Pilot's Operating Handbook (POH)

• Part 1 •

Lockheed C-141A/B/C Starlifter

Lowcost payware for X-Plane version 8.40 and 8.50.

First release 28th May 2005

Last update 05th October 2006

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http://www.x-plane.org/home/Caboclo/Galaxy/index.html

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Specifications

Dimensions	Only C-141B/C if value given for A		C-141A	
Length	168 feet 4 inches	51.3 m	145,0 ft	44,2 m
Height (Minimum, stabilizer and elevators neutral)	39 feet 3 inches	12 m		
Height (Minimum, stabilizer bullet tip full down, elevators full up)	40 feet 7 inches			
Wing span	160 feet	48.8 m		
Wing sweep	25.0 deg			
Stabilizer span	50 feet 4 inches			

Weights	Only C-141B/C if value for A		C-141A	
empty	148,120 lb	67,185 kg	133,730 lb	60,680 kg
Max ramp gross weight	325,000 lb	147,417 lb	318,500 lb	144,469 kg
Maximum takeoff gross weight	323,100 lb	146,555 kg	316,600 lb	143,600 kg
Maximum takeoff gross weight for C-141B/C at Emergency War Planning	343,000 lb	155,582 kg	316,600 lb	143,600 kg
Max payload 2,50G	74,233 lb	33,672 kg	70,850 lb	32,135 kg
Max payload 2,25G	94,508 lb	42,868 kg		
Normal landing weight (10 fps sink rate)	257,500 lb	116,800 kg	257,500 lb	116,800 kg
Maximum landing weight (6 fps sink rate) = Takeoff weight	323,100 lb	146,555 kg	316,600 lb	143,600 kg
EWP Maximum landing weight (6 fps sink rate) = Takeoff weight	343,000 lb	155,809 kg		

Speed			
Design cruise speed		489 kn	905 km/h
High speed cruise (ground speed)	0.767 Mach	478 kn	885 km/h
Long range Cruise Speed	0.740 Mach	465 kn	860 km/h
max. level speed at unknown altitude (ground speed)		492 kn	910 km/h

Ceilings	Only C-141B/C if value for A		C-141A
after take-off at max. GW	35,000 ft		more
normal	41,600 ft	12,680 m	
with no significant load	> 50.000 ft		more

Fuel capacity		
useable fuel (JP-4)	153,352 lb	69,559 kg

Engines

Four Pratt & Whitney TF-33-P-7 turbofan engines. Thrust each:	21,000 lb	93.5 kN

Range

With max. payload	2,570 nm	4,750 km
Ferry Range	5,550 nm	10,271 km

Unlimited range with inflight refueling (C-141B/C), which is also supported in by the respective XP models.

Crew

2 pilots, 2 flight engineers, 1 loadmaster (plus 1 navigator for airdrops, teams of 2 flight nurses and 3 medical technicians each for aeromedical evacuation)

Passengers

C-141B/C	C-141A
200 troops or 155 paratroops	154 troops or 123 paratroops

Initial Climb Rate

C-141B/C		C-141A
2,920 ft/min	890 m/min	more

Variants

Prototype	YC-141A
First production model; 284 built	C-141A
Prototype of the improved C-141A	YC-141B
In-flight refueling capability and a fuselage plug increasing length by 23.33 ft; 270 converted	C-141B
Update applied to C-141B fitte with modernized glass cockpit displays; 68 converted	C-141C

Introduction

It must be understood that an x-plane model can only reflect a friction of the complexity of the real C-141. Most systems and procedures are simulated in a very simplified manner. One reason is that x-plane does not support all those details, another is that you have to operate the aircraft from a one-man cockpit without using all the panels available in reality, where the workload is distributed on five crew members.

This document, which I call a Pilot's Operation Handbook, has the purpose of enabling a virtual pilot to operate a computer model within the x-plane system. While the real manual and all addendums fill thousands of pages, this one is a rough shortcut, rather meeting the demands and skills of the average x-plane pilot who has no intention to start complex calculations on countless sheets prior to each flight.

NOTE

Some x-plane pilots might even find this POH too complex. They should get along by reading the ENGINE START-UP procedure in this POH and using the panel legends und the views BACK and BACK LEFT within the XP cockpit.

At this place I want to state that wrote this document without the assistence or support by any other person and that I used no connection to U.S. military personal. Except from watching the C-141 operating at EDDF, all information has been aquired from websites open for public access on the internet, and sometimes it is hard to believe what you can find there, if researching patiently enough. I must assume that everything I found is non-restricted material, and I used it under this assumption. Nevertheless I found countless descriptions of systems and procedures - in particular those concerning the C-141C - which I do not want to forward or to refer to as an act of personal responsibility, since to my judgement such information should be classified, at least at this time, although the C-141 is not in active service for the U.S. Air Force anymore.

While in reality the C-141 was the predecessor of the C-5, in the x-plane world my C-5B appeared years before my C-141A. So I add some comparisons of the two models under this aspect.

The Aircrafts' History

The C-141 is the first military transport with jet propulsion and as such a landmark of aviation history. It went into service in 1964, but the first prototypes flew as early as 1953. So the roots of the C-141 go back to the dawn of the jet age, a fact that explains some of it's features and it's role within the AMC/MAC/MATS. It's propeller driven competitors had their strengths and could not simply be displaced by one single type of aircraft.

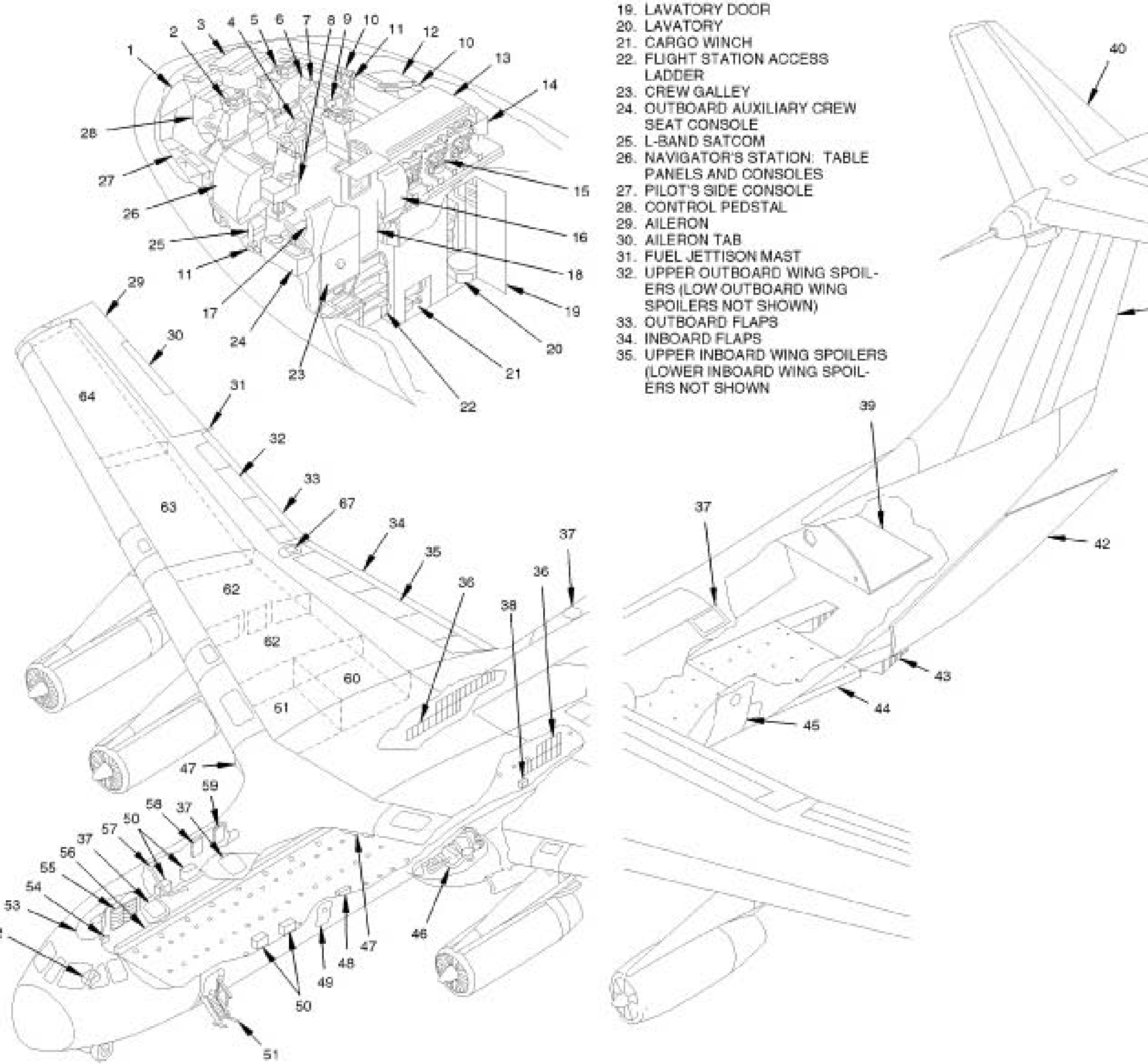
At the time the C-141 went into service, the C-124 Globemaster II was in charge of transporting outsized cargo. The C-141 could not compete in this aspect. It was the C-5A Galaxy who did that much later.

The C-130 Hercules maintained it's role as an agile tactical transport with outstanding STOL capabilities until today. The C-141 (and even the C-17) could only partially displace it.

Only the C-133 Cargomaster was more or less a victim of the C-141, although it was the newest, fastest and most powerful transport aircraft of the U.S. Air Force and had a higher payload than the C-141A. But the diameter of the cargoholds where roughly the same, and the C-141 was significantly faster. For this reason only 50 units of the C-133 were built and delivery was suspended by 1961. But it remeained in service until 1971. Again it was the C-5 who displaced this aircraft.

The C-141A quickly turned out to be severely overpowered. Reports say that an empty Starlifter could outperform an F/A 18 in it's initial climb rate. For this reason it was decided to stretch the fuselage by 7.1 meters and to increase the payload substantially. This plan lead to the C-141B put into service in December 1979 and later to the C-141C equipped with a class cockpit.

It was the C-17 who finally displaced the C-141. The Air Force took the Starlifters out of service in September 2004, but some C-141C units shall fly until 2006 for the AF Reserve.



