEMPERATURES AND WILL RESULT IN DECREASED BRAKE PERFORMANCE SHOULD THEY BE NEEDED ON A REJECTED TAKEOFF.

Flight control checks should not be performed while in turns.

EGT MONITORING DURING GROUND OPERATIONS

When the engine(s) is (are) being operated on the ground, one crewmember must monitor the EGT gauge(s). Continuous monitoring of EGT during ground operations is the Flight Engineer's responsibility. Any time he must divert for other activities, he must request and confirm, that another crewmember assumes this responsibility. To reduce the possibility of compressor stall on the ground, with a tailwind component, the engine should never be operated above the minimum power setting required to maneuver the aircraft. The Flight Engineer has the authority to shutdown any engine to prevent an "over temperature" during all ground operations except for "Takeoff Roll" and during "Landing Rollout", i.e., prior to coming out of Reverse. (See Abnormal Procedures chapter, this manual.)

When an engine is shutdown because of an actual or impending over temperature (such as during a non-recoverable compressor stall), the starter should be engaged below 20% N2 rpm and the engine motored for 30 seconds. (JT9D Engines: Continue motoring until EGT is 100"C or less.) It is permissible to exceed the starter duty cycle whenever cooling an engine by motoring after a precautionary high EGT shutdown.

TAXI FLOW (FE)

Taxi Flow will be accomplished after aircraft leaves congested ramp area.

1. FUEL PANEL SET

Setup for 4-minute sampling or extended taxi.
2. FUEL HEAT (If Installed) CHKD / OFF
ON if required and then checked off.
3. FLIGHT RECORDER CHKD / ON
After captain releases brakes, ensure flight recorder is on with no fault light.

TAXI CHECKLIST

1. Flaps_____-Handle, Gauges, Lts Ckd C,F,E
On the Captain's command, the FO will move the flap handle to takeoff setting. All crewmembers will state takeoff flap setting " .., verify flap "handle" position, verify needle indication on inboard and outboard flap "gauges" for agreement with flap handle, and check the leading edge flaps green "light" illuminated. FE will check LE flaps annunciator panel for all green indication.
2. Flight Controls Checked C,F
- While holding the tiller vertical, the Captain will slowly and smoothly push full left rudder pedal and check that control position indicator shows rudders move full left. Slowly and smoothly push full right rudder; check that control position indicator shows both rudders move full right.

NOTE: Rudder check should not be performed while turning.

- The FO will rotate the control wheel full left; check that control position indicator shows left outboard aileron full up, left spoiler extended, right spoiler retracted and right outboard ailerons full down. Reverse control wheel; check that indicated aileron and spoiler positions are reversed. Pull control column full aft; check that control position indicator shows outboard elevator position full up. Push control column full forward; check that control position indicator shows outboard elevators full down.

3. Yaw Dampers Checked C
The Captain will initiate a slight turn in either direction with the tiller and then straighten out. Check that both Rudder Position Indicators move opposite to the turn.
NOTE: The rudder position indicators display that the yaw dampers are calling for the rudder displacement to counteract the yaw of each turn.
4. Auto Brake Takeoff Switch (If Installed) ARM C
- Check AUTO BRAKE light out.
- Flight Engineer places Auto Brake Takeoff Switch to ARM on Captain's command.

5. Stabilizer Trim units, Checked C,F
- Move the stabilizer trim switches (thumb switches) and observe stabilizer trim wheel rotation and trim indicator movement are in the direction of trimming; both Brake Rel lights illuminate. While trimming turn Stab Trim Circuit switches Off and observe trimming stops and Brake Rel lights extinguish. Close cover guards and observe Brake Rel lights illuminate and trimming resumes. Release Thumb switches and observe Brake Rel lights extinguish.
- Move stabilizer trim handles in either direction and note stabilizer movement in the proper direction.

6. Green Band Select Switch / Light (if Insrd) ... Up, Mid, Dn / Lts Out C
- Check Green Band Select Switch in required position, GREEN BAND and STAB TRIM GREEN BAND lights extinguished.

NOTE: If Takeoff Stabilizer Trim setting is on a "mid band" boundary (within 1 unit), select the adjacent APL NOSE DOWN or APL NOSE UP GREEN BAND. This will prevent an inadvertent configuration warning signal during takeoff roll.

7. GPS Checked C,F

GPS should be on Nav Page 1 and if the flight is predicated on its use, the Cross Track Deviation bar and TKE bug on at least two units colored white or yellow to indicate the unit is not in DR. (See Supplemental Procedures.)

8. Pilot Heat On F

Turn probe heaters on and observe amber lights extinguished.

9. Fuel Heat (If Installed) Checked, Off E

Check engine fuel temperature; if +5°C or below apply fuel heat to all engines for one minute. After fuel heat valves closed, ensure engine fuel temperature decreases indicating valve is closed.

10. Anti-Ice Checked, On OR Off E

NOTE: This step may be accomplished as power is applied to leave the parking ramp.

- If outside air temperature is 50°F (10°C) or colder and visible moisture (precipitation, fog with visibility less than one mile), or same temperature range with temperature and dew point within 5°F is present, Nacelle Anti-Ice must be used.
- If Nacelle Anti-Ice is to be used, place the switches on one at a time and observe that the Nacelle Valve Open lights illuminate.
- If Nacelle Anti-Ice is not needed for takeoff, confirmation that the system is operating properly will be made by placing each switch to ON, observe the Nacelle valve open lights illuminate, then OFF.

11. Flight Recorder Checked On E

Check OFF light extinguished. If light is illuminated, place flight recorder switch to ON. Check that OFF light extinguishes.

12. Shoulder Harness On C,F,E

Seat Belts and Shoulder Harnesses must be on for all Takeoffs and Landings.

13. Takeoff Brief Understood NFP,E

- The Briefing is normally given by the Flying Pilot prior to Engine Start.
- For Briefing content, see Briefings at the beginning of this Chapter.

14. Flight Instruments Checked C,F

Attitude indicator and compass checked.

15. Taxi Check Complete E

BEFORE TAKEOFF

Captain will call for Before Takeoff Checklist to the line approaching the end of the takeoff runway and below the line when cleared onto the runway.

NOTE: The entire Before Takeoff Checklist must be completed prior to beginning the takeoff roll.

