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CHAPTER THREE
PROCEDURES AND TECHNIQUES

INTRODUCTION

This chapter of the Flight Crew Study and Training Guide explains each of the crew members’ duties throughout the flight. The sub-chapter breakdown is by preflight segments and then by phase of flight.

The flight engineer arrives at the aircraft early enough to complete the initial phases of the preflight before the pilots arrive. Beginning with Cockpit Preparation and all subsequent sub-chapters, deal with the full crew working in coordination.

Where appropriate, pictorial views have been used to assist in visualizing a maneuver, procedure, or flow pattern.

THE MATERIAL IN THIS PROCEDURES BOOKLET HAS BEEN PREPARED FOR USE BY THE LOCKHEED FLIGHT OPERATIONS TRAINING DEPARTMENT. WHERE A CONFLICT EXISTS BETWEEN THE MATERIAL IN THIS BOOKLET AND EITHER THE FAA/CAA APPROVED AIRPLANE FLIGHT MANUAL OR THE CUSTOMER’S CREW OPERATING MANUAL, THESE LATTER TWO BOOKS TAKE PRECEDENCE.
COCKPIT SAFETY INSPECTION

A cockpit safety inspection procedure is performed by the Flight Engineer on each originating trip or crew change, only when electrical and/or pneumatic power is not applied to the airplane, to ascertain that power may be applied safely.

1. Gear lever down.
2. Flap handle with flaps.
3. Fuel/Ignition switches OFF.
4. Speed brake handle forward.
5. ATM switches OFF.
6. AC hydraulic pump switches OFF.
APU AND AIR CONDITIONING STARTUP

Normally, when the aircraft is received by the flight crew, the external electrical power will be connected and the APU will be operating, providing air conditioning. Should it be necessary to start the APU, the flight engineer will use the following procedure:

If external power is not in use, but the green AVAIL light is illuminated, actuate the external power switch.

Note: If external power does not come on the airplane, turn the battery switch on. This will provide power to the GCU through the DC standby bus. Once external power is on the airplane, it will be able to power the GCU through the DC standby bus.

Prior to starting the APU, check the fire detection system for APU and engines.

1. Detector loop selectors . . . . . BOTH
2. Detector loop lights . . . . EXTINGUISHED
3. Press A & B Test buttons simultaneously and check:
   (a) Warning bell (press contact button to silence)
   (b) A and B loop lights illuminated
   (c) Master fire warning lights illuminated
   (d) Fire Pull handles illuminated
   (e) FIRE DET LOOP light on CAWP

APU START PROCEDURE

1. Select DC meter to BAT and AC meter to APU. Check that BATTERY CONDITION light is not illuminated.

2. Position the APU master power switch to ON.

   OBSERVE: Primary emergency shutoff fuel valve opens (monitor PRI emergency shutoff light). AUTO FIRE SHUTDOWN ARMED light illuminated.

3. If external AC power is available, turn on a #2 fuel tank pump.

4. Position the Bleed Air Mode selector to MIN MODE.

5. APU Bleed Air S/O switch unlatched and OPEN light extinguished.

6. Press the Start switch until the DOORS IN TRANSIT light illuminates

   OBSERVE: DOORS IN TRANSIT light cycle as the engine inlet and APU compartment ejector doors open.

7. Monitor the following:

   • DONT LOAD light and APU GEN OIL PRESS light (on electrical panel) illuminated after DOORS IN TRANSIT light extinguished.
- WHILE rpm and TGT are increasing, CHECK: BAT volts and amps. If either is low, monitor APU for an abnormal start.

- When rpm and TGT have stabilized in the green range, with the DONT LDAD light extinguished, CHECK: APU generator field flowbar illuminated, generator oil PRESS light extinguished, and generator volts and frequency are normal.

  Voltage = 117 ±2, frequency = 401 ±2 Hz.

- Check APU generator KW load. 81 KW max, but normal ground load is 40 – 50 KW.

- DC ammeter for normal battery charging.

Preparation for APU Air

1. Aft fuselage ISLN and both crossbleed valves latched in.

2. Pack Flow Control valve switches unlatched (closed). When Pack Flow Control valve switches 2 and 3 are unlatched, their hot air valves should be unlatched at the same time.

4. Ground control switch latched in and legend not illuminated.
5. Zone trim switches latched in and legend not illuminated.
6. Zone temperature controls to 12 o’clock position.

Accepting APU Air

7. Latch in APU Bleed Air S/O switch and observe the OPEN legend illumination.

8. Observe bleed air pressure on the engine duct pressure indicators.

9. Latch in the No. 2 pack flow control valve and its hot air valves.

10. Turn the APU Mode Selector to NORM.

CABIN PREFLIGHT INSPECTION

Normally, at this time while the aircraft is being heated or cooled and electrical power is applied, the cabin check would be accomplished, followed by the exterior inspection. For details on the external walk-around, see the Flight Crew Exterior Preflight Inspection Manual.

During the cabin preflight inspection, the flight engineer will use the flow pattern depicted below to check the items described on the following pages.

CABIN INSPECTION

CABIN PREFLIGHT SEQUENCE

1. Left Forward Lavatory: The lavatory is to be checked for general condition and required servicing.

2. Forward Service Center: Supplies and condition.

3. Cabin Attendants’ Area: CO₂ extinguisher, oxygen bottle, and radio beacon.
4. Left Forward Entry:
   a. Girth bar control . . . . ENGAGE
   b. Slide container . . . . . . . SECURE
   c. Slide inflation bottle pressure . . . . . . . CHECKED
      (Large doors = 3300 + 150 psi.
      Small exits = 3100 + 150 psi)
   d. Girth bar attach fittings . . CHECKED
   e. EVAC signals, aural & light . . . . . . . CHECKED
   f. Exit area emergency lighting . . . . . . . CHECKED

5. Overhead Stowage Cabinet: Megaphone and first aid kit.


7. Cabin Attendant Area: Water and CO₂ extinguishers.

8. Galley and MESC: (See flow pattern on next page.)
   a. Check left circuit breaker panel and oxygen supply.
   b. Check water quantity and pressure.
   c. Check galley for general condition.
   d. Check right circuit breaker panel.
   e. Check the battery condition and surrounding area.
   f. Check anti-skid in the FLIGHT position.

9. Left Center Entry: (Same as item 4.)

10. Check main landing gear downlock indicator, fuel caps, and wing upper surface for general condition.


12. Cabin Attendant Area: Oxygen supply.

13. Left Aft Entry: (Same as item 4.)


15. Left Emergency Exit: (Same as item 4.)

17. Aft Lavatory: Lighting, supplies, and condition.


19. Right Emergency Exit: (Same as item 4.)

20. Aft Lounge: Supplies and condition (or aft coffee bar).

21. Right Aft Entry: (Same as item 4.)

22. Cabin Attendant Area: Oxygen supply.

23. Check main landing gear downlock indicator, fuel caps, and wing upper surface for general condition.

24. Right Center Entry: (Same as item 4.)


27. Right Forward Entry: (Same as item 4.); Cabin Attendant Area: Water extinguisher.


29. Right Forward Lavatory: Lighting, supplies, and condition.

EXTerior PrElght

For details of this check, see the L-1011 Flight Crew Exterior Preflight Inspection Manual.

Preliminary Cckpit PrErparatin

Following the cabin and exterior inspections, the flight engineer proceeds to the flight station for the preliminary cockpit preparation.

A Preliminary Cockpit Preparation Procedure is performed by the flight engineer on an originating flight to actuate those components necessary to permit accomplishment of the Cockpit Preparation Procedure by the full crew. Included are the special tests required to ascertain system status for those systems controlled from the flight engineer’s station.

EQUIPMENT CHECK

Flight Engineer’s Area

Check the following:

- Check main oxygen on and pressure check (1500 psi minimum).
- Desk equipment
- Normal, Emergency, and Abnormal checklists
- Spare bulb supply

Coat Compartment Area

Check the following:

- First aid kit
- Door crank (BA)

Observers’ Stations

Check the following:

- CO₂ bottle
- Fire extinguisher
- Hand ax secured
- Portable oxygen bottle, mask attached, pressure normal
- FAA Manual stowed in case provided
- Escape hatch closed, locked
- Inertia reel handles secured
- Rain repellent, liquid level, and pressure
1. CAPTAIN'S SEAT
2. FIRST OFFICER’S SEAT
3. FLIGHT ENGINEER’S SEAT
4. FIRST OBSERVER'S SEAT
5. SECOND OBSERVER’S SEAT
6. PILOTS' CENTER CONSOLE
7. FLIGHT ENGINEER’S CONSOLE
8. RUDDER PEDAL ASSEMBLY
9. FORWARD ELECTRONICS COMPARTMENT ACCESS
10. FLIGHT CREW OXYGEN SUPPLY
11. STOWAGE FOR JACKETS
12. STOWAGE FOR HATS AND COATS
All Flight Crew Stations

During the preflight at each flight crew station, check the following:

- Smoke goggles
- Seat belt
- Shoulder harness
- Microphone
- Headset
- Life vest
- Oxygen mask, in place

Pilots' Overhead Panel

Note: Panels not specifically tested will be inspected for general condition.

1. Moving to the pilots’ overhead panel and using the flow pattern, first set the #1 INS ADU to the aircraft’s location (LAT & LONG).

2. Check that the Fire Pull handles are in and fire bottle discharge lights extinguished.
3. Set LAT and LONG in unit #2 INS ADU as required.

4. Latch in the Warning Caution and Advisory Test lights switch and check all lights.

   During the WARNING CAUTION and ADVISORY light test, most of the lights on the overhead and forward panels will illuminate. Note that the following lights will not test with the Test switch:

   - Fire Pull handles
   - Light marker beacon lights (6)

5. After testing, unlatch Test switch.


7. Continue flow pattern. If any FAIL lights are illuminated (except YAW SAS and the RUDDER LIMITER HYDRAULIC limiter PUSH light, when there is no hydraulic power available), cycle the switch slowly to extinguish the light.

8. With Anti-Skid control switch latched in, press NORM Test switch and observe eight amber lights illuminated. Repeat with ALT Test switch.

9. Continuing the flow pattern across the eyebrow panel, close the guard on the Emergency Lighting switch. This places the switch in the ARMED position.

   Confirm the emergency light in the flight station ceiling, next to the emergency exit, is extinguished. If not, cycle the switch to OFF and back to the ARMED position. This will extinguish the lights and rearm the system.

**EMERGENCY LIGHT LOCATION AND SWITCH**
Pilots’ Forward and Center Instrument Panels and Pedestal

The flight engineer should perform a limited check of the captain’s and copilot’s flight instruments, checking specifically that Fail flags are not in view.

If fail flags appear in any of these instruments, check the CB and, if necessary, Maintenance should be advised as soon as possible to minimize delays.

Check overspeed indicators on the center instrument panel and $N_2$ indicators on the F/E’s panel.

1. Press the MAX IND Reset switch.

   CHECK:
   Max TGT indicator lights extinguish and $N_1$, $N_2$, $N_3$, overspeed pointers are reset.

2. Check that all engine instruments indicate normally for existing conditions.

3. Erect the standby horizon by pulling the caging knob.

   CHECK:
   Off flag out of view and horizon erected.

4. Open flight engineer’s foot rest cover and check that:
   - Reverser, Alternate Gear Extension and Fuel Control Amplifier Test switches are guarded.

5. Check all circuit breakers are in the desired positions. (Normally, all are closed except for those noted in the maintenance log, placarded inoperative, or intentionally deactivated.)
PILOTS' FORWARD AND CENTER INSTRUMENT PANELS AND PEDESTAL
FLIGHT ENGINEER'S PANELS

Check Flight Engineer's Oxygen Mask and Regulator.

To verify oxygen is on, turn control to EMERGENCY; note indication of continuous flow. Reposition control to NORMAL.

Don mask and check for proper fit.

Select 100% OXYGEN and check that oxygen is available on demand.

Check O₂ mask microphone by selecting OXY on MIC selection panel and pressing PTT (Push To Talk) switch and checking output in headset and speakers.

MASK MOUNTED REGULATOR

PRESSURE CONTROLS
NORMAL — Selects oxygen on demand basis at low pressure.
EMERGENCY — Supplies continuous flow of oxygen at positive pressure.

DILUTER CONTROL HEAD TRIGGER
Pressing trigger releases a spring that forces diluter control head to rotate control head to rotate counterclockwise to the 100 percent oxygen position. Diluter control head must be manually rotated clockwise against the spring force until the trigger cocks and holds the control head in the DILUTE position.

DILUTER CONTROL HEAD
Permits selection of diluted or 100 percent oxygen flow regardless of cabin altitude.
Test the F/E Panel WARNING/CAUTION/ADVISORY Lights.

Check the lights, using the flow pattern.

All lights will test with the Warning/Caution advisory Test switch except:

- Engine and fire detection loop lights.
- APU Fire Pull handle will only test with the fire detection test.
- With the APU Master Power switch OFF, the APU generator field lights and APU GEN OIL OVHT PRESS lights, and on the APU panel, the Auto Shutdown flags. With the Master Power switch on, they will test and you will be able to reset the Auto Shutdown flags.

Brake Temperature Indicator

With any one selector switch latched in, press the Test switch and observe the temperature indicators. They should increase 100 degrees above existing brake temperature. Release that selector switch and repeat with each of the other switches.

Wheelwell Fire Detection

1. A and B loop lights should be extinguished.
2. Loop selector in BOTH position.
3. Press both A and B Test buttons simultaneously.
WHEEL WELL FIRE TEST

ENGINE TURBINE COOLING AIR OVERHEAT TEST
4. Press the Bell Cutout button.

CHECK:

Bell silenced.

A and B loop lights illuminated.

(2) Master FIRE warning lights illuminated.
(1) WHEEL WELL FIRE light on the CAWP illuminated.

Pressing both Test switches will give the full warning. Pressing a single Test switch, with the loop selector in BOTH, will only illuminate the WHEEL WELL FIRE light on the CAWP.

Engine Turbine Cooling Air Overheat Test

1. Press Test switch A.

CHECK:

OVHT lights on test panel and TURB AIR OVHT on CAWP not illuminated, then release Test switch A.

2. Press Test switch B.

CHECK:

OVHT lights on test panel and TURB AIR OVHT on CAWP not illuminated, then release Test switch B.

If any warning indications are observed, it indicates a fault in the system.

3. Press both the A and B Test switches simultaneously.

CHECK:

TURB AIR OVHT ENG 1, ENG 2, and ENG 3 on CAWP, and the three OVHT lights on test panel are illuminated. (On British Airways, the Fuel and Ignition switch barrier will be illuminated.) Then release the Test switches.

Pressing either A or B Test switch individually should give no warning. Pressing both A and B Test switches simultaneously should give the full warning.

Nacelle/Pylon Overheat Detection Test

1. Place loop selectors to BOTH position.

2. Check all (6) loop lights are extinguished.
3. Press the Test switch.

CHECK:
- All (6) loop lights illuminated.
- All (3) amber NACELLE OVHT lights on the CAWP illuminate.

4. Release Test switch.

**Engine and APU Fire Detector Test**

1. Detector loop selectors to BOTH.

2. Check all (8) fire detection loop lights are extinguished.

3. A and B Test buttons — press simultaneously.

4. Press the Bell Cutout button.

CHECK:
- All A and B loop lights (8) illuminate.
- Master FIRE warning lights (2) illuminate.
- FIRE DET LOOP annunciator light (on CAWP) illuminates.
- Indicator lights at Fuel and Ignition switches (if installed).
- Fire Pull handles (4) illuminate.

5. Release A and B Test buttons.

Fire Extinguisher Test

Check all lights (8) MAIN and ALTN extinguished.