1. MAIN INSTRUMENT PANEL
2. PILOT'S SEAT
3. OVERHEAD CONTROL PANEL
4. JUMP SEAT (INSTALLED POSITION)
5. COPILOT'S SEAT
6. COPILOT'S SIDE CONSOLE
7. ALDIS LAMP STOWAGE
8. NAVIGATOR'S SEAT
9. FLIGHT ENGINEER'S SEAT
10. CURTAIN
11. STOWAGE PROVISIONS: PORTABLE OXYGEN BOTTLES
12. FLIGHT ENGINEER'S CIRCUIT BREAKER PANEL
13. CREW BUNKS
14. BOOK SHELF
15. BUNK SEAT BACK INSTALLATIONS
16. INBOARD AUXILARY CREW SEAT
17. OUTBOARD AUXILIARY CREW SEAT
18. FLIGHT STATION ACCESS DOOR.
19. LAVATORY DOOR
20. LAVATORY
21. CARGO WINCH
22. FLIGHT STATION ACCESS LADDER
23. CREW GALLEY
24. OUTBOARD AUXILIARY CREW SEAT CONSOLE
25. L-BAND SATCOM
26. NAVIGATOR'S STATION: TABLE PANELS AND CONSOLES
27. PILOT'S SIDE CONSOLE
28. CONTROL PEDSTAL
29. AILERON
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31. FUEL JETTISON MAST
32. UPPER OUTBOARD WING SPOILERS (LOW OUTBOARD WING SPOILERS NOT SHOWN)
33. OUTBOARD FLAPS
34. INBOARD FLAPS
35. UPPER INBOARD WING SPOILERS (LOWER INBOARD WING SPOILERS NOT SHOWN
36. STOWAGE PROVISIONS: TIEDOWN DEVICES
37. EMERGENCY ESCAPE HATCH
38. EMERGENCY GENERATOR (ON LEFT WALL OF CARGO COMPARTMENT)
39. PRESSURE DOOR
40. ELEVATOR
41. RUDDER
42. PETAL DOOR
43. AUXILIARY LOADING RAMP
44. LOADING RAMP
45. TROOP DOOR (TYPICAL EACH SIDE)
46. AUXILIARY POWER UNIT
47. STALL STRIPS (TYPICAL BOTH WINGS)
48. UHF/VHF/SATCOM INTERFACE PANEL
49. EMERGENCY SIDE EXIT (FORWARD AND AFT OF WHEEL PODS ON EACH SIDE)
50. STOWAGE PROVISIONS: TIEDOWN FITTINGS AND CHAINS
51. CREW ENTRANCE LADDER
52. BATTERY (IN RH UNDERDECK RACK)
53. UNIVERSAL AERIAL REFUELING RECEPTACLE SLIPWAY INSTALLATION (UARRSI)
54. EXTERNAL POWER RECEPTICLE
55. STOWAGE PROVISIONS: TIEDOWN RINGS
56. WALKWAY (TYPICAL EACH SIDE OF CARGO COMPARTMENT)
57. STANCHION SUPPORT INSTALLATION
58. HF INTERFACE PANEL
59. USTS INTERFACE PANEL
60. NO. 3 AUXILIARY
61. NO. 3 MAIN TANK
62. RIGHT EXTENDED RANGE
63. NO. 4 AUXILIARY TANK
64. NO. 4 MAIN TANK

Systems

Important Note!

PLAIN TEXT is fully or at least partially relevant for the XP model (differences are indicated).

ITALIC TEXT **is for a better understanding of the real system. It has no relevance to XP or may differ from the XP model.**

Omitted Systems

The fuel quantity display, APU controls, pressurisation controls and indicators have been omitted, since their location is on the engineers' side panel, and I found no place on the pilots' panels to install them. Current fuel quantity may be displayed on the clipboard.

Engines / Thrust

The aircraft is equipped with four axial flow Pratt & Whitney TF33-P-7A flat rated, forward fan engines. The primary purpose of the flat-rated engine is to provide constant thrust over a wide ambient temperature range. Below 15° C, the engine operating at sea level develops a Rated Takeoff Thrust 20,250 pounds of static thrust. Above 15° C, thrust decreases with increasing temperatures. The amount of thrust is obtained by measuring the ratio between the air inlet total pressure and the exhaust gas total pressure.

The four Pratt & Whitney TF33-P-7 turbofan engines have a very low by-pass ratio (value unknown). For comparison, the C-5 has an extremely high ratio of 8:1 which makes it almost a turboprop. The low by-pass ratio makes the engines more effective at high speeds and altitudes than a high by-pass engine, at the cost of a higher fuel consumption.

The engines limits are:

- **max. EPR 2.10**
- **max. N1 101%**

whichever is more restrictive.

For more information refer to the figures in the section PERFORMANCE in the POH Appendix.

Target type thrust reverser doors are used to assist in decelerating the aircraft on the ground. **Reverse thrust is only allowed on the ground**, while the C-5 can set the 2 inboard engines on REVERSE IDLE during flight.

The aircraft has an auxiliary power unit (APU), located in the forward portion of the left wheel pod. (not simulated in XP 7, likely supported in v8)

The APU may be operated on the ground only and is operated from the APU control panel on the flight engineer's instrument panel in the real plane. In XP it wil be controlled from the OH panel (only on v8).

HORIZONTAL STABILIZER TRIM SYSTEM

Changing the angle of attack of the horizontal stabilizer is the method used to trim the aircraft's pitch axis. The horizontal stabilizer is limited to 4 degrees leading edge up travel under all conditions through limit switches. Leading edge down travel is limited through switches to 8 degrees with the flaps up and 9.6 degrees with the flaps extended. Mechanically, the horizontal stabilizer is limited to 4.5 degrees leading edge up travel and 10 degrees leading edge down travel. Nose-up trim is interrupted if a stall signal is present in the stall prevention system.

Hydraulic Pitch Trim Levers

Two levers are located on both sides of the center pedestal.

Electrical Pitch Trim Switches

Two electrical pitch trim switches are located on the center portion of the control pedestal and on the yokes of the pilot and copilot. The dual switches must be operated simultaneously to provide both power and ground to one clutch in the electric pitch trim power unit. For electrical actuation of pitch trim, both switches are moved up for nose-down trim or down for nose-up trim. The switches are spring-loaded to a central (OFF) position. If the autopilot pitch axis is engaged, the switches are inoperative and the autopilot must be disengaged to operate the electrical pitch trim switches.

Electrical Pitch Trim Disconnect Buttons

A TRIM DISC button on each pilot's control wheel provides disconnect of electrical and electrohydraulic pitch trim. - This button does not work in XP, but you may assign the TAKE-OFF TRIM button to your hardware. The XP take-off trim is set on 0° in order to reset the pitch trim on neutral. - Hydraulic pitch trim will still be available through use of the hydraulic pitch trim levers.

WING FLAP SYSTEM

The aircraft has double-slotted, high-lift, Lockheed Fowler flaps. The wing flaps consist of two sections on each wing, extending from the wing root to the aileron. The flaps are mounted on carriages which roll on curved tracks extending aft from the trailing edge of the wing structure. Two hydraulic motors are mounted on a gearbox and drive the jackscrew actuators by means of torque tubes. Hydraulic system No. 2 supplies one of the motors and hydraulic system No. 3 supplies the other. The flaps are normally fully extended or retracted in 15 seconds. With either motor inoperative, this time is approximately 30 seconds.

Wing Flap Lever

The wing flap lever, located on the control pedestal has three detent positions, placarded "FLAPS UP", "TAKE OFF/ APPROACH" and "LANDING". Additional markings are provided for the "25" percent and "50" percent positions. Any percentage of fully extended flaps can be selected with the lever. A springloaded friction brake locks the lever in position. The aft edge of the lever knob must be tilted upward to release the brake. Flap Lever Stop Position Indicator. The FLAP STOP POSITION INDICATOR pin is located on the flap lever quadrant. The pin is activated by a solenoid operated high force detent whenever the spoilers move from the locked position or the spoiler handle is armed in-flight. Refer to Section III for override procedure. Flap Position Indicator. The Wing Flap Position Indicator is located on the pilots' center instrument panel. The indicator is calibrated in percent of travel in increments of ten percent (100% equals 49 ±1 degree). The transmitter is located on the flap gearbox output.

During take-off and approach the C-141 normally operates with flaps extended to 75% (37.5°), which results in a very low AOA, which can be a negative AOA at moderate grossweight! This made a Leading Edge Device obsolete. While the C-5 has huge slats, the C-141 has none at all. - Both planes can set their flaps on any desired postion between 0-100%. But the C-5 strictly operates with only 3 positions for flaps extension, the C-141 with four and a smooth tapering or delay of retraction during transit to clean condition.

Flap settings in XP:

position	F0	0% = 0°	Flaps UP
	F1	12,5% = 6,3°	
	F2	25% = 12,5°	
	F3	50% = 25,0°	
	F4	75% = 37,5°	Take off and Approach
	F5	80% = 40°	
	F6	100% = 50,0°	Land

The positions F0, F2, F3, F4, F6 are indicated at the flap lever by markers, F0, F4, F6 are additionally named. F1 is for smooth transition, F5 is often used for airdrop maneuvres.

Speed limits for flap extend are:

LANDING: 185 kn or Mach 0.45

TAKE OFF: 200 kn or Mach 0.55

For detailed speed settings refer to the chapters TAKE OFF / CLIMBOUT, APPROACH AND FINAL APPROACH in the PROCEDURES section!

WING SPOILER SYSTEM

The wing spoiler system is used in-flight to increase drag, and during ground roll to reduce lift and increase drag. Four banks of spoiler panels, two in each wing (totaling 36 panels), hinged at their leading edges, are installed on the upper and lower surfaces of the wing. A bank of spoilers is a section controlled by an actuator (i.e., LH inboard, LH outboard, RH inboard, or RH outboard). The upper spoilers are located near the wing trailing edge and the lower spoilers are located between the wing rear beam and the wing flaps. A spoiler lever, located on the center console, mechanically operates a cable servo located below the center console. The cable servo reduces the effort required for spoiler control and allows rapid spoiler lever movement with the actuation system following at a slower rate. The servo valves on the spoiler actuators control the flow of high pressure fluid directly to the inboard and out board actuator cylinders. Each inboard and outboard actuator cylinder has a main and auxiliary piston connected to a common drive tube. Aerodynamic forces cause relief valves to operate, causing the spoilers to “blowdown” above 250 KCAS. Hydraulic pressure is supplied to the cylinders from the No. 2 and No. 3 hydraulic systems. Spoiler panel deflections are limited by mechanical stops.