TAKEOFF PROCEDURE (JT9D Engines)

1. THRUST LEVERS SET FOR TAKEOFF FP,E

The First Officer will hold a light forward pressure on the control column and maintain wings level until 80 knots. The Flying Pilot will maintain directional control with rudder pedal steering (if installed) until aerodynamic directional control is established. The Non-Flying

Pilot will callout, "80 knots", Flying Pilot will state, "checks". The Captain should guard the tiller until 80 knots. Actual tiller inputs should be kept to an absolute minimum.
CAUTION: OVER CONTROL OF THE TILLER, PARTICULARLY DURING SLIPPERY TAKEOFF CONDITIONS, CAN RESULT IN LOSS OF DIRECTIONAL CONTROL.
Prior to aligning the aircraft on the runway, review the takeoff data card. Extreme care should be used when setting takeoff EPR. Once aligned with the runway, the Flying Pilot will advance the thrust levers to approximately 1. 10 EPR.
The Flying Pilot will then smoothly advance all thrust levers toward the computed takeoff EPR. The Flight Engineer will make the final precise adjustments to obtain takeoff EPR by 80 knots. The Flight Engineer will then remove their hands from the throttles. At that time the Flight Engineer will state "Normal / Max Power Set, N 1 Checks". The lowest N1 RPM should be within ±2% of the predetermined target value. If takeoff power is not set by 80 knots, the Flight Engineer will not advance the throttles beyond Go-Around EPR. The Flight Engineer will compute Go-Around EPR prior to departure. Since the Captain is responsible for rejecting a takeoff, he will maintain control of the throttles on all takeoffs once power has been set. In no 94 instance will takeoff be considered assured below V1 speed. Due to RAM air effect on the JT9D engine, once takeoff power is set, the Flight Engineer will make no other power adjustments except those required to avoid exceeding N1 or EGT limits. If the RAGS 3.5 bleed valve sticks open during the application of takeoff thrust, it will be necessary to move the related power lever forward of its normal position to obtain takeoff EPR. On a temperature-limited engine, takeoff EPR may not be attainable. If the valve should close during takeoff, EPR and EGT will rise very quickly, probably exceeding limits. Subsequent maintenance action will depend upon the amount and duration of the excess EGT. Vigilance and quick corrective action are critical as always.
2. ENGINE INSTRUMENTS MONITOR E
The Flight Engineer will monitor the engine instruments to see that they do not exceed N1 or EGT limits, and advise of any abnormality throughout the remainder of the takeoff.
3. AIRSPEED CALL OUT NFP
Pilot not making the takeoff will call out 80 knots, 100 knots, V1, Rotate and V2 as those speeds are reached.
4. LANDING GEAR UP NFP
Non-Flying Pilot will call positive rate of climb as indicated on both the Altimeter and Vertical Speed indicator. The Flying Pilot will then call gear up. The NFP will move the Landing Gear Handle to the UP position. After the green and red lights on the forward instrument panel are extinguished, the NFP will place the gear handle to the OFF position.

TAKEOFF PROCEDURE (CF6 Engines)

AUTOTHROTTLE TAKEOFF
The Flying Pilot (FP), while holding the brakes, advances the thrust levers to approximately 70% N1 and checks engine indications are stable and symmetrical. As the brakes are smoothly released, the Captain engages the Autothrottles and the FP calls for the Flight Engineer to "SET NORMAL / MAX POWER". The Flight Engineer observes N1 increasing to takeoff value, follows through on the thrust levers, and makes the final trim of the takeoff thrust setting when THR HLD is displayed on the A/T FMA. When the final thrust is set the Flight Engineer will state "NORMAL / MAX

POWER SET, N1 CHECKS".
The FFRATS will not be used during takeoff under the following condition:

- If speed mode autothrottles are installed.

NOTE: See Supplemental Procedures for specific autothrottle operation.
MANUAL THROTTLE TAKEOFF
The Flying Pilot (FP), while holding the brakes, advances the thrust levers to approximately 70% N1 and checks engine indications are stable and symmetrical. As the brakes are smoothly released the FP advances the thrust levers toward the takeoff N1 setting and calls for the Flight Engineer to "SET NORMAL / MAX POWER". The Flight Engineer observes N1 increasing toward takeoff value, follows through on the thrust levers, and makes the final trim of the takeoff thrust setting by 80 knots. When takeoff thrust is set the Flight Engineer will state "NORMAL / MAX POWER SET, N1 CHECKS."

REJECTED TAKEOFF PROCEDURE

Captain Call, "ABORT SPOILERS" and simultaneously apply maximum braking. Retard thrust levers to idle, apply full reverse thrust on symmetrical engines, and check that spoilers are deployed. If they do not deploy, extend them manually. Maintain directional control during deceleration.

Flight Engineer Check speed brake lever in UP detent and call, "SPOILERS EXTENDED, REVERSE AVAILABLE".
Note airspeed and perform normal landing duties. Check brake cooling chart. NOTE: Following a rejected takeoff, a subsequent takeoff should not be started without considering the residual heat in the brakes and tires. If a maximum braking effort is made, return to the blocks for a cooling off period. Notify ground personnel to keep clear of the wheel area because of the possibility of explosion (thermal fuses are incorporated in attempt to prevent this possibility). Check maximum Quick Turn-Around weight from the Runway Analysis.

First Officer
As soon as conditions permit, the First Officer will inform the tower that the takeoff has been aborted and will get taxi instructions to clear the runway. Assist the Captain with full forward control wheel input and maintain wings level.

BRAKE OVERHEATING

Experience has shown that on short flights (or following high energy stops or prolonged taxiing), the 747 brakes may not adequately cool with the gear retracted. In such case the additional brake heating during the next landing and taxi-in may result in multiple wheel fuse-plug blowouts, usually after parking. To minimize exposure to this problem it is recommended that the gear be extended after obstacle clearance has been met for several minutes after the first takeoff. An alternative method to improve brake cooling is to extend the gear well in advance of the next landing. On very short segments, both of these procedures may be appropriate. Refer to Brake Overheat / Brake Cooling Schedule.

BEFORE TAKEOFF FLOW (FE)

Completed to the line when Captain calls for Before Takeoff Checklist. Complete below the line when Captain calls for Before Takeoff Checklist below the line.

1.	ANTI-ICE	ON / OFF
2.	APU, DOOR	ON / STOP, CLOSED
3.	FUEL PANEL	SET FOR TAKEOFF

4.	ANNUNCIATOR PANEL (AFT)	CHECKED
5.	AIR CONDITIONING	SET FOR TAKEOFF
6.	IGNITION (SYS 1 OR SYS 2)	ON
7.	ANNUNCIATOR PANEL (FWD)	CHECKED

BEFORE TAKEOFF CHECKLIST

NOTE: Prior to taking runway, FE will make P.A. announcement: "Grooms prepare for takeoff".

1. Flaps, V-Spds, Trim Rechkd Rwy C,F,E

- Recheck that flaps and airspeed bugs are set accurately for actual takeoff runway.
- Recheck takeoff trim setting.

2. Anti-Ice On OR Off E

Recheck TAT and airport conditions for T/O anti-ice requirements. Recheck Anti-ice switches positioned as required.

3. Radio / GPS Switch Radio C,F

- Both Radio / GPS switches in Radio.
- GPS No. 1: Nav Page 1
- GPS No. 2: Nav Page 1
- GPS No. 3: Nav Page 3

4. Altitude Alert ft C,F

- Set initial departure altitude as directed by ATC if not previously set.
- Place altitude mode selector switch to "ALT SEL" if not previously set.