Part 1:

1. Press the Test switch.

   CHECK:

   All MAIN and ALTN (8) lights illuminated. This indicates circuit continuity through the squibs. If a light does not illuminate, it indicates an open circuit to the squib.

Part 2:

2. While pressing the Test switch, also press the Short switch.
CHECK:

All (8) MAIN and ALTN lights extinguish.

If a light remains illuminated, it indicates a short in the circuit, and a fire bottle squib may not work when energized.

Pressing Test illuminates all 8 lights. Pressing Test and Short, all 8 lights should extinguish.

Hydraulic Panel

- Fluid level — minimum $\frac{3}{4}$ full.

- The suction shutoff flowbars illuminated (if installed) and the engine driven PUMP S/O flowbars illuminated.

- The only amber lights that should be illuminated are the four engine driven PUMP OUTPUT LO PR lights.

- Start B3 and C3 electric pumps and PTU’s to charge hydraulic pump accumulators. Pumps off.

Electrical Panel

- If external power is available, it should be used. If not, use the APU.

- IDG temp and power meter should reflect ambient or residual temperatures and zero load.

- With APU power, the only flowbars illuminated will be the APU generator field and generator breaker, and the (3) bus tie breakers.

- The only amber lights illuminated will be the (3) engine driven IDG Disconnect Low PRESS switches and the OPEN lights for each generator field and breaker. All other lights will be extinguished.

- The essential selector should be in NORM B3-(G1).
The schematic patterns on the system panels start at the source and flow schematically to the area of use. For example, from the fuel tank to the engine, or from the generator to the bus. The scan flow pattern follows this plan through all the systems.

The closed loop allows the FE to start the scan flow at any point and then make one complete scan back to the originating point. This allows great flexibility and complete panel coverage.
• Battery switch ON.

• With the DC Meter selector, check all DC sources. Indications will be bus voltage and respective T/R amperage. All amperages should be equal. Battery should be pulsecharging. Return selector to the essential transformer rectifier (ESS).

• Place the AC selector to the engine to be started.

Fuel Panel

• Verify refueling is complete and the REFUEL POWER ON switch legend is extinguished.

• Test the fuel quantity system. Check that fuel quantity indicators and digital readouts drive toward FULL, 2L and 2R INBD LOW quantity lights illuminate, and FUEL SYSTEM annunciator light on the CAWP is illuminated.

• Latch in one pump switch on 2L or 2R tank, and open all three crossfeed valves. This provides full pressure to all engines in preparation for start.

• All amber lights should be extinguished, and all tank valve and crossfeed valve switchlight flowbars illuminated, as well as one tank pump switch flowbar in 2L or 2R tank.

Fuel Control Amplifier

• Switches should be unlatched and OVRD legend extinguished.

Engine Fuel Used

• Turn the test knob on each indicator and observe the fuel flow indicators drive to 10,000 pph, and the Fuel Used indicator increases at that rate. Fuel Used indicators are then reset to zero by the switch on the fuel panel.

Engine Oil

• FILTER PRESSURE lights extinguished.

• Test the pressure gauges with the PRESS IND Test switch. Oil pressure indicators should go to 9 o'clock position.

• The (3) three oil temperature gauges should indicate approximately the same, depending on time since engine shutdown.

• Oil quantity should be adequate for the flight (normally 15 – 20 US quarts).

Engine Status Panel

• Airborne Vibration Monitor: With the selector switch in NORM, test the vibration monitor by first latching in the Fan switch and pressing the Test switch. Then unlatch the Fan switch and latch in the TURB switch. This checks Airborne Vibration Monitor (AVM) system and indicators. Indicator pointers should drive to approximately 4 units. The vibration caution lights (in each indicator) should illuminate at 2½ units, and the ENG/APU STATUS annunciator on the master caution/warning panel should illuminate. Unlatch TURB switch.

• Check N₂ indicators at zero and overspeed pointers at 100%.

• Reverser pressure lights should be extinguished.
Clock
- Set the clock to the correct time.

APU
- Check APU for normal operation. NG and TGT indicators in the green band.

Flight Recorder
- Set day, month, flight No., and leg; then insert by pressing DDI Insert button.

Weight and Balance
- Turn on power by pressing the Power switch. The ON light should illuminate.
- Test the lights by pressing the Test switch. All lights should illuminate with four (4) eights in the indicators window. Releasing the Test switch will cause the display windows to display $100.0 \pm 1.0$. This confirms the integrity of the weight and balance computer.

Note: The weight and balance computer cannot be used for dispatch at this time. It is only used to cross check the loading sheet.

Rated EPR Mode Panel
- Set the current runway temperature with the thumbwheel and press TO-1 or TO-2.
- Compare this data to the computed data to verify the integrity of the TAT/EPR computer, which may then be used for climb, cruise, and go-around.

Waste Water Panel
- All lights extinguished and drain mast heater switches latched in.

Humidity Control
- The humidity control is used, as necessary, to remove moisture from the air. Normally ON, except in cold or very dry climates.

Oxygen Panel
- Confirm the green OXYGEN FLOW light is extinguished and the deployment switch is guarded and safetied.

Annunciator Panel
- Check for abnormal indication.

Aural Warning Panel
- Test each aural warning.
Note: When testing CAB PRESS, use Horn Cutout switch on cabin pressurization panel to silence the horn.

During the Unsafe Takeoff switch, observe whether the three cargo door UNLOCK lights illuminate if doors are closed.

During the Flaps LRS test, hold the test button until aural warning terminates automatically, approximately 2 seconds.

Slat Monitor Panel

- Confirm slat gauge Off flag is not in view, and the lock switchlight is unlatched and LOCK lights extinguished.

- Latch in the slat monitor switch. ON light should illuminate. If the slats are extended, the green slat segment monitor lights should be illuminated.

Engine Bleed Control Panel

- All HI PRESS and ENG ISLN Valve switches latched in.

- All crossbleed valves open.

Test the Area OVHT System

Place the loop selector in the “A” position and press the Test button. There should be a total of 10 lights illuminated:

- 7 AREA OVHT lights on the ECS panel

- 2 DUCT FAIL lights on the Wing Anti-ice panel

- 1 AREA/DUCT OVHT on the CAWP.

Repeat test on “B” loop and then return the selector switch to BOTH if both of the loops check out. Should one fail the integrity check, leave selector on the other loop.

ECS Monitor Panel

- The cargo heat switches should be latched in and COLD and HOT lights normally will be extinguished.

Note: The only lights illuminated will be the AVIONIC AIR OVBD lights.

- Cabin and pack status are checked at this time and cabin temperature adjusted if required.

Cabin Pressurization Check

- Set the Mode Selector to NORM. The Norm Rate selector to the index and the Stby Rate selector to HOLD.

- Latch in both Manual switches and toggle outflow valves toward closed. Unlatch the Manual switches and observe that both outflow valves drive to fully open position.

- Set the anticipated cruise altitude with the Altitude Set knob.

- Set QNH (current altimeter setting) in both the Baro Set window and the cabin altimeter.
CABIN PRESSURIZATION CHECK

CABIN PRESSURE CONTROL

PACK FLOW
PACK SELECT
ECS

ECS MONITOR

FLIGHT CREW STUDY
AND TRAINING GUIDE
- Check that Cabin Alt/Diff Press gauges indicate field elevation and zero differential.
- Cabin rate of climb indicator at zero.
- Safety valve lights extinguished.

**COCKPIT PREPARATION**

The Cockpit Preparation Procedure is performed by the three crew members in final preparation for flight to prepare the panels and related components prior to initiating the Before Start checklist.

**CAPTAIN**

1. Adjust seat, using the eye locator.

2. Oxygen mask and regulator check.
   Verify oxygen is on by turning control to EMERGENCY; note indication of continuous flow.
   Reposition control to NORMAL.
   Don mask and check for proper fit.
   Select 100% OXYGEN and check that oxygen is available on demand.
   Check O₂ mask microphone by selecting OXY on MIC Selection panel and pressing PTT switch on panel or on control wheel and checking output in headset and speakers. Verify that at least one cockpit speaker is operating.

3. Nosewheel steering wheel centered.

4. Washer fluid control knob OFF.

5. Adjust lights intensity on lighting control panel.

6. Check engine Fire Pull handles in.

7. INS ADU cross checked.

8. Position compass MAG/DG controller switches to MAG position. Verify SYNC index indicator needles are centered, indicating the directional gyros are at the magnetic heading. Verify that all compass cards are in agreement.

   **Note:** When jetway ramps or servicing equipment are parked in the vicinity of the wing tips, there may be significant errors in compass card indications.

   Compass indications should be rechecked while taxiing.

9. HF (if installed) set as required.

10. Test the warning/caution advisory lights.
    Use the flow pattern in checking the lights.

**COPILOT**

3. Washer fluid control knob OFF.

4. Adjust light intensity on lighting control panel.

5. Follow captain through scan pattern, verifying all items are correct.
11. Master Radio Panel
   - Confirm the master radio switches (Essential and No. 2) are latched in.

12. Wiper Panel
   - The wiper control knob should be in the OFF position.

13. Cabin Interphone Panel
    - No action required.

14. Engine Anti-Ice Panel
    - Confirm switches unlatched and legends extinguished.

15. Wing Anti-Ice Panel
    - Switches unlatched and legends extinguished.

16. Windshield Heat Panel
    - Side window switches latched in and legends extinguished. The CAPT and COP windshield switches unlatched (IDLE illuminated).
    - Test the system by pressing the test switch and observing all (6) FAULT lights cycling ON and OFF.
    - The defog fan switch should be unlatched and legend extinguished.

17. Air Data Sensor Heat
    - All switches unlatched. All OFF lights illuminated. In very cold weather it is advisable to turn the Alpha heat on at this time to ensure adequate warm-up time.

18. Evacuation Signal Panel
    - No action required; confirm guard is in position and red EVAC light is extinguished.
19. Center Console Flood Light Control
   • As required.

20. Mach Feel/Rudder Limiter Panel
   • Mach Feel switches latched in and legends extinguished.
   • Rudder limiter -- Confirm switches latched in, ± 30° light illuminated. Rudder limiter HYDRAULIC PUSH light will be illuminated if there is no hydraulic power.

21. Cockpit Voice Recorder
   • Test the system by pressing the Test switch and observing the indicator moving to the green range.

22. Engine Start Panel
   • Select the appropriate ignition system. Alternate starts on A and B ignition systems if selector switch is installed.
   • All switchlights unlatched and legends extinguished.

23. Instrument Standby Light Switch
   • Position the switch in the BRIGHT position.

24. Passenger Address Panel
   • No action required.

25. PFCS Panel
   • If no hydraulic power (4) stabilizer INOP lights illuminated, all other lights on the PFCS panel will be extinguished.

26. FCES Panel
   • Test stall warning by pressing the Test button (this tests the No. 2 channel); unlatch the number 2 channel and press the Test button (this tests the number 1 channel). Latch the No. 2 channel switch.
CAPTAIN

- If no hydraulic power, the (2) YAW SAS FAIL lights will be illuminated — all other lights will be extinguished.

27. Compass Panel

- MAG light illuminated and Sync index needle centered.

28. Anti-Skid Panel

- Test anti-skid systems. (Latch in On/Off switch.) Press NORM then ALT and observe all eight brake indication lights illuminate. The brake system selector switch on the center instrument panel must be in the NORM position to test either system.

29. Wiper Panel

- No action.

30. Exterior Lights Panel

- As required by time of day or night. Use wing flood and wheelwell lights for added safety on ground.

31. Emergency Lighting

- Guard closed, (this places the switch in the ARM position) UNARMED light extinguished. (Previously accomplished by F/E.)

- The captain should look at the flight station emergency light in the ceiling, next to the emergency exit, to confirm it is extinguished. If not, cycle the switch to the OFF position, then to ARM. This will extinguish the light and ream the system.

32. Standby Power Check

- Turn the Standby Power switch on and check the flowbar is illuminated.

- Have F/E select INVERTER on the AC selector and confirm inverter is operating.

- Have F/E select DC standby bus on the DC selector and confirm it is powered.
CAPTAIN

The voltmeter will indicate bus voltage, while the ammeter will indicate zero.

- Position the switch to the ARM position and close the guard.
- UNARMED light extinguished. (If UNARMED is illuminated, the battery switch is not in the ON position.)

33. Interior Light Panel

- Magnetic compass light, as desired.
- Seat Belt/No Smoking switch lights latched in (ON illuminated).
- Eye locator, thunderstorm, and panel lights, as required.

34. Clock Sweep Switch

- Check for operation.

35. Autoflight/Navigation Panel

- Test DME. (Observe the following on the RDDMI: DME flags, followed by four four dashes and then four zeros.) After test, return to STANDBY.
- Set frequency as desired.
- ATS – No action required.
- Confirm stabilizer trim is set to zero. Ask F/E for hydraulic power on A and B systems. Turn both Flight Directors on. Move AFCS engage lever “A” to command position. Engage heading and altitude pitch modes. Observe indication on both AFCS mode annunciators. Rotate HDG knob left then right and confirm that control wheel and Flight Directors follow. Press the TURB switch. Observe the engage lever drop to CWS. Check that the modes are disengaged and TURB is the only mode on the AFCS annunciators. Also, check that the Flight Directors bias out of view. The captain should check his ability to disengage the autopilot by pressing the autopilot Disengage switch on the control wheel. This procedure is

COPILLOT

- Test DME. (Observe the following on the RDDMI: DME flags, followed by four zeros.) After test, return to STANDBY.
- Set frequency as desired.
duplicated for autopilot B, except the

- NAV modes — no action required except course set as required.
- Test the altitude select panel by:
  a. Selecting an altitude approximately 1000 feet above field elevation.
  b. Air data source selector in the STBY position (copilot’s altitude input).
  c. Move the Altitude Select toward field elevation. At 750 feet above, the ALTITUDE alert light will illuminate. At 250 feet above, the ALTITUDE alert light will extinguish and the C-chord will sound.
  d. Move the air data source selector to the NORM position (captain’s altitude input).
  e. Increase the Altitude Select. At 250 feet, the ALTITUDE alert light will start flashing and the C-chord will sound.
  f. Set the desired initial altitude as desired.

36. During the instrument comparator and AFCS warning and mode tests, the captain will test both INSTRU Comparator Test 1 and Test 2 and then with the assistance of the copilot, they will both check VG3 by pressing both Test 1 switches simultaneously and observing the VG3 light on the CAWP. From that point on, the copilot will be one test behind the captain, as listed below. This will reduce the amount of time required to complete all tests.

Instrument Comparator and AFCS Warning and Modes Tests

- Press Instr Comparator Test 1, then Test 2
- Press Instr Comparator Test 1
- Press Instr Comparator Test 1
  observe VG3 light illuminated
- Press AFCS Warning Test 1
- Press AFCS Warning Test 2
- Press AFCS Mode Test 1
- Press AFCS Mode Test 2
- Press Instr Comparator Test 1
- Press Instr Comparator Test 2
- Press AFCS Warning Test 1
- Press AFCS Warning Test 2
37. Flight Instruments
   - Check clock.
   - Airspeed — Compare $V_{MO}$ and check indicator at 60.
   - ADI — Erect, no flags.
   - Radio altimeter at zero — No flags.
   - Compare altimeter indications and BARO set. No flags.
   - Test marker beacon lights.
   - Check RDDMI for Fail flags and set VOR or ADF as desired.
   - Check HSI for Fail flags and NAV system in use, as indicated at the bottom of the HSI.
   - Check vertical speed indication is zero.
   - Check that the instrument source selector switches are all unlatched and lights extinguished.
   - Check SPI for normal indications.