SPOILER OPERATION IN-FLIGHT

With the landing gear lever up, the main and auxiliary pistons are used in unison to operate the spoilers, since high output loads are required. Full in-flight deflections are obtained up to 250 KCAS; above this, “blowdown” occurs. Spoiler retraction will occur when the spoiler lever is moved five degrees or more aft of the “FLT LIMIT” position.

The spoilers must not be extended while the flaps are down to avoid possible damage to the spoilers due to aerodynamic buffeting.

SPOILER OPERATION ON GROUND

When the landing gear handle is down, the fluid flow to the auxiliary piston in each cylinder is hydraulically shut off and bypassed by solenoid-operated valves. The main piston is used, since the loads are lower and a faster response is required. The inboard cylinder uses pressure from the No. 2 system only, and the outboard cylinder uses pressure from the No. 3 system only. With the landing gear lever down, the spoilers *will retract when No. 1 or 2 and No. 3 or 4 throttles are advanced beyond the 54-degree throttle position. This feature can be defeated by placing the SPOILER AUTO RETRACT DEFEAT switch to "DEFEAT".*

SPOILERS IN XP

The special arrangement of UPPER and LOWER spoilers with different extend angles and the "downblow" beyond 250 KCAS cannot be reproduced. A compromise has been made by simulating only the upper spoilers with a larger chord ratio and the max. extend angle set on 59° for in-flight use (authentic value). This does not correctly simulate the nose-up effect of the real C-141. Be cautious to only partially extend the spoilers above 250 KCAS! On the ground the spoilers cannot extend beyond 59° to 90° as in reality, so the loss of lift and increase of drag is lower

LANDING GEAR INDICATION

Landing Gear Position Indicators

Three DC flag-type position indicators, located above the landing gear lever (see figure on page 4 of Appendix), show the position of each landing gear. A miniature wheel flag indicates gear down and locked, an UP flag indicates gear up and locked, and a black and yellow striped flag indicates the gear is not locked. Limit switches, actuated by movement of the landing gear locks, control the position indicators.

Bogie Position Indicator

A DC flag-type BOGIE POSITION indicator for each main gear bogie is located on the pilots' center instrument panel (figure in Appendix). A miniature wheel flag indicates the associated bogie is in position for landing. A striped flag indicates the bogie is either in transit or up. Limit switches, actuated by movement of the bogies, control the position indicators. Horn Silence Button.

BRAKES

Like the C-5, the C-141 has anti-skid brakes but no auto-brakes.

IN-FLIGHT REFUELING

Only the C-141B and C are aquipped with in-flight refueling system, as the C-5B. It is supported by the respective XP models. The C-141A has no such system.

AUTOPILOT

The autopilot operates the flight control system of the aircraft to maintain normal, stabilized attitudes automatically. The autopilot also maintains any desired heading and provides coordinated turn control, automatic electric elevator trim, constant-pressure altitude control, automatic VOR, FMS, and TACAN tracking and automatic approach control for instrument landing system (ILS) approaches. Controls for the autopilot are located on the center pedestal (and on the main panel in XP for the C-141A/B).

All C-141 models have an INS system, Navigation Selector pad on the main panel and a Flight Command Indicator mounted on top of the Engine Fire Extinguisher Panel. The C-141C has - in addition - a complex Flight Management System (FMS), integrating these systems as well as the AP, INS and GPS, with several Monitors for display and data input, as are the Display Avionocs Management Units (DAMU), the Multi Function Control Display Units (MFCDU). This system is eytremely complex, even if you omit the functions concerning military operations and maneuvres. The XP model reflects a very simplified functionality, which cannot be not authentic in every detail.

Starting with XP 8.50, the C-141C is equipped with a Terrain Contour Flight button (TERR) which is part of the AP system. This is helpful to conduct special warfare missions. The C-141C normally was not equipped with this feature.

Autopilot disconnect buttons are located on the outer rim of the pilot's and copilot's control wheel (do not function in XP).

CAUTION

A partial or complete electric pitch trim failure could result in a mistrimmed condition. A rapid pitch up or pitch down may occur when the autopilot disconnects, either due to A/P trim failure condition or a manual A/P disconnect. The rapid pitch change could injure crew members or passengers not strapped in.

EXTERIOR LIGHTS

The exterior lights consist of two landing lights, four taxi lights, nine formation lights, three navigation lights, three anti-collision lights, and two leading edge lights. Aerial refueling system lighting is covered under the Aerial Refueling System.

LANDING LIGHTS

A landing light is mounted on the underside of each wing between the engine pylons. Switches for extending and retracting and for illumination of the lights are located on the LANDING LIGHTS portion of the extension pilot's overhead control panel. *The two extension and retraction switches are threeposition ("EXT", "OFF", "RET") toggle switches (in XP only ON/OFF). These switches control the landing actuators retracting or extending the lights when the switches are moved to "RET" or "EXT" positions. A LT EXTENDED indicator located above the extension and retraction switches illuminates when the landing lights leave the retracted position. When either switch is moved to the "OFF" position, the landing light actuator motor is deenergized and the light will lock in position.* Two 2-position ("ON", "OFF") toggle switches control the illumination of the landing lights. When either switch is moved to "OFF", the corresponding light is extinguished.

TAXI LIGHTS

Two taxi lights are mounted on the side of the main landing gear doors (in XP only one at the right side). Illumination of these lights is controlled by a two-position ("ON", "OFF") TAXI LIGHT toggle switch located just forward of the exterior lighting control panel. In addition, there is an interconnect between this switch and the wing leading illumination lights, so that when the taxi lights are illuminated, the wing leading edge lights are also illuminated. These lights should be turned off when the gear is retracted.

FORMATION LIGHTS (not in XP)

Nine formation lights are installed on the aircraft: three on the outer section of each wing and three on the top fuselage, aft of the wing. The illumination and brilliance of all nine formation lights are controlled through a three-position ("DIM", "OFF", "BRIGHT") EXTERIOR FORMATION toggle switch on the exterior lighting control panel.

Flight Characteristics

INTRODUCTION

Characteristic for the C-141 - and quite unsusual - is the low attitude after take-off and on final approach. For take-off the flaps are set on 37.5° (75%), which lets it climb almost like a helicopter

. The pilot must push the nose slightly down as soon as the aircraft gained some speed. I often could see that at EDDF, it looks as if the aircraft was pulled upward like a puppet on a string. The x-plane models behaves in the same manner. At low gross weight, climb out must be performed with moderate thrust. Only at very high crossweight the C-141 behaves more or less like a normal aircraft of it's size.

The aircraft is designed for high-speed, high altitude flight. A satisfactory level of stability and control is experienced throughout the airspeed and altitude range. Aerobatic flight is prohibited.

The range between slow-speed and high-speed flight is unusually large, but stability and control are normal for any trimmed condition.

STALLS

The figures on the pages 20 to 27 of the POH-Appendix show stall speeds in the various angles of bank and flap configurations as well as the Stick Shaker Onset Speeds.

STICK SHAKER ONSET SPEEDS AND STICK SHAKER ENVELOPES (C-141B)

The figure on page shows stick shaker speeds, in the various angles of bank and flap configurations. The speed envelope or buffet boundary for stick shaker operation is presented in the figure on page 25 for various altitudes, gross weights and Mach numbers. In the cruise configuration, stick shaker and natural buffet occur simultaneously for Mach numbers up to 0.70. At higher Mach numbers, natural buffet occurs earlier. With flaps extended natural buffet will always precede the stick shaker. shaker onset occurs is influenced by aircraft configuration.

STALL CHARACTERISTICS

During an approach to a straight flight stall, light buffet onset will be encountered prior to stick shaker actuation. At the angle of attack for buffet onset, lateral control is adequate. The initial stall of the wing is an airflow separation over the upper surface between the pylons. At angles of attack for shaker stall warning and greater, the loss of lift is not always symmetrical on both wings; therefore, the ability to maintain wings level becomes more difficult since roll control is less effective. Use of rudder will aggravate this lateral control problem and may result in a large bank upset during recovery. Timely use of aileron control after buffet or shaker onset will prevent excessive roll excursions. In turning-flight stalls, the aircraft exhibits a natural tendency to roll out of the turn at the stick shaker onset point. If this tendency is resisted or the turn tightened, the aircraft will show a tendency to roll under with an increase in buffet level. This tendency is best corrected by applying roll control and rolling out of the turn during recovery of airspeed. Do not tighten a turn or resist the aircraft tendency to roll to wings level when an inadvertent turning flight stall is encountered.

STALL WARNING

In XP visual and audible stall warning is available as a red warning light on the top of the pilot's and co-pilot's mainpanel (A/B) or in the center of the Primary Flight Display (C). A shaker is supported, but you need the respective hardware. In XP the STALL WARNING is set to 13°.

Shaker onset has been demonstrated to occur at speeds ranging from 2 knots to as high as 24 knots above calculated stall speed at altitudes of 10,000 to 12,000 feet and 24,000 to 26,000 feet. At 33,000 to 35,000 feet, shaker onset has been demonstrated to occur at speeds ranging from 15 to 33 knots above calculated stall speed. The speed at which shaker onset occurs is influenced by gear and flaps, gross weight, and center of gravity. For a given configuration, the number of knots above calculated stall speed at which shaker *onset occurs will increase as the calculated stall speed increases. Insufficient flight data exists to plot onset curves.*

PRACTICE STALLS

Intentional stalls are strictly prohibited.

Approach to stalls may be practiced during training to the stick shaker onset point under the supervision of an instructorpilot. When practice approach to stalls are undertaken, the aircraft should be trimmed at 1.4 times the computed stall speed for the aircraft configuration. Once the trim has been established, this setting should not be changed. Practice approach to stalls should be accomplished at idle or with small amounts of power. Deceleration during the approach to stall should be gradual (approximately one knot per second) until the stick shaker activates. High altitude practice approach to stalls may be practiced from the cruise configurations only. The approach to stall should be accomplished in turning flight from speeds above Mach 0.55. The speed should be decreased steadily at one knot per sec. until shaker has actuated. Practice approach to stalls will not be accomplished unless both Stall Warning systems are operable. The pilot should not carry the stall beyond a point of heavy aircraft buffet in case the stall warning system fails to operate properly.