5. APU On OR Off E

6. Fuel System Set for Takeoff E

Check all main tank fuel boost pumps ON, No. 1 & No. 4 cross-feed valves OPEN and No. 2 & No. 3 cross-feed valves CLOSED. Center wing pumps on (-200) if required.

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7. Radar / Transponder On F

- Select Radar to WX
- Check that ATC Transponder switch and Altitude reporting switch is selected to 1 or 2, as appropriate.
- TCAS Mode Selector should be positioned to TA / RA and range should be set to 6 NM.
- After out of airport traffic area, reselect TA / RA and 12 NM.
- Verify ATC assigned Squawk code is loaded and state the number.

8. Ignition On E

Select engine ignition to FLT START (SYS 1 odd days, SYS 2 even days)
NOTE: Use the same system that was used for engine start.
9. Air Conditioning Set E
- Monitor EGT when closing Pack Valves
- It is standard procedure to make all takeoffs with Packs OFF. If ambient temperature is 110°F or hotter, use Takeoff Procedure using APU for air conditioning, Supplemental Procedures.
- Packs on takeoff permitted if weight penalties accounted for.

10. Body Gear Steering Centered, Disarmed C
The Captain will state, "Centered, Disarmed" after turn onto the runway is completed and the aircraft has rolled straight ahead a short distance.
11. Annunciator Panels Checked E
The FE will check the forward and aft annunciator panel amber lights are extinguished.
12. Lights On C
- Outboard Landing Lights — ON
- Inboard Landing Lights — ON
- Runway Turnoff Lights — ON
- Strobes — ON

13. Before Takeoff Check Complete E

AFTER TAKEOFF TAKEOFF FLOW (FE)

400 FT. – 2000 FT. AGL
1. FE ANNUNCIATOR PANEL CHECK
Check GND SAF RELAY and door lights extinguished.
2. AIR CONDITIONING SET
Check Pack door pre-position and turn pack ON. Trim air OPEN.
RECIRC FANS ON
Position Recirc Fans as required.
3. PRESSURIZATION CHECK
Check outflow valves closing, cabin and differential pressure rising.

AFTER CLIMB POWER SET

4. NO SMOKING SIGN ON OR OFF
5. AIR CONDITIONING SET
Turn on second pack.
6. FUEL SYSTEM SET
Fuel panel set for climb as required. (See Supplemental Procedures chapter for fuel management).

AFTER TAKEOFF CHECKLIST

This checklist may be discontinued at any point if it is determined that the aircraft will remain below 18,000 feet and in the Captain's opinion the QUICK RETURN CHECKLIST would be more appropriate. In this case, complete the QUICK RETURN CHECKLIST in its entirety.

The Flying Pilot will normally call for After Takeoff checklist after calling for flaps up.

1. Landing Gear Up, Off, Lights Out NFP

Observe all landing gear lights are extinguished, then move the handle to OFF.

2. Flaps Up / Lights Checked NFP/E

- NFP will state flap position.
- The F/E will verify flap handle position, INBD and OUTBD flap position indicators and LED position lights, FWD and AFT, are in agreement with selected flap position.

3. No Smoking Sign On OR Off E

4. Ignition On OR Off E

Ignition is normally turned off here, but with the presence of adverse weather or turbulence, it may be left on.

5. Air Cond, Press Set E

IF TAKEOFF WAS UNPRESSURIZED:

One Pack Valve Switch — OPEN

Place one pack valve switch to the open position at not less than 400 ft above the field elevation and prior to reaching 2000 ft. If engine failure occurs do not open pack valve until obstacle clearance height has been reached.

Normal Air Conditioning — RESTORE

Stabilize cabin rate of climb. When cabin rate of climb is stabilized, place remaining pack valve switch(es) to open position.

NOTE: Fuel savings will result with two pack operation. (See Supplemental Procedures, Air Conditioning). If takeoff was made using the APU for Air Conditioning, refer to Supplemental Procedures, Air Conditioning.

6. Fuel System Set E

See Supplemental Procedures chapter for fuel management.

At 10,000 ft, with non flight crewmembers seated in the upper deck, F/E will signal termination of sterile cockpit by cycling the "NO SMOKING" sign twice. The Non- Flying Pilot should change TCAS range to 12 NM if not previously selected, and the satellite phone should be selected ON.

7. Altimeters 29.92" C,F,E

The altimeter will be set to 29.92" when approaching the transition altitude when climbing and cleared through this level. Baro set display on TAWS should be set at this time.

8. Lights Off NFP

Landing Lights should be illuminated until 18,000 ft. MSL unless in the opinion of the Captain it is desirable to have them extinguished at an earlier time.

9. After Takeoff Check Complete E

CLIMB

The Non Flying Pilot will make calls "Through for 1000 Feet below assigned altitude.

CLIMB POWER MANAGEMENT JT9D ENGINES

After setting Initial Climb EPR, the F/E will maintain MAX Power or Climb Power as required for temperature, altitude, airspeed and bleed conditions. Following the initial setting, power checks and throttle adjustments should be made at a minimum of 2000 feet intervals, and/or for each 5°C change in TAT. Close adherence to climb thrust schedules cannot be overemphasized. In this regime of flight, and initial cruise, EGT can be equal to and even greater than during takeoff.
It may be necessary to allow the climb speed to approach .83M to .84M when climbing above optimum altitude. 7F EPR values are based on 250 / 320 /.82 climb speed. 7A EPR values are based on 250 / 340 /.82. Correct EPR for speed deviation.

REDUCED CLIMB POWER PROCEDURES

In order to decrease the time at temperature factor on our engines, the following reduced climb power procedure will be followed anytime max climb power is not required.
At all takeoff weights, the initial and all subsequent settings will be reduced by a factor of .02 EPR. If climb performance decays to less than 500 FPM power should be advanced to Maximum Climb EPR.
These reductions are from the Initial Climb EPR and Maximum Climb EPR charts. Decrements for engine and/or wing anti-ice should be taken from MAX Climb EPR not Reduced Climb EPR.
This procedure is not to be used in the event of an Engine Failure after V1. Therefore, the Initial Climb Power setting that is placed on the Takeoff Data Card will be used after clean up and the Second Segment Climb Performance will not be altered.
It is understood that sometimes enhanced climb performance is required to meet ATC requirements or certain Noise Abatement procedures overseas. In those cases, deviation to Max Climb EPR is approved for the length of time it takes to comply with those requirements. Return to this procedure as soon as the necessity for maximum climb performance is over.
NOTE: To avoid exceedances, the flight engineer must be attentive and update climb power frequently.