38. Center Instrument Panel
   - Check standby horizon is erect, with no flags.
   - TAT/EPR have no Fail flags.
   - Standby airspeed is 60 kts.
   - Standby altimeter has correct BARO set, cross check altimeters.
   - Check CAWP for normal indications. Check engine instruments for Fail flags and overspeed needles, then press the MAX IND Reset switch, if desired.
   - Check reverse lights extinguished.

   COPILOT
   - Press AFCS Mode Test 1
   - Press AFCS Mode Test 2
   - Check clock.
   - Airspeed — Compare $V_{MO}$ and check indicator at 60.
   - ADI — Erect, no flags.
   - Radio altimeter at zero — No flags.
   - Compare altimeter indications and BARO set. No flags.
   - Test marker beacon lights.
   - Check RDDMI for Fail flags and set VOR or ADF as desired.
   - Check HSI for Fail flags and NAV system in use, as indicated at the bottom of the HSI.
   - Check vertical speed indication is zero.
   - Check that the instrument source selector switches are all unlatched and lights extinguished.
CAPTAIN

- Check flap indicator for correct indication.
- Check gear handle down, 3 green lights.
- Brake pressure normal and selector in NORM SYS B position.

COPilot

39. Center Console

- EACS and Area Nav pictorial display as desired, if installed.
- CDU checked and set.
- Check pitch and roll Disconnect handles are normal.
- Stabilizer trim zero.
- Speed brake lever forward.
- Flap handle is with the flap indicator.
- Throttles closed, not in reverse.
- Fuel and Ignition switches OFF.
- LRS override switch is guarded and light extinguished.
- VHF COM set as required.
- Radar and transponder set to STBY.
- Roll and yaw trim set to zero.

40. ANS – ADU panels

- NAV engage

41. Flight engineer panels

- NAV engage
- After receiving load sheet, set gross weight in fuel panel.
- Note gross weight and C of G as shown on the ON Board WT and BAL system, and compare with load sheet.

READY FOR ENGINE START CHECKLIST !!!
CHECKLISTS

In general, the copilot will read all checklists when the aircraft is not in motion. When the aircraft is in motion, the F/E will read the checklists.

Most items on the checklist will, normally, have been previously completed; therefore, the normal checklist is used as confirmation that everything is completed. When responding, the crew member should observe the challenged item to confirm it is correct. The items on the Abnormal and Emergency checklists in the box will be immediate action items and all others will be secondary, clean up items, to be completed when read on the checklist.

ENGINE STARTING COMMUNICATION

Engine starts should be made with the captain and flight engineer in communication with ground personnel, by use of interphone. Ground personnel are instructed to clear the area prior to starts and report any malfunction during starts. It is necessary that ground personnel be advised as each engine is being started, so they may properly direct their attention. The copilot will maintain communications with the tower on appropriate ground control frequency and make the necessary transmissions for pushback. The copilot will assist in the start by monitoring and advising the captain of any abnormalities.

If interphone is not available, hand signals may be used. Visual contact between ground and flight station must be maintained throughout each engine start when using hand signals for starting.

BEFORE START CHECKLIST

*C MASTER RADIO SWITCHES ............................................. ON
CREW OXYGEN MASK & INTERPHONE ..................................... CHECKED, ON, 100%
C, E FIRE PULL HANDLES ............................................. IN
*C, E WARNING LIGHTS .................................................. CHECKED
*C OVERHEAD PANELS .................................................... CHECKED
*C, COP COMPASSES ..................................................... CHECKED
C ANTI-SKID ................................................................. CHECKED & OFF
C EXTERIOR LIGHTS ....................................................... CHECKED
*C EMERGENCY LIGHTING & STANDBY POWER ....................... CHECKED & ARMED
*C SEAT BELT/NO SMOKING ............................................... ON
C, COP AUTO FLIGHT SYSTEM ........................................... CHECKED & OFF
C, COP AFCS WARNING MODES & INST COMPARATOR .............. CHECKED
*C, COP FLIGHT INSTRUMENTS .......................................... CHECKED
*C, CREW ALTIMETERS & CLOCKS .................................... SET & CHECKED
<table>
<thead>
<tr>
<th>C, COP</th>
<th>INSTRUMENT SOURCE SELECTORS</th>
<th>NORMAL</th>
</tr>
</thead>
<tbody>
<tr>
<td>C, E</td>
<td>ENGINE INSTRUMENTS</td>
<td>CHECKED</td>
</tr>
<tr>
<td>*C, E</td>
<td>ANNUNCIATORS</td>
<td>CHECKED</td>
</tr>
<tr>
<td>C</td>
<td>LANDING GEAR</td>
<td>DOWN, 3 GREEN</td>
</tr>
<tr>
<td>*C</td>
<td>BRAKE SYSTEM &amp; PRESS</td>
<td>NORMAL</td>
</tr>
<tr>
<td>*C</td>
<td>PARKING BRAKE</td>
<td>SET</td>
</tr>
<tr>
<td>C</td>
<td>PITCH &amp; ROLL DISCONNECTS</td>
<td>NORMAL</td>
</tr>
<tr>
<td>C</td>
<td>SPEED BRAKE LEVER</td>
<td>FORWARD</td>
</tr>
<tr>
<td>C</td>
<td>FLAP LEVER</td>
<td>WITH INDICATOR</td>
</tr>
<tr>
<td>C</td>
<td>FLAP LRS OVERRIDE</td>
<td>NORMAL</td>
</tr>
<tr>
<td>C</td>
<td>THROTTLES</td>
<td>CLOSED</td>
</tr>
<tr>
<td>C</td>
<td>FUEL &amp; IGNITION</td>
<td>OFF</td>
</tr>
<tr>
<td>*C</td>
<td>RADIOS, RADAR, TRANSPONDER</td>
<td>SET, STANDBY</td>
</tr>
<tr>
<td>C</td>
<td>TRIM</td>
<td>CHECKED &amp; 0</td>
</tr>
<tr>
<td>E</td>
<td>MECHANICAL GEAR RELEASES</td>
<td>NORMAL</td>
</tr>
<tr>
<td>*E</td>
<td>CIRCUIT BREAKERS</td>
<td>CHECKED</td>
</tr>
<tr>
<td>E</td>
<td>FIRE PROTECTION PANELS</td>
<td>CHECKED &amp; SET</td>
</tr>
<tr>
<td>*E</td>
<td>HYDRAULIC PANEL</td>
<td>CHECKED</td>
</tr>
<tr>
<td>*E</td>
<td>ELECTRIC PANEL</td>
<td>CHECKED</td>
</tr>
<tr>
<td>*E</td>
<td>BATTERY SWITCH</td>
<td>ON</td>
</tr>
<tr>
<td>*E</td>
<td>FUEL QUANTITY</td>
<td>_____ LBS</td>
</tr>
<tr>
<td>*E</td>
<td>FUEL PANEL</td>
<td>CHECKED &amp; SET</td>
</tr>
<tr>
<td>E</td>
<td>FUEL JETTISON</td>
<td>NORMAL</td>
</tr>
<tr>
<td>E</td>
<td>FUEL CONTROL AMPLIFIERS</td>
<td>NORMAL</td>
</tr>
<tr>
<td>*E</td>
<td>ENGINE OIL QUANTITY</td>
<td>CHECKED</td>
</tr>
<tr>
<td>E</td>
<td>FLIGHT RECORDER</td>
<td>ON</td>
</tr>
<tr>
<td>*E</td>
<td>AURAL WARNING &amp; GALLEY SMOKE</td>
<td>CHECKED</td>
</tr>
</tbody>
</table>
FLIGHT CREW STUDY AND TRAINING GUIDE

E  SLAT MONITOR PANEL .................................. CHECKED
*E ECS PANEL ............................................. SET & CHECKED
E  GEAR PINS ................................................ 3 PINS OUT
*C ADU ........................................................... NAV ENGAGE

*E GROSS WEIGHT & CG ...................................... ___ LBS ___ %
*C ANTI-COLLISION LIGHT ................................... ON
*E PACK FLOW CONTROL VALVES ......................... 1 OPEN

*Asterisked items required BEFORE STARTING ENGINES at thru stations.

Any crewmember observing an abnormal start indication which requires abandoning the start will call out the specific problem. Abnormals not requiring the start to be abandoned will not be called out during the start. If indications are not normal during engine start, the start will be discontinued in the following manner:

ABANDONED STARTS

If a start is abandoned below 35% N3, due to high TGT, monitoring the engine may be continued until TGT has fallen to 200°C; the Fuel and Ignition switch may then be reselected ON, provided the starter has not disengaged and the starter duty cycle has not been exceeded.

If a start is abandoned above 35% N3, but below starter cutout, starter crash reengagement can be minimized by pushing the Ground Start Release switch immediately after selecting Fuel and Ignition OFF. The engine should be allowed to decrease to zero N3 before a further start is attempted.

If during an abandoned start, after selecting Fuel and Ignition off, the TGT exceeds 550°C before the valve open light goes out, continue to motor the engine until TGT reduces, then push the Ground Start Release switch. Record and report for maintenance action.

If TGT exceeds 550°C or fire occurs during engine shutdown after selecting Fuel and Ignition switch OFF, the starter may be reengaged up to 38% N3. Any reengagement must be recorded and reported. Reengagement above 20% N3 requires maintenance action before next flight.

USE OF FUEL ENRICHMENT FOR STARTING

The ENRICH function of the Fuel and Ignition switch was originally introduced to expedite engine starting in cold ambient temperatures. Testing and operational experiences have indicated that the use of fuel enrichment need not be restricted to "Cold Day" starts only, provided that appropriate precautions are observed to avoid exceeding the allowable starting TGT limit.

Some additional amplification on the use of ENRICH is provided below; the application of this information should result in better operating techniques, and more satisfactory and consistent engine starts.
• Engine residual TGT is an important factor in determining whether or not to use fuel enrichment during starting. Residual TGT is dependent upon the length of time the engine has been shut down, ambient temperature, and wind. If the residual TGT is above 100°C, starting temperature limits may be exceeded, even without the use of enrichment. To avoid this, delay placing the Fuel and Ignition switch to ON until residual TGT has decreased to below 100°C; do not select ENRICH unless the engine fails to accelerate satisfactorily after lightoff.

• If ENRICH is used and the TGT rise overtakes the N3 rise, or the rate of TGT increase indicates that the start limit of 550°C will be exceeded, the start should be abandoned. The subsequent start should be attempted without the use of ENRICH.

• If, during a start with the Fuel and Ignition switch selected to ON, the TGT and N3 are slow to increase, the Fuel and Ignition switch may be selected to ENRICH to improve response. At up to 35% N3, the switch may be cycled between ENRICH and ON. If ENRICH is selected between 35% N3 and starter cutout, hold ENRICH until the VALVE OPEN light goes out; do not release to ON within this rpm band. Between VALVE OPEN light out and Ground idle, the switch may be cycled between ENRICH and ON.

• The Fuel and Ignition switch must not be cycled between ENRICH and ON above 35% N3 while the VALVE OPEN light is on. This action can result in crash reengagement of the starter in the starter pawl disengage/reengage range.

APU SURGE PREVENTION

When setting up the pneumatics panel and APU for engine start, the flight engineer should place the APU mode selector to MIN MODE before turning packs #1 and #3 off. This prevents APU surge that might be caused by the sudden reduction in airflow while the APU is in NORM mode. Operate at least one ECS pack when ATM’s are on.

The normal start sequence will be two (2), one (1), and three (3). The start sequence is as follows: The first engine (normally #2) will be started by the APU. After that it is recommended that a crossbleed start be used to start engines 1 and 3. During the crossbleed start, all packs should be off, the APU bleed air S/O valve closed, and the flight engineer should monitor the duct pressure. If the duct pressure falls below minimum during the start, simply advance the power on the operating engine enough to recover the duct pressure. Normally, idle power provides adequate duct pressure. After number 1 engine is started, close the left crossbleed and start the number 1 air conditioning pack. This will provide cabin air for passenger comfort during the remainder of the start. If external AC power is used, position to OFF after second engine is started and IDGs are operating. The following is a review of the starting procedures.

APU STARTS

1. APU selected to MIN MODE.

2. Minimize APU generator load. (FOR EACH 10 KW REDUCTION IN GENERATOR LOAD, THE AVAILABLE STARTER TORQUE INCREASES BY ABOUT 4%.)

3. No. 2 ECS pack ON.

This will reduce surging of the APU load compressor. The added airflow closes the surge control valve fully, and all dumping ceases. However, if the manifold pressure is lowered by more than 2 PSIG, with the pack on, the resulting pressure may be insufficient for a proper engine start. In this case, the pack load should be turned off and the start continued, despite the fluctuations. If fuselage ISLN valve is not required for the start, closing it may increase available duct pressure.
4. Close all three engine HP air shutoff valves.

5. Turn on one fuel boost pump and open fuel crossfeed valves.

6. Turn off hydraulic pump(s) on engine to be started.

   **Note:** If start air manifold pressures are marginal, or if difficulty is experienced in starting, turning the hydraulic pumps OFF will reduce the starter loads. If the engine driven pumps have been turned off to facilitate starting the engine, use the AC motor driven pumps and a PTU (as required) to pressurize the hydraulic system after engine start and before turning on the engine driven hydraulic pump. (On aircraft incorporating hydraulic reservoir accumulators, it is only necessary to charge the accumulators prior to turning on the engine driven hydraulic pumps.)

7. Galley power — OFF (if start air manifold pressures are marginal)

8. Parking brakes set and accumulator pressure normal.

9. AC hydraulic pumps — OFF


11. Fuel and Ignition switch — At a minimum of 20% N3, select ON or ENRICH, as required.

12. When engine rpm stabilizes, engine driven hydraulic pump(s) — ON.

   Refer to note under item 6.

**FOR CROSSBLEED STARTS**

13. Close APU bleed air shutoff valve.

14. Open HP air valve on operating engine(s).

15. Open pneumatic crossbleed manifold valves as required.

16. Push Start switch and when start valve opens, if necessary, advance throttle on operating engine(s) to maintain required duct pressure. The minimum recommended duct pressure during starting is given below and is usually obtained at ground idle rpm.

**MINIMUM RECOMMENDED DUCT PRESSURE DURING STARTING**

<table>
<thead>
<tr>
<th>ALTITUDE (feet)</th>
<th>AMBIENT TEMPERATURE (°F)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>-60</td>
</tr>
<tr>
<td>0</td>
<td>36</td>
</tr>
<tr>
<td>4,000</td>
<td>—</td>
</tr>
<tr>
<td>8,000</td>
<td>—</td>
</tr>
</tbody>
</table>
Engine starts may be achieved at slightly lower pressures than those shown above, but such starts may be prolonged or N3 may stagnate. The starting time may also be prolonged due to hydraulic pump and IDG loading. If the above duct pressure cannot be maintained, it is recommended that crossbleed starting be used for subsequent starts where operation circumstances permit.

**Note:** The following ‘rule of thumb’ can be applied:

- Datum = 27 psi, at 60°F, at SL.
- ( + 1 psi per 20°F reduction in ambient temperature)
- ( - 1 psi per 20°F increase in ambient temperature)
- ( - 1 psi per 1000 feet increase in altitude)

**STARTING ENGINES**

The pilot starting the engine is responsible for all aspects of the start, leaving the other pilot free to handle communications. There should be no superfluous conversation between crewmembers during the start. Only abnormal indications will be called out. The start sequence is at the option of the operator. The pilot will coordinate with the flight engineer when ready to start engines, contact ground crew, and turn on anti-collision lights.

**INITIATING START**

**CAPTAIN**

Command, “Turning No. ____.”

Push Ground Start switch. A residual TGT in excess of 100°C may result in the starting TGT limit being exceeded. The residual TGT should be reduced below 100°C by motoring the engine with the Fuel and Ignition switch OFF.