STALL RECOVERY

The stall recovery on the C-141 is conventional for this type of aircraft. At stick shaker onset, the relaxation of the elevator or a moderate push on the control column accompanied by an increase in engine thrust will produce a recovery with minimum loss of altitude. Ailerons should be used for lateral control during recovery. Use of rudder will delay recovery and could produce large bank angle upsets.

UNCOMMANDED YAWING MOTIONS (SMALL)

The C-141C exhibits small yawing motions at speeds greater than 200 KCAS. These motions are characterized primarily by their small (barely noticeable) magnitude and, because of the small magnitude, affect neither the handling characteristics nor the flight path of the aircraft. These motions are an inherent aerodynamic characteristics of the airframe and are not associated with any of the control systems of the aircraft, either automatic or manual. These motions are not continuous yawing oscillations. They are small changes in the yaw angle of the aircraft. The change is about one degree. The new yaw angle is held steady for a time ranging from several seconds to several minutes, then abruptly releases. It may repeat in several seconds or may not repeat for 15 or 20 minutes. Extensive flight tests have shown this phenomenon to be more prevalent at altitudes below FL200 but it has occurred at all altitudes. Some aircraft may not exhibit this characteristic on every flight and some may not exhibit it at all.

LATERAL CONTROL

Intentional operation in the speed range between 380 and 410 KCAS is not recommended since a substantial reduction in aileron control effectiveness is experienced. Positive lateral control is still available with full aileron control deflection; partial aileron control deflections may be ineffective. An increased roll rate will be obtained if full rudder, as well as full aileron, is utilized to recover from large lateral upsets at these high speeds. When operating at maximum speeds, positive pilot input to the rudder should be used when lateral correction is required, thus overcoming opposite yaw created by momentary yaw damper operation. During recovery from high speed upsets at speeds approaching maximum, a loss of aileron effectiveness will be noted. If this should occur, full aileron throw will provide a positive roll rate. The rudder is an effective roll control device at these high speeds and must be properly coordinated to obtain adequate roll response.

WAKE TURBULENCE

Every aircraft generates wake turbulence in-flight. Wingtip vortices are the most hazardous component of this wake. A wingtip vortex is a highly rotational mass of disturbed high energy air created by an airfoil as it produces lift. The strength of the vortex is governed by the angle of attack and shape of the aircraft wing. The greatest vortex occurs when the generating aircraft is HEAVY, CLEAN, and SLOW, i.e., high angles of attack. If an aircraft encounters wake turbulence, induced rolling moments caused by the wingtip vortex can roll the aircraft sharply, and may exceed flight control authority. In this situation, aileron input alone may not be sufficient for recovery. A timely application of power and coordinated flight control inputs may be necessary to escape the severe upward and downward forces.

WAKE TURBULENCE AVOIDANCE PROCEDURES

Avoid the area below and behind the generating aircraft, especially at low altitude where even a momentary wake encounter can be hazardous. In all phases of flight, pilots should consider the wake turbulence generated by their aircraft or preceding aircraft and plan or adjust their flight paths to minimize wake turbulence exposure to their own aircraft or wingmen. The amount of flight control input and the amount of time required to recover will depend on the severity of the wake turbulence encountered. At the first indication of encountering wake turbulence take immediate steps to recover: 1. Immediately apply power. 2. Pull up using elevator control, then apply rudder and aileron inputs. 3. When out of wake turbulence, normal flight control authority will be regained enabling complete recovery of aircraft control.

SPINS

Spins are a prohibited maneuver. If a spin is entered accidentally, a normal recovery should be effective. Reduce power to idle, apply full rudder (opposite to needle indication on the turn and slip indicator) and ailerons against the spin. Without changing the trim setting of the horizontal stabilizer, hold elevator control forward of the neutral position. When rotation stops, immediately return rudder and aileron to neutral. Perform dive recovery. Excessive aircraft structural loads or a secondary stall may result from an abrupt pullout during dive recovery.

DUTCH ROLL

Dutch Roll is a combination of yawing and rolling motion that is characteristic of sweptwing aircraft. These yawing and rolling motions are interrelated, in that the Dutch Roll cannot exist without both roll and yaw. Large rolling/yawing motions may become dangerous unless properly dampened. The Dutch Roll in this aircraft can be stable, neutral, or unstable and is a function of gross weight, altitude, and airspeed. The Dutch Roll oscillations are less stable with increased altitude, increased weight, and low airspeed. Dutch Roll can be induced by turbulence, aileron inputs, rudder inputs, or any combination of these conditions.

DUTCH ROLL RECOVERY PROCEDURES

The primary means of stopping Dutch Roll is the yaw damper. In addition, the autopilot lateral axis will dampen the Dutch Roll under all conditions. Manual recovery is accomplished with aileron control inputs. The yawing and rolling motion of the Dutch Roll is interrelated but the rolling motion is more noticeable. Stopping the rolling motion with ailerons will also dampen the yawing motion. The period of the Dutch Roll is approximately 5 to 7 seconds; therefore, the initial pilot action is to analyze the rolling motion. The rolling motion of the Dutch Roll will reverse direction every 3 to 4 seconds. The rolling motion to the left requires right aileron, and conversely a rolling motion to the right requires left aileron. Maintain a wings-level flight attitude. The use of rudders either singly or in conjunction with aileron to dampen the Dutch Roll is difficult and should not be attempted. There is a high probability of aggravating the Dutch Roll condition. The Dutch Roll is well damped at all altitudes and gross weights at 0.79 Mach and above. Increasing the Mach number to 0.79 – 0.80 by accelerating/descending will dampen the Dutch Roll with no lateral directional control inputs; however, increasing airspeed with large yaw/Dutch Roll oscillations may cause aircraft structural damage.

BUFFET BOUNDARY

At speeds in excess of Mach 0.85 with wings level, buffet intensity is such that deliberate operation is not recommended. It is possible to fly fast enough to cause a progressive airflow separation over the wing which results in aircraft buffet. At speeds above 0.84 Mach, natural aircraft buffet is experienced at all altitude and gross weight conditions with wings level. As bank angle is introduced, buffet onset occurs at proportionally lower Mach numbers as shown on the Buffet Boundary Limitation chart.

FLIGHT CHARACTERISTICS WITH SPOILERS

Spoiler deployment results in wing buffeting and pitch up tendency. The spoilers should be deployed or retracted slowly while in-flight to prevent sudden upsets from trimmed condition. Rapid spoiler retraction during recovery from a trimmed high speed descent will considerably increase the pilot effort due to pitch down tendency. The minimum allowable speed with spoilers deployed can be determined using the appropriate figure. An audible and visual under spoiler speed indication will occur at this minimum speed. If this warning should occur, retract the spoilers or increase speed immediately. Do not intentionally accelerate into a stall with spoilers extended. The spoiler under speed warning system may not provide adequate warning when accelerating into a stall.

FLIGHT CHARACTERISTICS - AILERON TAB LOCKOUT SYSTEM

The aileron tab lockout system provides a backup source of lateral control should an aileron lose hydraulic power. Roll rate is significantly reduced in this configuration and response time is increased. Level flight can be maintained using the aileron tabs, but the landing capability during gusting or crosswind conditions is unknown but probably hazardous. Therefore, the aileron tab lockout system is not to be used for landing except in emergency conditions. NOTE Considerably more force will be necessary to maintain wings level flight when only one aileron is placed in tab operable.

FLIGHT CHARACTERISTICS - FREE-FLOATING STABILIZER

A free-floating stabilizer will move in a direction opposite to the elevator deflection. Aircraft nose-up elevator causes the stabilizer to move aircraft nose down and conversely, due to aerodynamic loading aft of the hinge point.

PROCEDURES

Flight Planning

The max ramp gross weight for a C-141A mission is 177,730 lbs.
Max payload 2,50G: 70,850 lb*

*The gross weight is not of much significance in this aspect, because the C-141 has only wing tanks. Therefore the fuel weight does not stress the structure during flight.

Since the INS of the C-141A is not supported by x-plane, the pilot can use the right side of the clipboard attached to the yoke to create, load and save flight plans and to feed this data to the moving map and the autopilot (analog to FMS).

The left side of the clipboard can display and continiousely compute fuel available, current weight, range and endurance. In the real aircraft the flight engineer will provide these data to the pilots.

Engine Start

Here is how the engine of the real C-141 is started:

The 4-Joule continuous ignition system is an auxiliary system that minimizes the possibility of an engine flameout due to temporary fluctuations under operating conditions other than starting. When the continuous igniter plug is operating, the engine automatically relights as soon as the condition causing flameout corrects itself. A single CONTINUOUS IGNITION switch, located on the pilots’ overhead panel, arms the continuous ignition systems on all four engines. When the switch is “ON” AC current is fed into the continuous ignition exciter. The current is then passed through a series of filters, transformers, and rectifiers until a high voltage DC current is obtained

AIRSPEED LIMITATIONS

CONFIGURATION	LIMITATION	SPEED
Clean - Landing Light Landing Light Extended	Do not exceed	350 KCAS or Mach = 0.53
Landing Gear Extended	Do not exceed	235 KCAS or Mach = 0.55
Landing Gear Operation	Do not operate landing gear above	200 KCAS or Mach = 0.48
DOORS △1	Do not exceed	200 KCAS or Mach = 0.48
Petal Door Open Ramp Door Open Troop Doors Open Air Deflectors		
Air Refueling Door	Do not exceed	350 KCAS or Mach = 0.825
Stabilizer Access Door	Do not exceed	280 KCAS or Mach = 0.75
Take-off/Approach △2 Flaps	Do not exceed	200 KCAS or Mach = 0.48
Landing Flaps △2	Do not exceed	185 KCAS or Mach = 0.45
Any Configuration	Do not exceed	174 knots Ground speed at Touch-down (maximum demonstrated in tire test)
Any Configuration	Do not exceed	147 KCAS is the maximum Speed for Extension Of The Spoilers To the Ground Position (Not To Be Used In-flight.)

△1 Limitations on specific doors are independent of other door positions.

△2 These limitations also apply while flaps are being extended to or retracted from this position.

that will ionize the gap in the continuous ignition spark igniter in No. 4 combustion chamber and provide a continuous spark as long as the CONTINUOUS IGNITION switch is “ON” and the FUEL AND START IGNITION switch is in the “RUN” position.