CLIMB POWER MANAGEMENT CF6 ENGINES

When setting Initial Climb power the flying pilot will call for either MAX Climb Ni or a De-Rated Climb Ni as required for temperature, gross weight, altitude, airspeed and bleed conditions. Depending on conditions either Rating 1 (-4%) or Rating II (-10%) de-rate may be used. If the rate of climb decreases below 500 FPM at any time an increased Ni should be used up to MAX Climb Ni.
If the Ni Limit Computer is inoperative use the Initial Climb Ni and Max Climb Ni charts from the performance manual. The Ni adjustments for non-standard climb airspeed or bleed configuration shown in the tables must be applied.
See Supplemental Procedures chapter for specific operating procedures for the FFRATS.
NOTE: A de-rate used for takeoff will not revert to full thrust when the N1 Limit Mode Selector switch is moved to CLB.

CRUISE

HIGH ALTITUDE ENGINE ACCELERATION CHARACTERISTICS (JT9D Engines)

Slow engine acceleration and/or slow EPR response at high altitude could be misinterpreted as lack of engine response to thrust lever movement. Due to the engine inlet air spillage at low thrust settings near idle and the possibility of false EPR indications, other engine parameters should be monitored. If engine thrust appears to be unresponsive in terms of EPR, advance the thrust lever and monitor Ni, EGT and Fuel Flow increase; normally EPR should respond in approximately 15 to 20 seconds. Engine acceleration time up to one minute may be experienced. If Ni, EGT, and Fuel Flow do not respond normally, or if engine has flamed out, refer to Abnormal Procedures.

Set the required cruise thrust after level-off and after the airplane has accelerated slightly (approximately .01 M) above the desired cruise Mach.

The third digit on the Mach meter is very unstable and should not be used as the primary criterion for adjusting thrust. In unstable air, variations from .83 to .85 M are normal with .84 M is the target cruise speed. Do not continually adjust thrust to maintain .84 M; however, if Mach is allowed to decay below .83 M, Maximum Cruise Thrust may be required to accelerate to .84 M.

If an enroute crossing restriction required a speed reduction during cruise, do not slow below holding speed.

NOTE: During high altitude and low gross weight cruise, the engine bleed valve may open while setting cruise thrust. When this occurs, the EPR drops .10 to .15 with an associated decrease in Ni and Fuel Flow. Moving the thrust lever 2 or 3 knobs forward of the others can normally schedule the valves closed. Once the bleed valves have closed and thrust has increased, retard the thrust lever slowly to establish desired EPR setting.

EPR BUG

EPR bug will be set to max continuous EPR.

HIGH ALTITUDE ENGINE ACCELERATION CHARACTERISTICS (CF6 Engines)

After level-off and when the aircraft has accelerated to the desired airspeed, select SPEED on the A/T mode selector. Check that the autothrottle maintains the selected airspeed. Adjust thrust levers as required to balance the N1 on all engines to within 1 of each other with the autothrottles engaged. After 10 minutes in SPEED, select MACH on the A/T mode selector. Mach Hold is more economical than Speed Mode and allows a larger speed variation. Select CRZ on Ni LIM MODE selector after cruise Mach has stabilized. Check that the selected mode appears in the TAT/N1 indicator and on the FMA.

If operating manually, set the required cruise thrust after level-off. When the aircraft has accelerated slightly above the desired cruise airspeed, selected CRZ on the Ni LIM MODE selector and check that selected mode appears in the TAT/Ni indicator.

SEVERE TURBULENT AIR PENETRATION

Flight through severe turbulence should be avoided, if possible. When flying at 30,000 feet or higher, it is not advisable to avoid a turbulent area by climbing over it unless it is obvious that it can be over flown well in the clear. For turbulence of the same intensity, greater buffet margins are achieved by flying the recommended speeds at reduced altitudes.

Should turbulence be encountered, the recommended procedures are summarized as follows:

1. AIRSPEED

- B-747-100 280 – 290 KIAS or M.82 –.85, whichever is lower.
- B-747-200 290 – 310 KIAS or M.82 –.85, whichever is lower.
- Severe turbulence will cause large and often rapid variations in indicated airspeed. DO NOT CHASE AIRSPEED.

2. AUTOPILOT – Engage in TURB mode.

Check the engage switch MANUAL and the altitude switch OFF. The A/P will not hold heading or altitude and the stabilizer will not automatically trim. The A/P will maintain existing pitch attitude and wings lever.

3. YAW DAMPERS – Yaw dampers should be ENGAGED.

4. THRUST – Ignition switches positioned to ON.

Make an initial thrust setting of Ni RPM for the target airspeed depending on gross weight and altitude. Place the auto-throttle switch OFF.

5. TRIM

If autopilot not operative, after establishing the trim setting for penetration speed, DO NOT change stabilizer trim. Maintain control of the airplane with the elevators.

6. ATTITUDE

If autopilot is inoperative, maintain wings level, and smoothly control pitch attitude. USE ATTITUDE INDICATOR AS THE PRIMARY INSTRUMENT. In extreme drafts, large attitude changes may occur. DO. NOT use sudden large elevator control inputs.

7. ALTITUDE

Allow altitude to vary. Large attitude variations are possible in severe turbulence. Sacrifice altitude in order to maintain the desired attitude and airspeed. DO NOT CHASE ALTITUDE. If should be noted that the turbulence penetration speeds are for severe turbulence such as that encountered in a thunderstorm and are recommended to provide adequate structural margins and airplane control. From a passenger comfort standpoint, there is very little to be gained from reducing airspeed at high altitude in moderate turbulence. A reduction from Mach .85 to Mach .82 only reduces the true airspeed approximately 15 knots at FL 350. From the pilots standpoint, the airplane control is better at the higher Mach numbers and less time is spent in the turbulent area.

The increase indicated airspeed and Mach numbers over previous jet transports are a direct reflection of the advanced aerodynamic design of the 747 series airplane. Normal cruise speeds near optimum altitudes will be within or very close to the recommended turbulent penetration speed range. In the event the airplane is cruising at a higher Mach than the recommended turbulent penetration speed range when severe turbulence is encountered, the desired speed reduction can be obtained by a slight reduction in thrust. If a faster deceleration to the target speed range is desired, the speed brakes may be used.

CAUTION: UNDER NO CONDITION SHOULD THE LANDING GEAR BE EXTENDED AS A DRAG BRAKE AT HIGH AIRSPEEDS. THE RESULTING PITCH CHANGE COULD BE VIOLENT ENOUGH TO CAUSE STRUCTURAL DAMAGE, AND THE GEAR DOORS MAY BE TORN AWAY.
NOTE: Thrust lever movements at high altitude should be made smoothly and slowly from stabilized thrust settings. Do not retard thrust levers and then advance them while the engines are decelerating; conversely, do not advance thrust levers and then retard them while the engines are accelerating. If a non-recoverable engine surge occurs (rapidly rising EGT), complete the Engine Fire (Severe Damage or Separation) checklist. Note the peak EGT and duration in seconds / minutes. If engine limitations have not been exceeded, restart the engine using the Inflight Start checklist. Airspeed reductions to the target speed range at medium altitudes can be obtained by smoothly retarding thrust levers and/or by the use of speed brakes.