**COPILOT**

Observe green VALVE OPEN legend — call out malfunctions only. Maintain radio and communication watch.

**FLIGHT ENGINEER**

Check engine isolation valve switch flowbar illuminates. If not illuminated and there is no rotation, call out, “No air to Engine No. ____.” Check HP valve open on engine being used to supply air for a crossbleed start.

**AFTER INITIAL ENGINE ROTATION**

**CAPTAIN**

Observe N3 for indication. If no indication, check the VALVE OPEN legend; if not illuminated, push the GRD Start Release switch (hold for two (2) seconds).

**COPILOT**

If no rotation, check the VALVE OPEN legend.

**FLIGHT ENGINEER**

Check: Duct pressure. Check APU rpm and TGT, MAX MODE light (if APU used), and oil pressure.

**Note:** If the APU is used, observe an increase in duct pressure when the VALVE OPEN light illuminates. On crossbleed starts, the air pressure will decrease momentarily.
<table>
<thead>
<tr>
<th>CAPTAIN</th>
<th>COPilot</th>
<th>FLIGHT ENGINEER</th>
</tr>
</thead>
<tbody>
<tr>
<td>20% N₃</td>
<td>At 20% N₃, position Fuel and Ignition switch ON or ENRICH to improve acceleration.</td>
<td>Observe fuel flow meter for indication.</td>
</tr>
<tr>
<td>FAILURE TO LIGHT</td>
<td></td>
<td></td>
</tr>
<tr>
<td>If an engine fails to light off within 30 seconds from selecting the Fuel and Ignition switch to ON, select the Fuel and Ignition switch OFF, continue to motor the engine for an additional 30 seconds, and then select the other ignition system (A or B); then reselect the Fuel and Ignition switch ON. If the engine still fails to light off within 30 seconds, abandon the start.</td>
<td></td>
<td></td>
</tr>
<tr>
<td>30% N₃</td>
<td>Check N₁ for rotation prior to 30% N₃. Abandon start, Fuel and Ignition switch OFF if:</td>
<td>Check N₁ for rotation prior to 30 N₃. If no rotation, call, “No N₁.” Monitor TGT for hot or hung starts.</td>
</tr>
<tr>
<td>1. No oil pressure within 30 seconds after rotation.</td>
<td></td>
<td></td>
</tr>
<tr>
<td>2. No N₁ – N₂ rotation by 30% N₃.</td>
<td></td>
<td></td>
</tr>
<tr>
<td>3. TGT rises rapidly or nears start limit.</td>
<td></td>
<td></td>
</tr>
<tr>
<td>If, during starting, the rate of increase of TGT indicates that the TGT limit will be exceeded, abandon the start. If the TGT rise overtakes N₃ rise (e.g., if 350°C is reached before 35% N₃), release Fuel and Ignition switch from ENRICH to ON if below 35% N₃; if above, the start may have to be abandoned.</td>
<td></td>
<td></td>
</tr>
<tr>
<td>EXCESSIVE TGT/INTERNAL FIRE</td>
<td></td>
<td></td>
</tr>
<tr>
<td>If TGT exceeds 550°C, or fire occurs during engine shutdown, the starter may be reengaged up to 38% N₃. Any running reengagement must be recorded and reported. Running reengagements above 20% N₃ require maintenance action before next flight.</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
CAPTAIN

Monitor engine parameters for normal start, primarily TGT and N3.

51% N3

Release the Fuel and Ignition switch to the ON position after VALVE OPEN light extinguished or engine stabilized.

Note: Ground Idle – -21.0 – 23.3% N1.

If VALVE OPEN light or ground start release light are not extinguished, push the GND Start Release switch. If the VALVE OPEN light remains on after reaching ground idle rpm, with the GND START RELEASE light extinguished, shut down the engine.

COPilot

Observe starter cutout at 43 – 46% N3; VALVE OPEN light extinguishes. If not, monitor until 51% N3.

FLIGHT ENGINEER

Close APU Bleed Air Shutoff Valve.

1. Check that IDG LO PRESS light goes out.

2. Check for fuel flow indication prior to ground idle.

3. As engine stabilizes, check all engine instruments for normal indications.

4. As engine reaches ground idle, check engine driven hydraulic pump LO PR lights are extinguished.

5. Use crossbleed air to start remaining engines.

AFTER START/BEFORE TAXI

CAPTAIN

1. Confirm the gear pins have been removed.

2. Contact the ground crew to have external power removed.

COPilot

1. Call for taxi clearance.

2. Pitot, Alpha and Windshield Heat switches latched in and legends extinguished.

FLIGHT ENGINEER

1. Reestablish air conditioning as required; open both crossbleed valves and all high pressure valves.

2. Check hydraulic panel. All engine driven pumps ON and pressure normal in all systems. AC pumps and PTUs OFF.

3. Confirm that external power is removed and that generators are on the line and operating normally.

4. Turn on all tank pumps and close the crossfeed valves.

5. Advise captain of your intentions to shut down the APU, because
it will cause the electrical system annunciator on the CAWP to illuminate.

- Shut down the APU by pressing the stop button. Start the clock (Don’t turn the master power switch off until the DOORS IN TRANSIT light cycles, approximately 2½ minutes after pressing the stop button).

6. Check the cargo door warning lights by selecting UNSAFE TAKEOFF (CONFIG WARNING) on the aural warning test panel and pressing the test switch. Observe the cargo door lights illuminate.

READY FOR BEFORE TAXI CHECKLIST!!

TAXI CONSIDERATIONS

The eye position of the pilot is approximately 19 feet above the taxiway and 20 feet in front of the nose gear. The height above the taxiway tends to give a slower-than-actual speed sensation during initial taxiing; hence, care should be taken to keep taxi speeds relatively slow.

The wing tip is aft of the center of turn and moves outboard during a minimum radius turn. The wing tips extend 78 feet from the taxiway centerline and, although visibility from the cockpit is good, the wing tips cannot be seen from the cockpit and clearance may be difficult to judge.

The long wheelbase may cause problems with taxiway alignment in turns. The nosewheel is well aft of the cockpit. The main gear is an additional 70 feet aft of the nose gear. The center-of-turn is always in line with the main gear. This means the pilot should always be outside the centerline during turns and must overshoot the desired centerline before starting a turn.

The wing engines extend approximately 5 feet on either side of a 50 foot taxiway, thus it is necessary to use low power on the wing engines to reduce the possibility of foreign object ingestion.

Flaps and slats should be selected after taxiing clear of congested areas. Check that flap lever, indicators, and lights are in agreement.

Normally, two (2) or three (3) packs will be on during taxi.

Do not use reverse thrust for backing the aircraft.

Keep in mind the proximity of objects that may be affected by wing clearance, tail clearance, and jet blast.
When initiating taxi, apply only enough power to start moving (approximately 70% N\textsubscript{2}). Once rolling, the taxi speed can be maintained with virtually idle power. Under certain light gross weight conditions, the aircraft may be taxied with No. 2 engine in idle reverse to prevent excessive brake applications necessary to slow to taxi speed.

The nosewheel should remain centered until the aircraft starts rolling prior to initiating a turn. Use equal thrust on engines to initiate motion.

If breakaway cannot be accomplished with reasonable thrust while in congested areas, the aircraft should be towed from the critical area.

During ground operations, aircraft response to throttle movements is slow, particularly at higher gross weights. Time must be allowed for aircraft response before increasing thrust beyond normal requirements.

Differential engine thrust may be used while turning. When a short radius turn is required, use outboard engine thrust in conjunction with nosewheel steering to maintain taxi speed. Maintain as wide a radius of turn as possible to avoid scrubbing tires. Use gradual pressure on nose steering wheel to start turns.

During ground maneuvers while taxiing straight or where only small changes or direction are required, rudder pedal steering should be used. Do not rest hand on steering wheel while using rudder pedal steering. Even a slight pressure on the steering wheel will disconnect the rudder pedal steering system.

If the cockpit steering wheel is released while in a turn, the nosewheel returns to the rudder pedal steering position through an electrically driven actuator.

Apply brakes slowly and smoothly when taxiing in close quarters and congested ramp areas.

During taxi, the captain will control the airplane while the copilot receives clearances, and activates and checks systems. During the control check, the captain and copilot will check the rudder, ailerons, spoilers, and stabilizer by observing the SPI while moving the controls.

The anti-skid system may be tested after the aircraft is clear of ramp areas, but the test will not be valid if taxi speed is over approximately 17 knots.

The flight engineer should monitor brake temperatures during a prolonged taxi operation and after a normal landing or rejected takeoff.

AVOID

1. Riding the brakes. Allow the aircraft to accelerate; then brake to a slow taxi speed, release the brakes, and repeat the sequence. Or if the airplane is extremely light, control taxi speed with No. 2 engine in reverse.

2. Use of cockpit steering wheel except when required for short radius turns.

3. Differential braking. The nose strut can be subjected to high side loads if excessive differential braking is applied while holding or using nosewheel steering.

4. Braking while turning. Slow the aircraft prior to initiating the turn. Allow for decreased braking effectiveness on slick surfaces.
NOTE
SPECIAL CONSIDERATION SHOULD BE ACCORDED NO. 2 ENGINE START. IF THE TERMINAL HAS AN OBSERVATION DECK OR IS MORE THAN ONE STORY HIGH, INJURY OR DAMAGE COULD RESULT IF THE NO. 2 ENGINE BLAST PATTERN WOULD ENCOMPASS THE ELEVATED PORTION..
THEORETICAL CENTER OF TURN FOR MINIMUM TURNING RADIUS. TURN INITIATED WITH AIRPLANE IN MOTION, APPROXIMATELY IDLE THRUST ON ALL ENGINES. NO DIFFERENTIAL BRAKING.
LANDING GEAR TIRES AT EDGE OF TAXIWAY
125 FT (38.1 M)
75 FT (22.9 M)

11 FT 8 IN. (3.6 M)
NOSE STEERING ANGLE 50° (approximate)

44 FT 8 IN. (13.6 M)
11 FT (3.35 M)

18 FT
25 FT R. (min) (7.62 M)

AIRPLANES ON CENTERLINE
30 FT (9.14 M)
50 FT R (15.24 M)

Nose steering angle 50° (approximate)

30 FT (9.14 M)
FLIGHT STATION PATH
141 FT MINIMUM PAVEMENT WIDTH FOR 180° TURN

MORE THAN 90° TURN
180° TURN

150 FT (45.7 M)
150 FT (45.7 M)
141 FT MINIMUM PAVEMENT WIDTH FOR 180° TURN

70 FT
36 FT
107 FT
121 FT
64° STEERING ANGLE
TAXI MANEUVERING IN TIGHT QUARTERS

There have been incidents wherein the nose or main landing gear has been run off the runway while attempting to execute a 180° turn on a narrow runway.

Tests were conducted to determine the best technique for accomplishing this type maneuver without assistance from outside the cockpit. The following three procedures cover the most common types of turns.

180° U TURN ON ONE SIDE TURN PAD

INSTRUCTIONS
180° U-TURN ON ONE SIDED TURN PAD.
1. APPROACH APPROXIMATE CENTER OF LEFT HAND EDGE OF PAD AT APPROXIMATELY 30° ANGLE.
2. WHEN FLIGHT STATION NEARS EDGE, BEGIN MAXIMUM STEERING ANGLE TURN TO RIGHT.
3. MAINTAIN MAXIMUM STEERING UNTIL AIRCRAFT BEGINS TO APPROACH RUNWAY CENTERLINE.

NOTE: LIGHT RIGHT BRAKING AND LEFT ENGINE (#1) MODERATE THRUST INCREASE WILL MAINTAIN SMOOTH, CONTINUOUS MOVEMENT

3-50
180° U-TURN ON 150 FT WIDE RUNWAY END

DEGREES FROM RUNWAY HEADING TO INITIATE MAX STEERING ANGLE TURN

FLIGHT STATION AT EDGE

MAX STEERING ANGLE NOSE WHEEL PATH

FLIGHT STATION WILL EXTEND BEYOND EDGE OF RUNWAY APPROX 18 INCHES IN NORMAL TURN.

RUNWAY END LIGHTS

RUNWAY LIGHT (CUE TO INITIATE TURN)

150 FT

150° U-TURN ON 150' RUNWAY.

1. NOTE RUNWAY CENTERLINE HEADING.
2. LATEST POINT TO INITIATE 180° TURN IS ONE LIGHT FROM END (200')
3. INITIATE TURN TO LEFT AND PROCEED TOWARD EDGE AT 45° ANGLE.
4. AS PILOT POSITION APPROACHES EDGE OF PAVEMENT, REDUCE STEERING ANGLE TO MAINTAIN PILOT POSITION AT EDGE OF PAVEMENT AS AIRCRAFT PROCEEDS FORWARD.
5. WHEN AIRCRAFT HEADING REACHES 15° OFF RUNWAY HEADING, INITIATE MAXIMUM STEERING ANGLE TURN TO RIGHT.
6. MAINTAIN MAXIMUM STEERING ANGLE UNTIL AIRCRAFT IS APPROXIMATELY 45° FROM RUNWAY OPPOSITE HEADING.

IMPORTANT: STEP 5 IS CRITICAL AND MUST BE INITIATED AS NOTED OR MAIN LANDING GEAR WILL RUN OFF ON LEFT SIDE.

CAUTION: IF NOSE GEAR DOES NOT Respond PROPERLY TO MAXIMUM STEERING ANGLE, DUE TO NOSE TIRE SLIPPING, APPLY LIGHT RIGHT GEAR BRAKING. SOME LEFT (#1) ENGINE THRUST MAY ALSO ASSIST IN MAINTAINING MOMENTUM. EXCESSIVE BRAKING AND THRUST SHOULD BE AVOIDED TO REDUCE DAMAGE TO ASPHALT OR BLASTING AREAS BEHIND AIRCRAFT.

NOTE: A NORMAL TURN CAUSES PILOT POSITION TO TRAVEL APPROXIMATELY 15' TO 18' OVER OPPOSITE EDGE OF PAVEMENT.

EMERGENCY: IF TURN IS APPARENTLY NOT PROGRESSING PROPERLY, EITHER DUE TO IMPROPER INITIATION OR EXCESSIVE NOSE TIRE SLIPPING, AN EMERGENCY MEASURE OF APPLICATION OF THE RIGHT HAND BRAKES, AND #1 THRUST LEVEL INCREASE, MAY PERMIT THE REGAINING OF TURN CONTROL.
180° U-_TURN ON 200 FT DIAMETER RUNWAY BULB END

INSTRUCTIONS
180° U- TURN ON 200 FT DIAMETER RUNWAY BULB END.

1. ON ENTERING BULB END, TURN TO LEFT TO INTERSECT THE FIRST QUARTER OF CIRCLE AT APPROXIMATELY 45°.
CAUTION: IF AIRCRAFT APPROACHES EDGE AT TOO STEEP AN ANGLE (MORE HEAD-ON), THE NOSE STEERING IS INADEQUATE TO COMPLETE TURN. NOSE GEAR WILL GO OFF.

2. WHEN FLIGHT STATION IS AT EDGE OF CIRCLE, STEER TO RIGHT TO KEEP FLIGHT STATION AT EDGE OF PAVEMENT. STEERING ANGLE WILL BE SLIGHTLY LESS THAN MAXIMUM.