Four 2-position (START, STOP) STARTER buttons are on the pilots’ forward overhead panel. The buttons control the opening of the related starter control valve. Depressing the button energizes the valve solenoid, opening the valve. A holding coil automatically holds the button in the depressed (START) position until the N2 compressor speed increases to between 35 and 45 percent RPM. A cutout switch then automatically releases the button, allowing it to pop out. The button can be manually pulled out at any time. A red light in the center of the button glows while the button is in the START position. A guard is provided around the button to prevent inadvertent energizing of the starter. The overheat protection normally provided by the automatic closing feature of the pylon shutoff, wing isolation and floor heat shutoff valves is removed when a STARTER button is in the START position. Starter Valve Light.

The red starter buttons are each pushed in (during engine start and with normal pneumatic pressure), the button is magnetically held "in" and the light in the button comes on (red). The fuel and start ignition switch (directly above it) is put to "run", allowing ignition and fuel to go to the engine. When the engine accelerates to 35 and 45%, the button "pops" out to the original position and the light extinguishes.

The x-plane procedure:

First switch OFF the 4 FUEL AND START IGNITION switches if active by default, as in XP7 (not in XP8)

1.) Switch on all 4 mixture sliders (to UP position) on the engine-fire extension panel, each located directly at the inboard sides from the corresponding fire estinguisher switch. (The white mixture handles are very small in my model, since they do not exist in the real C-141.)

2.) Push the red STARTER button (which actually is the fuel pump switch) of the first engine to start for a couple of seconds until N2 reaches 13-14%. Hit the center of the red light in order to simultaniously activate the fuel pump AND the starter button hidden below. The red light is turned on and must stay alit.

3.) Immediately switch ON the FUEL AND START IGNITION for this engine and monitor ITT and N1. ITT shall not exceed 400° or the engine has to be shut down instantly. The start atempt may be repeated after 10 min.

4.) When N1 is at least at 10%(18% = idle), switch on the generator for this engine (OH panel).

5.) Repeat steps 2, 3 and 4 for the other 3 engines.

6.) Deactivate the starter buttons manually once the engine(s) have gained 18% N1 for the first time (46% in the real C-5). Be shure to press on the upper white part of the switch, in order to avoid hitting the start button again, which is located under the red part of the switch. The red lights must be extinguished. - Leave the 4 FUEL AND START IGNITION switches on! Turning off will shut down the engine by closing the fuel supply and interupting the ignition.

Taxi

Engage INS (Inertial Navigation System, in XP = FMS) BEFORE taxi in order to avoid significant error in INS position!

The front wheel can steer up to 60° into both directions (120° total turning angle).

Do not taxi at more than 20 kn, for 90° turns reduce speed to less than 10kn!

Do not tow or taxi the aircraft for 2 minutes after INS shutdown to preclude damage to the equipment.

Take-off procedures

The take-off calculations are for either a reduced (RED) or take-off rated thrust (TRT) take-off. A set take-off rated thrust before brake release (MAX) has to be calculated when a RED or a TRT take-off cannot be performed.

Take-offs may be made with TRT-EPR or reduced EPR using rolling or standing techniques. A reduced EPR take-off is the preferred method, conditions permitting. A TRT take-off shall be made when gross weight is limited by critical field length, obstacle clearance, three-engine climb, windshear, or gust front from a thunderstorm or CB is anticipated. Set TRT prior to brake release when gross weight is limited by critical field length or obstacle clearance.

In the real C-141 throttle settings are rather defined by EPR than by N1, but XP seems to be unprecise in EPR handling.

Max. N1 is 101%. For the C-141A a RED take-off thrust around 90% or even less is sufficient under most conditions.

WARNING

• Do not take-off if an engine fails to reach take-off EPR.

• The C-141A is overpowered. Be careful not to exceed speed limits for tyres and extended flaps and gears!

Set flaps on F4 = 75%.

For XP default weight:

rotation speed 135-140 KIAS
lift-off 145-150 KIAS
save climbout speed 160-170 KIAS
Initial climb rate: 2,500-2,900 ft/min
Retract flaps between 180 and 190 KIAS!
AOA should not exceed ±3° at clean condition.

STANDING TAKE-OFF

1. While holding brakes, the pilot flying will slowly advance the throttles to 70% N1 RPM.
2. The pilot flying will release brakes and smoothly advance the throttles to take-off EPR. The pilot not flying will make the final power adjustment. The pilot flying will maintain primary control of the throttles throughout the takeoff and initial climb. Full throttle will not normally be required.
3. The pilot will use nose wheel steering until takeoff EPR is set and then transition to the yoke. a. If the pilot is performing the take-off, the copilot will maintain wings level and a slight forward pressure on the yoke until the pilot takes control of the yoke. b. If the copilot is performing the take-off, the procedures remain the same except the copilot retains control throughout the take-off.
4. The pilot not flying will check the airspeed indicators and the pitch trim indicator for movement during take-off roll.

WARNING

• The pilot not flying must monitor the SFD CWA and PFD annunciations and advise the pilot flying immediately.

• When the center of gravity is aft of 25% MAC and a runaway pitch trim to the full nose-up limit (10.0 degrees) goes undetected, pitch control problems will be encountered. Considerable forward pressure will be required on the yoke for extreme nose-up trim settings. Approximately 8 degrees noseup trim is the maximum that can be controlled in a wings-level attitude.

5. If any crewmember notes an unsafe condition before GO speed, state “REJECT”. The final decision to reject shall be made by the aircraft commander.

6. If GO speed is rotate, the pilot not flying will state “GO, ROTATE”. If GO speed is less than ROTATE speed, the pilot not flying will state “GO” at GO speed followed by “ROTATE” at ROTATE speed.

7. At rotation speed, rotate smoothly approximately 6 to 8 degrees.

ROLLING TAKE-OFF

The rolling take-off procedure is the same as the standing procedure except that the pilot flying will not hold the brakes while applying power for take-off. Align the aircraft with the runway centerline at slow speed and prior to advancing power for take-off. Refusal speed must be equal to or greater than rotation speed. Rolling take-offs may be accomplished from the right seat after the aircraft is aligned on the runway, stopped, and control transferred to the copilot.

TAKE-OFF GUST CORRECTION

If surface winds are gusting, increase rotation speed by the amount of the gust up to a maximum of 10 knots. If GO speed is based on rotation speed, it will also be increased. GO speed must never be increased above refusal speed, maximum braking speed, or 147 KCAS. Reset pilot and copilot command markers accordingly.

WIND SHEAR ON TAKE-OFF

Forecast wind shear must be carefully analyzed prior to attempting a take-off. Take-off wind shear may be associated with frontal passage, thunderstorm activity, low level jet stream, or microburst phenomena. Pilots should be aware of this activity and delay take-off, if necessary.

WARNING

Do not take-off if evidence of a microburst is reported or observed. Make a TRT take-off if wind shear or microburst phenomena are forecast or likely to occur. An increasing tailwind during takeoff roll may invalidate a precomputed refusal speed. Closely monitor aircraft performance on climbout.

Maintain pitch attitude at or slightly above takeoff attitude and use maximum engine thrust. If approach to stall is indicated, make small pitch adjustments to eliminate indications. Decreasing pitch attitude in an attempt to regain airspeed during initial shear encounter may prevent successful recovery.

INSTRUMENT TAKE-OFF

Select the navigation aids to be used for the departure and set the desired course in the course selection window. The heading marker may be set to the runway heading or the initial departure heading, whichever is most logical. After aligning the aircraft on the runway, check the heading. Complete the Lineup checklist and make a standing or rolling take-off. Maintain runway alignment by visual means as long as possible.

WARNING

When a TAWS warning is received, take immediate action to ensure terrain clearance.

1. After a positive rate of climb, the pilot flying will state “GEAR UP.” The pilot not flying will acknowledge if the gear and bogie position indicators are normal. The copilot will then place the landing gear lever UP. If the gear or bogie position indicators are not normal before retraction, refer to landing gear malfunctions, Section III. If the gear does not retract, advise the pilot flying. When the gear indicates up, the pilot not flying will state, “GEAR IS UP”.

2. The copilot will DISARM the spoiler lever when flight station duties permit. NOTE If defensive systems are required immediately after take-off, have the engineer accomplish item 2 of the After Take-Off, Climb Checklist. 3. Maintain a pitch attitude that will give a rate of climb of approximately 1,000 FPM and accelerate to flap retract speed. The pilot flying will state “FLAPS

UP.” The pilot not flying will acknowledge and raise the flaps. When the flaps are retracted, the pilot not flying will state, “FLAPS ARE UP."

WARNING

To ensure an adequate margin above stall is maintained, do not exceed 10 degrees of bank if flaps are retracted at minimum flap retract speed. If an increased angle of bank is required (not to exceed 30 degrees), airspeed shall be increased to a minimum of 20 knots above flap retract speed prior to flap retraction.

4. Maintain approximately 1,000 FPM and accelerate to 250 KCAS. The pilot flying, will set climb power or state “CLIMB POWER” (approximately 92% N1 RPM). The pilot not flying will acknowledge and set climb power. The flight engineer will compute a corrected EPR setting for climb. After passing 10,000 feet, accelerate to 280 KCAS.

NOTE

If low altitude maneuvering is required, maintain 200 knots. altitude restrictions), the pilot flying may direct the pilot not flying to set the next altitude restriction.

OBSTACLE CLIMBOUT

This climbout will be used anytime obstacle clearance is a factor. Set TRT prior to brake release. After takeoff, maintain approximately 1,000 FPM until reaching VMFR. Climb at VMFR with flaps approach until clearing the obstacle. Retract the flaps, maintain approximately 1,000 FPM and accelerate to climb airspeed. Normal climb procedures then apply.

CLIMBOUT

During climbout maintain AOA <3.5° with flaps extended and clean.

As soon as ATC speed restrictions allow it, the optimum climb schedule is 280 knots until reaching MACH 0,74.

Cruise

The flight engineer will provide KCAS, Mach, and target EPR prior to reaching cruise altitude. The pilot flying will fly the computed KCAS to maintain the desired Mach.

CRUISE

For C-141C only: FMS CRUISE Modes are Economy, Long Range, Selectable Speed, Engine-out, and RTA (Required Time of Arrival). Each CRUISE Mode is capable of being coupled to an autopilot.

Cruise speeds GS:

465 kn economic cruise
489 kn design cruise speed
478 kn max. cruise speed

Maintain AOA < 2°

Climb rates: at XP default weight

2,500 ft/min < 10.000 ft
2,000 ft/min < 25.000 ft
1,500 ft/min < 29.000 ft
1,000 ft/min < 35.000 ft
500 ft/min > 35.000 ft

Standard service ceiling: 41,600 ft.
For further values and climb rates refer to the figures in the document APPENDIX!
300 fpm climb altitude is the highest recomendable altitude!