ENGINE OPERATION IN HEAVY PRECIPITATION (CF6 ENGINES)

With extremely heavy rain conditions N1 indications may momentarily increase or decrease up to 6%. Water ingestion, up to a certain level (saturation point) will reduce the compressor inlet temperature and increase the airflow demand for the high- pressure compressor (N2). The increased airflow will result in an increase in N1. Continued or increased water ingestion beyond the saturation point will result in water entering and evaporating in the N2 compressor and combustion sections. This results in a reduction of the cycle temperature of the engine, which in turn reduces the work available to drive the fan. Consequently N1 will decrease.
No action is required unless thrust reduction is necessary to maintain N1 within limits. Thrust lever movements should be made in a slow, deliberate manner. Readjust thrust as required when rain decreases. To provide improved compressor stall margin when precipitation is anticipated or experienced, place the autothrottle switch off and turn on nacelle anti-icing. If total temperature is above 10°C, turn anti-ice off when clear of precipitation.

DESCENT

Flying Pilot will call for the Descent Checklist just prior to descent.
Normally the aircraft is within range of the destination so that automatic terminal information (ATIS) may be received prior to descent. When possible, the airport information should be received and the approach briefing completed prior to descent. Use Flaps 25° for approach and landing when conditions are ideal. The crew should be briefed on which flap setting is to be used.
The Flight Engineer will listen to ATIS or contact the appropriate ground facility, and obtain the most current information available to fill out the Landing Data card. This should be accomplished at the earliest opportunity for coordination between crewmembers regarding active runway, weather, etc.
Landing data should be computed by the Flight Engineer, presented to the Flying Pilot and the appropriate instrument bugs set prior to descent.
Turn on Nacelle Anti-Ice prior to entering icing conditions. Nacelle Anti-Ice will remain on until TAT is warmer than +50°F (+10°C). Thrust reductions should be made very

slowly.
All exterior lights will be turned on below 18,000 feet MSL except, when in the Captain's judgment they present a hazard or distraction to safe flight.
Pressurization will be set as soon as possible, to field elevation and altimeter barometric setting for the destination airport.
At low altitudes and/or when the desired arrival cabin altitude has been achieved, selecting the maximum rate position on the rate knob will better allow the pressure controller to keep up with airflow rates of change due to changes in power setting or the shifting between high and low stage that occurs with large power changes when maneuvering for the approach. The Non-Flying Pilot will make calls "Through _____for 1000 feet above assigned altitude.

DESCENT FLOW (F/E)

Descent Flow will be completed prior to execution of the Descent Checklist and prior to Descent.
1. UPPER DECK, GALLEY INSPECT AND SECURE
Inspect and secure upper deck area and galley. Brief upper deck occupants on cabin signs, seat belts, and sterile cockpit.
2. IGNITION (SYS 1 OR SYS 2) ON
3. CIRCUIT BREAKERS (P-7, P-12, P-6) CHECKED
4. AIR CONDITIONING, PRESSURIZATION SET
Set cabin altitudes selector to destination field elevation, and non operating packs to AUTO. Return any pack operating in the 1/2 position to full.
5. FUEL SYSTEM SET
Open #1 and #4 reserve valves at top of descent (as required by Limitations).

DESCENT CHECKLIST

1. Ignition On E
Turn on ignition at top of descent. (System 1 or System 2).
NOTE: Use the same system that was used for engine start.
2. Circuit Breakers Checked E
3. Air Cond, Press Set E
Set the Cabin Altitude selector to destination field elevation and set altimeter to destination barometric setting. Place non-operating pack control switches to Auto.
4. Fuel System Set E
Unless tankering fuel, open #1 and #4 reserve valves at top of descent. Reserve tanks must be transferred prior to main tanks #1 and #4 reaching 5000 lb.
5. Approach Brief Understood NFP,E
- Normally completed prior to descent.
- Flying Pilot will ensure that NFP and F/E are briefed about aspects of descent and approach. (See Briefings, this Chapter).

6. Airspeed, N1 / EPR Bugs Set C,F,E
- Set Airspeed, N1/EPR bugs to the appropriate numbers.

- EPR bugs should be set to Go-Around EPR (JT9D)
- The bugs on the Captain's and F/O's airspeed indicators should be set:
- Lowest white perimeter bug set at VREF (Flaps 25 or 30).
- Remaining bugs set for Flaps 10, 5, 1, up.
- Select GA on the N1 LIM MODE selector. Check the selected mode appears in the MODE window and N1 bugs go to Go-Around N1. (CF6)

7. Shoulder Harness On C,F,E

Ensure observers and upper deck occupants are seated and have seat belts on.

8. Descent Check Complete E

APPROACH

Flying Pilot will call for "Approach Checklist to the line" transiting 18,000 feet.
The Non-Flying Pilot will advise the Flying Pilot when approaching 10,000 feet MSL.
When passing 10,000 feet MSL, the satellite phone should be selected OFF for normal operations.
While being vectored for landing normally the first radar heading vector received by ATC is an opportune time to re-tune the navigation radios and program the Flight Directors, Autopilots and Autothrottles panel. When all radios have been tuned and identified and transition level has been reached, the pilot flying will call for the Approach Checklist, below the line.
As flaps are lowered during the approach, the non-flying pilot will reset the Command Bug for the target maneuvering speed for that flap setting.
CAUTION: THE USE OF SPEED BRAKES AND FLAPS SIMULTANEOUSLY SHOULD BE USED WITH CAUTION WHEN APPROACHING MINIMUM MANEUVERING AIRSPEEDS.

APPROACH CHECKLIST

1. Lights On NFP
2. Seat Belt Sign On E

Seat Belt Sign should be turned on at 18,000 ft. At 10,000 ft. F/E will signal sterile cockpit by cycling smoking sign twice.

3. Auto Brake Landing Switch (If Installed) set C

Captain will call for switch setting and F/E will set the appropriate position.

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4. Air Conditioning Set E
- Standard procedures dictate landing MAX one pack on.
- Upper deck heat off. (If Installed)

5. Altimeters " / X-Checked C,F/E
- Barometric setting rechecked and stated by Captain / F/O. F/E will cross-check and note any discrepancy.
- The altimeter will be set to field pressure when approaching the transition level when descending and cleared through this altitude. Baro set display on TAWS should be set at this time.

6. NAV Radios Tuned, Ident NFP

7. CDI's C,F

- Course Selectors set to final approach runway heading, or crossing radials, or appropriate combinations of the above, to accomplish approach to be flown.

8. Radio / GPS Switch Radio C,F

- GPS No. 1: Nav Page 1
- GPS No. 2: Nav Page 1
- GPS No. 3: Nav Page 3

9. VOR / ADF Selectors C,F

RMI presentation selectors positioned as required to the VOR or ADF positions as appropriate for the approach to be flown.