3. CONTINUE TURN UNTIL AIRCRAFT BEGINS TO APPROACH RUNWAY CENTERLINE.
NOTE: LIGHT RIGHT BRAKING AND LEFT #1 ENGINE MODERATE THRUST INCREASE WILL MAINTAIN SMOOTH, CONTINUOUS MOVEMENT.
### DURING TAXI

<table>
<thead>
<tr>
<th>CAPTAIN</th>
<th>COPilot</th>
<th>FLIGHT ENGINEER</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. When the aircraft starts rolling, the captain will check the brakes to confirm operation.</td>
<td>1. Engine anti-ice as required. Windshield and side window heat switch latched in and all light legends extinguished.</td>
<td>1. Check the ATMs by turning them to ON, observing that they operate and positioning their control knobs to AUTO. They should cycle OFF after approximately 15 seconds.</td>
</tr>
<tr>
<td>2. When clear of the congested area, direct the copilot to select takeoff flaps.</td>
<td>2. The copilot will select takeoff flaps as directed by the captain.</td>
<td>2. If takeoff data card has not been completed, do so now.</td>
</tr>
<tr>
<td>3. Direct the copilot to set the stabilizer trim.</td>
<td>3. Set the stabilizer trim as directed by the captain.</td>
<td>3. The F/E will monitor slat operation and hydraulic systems.</td>
</tr>
<tr>
<td>a. Check stabilizer trim indication on SPI and trim wheel.</td>
<td></td>
<td>4. Monitor brake pressures.</td>
</tr>
<tr>
<td>4. Check the rudder travel left and right while maintaining directional control with the nosewheel steering wheel. Observe the SPI for rudder movement.</td>
<td>4. Observe SPI for rudder movement.</td>
<td></td>
</tr>
<tr>
<td>5. With the ailerons deflected, press the outboard aileron switch on the SPI to check the outboard ailerons.</td>
<td>5. Assist captain with aileron check. Hold the ailerons left and then right. The captain will press the outboard aileron switch to check the outboard ailerons. with flaps extended, observe the spoiler deployment operating in roll assist.</td>
<td>5. Cross check airspeed bugs and EPR bugs.</td>
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<tr>
<td>6. Check stabilizer by displacing the control column nose-up and nose-down and observe the SPI.</td>
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<tr>
<td>7. Airspeed bug should be set to V2.</td>
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<tr>
<td>8. Captain calls for taxi and Before Takeoff checklist.</td>
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<td></td>
<td>6. The airspeed bug should be set to V2 and the takeoff EPR is set.</td>
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<tr>
<td></td>
<td>6. Reads the Taxi and Takeoff checklist. When reaching the line, call out, “Down to the Line.”</td>
<td></td>
</tr>
<tr>
<td>CAPTAIN</td>
<td>COPILOT</td>
<td>FLIGHT ENGINEER</td>
</tr>
<tr>
<td>------------------------------------------------------------------------</td>
<td>------------------------------------------------------------------------</td>
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</tr>
<tr>
<td>9. Position the flight directors to ON and select heading mode.</td>
<td>7. Alert the flight attendants, check the ALPHA HEAT OFF lights out and Temp Probe switch in, Continuous Ignition ON, Anti-Skid ON, Strobes ON.</td>
<td>7. Turn off pack number 1.</td>
</tr>
<tr>
<td>Confirm runway heading in the HSI. Press the Takeoff/Go-Around switch on the control wheel and select assigned altitude and press ARM switch.</td>
<td>8. Arm the desired initial altitude, on the Altitude Select panel, if not already armed. Each AFCS mode annunciator should display HEADING SELECT, ALTITUDE ARM, and TAKEOFF.</td>
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<tr>
<td></td>
<td>• On the center console, activate the transponder and if required, the radar.</td>
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<tr>
<td>10. Call for the items “below the line.”</td>
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</tr>
</tbody>
</table>

**PRIOR TO TAKEOFF**

Each pilot should check that his seat is in a position that allows full rudder and brake application.

The flight engineer should position his seat to face within 30 degrees of forward and remain in this position during the critical phases of takeoff and initial climb.

If icing conditions are anticipated during taxi, takeoff, or immediately after takeoff, the engine anti-ice system should be selected ON. Wing Anti-ice should not be selected ON until after the first power reduction.

When engine anti-icing is selected ON at ground idle, the valve will open, but the HEAT light may not illuminate. Engines should be accelerated until heat light comes on prior to takeoff. This should normally occur by 75% N3. Continuous Ignition should be on anytime engine anti-icing is being used.

**PRE-TAKEOFF BRIEFING**

The handling pilot should brief his crewmen prior to lineup, regarding: emergency actions to be taken, expected crew actions, performance, oral callouts, clearance limitations, type of takeoff (normal or noise abatement), and any other pertinent subjects pertaining to the takeoff.

**RUNWAY ALIGNMENT**

Normally, rudder pedal steering is adequate to maintain runway centerline alignment. Stay on the centerline, with wings level throughout the takeoff roll. Adherence to these criteria will automatically aid the pilot when contending with an engine out, or when correcting for a crosswind.

3-54
PERFORMANCE MONITORING

This procedure calls for the captain and copilot to monitor airspeed indications, and for the copilot and flight engineer to monitor engine performance. The flight engineer will advise the captain of any significant malfunction during the takeoff.

AIRCRAFT CONTROL

Holding the control column slightly forward increases nose steering effectiveness, prevents porpoising on rough runways, and assists directional control. It prevents early rotation that could occur with an incorrect stabilizer setting.

Primary directional control during the takeoff roll is achieved with the rudder (and rudder pedal steering). Wet or icy runways will reduce nosewheel steering effectiveness. Asymmetrical power is effective in maintaining directional control until the rudder becomes effective, approximately 60 to 70 knots.

SETTING THE THRUST

Symmetrically advance the throttles to approximately 60 – 70% N1 and allow the copilot to make the fine setting of all throttles. (Takeoff thrust must be set prior to reaching 80 knots.) The flight engineer will monitor all engine parameters and notify the captain of significant deviation from desired values.

TAKEOFF ROTATION/INITIAL CLimb

The flight manual performance data normally schedules the airplane to lift off at about a 12-degree attitude. Any rotation technique initiated at the correct VR, that achieves at least a 12-degree body angle within 4 – 6 seconds, will equal the certified performance to liftoff.

Standard ADI attitude reference marks are 12.5 and/or 15-degrees. The tailskid will contact the runway at 13.5-degrees body angle if the airplane is still on the ground; however, if proper speeds and rotation rates have been observed, the aircraft will not be on the ground, having lifted off at about a 12-degree body angle.

TAKEOFF TECHNIQUE

At VR, rotate smoothly to a 12.5-degree attitude over approximately a 4 – 6 second interval. Normally, liftoff will occur during the rotation, as attitude passes through about 12 degrees. After liftoff, readjust from the target 15-degree attitude, as required, for V2 schedule, noise abatement, or passenger comfort. Pitch attitude adjustment above 15 degrees (V2 attitudes vary from 15 to 18 degrees) may be required to meet critical engine out performance. If 2nd segment climb limit conditions will be approached during simulated engine failure training maneuvers, rotation should be limited to a 12.5-degree pitch attitude until airborne. The landing gear TRUCK light will illuminate at rotation and go out at liftoff.

CROSSWIND TAKEOFF

The maximum demonstrated crosswind component is 35 knots at a 50-foot height. This component is not considered to be limiting.

To keep the wings level during the takeoff, a maximum control wheel angle of up to 15° into the wind may be applied; if this angle is exceeded, the spoilers will extend and overcontrolling may occur. As speed and aileron effectiveness increase during the takeoff runs, the control wheel angle may have to be reduced. The control column should be held forward to keep the nosewheel firmly on the ground. Nosewheel or rudder pedal steering should be used smoothly, and the amount applied reduced as rudder effectiveness increases. As rotation is initiated, the control wheel should be slowly centered to avoid becoming airborne in a wing-down attitude or with crossed controls.
### NORMAL TAKEOFF

<table>
<thead>
<tr>
<th>CAPTAIN</th>
<th>COPilot</th>
<th>FLIGHT ENGINEER</th>
</tr>
</thead>
<tbody>
<tr>
<td>All takeoffs should be made with the thought of a possible abort prior to ( V_1 ) speed or engine loss thereafter. This will preclude indecision should such problems arise. Only necessary conversation can be accepted during takeoff.</td>
<td>1. When commanded to &quot;Set T.O. power,&quot; adjust the throttles for the correct T.O. EPR prior to 80 kts. Advise captain, &quot;Power set.&quot;</td>
<td>1. Check engine instruments on FE panel for normal indications, especially N(_2) for normal acceleration and possible overspeed (Inlet guide vane scheduling). After power is set and N(_2)'s are stable, scan the other panels for red or amber lights (there should be two (2) amber AVIONIC AIR OVBD lights illuminated).</td>
</tr>
<tr>
<td>1. Align the airplane with the runway, advance throttles to approximately 60% ( N_1 ), and command the copilot to &quot;Set T.O. power.&quot; During the takeoff roll, maintain light forward pressure on the yoke and maintain directional control with the rudder pedal steering.</td>
<td>2. Call, &quot;80 knots.&quot;</td>
<td>2. After a scan of the F/E panel, monitor EPR, ( N_1 ), TGT, and ( N_3 ). In the event of an engine failure, advise the captain, &quot;Engine failure, No. _____.&quot;</td>
</tr>
<tr>
<td>2. After power has been set, place right hand on throttles.</td>
<td>3. Call, &quot;( V_1 ).&quot;</td>
<td>3. Call, &quot;Rotate&quot; and &quot;( V_2 ).&quot;</td>
</tr>
<tr>
<td>3. At ( V_1 ), place right hand on control wheel.</td>
<td>4. Call &quot;Rotate&quot; and &quot;( V_2 ).&quot;</td>
<td></td>
</tr>
<tr>
<td>4. At ( V_R ), rotate the aircraft smoothly.</td>
<td></td>
<td>5. Select gear up, check normal indicator, and place gear lever in the neutral position when the gear doors are closed.</td>
</tr>
<tr>
<td><strong>CAUTION:</strong> Avoid early and fast rotation to preclude tailskid contact.</td>
<td></td>
<td>3. After liftoff and gear selected up, the flight engineer will check ATMs, avionic air OBVD lights, outflow valves, gear, doors, hydraulic systems, and tailskid for proper operation.</td>
</tr>
<tr>
<td>5. With indication of positive rate of climb, command, &quot;Gear up.&quot; Increase body angle to the command bar pitch limit (at heavy weight or with power loss, the pitch value may be less than normal).</td>
<td>6. Set new heading, if required.</td>
<td>4. Activate pack number 1, continue to scan engine instruments, pilots' overhead, F/E panels for any abnormalities, and maintain traffic watch.</td>
</tr>
<tr>
<td>6. If a turn procedure is required, select new heading at minimum 400 and commence turn to desired heading. (Direct the copilot to set heading.)</td>
<td>7. Select IAS mode and ( V_2 + 10 ) as directed.</td>
<td>5. Select the proper Rated EPR Mode (CL1 or CL2) and check TAT/EPR indicator.</td>
</tr>
<tr>
<td>7. Maintain ( V_2 + 10 ) knots or Flight Director pitch limit. Direct the copilot to select IAS mode and desired airspeed.</td>
<td>8. Set new heading.</td>
<td></td>
</tr>
<tr>
<td>8. If close-in turn is required, hold takeoff flaps. Direct the copilot to select new heading.</td>
<td>9. Select VS mode and retract flaps as ordered.</td>
<td>6. Monitor flaps and hydraulic systems. Check cabin differential pressure and rate of climb.</td>
</tr>
<tr>
<td>9. At 400 feet above runway, allow aircraft to accelerate, and retract flaps on speed</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
CAPTAIN

schedule. Direct copilot to select VS mode and approximate ____ ft/min climb.

10. At $V_2 + 60$, direct flaps to zero. Have F/E set climb thrust.

11. Select IAS mode to departure speed.

12. Call for After T.O. checklist.

COPILOT

10. Retract flaps.

FLIGHT ENGINEER

7. Set climb thrust as ordered. Monitor flaps, slats, and hydraulic systems.

8. Read After T.O. checklist.

PITCH ATTITUDE-TAKEOFF

<table>
<thead>
<tr>
<th>PITCH ALTITUDE - DEG</th>
<th>PITCH ALTITUDE AFTER TAKEOFF IS COMPARABLE TO CURRENT JET AIRPLANES. THE ATTITUDE AT MAXIMUM GROSS WEIGHT IS APPROXIMATELY 14 DEGREES.</th>
</tr>
</thead>
<tbody>
<tr>
<td>ALL ENGINES OPERATING AT $V_2 + 10$ KTS</td>
<td></td>
</tr>
<tr>
<td>ONE ENGINE INOPERATIVE AT $V_2$</td>
<td></td>
</tr>
<tr>
<td>MAX TAKEOFF WEIGHT</td>
<td></td>
</tr>
</tbody>
</table>

GROSSWEIGHT - 1000 LB

TAKEOFF GROUND CLEARANCE ANGLES

<table>
<thead>
<tr>
<th>PITCH ANGLE - DEG</th>
<th>BANK ANGLE - DEG</th>
</tr>
</thead>
<tbody>
<tr>
<td>AFT FUSELAGE SCRAPE</td>
<td>HORIZONTAL TAIL SCRAPE</td>
</tr>
<tr>
<td>RANGE OF LIFTOFF PITCH ANGLES</td>
<td>ENGINE POD SCRAPE</td>
</tr>
</tbody>
</table>

A NORMAL WINGS-LEVEL TAKEOFF PROVIDES A NOSE-UP PITCH SAFETY MARGIN OF MORE THAN THREE DEGREES, OR APPROXIMATELY FOUR FEET OF TAIL CLEARANCE.

THRUST REDUCTION

Prior to thrust reduction, the flight engineer should select CL1 or CL2 on the EPR computer. When flaps are fully retracted, retard throttles until climb EPR is reached.

NOISE ABATEMENT

Maintain takeoff power, takeoff flaps, and $V_2$ to $V_2 + 10$ knots until reaching 2000 feet above the airport or until past the sensitive area. If a turn is required (maximum bank, 15 degrees), begin to turn as soon as practicable, but not before reaching 300 feet above the airport. Continue the turn until reaching the desired heading.