The AMC thunderstorm avoidance criteria state that thunderstorms and CB clouds are to be avoided by 20 nautical miles when flying FL 230 and above.
In areas of turbulence and thunderstorms it is recommended that the autopilot's altitude hold mode or mach hold mode should be disengaged and the autopilot should be used in the basic attitude modes.
Refer to chapter Bad Weather Procedures!

DESCENT PROCEDURES

ENROUTE DESCENT

Enroute descents are accomplished by retarding throttles with the landing gear up, flaps and spoilers retracted, and descending at 0.74 or 0.767 Mach until reaching 300 KCAS at which time 300 KCAS may be maintained to 10,000 feet. Maintain 250 KCAS below 10,000 feet.

PENETRATION

1. Complete the descent and approach checklists prior to beginning the penetration.
2. Begin the penetration from the initial approach fix with the gear and flaps up and throttles at idle start. Deploy the spoilers as required to maintain 4,000 to 6,000 FPM and an airspeed of 230 to 250 knots.

NOTE

It may be necessary to advance symmetrical throttles slightly to maintain pressurization. If distance versus altitude loss is critical, the spoilers may be deployed immediately departing altitude. A sizable altitude loss will occur while the aircraft is accelerating to normal penetration airspeed.

3. Begin level off approximately 1,000 feet above published penetration altitude by decreasing vertical velocity by half. Allow the airspeed to decrease toward approach plus 10 knots. Retract the spoilers, if extended, and extend the flaps to approach prior to slowing below minimum flap retract speed plus 20 knots. Extend the landing gear, and accomplish the Before Landing checklist.
4. After passing the final approach fix, low altitude procedures apply.

HOLDING

Holding will be conducted in a clean configuration at 200 KCAS, at gross weights of 257,500 pounds and below. At gross weights above 257,500 pounds, hold at 220 KCAS. If endurance holding is required, hold at best endurance speed plus 10 knots. When fuel is not a factor, low altitude holding may be conducted with the gear down and flaps APPROACH at approach speed plus 30 knots.

WARNING

If holding is required at altitudes higher than the maximum endurance altitude, hold at best endurance speed plus 10 KCAS or stall speed (30° angle of bank) plus 25 KCAS, whichever is higher.

DESCENT

The descent check should be completed prior to departing cruise altitude. The flight engineer will compute the landing data based on the anticipated landing weight and weather. Forecast data may be used for flights of three hours or less, but it will be confirmed prior to landing. The pilot flying should complete the crew briefing prior to descent.

The pilot will set QNH on the MFSI. The crew will remain on 29.92 until cleared below transition level and descent is started. The pilot not flying the aircraft will advise the crew of the proper altimeter setting and receive acknowledgment of the setting prior to descending through the transition level.

FMS DESCENT (only on C-141C)

FMS DESCENT modes are: ECON (Economy), Rapid, Selective Speed, and Descent Direct. Each DESCENT mode (except Rapid) may be coupled to the autopilot.

The FMS computes and displays descent speed targets and distance to go in descent to provide a fuel efficient descent performance for any selected speed schedule. Descent mode computations are automatically adjusted for the effects of wind and any mission-imposed speed or altitude constraints that may apply.

APPROACH PROCEDURES

INSTRUMENT APPROACHES

Limit all turns to standard rate, except during twoengine operation when minimum bank angles should be used. The angle of bank should not exceed 30 degrees. The figures in this section depict typical approaches and penetrations and apply to four and three-engine operations. The procedures listed on the figures are general in nature due to the many variables encountered during an instrument approach. Normally, they will be accomplished as depicted on the figures. The procedures and techniques outlined in current directives should be followed when flying the aircraft on instruments.

WARNING

• Spoilers shall not be used at any time during the final approach phase of landing because high sink rates can result.
• When at night or in IMC, a TAWS aural or visual warning is received, immediately rotate the aircraft and simultaneously add power to alter the aircraft's flight path sufficiently to stop the warning. Continue the approach only after verifying terrain clearance, sink rate, and configuration (gear and flaps), and whether the altered flight path will still allow a safe approach and landing. If on approach, past the final approach fix, and the approach cannot be safely continued, execute a missed approach. EXCEPTIONS: For a "too low flaps" warning, the approach may be continued if configuration is confirmed. For a wind shear warning, the approach may be continued if normal wind shear procedures subsequently silence the warning.

LOW ALTITUDE INSTRUMENT APPROACHES

Conduct low altitude approaches in accordance with the appropriate approach charts and as described below. Aircraft configuration and airspeeds should be established in accordance with the procedures and typical instrument approach illustrations contained in the document APPENDIX. Instrument flight procedures will be accomplished in accordance with current Air Force instrument flying manuals.

1. Cross the Initial Approach Fix (IAF) at or below 200 KCAS. Lower flaps to approach position, lower the gear, complete the Before Landing checklist, and reduce airspeed to approach speed plus 30 knots. If configuration is delayed, do not allow airspeed to decrease below minimum flap retract speed plus 20 knots.

NOTE

If the approach and landing are to be accomplished with zero flaps, do not allow airspeed to decrease below approach plus 20 knots until inbound to the Final Approach Fix (FAF). At high gross weights, care must be taken not to exceed tech order limitations for lowering the landing

gear.

2. When inbound to the FAF, allow airspeed to decrease to approach speed plus 10 knots.

3. Side-step Maneuver. ATC may authorize an approach which serves either one of parallel runways that are separated by 1,200 feet or less, followed by a straight-in landing on the adjacent runway. Pilots are expected to commence the side-step maneuver when the runway or runway environment is in sight. Remain at or above side-step MDA, with flaps at final setting, at approach speed, until intercepting a normal glidepath to the landing runway.

NOTE

Maintain approach plus 30, 20, and 10 knots as specified. If required for mission accomplishment or directed by ATC, higher speeds may be flown if intentions are briefed. Do not exceed aircraft limitations.

4. Make final flap setting at the FAF or just prior to glide slope intercept and establish approach speed.

CIRCLING APPROACH

The circling approach will be made with landing gear down, spoilers closed, flaps in approach position, and airspeed at approach plus 10 knots. During the turn to final, make final flap setting and reduce airspeed to approach speed. Cross the threshold at approach speed minus 10 knots

MISSED APPROACH

Execute the missed approach as published or as directed using normal go-around procedures. If the gear and flaps are retracted, maneuver at 200 knots. If the gear and flaps are left down, maintain at least approach speed plus 30 knots. If a subsequent approach is flown, the Before Landing checklist will be accomplished.

NOTE

Approach speed plus 30 knots should be maintained. If required for mission accomplishment or directed by ATC, higher speeds may be flown if intentions are briefed. Do not exceed aircraft limitations.

CATEGORY II APPROACHES

The radar altimeter, both ILS receivers and both CDSs must be operational before attempting a CAT II approach. For a coupled approach, both autopilots must be operational. Aircraft Equipment Requirements.

1. Dual operational AFCPs.
2. Dual operational ILS receivers/Flight Directors (verified by green ILS annunciation).
3. Operational Radar Altimeter.
4. Dual operational CDS. Exception: To continue the approach below 300 feet, 3 Display Units (two Primary Flight Displays (PFDs) and one Secondary Flight Display (SFD), one Display Processor Unit (DPU) and one DAMU are required.
5. Rain removal system (only if required by weather).
6. Dual Autopilots (coupled approaches).

Restrictions.

1. Category II coupled approaches and autoland must be performed with both autopilots engaged (verified by an AP 1/2 ON annunciation in upper right corner of the PFD).
2. Autopilot must be engaged prior to GS TRK, or sudden pitch changes could occur.
3. Intercept localizer at not less than V APP +20.
4. Localizer must be intercepted before glideslope is captured.
5. Automatic landing must be accomplished with both autopilots engaged and must be monitored with normal outside visual reference below decision height.
6. Autopilots must be disengaged immediately after touchdown.

CAT II Flight Director Approach

The flight director provides lateral and vertical steering commands to allow the pilot to manually steer the aircraft to a CAT II ILS approach.

1. Set VOR1 on runway frequency
2. Set OBS1 on runway heading
3. Set heading marker on pilot's and copilot's HSI to the aircraft heading.
4. Select AP source VOR 1
5. Select VNAV and LNAV on AP
6. Set published front course on pilot's and copilot's HSI.
7. Set radar altimeter to published RA/HAT.
8. When localizer capture occurs, varify that the AP announciator changes from HDG SEL + ARM to LNAV.
9. Determine the desired intercept angle and rotate the heading marker on the pilot's HSI to the desired intercept heading.
10. When G/S capture occurs, varify that the AP announciator changes from ALT SEL + ARM to VNAV.
11. Verify that at glide slope capture the pitch bar is displayed and provides proper steering commands to intercept and maintain glide slope.
12. Marker beacon annunciations. Visual annunciations appear as the aircraft passes over the outer, middle, and inner markers.
13. Monitor ILS progress on the ADI and HSI. When DH annunciates the aircraft is at decision height. At approximately the same time, "I" annunciates momentarily above DH, indicating that the aircraft is over the Inner Marker.

NOTE

TAWS mode 6 callout "MINIMUMS - MINIMUMS" is issued at the point where the aircraft passes through the decision height based on the radar altimeter setting.

a. Visual cues must be sufficient to determine that the aircraft is within, and tracking to remain within, lateral confines of the runway extended. If cues are sufficient, the pilot may continue. If cues are insufficient, execute missed approach.

WARNING

If G/S is selected and the glide slope beam is intercepted prior to intercepting the localizer beam, the autopilot will capture glide slope, which may result in descent prior to entering the cleared descent zone.

BEFORE LANDING

Pilot flying will command the extension of the flaps and landing gear. The pilot flying will state "GEAR DOWN, BEFORE LANDING CHECKLIST," and the pilot not flying will acknowledge the command. The copilot will then extend the gear, and the engineer will accomplish the checklist. If the gear is already down, the pilot flying need only state, "BEFORE LANDING CHECKLIST." During a series of approaches, the pilot flying will revise the crew briefing as necessary prior to the FAF.

CAUTION

The flaps and landing gear should not be operated simultaneously due to insufficient No. 2 hydraulic flow at low power settings and the resultant drop in pressure.