10. Flight Instruments No Flags C,F

- No flags in view in the flight instruments.

NOTE: G/S Fig will be visible on Back Course.

11. Approach Check Complete E

NOTE: Approximately 3 minutes prior to landing F/E will make PA announcement: "Grooms prepare for landing".

BEFORE LANDING

Flying Pilot will call for Before Landing Checklist when gear lever is moved to the down position. After passing the final approach fix, the Non-Flying Pilot will set the altitude alerter to the missed approach altitude.

FINAL FLARE / TOUCHDOWN

The Flight Engineer will state "50 feet" at 50 radio altitude which signals the FP to begin the flare maneuver. The Flight Engineer will state "40 feet" at 40 radio altitude and "30 feet" at 30 radio altitude to signal the FP to close the thrust levers. The Flight Engineer will state "20 feet, 10 feet" at those respective radio altitudes.
NOTE: If GPWS audio callouts operative, F/E altitude call outs are not required.
Landing flare should normally involve only a 1* to 2* increase in deck angle held on glideslope during final approach. Avoid trimming stabilizer during flare; avoid holding it off and allowing airspeed to decrease appreciably below VREF. Doing so not only increases runway requirement but may result in aft body contact with runway.
The Flight Engineer will call, 'SPOILERS EXTENDED" when they have extended and will call "REVERSE AVAILABLE" when all operative engine's Full Reverse or Reverser Operating lights illuminate. If any engine does not reverse, the Flight Engineer will call "NO REVERSE # – ENGINE". If the spoilers do not automatically extend, the Flight Engineer will call "NO SPOILERS" and the Captain will manually extend them.

REVERSING PROCEDURE

Reversing should be initiated as soon as possible after landing.
As the speed brakes are extended, raise all reverse thrust levers to the interlocks and apply light pressure while lowering the nose gear onto the runway.

JT9D

When the reverser interlocks release, apply reverse thrust not to exceed 70% N1. After confirming all four FULL REV or Reverser Operating lights ON, the FE will monitor EGT and N1 as required to ensure 70% is not exceeded, and that Max Continuous EGT is not exceeded.
Once the maximum reverse thrust judged necessary has been applied, maintain that setting until reaching 100 knots. At 100 knots, start coming out of reverse by advancing the reverse thrust levers forward in order to be in reverse idle by 80 knots and out of reverse by 60 knots. If confronted with adverse runway conditions, requiring a longer reverse cycle, a maximum of 55% N1 may be used down to runway turn-off speed.

CF6

When the reverser interlocks release, symmetrical reverse thrust may be used up to 95% N1. Maximum reverse thrust may be maintained until 60 knots if required for stopping performance on short, wet or slippery runways. At 60 knots smoothly reduce reverse thrust to 85% N1 and maintain until a safe stop is assured.
NOTE: Engine power is automatically limited in reverse thrust to 100% N1 (CF6)
NOTE: In an emergency, maximum reverse thrust may be used to a full stop. (CF6)

EGT shall be monitored throughout the entire reversing cycle to verify normal EGT decay with return to idle power. The Non-Flying Pilot will call out 100, 80, and 60 knots. The Flight Engineer will monitor the reverse unlock lights and will call out,
"REVERSER LIGHTS OUT", when all operative engines are out of reverse. The FE will call GPS Ground Speeds during rollout deceleration to assist the Captain for turn-off planning (i.e. 50, 40, 30, 20, 10 knots). At 25 knots, the FE will state, "Body Gear Steering" to serve as a reminder to the Captain to command the FE to, "Arm the Body Gear Steering", if needed. The FE will continue to monitor EGT with his hand near the Start Levers after un-reversing during rollout.
During and after reversing it is important that the FE not divert his attention from engine monitoring until after landing turns for taxi-in have been completed and engines have stabilized. When the FE finally must divert his attention to his panel to perform the After Landing checklist, the FE will advise the FO and the FO will assume primary responsibility for monitoring. When at his panel, the FE should monitor N2. If N2 begins to decay, the FE should immediately return his attention to the EGT gauges, as a decaying N2 may be the first indication of an impending overtemp.
Should any EGT show an abnormal rise that clearly indicates an impending overtemp, the FE will promptly call out, "No._____ overtemp" and move Start Lever to CUTOFF, subject to the following:
1. FE is authorized to shutdown an engine on the ground for this specific cause without waiting for Captain's command. EXCEPT if more than idle reverse thrust is still being applied and such immediate shutdown might create or aggravate an airplane directional control problem due to wind, weather and/or runway surface conditions, then the FE shall wait for the Captain's command. In any event, an

immediate shutdown is vitally important to prevent damage; even a few seconds delay can significantly increase heat damage.
2. As soon as possible after engine shutdown, the FE should motor the engine with the starter, and continue this procedure until the engine temperature is less then 100°C EGT (JT9D engines). The starter should NOT be engaged until N2 is less than 20%.

NOTE: The Flight Engineer should record peak EGT and the duration of the overtemp in seconds / minutes.
If an engine fails to return to forward thrust, procedures should be followed to return that engine to forward thrust or consideration given to shutting it down as applicable.
If an engine is shutdown, check that hydraulic pressure is available for braking.

CAUTION: DO NOT CHANGE DIRECTION OF REVERSE LEVER UNTIL REVERSER HAS COMPLETED ITS STROKE (REV UNLOCK TO FULL REV OR FULL REV BACK TO FORWARD THRUST) AS THIS CAN SEVERELY DAMAGE FAN THRUST REVERSER PNEUMATIC DRIVE UNTIS.
Overtemps during reversing can occur on any engine. However, engines that exhibit extremely slow acceleration after light off during start or sluggish response to throttle movement may be more susceptible.

BRAKING TECHNIQUE

To obtain optimum results from the 747 Anti-Skid system, the following procedures are recommended:

- Use Auto Brakes. Medium setting is recommended. If in the judgement of the crew, conditions dictate medium is not required, i.e. long dry runway, light winds, or low aircraft landing weight, select minimum, but Auto Brakes use is still recommended.
- Without Auto-Braking, immediately after main gear touchdown, apply brakes smoothly and symmetrically with moderate-to-firm pedal pressure.
- Do not release brake pedal pressure until the airplane speed has been reduced to a safe taxi speed.
- If brakes have been released, release them full; re-apply them early when approaching the runway turn-off point and hold steady brake pedal pressure until the desired speed is achieved.
- Conditions permitting, use the full length of the runway, do not try to make the high speed taxi ways.

WARNING: IF A DIRECTIONAL CONTROL SITUATION ARISES, THE CAPTAIN MUST ASSUME CONTROL OF THE AIRCRAFT.