When clear of the sensitive area, accelerate and retract flaps on normal speed schedule.
NORMAL TAKEOFF

ROLL OUT
ACCELERATE
RETRACT FLAPS
ON SCHEDULE

CLOSE IN TURN
MAINTAIN
TAKEOFF FLAPS
V₂ + 10 MIN.
BANK ANGLE NOT TO
EXCEED 15°

V₂ + 60 KTS
FLAPS TO 0
SET CLimb THRUST
OBSERVE DEPARTURE
SPEEDS

AT 400 FEET,
ACCELERATE AND
RETRACT FLAPS
ON SCHEDULE

SET TAKEOFF
THRUST
40 TO 80 KTS

Vₐ - ROTATE
SMOothLY TO
LIFtoFF
ATTITUDE

POSITIVE RATE
OF CLIMB
GEar UP

MAINTAIN V₂
TO V₂ + 10 KTS

FLAP RETRACT
SCHEDULE

22° OR 18° TO 10° V₂ + 10 KTS
10° TO 4° V₂ + 20 KTS
4° TO 0° V₂ + 60 KTS

NOISE ABATEMENT TAKEOFF

IF TURN REQUIRED,
MAINTAIN FLAP SETTING
V₂ + 10 KTS

SET TAKEOFF
THRUST
40 TO 80 KTS

Vₐ - ROTATE
SMOothLY TO
LIFtoFF
ATTITUDE

POSITIVE RATE
OF CLIMB
GEar UP

MAINTAIN V₂
TO V₂ + 10 KTS

AT 2000 FT OR CLEAR
OF CRITICAL AREA:
ACCELERATE
RETRACT FLAPS
ON SCHEDULE
SET CLimb THRUST

CLEAR OF CRITICAL AREA
SET CLimb THRUST
ACCELERATE
RETRACT FLAPS ON SCHEDULE

FLAP RETRACT
SCHEDULE

22° OR 18° TO 10° V₂ + 10 KTS
10° TO 4° V₂ + 20 KTS
4° TO 0° V₂ + 60 KTS
FLAP RETRACTION AND MANEUVERING SPEED SCHEDULE

FLAP 22° TAKEOFF

<table>
<thead>
<tr>
<th>AT</th>
<th>FROM - TO</th>
<th>WITH</th>
<th>MANEUVER AT</th>
</tr>
</thead>
<tbody>
<tr>
<td>$V_2 + 10$</td>
<td>$22° - 10°$</td>
<td>$10°$</td>
<td>$V_{REF} + 30\text{ MIN}$</td>
</tr>
<tr>
<td>$V_2 + 20$</td>
<td>$10° - 4°$</td>
<td>$4°$</td>
<td>$V_{REF} + 40\text{ MIN}$</td>
</tr>
<tr>
<td>$V_2 + 60$</td>
<td>$4° - 0°$</td>
<td>$0°$</td>
<td>$V_{REF} + 60\text{ MIN}$</td>
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</tbody>
</table>

FLAP 18° TAKEOFF

<table>
<thead>
<tr>
<th>AT</th>
<th>FROM - TO</th>
<th>WITH</th>
<th>MANEUVER AT</th>
</tr>
</thead>
<tbody>
<tr>
<td>$V_2 + 10$</td>
<td>$18° - 10°$</td>
<td>$10°$</td>
<td>$V_{REF} + 30\text{ MIN}$</td>
</tr>
<tr>
<td>$V_2 + 20$</td>
<td>$10° - 4°$</td>
<td>$4°$</td>
<td>$V_{REF} + 40\text{ MIN}$</td>
</tr>
<tr>
<td>$V_2 + 60$</td>
<td>$4° - 0°$</td>
<td>$0°$</td>
<td>$V_{REF} + 60\text{ MIN}$</td>
</tr>
</tbody>
</table>

FLAP 10° TAKEOFF

<table>
<thead>
<tr>
<th>AT</th>
<th>FROM - TO</th>
<th>WITH</th>
<th>MANEUVER AT</th>
</tr>
</thead>
<tbody>
<tr>
<td>$V_2 + 20$</td>
<td>$10° - 4°$</td>
<td>$4°$</td>
<td>$V_{REF} + 40\text{ MIN}$</td>
</tr>
<tr>
<td>$V_2 + 60$</td>
<td>$4° - 0°$</td>
<td>$0°$</td>
<td>$V_{REF} + 60\text{ MIN}$</td>
</tr>
</tbody>
</table>

FLAP 4° TAKEOFF

<table>
<thead>
<tr>
<th>AT</th>
<th>FROM - TO</th>
<th>WITH</th>
<th>MANEUVER AT</th>
</tr>
</thead>
<tbody>
<tr>
<td>$V_2 + 60$</td>
<td>$4° - 0°$</td>
<td>$0°$</td>
<td>$V_{REF} + 60\text{ MIN}$</td>
</tr>
</tbody>
</table>

NORMAL FLIGHT PROFILE AND CREW DUTIES

INITIAL CLIMBOUT

Initial climbout is limited to a minimum of $V_2 + 10$, or the Flight Director pitch limit.

Maneuvering speed for the existing flaps must be attained prior to exceeding a 15° bank angle.

After reaching flap retraction altitude, select vertical speed mode and the appropriate rate of climb for cleanup. Accelerate to 250 knots and then select IAS.

CLIMB

When desired climb speed is attained, select IAS. Comb speeds are 250 knots to 10,000 feet, then 300 KIAS/0.80 low speed climb or 350 KIAS/0.82 high speed climb, to top of climb.

Altitude Alert will be set to all assigned altitudes. Humidity control switch unlatched. Cabin zone temperature adjusted to 75 – 77° F.

ICING CONDITIONS

Continuous ignition should be on prior to selecting engine anti-ice.

Activate engine anti-ice when ICING light illuminates or when operating in visible moisture at +5 to -10°C OAT. Activate Wing Anti-Ice when ICING light illuminates after first power reduction on takeoff. Monitor pneumatic duct pressure.
Note: If in heavy icing conditions, engine vibration indicators may increase by 2.5 units. No action is required unless there are other indications of a mechanical failure.

APFDS

At any time either FD is selected to ON, or either autopilot is engaged, one of the pitch modes SHOULD be selected.

Upon command of the captain, the copilot will select headings, using the heading select knob. All other modes will usually be selected by the captain, and selections monitored by the copilot.

CRUISE

Maintain climb thrust until desired Mach number is reached. Select Rated EPR Mode (CRZ). This will provide max speed cruise or cruise limit EPR. Set the engines to these EPR cruise figures, cross checking Mach, EPR, TAT, and fuel flow. Reset thrust as weight is reduced to maintain desire Mach.

At some high weight and altitude combinations, the L-1011 requires relatively constant thrust in the M0.80 to M0.83 region. The apparent speed stability is reduced in this region and more attention is required while flying manually to maintain a precise cruise Mach number. At M0.84 or above, with any weight and altitude combination, speed stability is increased and a precise cruise Mach number can easily be maintained.

After the aircraft is stabilized in the cruise configuration, check that all switches, controls, and indicators are in the normal cruise configuration, using normal scan pattern.

TURBULENCE

Before entering areas of known turbulence, or when encountering turbulence, adjust thrust to obtain best penetration speed. Turn on Continuous Ignition. If autopilot is used, select Turbulence mode. Target speed for turbulence penetration increases linearly form 270 kts at 10,000 feet to 300 kts at 30,000 feet. Above 30,000 feet, maintain speed between 0.80 and 0.84 Mach No.

During manual flight in moderate to severe turbulence, attempt to maintain wings level and the desired pitch attitude, using the attitude indicator as primary pitch and bank instrument. Avoid abrupt control inputs. For turbulence of equal intensity, greater buffet margins are achieved by flying the recommended speeds at lower altitudes.

Mach Tuck

There is a small tendency for longitudinal trim change at high Mach number, which can easily be controlled by the pilot. However, control by the pilot should not be necessary since the initial nose-down tendency is countered automatically by the Mach Trim system, which is designed to take out the Mach effect at all speeds.

DESCENT

Speed Brakes

Speed brakes may be used for faster descents; however, descent and speed reductions should be planned without the use of speed brakes, if possible.
CRUISE BUFFET ONSET BOUNDARY

APPLICABLE TO S/N 1039 AND UP
APPLICABLE TO S/N 1002 TO 1038 IF MODIFIED BY SB 093-57-037
FLAPS AND GEAR UP

EXAMPLE:
380,000 LB GROSS WT.
31,000 FT ALTITUDE, 0.85M
A  HIGH SPEED BUFFET ONSET
   AT 1.9g OR 58° BANK
B  LOW SPEED BUFFET ONSET
   AT 1.0g AT 0.545M OR
   198 KIAS.
Full speed brakes will produce light airframe buffeting at higher speeds. Any time speed brakes are used, they should be slowly extended or retracted for utmost passenger comfort. If objectionable buffing is encountered, it can be diminished by forward pressure on the control column. The use of speed brakes with flaps extended is not recommended.

**Flight Engineer Duties**

In general, during climb, cruise, and descent his primary concern is to monitor all systems for normal operation. If required, he will also maintain a fuel used log and engine operation record. He should record all discrepancies in the ship’s log and be prepared to discuss them with the maintenance personnel after landing. He will use the FIRM code if applicable. He should also be alert for traffic.

Prior to, or during, descent, the flight engineer will set cabin pressure control, CAB ALT set selector, to destination airport altitude. Set Cabin Altimeter and cabin pressure BARO set control to landing airport QNH altimeter setting. During descent, monitor cabin rate of climb DIFF PRESS, cabin ALT.
DESCENT IN RANGE

HOLDING PATTERNS AND PROCEDURES

1. Below 14,000 feet ........................................ FLAPS UP - \( V_{REF} + 60 \) MIN.

2. Above 14,000 feet ...................................... REF MAX RANGE CRUISE/HOLD CHARTS.

Coordinate airspeed with ATC.
FAA MAXIMUM AIRSPEED

Holding Pattern - Arrivals

1. Through 6,000 feet MSL ........................................... 200 KTS
2. Above 6,000 feet, through 14,000 ft MSL ...................... 210 KTS
3. Above 14,000 feet MSL ........................................... 230 KTS

PILOT ACTION

1. Begin speed reduction 3 minutes before estimate for holding fix.
2. Make all turns during entry and while holding at 30 degrees of bank angle, or a 25 degree bank angle using the flight director system.
3. Compensate for known effect of wind, except when turning.
4. Advise ATC immediately if increase in airspeed is necessary due to turbulence, or if unable to accomplish any part of the holding procedure.

TIMING

1. Inbound leg:  
   1 Minute  
   1 Minute  
   1-1/2 Minutes  
   1 Minute  
   1 Minute  

14,000 feet or below  
Above 14,000 feet

The initial outbound leg should be flown for 1 minute or 1-1/2 minutes (as required by altitude). Timing for subsequent outbound legs should be adjusted, as necessary, to achieve proper inbound leg time on expected approach time.

Plan flap extension speeds to coincide with published extension and maneuvering speeds.

Note: Use of speed brakes with flaps extended is not recommended.

DESCEnt-IN-RANGE

CAPTAIN

Altimeters set to the current altimeter setting for the destination airport.
The CAWP annunciations should be checked when recalled by the copilot.

COPiLOT

Altimeter set to the current altimeter setting for the destination airport.
The CAWP annunciations should be recalled and checked.
The seatbelt sign should be turned on.
The anti-ice systems should be on or off, as required.

FLIGHT ENGINEER

The BARO Set in the cabin pressure control panel, and the cabin altitude/differential pressure gauge should be set to the current altimeter setting for the destination airport.
The circuit breakers should be checked.
All panels should be checked for normal operation.
<table>
<thead>
<tr>
<th>CAPTAIN</th>
<th>COPILOT</th>
<th>FLIGHT ENGINEER</th>
</tr>
</thead>
<tbody>
<tr>
<td>The approach, and missed approach, procedures should be reviewed and the proper DH or MDA set in the radio altimeter. The copilot should be briefed as to his duties during the approach or in the event of a missed approach.</td>
<td>The approach and missed approach procedure should be reviewed and the proper DH or MDA set in the radio altimeter. The copilot will be briefed by the captain as to his duties during the approach or in the event of a missed approach.</td>
<td>The fuel panel should be checked for normal operation, all pumps on, and all crossfeeds closed. If desired or necessary, the APU may be started. (Observe altitude limits.) The ECS panel should be checked for normal cabin descent. The flight engineer will complete the landing data card and pass it to the pilots. This signifies to the rest of the crew that the flight engineer is ready for the Descent-In-Range checklist.</td>
</tr>
<tr>
<td>Upon receiving the landing data card from the flight engineer, the captain should set the computed ( V_{REF} ) speed on the airspeed bug and cross check with the copilot.</td>
<td>Upon receiving the landing data card from the flight engineer, the copilot should set the computed ( V_{REF} ) speed on the airspeed bug and cross check with the captain.</td>
<td>If the aircraft is equipped with an EPR mode computer, select the Go-Around mode. Humidity control to ON if destination climatic conditions are warm and humid.</td>
</tr>
<tr>
<td>Confirm go-around EPR has been set in the EPR indicators and the Go-Around mode has been set on the EPR mode panel.</td>
<td>Set go-around EPR in the EPR indicators.</td>
<td>Assure pneumatic crossbleed valves are open.</td>
</tr>
</tbody>
</table>

**CALL FOR THE DESCENT-IN-RANGE CHECKLIST!!**

**INSTRUMENT APPROACH CALLOUTS**

At 1000 feet above field elevation, the copilot will check all instruments for flags; if none, call out, “1000 feet, no flags.” Should any flags be visible, the 1000 foot point will be called along with the instrument flag that is visible.

The copilot will call out, “500 feet.” This value is above touchdown altitude, which is referenced to the barometric altimeters for nonprecision approaches and to the radio altimeters for ILS approaches. In addition to the 500 foot callout, airspeed and sink rate will be identified by calling out, “500 feet, _____ knots sink rate _____ ft.”

During any portion of the approach, if the airspeed and/or sink rate is not normal, such value must be called out by the copilot. Normal airspeed will mean the airspeed is within the parameters of \( V_{REF} \) to \( V_{REF} + 10 \) knots, or + factors if applicable. Normal sink rate will mean that the rate of descent is compatible with the specific approach being made.

At 100 feet above alert height (AH) for CAT IIIA, or 100 feet above decision height (DH), the callout will be, “100 feet above minimums” by copilot.
<table>
<thead>
<tr>
<th>TYPE OF APPROACH</th>
<th>CONDITION/LOCATION</th>
<th>CALLOUT</th>
</tr>
</thead>
<tbody>
<tr>
<td>NORMAL DESCENT/CLimb</td>
<td>Approaching:</td>
<td></td>
</tr>
<tr>
<td></td>
<td>18,000 ft MSL (reset altimeter)</td>
<td>18,000 ft MSL</td>
</tr>
<tr>
<td></td>
<td>1000 ft above/below assigned altitude</td>
<td>1000 to go</td>
</tr>
<tr>
<td></td>
<td>10,000 ft (MSL) (reduce airspeed)</td>
<td>10,000 ft</td>
</tr>
<tr>
<td></td>
<td>Final approach:</td>
<td></td>
</tr>
<tr>
<td></td>
<td>1000 ft above field if VFR</td>
<td>1000 ft above field</td>
</tr>
<tr>
<td>ILS APPROACH</td>
<td>First positive INWARD motion of</td>
<td>Localizer alive</td>
</tr>
<tr>
<td></td>
<td>localizer bar</td>
<td></td>
</tr>
<tr>
<td></td>
<td>First positive DOWNWARD motion of</td>
<td>Glideslope alive</td>
</tr>
<tr>
<td></td>
<td>glideslope</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Outer marker (altimeter and instrument</td>
<td>Outer marker____ ft, no flags</td>
</tr>
<tr>
<td></td>
<td>crosscheck)</td>
<td>(or_____ flags)</td>
</tr>
<tr>
<td></td>
<td>Final fix inbound (altimeter and</td>
<td>At beacon, VOR, etc., ____ ft,</td>
</tr>
<tr>
<td></td>
<td>instrument crosscheck)</td>
<td>no flags (or____ flags)</td>
</tr>
<tr>
<td></td>
<td>500 ft above field</td>
<td>500 above field, no flags (or</td>
</tr>
<tr>
<td></td>
<td></td>
<td>flags), airspeed and rate of</td>
</tr>
<tr>
<td></td>
<td></td>
<td>descent</td>
</tr>
<tr>
<td>ALL INSTRUMENT</td>
<td>100 ft above minimums</td>
<td>100 above minimums, airspeed and</td>
</tr>
<tr>
<td>APPROACHES</td>
<td></td>
<td>rate of descent</td>
</tr>
<tr>
<td></td>
<td>minimum altitude</td>
<td>Minimums, runway in sight (or no</td>
</tr>
<tr>
<td></td>
<td></td>
<td>runway in sight)</td>
</tr>
<tr>
<td></td>
<td>Each subsequent 100 ft above field</td>
<td>____ ft airspeed, rate of descent,</td>
</tr>
<tr>
<td></td>
<td>evaluation after runway in sight</td>
<td>etc., if significant deviations</td>
</tr>
<tr>
<td></td>
<td>50 ft above runway</td>
<td>Fifty</td>
</tr>
<tr>
<td></td>
<td>30 ft above runway</td>
<td>Thirty</td>
</tr>
<tr>
<td>PILOT FLYING CALLOUTS</td>
<td>GO-AROUND OR</td>
<td></td>
</tr>
<tr>
<td></td>
<td>REJECTED LANDING</td>
<td>At any time before touchdown</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Go-around</td>
</tr>
</tbody>
</table>

3-66
The copilot will call out, "Minimums" for CAT I or CAT II approaches and will call, "Alert height" for CAT IIIA approaches.