1. Landing Gear Warning Horn Cut-Out Switch "NORMAL" (CP)
2. Landing Gear - "DOWN" (CP), "DOWN AND CENTERED" (P) During the extension cycle, the copilot will check the NOSE LANDING GEAR indicator to ensure that the in-transit position pauses in view during the extension cycle. If the in-transit position is not viewed, a visual scan of the nose landing gear will be accomplished by the scanner prior to landing.

Both copilot and pilot shall ensure:

a. The LANDING GEAR lever is down.

b. The LANDING GEAR and BOGIE indicators show down and level.

c. The spoilers are closed.

Switch to MANUAL prior to landing as mission dictates. This disconnects the receiver from the dispense unit and terminates automatic ejection of flares as threats are detected. Flares can still be dispensed by depressing the remote dispense pushbuttons.

FINAL APPROACH

APPROACH SPEED

Approach speed is calculated using the chart in the POH Appendix.

EFFECT OF GUST

It is generally better to maintain a slightly higher airspeed throughout the landing phase in gusty wind conditions. Therefore, touchdown speed, threshold speed and final approach speed should be increased by the reported gust increment, not to exceed 10 knots. Resetting the Airspeed Marker is not required.

REFERENCE GROUND SPEED

Reference ground speed is the expected ground speed on final at approach speed in a no-shear condition. Reference ground speed is computed by subtracting the surface headwind component or adding the tailwind component to approach true airspeed. When actual ground speed differs from reference ground speed, wind change or shear will occur during the approach.

WIND SHEAR

Forecast wind shear, thunderstorm, or gust front activity must be carefully analyzed prior to starting an approach. Wind shear conditions occurring at low altitudes may be hazardous to aircraft on final approach. Pilots must be alert to the possibility of wind shear or microbursts on all approaches. Wind shear may be recognized by a sudden uncommanded change in airspeed and/or rapid uncommanded change in flight path. The comparison of actual ground speed and reference ground speed during an approach is a proven procedure for detecting and coping with low level wind shear. Reference ground speed is the expected ground speed on final at approach speed in a no-shear condition. If actual ground speed exceeds reference ground speed, expect a decreasing tailwind condition or shear during the approach. Decreasing tailwind example: Approach speed = 125 KCAS. Reference ground speed = 115 knots. Actual ground speed is 160 knots. If the shear is abrupt, airspeed will increase by 45 knots. Maintain approach speed of 125 KCAS and monitor actual ground speed. Be aware that once the shear occurs, the power required will increase; resist the temptation to pull off power. If actual ground speed is less than reference ground speed, expect a decreasing headwind condition or shear during the approach. Decreasing headwind example: Approach speed = 125 KCAS. Reference ground speed = 115 knots. Actual ground speed is 95 knots. Accelerate to 145 knots KCAS initially to maintain 115 knots ground speed. Maintaining the reference ground speed provides the necessary energy to penetrate the shear safely or go around.

WARNING

- **The severity of the shear will be dependent on the altitude and magnitude of the wind change. Severe wind shear should be avoided whenever possible.**
- **A normal go-around pitch attitude may be insufficient to recover the aircraft. A pitch attitude greater than normal and the use of maximum engine thrust may be required. Decreasing pitch attitude in an attempt to regain airspeed during an initial shear encounter may prevent a successful recovery.**

LANDING

Normal Landings (Flaps 75 To 100%)

CAUTION

• Due to aft body clearance, minimize landing flare angles and avoid touchdown speeds less than the recommended touchdown speeds including corrections for gust increments. Failure to do so may cause inadvertent tail scrape.

The final approach should normally be flown with landing flaps (100%). Situations when an approach flap landing may be considered are extreme forward CG, high crosswinds, and actual or forecast wind shear.

1. Determine approach speed for the appropriate flap setting. Fly a normal glidepath with close airspeed control. NOTE If flaps are set to less than 75%, the TAWS "TOO LOW FLAPS" annunciation will occur. Press the FLAP OVRD switch on either TCAP after final configuration is established.

2. Approaching the threshold, reduce power to cross the threshold at approach speed minus 10 knots.

WARNING

The landing gear warning horn can be manually silenced, even though the gear is not down and locked, when landing with less than landing flaps. Result in loss of directional control. If an engine overspeeds or is uncontrollable during thrust reverser operation, it should be shut.

3. Make a normal flare. Touchdown speed is approach speed minus 20 knots. Do not slow below recommended touchdown speed.

4. When the main landing gear is firmly on the runway, the pilot flying will place all four throttles to the REV IDLE position. After achieving a three-point attitude, the pilot flying will state "SPOILERS" and the pilot not flying will deploy the spoilers. Monitor spoiler needles during deployment for any extreme differential. Maintain forward pressure on the yoke to prevent pitch-up during spoiler deployment.

WARNING

• Aerodynamic braking will not be used to decelerate the aircraft during landing ground roll. This technique invalidates performance data computations and can result in the aircraft becoming inadvertently airborne in a nose high attitude.

• If the flight limit stop fails to retract for any reason, the landing distance will increase because the spoilers will not deploy to the ground position.

5. Primary directional control will be rudder, aileron, nose wheel steering, and differential braking, in that order. The copilot will assist with aileron control during the landing roll as directed by the pilot. The rudder should be used primarily at the higher speeds and on wet and icy runways.

Do not apply brakes until wheel spin-up has occurred.

6. After the nose wheel is on the runway, move all throttles to the desired reverse position. The pilot not flying will call 80 knots. At 80 knots, slowly advance all throttles toward REV IDLE to have all throttles at REV IDLE by 60 knots.

WARNING

An uncontrollable or overspeeding engine may result in loss of directional control. If an engine overspeeds or is uncontrollable during thrust reverser operation, it should be shut down before returning the throttle to forward idle.

CAUTION

Exercise caution in the rate of application of reverse thrust as asymmetrical conditions may develop.

7. The pilot not flying will observe that all four THRUST REV EXTENDED lights are illuminated and announce any light that is not illuminated.

8. After slowing to taxi speed, all throttles may be returned to IDLE START. For ground emergency, all throttles may be left in full reverse position at any speed. Normal Brake Operation.

NORMAL BRAKING

1. Take full advantage of the length of the runway. Use spoilers and thrust reversers.
2. Anti-skid systems are intended to prevent skidding at high speeds under light wheel loads. Brakes may be applied immediately after touchdown, but this should be done only when maximum performance stops are required.
3. Do not drag brakes while taxiing. If possible, avoid using brakes for turning the aircraft on the ground.

MAXIMUM STOPPING

When a short landing roll is required, a single smooth application of the brakes with constantly increasing pedal pressure up to skid control cycling will result in optimum braking.

Landing With Flaps Less Than 75%

Prior to landing without full flaps, special consideration will be given to the following:

1. Available runway length and surface conditions.
2. Weather.
3. Landing gross weight.
4. Brake limits.
5. Missed approach capability. A wider than normal visual approach pattern should be flown because of the higher airspeeds in consideration of higher stall speeds.

Landing with flaps less than 75% will be flown the same as normal landings with the following exceptions:

NOTE

If flaps are set to less than 75%, the TAWS "TOO LOW FLAPS" annunciation will occur.

1. On either TCAP, press the FLAP OVRD switch annunciator illuminates (NVIS GREEN).
2. Power management after crossing the threshold and flare requirements will vary depending on flap setting. Power should be reduced early for zero flaps (and proportionately later as flap setting is increased). No flare is required for zero flaps while, as flap settings increase, flare requirements proportionately increase in order to slow the sink rate. Touchdown speed is approach speed minus 15 knots. Do not slow below recommended touchdown speed.
3. Do not exceed 5 degrees of bank at touchdown to preclude dragging a wingtip.
4. When the main landing gear is firmly on the runway, the pilot flying will place all four throttles to the REV IDLE position. After achieving a three-point attitude, the pilot flying will state "SPOILERS" and the pilot not flying will deploy the spoilers. Monitor spoiler needles during deployment for any extreme differential. Maintain forward pressure on the yoke to prevent pitchup during spoiler deployment.

WARNING

If the flight limit stop fails to retract for any reason, the landing distance will increase because the spoilers will not deploy to the ground position. Failure to lower the nose gear to the runway prior to spoiler deployment may result in the aft fuselage contacting the runway.

5. Do not exceed the spoiler FLT LIMIT until below 147 KCAS.

Crosswind Landing

On final approach, use wing down or crab technique. Approaching the threshold, maintain a slight wing down attitude and remove the crab prior to touchdown. Three degrees of bank should compensate for any wind in the normal zone of the crosswind chart. Land on centerline and do not allow the upwind wing to rise above wings level. After the main landing gear is firmly on the runway, follow normal landing procedures. Deploy the spoilers as quickly as possible after nose gear is on the runway. These procedures also apply when landing with flaps less than 75%.

Heavyweight Landing

Normal landing techniques should be used for heavyweight landings. Touchdown smoothly. Refer to the rate of sink limitations at weights greater than 257,500 pounds.

Touch-And-Go Landing

Touch-and-go landings will be made only when authorized by the Major Air Command. These landings introduce a significant element of danger because of the many rapid actions which must be executed while rolling on the runway at high speed. The following fuel load and gross weight limits apply for landings during training:

1. Full stop landings will not be made at a fuel weight above 75,000 pounds or 257,500 pounds gross weight.

2. Touch-and-go landings with fuel loads in excess of 75,000 pounds, not to exceed 257,500 pounds gross weight, may be made not to exceed two landings per hour.

3. Coupled landings will not be made at fuel weights above 75,000 pounds or 257,500 pounds gross weight. When staying in the traffic pattern for a series of touchand-go landings, the gear and flaps may be retracted after each take-off or left extended.

The specific procedures will be as follows:

1. The pilot flying will state in the crew briefing, “THIS WILL BE A TOUCH-AND-GO LANDING.”

2. After touchdown, the instructor pilot, unless otherwise briefed, will reset the flaps to the TAKE OFF/ APPROACH position, reset the trim for take-off, and state, “FLAPS AND TRIM SET.”

3. The pilot flying will then smoothly advance the throttles toward 90% N1 RPM, not to exceed go-around EPR. The pilot not flying will back up the throttles and make the final adjustment of power. The pilot flying will retain primary control of the throttles. Normal takeoff procedures will be followed from that point.