BEFORE LANDING FLOW (FE)

The Before Landing Flow will be accomplished at gear down.
1. FUEL PANEL SET FOR LANDING
2. LANDING GEAR ANNUNCIATOR CHECKED

3. ANTI-SKID ANNUNCIATOR LIGHTS EXTINGUISHED
4. HYDRAULIC PRESSURES NORMAL
5. PRESSURIZATION DIFFERENTIAL APPROACHING ZERO
6. ELECTRICAL SYSTEM ALL BUSSES POWERED
7. NO SMOKING SIGN ON
8. BRAKE PRESSURE NORMAL
9. ANNUNCIATOR PANEL CHECKED

BEFORE LANDING CHECKLIST

1. Landing Gear / Tilt Down, Gm / Tilt Ckd NFP/E

- On command from the Flying Pilot, the NFP will place the Landing Gear

Lever down and check Gear Down Green lights and no Red lights are illuminated, when gear is down and locked.

- The FE will check the Landing Gear Annunciator Panel for proper Tilt

indications. If any TILT light is illuminated, PRIMARY or ALTERNATE, DO NOT ARM SPEED BRAKE.

- Ground Safety Relay ON light – Extinguished

NOTE: If the GRD SAF RELAY ON light illuminated, accomplish the GRD SAF RELAY ON light illuminated procedure in the Abnormal Procedures chapter.

2. No Smoking Sign On E
3. Speed Brake Handle Armed C

After the FE reports that "TILT CHECKED", position the Speed Brake Handle to ARM and observe the Auto Spoiler light on the Master Annunciator panel remains extinguished. The Speed Brakes will automatically extend when the aircraft is on the ground with thrust levers retarded to IDLE.

4. Anti-Skid On, Lts Checked E

- The FE will ensure the anti-skid switch is in the ON position.
- The FE will check the anti-skid annunciator panel for any illuminated lights.

If two or more lights are illuminated, accomplish the Anti-Skid light illuminated procedure, Abnormal Procedures chapter.

5. Brakes, Hyd System Normal E

- Brake LOW Press light – Extinguished
- Hydraulic Temperature, Pressure, and Quantity Indicators – In Green Band
- Brake Pressure Indicator – In Green Band

6. Fuel System Set E

- All Main Tank Pumps ON. Observe fuel pressure lights extinguished.
- No. 1 and 4 Cross-Feed Valves OPEN, 2 & 3 Cross-Feed Valves CLOSED.
- Fuel Heat Switches OFF (If Installed).

7. Annunciator Panels Checked E

Check that no amber lights are illuminated on the pilot's and FE's annunciator panels.

8. Flaps NFP

- On the Flying Pilot's command and observing the flap placard speeds, the

NFP will move the Wing Flap Handle to the commanded positions.

- Once landing flaps have been selected, NFP will state landing flaps setting

FE will verify flap handle position, INBD and OUTBD flap position indicators, and LED position lights, FWD and AFT are in agreement with selected flap position.
9. Before Landing Check Complete E

BEFORE LANDING CHECKLIST

LANDING FLOW (FE)
Call outs on Final — Starting at 50 feet Radio Altitude:
"50"
"40"
"30"
"20"
"10"
"Spoilers Extended" or "No Spoilers"
"Reversers Available" or "No Reverse No.
"N1, 60%, 65%, 70%," etc.
"Auto Brakes OFF" (If Applicable)
"50 knots"
"40 knots"
"30 knots"
"Body Gear Steering" (Arm on Captain's command)
"20 knots"
"Reverser Lights Out" or as appropriate

QUICK RETURN CHECKLIST

(Flight Engineer Reads)
This checklist will be used in lieu of the After Takeoff, Descent, and Approach Checklists, when a missed approach has been executed, and/or an immediate return for another approach or landing is anticipated. This checklist may also be used if it has been determined that the aircraft will remain below 18,000 feet and in the Captain's opinion the QUICK RETURN CHECKLIST is appropriate. When final flaps are reached, if the situation requires, perform Quick Return Check down to the line, accomplish appropriate emergency or abnormal check from the top, and then return to Quick Return Check and continue with items below the line.
1. Landing Gear Up, Off, Lts Out NFP
Observe all landing gear lights are extinguished, then move the handle to Off.
2. Flaps Lts Ckd NFP/E
- NFP will state flap position.
- F/E will verify flap handle position INBD and OUTBD flap position indicators, and LED position lights, FWD and AFT are in agreement with selected flap position.

3. Speed Brake Handle Fwd Detent C
Check speed brake handle to be in full forward position.
4. Ignition On E
5. Approach Brief Understood NFP,E

• Flying Pilot will ensure that NFP and F/E are briefed about aspects of descent and approach. (See Briefings, this Chapter).

6. AIRSPEED, N1 / EPR Bugs Set C,F,E

• Set Airspeed and N1/EPR bugs to the appropriate numbers as indicated on the Takeoff and Landing data card.

• The bugs on the Captain's and F/O's airspeed indicators should be set:

• Lowest white perimeter bug set at VREF.

• Command bug set at VREF +5 or higher additive for wind (1/2 steady wind plus gust factor, not to exceed 20 knots total).

• Remaining bugs set for the various flap maneuvering speeds.

• EPR bugs should be set to Go-Around EPR (JT9D).

• Select GA on the N1 LIM MODE selector. Check that the selected mode appears in the MODE window and N1 bugs go to Go-Around N1 (CF6).

7. Altimeters " / X-Checked C,F/E

Barometric setting rechecked and stated by Captain / F/O. HE will cross-check and note any discrepancy.

8. Navigation Radios Tuned, Ident NFP

9. CDI's C,F

Course Selectors set to final approach runway heading or crossing radials or appropriate combination of the above, to accomplish the approach to be flown.

10. Radio /GPS Switch Radio C,F

• GPS No. 1: Nav Page 1

• GPS No. 2: Nav Page 1

• GPS No. 3: Nav Page 3

11. VOR / ADF Selectors / — C,F

RMI presentation selectors positioned as require(Tt—o the 'VOR or ADF positions as appropriate for the approach to be flown.

12. Flight Instruments No Flags C,F

• No unusual flags in view in the flight instruments.

13. Air Cond, Press Set E

• Set cabin altitude selector to destination field elevation.

• Max one pack operating.

14. Auto Brake Landing Switch (If Installed) Set C

Captain will call for switch setting and F/E will set the appropriate position

15. Quick Return Check Complete E

GO-AROUND PROCEDURE

The Non-Flying Pilot will be extremely busy.

1. POWER GO AROUND

Apply maximum go-around power.

2. GO-AROUND SWITCH .. PRESS

After GO ARND is armed, pressing either palm switch on 2 and 3 thrust levers will disengage the A/P and the Arr. The F/D will display commands of 12° pitch-up and wings level.

3. ROTATE GJO-AROUND ATTITUDE

Rotate to go-around attitude as thrust levers are advanced. Maintain at least approach speed.

4. FLAPS RETRACT

- The flying pilot calls for 'Max Power, Flaps 20°". The non-flying pilot makes flap selection and the F/E adjusts go-around power.
- Check engine instruments and flap position indication.
- Continue with flap retraction at proper altitude and flap retraction speed schedule.