The captain will call out, "Visual" upon reaching minimums, meaning he has visual cues in sight and his intentions are to land, or will call out, "Go-around."

The copilot should call out, "50 feet," and "30 feet" for all landings.

**APPROACHES, TRAFFIC PATTERN, AND LANDINGS**

**NORMAL, 3-ENGINE APPROACH**

While maneuvering for the approach, the minimum maneuvering speed for a given flap/slat configuration is obtained by adding to the computed $V_{REF}$ speed in accordance with the following schedule:

- Flaps/slats retracted: $V_{REF} + 60$ KNOTS
- Flaps $4^\circ$/slats extended: $V_{REF} + 40$ KNOTS
- Flaps $10^\circ$/slats extended: $V_{REF} + 30$ KNOTS
- Flaps $22^\circ$/slats extended: $V_{REF} + 20$ KNOTS
- Flaps $33^\circ$ or $42^\circ$/slats extended: COMPUTED $V_{REF}$

Prior to final approach, the copilot should turn on the Continuous Ignition and the seatbelt sign. On command from the captain, the copilot will lower the landing gear and test the anti-skid.

The flight engineer will position his seat forward. He will monitor slat extension and call out any abnormalities. When called for by the captain, he will read the Landing Final checklist.

Approaching the downwind leg, the Descent-in-Range checklist should be completed. Slow the airplane so that the flaps may be positioned to $10^\circ$ and speed $V_{REF} + 30$ knots abeam the approach end of the runway. Call for gear down when turning base leg and position the flaps to $22^\circ$. Slow the airplane to $V_{REF} + 20$ knots and start 800 feet per minute descent (approximately). Plan to turn final at 800 to 1000 feet, and call for flaps $33^\circ$ or $42^\circ$ as soon as the airplane is established in the slot. (There is no requirement to wait until the airplane is on final before selecting flaps $33^\circ$ or $42^\circ$.) After flaps are set to $33^\circ$ or $42^\circ$, complete the Landing Final checklist, and slow the airplane to $V_{REF}$ plus the wind-gust correction, up to 20 knots.

A normal slot should result in a sink rate of approximately 600 to 800 feet per minute; the vertical speed indicator should be used as a reference if no glideslope is available.

**NORMAL LANDING**

The normal attitude on final approach will be about 7.5 degrees nose-up, with the gear down and DLC operative. The landing flare requires only 1-1/2 to 2-degrees pitch change from the normal approach attitude. This is adequate to arrest sink rates of up to 1000 feet per minute. Normal touchdown should be achieved with a 9- to 10-degree attitude, which will provide a tailskid clearance of approximately 3-1/2 feet. The tailskid will contact the runway between 12-1/2 or 13-1/2 degree body angle, depending on rate of descent (strut compression).

Speed control and constant rate of descent, on the glidepath prior to flare, are fundamental considerations for avoiding tailskid strikes on landing. The aircraft should be aimed so as to touch down approximately
1000-1500 feet beyond the threshold. If the rate of sink exceeds 1000 ft/min below 200 feet altitude, or if the airspeed is less than $V_{REF}$ below 100 feet altitude and prior to flare, a missed approach should be executed.

**Touchdown zone safety margin and threshold height are substantially reduced if ILS glidepath is less than 2-1/2 degrees or glideslope ground intercept point is less than 1000 feet from the runway threshold.**

Since the L-1011 has exceptional over-the-nose visibility, the vision restriction cues apparent on other aircraft are absent. Therefore, be alert to avoid over-rotated and prolonged landing flares. The flare should be initiated no later than 30 feet radio altitude. If the flare is accomplished too high, or if the aircraft is held off in an effort to achieve a smoother landing, the tailskid will probably strike the runway.

**Touchdown Limits on Runway**

Desired touchdown distance from the runway threshold is 1000 to 1500 feet. During training, 1000 feet to 3000 feet is acceptable. At completion of training, acceptable limits are 1000 feet to 2000 feet from the end of the runway.

**Short Touchdowns**

Observation of many approaches by jet aircraft shows that there is a tendency for them to drop below the glideslope during the final stages of approach, and to flare and touch down well short of the desired reference point. This tendency is particularly marked in instrument conditions, commencing a breakthrough to visual reference, but is also noticeable under completely VFR conditions. This procedure gives a sharply increased rate of descent during the latter stages of the approach and, consequently, a tendency to touch down short of the runway. The airplane must be held on the glideslope with a constant rate of descent to the flare, a few feet above ground. The aircraft must be aimed to touch down 1500 feet beyond the threshold of the runway.

**Approach Path Corrections**

Maintain stabilized correct approach path. Be flexible and make corrections, as required, just as on any other airplane. What you are aiming for is a correct slot setting before reaching 500 feet, with no adjustments below 200 feet, and a stable platform to the flare. Vertical speed varies with ground speed, being normally somewhere between 600-800 ft/min.

Smooth landings will be achieved by completing the flare, then closing the throttles. A very subtle relaxation of the control column back pressure, just as the wheels touch, will further refine the touchdown. The ground spoilers will deploy automatically, but good practice dictates that the pilot consciously confirm and be aware that this action has taken place. Brakes can be applied and throttles should be set to reverse idle descent immediately after main wheel touchdown.

Normally, the nosewheel will tend to land itself firmly unless the pilot lowers it gently. Hard, immediate braking on a dry runway will result in a very pronounced nose-down tendency, which can be controlled smoothly. Conversely, heavy reversing at very aft CG results in a moderate pitchup tendency. Brakes are very effective in controlling this tendency.

Primary directional control during landing rollout is achieved with the rudder (and rudder pedal steering). Rudder pedal steering should be used until turning off the runway, unless wet or icy conditions require aerodynamic rudder only.
Maximum asymmetric reverse thrust can be controlled by aerodynamic means, down to approximately 60 knots on a dry runway and 70 knots on a wet runway.

There is a pronounced nose-up moment with only No. 2 engine in maximum reverse. This should be anticipated by applying forward pressure on the control column.

Reverse thrust should be reduced so as to be at reverse idle by 70 knots. Forward idle should not be selected until N1 is less than 33%.

After cancelling reverse thrust, the throttles must not be advanced in attempt to increase forward thrust above 33% N1 until the REVERSER PRESSURE light has gone out.

The copilot will call eighty (80) knots, and seventy (70) knots during rollout. The captain will begin reducing the amount of reverse that was applied at eighty (80) knots. The engines should be in idle reverse at seventy (70) knots and reversers stowed at approximately sixty (60) knots. Forward idle may be delayed on No. 2 engine (only) to assist in retarding taxi speed if desired.

Braking is accomplished by maintaining constant brake pedal pressure during braking. On initial brake application, the anti-skid system modulates the applied brake pressure in order to determine the skid threshold. On detecting an incipient skid, the anti-skid system reduces the brake pressure sufficiently to avoid the impending skid. Three or four pressure adjustments will occur in the process of determining the existing runway conditions. When the brake pedals are modulated or re-adjusted by the pilot for additional or less braking, this process is repeated. Braking effectiveness during this readjustment period is reduced. In other words, on slick surfaces, the optimum applied brake pressure is appreciably reduced by manipulating the pedals.

The varying runway surface conditions associated with ice and snow will result in additional anti-skid system brake releases. These, combined with the reduced traction, will significantly increase stopping distances. Modulating the brake pedals will only aggravate the situation. For these conditions, the anti-skid system is still effective and should not be turned off until a safe taxi speed is reached.

**PRECISION INSTRUMENT APPROACHES**

The captain and copilot will review the applicable approach plate, which should be accomplished well in advance of initiating the approach. Areas of review should include, but not be limited to, appropriate frequency for the approach, runway to be used, inbound bearing, D/H visibility minimums, touchdown elevation, and missed approach procedure.

While in visual conditions, all flight crew members should devote as much time as possible to scanning for other traffic.

The captain and copilot should monitor mode annunciations and warnings throughout the approach, landing, or go-around. Any malfunction or deviation from normal shall be called out by the crew member first observing the discrepancy.

When the localizer or glideslope becomes active, the copilot will call out, "localizer alive" and "glideslope alive."

**AUTOPilot AUToland**

The prelanding check includes necessary preparations for the proposed approach and landing.

On radar vectors to intercept the localizer, slow the airplane and select flaps 10°; speed V_{REF} + 30. Both flight directors and one autopilot should be engaged. After selecting the current speed in the ATS panel,
engage the autothrottles. The ILS frequency should be tuned and identified, and the inbound ILS course set in both course selectors. For the purpose of this discussion, HDG Select will be used for precapture guidance, and ALT Hold will be used to maintain initial approach altitude. With the HDG mode engaged, set the intercept heading with the Heading Select knob. Press the Approach/Land switchlight and engage the second autopilot.

Localizer capture will occur at various points, depending on rate and angle of intercept. At localizer capture, the HDG mode will disengage and LOC ARM will change to LOC in the AFCS modes annunciator. At this time, the HDG Bug should be set to the inbound ILS heading. At “Glideslope Alive,” select gear down. At one dot glideslope deviation, select flaps $22^\circ$ and slow the airplane to $V_{REF} + 20$. At glideslope capture, the altitude mode will disengage. The flaps should be selected to $33^\circ$ or $42^\circ$ at this time. The airplane will pitch down to establish approximately a 750 ft/min rate of descent until glideslope tracking begins. The autothrottle system goes into the Alpha mode, and $V_{REF} +$ gust compensation will be provided throughout the remainder of the approach. The Before Landing checklist should be completed at this time. At 1500 feet, the autopilots begin to cross-compare calculations. The A/L arm annunciation in the AFCS modes annunciator will change to A/L; this, and the absence of a NO DUAL annunciation on the AFCS warning panel, indicates that all autopilot computer functions are operating properly. The autopilot is now in Approach Land Track. Throughout the remainder of the approach, no single failure will cause the approach and autoland to be discontinued. Also, at this time, the align and flare functions are armed. The rudder goes to the parallel mode of operation and rudder inputs will be felt by the pilot.

At 150 feet, the autopilot will align the airplane by a combination of wing-down and opposite rudder. As much as $3-1/4^\circ$ wing-down is available. This is enough to correct for $8^\circ$ of crab angle.

At 50 feet, alert height for a CAT IIIA approach, the flare is initiated by the radio altimeters. The autothrottles start to reduce power. At 5 feet radio altitude, rollout guidance is initiated. The autothrottles reduce to the minimum point. The approach gate, if installed, will bias out of view. The command bars will also bias out. If installed, the rollout bar comes into view. At touchdown, the autothrottles drive closed and disconnect. Normal reverse thrust and braking should be used. At 70 kts, the engines should be in reverse idle. By 60 kts, the throttles should be in forward idle. The autopilot may be left engaged through the rollout. When ready to turn off the runway, disconnect the autopilot.

Throughout the approach, the pilot should monitor the autopilot. The accepted technique is for the pilot flying to rest one hand lightly on the control yoke and the other hand on the throttles. If a go-around becomes necessary, it is important not to disconnect the autopilot, but instead use the index finger to activate the Go-Around mode.

**ILS APPROACH/LANDING - FLIGHT DIRECTOR ONLY**

- Engage both Flight Directors.
- Set desired intercept heading on heading selector.
- Press ALT switchlight and HDG switchlight for precapture guidance.
- Set both VHF NAV radios to the appropriate ILS frequency.
- Set both course selectors to the inbound ILS course.
- Tune ADF receivers to the LOM if available.
- Select ADF on RDDMI pointers.
- On final intercept heading to the ILS, press the Approach/Land (A/L) switchlight.
Notice that LOC ARM and GS ARM only appear on both AFCS mode annunciators.

Reduce speed and select flaps in accordance with standard approach procedures.

Localizer capture will occur at different distances from the localizer, depending on the rate and angle of intercept.

At localizer capture, the HDG SEL will disengage, and LOC ARM will change to LOC. Set the HDG Bug to the inbound ILS course. When localizer tracking is obtained, a flashing alert light will appear along with a NO ALIGN on the AFCS mode annunciators. This serves as a warning that there is no alignment guidance in this mode of operation.

Select gear down as the glideslope indication becomes active.

Select flaps 22º at one dot glideslope deviation. Minimum speed is $V_{REF} + 20$ knots. At glideslope capture, select landing flaps. When the flaps are lowered past 30º, the speed command system reverts to the stall margin mode, the Alpha flag covers the numbers in the ATS panel airspeed window, the fast/slow needle commands $1.3 V_s$ + gust compensation for the remainder of the approach, and the DLC becomes active. At 1500 feet radio altitude and 30 seconds after glideslope capture, gain programming is initiated. This is strictly a function of radio altitude and reduces sensitivity of pitch and roll commands down to a radio altitude of fifty feet.

At 150 feet radio altitude, NO FLARE is announced on the AFCS warning annunciator. At 50 feet, the flight director command bars are biased out of view, and a normal landing may then be made using visual references.

**AUTO GO-AROUND**

If a go-around becomes necessary, press the Takeoff/Go-Around switch. This initiates the automatic go-around. GO ARND appears in both AFCS mode annunciators. All other annunciations are removed. All heading, pitch, and NAV modes are disengaged. If both autopilots are engaged, the second autopilot which was engaged for the approach will be disengaged. The ATS will disengage, and the DLC spoilers will stow automatically.

The Go-Around mode provides vertical guidance commands to arrest the airplane’s descent rate, and to produce a climb rate commensurate with the airplane’s speed by commanding the proper pitch attitude. At no time will the aircraft speed drop below $1.25 V_s$. Set the go-around thrust and immediately raise the flaps to 22º. After positive rate of climb is established, raise the landing gear. The HDG mode may be used in conjunction with the Go-Around mode for lateral guidance.