GO-AROUND

When the decision to go-around has been made, the pilot flying will advance the throttles toward go-around EPR. The pilot not flying will back up the throttles and make the final power adjustment to go-around EPR. The pilot flying will direct the pilot not flying to retract flaps to approach, retract the gear when a positive rate of climb has been established. Continue climbing to desired altitude using normal or obstacle climbout procedures as applicable. If the gear and flaps are not retracted, maneuver at approach speed plus 30 knots.

GO-AROUND AFTER TOUCHDOWN

Emergency go-around after touchdown has proven to be the most dangerous maneuver for any aircraft. In many cases it may be preferable to accept the consequences of completing the landing rather than attempting to become airborne again. If an emergency goaround from the runway is necessary, use normal go-around procedures.

AFTER LANDING

This check may be accomplished on the runway or after clearing the runway when the aircraft has slowed to taxi speed and when good judgment dictates that it can be accomplished safely. After clearing the runway, the pilot may shut down symmetrical engines to preclude excessive braking, FOD and for fuel conservation. When taxiing back for take-off, IFF, radios, radar, and radar altimeter may be left in standby, normal, or on.

1. Radar - “AS REQUIRED” (CP/N).
2. Anti - Collision/Strobe Lights - “SET” (CP) Position top strobe to “RED” and bottom strobe to “OFF”.

NOTE

If performing an Engines Running Off/On-load followed by an immediate take-off, installation of countermeasure (EMI) safety pins is at the discretion of the aircraft commander. This step may be accomplished prior to landing. Five EMI safety pins are required.

3. Wing Anti-Ice and Empennage De-ice - “OFF”
4. Engine Anti-Ice - “AS REQUIRED”
5. Pitot Heat and Temp Probe Deice - “OFF”
6. Angle of Attack De-ice “OFF”
7. Rain Removal - “AS REQUIRED”
8. IFF - “AS REQUIRED” STANDBY for a taxi-back. OFF if terminating.
9. Yaw Damper - “OFF”
10. Spoilers - “CLOSED”
11. Flaps - “SET FOR TAKE-OFF”
12. Radar Altimeter - “AS REQUIRED”
13. Door Arming Switch - “AS REQUIRED”

ENGINE SHUTDOWN

The pilot may accomplish item 1 prior to calling for the checklist.

PILOTS

1. Parking Brake - “SET” (P)
2. Door Arming Switch - “OFF” (P)
3. Engine Anti-Ice and Ice Detect Switches - “OFF” (P)
5. Fuel and Start Ignition “STOP” (P)
6. Continuous Ignition - “OFF” (P)
7. Anti-Collision/Strobe Lights - “OFF” (CP)
9. Windshield Heat - “OFF” (CP)
10. Seat Belt Switch - “OFF” (P)
11. Engineer’s Report - “CHECK COMPLETED” (E)
12. Engine Shutdown Check ”COMPLETED” (CP)

BEFORE LEAVING AIRCRAFT

1. Trim Disconnect - “DISCONNECTED” (CP)
2. Parking Brake - “OFF” (P)
3. Radios and IFF - “OFF, CODES REMOVED” (CP)
4. Remove classified codes.

Bad Weather Procedures

TURBULENCE AND THUNDERSTORMS

When weather conditions indicate a likelihood of encountering turbulence, or when flight through moderate to severe turbulence becomes necessary, the following procedures shall be followed. Flight through thunderstorms, cumulonimbus clouds, or other conditions of extreme turbulence must be avoided whenever possible. The CONTINUOUS IGNITION switch shall be "ON" for flight in known or anticipated turbulent air.

1. AIRSPEED. Use 260 KCAS or 0.74 Mach, whichever is lower, when operating above 15,000 feet. Use 230 KCAS to 250 KCAS when operating at or below 15,000 feet. Do not exceed 270 KCAS or 0.825 Mach for operation in severe turbulence.

2. ALTITUDE. The maximum cruise altitude should be one flight level (4,000 feet) below the 300 fpm cruise ceiling for penetrating moderate to severe turbulence.

NOTE

A reduction in altitude has an appreciable effect on improving buffet and controllability margins. Where there is any doubt as to controllability, altitude reductions greater than 4,000 feet should be carefully considered.

3. TRIM. Trim the aircraft to zero stick force for the penetration altitude and airspeed. This trim setting should not be changed once it is set. Retrimming the aircraft to maintain attitude could produce an excessive nose low/high condition that could cause severe pitch changes when opposite direction vertical drafts are encountered. If turbulence is encountered before penetration speed can be established, the method below should be used.

4. ATTITUDE. Concentrate on the attitude indicator as the primary control reference. Do not attempt to control attitude by reference to airspeed, altimeter, or vertical velocity, since these instruments may give false and misleading information on pitch attitude. Do not attempt to maintain pitch attitude rigidly. For level flight at turbulent air penetration speed, the pitch attitude will normally be between zero to two degrees nose up. In a climb, it will obviously be higher, and in a descent, lower. Whatever the nominal value is, attempt to remain within ± 10 degrees pitch attitude rather than trying to hold an absolutely constant attitude. Allow the aircraft to "ride with the gusts", assisting with elevator inputs as necessary to keep the attitude within this band. Do not attempt to control attitude with stabilizer trim. Avoid unnecessary maneuvering. An increase of bank will increase the stress and the possibility of a stall.

5. ENGINE POWER. Set thrust as required to maintain penetration airspeed and do not vary unless airspeed and altitude variations are large and persistent.

6. AUTOPILOT. The autopilot may be used and, in some cases, is desirable. Altitude hold or Speed On Pitch (SOP) should not be engaged. Do not help the autopilot by applying inputs on the control column because the possibility of mistrim will be increased. Make as few changes with the autopilot pitch wheel as practical. With a fixed pitch control knob position, the autopilot will attempt to maintain a constant attitude, and this is the desired goal. Be alert for inadvertent autopilot disconnects. The yaw damper should be ON. NOTE When flying at night in the vicinity of thunderstorms, the thunderstorm lights should be turned on to preclude momentary blinding effects of lightning. uring recovery from high speed upsets at speeds approaching maximum, a loss of aileron effectiveness will be noted. If this should occur, full aileron throw will provide a positive roll rate. The rudder is an effective roll control device at these high speeds and must be properly coordinated to obtain adequate roll response. An increased roll rate will be obtained if full rudder, as well as aileron, is used to recover from large lateral upsets at high speeds. When operating at maximum speeds, positive input to the rudder should be used when lateral correction is required. This will avoid possible adverse roll created by independent yaw damper operation.

WIND SHEAR

Severe wind shear conditions occurring at low altitudes are hazardous to aircraft encountering them during final approach and take-off. When an aircraft is flying only slightly above stall speed, a major change in wind velocity can lead to a loss of lift. If the loss is great enough that the power response is inadequate, it results in a high rate of descent. The altitude at which the encounter occurs, the pilot reaction time, and the aircraft response capability determine if the descent can be slowed in time to prevent an accident. The following conditions indicate the possibility of significant wind shear and should be considered by the pilot during weather briefings/analyses:

1. Thunderstorms and associated gust fronts.
2. Frontal passage.
3. Temperature inversion.
4. PIREPS.

APPROACH AND LANDING

The following types of shear can significantly affect an approach:

1. Decreasing headwind. The power required is higher than normal, vertical velocity is less than planned, and actual ground speed is less than expected ground speed (TAS minus runway headwind component). When the shear is encountered, the aircraft reaction is a drop in airspeed and a loss of altitude. The pilot must be ready to add power when indicated airspeed starts to decrease. Once speed and glide path are regained, however, prompt reduction of thrust is necessary. It will now require less thrust and a greater rate of descent to maintain the proper profile in the decreased headwind. If the initial corrections of increased thrust and pitch are not promptly removed after regaining glide path and airspeed, a long landing at high speed may result. Be prepared for a goaround.

2. Decreasing tailwind. The power required is less than normal, the vertical velocity is more than planned for the approach, and actual ground speed is more than the expected ground speed (TAS plus runway tailwind component). When the shear is encountered, aircraft reaction is an increase in airspeed and a gain in altitude. The pilot's natural reaction to this condition is to lower the nose to regain glide path and reduce thrust to regain airspeed. However, be prepared to raise the nose and add thrust promptly once speed and glide path are regained. It will now require more thrust and a decreased rate of descent to maintain the proper profile in the increased headwind. Be very cautious in making the initial reductions of thrust and pitch to avoid the low-power, high-sink condition which could lead to correction through the glide path from which a recovery cannot be made. Be prepared for a go-around.

The following techniques may assist the pilot in coping with wind shear on approach:

1. Be alert for the possible need for additional airspeed or power on final approach when a decreasing headwind (increasing tailwind) shear is anticipated.

2. If necessary, delay the approach until the shear situation has subsided or divert to a suitable alternate.

3. If wind shear is encountered on final approach, do not hesitate to go-around if the approach profile and airspeed become destabilized and cannot be restabilized.

4. When wind shear is encountered, pass this information, including magnitude of airspeed change and altitude encountered, to ATC so that other aircraft may be informed.

TAKE-OFF

If a wind shear or gust front from a thunderstorm/CB is anticipated, it is important to penetrate the shear at a relatively high airspeed. A TRT take-off with a normal climb will be made. A departure route that will provide the most favorable wind condition (generally a headwind) should be used. Delay take-off until shear situation subsides.

MICROBURST

Microbursts are concentrated downdrafts that can occur anywhere convective weather conditions exist (thunderstorms, rain showers, virga, etc.). Downdrafts associated with microbursts are typically only a few hundred to 3,000 feet across and usually dissipate within 10-20 minutes. When the vertical winds contact the ground, they may form one or more horizontal vortex rings. This outflow region is usually 6,000 to 12,000 feet across and may extend over 2,000 feet AGL. Evidence of a microburst striking the ground includes rings of blowing dust, flailing trees, strong localized winds or aerodrome windshear alerts. Wind speed and/or direction can vary greatly at either end of the runway. Pilots can request this information from the tower. Traversing the microburst may result in a rapidly decreasing tailwind (performance gain) followed by a rapidly decreasing headwind (performance loss). In areas of convective activity, a significant performance gain may be a pilot's first indication of a microburst. If a microburst is inadvertently encountered, resist the initial tendency to decrease pitch attitude to regain airspeed. Maximum power and pitch attitude control are critical for controlling flight path. Lower than normal airspeeds and unusual yoke forces may have to be tolerated until the condition can be flown through. If approach to stall is indicated, reduce pitch attitude in small increments to eliminate indications. Decreasing pitch attitude in an attempt to regain airspeed during initial shear encounters may prevent a successful recovery.