5. LANDING GEAR

The NFP calls positive rate. The FP verifies positive rate and calls for "Gear up". The NFP places gear lever up and checks for normal gear retraction.

On command from the FP, the NFP will select heading mode and set the applicable heading for the missed approach. The NFP will tune and identify the necessary radios, select course on CDI, and if necessary arm the NAV for the FP.

The NFP will notify ATC of the miss and copy clearance.
In the case of a 3 Engine Approach and miss, the NFP will select the altitude hold at OCH. Thereafter, follow the 3 Engine procedure.

After the missed approach, use either the Quick Return or the After Takeoff checklist.
Flap speeds are:

VREF	Flaps 20	=	15° Bank
VREF + 20	Flaps 10	=	30° Bank
VREF + 40	Flaps 05	=	30° Bank
VREF + 60	Flaps 01	=	30° Bank
VREF + 80	Flaps UP	=	15° Bank
VREF + 100	Flaps UP	=	30° Bank

Example: At V+ 20 Flaps 10, Max Bank is 30°;
at VREF + 40 Flaps 05, Max Bank is now 30°.

AFTER LANDING

Captain will call for "Flaps up, After Landing Checklist" when aircraft has cleared active runway. This checklist will be accomplished using a "FLOW PATTERN" down to the "Engine Shutdown" step.

(1). BODY GEAR STEERING Armed E

When taxi speed is reached and upon the Captain's command, the F/E will move the BODY GEAR STEERING switch to ARM prior to executing a turn.

(2). AUTO BRAKE SWITCH OFF E

(3). SPEED BRAKE HANDLE FORWARD DETENT E

Captain places speed brake handle in forward detent position. F/E checks that spoiler indices move to the down position.

(4). FLAPS UP, LIGHTS OUT E

F/O places flap lever to flaps up position. F/E observes position indicators for proper indications of flaps up and LE Flaps annunciator lights are extinguished.
(5). LIGHTS SET FOR TAXI E
- All lights should be positioned as required for Taxi.
- Strobes - OFF.

(6). RADAR, TRANSPONDER STANDBY E
F/E places Radar and Transponder to standby.
(7). STAB TRIM SET 3 UNITS E
Verify F/O has set stab to 3 units.
(8). IGNITION OFF E
(9). WINDOW, PITOT HEAT OFF E

NOTE: Leave window heat "ON' during enroute stops and Quick Turnarounds when ambient temperature is below 40°F. (10). PRESSURIZATION CHECKED E
Confirm outflow valves open and aircraft depressurized.
(11). HYDRAULICS, BRAKES CHECKED E
- Captain moves the Reserve Brake Switch cover to the Unguarded position.

If any loss of braking effectiveness occurs, open the Reserve Brake Valve.
If still no braking action — turn Anti-Skid off.
- F/E monitors the Brake Pressure Gauge, Brake Temperature gauge is installed, Hydraulic Pressure and Quantity gauges, and verifies Captain has moved the Reserve Brake Switch Guard to open.
- F/O will monitor Brake Pressure.

(12). FWD & AFT CARGO HEAT OFF E
(13). FUEL SYSTEM SET E
- Turn boost pumps OFF to check engine first stage fuel pump.
- If respective engine flames out, first stage pump is inoperative.
- Reserve tank transfer valves CLOSED.

(14). APU START, CHECKED E
- Start the APU.
- Close the APU Generator Field Switches and push the AC meter selectors observing frequency and voltage within limits.

Do not close APU G.B. until aircraft comes to a complete stop at gate.
APU bleed must be ON if icing conditions exist.
(15). #2 & #3 ENG SHUTDOWN E
Engine shutdown is discretionary at the Captain's command.
NOTE: (JT9D) If more than 85% N2 was used for) 1 minute during approach and landing, the engines should be cooled for 5 minutes prior to shutdown.
(CF6) A three-minute cool down period should normally be allowed at or near ground idle prior to engine shutdown. Taxi time may be included as part of the three minute period.
With the following conditions met, it is standard procedure to taxi in with the No. 2 and No. 3 engines shutdown. Conditions:
No. 1 and No. 4 generators operating.
No. 2 ADP operating.
Body Gear Steering operable.
Max one pack on.

No sharp turns anticipated.
Prior to shutting down an engine, close the bleed air switch and turn off the engine anti-ice.
NOTE: Additional consideration should be given to ramp and taxiway conditions (i.e. snow, ice, slope).
NOTE: Under certain circumstances, the Captain may elect to shutdown engines #1 and/or #4 for extremely narrow taxiways or to prevent foreign object damage.
With the following conditions met and at the Captain's discretion, #1 and/or #4 engines may be shutdown for taxi-in only:
Runway cleared and flaps retracted.
#2 and #3 generators operating.
#1 and #4 ADP's to continuous and operating.
Body gear steering operable.
Max one air conditioning pack ON.
No sharp turns anticipated.
16. AFTER LANDING CHECK COMPLETE E
NOTE: As aircraft comes to final stop at ramp, FO will make PA announcement: "GROOMS PREPARE FOR ARRIVAL".

2 ENGINE TAXI-IN

When feasible and when executed under favorable conditions, less than four engines taxi-in will facilitate brake cooling and fuel savings.

JT9D ENGINE SHUTDOWNS – NORMAL AND PRECAUTIONARY

A cooling period on the JT9D Engine is essential after high power operation. If the engine is not allowed to cool at idle power prior to shutdown, the heat and lack of cooling air flow can cause the N1 turbine seals to lock up (frozen N1). When this condition occurs, the turbine will later free itself after cooling: however, this period can be as long as three hours. Therefore, prevention of the problem in accordance with the following procedure is important. The importance of proper monitoring of all indications of a satisfactory engine shutdown, especially an immediate decrease in fuel flow cannot be over emphasized. Even though a satisfactory engine shutdown was observed on the last flight, it is possible that some maintenance action might require positioning the start lever to other than CUTOFF position and that the condition actuator may fail to return to the cutoff position. If either an unsatisfactory shutdown goes undetected or a malfunction of the condition actuator has occurred during maintenance action, during the next start fuel will flow into the engine during early rotation, and a hot start and/or torching may occur. When an engine start lever is placed to the CUTOFF position, a condition motor on the fuel control unit should cutoff fuel within three seconds. Indication that the condition motor did in fact operate is an immediate decrease in fuel flow and a decrease in EGT or RPM. The engine start lever being moved to CUTOFF should also close the tank-to-engine shutoff valve, as indicated by the shutoff valve light going bright and then dim. If the condition motor on the fuel control unit fails and the tank shutoff valve closes, the engine will continue to run for approximately 40 seconds. This condition requires maintenance action prior to further engine operations. NOTE: When engine rotation has ceased after shutdown, EGT may increase due to heat soak.