At 400 feet and $V_{REF} + 10$, flaps should be selected to 10º. Depending on obstacle clearance altitude, an acceleration to normal flap retraction speeds can be made. This is normally done by selecting the vertical speed mode which disengages the go-around mode and selecting a vertical speed which will result in aircraft acceleration. In the case of a 2 engine go-around, this vertical speed will be a nominal 200 to 300 foot per minute rate of climb. Flaps should be retracted on the normal flap retraction schedule. Flaps 10 at $V_{REF} + 10$ and 400 feet, flaps 4 at $V_{REF} + 20$, and flaps up at $V_{REF} + 60$. 
DUAL A/L APPROACH

APPRAoch
- Tune ILS and set up inbound course with course knobs
- Set intercept heading with heading knob, press HDG mode selector
- Set decision height on altimeters
- Set autopilot to CMD, set flight directors ON
- Set approach speed in autothrottle window
- Engage autothrottle
- Press A/L mode selector
- Second autopilot to CMD
- Use HDG select knob to maneuver
- Use VS or ALT for pitch guidance

LOC CAPTURE
- Capture point varies with beam rate change and angle of intercept
- Approach gate appears in ADI (if gate incorporated)
- HDG SEL disengages

LOC   GS ARM   A/L ARM   VS

GS CAPTURE
- Automatic pitch to 750 FPM descent until GS tracking
- Pitch mode disengages

LOC   GS   A/L ARM

1500 FT
- Autopilots begin dual channel cross monitoring
- ALIGN function is armed
- FLARE function is armed
- Rudder goes to parallel operation and pitch trim bias

1500 FT
- ATS goes ALPHA at 30° FLAPS
- Autopilot go-around armed at 30° flaps

150 FT
- Autopilot aligns aircraft with runway and sets up crosswind correction

50 FT
- Flare initiated by radio altimeters
- ATS reduces power
- Glideslope centers

ROLL OUT
- At 5 feet above touchdown, rollout guidance initiated
- ATS moves throttles to idle. When full weight of aircraft is on gear, ATS disconnects
- Approach gate out of view (if incorporated)
- Command bars out of view
- Rollout bar in view
<table>
<thead>
<tr>
<th>DEMONSTRATED EQUIPMENT</th>
<th>CAT I</th>
<th>CAT II</th>
<th>CAT IIIa</th>
</tr>
</thead>
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<tr>
<td></td>
<td>COUPLED APPROACH</td>
<td>AUTOMATIC LANDING</td>
<td>COUPLED APPROACH</td>
</tr>
<tr>
<td>AUTOPILOT (A/P) AND FLIGHT DIRECTOR (F/D)</td>
<td>1 A/P</td>
<td>1 A/P AND 1 F/D</td>
<td>1 A/P AND 1 F/D WITH DUAL DISPLAY</td>
</tr>
<tr>
<td>DLC</td>
<td>W/WO</td>
<td>W/WO</td>
<td>W/WO</td>
</tr>
<tr>
<td>AUTO PITCH TRIM</td>
<td>W/WO</td>
<td>1</td>
<td>W/WO</td>
</tr>
<tr>
<td>* INST FAIL WARN. SYS.</td>
<td>W/WO</td>
<td>WITH</td>
<td>WITH</td>
</tr>
<tr>
<td>ILS RCVRS</td>
<td>1</td>
<td>1</td>
<td>2</td>
</tr>
<tr>
<td>RADIO ALTIMETERS</td>
<td>1</td>
<td>2</td>
<td>1</td>
</tr>
<tr>
<td>AUTOTHROTTLE SYSTEM (ATS)</td>
<td>W/WO</td>
<td>1</td>
<td>W/WO</td>
</tr>
<tr>
<td><strong>CROSSWIND LESS THAN 10 KTS</strong></td>
<td>W/WO</td>
<td>2</td>
<td>W/WO</td>
</tr>
<tr>
<td>MISSED APPROACH ATTITUDE GUIDANCE</td>
<td>ATTITUDE GYROS, F/D PITCH COMMAND OR AUTOMATIC GO-AROUND</td>
<td></td>
<td></td>
</tr>
<tr>
<td>RAIN REMOVAL</td>
<td>W/WO</td>
<td>W/WO</td>
<td>WITH</td>
</tr>
</tbody>
</table>

* NORMAL INSTRUMENT FLAG INDICATIONS

W/WO = With or without

NOTE: With DLC "OFF" the landing longitudinal touchdown dispersion may be increased approximately 300 feet.
NON-PRECISION APPROACHES

In general, all non-precision approaches should be accomplished with the aid of the Autoflight (Autopilot/Flight Director) System. The two exceptions to this statement are the back course approach and the ADF approach.

In the case of the back course approach, there is an AFM limitation against using any approach mode. During ADF approaches, constant heading corrections necessitate the continuous changing of the selected autoflight heading. This could distract the pilot, producing undesirable results. It is recommended that the ADF approach be made in reference to raw data only.

During a VOR approach, the HDG or NAV mode may be used for lateral navigation. It should be noted, however, that the NAV mode may be unacceptable when making relatively large intercepts close to the station. For vertical navigation, the VS mode may be used in conjunction with the ALT Arm and ALT modes.

VOR APPROACH (straight in)

Inbound to the VOR, the flaps should be set to 10° and a speed of \( V_{REF} + 30 \text{ kts} \) minimum should be maintained.

When intercepting the final approach course inbound, or at the final approach fix inbound, the landing gear should be lowered and flaps extended to 22°. Airspeed should be \( V_{REF} + 20 \) minimum. When the field is in sight and the airplane is in the landing slot, select landing flaps and complete the Before Landing checklist. Airspeed should be \( V_{REF} + 1/2 \) the wind plus the gust factor (not to exceed \( V_{REF} + 20 \text{ kts} \)).

ADF APPROACH

Because of reasons previously stated, use of the Autopilot Flight Director System during the ADF approach is not recommended. The approach should be flown in the standard manner. Flap settings and speed control are the same as other non-precision approaches.

PAR/ASR APPROACH

When inbound on final approach, request the controller to give a 10-second warning before glideslope interception, then select gear down, flaps 22° and airspeed \( V_{REF} + 20 \). Position flaps 33° or 42° and airspeed \( V_{REF} + \) plus the wind-gust correction as the runway comes into view. Accomplish the Landing Final checklist.

BACK COURSE ILS APPROACH

ILS back course approaches are non-precision approaches, and glidepath information is not reliable. During back course approaches, the glideslope warning flag may be pulled out of view by spurious signals, and false glideslope indication must be ignored.

Back course approaches may be made using raw data only and are flown using techniques applicable to other non-precision approaches.

To maintain the proper aircraft heading/localizer course relationship, set the published front course in the course selector. Inbound to the initial approach fix, flaps should be lowered to 10°; speed should be \( V_{REF} + 30 \text{ minimum} \). Prior to reaching the final approach fix, the gear should be lowered and the flaps selected to 22°. Speed should be \( V_{REF} + 20 \text{ minimum} \). With the field in sight and the airplane in the landing slot, landing flaps should be selected and the speed should be \( V_{REF} + 1/2 \) the wind + all the gust increment (\( V_{REF} + 20 \text{ maximum} \)). Complete the landing checklist.
LANDING, 2 OR 3 ENGINES

GEAR DOWN
FLAPS 22
$V_{REF} + 20$ KTS MIN
DESCEND AS REQUIRED

FLAPS 10
$V_{REF} + 30$ KTS MIN

FLAPS 4
$V_{REF} + 40$ KTS MIN

CLEAN;
$V_{REF} + 60$ KTS MIN

INTERCEPTING APPROACH SLOT
FLAPS $33^\circ$ OR $42^\circ$
$V_{REF} + \frac{3}{4}$ WIND + GUST

500 FEET
STABILIZE IN SLOT

ILS, 2 OR 3 ENGINES

FLAPS $10^\circ$
$V_{REF} + 30$ KTS MIN

FLAPS $4^\circ$
$V_{REF} + 40$ KTS MIN

GLIDESLOPE INTERCEPT
FLAPS $33^\circ$ OR $42^\circ$
$V_{REF} + \frac{3}{4}$ WIND + GUST
(15 KT MAX)

GLIDESLOPE ALIVE
GEAR DOWN
GLIDESLOPE 1 DOT
FLAPS $22^\circ$
$V_{REF} + 20$ KTS MIN
APFDS VOR PROCEDURES

A. VOR ARMED FOR CAPTURE
- Tune VOR and set desired course with course knobs
- Set intercept heading with heading knob
- Set autopilot to CMD, set flight director ON
- Press NAV mode selector
- Use CWS or HDG select knob to maneuver
- Use any pitch mode except TURB

B. VOR CAPTURE
- Capture point varies with beam rate change and angle of intercept
- HEQ SEL disengages
- Max bank angle 28°

C. VOR TRACKING
- When track acquired, max bank angle 10°
- Autopilot provides for wind correction

D. OVER STATION SENSING
- Begins when rapid VOR deviation is sensed
- Heading and wind correction is maintained

E. COURSE CHANGE
- Course changes may be made with the course knob while passing over station max bank angle 28°

F. STATION PASSAGE
- Autopilot picks up course set in course windows
APR APPROACH

LOC CAPTURE
- Capture point varies with beam rate change and angle of intercept
- HDG SEL disengages

LOC
GS ARM
VS

APPROACH
- Tune ILS, and set inbound course with course knobs
- Set intercept heading with heading knob, press HDG mode selector
- Set decision height on altimeters
- Set autopilot on CMD, flight directors ON
- Set approach speed in autothrottle window
- Engage autothrottle
- Press APR mode selector
- Use HDG select knob to maneuver
- Use VS or ALT for pitch guidance

LOC ARM
HDG SEL
GS ARM
VS

GS CAPTURE
- Automatic pitch to 750 FPM descent until glideslope tracking begins
- Pitch mode disengages
- ATS goes to ALPHA at 30° flaps
- Autopilot go-around armed at 30° flaps

LOC
GS

DECISION HEIGHT
- Disconnect autopilot and ATS
- Land manually

LOC
GS
APPRAOCH AND LANDING GEOMETRY

As mentioned before, the normal aiming point on landing is 1500 feet from the approach end of the runway. Referring to the chart below, it can be seen that with a normal glidepath of 2.5°, the eye level at the threshold will be approximately 65 feet, and the landing gear clearance height approximately 27 feet. If either the glidepath or the aiming point is reduced, the landing gear clearance altitude at the threshold will be substantially reduced.

T A I L  B U M P E R  S T R I K E

The normal attitude on final approach will be about 7° to 8° nose-up with the gear down and flaps 42°, following a 2.5° glideslope. The landing flare requires only a 1.5° to 2° pitch change from the normal approach attitude. This is adequate to arrest sink rates of up to 1000 feet per minute. Normal touchdown should be achieved with a 9° to 10° pitch attitude, which will provide a tailskid clearance of approximately 3-1/2 feet. The tailskid will contact the runway between 12-1/2 and 13-1/2 degree body angle, depending upon rate of descent (strut compression).
APPROACH AND LANDING GEOMETRY
GROSS WEIGHT 350,000 LBS (DLC OPERATIVE)

2.5° GLIDEPATH
(MINIMUM GLIDEPATH ANGLE)

1.5° GLIDEPATH
(NCT RECOMMENDED)

RUNWAY THRESHOLD HEIGHT DATA

<table>
<thead>
<tr>
<th>GLIDEPATH DEGREES</th>
<th>BODY ATTITUDE DEGREES</th>
<th>1000 FT</th>
<th>1500 FT</th>
<th>2000 FT</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>EYE LEVEL</td>
<td>GEAR</td>
<td>EYE LEVEL</td>
</tr>
<tr>
<td>1.5</td>
<td>8.8</td>
<td>26.4</td>
<td>-11.8</td>
<td>39.5</td>
</tr>
<tr>
<td>2.5</td>
<td>7.8</td>
<td>43.2</td>
<td>5.4</td>
<td>65.3</td>
</tr>
<tr>
<td>3.5</td>
<td>6.8</td>
<td>61.2</td>
<td>23.1</td>
<td>91.7</td>
</tr>
</tbody>
</table>

3-79
The flare should be initiated no later than 30 feet radio altitude. If the flare is accomplished too high, or if the aircraft is held off in an effort to achieve a smoother landing, the tailskid will probably strike the runway.

**CROSSWIND LANDINGS**

The L-1011 has generally excellent crosswind capability, and recommended techniques are similar to other sweptwing jet transports with high-lift-device flaps.

Increase approach speeds 1/2 the steady wind value plus the full gust increment to a total maximum of 20 knots. Maintain runway tracking with a wings-level crab. At approximately 200 to 100 feet, begin decrabbing and aligning with the runway centerline, using the rudder. At the same time, compensate for any resulting drift by banking slightly into the wind. The resulting sideslip should be aligned and stabilized well before flare. The flare should be initiated at approximately 30 feet. Normally, only a 1-1/2 to 2 degree pitch change is needed. Smoother landings will be achieved by essentially completing the flare first — then closing or easing back the throttles. The aircraft should then be landed without delay (within 1 to 3 seconds). Prolonged flares tend to aggravate drift. The wings can be leveled just before touchdown; however, it is also permissible for the upwind gear to touch slightly first. Initiate normal stopping sequence while the nosewheel is being lowered. Continue to fly the wings level after lowering the nose and until below 100 knots. The rudder is more effective at higher speeds than nosewheel steering. Maintain directional control with rudder, down to approximately 60 knots.

Overcontrol or undercontrol laterally can cause difficulty. Any downwind lateral control inputs can allow the wind to get under and raise the upwind wing. Maximum braking is achieved with airplane weight equally distributed on the wheels.

The pilot should be expected to make suitable drift allowance on the downwind leg and to make due allowance to the effect of crosswind on the turn to final approach.

**AFTER LANDING PROCEDURES**

<table>
<thead>
<tr>
<th>CAPTAIN</th>
<th>COPILOT</th>
<th>FLIGHT ENGINEER</th>
</tr>
</thead>
<tbody>
<tr>
<td>When the aircraft is down to taxi speed, the flaps should be raised.</td>
<td>Monitor hydraulic systems and brake pressures.</td>
<td>Select the AC hydraulic pumps to ON to insure nosewheel steering and brake pressure</td>
</tr>
<tr>
<td>Check the spoilers to be sure they are stowed.</td>
<td></td>
<td>The ATMs should be selected OFF.</td>
</tr>
<tr>
<td>The stabilizer trim should be moved to zero.</td>
<td></td>
<td>Start the APU and check the APU generator is on the AC tie bus.</td>
</tr>
<tr>
<td>The air data sensor and windshield heat should be selected OFF.</td>
<td></td>
<td></td>
</tr>
<tr>
<td>The anti-ice should be selected OFF.</td>
<td></td>
<td></td>
</tr>
<tr>
<td>The Continuous Ignition should be selected OFF.</td>
<td></td>
<td></td>
</tr>
<tr>
<td>The anti-skid should be selected OFF.</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Check the brake pressure.</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Position the landing lights and strobe lights to OFF.</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
### AFTER LANDING PROCEDURES (Continued)

<table>
<thead>
<tr>
<th>CAPTAIN</th>
<th>COPilot</th>
<th>FLIGHT ENGINEER</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>CALL FOR THE AFTER LANDING CHECKLIST!!!</strong></td>
<td>Select the radar to OFF and the transponder to standby.</td>
<td></td>
</tr>
</tbody>
</table>

#### SECURE COCKPIT PROCEDURES

<table>
<thead>
<tr>
<th>CAPTAIN</th>
<th>COPilot</th>
<th>FLIGHT ENGINEER</th>
</tr>
</thead>
<tbody>
<tr>
<td><em>Check the exterior lights. At night, the wing flood and wheel-well lights may be selected ON for servicing and safety. Emergency lighting and standby power should be selected OFF.</em></td>
<td>Master radio switches should be selected OFF. #2 VHF radio will still be operating, as will the flight interphone for ground crew communication.</td>
<td></td>
</tr>
<tr>
<td><em>Check the brake pressure and set parking brake with brake selector on System B if chocks are not installed. If chocks are installed, the parking brake need not be set. Check with the flight engineer to determine if he is ready for engine shutdown. If he is, shut down the engines and observe engine instruments for normal shutdown.</em></td>
<td>Observe engine instruments for normal shut down</td>
<td></td>
</tr>
<tr>
<td>*Call for the Secure Cockpit checklist.</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

*Prior to engine shutdown, check the electrical panel to make sure the APU generator is paralleled on the AC tie bus or external electric power is available.*

*Select one fuel pump OFF for each tank.*

*Select #1 pack OFF and assure crossbleed valves are open.*

*Check the hydraulic panel. Select the AC hydraulic pumps OFF and check brake pressure.*

*Advise the captain when ready to shut down engines. When the Fuel and Ignition switches are selected OFF, open the APU bleed air shutoff valve. When duct pressures stabilize, select the NORM mode.*

*After engine shutdown, check the hydraulic panel.*

*Select the remaining tank pumps in the number one and three tanks OFF, leaving one pump on in the 2L tank or one on in the 2R tank.*

*Select the flight recorder OFF. Turn off crew oxygen.*

If the APU is not required, i.e., external power available, select MIN mode, turn off packs, close the APU bleed air shutoff valve, and shut down the APU after passengers have deplaned.

Turn off the battery switch.

**Note:** *Asterisked items required on shutdown check at thru stations.*